Alaska Habitat Management Guide

Southcentral Region
Volume II:

Distribution, Abundance, and Human Use of Fish and Wildlife

Produced by
State of Alaska Department of Fish and Game
Division of Habitat

Juneau, Alaska
1985

Alaska Habitat Management Guide

Southcentral Region
Volume II:

Distribution, Abundance, and Human Use of Fish and Wildlife

Produced by
State of Alaska Department of Fish and Game
Division of Habitat

HARZA-EBASCO
Susitna Joint Venture
Document Number
2980

Juneau, Alaska
1985

Volume II: Book 2 of 2

©1985 BY THE
ALASKA DEPARTMENT OF FISH & GAME

Contents

DISTRIBUTION AND ABUNDANCE OF SELECTED FISH AND WILDLIFE

Wildlife

Contents (continued)

Contents (continued)

Contents (continued)

Contents (continued)

Contents (continued)

Sportfishing

Contents (continued)

Contents (continued)

Personal Use Fishing

Appendices

Volume 1 contains narratives on the life histories and habitat requirements of selected species of fish and wildlife.

Maps

Wildlife Distribution and Abundance

Fish Distribution and Abundance

Maps (continued)

Hunting and Trapping

Commercial Fishing

Maps (continued)

Figures

Wildlife Distribution and Abundance

Fish Distribution and Abundance

Subsistence and Other Local Use of Resources by Subregion

Tables

Wildlife Distribution and Abundance

Tables (continued)

Tables (continued)

Tables (continued)

Tables (continued)

Personal Use Fishing

Subsistence and Other Local Use of Resources by Subregion

Tables (continued)

Marine Mammals

Harbor Seal Distribution and Abundance

I. REGIONWIDE INFORMATION

Information will be organized and presented in accordance with the following sequence of areas: Controller Bay-Copper River Delta, Prince William Sound (PWS), Kenai Peninsula, and Cook Inlet. Most harbor seal data are not evaluated at the game management unit (GMU) level because the ADF&G has no managerial authority over this species. Also, past data-collection efforts have ignored GMU boundaries and focused on specific biologically distinct areas within the Southcentral Region.

A. Regional Distribution

Harbor seals have a ubiquitous distribution along the coastal areas of Southcentral Alaska. They occupy virtually all nearshore marine habitats and may be found during spring and summer in some rivers and lakes. Harbor seals are usually found in close proximity to coastal and nearby island shorelines and are seldom found more than 5 mi from shore (Spalding 1964, Bigg 1969).

B. Areas Used Seasonally and for Life Functions

See the 1:1,000,000-scale printed maps in the Southcentral Atlas and the 1:250,000-scale reference maps located in ADF&G area offices.

Harbor seal parturition is not restricted to only a few major rookeries, as is the case with many pinniped species. Pupping appears to take place at nearly all locations where seals haul out (Pitcher and Calkins 1979). Therefore, only known haulout concentration areas were mapped.

C. Factors Affecting Distribution

Commonly used haulout area substrates include offshore rocks and reefs, sandbars, beaches of remote islands, mainland beaches backed by cliffs, ice floes calved from tidewater glaciers, shelf ice at the head of bays, and floating sea ice (ibid.). Calkins et al. (1975) pointed out the high level of adaptability of harbor seals to local conditions by noting their ability to successfully occupy areas with varying bottom types, water clarity, temperatures, and salinity. (For further details, see the Life History and Habitat Requirements volume.)

D. Movements Between Areas

Harbor seals are year-round residents of the Southcentral Region. They are generally considered sedentary animals, making local movements associated with such factors as tides, food availability, reproduction, and season (Pitcher 1984).

Seals utilize the Copper River Delta (CRD) area during the ice-free period. During winter, the Copper River freezes and the delta is ice-covered. Except for small numbers of seals along the ocean bars, most of this population apparently disperses into PWS or southeast along the coast to Icy Bay (Pitcher 1977). From

April or May through late September, most seals in the CRD are found several miles below Miles Lake (Buccaria 1979).

The behavioral pattern of seals in the CRD is also evident in Cook Inlet. Seal movements into upper Cook Inlet in the summer coincide with movements of anadromous fish such as eulachon (Thaleicthys pacificus) and salmon (Oncorynchus spp.) into the upper inlet. They are absent in the upper inlet during the winter period, probably moving to the lower inlet. In some winters, heavy sea ice forms in Cook Inlet, which may influence distribution. Harbor seals tend to use the ice edge to haul out and are not found within areas of extensive ice cover (Calkins 1979).

Tagging studies indicate that juveniles have been located up to 250 km from their birth places (Pitcher 1984). One adult seal was discovered 194 km from its capture location (Pitcher and McAllister 1981). In these same studies, movement rates up to 27 km/day were recorded (ibid.).

E. Population Size Estimation

Population estimates specific to the Southcentral Region are not currently available. Current survey techniques for harbor seals are not adequate for precisely estimating population size (Pitcher 1975). Aerial surveys (fixed-wing and helicopter) have often been used to determine distribution and relative abundance (Mathisen and Lopp 1963, Pitcher 1975). Seals are difficult to see in the water, and most are undoubtedly missed during census attempts. Even when large numbers are hauled out and can be counted, it is not known what proportion of the total population this represents. The number of harbor seals hauled out at any point in time is dependent on tidal activity (which affects the amount of haulout space available), weather, time of day, food availability, and the age, sex, and reproductive condition of the individuals (Murphy and Hoover 1981). Pitcher and Vania (1973) reported that four to five times more seals can be counted at low tide than at high tide. In glacier-fed bays, Bishop (1967) believed that more seals, in total, hauled out on the floating ice pans when the ice was concentrated at high tide near the glaciers than when ice was scattered by the outgoing tides.

F. Regional Abundance

Pitcher (1984) generated a crude estimate of 270,000 harbor seals in Alaska, with 70,000 seals from Cape Fairweather to the Kenai Peninsula, including PWS. These estimates were based on harvest data, observed densities of seals, the amount of available habitat, and the effects of harvest levels on populations.

II. CONTROLLER BAY-COPPER RIVER AREA

Major marine concentration areas occur on Kayak Island, on the tidally exposed rocks at Cape St. Elias, and on sandbars bordering Okalee Channel and Okalee Spit (Pitcher and Vania 1973, Pitcher and Calkins 1979). Bering River and Bering Lake have seals living during summer in a freshwater environment (Pitcher and Vania 1973). Pitcher (1975) also reported seal observations at Miners and Coghill lakes. Middleton

Island and Wessel Reef (19 mi north of the island) have been reported to be abundant concentration areas for seals (Calkins et al. 1975). Information on the abundance of harbor seals is incomplete. Therefore, population estimates are difficult to derive. Based on aerial surveys on 25 July 1973 and 15 May 1975, 1,349 and 1,571 seals were counted (Pitcher 1975). Pitcher (1977) estimated 3,000 seals within the CRD area. Calkins et al. (1975) stated that a reported 30,250 seals were killed from 1951 through 1958 by federal wildlife agents because of severe depredation problems on the CRD drift net fishery. Assuming the numbers reported killed are relatively accurate, Calkins et al. (1975) estimated a seal population in excess of 15,000 animals before control activities took place.

III. PRINCE WILLIAM SOUND

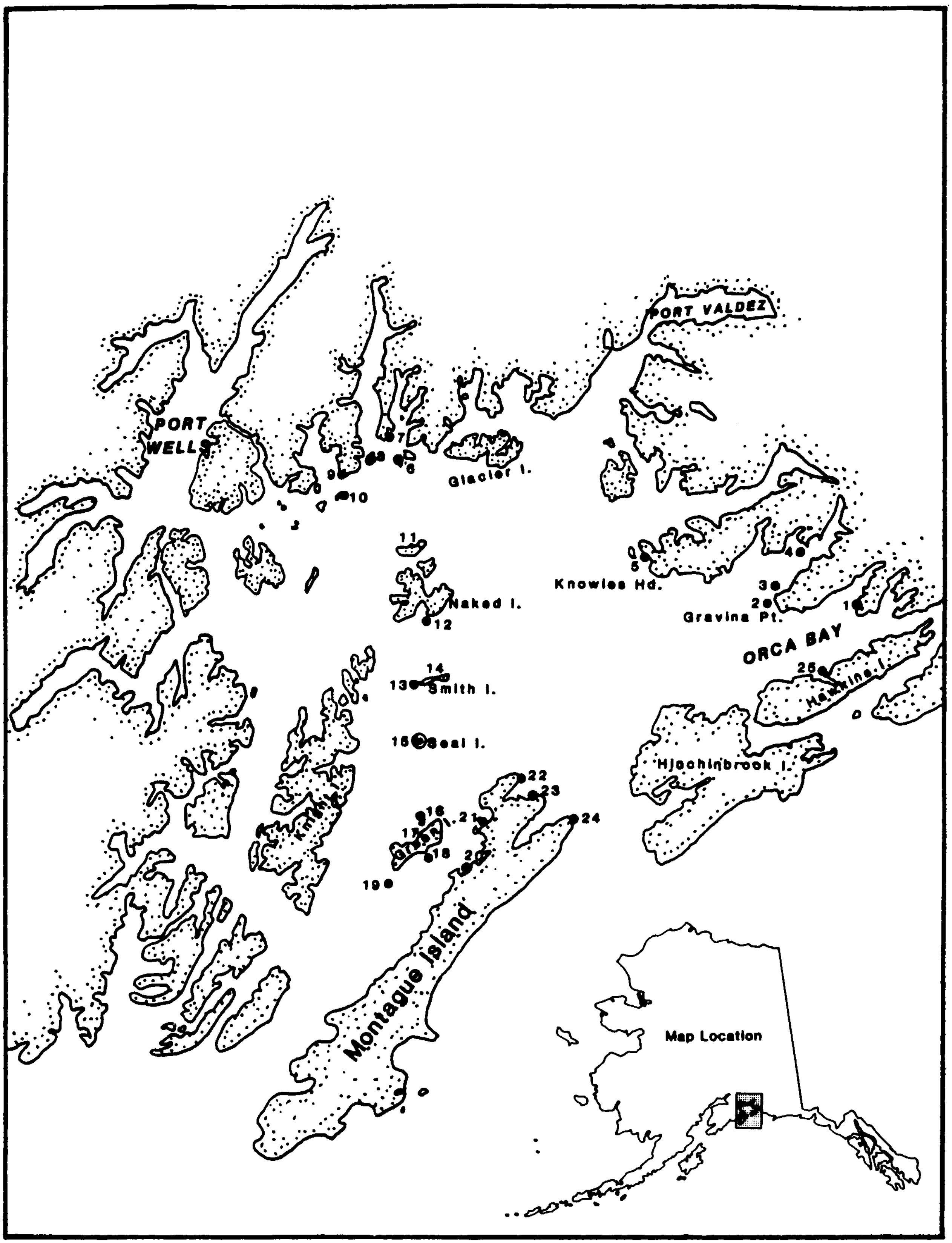
Harbor seals are fairly common residents throughout the PWS area. Glacial ice floes serve as haulout platforms in Columbia Bay, Unakwik Inlet, College Fiord, Harriman Fiord, Blackstone Bay, Derickson Bay, and Icy Bay (Pitcher and Vania 1973). Female seals with young pups haul out on the floating ice in these areas mainly during the month of June (Pitcher 1975). Glaciers are more active in summer, making more floating ice available at that time. Also, in winter there are no pups to nurse or rest on ice platforms. These factors may explain the significant decline in winter use of these areas.

Offshore rocks, reefs, and islets with seal concentrations are found at the Port Chalmers-Stockdale Harbor area, Applegate Rocks, Port Bainbridge, and at Seal, Channel, Little Green, Olsen-Fairmount, Naked, Knight, Danger, and Evans islands (ibid.). Other concentration areas include Port Etches on Hinchinbrook Island, MacLeod Harbor and Patton Bay on Montague Island, Wooded Islands, Port Gravina, Knowles Bay, the Eleanor-Disk Island area, Icy Bay, Fleming Island, and Latouche Island (Pitcher and Vania 1973). (See map 1, table 1.)

Pitcher (1975) counted approximately 4,000 seals in PWS proper. No population estimate was made, but numbers of seals were probably far in excess of the number counted. Seals can be counted most accurately only when hauled out. That proportion of the total still in the water is unknown. Based on harvest data and reproductive parameters for PWS, Calkins et al. (1975) estimated a population of 13,000 seals. This estimate is not precise but was derived to indicate the relative magnitude of the population.

IV. KENAI PENINSULA

The Kenai coast from Cape Puget to Pt. Adam is generally rocky and steep, with many deep-water fiords. Harbor seals are found along the entire coast, with concentrations near certain points and capes, in some bays, and in glacial fiords. The Johnstone Bay-Cape Fairfield area is a recognized high-density concentration area (ADF&G 1973). Resurrection Bay contains large numbers of seals but not in concentrated areas, except for Cheval Island (Calkins et al. 1975, Pitcher and Calkins 1979). Although pupping activity occurs at almost all haulout areas, three major concentration areas have been identified



Map 1. PWS harbor seal trend count route. Haulout site names and count data summary are presented in table 1 (adapted from Calkins and Pitcher 1984).

Table 1. Data Summary for PWS Harbor Seal Trend Count Surveys, August-September 1983

Map No.[a]	Site	Mean No. Seals	Sample Variance	N[b]	Range	FOU[c]
1	Sheep Bay	18.5	182.5	10	0- 47	0.90
2	Gravina Is.	22.6	363.6	10	0- 52	0.70
3	Gravina R.	57.7	228.0	10	31- 86	1.00
4	Olson Bay	81.0	1,183.4	9	31-149	1.00
5	Porcupine Pt.	19.2	272.6	10	0- 49	0.70
6	Fairmount Is.	84.6	2,735.3	10	12-170	1.00
7	Payday Pt.	22.0	182.8	9	0- 39	0.89
8	Olson Is.	23.5	72.3	8	12- 37	1.00
9	Pt. Pellew	23.0	478.3	9	0- 73	0.78
10	L. Axel Lind	21.1	665.5	7	0- 67	0.57
11	Storey Is.	18.8	108.2	10	6- 39	1.00
12	Agnes Is.	66.4	882.1	8	11-114	1.00
13	Little Smith Is.	95.6	1,346.9	10	55-171	1.00
14	Big Smith Is.	130.5	3,564.1	8	31-240	1.00
15	Seal Is.	116.0	3,540.3	9	45-216	1.00
16	Applegate Rocks	251.9	11,449.0	8	113-398	1.00
17	Green Is. N.	25.9	494.7	8	0- 58	0.75
18	Channel Is.	143.0	16,978.1	6	28-327	1.00
19	L. Green Is.	85.6	3,364.0	7	26-199	1.00
20	Port Chalmers	36.8	968.2	6	0- 68	0.83
21	Stockdale Hbr.	32.3	474.6	7	0- 65	0.86
22	Montague Pt.	35.1	266.1	8	0- 58	0.88
23	Rocky Bay	35.8	461.1	8	0- 61	0.88
24	Schooner R.	86.4	1,049.8	10	19-117	1.00
25	Canoe Pt.	51.3	1,135.7	8	10- 86	1.00

Source: Calkins and Pitcher 1984.

a Site locations shown in map 1.

b N = number of times each haulout was checked for seals.

c FOU (frequency of use) = number of times a haulout is occupied by seals divided by total number of times haulout is checked for seals.

where large numbers of pups occur; these areas include Aialik Bay, Harris Bay, and McCarty Arm in Nuka Bay (Pitcher and Calkins 1979). Seals are found throughout the Chugach Islands, especially in the outside coastal areas and along the mainland coast.

Population estimates for the Kenai coast are lacking. Bailey (1976) counted 2,586 seals as part of a boat survey for marine birds between Cape Resurrection and Pt. Adam. Selected major concentration areas, with the maximum number of seals observed in parentheses, include Cape Fairfield (200-300), Cheval Island (200), Aialik Bay (1,633), Surok Pt.-Aligo Pt. (Harris Bay) (691), East Arm of Nuka Bay (484), No Name Bay (176), and Elizabeth Island (619) (Bailey 1976, Pitcher and Calkins 1979, Murphy and Hoover 1981).

V. COOK INLET

It appears that upper Cook Inlet waters are poor habitat for harbor seals, except during summer runs of anadromous fish (Calkins 1979). At this time, seals have been observed in the Susitna River and are believed to enter other upper Cook Inlet rivers (Pitcher, pers. comm.). In winter, ice in the upper inlet forces seals to migrate to the lower inlet.

In lower Cook Inlet, particularly high-density haulout concentration areas are found on Yukon Island (250) and the Bradley-Fox River Flats (140) within Kachemak Bay. Seals are present year-round along the western shore of lower Cook Inlet and Kamishak Bay, where major haulout areas include Gull Island (400), the area between the mouths of Oil Bay and Iniskin Bay (200), Augustine Island (850-1,500), No Name Reef (200), Nordyke Island (109), Juma Reef (150), Douglas River Reefs (200), and Shaw Island (500-1,000) (Pitcher and Calkins 1979).

REFERENCES

ADF&G. 1973. Alaska's wildlife and habitat. Vol. 1 [R.A. Hinman and R.E. LeResche, eds]. 144 pp. + maps.

Bailey, E.P. 1976. Breeding seabird distribution and abundance along the south side of the Kenai Peninsula, Alaska. USFWS/NPS rept., Anchorage, AK. 69 pp.

Bigg, M.A. 1969. The harbor seal in British Columbia. J. Fish Res. Bd. Can. Bull. 172. 33 pp.

Bishop, R.H. 1967. Reproduction, age determination, and behavior of the harbor seal (Phoca vitulina) in the Gulf of Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 121 pp.

Buccaria, G.P. 1979. Copper River Delta area wildlife inventory. USDA: USFS. 114 pp.

Calkins, D.G. 1979. Marine mammals of Lower Cook Inlet and the potential for impact from outer continental shelf oil and gas exploration, development, and transport. ADF&G, Anchorage. 89 pp.

Calkins, D.G., K.W. Pitcher, and K. Schneider. 1975. Distribution and abundance of marine mammals in the Gulf of Alaska. Unpubl. rept. prepared by ADF&G under contract with USDC: NOAA. 67 pp.

Calkins, D.G., and K.W. Pitcher. 1984. Pinniped investigations in southern Alaska: 1983-84. Unpubl. rept. ADF&G, Anchorage. 19 pp.

Mathisen, O.A., and R.J. Lopp. 1963. Photographic census of the Steller sea lion herds in Alaska, 1956-1958. USFWS Spec. Sci. Rept. No. 424. 20 pp.

Murphy, E.C., and A.A. Hoover. 1981. Research study of the reactions of wildlife to boating activity along Kenai Fiords coastline. Final rept. NPS Contract No. CX-9000-8-0151. 125 pp.

Pitcher, K.W. 1975. Distribution and abundance of sea otters, Steller sea lions and harbor seals in Prince William Sound, Alaska. ADF&G unpubl. rept. 31 pp.

________. 1977. Population productivity and food habits of harbor seals in the Prince William Sound-Copper River Delta Area, Alaska. Final rept. to U.S. Marine Mammal Comm. in partial fulfillment of contract MM5AC011. Rept. No. MMC-75/03. 36 pp.

________. 1984. Species account: the harbor seal (*Phoca vitulina richardsi*). Unpubl. rept., ADF&G, Anchorage. 9 pp.

________. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Anchorage.

Pitcher, K.W., and J. Vania. 1973. Distribution and abundance of sea otters, sea lions, and harbor seals in Prince William Sound, Summer 1973. Unpubl. rept. ADF&G. 18 pp.

Pitcher, K.W., and D.G. Calkins. 1979. Biology of the harbor seal, *Phoca vitulina richardsi*, in the Gulf of Alaska. OCSEAP rept. prepared by ADF&G. RU-229. Contract No. 03-5-002-69. 72 pp.

Pitcher, K.W., and D.C. McAllister. 1981. Movements and haulout behavior of radio-tagged harbor seals, *Phoca vitulina*. Can. Field-Nat. 95(3):292-297.

Spalding, D.J. 1964. Comparative feeding habitats of the fur seal, sea lion, and harbor seal on the Bristish Columbia Coast. J. Fish. Res. Bd. Can. Bull. 146. 52 pp.

Steller Sea Lion Distribution and Abundance

I. REGIONWIDE INFORMATION

Information will be organized and presented by haulout area, by the south Kenai coast versus the Cape St. Elias-Prince William Sound (PWS) coast, and by the region. Most sea lion data are not considered at the game management unit (GMU) level because the ADF&G has no managerial authority for this species. Also, past data have been collected on a regional basis.

A. Regional Distribution

The distribution of Steller sea lions within Southcentral Alaska includes the entire outer coast to the edge of the continental shelf. According to Fiscus and Baines (1966), sea lions generally feed in relatively shallow waters (less than 180 m) or within 10 to 15 mi from shore. Sea lions do haul out at Middleton Island, however (45 mi from the nearest landfall), and have been observed 70 to 85 nautical miles offshore in the Bering Sea (Calkins and Pitcher 1982, Fiscus and Baines 1966).

Table 1 lists all recognized sea lion rookeries and haulout areas in the Southcentral Region. Table 2 describes stopover or rest area locations within the region.

B. Areas Used Seasonally and For Life Functions

See the printed 1:1,000,000-scale sea lion distribution maps in the Atlas to the guide for the Southcentral Region and the 1:250,000-scale reference maps located in the ADF&G area offices. The following categories have been used to describe sea lion distribution:

- Rookeries
- Haulout areas

Sea lions differ from other marine mammals in the Gulf of Alaska (GOA) by showing a strong affinity for specific, well-defined, perennially used locations: rookeries, haulouts, rest areas. Pupping and breeding activities occur primarily in rookeries; haulouts are areas used by sea lions to haul out of the water to rest.

C. Factors Affecting Distribution

Seasonality, degree of exposure to environmental factors, type of shoreline substrate, distance to food sources, and the recurrence of use are important factors influencing utilization of an area by sea lions (Calkins and Pitcher 1982). Sea lions prefer relatively clear water and are uncommon in glacial areas where waters may be highly turbid. Normally, sea lions inhabit the marine environment, but occasionally they enter freshwater rivers for short periods of time. For further details, see the Life History and Habitat Requirements narrative.

Table 1. Recognized Sea Lion Haulout and Rookery Areas in Southcentral Alaska

Use Area	Location	Peak Population Estimate (Year)
<u>Rookery</u>		
Seal Rocks(PWS)	60°09'58"N, 146°50'30"W	2,961 adults, 491 pups(1979)
Outer Islands	59°20'50"N, 150°24'07"W	3,155 adults, 888 pups(1979)
<u>Haulout</u>		
Cape St. Elias	59°47'48"N, 144°36'05"W	1,628 adults, 25 pups (June 1976)
Middleton Is.	59°29'15"N, 146°18'30"W	2,901 animals (May 1976)
Lewis Is.	59°52'50"N, 147°20'43"W	878 adults, 35 pups (1976)
Glacier Is.	60°51'03"N, 147°10'57"W	197 animals (1976)
Perry Is.	60°41'15"N, 147°51'05"W	308 animals (1976)
Pt. Eleanor	60°35'00"N, 147°33'45"W	222 animals (1976)
The Needle	60°06'45"N, 147°36'40"W	666 animals (March 1976)
Pt. Elrington	59°55'48"N, 148°13'20"W	2,014 animals (March 1976)
Rugged Is.	59°30'12"N, 149°22'53"W	215 animals (March 1976)
Chiswell Is.	59°35'57"N, 149°33'59"W	4,000+ animals (April 1976)
Seal Rocks (Kenai)	59°31'15"N, 149°37'00"W	630 animals (March 1976)
Gore Point	59°10'47"N, 150°39'30"W	535 animals (June 1976)
E. Chugach Is.	59°08'20"N, 152°39'30"W	20 animals (1957)
Perl Is.	59°05'58"N, 151°39'31"W	33 animals (June 1976)
Nagahut	59°05'58"N, 151°39'31"W	344 animals (June 1976)
Cape Elizabeth	59°05'58"N, 151°39'31"W	124 animals (June 1976)

Source: Calkins and Pitcher 1982.

D. Movements Between Areas

Sea lions are year-round residents of the Southcentral Region. Shifts in distribution and movements of Steller sea lions have been demonstrated throughout the Southcentral Alaska portion of the Gulf of Alaska (GOA): Mathisen and Lopp (1963) found pronounced seasonal variations in use of areas; Kenyon and Rice (1961) reported distinct seasonal shifts in distribution and abundance of sea lions in the GOA; and Pitcher (1975) noted seasonal changes in sea lion distribution in PWS. Sea lions are

Table 2. Sea Lion Stopover Areas,* Southcentral Alaska

Name	Latitude	Longitude
Porpoise Rocks	60°19'00"N	146°41'00"W
Fox Point	60°35'00"N	145°57'00"W
Knowles Head	60°41'10"N	146°57'00"W
Pleiades Islands	60°13'42"N	148°00'50"W
Latouche Island	59°56'25"N	148°02'25"W
Danger Island	59°55'30"N	148°04'45"W
Fountain Rocks	59°35'00"N	146°21'00"W
Wessels Reef	59°47'00"N	146°12'00"W
Cape Puget	59°56'40"N	148°27'00"W
Cape Junken	59°55'04"N	148°38'25"W
Barwell Island	59°51'45"N	149°16'40"W
Hive Island	59°53'12"N	149°22'00"W
Aialik Cape	59°42'00"N	149°32'00"W
Nuka Point	59°17'30"N	150°43'00"W
Flat Island	59°19'40"N	151°59'20"W
Augustine Rocks	59°13'30"N	153°22'00"W

Source: Calkins and Pitcher 1982.

* Sea lions have occasionally been sighted at these locations, but they are considered stopover areas and not true haulouts, because of an inconsistent use pattern.

dispersed throughout the GOA in winter and occupy different haulout areas than in summer (ibid.). For example, sea lions move to more protected, inland areas such as PWS in winter.

Juvenile sea lions gradually disperse widely from the rookeries of birth after their first summer of life. Most eventually return to those same rookeries but generally not until after the third year (ibid.).

Many adult females return to the rookeries of their birth for breeding and parturition (ibid.). In the northern GOA, 15 branded females bore pups at two rookeries where branding occurred, with only one of these cows giving birth at a rookery other than where she was born (ibid.).

Although Calkins and Pitcher (1982) demonstrated a distinct easterly movement across the northern GOA, sea lions also move in other directions. The longest documented movement is a nearshore distance of 1,500 km between Cape St. Elias and the Queen Charlotte Islands (ibid.).

There have been no detectable seasonal movements by subadults less than four years old. Moreover, in 1977, an eastward shift of juveniles across the northern GOA occurred (ibid.). These movements appeared to be subadult dispersals but were not correlated to any specific season.

E. Population Size Estimation

Abundance estimates are made using aerial survey data. Haulout areas are photographed and animal numbers counted. (For a more detailed description of the photo-survey technique, see Calkins and Pitcher 1982, Mathisen and Lopp 1963.) Sandegren (1970) observed considerable movement to and from rookery areas. Sea lion population estimates based on rookery or haulout area counts should be considered minimal estimates, as some portion of the total population is in the water at any point in time.

The most accurate population estimates currently available are based on total pup counts in combination with sex and age-specific survival rates, birth rates, and age-structure data. This estimation procedure is more accurate than periodic rookery and haulout area counts because it encompasses all segments of a population, including those animals that may be in the water during the census.

F. Regional Abundance

No sea lion population estimates specific to the Southcentral Region are available. However, Mathisen and Lopp (1963) censused the outer coastal area between Cape St. Elias and Cape Elizabeth, which includes almost all of the southcentral rookeries/haulout areas of PWS and the southern Kenai coast. June and October population estimates were 8,880 and 10,582 animals, respectively. Minimal population estimates for rookeries and haulouts within the Southcentral Region are presented in table 1.

This regional population estimate is comparable to other population estimates for larger areas. The total Alaska population is estimated at 242,000 animals, with a worldwide population at 281,000 (ibid.).

Mathisen (1959) estimated 165,000 sea lions in the area from Cape St. Elias (144°W) to the Islands of the Four Mountains (170°W). This estimate was raised to 175,000 animals by Mathisen and Loop (1963). Kenyon and Rice (1961) estimated 225,000 sea lions worldwide. Calkins and Pitcher (1982), based on pup counts, estimated 135,000 sea lions in the GOA between Cape Spencer (136°W) and Scotch Cap (168°W).

II. CAPE ST. ELIAS-PWS

A. Present Abundance

Abundance data for the major haulout areas in the Cape St. Elias-PWS area are presented in table 3. Pitcher (1975) reported 5,134 sea lions counted in the June 1973 survey and 4,614 animals in the March 1974 survey. Differences in photographic quality and coverage, animal distribution, and the unknown numbers of sea lions in water during a survey preclude precise estimates of abundance (Pitcher 1975).

Table 3. Summary of Cape St. Elias-PWS Area Sea Lion Survey Counts

Location	Survey Date	Total No.	Sources
Cape St. Elias	2 Oct. 1957	1,343	a
	26 June 1973	1,566	b
	6 Mar. 1974	505	b
	Mar. 1976	435	c
	June 1976	1,628	c
Middleton Island	Feb. 1975	175	b
	Mar. 1976	92	c
	late May 1976	2,901	c
Fish Island (Lewis Island)	22 July 1956	679	a
	Summer 1956	2,500	a
	1 Sept. 1956	2,556	a
	14 Dec. 1956	1,694	a
	24 Mar. 1957	810*	a
	27 June 1957	3,000	a
	2 Oct. 1957	3,762	a
	27 May 1968	1,549	d
	26 June 1973	1,269	b
	6 Mar. 1974	568	b
Seal Rocks	22 July 1956	183*	a
	24 Mar. 1957	0	a
	2 Oct. 1957	95	a
	4 Sept. 1966	846	e
	26 June 1973	1,733	b
	5 Mar. 1974	1,750 *	b
	Mar. 1976	2,500	c
	June 1976	1,709	c
	June 1978	3,008	c
	June 1979	3,452	c
The Needle	21 July 1956	195*	a
	1 Sept. 1956	150	a
	14 Dec. 1956	165	a
	24 Mar. 1957	190	a
	27 June 1957	179	a
	2 Oct. 1957	130	a
	27 June 1973	236	b
	6 Mar. 1974	568	b
	Mar. 1976	666	c
	June 1976	537	c

(continued)

Table 3 (continued).

Location	Survey Date	Total No.	Sources
Pt. Elrington	21 July 1956	31*	a
	1 Sept. 1956	0*	a
	14 Dec. 1956	550*	a
	24 Mar. 1957	200*	a
	29 May 1957	300*	a
	27 June 1957	250	a
	2 Oct. 1957	353	a
	27 June 1973	250	b
	15 Mar. 1974	339	b
	Mar. 1976	2,014	c
	June 1976	725	c
Glacier Island	12 Mar. 1974	55	b
	Mar. 1976	197	c
Pt. Eleanor	15 Mar. 1974	91	b
	Mar. 1976	222	c
Perry Island	24 Mar. 1957	80*	a
	16 Mar. 1974	153	b
	Mar. 1976	308	c

* Visual estimate.

a Mathisen and Lopp 1963.

b Pitcher 1975.

c Calkins and Pitcher 1982.

d Sandegren 1970.

e BLM aerial photo in Pitcher 1975.

Pitcher (1975) calculated a minimal population estimate for the PWS-Cape St. Elias area at 6,500 to 7,500 sea lions. The apparent stability of the PWS population over the past 25 years, combined with the absence of human exploitation, is indicative of a population at or approaching carrying capacity (ibid.).

III. SOUTH KENAI COAST

A. Present Abundance

Abundance data for the major haulout areas in the southern coast of the Kenai Peninsula area are presented in table 4. Precise estimates of abundance for the south Kenai coast are not available. Bailey (1976) reported total observations of 6,655 sea lions between Point Adam and Cape Resurrection.

Table 4. Summary of Southern Kenai Coast Area Survey Counts

Location	Survey Date			Total No.	Sources
Rugged Island		---		100*	c
		Oct.	1975	0	b
		Mar.	1976	215	b
		Apr.	1976	150	b
		July	1976	100**	d
Chiswell Islands	21	July	1956	2,023	a
	1	Sept.	1929	1,929	a
	14	Dec.	1956	4,759	a
	24	Mar.	1957	4,715	a
	29	May	1957	3,593	a
	27	June	1957	2,012	a
	2	Oct.	1957	2,527	a
		Oct.	1975	3,158	b
		Mar.	1976	2,076	b
		Apr.	1976	4,000+*	b
		June	1976	1,106	b
		July	1976	1,303**	d
Seal Rocks (Kenai)	21	July	1956	499	a
	24	Mar.	1957	100*	a
	27	June	1957	250*	a
	2	Oct.	1957	60*	a
		---		500*	c
		Oct.	1975	154	b
		Mar.	1976	630	b
		June	1976	320	b
		June	1976	450**	d
Outer Island	21	July	1956	1,783	a
	1	Sept.	1956	2,047	a
	14	Dec.	1956	1,466	a
	24	Mar.	1957	1,050	a
	29	May	1957	6,073	a
	27	June	1957	2,989	a
	2	Oct.	1957	2,191	a
		---		6,000*	c
		Oct.	1975	2,904	b
		Mar.	1976	1,528	b
		June	1976	3,847	b
	late	June	1976	4,100**	d

(continued)

Table 4 (continued).

Location	Survey Date			Total No.	Sources
Outer Island (cont.)		June	1978	3,573	b
		June	1979	4,043	b
Gore Pt.	21	July	1956	221*	a
	14	Dec.	1956	0*	a
	24	Mar.	1957	0	a
	29	May	1957	31*	a
	27	June	1957	200*	a
	2	Oct.	1957	35*	a
		Oct.	1975	2	b
		Feb.	1976	90*	b
		Mar.	1976	200	b
		June	1976	535**	b
		June	1976	307	d
Chugach Island group	21	July	1956	874	a
	1	Sept.	1956	12	a
	24	Mar.	1957	12	a
		Mar.	1976	144	b
		June	1976	501	b

* Visual estimate.

** Boat survey.

a Mathisen and Lopp 1963.

b Calkins and Pitcher 1982.

c ADF&G 1973.

d Bailey 1976.

REFERENCES

ADF&G. 1973. Alaska's wildlife and habitat. Vol. 1 [R.A. Hinman and R.E. LeResche, eds.]. 144 pp. + maps.

Bailey, E.P. 1976. Breeding seabird distribution and abundance along the southside of the Kenai Peninsula, Alaska. USFWS/NPS rept. Anchorage, AK. 88 pp.

Calkins, D.G., and K.W. Pitcher. 1982. Population assessment, ecology, and trophic relationships of Steller sea lions in the Gulf of Alaska. Final rept. to OCSEAP. Boulder, CO.

Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of Steller sea lions. J. Mammal. 47:195-200.

Kenyon, K.W., and D.W. Rice. 1961. Abundance and distribution of Steller sea lions. J. Mammal. 42:223-234.

Mathisen, O.A. 1959. Studies on Steller sea lion (_Eumetopias jubata_) in Alaska. Trans. N. Am. Wildl. Conf. 24:346-356.

Mathisen, O.A., and R.J. Lopp. 1963. Photographic census of the Steller sea lion herds in Alaska, 1956-1958. USFWS Spec. Sci. Bull. 424. 20 pp.

Pitcher, K.W. 1975. Distribution and abundance of sea otters, sea lions, and harbor seals in Prince William Sound, Alaska. ADF&G, unpubl. rept. 31 pp.

Sandegren, F.E. 1970. Breeding and maternal behavior of the Steller sea lion (_Eumetopias jubatus_) in Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 138 pp.

Sea Otter Distribution and Abundance

I. REGIONWIDE INFORMATION

Information will be organized and presented for the Prince William Sound (PWS), Kayak Island-Controller Bay area, the Kenai Peninsula, and Kamishak Bay (see maps 1 and 2). Past data collection efforts have ignored game management unit boundaries and focused on specific biologically distinct areas within the Southcentral Region (e.g., PWS, Kenai Peninsula, Kamishak Bay), because the ADF&G has no managerial authority for this species.

A. Regional Distribution

Historical records indicate that sea otters were eliminated from most of their original range during 170 years of exploitation (1742-1911) by Russian and American fur hunters. Small remnant groups apparently survived within the Southcentral Region in PWS, Kamishak Bay, and the Barren Islands (Lensink 1962). After protection by international treaty in 1911, the surviving groups increased in numbers and have repopulated most of their former range, which included PWS, lower Cook Inlet, and the entire outer coast of Southcentral Alaska.

In the Southcentral Region, sea otters occur in the Controller Bay-Kayak Island area, throughout PWS, the southern coast of the Kenai Peninsula, Kachemak Bay, lower Cook Inlet, Kamishak Bay, and the west side of Cook Inlet, north to Tuxedni Bay (Pitcher 1975, Calkins 1979). Major sea otter concentration areas for PWS and the Kenai Peninsula are listed in table 1.

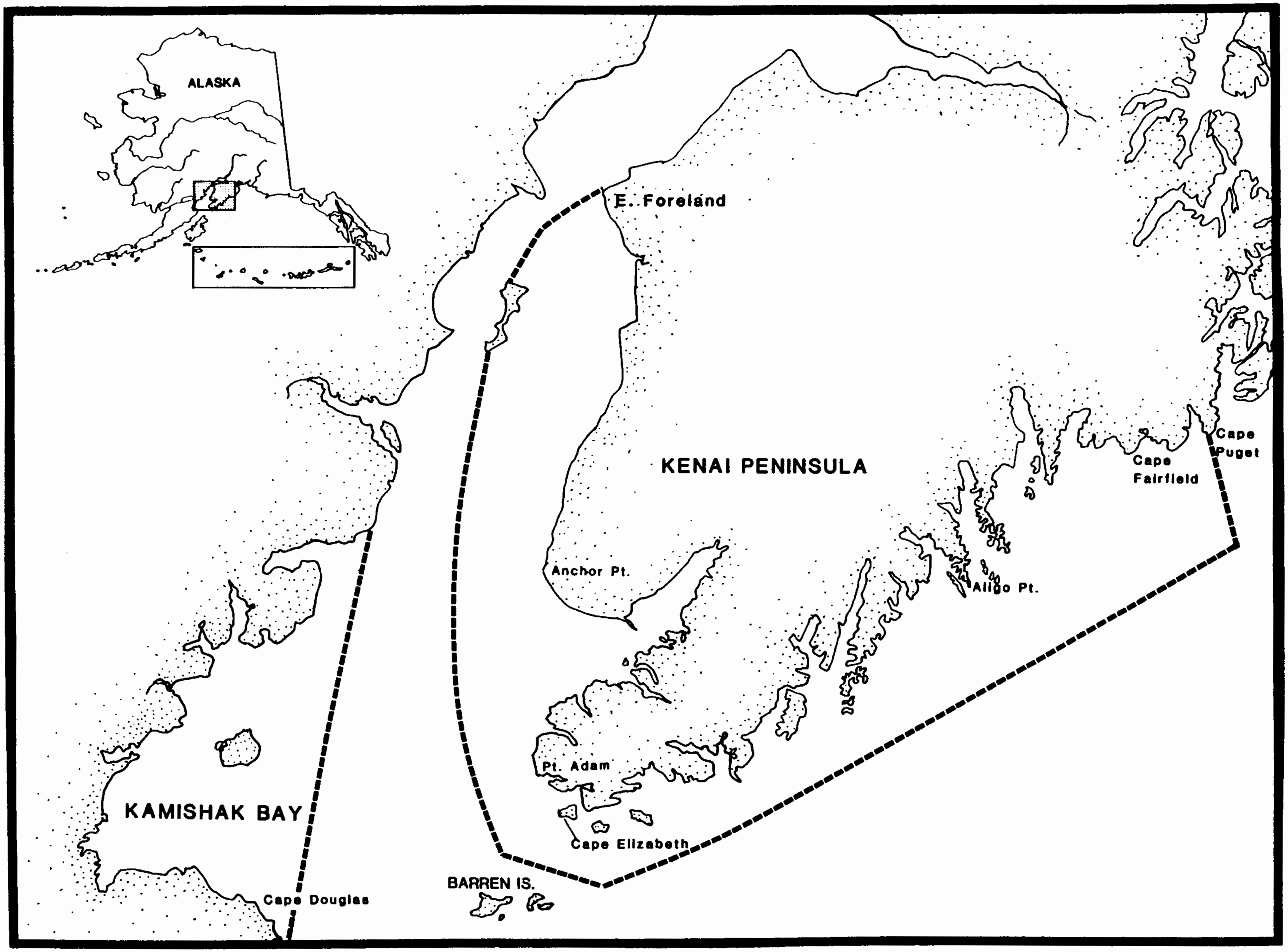
B. Areas Used Seasonally and for Life Functions

See the 1:1,000,000-scale printed maps found in the Atlas to the Southcentral Region and the 1:250,000-scale reference maps located in ADF&G area offices. These maps show known concentration areas, areas with established populations, and areas of unpopulated habitat.

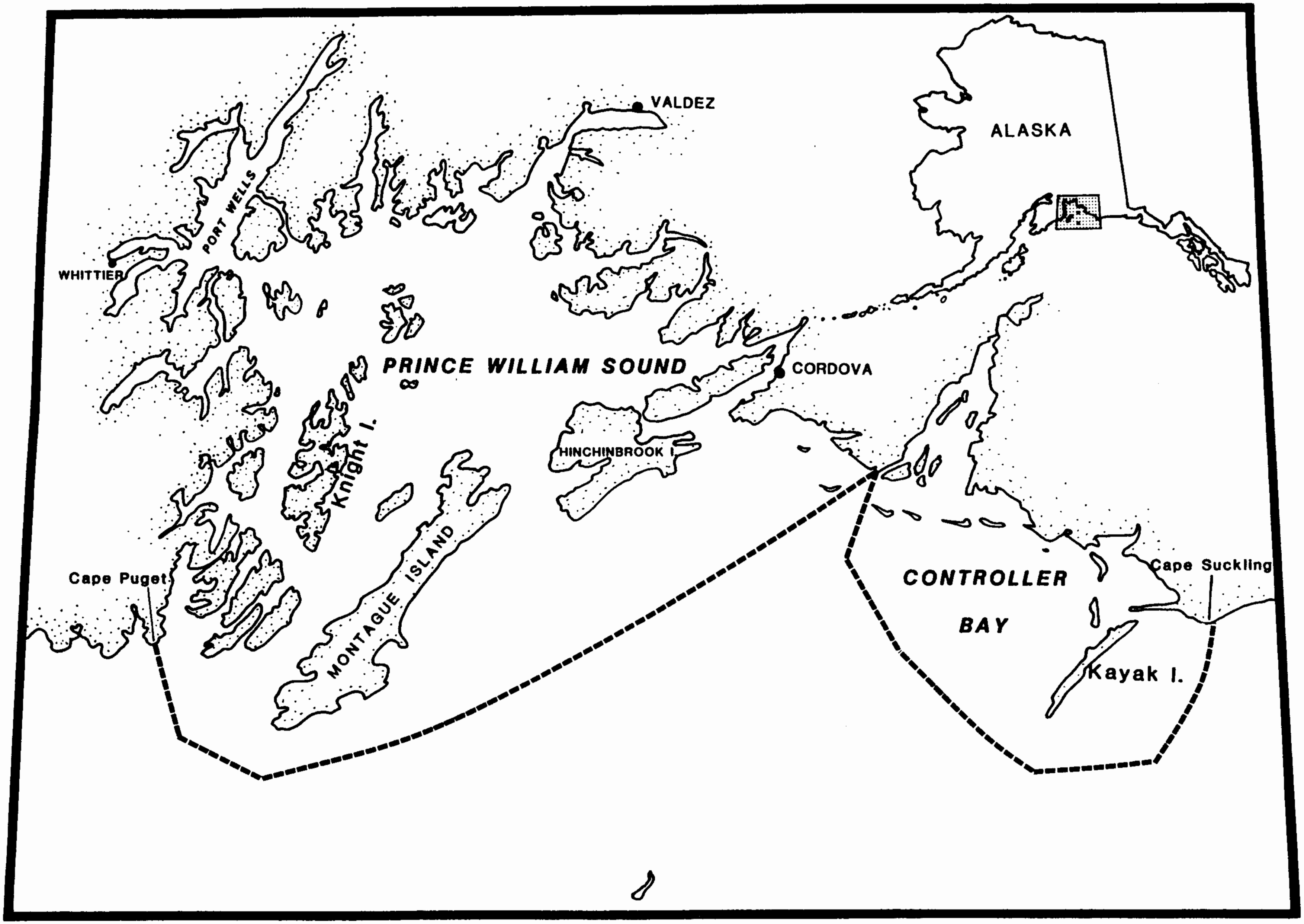
C. Factors Affecting Distribution

The most important factor affecting sea otter population distribution appears to be food availability. Generally, sea otters are nonmigratory and feed on bottom-dwelling invertebrates but can turn to fish if the invertebrate supply is depleted (Calkins and Schneider 1984). They are very sensitive to changes in the food chain and prey availability.

Kenyon (1969) described a common pattern of range expansion in which otter concentrations increased at the fringes of a population and, because of competition for food, suddenly dispersed into adjacent suitable habitat. This process is presently occurring in the Kachemak Bay area and PWS (Schneider, pers. comm). Food availability and the occurrence of sea ice will probably determine the northern limits within Cook Inlet for the sea otter range expansion in lower Cook Inlet.



Map 1. Boundaries of the Kamishak Bay and Kenai Peninsula areas discussed in this narrative.



Map 2. Boundaries of the Prince William Sound and Kayak Island-Controller Bay areas discussed in this narrative.

Table 1. Major Sea Otter Concentration Areas

Location	Maximum Population Count (Year)	Source
Prince William Sound:		
Hawkins Island	123 (1974)	a
Hinchinbrook Island	467 (1978)	b
Montague Island	492 (1978)	b
Galena Bay to Fish Bay	145 (1978)	b
Green Island Area	152 (1974)	a
Evans Island	107 (1984)	c
Knowles Head	153 (1973)	d
Naked Island-Peak Island	153 (1973)	d
Knight Island Complex	264 (1984)	c
Hawkins Cutoff	330 (1981-82)	g
Latouche Island	210 (1984)	c
Bainbridge Island	138 (1984)	c
Harriman Fjord	192 (1984)	c
Collge Fjord	195 (1984)	c
Sheep Bay	202 (1974)	a
Orca Inlet	640 (1981-82)	g
Kenai Peninsula:		
Dangerous Cape-Port Graham	54 (1982)	f
Koyuktolik Bay	29 (1982)	f
Koyuktolik Bay-Chrome	77 (1982)	f
Elizabeth Island	106 (1982)	f
Perl Island	85 (1982)	f
E. Chugach Island	26 (1982)	f
Chugach Bay	75 (1982)	f
Rocky Bay	45 (1982)	f
Port Dick	25 (1982)	f
Nuka Bay-West Arm	127 (1976)	e
Nuka Bay-East Arm	86 (1982)	f
Tonsina Bay-Long Island	27 (1982)	f
Harris Bay	100 (1976)	e
Aialik Bay	36 (1976)	e

a Pitcher 1975.

b Zmarzly et al. 1978.

c Irons, pers. comm.

d Pitcher and Vania 1973.

e Bailey 1976.

f USFWS 1983.

g Garshelis 1983.

Water depth is a major factor limiting food availability and hence sea otter distribution patterns (Calkins 1979). Based on sea otter predation studies, it appears that most preferred prey items are bottom-dwelling invertebrates (Calkins 1978, Calkins and Schneider 1984). High concentrations of sea otters usually occur in waters less than 60 m (33 fathoms) in depth (Calkins 1979). However, sea otters have been known to dive to 80 and 100 m (44 and 55 fathoms) (Schneider 1976). Sea otter densities between Gore Point and Cape Puget are relatively low (ibid.). This area consists mainly of steep-sided, deep-water fjords. Suitable water depths for foraging are limited to a narrow band along the shores, shallow lagoons, and a few scattered submerged glacial moraines. Schneider (1976) pointed out that the observed distribution of otters generally falls within the distribution of shallow water.

D. Movements Between Areas

1. Home range. Based on 29 recoveries of marked sea otters, primarily females, Kenyon (1969) tentatively concluded that, in the Aleutians, home range included 5 to 10 mi (8 to 16 km) of coastal habitat. Males were thought to have a larger home range than females. In PWS, Johnson (1982) observed that tagged adult females may limit their movements to relatively small areas less than 4 km^2 (1.5 mi^2) for several days. During a season, however, female otters regularly move their use area several kilometers so that their seasonal or yearly range may include several square kilometers (ibid.). Garshelis (1983), working in PWS, found that home range size depended largely on the area of available habitat, or, more specifically, on the configuration of land masses and the distribution of feeding and resting areas. The strong influence of habitat precluded attempts to compare home range size between sexes or geographic localities. Nevertheless, male home ranges (11.0 km^2) in Nelson Bay were larger than female home ranges (4.0 km^2) at Green Island (ibid.).

   Kenyon (1969) and Schneider (1978) observed that sexes generally segregated into pods. Male areas had discrete boundaries, were often located near exposed points of land, and extended 4 to 12 km offshore. Females tended to occupy areas of higher quality habitat than males, with more abundant food resources, with less exposure to heavy seas and winds, and with generally less discrete boundaries. Evidence indicates that the permanent classical male areas, as found in the Aleutian Islands, do not presently exist in PWS (Schneider 1978). Reasons for this difference are not clear at this time.

2. Timing. Schneider (1978) noted that some adult males may make seasonal movements between male and female areas in response to changing numbers of estrous females. In PWS, these movements to female areas probably occur during late summer (ibid.). Garshelis (1983) noted that males may travel up to 100 km to female areas during the late summer breeding

season in PWS. After the peak breeding time in autumn, most males returned to male areas.

3. Seasonal movements. Kenyon (1969) proposed that sea otters do not migrate seasonally. Moreover, nonbreeding males and, occasionally, females move to sparsely populated areas or to the fringe areas of expanding populations where higher quality habitat not dominated by breeding adults is available (Schneider 1978). Males have been known to travel as much as 39 km from one male area to another (ibid.). Distances between extreme locations for males in northeastern PWS (range 4.8-37.0 km) were greater than for females at Green Island (range 2.6-16.0 km) (Garshelis 1983). This difference resulted because some of the males moved from the male area to territories within a female area (Johnson, pers. comm.). Travel rates greater than 5 km/h were common in PWS sea otters (ibid.).
   Garshelis (1983) found that seasonal movements between male or female areas were mainly influenced by breeding, pup rearing, boat traffic patterns, and availability of sites used to escape stormy weather.
4. Repopulation pattern. Repopulation of vacant habitat has followed a predictable pattern. Populations typically build to higher levels than the habitat can support on a sustained basis and then drop as animals emigrate to adjacent vacant habitat, creating "fronts" of range expansion. Numbers of sea otters in suitable habitat may increase from a few scattered individuals to over a thousand in two or three years as these fronts pass through the area. Consequently, many areas with current low densities will become important concentration areas within the next decade. Similarly, some concentrations are short-term. Eventually, densities stabilize and fluctuate within a narrower range. Knowledge of recent population changes is essential to the understanding of the significance of current distribution patterns and may allow prediction of future changes (Schneider, pers. comm.).

E. Population Size Estimation

Schneider (1971) described and compared five sea otter survey techniques, pointed out advantages and disadvantages of each, and evaluated these techniques in light of known changes in population abundance caused by harvests, transplants, and natural mortality. The five survey types are fixed-wing aircraft, helicopter, skiff or dory, shore, and photographic counts. Aerial counts can be used to monitor large changes in distribution and abundance, but due to the problems listed below, they have limited value in estimating population size or for a regular management program (Schneider 1971). Skiff surveys are more sensitive than aerial surveys but are limited in range, more difficult to conduct in remote areas, and not feasible for monitoring changes over large areas (ibid.). A third technique, shore survey counts, often results in estimates 2 to 4 times higher than helicopter counts and 6 to 10 times higher than fixed-wing aircraft counts (ibid.). Shore counts may be limited by lack of suitable observation points. Aerial photocensusing costs more than visual counts from the same aircraft and does not appear to improve survey results significantly (ibid.).

Schneider (1971) also enumerates factors that cause variability among surveys of the same type. The most important set of factors are those conditions affecting visibility:

- Wind ripple, wind chop, and swells
- Glare from the sun on water surface
- Dense kelp
- Shadows from high cliffs
- Precipitation (fog, snow, rain)

Other factors, such as turbulence affecting the aircraft, tear formation in the observers' eyes from wind, and the formation of water droplets from spray on optical equipment, can reduce observer effectiveness. The distribution and activity of otters (resting in pods vs. scattered and feeding) and the time of day and weather conditions, both during the count period and for several days previous to a count, can affect survey estimates. Kenyon and Spencer (1960) assumed that almost 25% of the individuals in a flight path will be under water and missed during a survey.

F. Regional Abundance

Using techniques developed in other areas of Alaska, Calkins and Schneider (1984) calculated a population estimate of 6,500 to 9,500 animals for the Southcentral Region.

Reliable estimates of sea otter abundance in Alaska before the onset of exploitation (ca. 1740) do not exist. Schneider (1978), however, estimated that 100,000 to 120,000 otters had reoccupied approximately one-half of their previous range by 1972. Johnson (1982) concluded that the otter population in 1740 probably exceeded 200,000 animals. Lensink (1960) estimated that approximately 800,000 sea otters were harvested by all nationalities during the period of Russian occupation of Alaska (1741-1867). By the early 1800's, the previously uncontrolled harvest of otters in Alaska of necessity came under regulatory management by the Russian-American Fur Trading Company. After the purchase of Alaska in 1867, another period of uncontrolled hunting ensued until otters had been eliminated from all but a few remote areas. Lensink (1962) noted that otter harvests for the four decades from 1870 through 1910 were 40,283, 47,842, 6,467, and 572, respectively. In 1911, when protection of sea otters began, the world population probably numbered less than 2,000 individuals (Calkins and Schneider 1984). By the 1960's, sea otter populations had increased to approximately 40,000 animals in Alaska (Kenyon 1969). Currently, the Alaska sea otter population numbers between 115,000 and 160,000 animals, with almost 7% of these found in the Southcentral Region (Schneider, pers. comm.).

II. PRINCE WILLIAM SOUND (PWS) AREA

A. Present Abundance

Pitcher (1975) estimated 5,000 sea otters between Cape Puget and Cape St. Elias, based on the results of two helicopter surveys and information from comparative shore-helicopter counts on Amchitka Island (ibid.). In the June 1973 survey, 2,015 sea otters were counted (Pitcher and Vania 1973); 1,444 animals were counted in the March 1974 survey (Pitcher 1975). A comparison of otter counts by helicopter and boat was also conducted in selected areas of PWS. Boat survey counts were 73% greater than helicopter counts, lending support to Schneider's (1971) contention that boat surveys were more accurate than aerial surveys. Schneider further suggested that shore counts were higher than boat counts and that even then not all animals could be counted. An estimate, similar to that of Pitcher and Vania (1973), of 5,000 sea otters was made by the ADF&G (1973), and, as Pitcher and Vania (1973) concluded, this estimate appeared reasonable.

Pitcher (1975) proposed that the population is still expanding and dispersing into areas of previously unoccupied habitat at a fairly rapid rate.

In July 1978, 2,148 sea otters were counted in a helicopter survey with excellent visibility over an area slightly smaller than Pitcher's (1975) area (Zmarzly et al. 1978). These workers concluded that the PWS sea otter population had grown from 1973 to 1978.

B. Historic Distribution and Abundance

As previously mentioned, sea otters were almost exterminated by commercial hunting in the North Pacific region during the 1700's and 1800's. Only 13 remnant populations totaling less than 2,000 otters existed when an international hunting moratorium was established in 1911 (Kenyon 1969). PWS contained a remnant group of possibly less than 50 sea otters when hunting was terminated (Garshelis 1983). These otters apparently inhabited the southwest portion of PWS, as the first group of surviving otters were observed in this area in 1949 (Lensink 1962). Repopulation to current levels was undoubtedly the result of a buildup and dispersal of remnant groups.

By the late 1940's and early 1950's, large groups of otters were reported in the Montague, Hinchinbrook, LaTouche, and Elrington island areas (Pitcher 1975). During the early 1960's, the distribution pattern remained the same, but otter abundance appeared to have increased (ibid.). These otter populations continued to grow through the late 1960's and by 1970 had expanded rapidly into vacant habitat along the mainland coast and adjacent islands within PWS. Along the western and northern sides of the sound, where otter habitat is a narrow band along shore, the population consisted of scattered individuals and small localized concentrations. Specifically, the recently repopulated areas included College and Harriman fjords, the north end of Culross Island, Glacier Island, and the Fairmount-Olsen Island area (ibid.). A 1984 USFWS survey in western PWS indicated a large increase in sea otter numbers over Pitcher's (1975) counts in the area between Chenega Island and College Fjord (Irons, pers. comm.). The densities in portions of the area exceeded those that have been observed for a sustained period elsewhere. Consequently, these concentrations may be temporary (Schneider, pers. comm.).

Even more dramatic changes have been observed along the east side of the sound, where broader areas of shallow water provided more suitable habitat. A concentration of sea otters was first documented in Port Gravina in 1970. This group grew in size and expanded its range into adjacent bays in a stepwise manner similar to that described by Kenyon (1969). Significant numbers were first sighted in Sheep Bay in 1974 (Pitcher 1975), in the Port Fidalgo area in 1975, Tatitlek Narrows in 1976 (Schneider, pers. comm.), Simpson Bay in 1977, and Nelson Bay in 1979 (ibid.).

By 1980, large numbers were occupying Orca Inlet during winter but avoiding the area during summer, perhaps in response to boat traffic (Garshelis 1983). At this time, the groups of otters repopulating the eastern side of PWS had merged with a group that had persisted near the east end of Hinchinbrook Island since the early 1960's (Schneider, pers. comm.) and occupied the Hawkins Cutoff and lower Orca Island area at least seasonally (Pitcher 1975).

Schneider (pers. comm.) emphasizes that it is important to recognize the dynamic nature of the groups of sea otters inhabiting the east side of PWS, as more changes are likely in the near future. The population has followed a classic pattern of range expansion, which has repeatedly been documented throughout the sea otters' range from California through the Aleutian Islands. Where food is abundant, large numbers of otters may abruptly move into the area from adjacent areas where food has been depleted. Usually, the majority of new arrivals are males. As food becomes depleted, the "expanding front" moves on. If adequate food supplies remain, the "front" of males is replaced by a more stable population that may be less dense and consists of a much larger proportion of females.

Each bay in PWS seems to be following a pattern that can be illustrated by the history of Sheep Bay. Sea otter numbers built up from essentially 0 to about 450 over a two to three year period. The vast majority were males. The population then declined to very low levels for two to four years and then increased, approximately a decade after original repopulation, to moderate numbers, many of which were females (Johnson, pers. comm.).

It is likely that this pattern will continue as the "front" of males expands out of PWS eastward along the Gulf of Alaska coast (Schneider, pers. comm.). Until 1965, repopulations of vacant habitat throughout southeast Alaska, British Columbia, Washington, and Oregon depended on continued expansion of the PWS population.

A series of transplants conducted by the ADF&G between 1965 and 1972 established several populations throughout this area (Schneider 1973, Burris and McKnight 1973).

III. KAYAK ISLAND - CONTROLLER BAY AREA

A. Present Abundance

No detailed population estimates are currently available for the Kayak Island-Controller Bay area. However, Schneider (pers. comm.) believes that probably less than 100 otters may be found in this area. Because of the dynamic nature of the sea otter range expansion process and the geographic location of the area, reliable estimates are difficult to derive at this time.

B. Historic Distribution and Abundance

The only group of sea otters surviving between PWS and Monterey, California, existed in the Kayak Island-Controller Bay area. Lensink (1962) estimated that about 200 otters were present in 1959. Reports of up to 100 persisted until 1965, after which the population declined to a few scattered individuals. During the 1970's, sightings in Icy Bay, Yakutat Bay, and along the outer gulf coast southeast of Yakutat increased. An extensive search by helicopter of the Kayak Island-Controller Bay area in 1979 indicated no significant increase. By 1982, pods of up to 50 were being reported in Yakutat Bay, and by 1984 unconfirmed reports of larger numbers near Kayak Island were received (Schneider, pers. comm.).

According to Schneider (pers. comm.), these sightings suggest that sea otters were straying out of PWS but were bypassing large areas of potential habitat. This often occurs several years prior to the front-like population expansion described earlier. The front that has repopulated the eastern side of PWS will probably move out into the Gulf of Alaska toward Kayak Island in the near future. However, the rate of expansion and the pattern of distribution cannot be predicted with certainty.

IV. KENAI PENINSULA AREA

A. Present Abundance

Sea otter abundance for the Kenai Peninsula area has not been calculated. However, Calkins and Schneider (1984) roughly estimated 2,500 to 3,500 sea otters for the Kenai Peninsula and lower Cook Inlet area. Schneider (1976) felt that 500 to 1,000 animals occupied the Kamishak Bay area, suggesting that a minimal estimate of 1,500 to 2,500 sea otters is reasonable for the Kenai Peninsula area.

Calkins (1979) suggested that the otter populations of the the outer coast of the peninsula from Gore Point to Port Graham are well established and probably approaching carrying capacity. Otters from this area are expanding their range northward into Kachemak Bay and lower Cook Inlet. Several hundred otters now inhabit a shallow offshore area west of Homer and south of Anchor Point. The area east of Gore Point is considered an established area but below carrying capacity; significant increases in density are expected in the near future.

B. Historic Distribution and Abundance

Sea otters probably were eliminated from the Kenai Peninsula in the early 1900's by market hunters. Prior to 1967, only scattered sea otter sightings had been reported from Cape Puget to Port Graham. Lensink (1960) reported 15 animals near Elizabeth Island in 1953. Kenyon (1969) felt that no significant otter populations occupied the area by the mid 1960's. In 1967, as many as 1,000 animals suddenly appeared in the Koyuktolik Bay-Chugach Bay area. In a 1968 survey of that area, 400 otters were observed, but unconfirmed reports indicated that twice this number were present (Schneider 1976). Some sea otters probably migrated from the Kodiak archipelago, and some may have crossed Cook Inlet from Kamishak Bay (ibid.). By 1970, the number of otters in this concentration area had declined as a result of dispersal and repopulation of the entire outer coast of the Kenai Peninsula (ibid.). Within the same time period, sea otter sightings in Resurrection, Aialik, and Harris bays increased, suggesting that otters from PWS probably contributed to the repopulation of the area east of Gore Point.

In a 1975 helicopter survey of the south coastal area, Schneider (1976) counted 531 otters. Due to the less than ideal survey conditions, as many as 1,500 sea otters could have been present (Schneider 1976). Results of Bailey's (1976) boat counts are believed to be the best information on abundance within the area he covered. Bailey (1976) counted 745 sea otters between Point Adam and Resurrection Bay. At that time, the distribution of sea otters between Port Graham and Cape Puget appeared similar to the distribution of available habitat, with the highest numbers west of Gore Point. The only active range expansion evident was north of Port Graham. Small numbers had moved into Kachemak Bay, and a group of several hundred had been established in the shallow offshore waters between Homer and Anchor Point. This latter group may consist of immigrants from both the outer Kenai coast and Kamishak Bay (Schneider, pers. comm). The USFWS (1983) counted 1,036 otters, with 880 adults in approximately the same area surveyed by Bailey (1976) and Schneider (1976), by means of the small-boat survey technique. The area from Point Adam to Chugach Bay contained 50% of the adults. By 1984, the front of the former group had moved northeast past Seldovia, and individuals and small groups were sighted more frequently throughout Kachemak Bay (ibid.).

Large areas of Cook Inlet are shallow enough to provide habitat for sea otters. The suitability of much of this habitat is unknown, but substantial room for population growth appears to remain. Food availability and possibly seasonal sea ice will probably limit the northward expansion of sea otters in Cook Inlet, but the eventual limit of their range is unknown. Kachemak

Bay, in particular, appears to contain excellent sea otter habitat and should become a concentration area in the near future (ibid.).

V. KAMISHAK BAY AREA

A. Present Abundance

Schneider (1976) developed a rough estimate of 500 to 1,000 otters in Kamishak Bay. The population is expected to expand its range to the southwest and to the north along the west side of lower Cook Inlet (Calkins 1979).

Sea otters are found throughout the shallow waters of Kamishak Bay and thus often may be observed far from shore. Concentrations generally occur on the north side of Augustine Island (approximately 50 animals), in the waters west of Augustine Island, around Shaw Island, at Shakun Rocks, and at Douglas Reef (ibid.).

Observations of sea otters north of Kamishak Bay are becoming more common. Schneider (1976) proposed that range expansion to the north on both sides of Cook Inlet is most probable.

Observations of otters midway between Kamishak Bay and Homer may indicate that sea otter populations on both sides of lower Cook Inlet may become contiguous.

B. Historic Distribution and Abundance

A summary of significant sea otter survey counts in the Kamishak Bay area is presented in table 2.

Table 2. Significant Sea Otter Survey Counts in the Kamishak Bay Area

Area	1948	1957	1959	1965	1969	1971	1976
Augustine Island	50[a]	40[a]	52[a]*	18[b]	62[c] 130[c]	24[e]	50[e]
Shaw Island		1[a]				60[d]	
Shaw Island-Cape Douglas Area				101[b]			
Augustine Island-Tignagvik Pt.						150[c]	42[e]
Chinitna Pt.-Douglas River (including offshore areas)						100-150[e]	28[e]

* Considered a poor count.

a Lensink 1962.

b Kenyon 1965.

c Calkins et al. 1975.

d Prasil 1971.

e Schneider 1976.

REFERENCES

ADF&G. 1973. Alaska's wildlife and habitat. Vol. 1 [R.A. Hinman and R.E. LeResche, eds.]. 144 pp. + maps.

Bailey, E.P. 1976. Breeding seabird distribution and abundance along the south side of the Kenai Peninsula, Alaska. USFWS/NPS rept. Anchorage, AK. 88 pp.

Burris, O.E., and D.E. McKnight. 1973. Game transplants in Alaska. Wildlife Tech. Bull. No. 4. ADF&G, Anchorage. 57 pp.

Calkins, D.G. 1978. Feeding behavior and major prey species of the sea otter, Enhydra lutris, in Montague Strait, Prince William Sound, Alaska. Fish. Bull. 76(1):125-131.

________. 1979. Marine mammals of lower Cook Inlet and the potential for impact from outer continental shelf oil and gas exploration, development and transport. ADF&G, Anchorage. 89 pp.

Calkins, D.G., K.W. Pitcher, and K.B. Schneider. 1975. Distribution and abundance of marine mammals in the Gulf of Alaska. Rept. for USDC: NOAA. ADF&G, Anchorage. 67 pp.

Calkins, D.G., and K.B. Schneider. 1984. In J.J. Burns, Jr., ed. Marine mammal species accounts. Wildl. Tech. Bull. No. 7, ADF&G, Juneau.

Garshelis, D.L. 1983. Ecology of sea otters in Prince William Sound, Alaska. Ph.D. Dissert., Univ. Minnesota, St. Paul. 324 pp.

Irons, D. 1984. Personal communication. Wildlife Biologist, USFWS, Anchorage, AK.

Johnson, A.M. 1982. Status of Alaska sea otter populations and developing conflicts with fisheries. Trans. N. Am. Wildl. and Nat. Res. Conf. 47:293-299.

________. 1984. Personal communication. Marine Mammal Biologist, USFWS, Anchorage, AK.

Kenyon, K.W. 1965. Aerial survey of sea otters and other marine mammals, Alaska Peninsula and Aleutian Islands, 19 April to 9 May 1965. Unpubl. rept., USFWS.

________. 1969. The sea otter in the eastern Pacific Ocean. N. Am. Fauna 68:1-352.

Kenyon, K.W., and D.L. Spencer. 1960. Sea otter population and transplant studies in Alaska, 1959. USFWS. Spec. Sci. Rept. Wildl. No. 48:1-29.

Lensink, C.J. 1960. Status and distribution of sea otters in Alaska. J. Mammal. 41:172-182

________. 1962. The history and status of sea otters in Alaska. Unpubl. Ph.D. Dissert., Purdue Univ., Layfayette, Ind. 186 pp.

Pitcher, K.W. 1975. Distribution and abundance of sea otters, sea lions, and harbor seals in Prince William Sound, Alaska. Unpubl. rept., ADF&G, Anchorage. 31 pp.

Pitcher, K.W., and J.S. Vania. 1973. Distribution and abundance of sea otters, sea lions, and harbor seals in Prince William Sound, summer 1973. Unpubl. rept., ADF&G, Anchorage. 18 pp. + maps.

Prasil, R.G. 1971. Distribution of sea mammals and associated land mammals found along the Katmai coast, Katmai National Monument. Proceedings of the 22nd Alaska science conference. 8 pp.

Schneider, K.B. 1971. An evaluation of sea otter survey techniques. Unpubl. rept., ADF&G, Anchorage. 18 pp.

________. 1973. Sea otter distribution and abundance in Alaska. Unpubl. rept., ADF&G, Anchorage. 5 pp.

________. 1976. Assessment of the distribution and abundance of sea otters along the Kenai Peninsula, Kamishak Bay, and the Kodiak archipelago. Final rept. RU-240. BLM/NOAA OCS Studies. 72 pp.

________. 1978. Sex and age segregation of sea otters. Final rept., Fed. Aid in Wildl. Rest., Projs. W-17-4 through W-17-8. ADF&G, Juneau. 45 pp.

________. 1984. Personal communication. Regional Research Coordinator, ADF&G, Div. Game, Anchorage.

USFWS. 1983. Distribution and abundance of sea otters in the Kenai Fjords National Park. Unpubl. rept. 11 pp.

Zmarzly, D., G. Kooyman, and D. Costa. 1978. Patterns in sea otter population growth and distribution in Prince William Sound. Unpubl. rept. Physiological Research Lab. Scripps Inst. Oceanography. 10 pp. + maps.

Terrestrial Mammals

Sitka Black-tailed Deer Distribution and Abundance

I. REGIONWIDE INFORMATION

Since black-tailed deer occur in one game management unit (GMU) within the Southcentral Region, information will be presented for GMU 6 only.

A. Regional Distribution

Within the Southcentral Region, black-tailed deer range is limited primarily to the larger islands of Prince William Sound (PWS). Deer in limited numbers, however, also occur on mainland areas, from Port Gravina to the Copper River, including the Heney Range near Cordova (ADF&G 1976). Since the original transplant in 1916, deer have increased in numbers and have dispersed throughout PWS where suitable habitat exists (Burris and McKnight 1973). The most abundant deer populations can now be found on the following islands: Hawkins, Hinchinbrook, Montague, Green, Knight, Eleanor, Ingot, Latouche, Naked, Peak, and Storey. Other islands that probably have fewer than 25 deer include the following: Disk, Elrington, Evans, Chenega, Culross, Bligh, Channel, Observation, Crafton, and Fleming (Reynolds, pers. comm.).

1. <u>Special interest areas</u>. Suitable winter range for deer consists of closed-canopy conifer forests bordering the tidelines of gently sloping beaches. Conifers are an important component of beach-fringe habitat because snow depths beneath the canopy they form are less than in open areas, affording deer mobility and access to food resources. Similarly, intertidal habitat is important because it is snow-free, thus allowing deer to move about unimpeded to locate intertidal food sources, especially kelp (Reynolds 1979). In winters of heavy snowfall, the snow-free intertidal area affords deer greater mobility and easier access to the beach-fringe area.

   Most of the northwest shore of Hawkins Island is considered high-density winter range (Reynolds, pers. comm., in ADF&G 1976). Beaches in this area have gentle slopes, abundant kelp, and are exposed to winds off the open sound. The rest of the island is moderate to low density range for just the opposite reasons: less wind, steeper terrain, and less kelp (ADF&G 1976).

   On Hinchinbrook Island, high-density winter range is found along the western shore from Johnstone Point to Bear Cape, the southeastern shore within Port Etches, and the northeastern portion of the island from Pt. Steele to Hook Pt. (ibid.).

   Two large areas on Montague Island have been identified as high-density deer winter range. One area extends from Cape Cleare northeast to Beach River. The other area extends from Port Chalmers to Zaikof Point, including Rocky and Zaikof bays (Reynolds, pers. comm.).

Presently, deer are numerous on Knight Island, except along the western shore (ibid.).

The inner beach on Latouche Island, especially near the southern tip, is a good wintering area, whereas the outer beach facing Montague Strait is too rugged. The entire area of Green Island is important winter range, with the southeastern beach the primary wintering area (ibid.).

B. Areas Used Seasonally and for Life Functions

The 1:1,000,000-scale printed maps found in the Southcentral Region Atlas and the 1:250,000-scale reference maps located in ADF&G area offices show known winter concentration areas and the general distribution of the species.

C. Factors Affecting Distribution

The following factors affect the distribution of deer:

- Winter duration
- Winter snow conditions
- Plant growth
- Availability of suitable winter range (timbered beach fringe)
- Plant succession patterns

For further details, see the Life History and Habitat Requirements volume of the Alaska Habitat Management Guide for the Southcentral Region.

D. General Movements Between Areas

1. Movements. The longest documented movement by individual deer in PWS is a straight line distance of 9 mi over a total period of 3.5 years (Reynolds 1979).
2. Timing. In the summer, deer generally prefer areas at or above timberline, but they can be found at almost any elevation. After autumn frost reduces forage in their alpine range, deer move down into the high-elevation timbered areas to feed on preferred evergreen forbs. In winter, deer remain just below the snowline, moving up or down in accordance with snow conditions. As snow depth increases, deer are forced to lower elevations to feed on woody plants (especially *Vaccinium* spp.), usually near the beach. As the *Vaccinium* disappears, they become more dependent on kelp found in the intertidal area. Deer move onto the beaches at low tide to feed on the kelp, and at high tide they retreat to the timbered beach fringe (ibid.).
3. Home range. No pertinent data are available for the PWS deer populations. Schoen and Kirchhoff (1984) found that the mean summer and winter home range size of radio-collared deer on Admiralty Island, Alaska, was 79 ha, with no significant size differences between seasons or sex.

II. GMU 6

A. Present Abundance

No attempt to estimate black-tailed deer abundance in PWS has ever been made (ibid.). Because deer populations have been considered to be relatively stable in PWS for a long time, funding for basic quantitative abundance data has been difficult to justify; and because of the heavy vegetative cover common to the PWS area, it would be very difficult to conduct an aerial census of deer.

Deer populations in PWS were at a moderate level during the mid 1970's and gradually increased to their present high level as a consequence of a series of mild winters (ADF&G 1983).

B. Historic Distribution and Abundance

Deer are not indigenous to the PWS area. In 1916, eight deer were captured near Sitka and transplanted to Hawkins and Hinchinbrook islands (Burris and McKnight 1973). From 1917 to 1923, 16 additional deer were added to supplement the original transplant. This deer-transplant program has proven to be one of the most successful of all transplants in Alaska. Lacking competition for browse from other ungulates, deer responded rapidly and dispersed throughout PWS where suitable habitat existed. By 1945, the deer population peaked, and severe range damage was evident in 1950 (Robards 1951). The carrying capacity of winter range was drastically reduced. Major die-offs were recorded in the late 1940's, mid 1950's, late 1960's, and early 1970's, because of severe winters.

REFERENCES

ADF&G, comp. 1976. A compilation of fish and wildlife resource information for the State of Alaska. Compiled by the ADF&G under contract to the Alaska Federal-State Land Use Planning Commission. Anchorage. 873 pp.

ADF&G. 1983. Annual report of survey-inventory activities. Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 2.0, 9.0, 10.0, 13.0, and 16.0.

Burris, O.E., and D.E. McKnight. 1973. Game transplants in Alaska. Tech. Bull. 4. ADF&G, Juneau. 57 pp.

Reynolds, J.L. 1979. History and current status of Sitka black-tailed deer in Prince William Sound. Pages 177-183 in J.W. Schoen and O.C. Wallmo, eds. Proceedings of the Sitka black-tailed deer conference. USFS, Juneau, AK. 231 pp.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Cordova.

Robards, F.C. 1951. Annual report, game, fur, and game fish. USFWS, Cordova, AK. Cited in Reynolds 1979.

Schoen, J.W., and M.D. Kirchhoff. 1984. Seasonal distribution and home range patterns of Sitka black-tailed deer on Admiralty Island, Southeast, AK. M.S. submitted to J. Wildl. Manage.

Caribou Distribution and Abundance

I. REGIONWIDE INFORMATION

Information will be organized and presented by individual caribou herds, because many caribou migrations cross regional and game management unit (GMU) boundaries, and little ecological considerations usually exist simply to expedite administrative enforcement and managerial concerns. In reality, the biological reason(s) for some management strategies, such as bag limit and season length, may extend well beyond the boundaries of a jurisdictional unit.

Portions of the geographic distribution of those herds normally found outside the Southcentral Region but which occasionally occupy areas within the region will be mapped on the caribou distribution maps for the Southcentral Region. All narrative descriptions of the distribution and abundance of these herds, however, will be presented in the Alaska Habitat Management Guide for the Interior and Western Regions.

A. Regional Distribution

Several caribou herds use portions of the Southcentral Region. The largest group, the Nelchina herd, occupies the upper Copper, Nelchina, and Susitna river basins. The Mentasta herd, a much smaller group, ranges on the northwest slopes of the Wrangell Mountains, the headwaters of the Copper River, and the Mentasta Mountains. A small caribou herd is resident in the northern Kenai Mountains in the vicinity of American Pass. An even smaller band winters on the Moose River Flats and then calves and summers in the lowlands just north of the Kenai Airport. The bench land area between Tustumena and Skilak lakes and the Caribou Hills area appear to contain suitable caribou habitat and may be transplant sites in the near future (Pitcher, pers. comm.). Two additional herds seasonally occupy portions of the Southcentral Region. The McKinley herd ranges primarily on the north side of the Alaska Range and calves mostly within Denai National Park. Occasionally, small numbers of the Mulchatna herd move over Rainy Pass and occupy the Happy River drainage in GMU 16B.

B. Areas Used Seasonally and for Life Functions

See the 1:1,000,000-scale reference maps located in ADF&G offices. The maps show the following categories:

- General distribution
- Known calving areas
- Known rutting areas
- Known winter use areas
- Known migration patterns
- Known summer concentration areas

C. Factors Affecting Distribution

The following factors affect the distribution of caribou:

- ° Winter duration
- ° Winter snow conditions
- ° Predation
- ° Human activity (development projects, fires, hunting)
- ° Range condidtions
- ° Insects
- ° Availability of preferred forage

(See volume 1, Life History and Habitat Requirements, for further details.)

D. Movements Between Areas

One of the most important aspects of caribou ecology is survival through adaptive movements and migrations. Bergerud (1974a) postulated that caribou interactions with wolves led to their gregarious nature. As a result, behavioral adaptations, such as movements and migration, developed so that caribou could sustain themselves in relation to their varying forage supplies.

1. Size of seasonal home range and life function areas. Because caribou frequently are on the move and the distances animals travel vary from herd to herd and frequently from year to year, no home range or life-function area size has been determined.
2. Biotic factors affecting route selection. Terrain features influence movements to a large extent. Open waters such as oceans or seas, large lakes, and swift rivers will often alter the course of migration. Rivers with floating ice cakes represent barriers. Areas that lack forage are a barrier to some extent; typical are the rocky regions of high mountains, large volcanic cinder patches, glaciers, and burns (Banfield 1954, Lent 1966, Skoog 1968, Miller 1982). Certain terrain features facilitate movements - including ridge tops, eskers, stream beds, hard-surfaced snow drifts, and frozen lakes and rivers. Frozen lakes and rivers are particularly important avenues for travel (Skoog 1968).
3. Migration routes and timing:
   a. Nelchina herd. In early April, as the amount of daylight increases and snow begins to recede, wintering groups of caribou begin to coalesce and migrate to calving grounds. Skoog (1968) suggested that the onset of spring migration could be triggered by the appearance of new plant growth in snow-free areas.

      This movement involves mostly the cow-calf segment of the herd plus some young bulls. Adult bulls generally linger near the wintering grounds (Hemming 1971, Pitcher 1982).

      Nelchina caribou have used many different wintering areas in the Southcentral Region. In recent years, the herd has wintered in the Lake Louise Flats area, eastward to the middle portions of the Gakona and

Chistochina drainages, the upper Copper River, Tok River, and Mentasta River drainages, with calving activities occurring, as they have for the last 30-35 years (and perhaps eons before), in the Kosina Creek, Goose Creek, Black River, and Oshetna River drainages between 900 and 1,400 m elevation (Pitcher 1982, 1983, 1984).

Animals moving westward from the Wrangell Mountains cross the Copper River just south of Chistochina and proceed across the Richardson Highway, crossing the Gulkana River between Sourdough and Paxson Lake. This movement continues through the Lake Louise Flats to the foothills of the Talkeetna Mountains. Animals from the north usually cross the Susitna River between the mouths of Deadman Creek and Jay Creek.

Late spring thaws can delay movement to the calving grounds, resulting in calves being born en route (Lentfer 1965).

The eventual route of travel is dependent to varying degrees on weather conditions, especially snow cover and icing conditions. In 1981, for example, the primary route from the Lake Louise Flats was westward on a broad front from Lone Butte to Kosina Creek. Many animals also used the frozen Susitna River between the Oshetna River and Kosina Creek as a major travel route (Pitcher 1982). In the spring of 1982, the migration route was along the western edges of Lake Susitna and Lake Tyone, the west side of the Tyone River to the big bend of the Susitna River, and into the traditional calving area from the lower Oshetna River and Goose Creek. The 1982 migration began somewhat later than in 1981. The Susitna River was open in 1982, as opposed to 1981, when it was frozen and used as a travel corridor (Pitcher 1983).

The calving period generally extends from mid May to early June. Although calving grounds and summer range largely overlap, some portions of the female-calf segment leave the calving grounds in late June and disperse to summer ranges in the northern and eastern portions of the Talkeetna Mountains. During the autumn rut period (September-October) in recent years, the main herd concentrates in three areas: the Lake Louise Flats, the northeastern Talkeetna Mountains, and, to a minor extent, the Alphabet Hills. After the rutting period is completed, animals generally disperse to overwintering grounds and remain there from November to the beginning of April (Pitcher 1982). Pitcher (pers. comm.) has suggested that rutting areas are transitional as animals move from summer to winter areas. Nelchina caribou do not exhibit strong annual fidelity to specific areas during the rutting period.

b. Kenai Lowlands herd. This herd generally moves from winter concentration areas in the Moose River Flats and vicinity to the area north of the Kenai Airport during late May and June. The herd spends the summer and autumn period in this same general area. Caribou move to the Moose River Flats rutting area from October 1 to October 10 and breed there (Spraker, pers. comm.). No specific migration corridors have been identified (Holdermann 1983).

c. Kenai Mountains herd. This herd generally moves from its winter range in the small upper drainages of Big Indian Creek south to American Pass for calving. After the calving period, durig summer and fall, caribou can be found throughout the Kenai Mountains north and west of the Sterling Highway, except that portion south of the Chickaloon River and west of Juneau Creek (Spraker, pers. comm.).

d. Mentasta herd. This relatively small herd generally occupies the northwestern Wrangell Mountains. The herd calves mainly in the Sanford River, Drop Creek, and Boulder Creek drainages during late May and June (Bos 1974). In July and August, caribou are generally found in the upland areas between the Copper River and Long Glacier (Tobey, pers. comm.). However, the principal summer range probably does not extend southward beyond the Dadina River (Bos 1974). In late September, Mentasta caribou aggregate for the rut and begin to move toward wintering areas. Mentasta caribou have wintered as far south as the Nadina River and as far north as the Tetlin Lake-Nabesna River-Chisana region (Tobey, pers. comm.; Lieb 1984).

E. Population Size Estimation

Parker (1972, 1975) reviewed many different aerial censusing techniques for wildlife management and classified these into six general categories:

1. Linear strip transect survey
2. Stratified random sampling survey
3. Total count census
4. Aerial photography
5. Infra-red and heat-sensitive photography
6. Habitat sampling survey

Techniques from each of these categories have been applied to caribou with varying success.

In Alaska, aerial photography has been shown to be the most reliable and efficient method of censusing caribou. Hemming and Glenn (1968) described the development of the Aerial Photo-Direct Count-Extrapolation (APDCE) technique. In 1967, APDCE was used successfully on the Nelchina herd. Hemming further refined and tested the technique on the Western Arctic herd in 1970. Since then, the APDCE or modified versions have been used on several Alaskan caribou herds.

The APDCE technique consists of the following recommended steps:

1. Precensus reconnaissance flight. These flights serve to identify portions of the range likely to contain postcalving aggregations. Currently radio-telemetry is often used to locate these aggregations.
2. Aerial photography. Once the caribou have suitably aggregated, aerial photographs of the aggregations are made and numbers of animals counted. Numbers of caribou not present in the aggregations are either counted or estimated.
3. Sex and age composition of animals in postcalving concentrations. This step determines the proportion of adult females.
4. Sex and age composition of animals during rut. The entire herd is classified to determine the relative portions of females, males, and calves.
5. Estimation of population size. Finally, a population estimate is based on the data collected.

The APDCE caribou census technique depends on four assumptions:

1. All adult females in the herd are present in the postcalving aggregations.
2. Adult females are randomly distributed throughout the postcalving aggregations.
3. Age and sex cohorts are randomly distributed throughout the herd in the fall.
4. Mortality of adult females from the time of the mid summer postcalving aggregations to the time of the fall composition counts is zero or can be accounted for.

Davis et al. (1979) evaluted these assumptions and found that all but the third assumption were valid. Collection of representative fall-composition count data was considered difficult and constituted a major problem with the technique. They also pointed out the many logistical problems associated with photocensusing the large arctic herds. Other censusing procedural problems are that the number of caribou counted on photographs will vary in accordance with the readability factor and that the variability of fall-composition count dat is too large to be useful.

F. Regional Abundance

Regional population estimates for caribou are usually not calculated. Table 1 is a summary of the most recent published population estimates and caribou survey data for the Southcentral Region. By summing the available abundance estimates for the individual herds, a regional estimate of 28,265-28,615 caribou was obtained.

Table 1. Most Current Survey Results for Southcentral Alaska Caribou Herds

Herd	Type of Survey	Date	Count	Estimated No.
Kenai Mountains	Fixed-wing	2-19-85	343	395*
Kenai Lowlands	Helicopter	10-25-82	65	80
Kenai Lowlands	Helicopter	6-07-83	71	80
Mentasta	Fixed-wing	10-09-84	---	2,722
Nelchina	Fixed-wing	10-04-83	---	24,825

Source: ADF&G 1984.

--- means no data were available.

* Estimate of population size prior to previous fall hunting season.

II. KENAI LOWLANDS HERD (occupies portions of GMU 15A)

A. Present Abundance

The Kenai Lowlands caribou herd has been surveyed regularly since 1979. Table 2 summarizes sex and age composition data and includes survey data and population estimates, when available, back to 1974. Since 1979, population estimates and herd counts have exhibited a trend toward slightly increasing abundance. Holdermann(1983) suspected predation of young calves (less than 30 days old) by domestic dogs and wild carnivores as the primary limiting factor on herd population growth.

B. Historic Distribution and Abundance

On April 24, 1966, 29 caribou from the Nelchina herd were transplanted and released at Watson Lake. Following the transplant, caribou were observed from Anchor Point to Hope. By 1969, sightings of wandering caribou had ceased, and the animals had formed two distinct groups. One caribou had established itself in the mountainous area west of the headwaters of Resurrection Creek. The second group, the Kenai Lowlands herd, occupied an area of approximately 72 mi^2 north and east of the Kenai Municipal Airport during their calving period, and range north and south in a larger area.

Table 2. Composition Count Data and Annual Population Estimates for the Kenai Lowlands Herd, 1974-83

Date		No. Counted	Estimated Population	Calf/Cow Ratio	Bull/Cow Ratio	No. Calves(%)	Type of Survey
18 Feb.	1974	41	41-50	---	---	---	
20 Jan.	1975	22	---	---	---	---	
Spring	1975	62	75-100	---	---	---	
	1976	---	80-100	---	---	---	
28 June	1977	32	75	---	---	8(23)	c
	1978	---	75-100	---	---	---	
22 June	1979	59	---	52:100	47:100	15(25)	c
22 Oct.	1979	55	65-80	37:100	47:100		b
10 June	1980	54	65-80	36:100	80:100	9(17)	a
27 Oct.	1980	55	---	29:100	48:100	9(16)	a
10 June	1981	60	65-80	22:100	41:100	8(13)	a
15 June	1982	66	65-80	71:100	65:100	20(30)	a
25 Oct.	1982	65	70-80	49:100	37:100	17(26)	a
7 June	1983	71	70-80	47:100	39:100	18(25)	a

Source: ADF&G 1973-84.

--- means no data were available.

a Helicopter. b Fixed-wing. c Incidental observations.

This herd has traditionally calved only in the area neighboring the Kenai Airport. By 1982, cows with young calves were also observed on the Moose River Flats near the mouth of the Kenai River and within the Kalifonsky Beach gas field (ibid.). The herd normally winters in the Moose River Flats, but by the winter of 1977-1978 numerous sightings of caribou from this herd were reported from the Jean Lake area, approximately 12 mi southeast of their normal wintering area (Leroux 1979). In recent years, caribou have extended their range to the north shore of Skilak Lake (Spraker, pers. comm.).

Fires have played a major role in changing caribou ranges in many parts of Alaska. Extensive man-made fires at the turn of the century are believed to have reduced the theoretical carrying capacity of caribou range on the Kenai Peninsula area by 1913. Several large fires have occurred since caribou were extirpated from the area, and these burns have prevented large areas from reverting to the climax vegetation favorable to caribou.

Although many northern biologists have concluded that fires and logging activities destroyed lichen range, which precipitated the decline in caribou numbers at the turn of the century (see Lutz 1956, Buckley 1958, Leopold and Darling 1953, Klein 1965), Davis and Franzmann (1979) felt that this conclusion was not tenable. Bergerud (1974b) and Davis and Franzmann (1979) believe that overhunting caused the decline and ultimate extirpation of caribou on the Kenai Peninsula. Although fires may have reduced carrying capacity, a sufficient amount of suitable caribou habitat was always available for the remnant populations.

III. KENAI MOUNTAINS HERD (occupies portions of GMU 7)

A. Present Abundance

Spraker (1984) estimated the size of the Kenai Mountains caribou herd at 250-300 animals. Table 3 summarizes survey and population estimates and also includes sex and age composition count data when available back to 1974. Survey data collection since 1977 indicates this herd has been increasing slightly in size (Spraker 1984). Regulated harvesting to prevent range overuse, increased numbers of wolves, and a limited winter range have probably combined to slow the rapid rate of growth in this herd, as demonstrated in the late 1960's and early 1970's.

B. Historic Distribution and Abundance

The Kenai Mountains herd resulted from introductions made by the ADF&G in 1965 and 1966 (see section II.B.). In May 1965, 15 caribou from the Nelchina herd were released near the Chickaloon River. These animals became established in the area by 1969 and flourished on the excellent range. The herd grew to 119 animals in the fall of 1970, and by November 1974, 292 caribou were counted (ADF&G 1976). Since then, the estimated population size has been somewhat stable at 300 animals, although the numbers of animals counted have annually increased slightly.

The historic distribution of this herd has remained fairly constant. They utilize the same summer and winter range. No significant alterations in the habitat have occurred because of human disturbance or development to affect the distributional pattern of the caribou herd. Spraker (1981), however, suggested that the winter range distribution of caribou was limited by snow conditions.

Low natural mortality in the Kenai Mountains herd was reflected in its rapid rate of growth through the late 1960's and early 1970's. By 1975, the annual recruitment rate had dropped to 20% from 36% per year in the previous period. This decline in herd growth could have been a consequence of wolf predation, although the extent of such predation has never been determined (State of Alaska 1977). Spraker (1981) also reported an increase in wolf numbers and in caribou predation by wolves. Peterson et al. (1984) described the territory of the Big Indian Creek Pack (BICP) of at least 17 wolves, which was first identified in 1978. The

Table 3. Composition Count Data and Annual Population Estimates for the Kenai Mountains Herd, 1974-82

Date	No. Counted	Estimated Population	Calf-Cow Ratio	Bull/Cow Ratio	No. Calves(%)	Type of Survey
10 Mar. 1974	246-251	290	---	---	---	---
18 Nov. 1974	292	---	---	---	---	---
19 Nov. 1974	196	340	44:100	73:100	36(18)	c
8 Dec. 1976	249	---	---	---	---	---
8 Mar. 1977	140	300*	---	---	---	---
24 Jan. 1978	150-200	---	---	---	---	b
28 Oct. 1978	178	---	---	---	26(15)	b
22 June 1979	125	300*	---	---	29(23)	b
19 Oct. 1979	173	300*	24:100	44:100	25(14)	a
19 Apr. 1980	162	300*	---	56:100	---	a
31 Oct. 1980	227	250	35:100	36:100	46(20)	a
19 Oct. 1981	256	---	47:100	30:100	68(27%)	a
27 Oct. 1982	266	250-300	51:100	27:100	69(26)	a
19 Feb. 1985	343	395**				

Source: ADF&G 1973-84.

--- means do data were available.

a Helicopter.

b Fixed-wing.

c Ground count.

* Rough estimate.

** Minimum population estimate before hunting season (1984-85) began.

BICP territory included most of the winter and summer range of the Kenai Mountains caribou herd.

IV. MENTASTA HERD (occupies portions of GMU 11)

A. Present Abundance

Estimates of abundance and data describing age and sex composition for the Mentasta caribou herd are presented in table 4. The mean annual estimated total population is 2,273 (s.d.=307) caribou from 1973 to 1982. Lieb (1984) reports that this herd is stable. Fluctuations in annual population estimates in recent years probably reflect variability in survey conditions rather than actual changes in herd numbers (Lieb 1984). Any of the following factors could cause significant fluctuations in the annual

Table 4. Population Estimates, Spring Counts, and Age/Sex Composition Data for the Mentasta Herd, 1973-84

Date	Spring Postcalving Count	Total Fall Population Estimate	Fall Calves/ 100 Cows	Fall Bulls/ 100 Cows	Estimated No. Adults
18-19 Oct. 1973	1,995	2,202	32	40	---
27 June 1975	2,456	---	---	---	1,978
14 June 1976	1,754	---	---	---	1,226
24 June 1977	2,262	2,711	25	16	2,022
10 Oct. 1977[a]	2,262	2,711	27	42	2,274
13 Oct. 1978	2,278	2,239	25	42	1,899
30 June 1979	1,834	---	---	---	---
23 June 1980	2,396	---	---	---	---
22 Oct. 1981	2,621[b]	2,819	40	43	2,202
13 Oct. 1982	2,393	2,210	39	36	1,719
4 Oct. 1983	2,667	2,766	28	44	2,316
9 Oct. 1984	3,022	2,722	29	36	2,244

Source: ADF&G 1973-84.

--- means no data were available.

a Unadjusted for 1977-78 harvest.

b Includes 243 caribou outside spring composition count area.

population estimates:
- Difficulties in locating all segments of the herd prior to the census
- Different weather conditions
- Different observers

B. Historic Distribution and Abundance

Observations of caribou in the upper Copper River area and the Wrangell Mountains have been recorded in several accounts and journals of visitors to these areas. Records of caribou sightings extending from the Chitina River Valley to the White River area north to the Alaska Range from the late 1800's to the 1930's are summarized in Skoog (1968). These relatively few observations are scattered in time and area.

During the 1920's, Murie (1935) reported that parts of the Fortymile caribou herd, which numbered over half a million animals at that time, moved south through Isabel Pass and Mentasta Pass to winter in the upper Copper River Basin. Great numbers of caribou moved south to the White, Chisana, Nabesna, and Copper rivers. When these movements suddenly stopped in 1931 (Skoog 1968), small remnant groups of caribou remained south of the Mentasta Mountains and in the northwest portion of the Wrangell Mountains. Skoog (1968) speculated that these remnant groups may have formed the present-day Mentasta and Chisana herds. Bos (1974) proposed that it was more likely that caribou occupied these areas prior to the Fortymile herd's migrations.

Hemming (1971) defined caribou populations in terms of their calving areas, with the members of a "herd" utilizing a specific area for calving. Based on Hemming's definition, the so-called Mentasta herd has been misnamed, as suggested by Bos (1974), because no calving activity has ever been observed in the Mentasta Mountains. Calving activity in the upper Drop Creek drainage was first documented in 1956. Another survey in July, 1968, located almost 1,000 cows and calves near Boulder Creek (approximately 6 mi west of Drop Creek) (Bos 1974). Further surveys have confirmed the Drop Creek-Boulder Creek area as the main calving area for this herd (ADF&G 1976). In fact, the major portion of this herd has occupied the northwest Wrangell Mountains since the early 1960's.

The earliest published population estimate for the Mentasta herd was 50 caribou, based on an aerial survey in November, 1948 (Scott et al. 1950). Bos (1974) suggested that this number would constitute an underestimation if caribou were using timbered areas as they had usually done in previous Novembers, and he also faulted the survey for lacking a systematic method. In July 1956, a survey by Bob Burkholder (USFWS) in the Drop Creek area counted 152 caribou. As part of a formal census of the Nelchina herd in February, 1962, over 12,000 Nelchina caribou were counted wintering in the Mentasta area along with a group of 2,305 Mentasta caribou. The Mentasta animals were located on the slopes of Mt. Sanford and were considered geographically distinct from the Nelchina group (Bos 1974). A review of the ADF&G Game Division caribou data files in Anchorage shows Mentasta caribou numbers at 5,000 animals from 1962 to 1967. These estimates were somewhat rough, as they were based on extrapolations of the 1962 estimate using assumed rates of growth. From 1967 to 1972, survey flights were conducted annually in early summer to locate calving areas and in the fall to monitor fall movements (ibid.). Estimates of caribou numbers on these flights ranged between 1,000 and 2,000 individuals (ibid.). Table 4 presents abundance estimates from 1973 to the present, which corroborate these survey-flight estimates.

V. NELCHINA HERD

A. Present Abundance

The Nelchina caribou herd has been censused regularly since 1976 except for 1979, when inclement weather conditions and widespread animal movements precluded conducting an accurate census. Table 5 summarizes all available count data and abundance estimates. The Nelchina herd numbers approximately 25,000 animals and has been in a period of continued expansion since 1972. Currently, the Nelchina herd contains about 85% of the total caribou in the Southcentral Region and about 6% of the estimated 1982 statewide caribou population (416,000). This herd is approximately the same size as the Mulchatna and Alaska Peninsula herds and is exceeded in size only by the large Western Arctic and Porcupine herds.

Population estimates derived by the APDCE censusing technique for the Nelchina caribou herd can be influenced by several factors. Pitcher (1983) mentions that when caribou are molting in late June or July it can be difficult to distinguish males from females by genital characteristics in the postcalving aggregation-composition counts. If the cow-calf aggregations of the herd are dispersed over too large an area, there exists an increased likelihood of missing animals and undercounting in the photo census. This will lead to an underestimation of the total population. The timing of the fall-classification counts is very critical to the preciseness of the population estimate. The distribution of sexes and age classes is most random during the main rutting period (Skoog 1968). Inclement weather conditions in the October 1981 composition sampling period caused a one-week delay. Pitcher (1982) noted that some bulls had begun to separate from the cow-calf segment and that therefore males could have been slightly underrepresented in the sampling, thus affecting the total population estimate.

B. Historic Distribution and Abundance

Caribou have occupied the Nelchina Basin since at least the middle of the 19th century (Skoog 1968). Sometime between 1848 and 1885, the Nelchina herd reached a population peak similar to that of the 1960's (70,000 animals) and ranged from the Talkeetna Mountains eastward over the entire Copper River basin (map 1) (ibid.). Travelers to the area in the late 1890's noted the remains of Indian traps and drive fences, indicating regular seasonal movements of the large population. Observers also discovered drive fences and huge numbers of shed antlers in the Chitina River Valley (ibid.). The presence of the shed antlers meant that the available suitable winter range to the northwest must have been saturated with caribou. Aniamls were forced to utilize the marginal Chitina River Valley, which regularly receives heavy and frequently wet snowfall. Caribou have not occurred along the Chitina River since that supposed peak period. By 1885, very few caribou were being observed in the Chitina and Copper River valleys (ibid.).

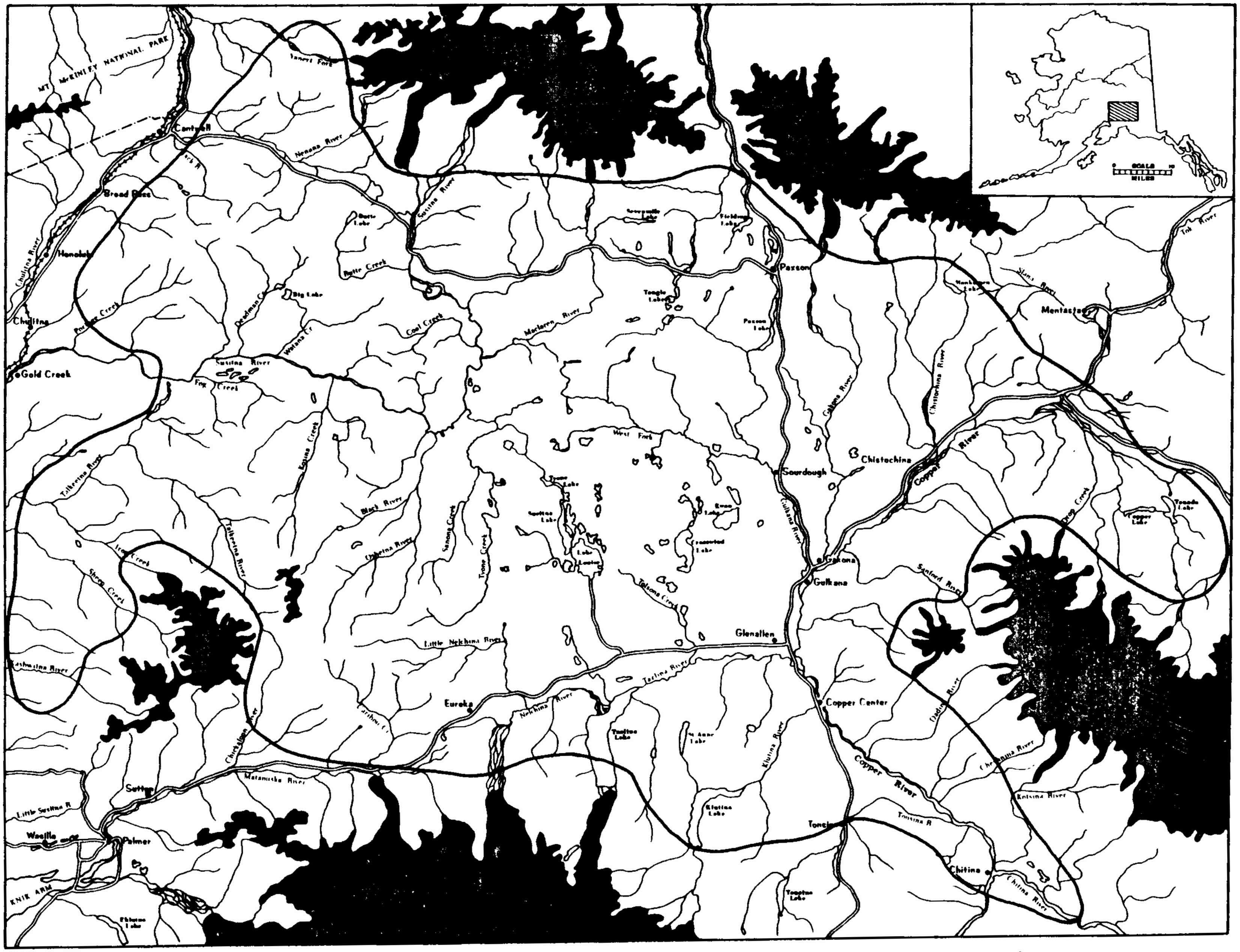
Table 5. Population Estimates for the Nelchina Caribou Herd, 1948-83

Date		No. Counted	Minimal Population Estimate	Source
	1948	4,019	4,500-5,000	Watson and Scott 1956
	1950	4,447	5,000-5,500	Watson and Scott 1956
	1952	6,973	---	Watson and Scott 1956
	1953	6,263	7,600*	Watson and Scott 1956
	1954	9,923	13,200	Watson and Scott 1956
1-2 Feb.	1955	18,654	39,466	Watson and Scott 1956
6-8 Mar.	1956	28,910	36,240	Skoog and Scott 1956
1 May	1957	---	47,710	Skoog 1968
1 May	1958	---	52,670	Skoog 1968
1 May	1959	---	58,850	Skoog 1968
1 May	1960	---	64,230	Skoog 1968
1 May	1961	---	69,180	Skoog 1968
23-27 Feb.	1962	41,824	71,000	Skoog 1968
	1967		61,000	Hemming and Glenn 1968
	1972	8,342	7,857	Pitcher 1984
	1973	8,757	7,693	Pitcher 1984
	1974	10,245	---	Pitcher 1984
	1976	8,342	8,081	Pitcher 1984
	1977	14,000	13,936	Pitcher 1984
	1978	16,800	18,981	Pitcher 1984
	1979	13,508	---	Pitcher 1984
	1980	---	18,713	Pitcher 1984
	1981	---	20,694	Pitcher 1984
	1982	---	21,356	Pitcher 1984
	1983	---	24,825	Pitcher 1984

* Underestimated by factor of 2 or 3.

--- means no data were available.

At the turn of the century, evidence suggests the Nelchina herd was decreasing but still numerous, with a geographical distribution closely resembling that of the 1960's. The status of the Nelchina herd from 1900 to 1930 is somewhat unclear. In the 1920's, the adjacent McKinley and Fortymile herds had peaked in size. Murie (1935) estimated the Fortymile herd at a minimum of 538,000 animals in 1920. By 1918, seasonal migrations through Isabel and Mentasta passes were occurring regularly, bringing thousands of caribou into the Mentasta-Nabesna River-White River

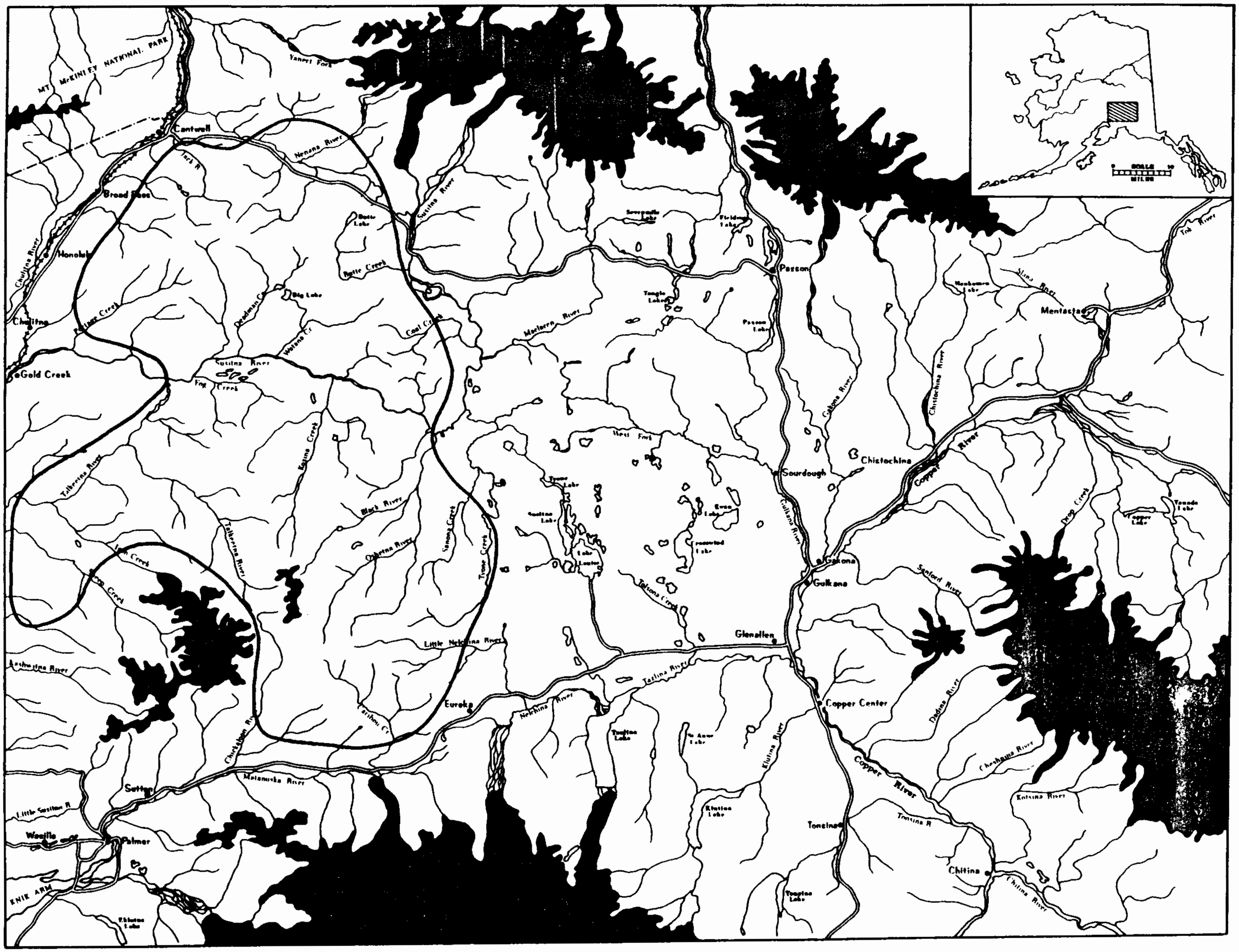


Map 1. Approximate range of the Nelchina caribou herd, 1948-1885 (from Hemming 1975).

area, the Tangle Lakes-MacLaren River area, the Lake Louise Flats, and even the Copper River valley as far south as Copper Center (Skoog 1968). Skoog (1968) recounts a confirmed report of some 300,000 caribou of the Fortymile herd moving into the Nelchina range in the fall of 1921. In 1925, the McKinley herd began to move seasonally eastward across Broad Pass into the mountains adjacent to Broad Pass, Jack River, the upper Nenana River, crossing Monahan Flat, reaching Valdez Creek and the upper MacLaren River (Murie 1944). All these movements stopped after the winter of 1931-1932. Skoog (1968) felt that it was quite possible that the Nelchina herd may have lost animals to the temporary seasonal influxes of these large herds when they returned to their summer ranges each year. Skoog (1968) reported taht, based on the available information, the northwest portion of the range north of the Susitna River was used extensively in winter during the early 1930's. In the late 1930's, a shift in winter range use southward to the Talkeetna Mountains occurred. By the late 1930's and early 1940's, the Nelchina population probably reached a low. According to Alaska Game Commission reports (1931-1940) and Hemming (1975), remnants of the Nelchina herd apparently remained mostly within the western half of their historical range (map 2) and, in particular, in the Talkeetna Mountains.

In the early 1940's, fall and winter range use shifted northward again to the Nenana River drainage, the Denali Highway, Deadman Lake, and the upper MacLaren River-Paxson Lake area (Skoog 1968). The first report of caribou wintering on the Lake Louise Flats occurred in 1945-1946, with the animals concentrated in the western portion (ibid.). From 1946 to 1950, areas of calving and summer range use were regularly used, but winter range use areas shifted annually. Table 6 summarizes the seasonal range and life-function area used by the Nelchina caribou herd from the late 1940's to the present.

Prior to 1948, population estimates for the Nelchina herd were constructed from reports from wildlife enforcement agents, trappers, bush pilots, and other outdoorsmen. The most recent estimate before aerial censusing began in 1948 was about 4,000 caribou (Watson and Scott 1956). Aerial counts of the Nelchina herd began in November, 1948, but the accuracy was questionable because of observer inexperience, the uneven distribution of caribou, an inadequate sampling design, and other characteristic difficulties associated with big game aerial census work. The 1948 census produced an esimate of 4,500 to 5,000 animals (table 5). However, continued refinement of aerial census techniques in the succeeding seven years showed that the original 1948 estimate accounted for only about one-half the animals probably present at that time. The 1955 census was desinged as an extremely intensive effort resulting in a high degree of reliability and indicated a caribou population of almost 40,000 animals (Watson and Scott 1956).



Map 2. Approximate range of the Nelchina caribou herd, 1900-1945 (from Hemming 1975).

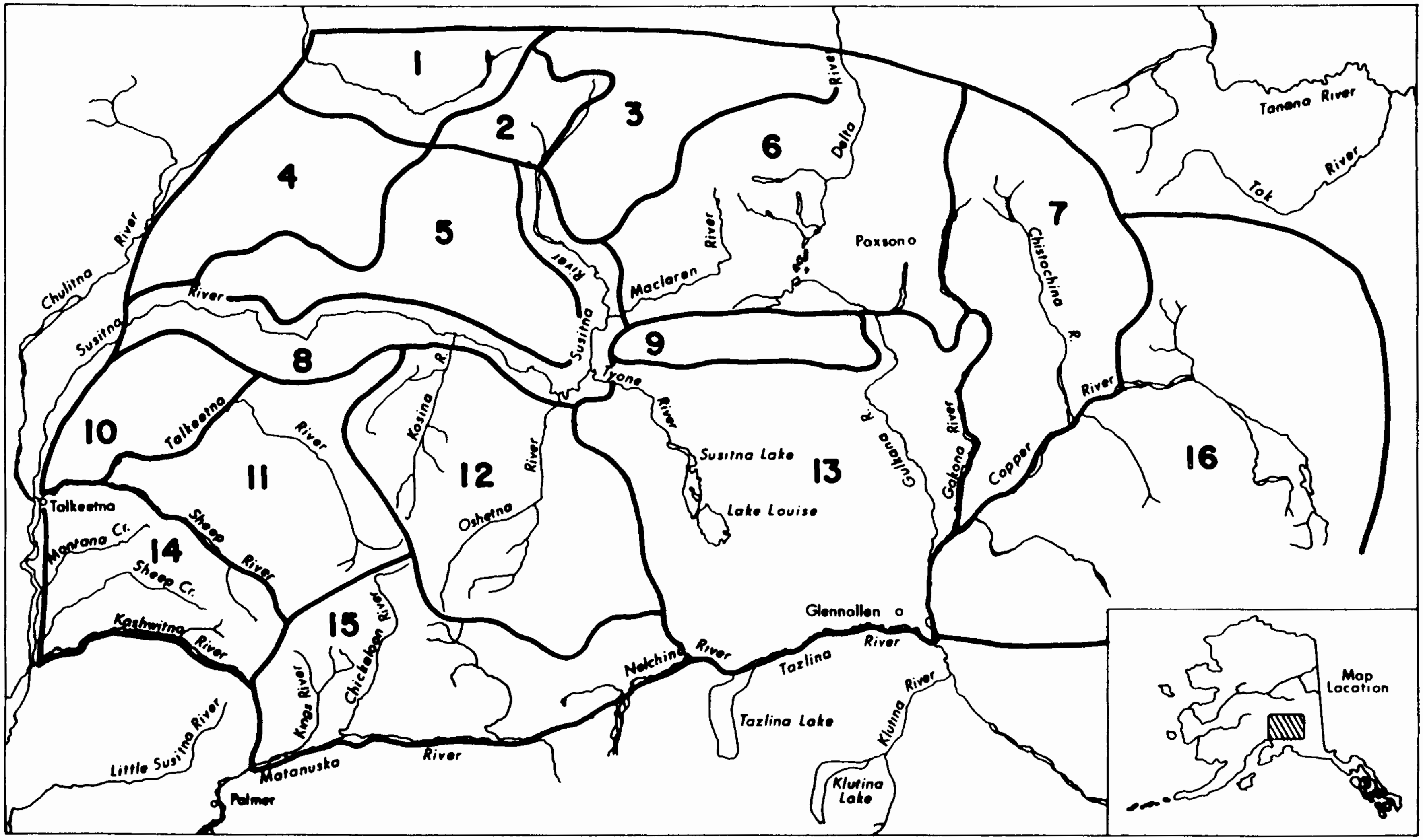
Table 6. Historical Range Use of Nelchina Caribou Herd, 1948-84

Year	Grounds (May-June)	Summer Range* (July-Aug.)	Rut	Winter Range*
1948-49	12	---	---	---
1949-50	---	---	---	---
1950-51	---	---	---	---
1951-52	12	12,5	13,5,12	13,12
1952-53	12	12,5,15	13,12,15	13
1953-54	12	5,12	5,12,13	13
1954-55	12	5	5,6	13
1955-56	12	12,15	12,15,16	5,12,6,9
1956-57	12	5,12,15	5,6	5,1,6,11
1957-58	12	5,12	5,6,13,15	11,2,5,15
1958-59	12	5,12	5,13,11,12,13	11,15,1,5,6,13
1959-60	12	5,12	12,15,6	1,11,5,13
1960-61	12	5,9,6,12	13,15,5,11	5,11,1,2,13
1961-62	12	5,9,6,12	12,13,6,12	1,6,2,5,11
1962-63	12	5,12	13,15,6,12	1,13,2,5,11,15
1963-64	12	5,12	5,13,6,12	1,5,6,11
1964-65	1,5,12	5,12	5,9,13,6	1,5,6
1965-66	12,8,11	5	6,9,13	16,13,15
1966-67	12,8,11	5,4	9,11,13	16,13,1,2
1967-68	12	5,4,12	---	16,13,1,4,5
1968-69	12	5,12	13	13,7,8,11,2
1969-70	12	12,5	12	13
1970-71	12	5,12	13	16,13
1971-72	12	5,12	13	16,13,15
1972-73	12	12,5	12,15	15,7,13
1973-74	12	---	15,13,12	15,13,12
1974-75	12	12	---	16,13
1975-76	12	12	---	13
1976-77	12	12,5	12,13	13,16
1977-78	12	12	12,13	13,16
1978-79	12	12	13	13,16
1979-80	12	12	---	13,7
1980-81	12	12,15	13	13,7
1981-82	12	12,15	13,7	13,7,
1982-83	12	12,15	13	13,7,16
1983-84	12	12,15	7,16	---

Source: Adapted and expanded from Pitcher 1982.

--- means no data were available.

* Range Units modified from Skoog 1968 (see map 3).



Map 3. Distribution of the Nelchina caribou herd divided into range units based upon topography, vegetation, and caribou use (adapted from Skoog 1968, Pitcher 1982).

In light of this result, the previous annual censuses were acknowledged to be in error.

In the following year, Skoog and Scott (1956) conducted a similar census, producing a population estimate of 36,200, which corraborated the previous year's estimate.

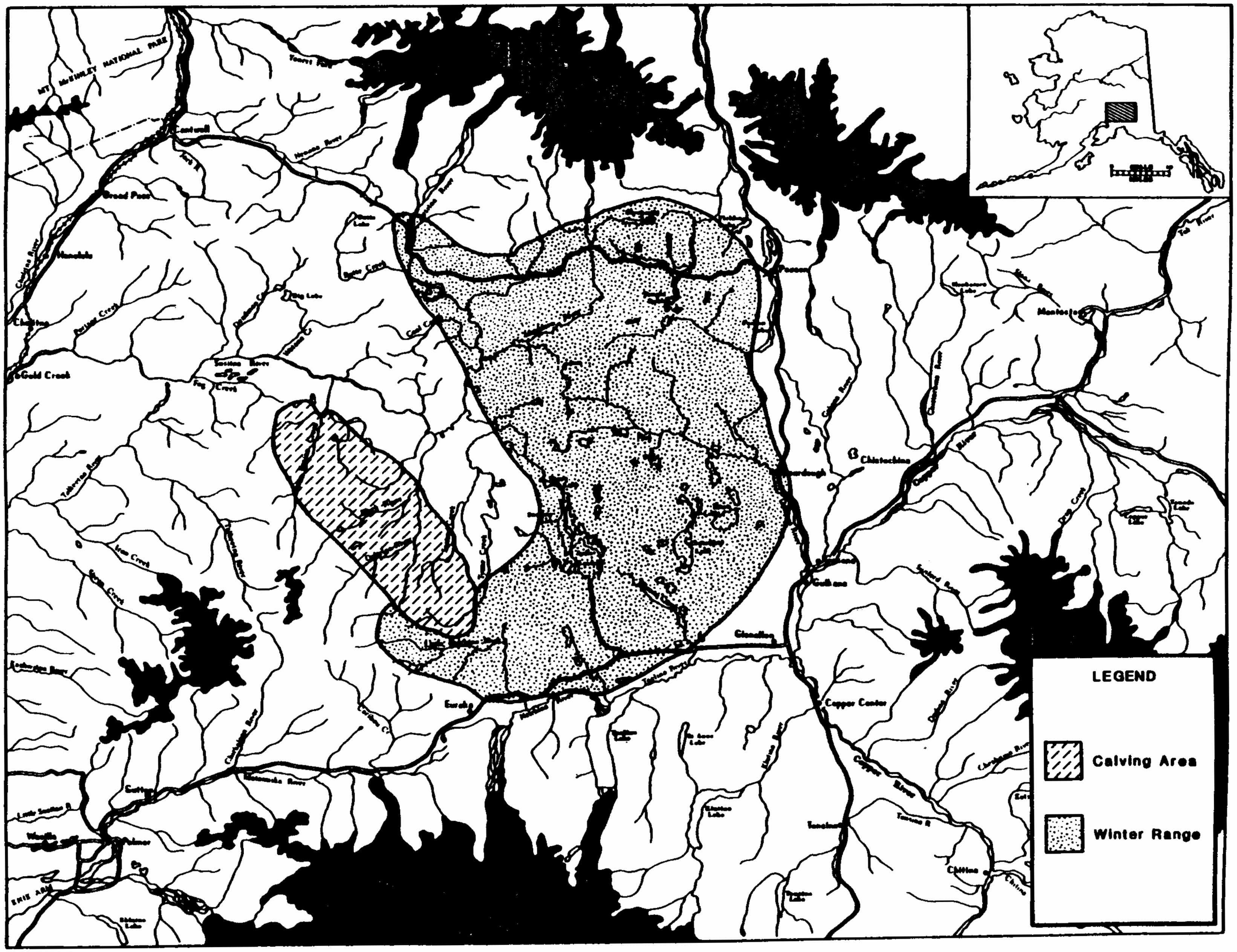
In 1950, the Nelchina herd began to increase in numbers (table 5) and occupied an area (map 4) of approximately 26,000 km^2 (10,000 mi^2) (Hemming 1975). The main body of the herd (cow-calf portion) began to split into two or more segments, each wintering in separate areas by 1955 (map 5) (ibid.). As the size of the herd increased even more, winter range expansion occurred, and by 1960 the herd utilized an area of approximately 52,000 km^2 (20,000 mi^2) (ibid.). Maps 4 through 8 illustrate the expansion of the Nelchina caribou range eastward across the Richardson Highway, with the increase in caribou numbers from 1948 to the mid 1960's. The increase in numbers was also closely correlated to an increase in annual movements as reflected in annual distances traveled (Skoog 1968). Summer range is depicted on map 9 for the years 1950-1970.

Based on field work conducted in 1961 and 1962, Skoog (1963) stated, "the range is beginning to show signs of deterioration and there is some indication that carrying capacity has been reached."

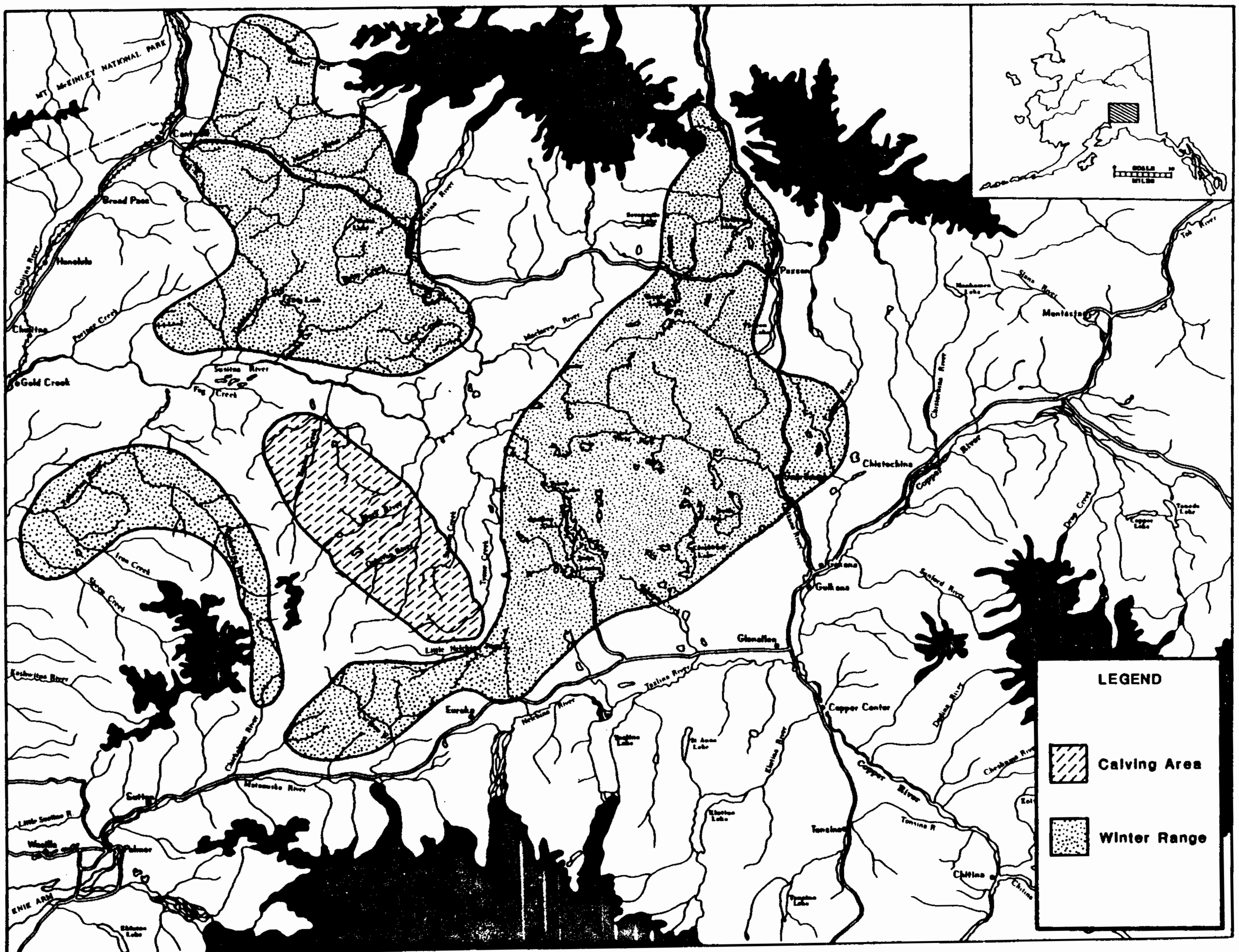
In February 23-27, 1962, an aerial census using a stratified random sampling technique for certain concentration areas, combined with direct counts for other concentration areas, produced a minimum estimate of 71,000 caribou (Siniff and Skoog 1964). This census corroborated evidence that the herd was expanding its range and increasing rapidly in numbers.

From 1948 to 1954, over 200 wolves were removed from the Nelchina herd almost doubled in size. Overwinter calf survival rates were estimated at 84%, and calves soon exceeded 20% of the herd (Skoog 1968). Natural mortality was low, and the herd sustained a relatively low hunter kill (8%) that was well below recruitment levels (ibid.). Wolf predation rates were somewhat low (approximately 1-2%), but they increased gradually as wolf populations recovered from the effects of the intensive federal predator control program. It is also interesting to note that Nelchina Basin wolf populations increased at a rate similar to the annual net increases for caribou (20%) (ibid.).

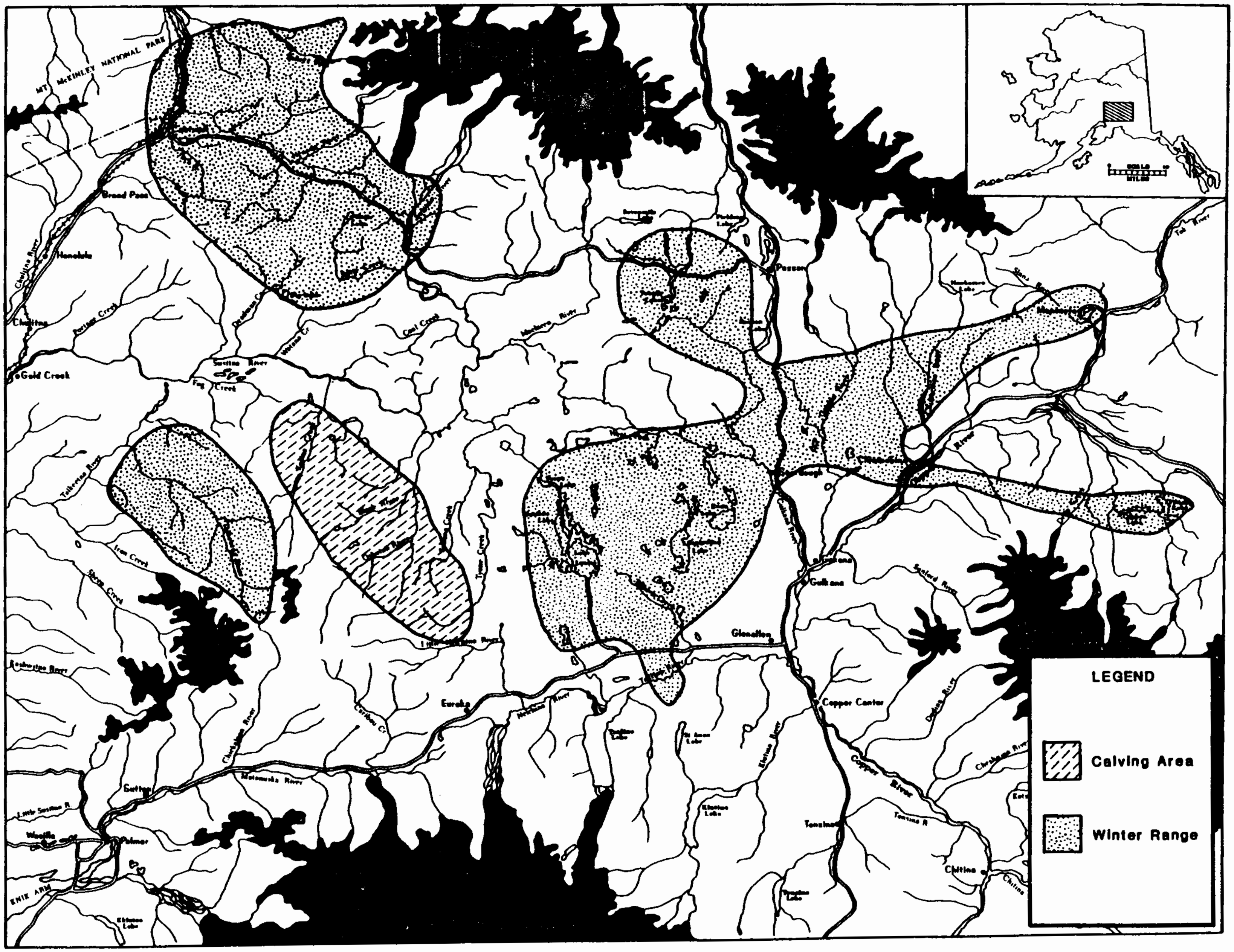
Bergerud (1983) proposed that the herd probably peaked by 1964 and based his conclusion on an analysis of age-structure data from harvested animals of that time period. Bos (1975) and Bergerud (1983,1984) both agree that a major drop in recruitment occurred in the 1964-1966 period. Bergerud (1983) stated that wolf predation and possibly some brown bear predation seemed the most probable cause of the 1964-1966 decline and ruled out winter mortality, windchill mortality of calves, and reproductive failure as unlikely factors. Bos (1975) suggested that the initial stages of the decline (1962-1966) were caused by large emigrations of caribou to other ranges. Poor recruitment of yearlings and a



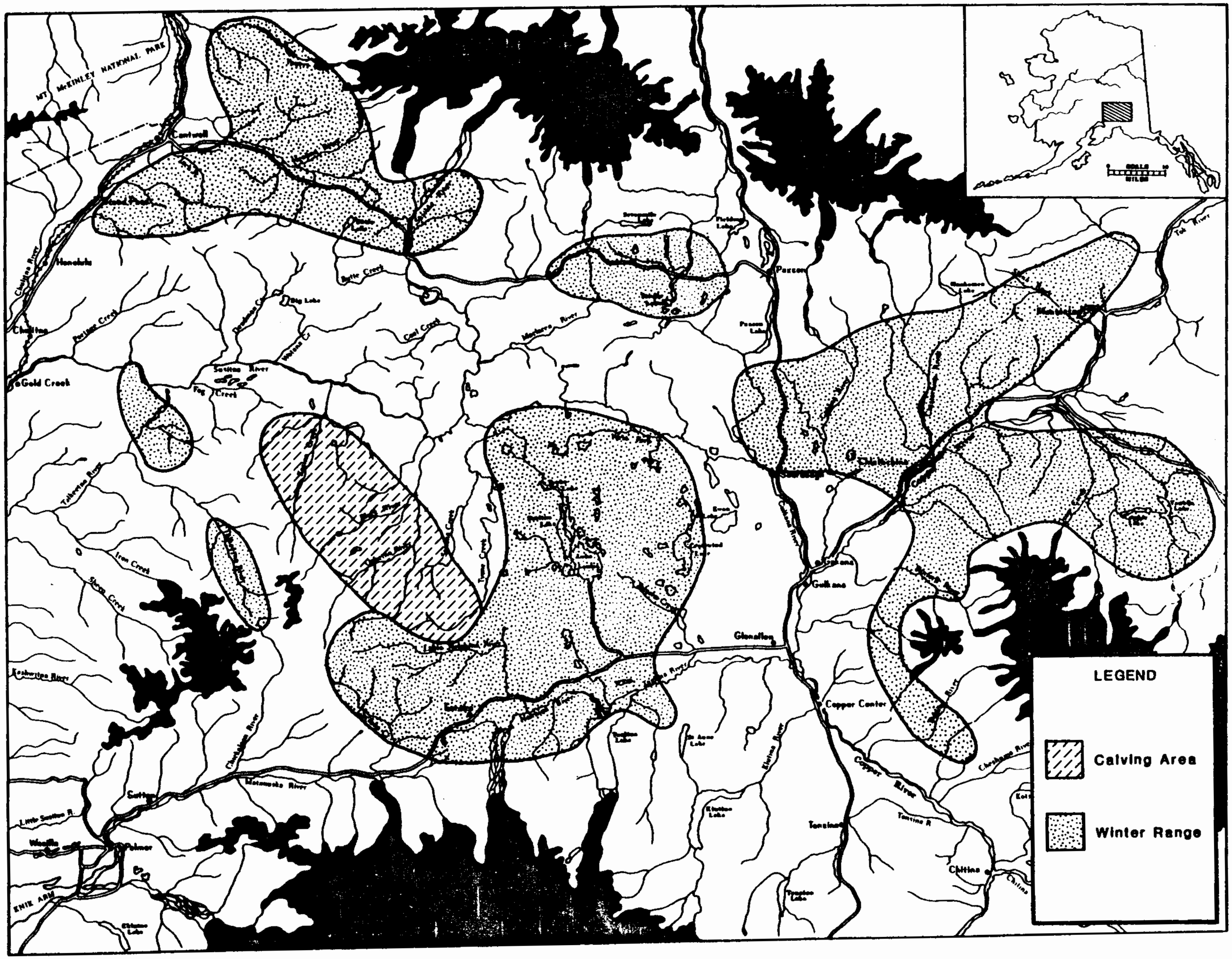
Map 4. Distribution of winter range use by the Nelchina caribou herd, 1950-1955 (adapted from Hemming 1971).



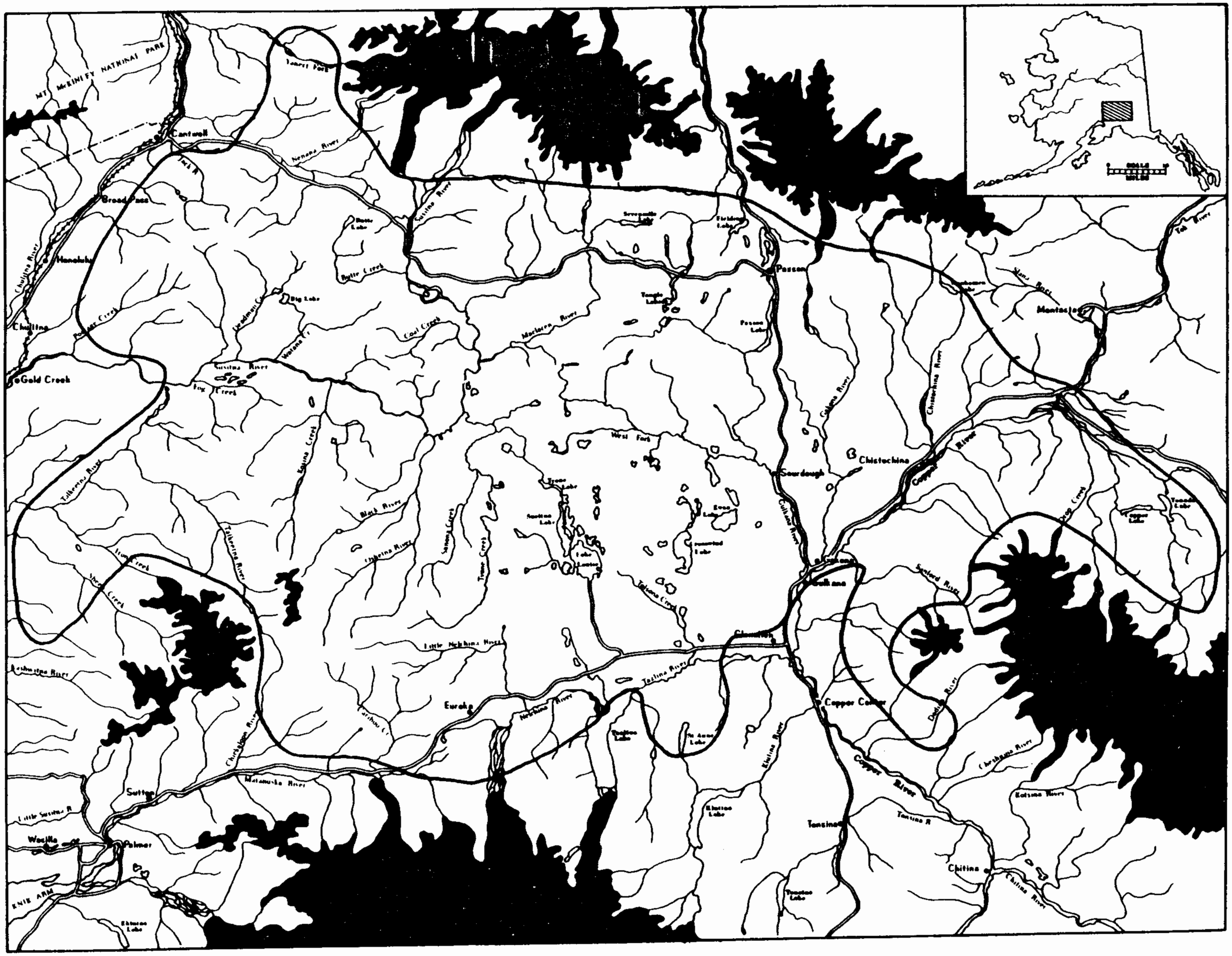
Map 5. Distribution of winter range use by the Nelchina herd, 1955-1960 (adapted from Hemming 1971).



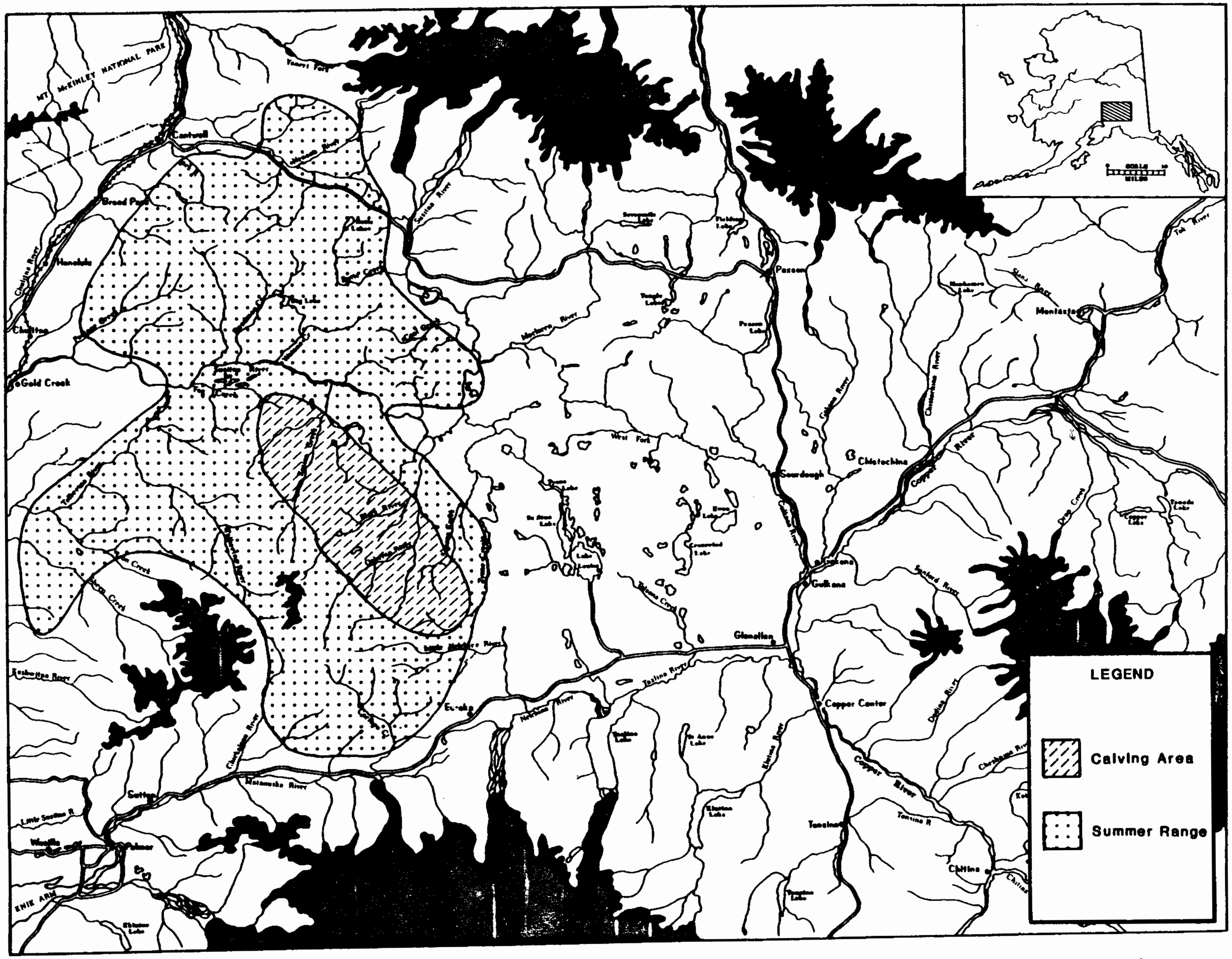
Map 6. Distribution of winter range use by the Nelchina caribou herd, 1960-1965 (adapted from Hemming 1971).



Map 7. Distribution of winter range use by the Nelchina herd, 1965-1970 (adapted from Hemming 1971).



Map 8. Range of the Nelchina caribou herd, 1960-1970 (Hemming 1975).



Map 9. Distribution of summer range use and calving grounds of the Nelchina herd, 1950-1970 (adapted from Hemming 1971).

large increase in caribou harvests accelerated the rate of population decrease (ibid.). Doerr (1980) stated that subadult natural mortality rates increased from 22 to 42% in the period from 1962 to 1966 and averaged 47% from 1966 through 1969. Hunting mortality rates increased slightly. Wolf predation rates almost doubled those of 1954 through 1962 but were still considerably less than hunting mortality (ibid.). The rapid decline of the herd from 1969 to 1972 was largely due to excessive hunting, increased wolf predation, and relatively high overwinter natural mortality of calves and subadult groups (ibid.).

The Nelchina caribou herd continued to decline until 1974, when a postcalving census counted 10,245 animals versus 8,757 and 8,342 in 1973 and 1972, respectively. The relatively low hunter harvest for 1972 and 1973, combined with an extremely high increase in yearling survival during 1973, resulted in a marked increase in herd size during 1974 (McIlroy 1975). However, an APCDE census in 1976 (considered unreliable by Eide 1979) indicated the Nelchina caribou herd still had not increased substantially above 1972 levels, even though calf ratios and yearling survival rates were similar to those reported for this herd during the population increase. A series of protective measures were implemented by the ADF&G, beginning with an early hunting season closure in 1976, and permit-only hunting for 1977. A wolf removal program was active from January 1976 to March 1978, but concentrated in an area (north of the Susitna River) resulting in minimal and/or no impacts on the main herd. By 1983, these factors, together with an increasing survival rate and increased calf production and survival, pushed the Nelchina caribou population to 24,825. Figure 1 depicts the historical pattern of abundance estimates from 1948 to 1983.

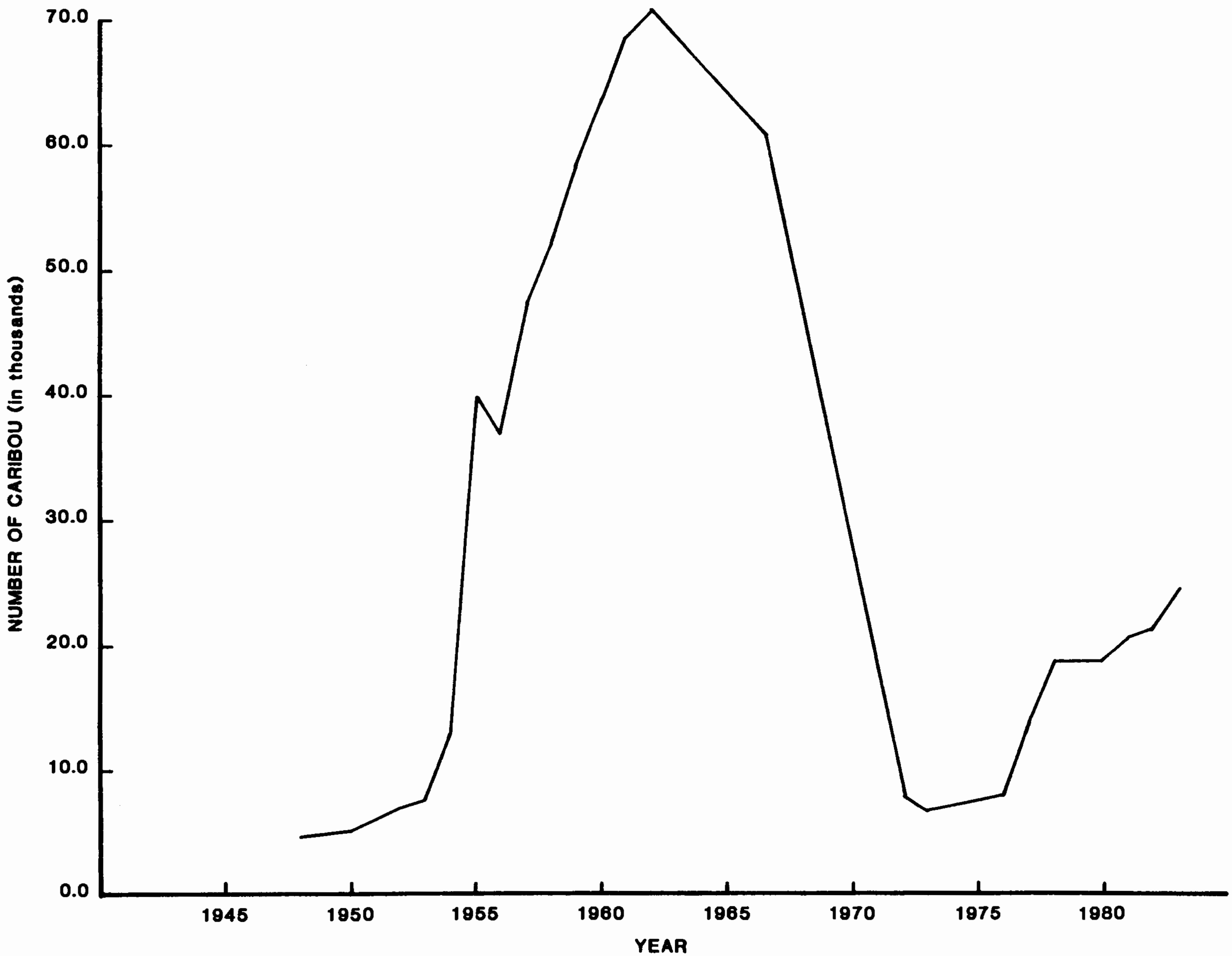


Figure 1. Historical pattern of population estimates for the Nelchina caribou herd from 1948-1983.

REFERENCES

ADF&G. 1973-1984. Annual reports of survey-inventory activities and research reports. Fed. Aid in Wildl. Rest.

_______. 1984. Annual report of survey-inventory activities. J.A. Barnett, ed. Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2. 59 pp.

ADF&G, comp. 1976. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 1: Wildlife. [Juneau.] 265 pp.

Atwell, G. 1963. An aerial census of wolves in the Nelchina wolf study area. Proc. Alaska Sci. Conf. 14:79-83.

Banfield, A.W.F. 1954. The role of ice in the distribution of mammals. J. Mammal. 35:104-107.

Bergerud, A.T. 1974a. The role of the environment in the aggregation, movement, and disturbance of caribou. Pages 552-584 in V. Geist and F. Walther, eds. The behavior of ungulates and its relationship to management. New Series No. 24. Morges, Switzerland: IUCN Publications.

_______. 1974b. Decline of caribou in North America following settlement. J. Wildl. Manage. 38(4):757-770

_______. 1983. The natural population control of caribou. Pages 14-61 in F.L. Bunnell, D.S. Eastman, and J.M. Peek, eds. Symposium on natural regulation of wildlife populations. March 10, 1978. Vancouver, B.C. Proc. No. 14. Forest, Wildlife, and Range Experimental Station, Univ. Idaho, Moscow.

_______. 1984. The buffalo of the north: caribou (Rangifer tarandus) and human developments. Arctic 37(1):7-22.

Bos, G.N. 1974. Nelchina and Mentasta caribou reports. ADF&G, Fed. Aid in Wildl. Rest. Projs. W-17-5 and W-17-6.

_______. 1975. A partial analysis of the current population status of the Nelchina caribou herd. Pages 170-180 in J.R. Luick, P.C. Lent, D.R. Klein, and R.G. White, eds. Proceedings of the first reindeer and caribou symposium. Biol. papers, Univ. Alaska. Spec. Rept. No. 1.

Buckley, J.L. 1958. Wildlife in arctic and subarctic Alaska. Biology colloquium: arctic biology. Oregon State College, Corvallis.

Davis, J.L., P. Valkenburg, and S.J. Harbo, Jr. 1979. Refinement of the aerial photo-direct count-extrapolation caribou census technique. Final rept. Fed. Aid in Wildl. Rest. Proj. W-17-11, Job 3.25R.

Davis, J.L., and A.W. Franzmann. 1979. Fire-moose-caribou interrelationships: a review and assessment. Proc. N. Am. Moose Conf. 15:80-118.

Doerr, J.G. 1980. Modeling the population decline of two Alaskan caribou herds. Pages 611-623 in E. Reimers, E. Gaare, and S. Skjenneberg, eds. Second international reindeer/caribou symposium proceedings. Roros, Norway.

Eide, S. 1979. Caribou survey-inventory progress report, 1977-78. Pages 150-154 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl.

Hemming, J.E. 1971. Distribution and movement pattersn of caribou in Alaska. ADF&G, Fed. Aid in Wildl. Rest. Vol. 9, Part 3. Proj. W-17-10.

________. 1975. Population growth and movement patterns of the Nelchina caribou herd. Pages 162-169 in J.R. Luick, P.C. Lent, D.R. Klein, and R.G. White, eds. Proceedings of the first international reindeer and caribou symposium. Biol. papers, Univ. Alaska. Special Rept. No. 1.

Hemming, J.E., and L.P. Glenn. 1968. Caribou report. ADF&G, Fed. Aid in Wildl. Rest. Projs. W-15-R-2 and W-15-R-3.

Holdermann, D.A. 1983. Caribou survey-inventory progress report, 19811982. Pages 22-23 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1.

Klein, D.R. 1965. Ecology of deer range in Alaska. Ecol. Monog. 35(3):259-284.

Lent, P.C. 1966. Calving and related social behavior in the barren-ground caribou. 2. Tierpsychol. 23:701-756.

Lentfer, J. 1965. Caribou report. ADF&G, Fed. Aid in Wildl. Rest. Projs. W-6-5-5 and W-6-R-6. 20 pp.

Leopold, A.S., and F.F. Darling. 1953. Wildlife in Alaska. New York: Ronald Press Co. 129 pp.

Leroux, P.A. 1979. Caribou survey-inventory progress report, 1977-78. Pages 133-136 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 9, Part 3. Proj. W-17-10.

Lieb, J.W. 1984. Caribou survey-inventory progress report, 1982-83. Pages 13-14 in J.A. Barnett, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 14, Part 6. Proj. W-22-2.

Lutz, M.J. 1956. Ecological effects of forest fires in the interior of Alaska. USDA Tech. Bull. 1,133. 121 pp.

McIlroy, C.W. 1975. Caribou survey-inventory progress report-1973. Pages 13-15 in D.E. Knight, eds. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 5. Proj. W-17-6.

Miller, F.L. 1982. Caribou. Pages 923-959 in J.A. Chapman and G.A. Feldhamer, eds. Wild mammals of North America. Baltimore: Johns Hopkins Univ. Press. 1,147 pp.

Murie, A. 1944. The wolves of Mount McKinley. USNPS, Fauna Natl. Parks, Fauna Ser. 5. Washington, DC. 238 pp.

Murie, O.J. 1935. Alaska-Yukon caribou. U.S. Bur. Biol. Survey. N. Am. Fauna 54:1-93.

Parker, G.R. 1972. Biology of the Kaminuriak population of barren-ground caribou. Part 1: Total numbers, mortality, recruitment, and seasonal distribution. Can. Wildl. Serv. Rept. Ser. No. 20, Ottawa. 95 pp.

_______. 1975. A review of aerial surveys used for estimating the numbers of barren-ground caribou in northern Canada. Polar Record 17(111): 627-638.

Peterson, R.O., J.D. Woolington, and T.N. Bailey. 1984. Wolves of the Kenai Peninsula, Alaska. Wildl. Monogr. 88. 52 pp.

Pitcher, K.W. 1982. Susitna Hydroelectric Project. Phase 1: final rept., big game studies. Vol. 4: Caribou. ADF&G, submitted to the Alaska Power Authority. Anchorage. 101 pp.

_______. 1983. Susitna Hydroelectric Project. Phase 2: 1982 ann. rept., big game studies. Vol. 4: Caribou. ADF&G, submitted to the Alaska Power Authority. Anchorage. 43 pp.

_______. 1984. Susitna Hydroelectric Project. Phase 2: 1983 ann. rept., big game studies. Vol. 4: Caribou. ADF&G, submitted to the Alaska Power Authority. Anchorage. 41 pp.

_______. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Anchorage.

Scott, R.F., E.F. Chatelain, and W.A. Elkins. 1950. The status of the Dall sheep and caribou in Alaska. Trans. N. Ame. Wildl. Conf. 15:612-626.

Siniff, D.B., and R.O. Skoog. 1964. Aerial censusing of caribou using stratified random sampling. J. Wildl. Manage. 28(2)391-401.

Skoog, R.O. 1963. Caribou investigations. ADF&G, Fed. Aid in Wildl. Rest. Proj. W-6-R-3.

________. 1968. Ecology of the caribou (Rangifer tarandus grant) in Alaska. Ph.D. Thesis, Univ. California, Berkley. 699 pp.

Skoog, R.D., and R.F. Scott. 1956. Movments, distribution, and numbers - Nelchina herd. Pages 21-26 in USFWS, Fed. Aid in Wildl. Rest. Quart. Rept. 10(3):1-34.

Spraker, T.H. 1981. Caribou survey-inventory progress report, 1980-1981. Pages 1-4 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12, Part 2. Projs. W-19-1 and W-19-2.

________. 1984. Caribou survey-inventory progress report, 1982-83. Pages 1-2, 22-23 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 14, Part 6. Proj. W-22-2.

________. 1984, 1985. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Anchorage.

State of Alaska. 1977. Alaska wildlife management plans: public proposal for management of Alaska's wildlife. Fed. Aid in Wildl. Rest. Proj. W-17-R.

Tobey, R. 1985. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game Anchorage.

Watson, G.W., and R.F. Scott. 1956. Aerial censusing of the Nelchina caribou herd. N. Am. Wildl. Conf. Trans. 21:499-510.

Dall Sheep Distribution and Abundance

I. REGIONWIDE INFORMATION

In Southcentral Alaska, Dall sheep are present thoughout the Talkeetna, Chulitna, and Watana mountains (TCW), the Wrangell Mountains (WMR), the Kenai Mountains (KMR), and the Chugach Mountains (CMR). The distribution and abundance of Dall sheep in Southcentral Alaska will be discussed in terms of these mountain ranges (map 1).

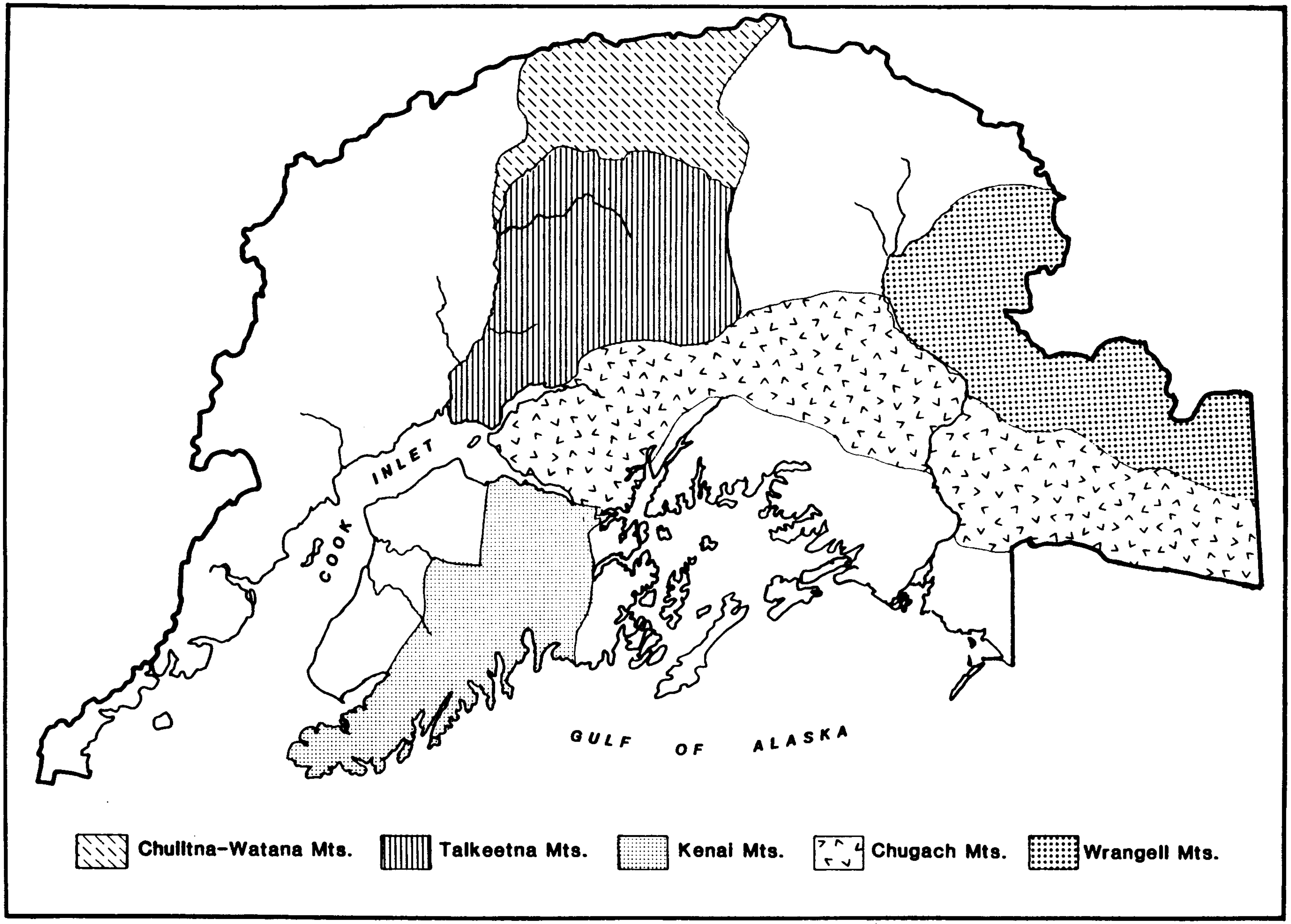
Historical information on Dall sheep populations within the Alaska is limited to personal reports from residents, Murie's observations in McKinley Park, and surveys conducted by the Alaska Game Commission. These sources provide a basis for determining the level of sheep abundance in areas of the state during recent history. They should be viewed, however, as preliminary estimates obtained under difficult circumstances that are subject to some bias and that are difficult to substantiate.

Personal reports indicate that between 1915 and 1940 sheep numbers were reduced over most of Alaska. Indiscriminate killing reduced the populations of available herds during the gold stampede and market-hunting days of this period, but through the 1920's sheep were still abundant. A series of severe winters in different regions of the state in the 1930's and 1940's contributed to the large decline in sheep populations during that period. After 1940, the sheep decline slowed, reaching a low point about 1945 (Scott et al. 1950).

Murie's observations in McKinley Park (Murie 1944) also indicated very large sheep populations in the early part of this century, despite extensive market and other illegal hunting in some areas. Severe weather conditions during the winters of 1928-1929 and 1931-1932 decimated the sheep population in the park and possibly in other areas of the state. Deep snow with hard crusts covered most available forage, and sheep populations suffered heavy losses through starvation (ibid.). The park sheep population in 1932 was estimated at 1,500 animals, down from 10,000-25,000 in 1928 (ibid.).

The accuracy of Murie's population estimates has been questioned and reevaluated (Murphy 1974), and most researchers believe that his estimates were too high. There is no doubt, however, that a large die-off did occur.

The Alaska Game Commission conducted surveys in 1949 covering over 29,000 sq mi of potential sheep habitat. They were conducted on the Kenai Peninsula, in the Chugach and Talkeetna mountains, the Tanana Hills and White Mountains, and in the Alaska Range from Mt. McKinley to the Canadian border (Scott et al. 1950). These surveys were pioneer efforts at estimating sheep distribution and abundance in Alaska utilizing aerial prevented observers from surveying difficult or dangerous areas. Also, remote areas were difficult to reach and costly to survey. Therefore, these survey efforts were incomplete at best and



Map 1. Southcentral Region showing mountain ranges where Dall sheep occur (ADF&G 1984).

are not comparable to modern techniques or effort (Heimer, pers. comm.).

A. Regional Distribution

Dall sheep in Southcentral Alaska are found in suitable habitat in GMUs 7, 11, 13, 14, and 15, located in the Kenai, Chugach, Wrangell, and Talkeetna mountains. Map 2 presents the Southcentral Region's boundary and associated GMU boundaries.

The Southcentral Region's boundary follows the drainage divide along portions of the Alaska Range. Sheep are limited in distribution on the south slopes of the Alaska Range to small areas of low-density discontinuous habitat. Therefore, sheep distribution and abundance for the Alaska Range (i.e., Alaska Range East [ARE], Delta and Tok management areas, and GMUs 12 and 20) will be discussed in the Alaska Habitat Management Guide for the Interior Region.

Sheep distribution is limited to the northern slopes of the Chugach range, except for the eastern end, where habitat is available on both slopes. Prevailing weather renders the southern side of most of the Chugach range uninhabitable to sheep because of heavy winter snowfall (Heimer 1984).

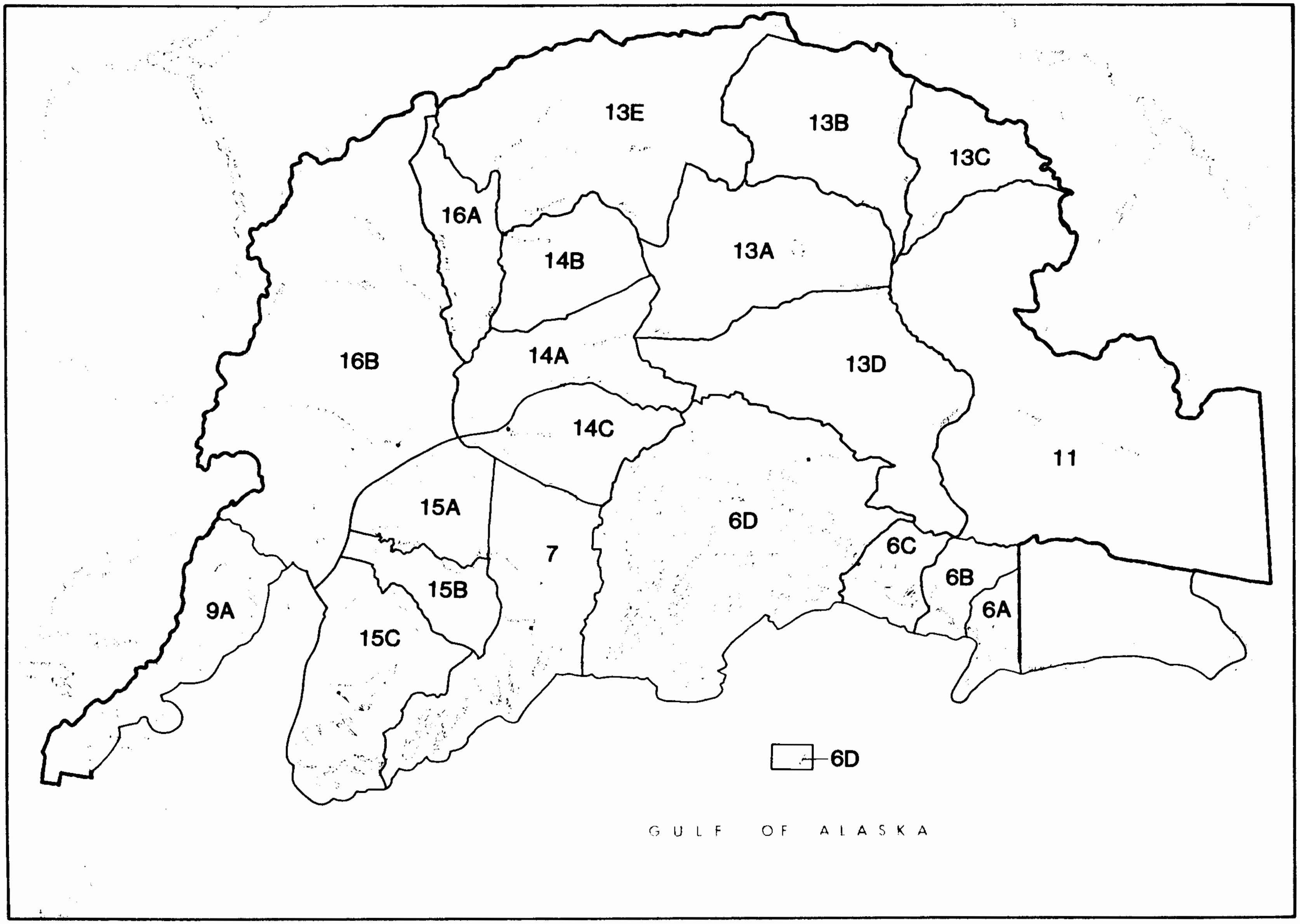
B. Areas Used Seasonally and for Life Functions

Dall sheep utilize different ranges at different times of the year. Most populations have a winter and a summer range (Heimer 1973), although some researchers have identified several seasonal use areas for mountain sheep (Beist 1971). Winter range is characterized by areas of low snow accumulation, higher elevations, wind-swept ridges, or other areas protected from show. The entire mountain block that sheep inhabit is available to sheep populations for summer range. Mineral licks are visited by some, if not all, Dall sheep populations (Heimer 1973). (For further information, see the 1:1,000,000-scale maps in the Map Atlas to the Southcentral Guide and the 1:250,000-scale maps available in ADF&G offices. These maps indicate the general distribution, known winter use areas, and known mineral locks of sheep in the Southcentral Region.)

C. Factors Affecting Distribution

Sheep are found in steep, mountainous terrain, usually above 2,500 ft, throughout the year. The rugged terrain provides readily available escape cover from predators. Also, the higher wind-blown slopes provide snow-free areas where forage is available during winter. Deep snow in other feeding areas prevents sheep from reaching forage.

Summer range use in some areas is affected by winter snow deposition and the timing of the snow-melt. Specific geographic areas tend to have deeper snow accumulations because of weather conditions and physiographic features. These areas are unavailable to sheep during winter and can provide summer range only after snow-melt (ibid). (See the Life History and Habitat Requirements volume for specific information.)



Map 2. Game management units in the Southcentral Region.

D. Movements Between Areas

In many areas, movements by Dall sheep between seasonal use areas are associated with mineral lick use (ibid.). In these areas, sheep travel from their winter range to the mineral lock, then continue to their summer range. The movement of sheep from winter to summer ranges in the Dry Creek area of the Alaska Range may occur as early as late May or the first week in June and peaks in mid-to-date June (ibid.). Distances traveled one way range from 2 to 12 mi (3.2 to 20 km) (ibid.). Tankersley (1984) found that sheep in the Watana Hills are (TCW) used mineral licks from early May through August, with most use occurring in June. Sheep traveled at least 5 mi from the nearest mountainous habitat to visit the lick (ibid.).

E. Population Size Estimation

Dall sheep distribution and abundance information is obtained from aerial surveys conducted by ADF&G biologists during mid summer (July). Aerial surveys are flown in predetermined areas of known sheep habitat. Surveys are conducted similarly, in attempts to ensure that results are comparable to previous years. Weather is an uncontrollable factor in these surveys and sometimes causes partial or complete cancellation. All areas are not surveyed every year, primarily because of budgetary and weather constraints. Instead, most areas are surveyed every other year or at longer intervals. This frequency is acceptable and provides sufficient data to assess trends in the population.

Since statehood, sheep surveys have been conducted based on available habitat within GMU boundaries. A decision to manage sheep on a population, or mountain range, basis has resulted in changes in the presentation of survey data. Prior to 1980 or 1981, depending on the area, Dall sheep distribution and abundance information was recorded by GMUs; since then, information has been recorded by GMU within the mountain range. The two sets of information are not directly comparable, but population trends can still be determined.

Aerial survey information on population composition is presented in the form of total sheep observed, total lambs observed, lambs per 100 unclassified animals, and total number and percentage of legal rams. The last two categories are sometimes not available because of the difficulty in determining legal rams from the air. The ewe-lamb groups contain animals of both sexes and many age classes and are difficult to classify accurately. Therefore, all ewe-like animals (ewes, yearlings of both sexes, and young rams) are designated as unclassified animals.

F. Regional Abundance

Approximately 70,000 Dall sheep are currently estimated to be present in the Alaskan sheep population (Heimer 1984). Approximately 13,000 sheep are present in the Southcentral Region (ibid.). Densities and population composition vary by areas. Specific regional abundance information is given in the following paragraphs.

II. KENAI MOUNTAINS (GMUs 7 and 15)

The southernmost extension of Dall sheep range in Alaska is in the Kenai Mountains, which begin on the Kenai Peninsula and proceed northeasterly to the Turnagain Arm of Cook Inlet.

A. Present Abundance

Sheep habitat on the Kenai Peninsula occurs in GMUs 7 and 15. Population information for this area is obtained as a unit rather than as separate areas because sheep populations occur throughout the mountain block. The 1984 total sheep population for this area was estimated at 1,500 (Spraker, pers. comm.), reduced from about 2,750 sheep because of difficult winters in the early 1970's (ibid.).

Population information from 1979 to 1983 is presented in table 1. The population appears to be stable or increasing slightly, with the percentage of lambs (22.0%) remaining at its highest level in five years and above the five-year average of 18.4% (ADF&G 1984). The number of lambs/100 unclassified animals (37.4%) is also at its highest level in five years and above the five-year average of 29.9% (ibid.).

B. Historic Distribution and Abundance

The total sheep population on the Kenai Peninsula in 1949 was estimated to be about 350 sheep (Scott et al. 1950). Sheep populations between 1935 and 1939 in the Indian Creek drainage near Tustumena Lake were reported to be over 500 animals; however, surveys conducted in 1949 indicated that sheep numbers in this area were less than 150 animals (ibid.). Dall sheep were reported to be abundant in the Kenai Mountains until an extensive die-off occurred in the early 1940's. Winter weather was thought to be the major factor in this decline (Rhodes, pers. comm.).

III. WRANGELL MOUNTAINS (GMU 11)

Almost all of GMU 11 is enclosed within the Wrangell-St. Elias National Park/Preserve. The Wrangell Mountains portion of GMU 11 includes those mountains south of the unit boundary, north of the Chitina River, east of the Copper River, and extending to the Canadian border.

The National Park Service (NPS) and the ADF&G in 1981-1982 determined Dall sheep distribution and abundance within the park/preserve boundaries (Singer 1982). GMU 11 and portions of GMU 12 were surveyed. GMU 12 (which includes count units 1,3,4,5,5,7,8,9, and 19 [map 3] is located in the Interior Region, and results from this survey for that GMU will be included in that regional discussion.

A. Present Abundance

During 1981-1982, a total of 3,946 sheep (table 2) were visually counted in 12 of 15 GMU 11 count areas located within Wrangell-St. Elias National Park and Preserve (map 3) (ibid.). Three count units (17, 18, and 24) were not covered during 1982-1982 but had sheep surveys conducted in the early 1970's (Heimer and Smith 1979). A population figure for these three count units was determined from the earlier surveys and added to the visual count, resulting in an estimated population of 4,759 sheep (table 2).

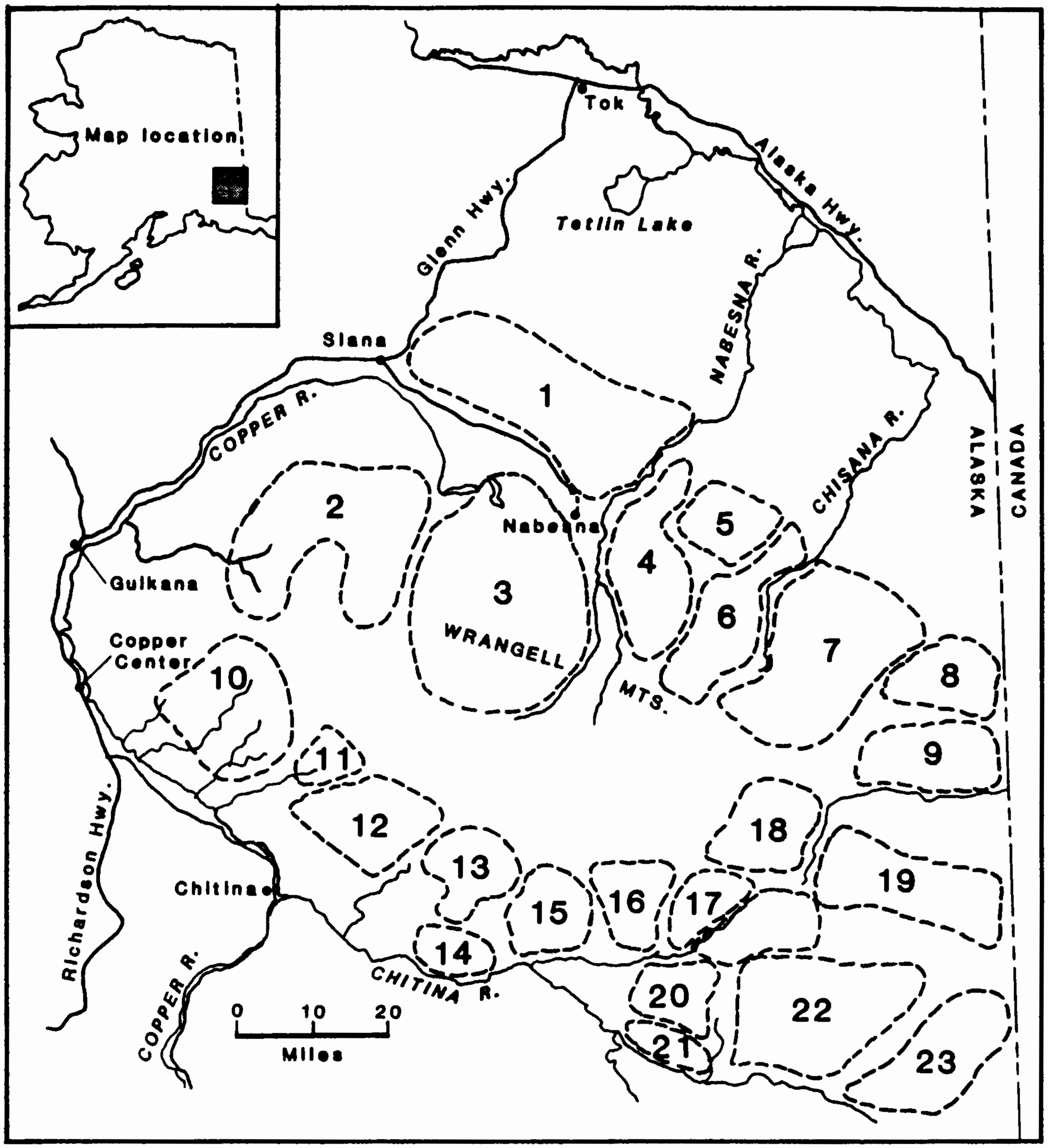
Table 1. Composition of Sheep Observed in the Kenai Mountains, 1979-83

Year	GMU Area	Legal Rams[a]	Sublegal Rams	Lambs	Unclass.*	Total	Lambs/100 Unclass.	% Lambs
1979	Portions of 15	46	88	77	340	551	22.6	14.0
1980	Portions of 15	30	45	75	302	452	24.8	16.6
1981	7 & 15	38	112	140	442	732	31.7	19.1
1982	7 & 15	23	22	133	421	599	31.6	22.0
1983	7 & 15	33	75	124	331	563	37.4	22.0

Source: ADF&G 1984.

a Legal ram is designated as a 7/8 curl.

* Unclassified includes unidentified young rams and yearlings of both sexes.



Map 3. NPS survey areas in Wrangell Mountains listed in table 2 (Singer 1982).

Table 2. Recent and Previous Counts of Dall Sheep in 15 Count Units North of the Chitina River, Wrangell - St. Elias National Park/Preserve

Count Unit	Recent Count 1982	Recent Count 1981	% Change From Last Previous Count	Last, Most Complete, & Accurate Count	Year of Last Count
2	---	508[b]	+131%	220	1973
10	---	201	- 3%	208	1973
11	557	---	---	---	---
12	---	566[b]	+ 39%	407	1973
13	---	234[b]	+ 12%	209	1973
14	---	230[b]	+ 26%	183	1973
15	---	159	e	48	1973
16	---	225[b]	---	---	---
17	---	---	---	224	1973
18	---	---	---	335	1968
20	---	164	+ 9%	151	1973
21	---	353[b]	+ 45%	244	1973
22	---	249	+ 4%	240	1970
23W	303(500)	247	e	278	1970
24	---	---(254)		---	---
Total count		3,946		2,747	
Count plus estimate for uncounted units[d]		4,759		3,783	
Estimated population		5,949		4,729	

Source: Singer 1982.

--- means no data were available.

a From Heimer and Smith 1979.

b Helicopter count.

c Helio 295; all other counts are Super Cub.

d Estimates for uncounted units from Heimer and Smith (1979) were based upon densities in adjacent, similar units.

e Boundaries changed or only part of unit counted. No comparisons were made.

Some sheep escape observation, and some areas are inevitably missed in a sheep survey of this magnitude. To adjust for this variable, the observed total was multiplied by a factor of 1.25, resulting in an estimated total population of 5,949 sheep (table 2).

An apparent population increase in the southern areas is evident since the early 1970's. A portion of the apparent increase was undoubtedly due to greater counting efficiency, as fewer changes were made in observers during the 1981-82 surveys, more time was spent, and peripheral areas were counted (Singer 1982).

B. Historic Abundance

Historic information, as mentioned previously, is very limited. Populations in this area probably followed the general historic trend for sheep in the state, with early 1900's populations decreasing because of market and other kinds of hunting and severe winters until the early 1940's, after which occurred an increase in numbers to the present level. The estimated sheep population in 1949 for the Wrangell Mountains was 700 animals (Scott et al. 1950). This probably represents an incomplete limited population estimate but nevertheless reflects the low density of sheep at that time.

IV. TALKEETNA MOUNTAINS AND CHULITNA-WATANA HILLS (TCW)

The Talkeetna Mountains and Chulitna/Watana Hills sheep ranges (TCW) are located in portions of four game management subunits. The Talkeetna Mountains sheep includes Subunit 14A, north of the Matanuska River, Subunit 14B, Subunit 13A, and Subunit 13E, south of the Susitna River (map 1). The Chulitna/Watana Hills sheep range includes that portion of Subunit 13E between the Susitna, Chulitna, and Nenana rivers (map 1) (ADF&G 1984).

A. Present Abundance

Dall sheep surveys were conducted in Subunit 14A of the Talkeetna Mountains during 1980 and 1982. A total of 559 sheep were observed during 1982, comparable to the 502 seen in 1980 (table 3). The number of lambs observed increased from 76 in 1980 to 120 in 1982, with an increase in percentage of lambs from 15.1 to 21.5 (ADF&G 1983). This increase in the number of percentage of lambs in the population suggests good lamb production and survival in this portion of the population (ibid.).

Subunits 14A and B were surveyed in 1981 and 1983. These surveyus were similar to the 1980 and 1982 surveys of 14A but included additional areas of Subunit 14B. Table 3 presents survey information for this area. The total count in 1983 (538) showed a decrease of 90 animals (14%) from the 628 observed in 1981. However, this still represents a much larger total count than the 423 sheep counted in 1974 (ADF&G 1983). Lambs/100 unclassified animals decreased from 38.4 in 1981 to 23.7 in 1983, and the number and percentage of lambs in the population also decreased (ibid.).

Table 3. Composition of Sheep Observed in the Talkeetna/Chulitna Mountains - GMUs 14A and B, 13A and E, 1980-81

Year	GMU Area	Legal Rams[a]	Sublegal Rams	Lambs	Unclass.*	Total	Lambs/100 Unclass.	% Lambs
1979	14A	49	97	76	280	502	27.1	15.1
1982	14A	38	65	120	336	559	35.7	21.5
1981	14A & B	53	99	132	344	628	38.4	21.0
1983	14A & B	43	103	75	317	538	23.7	13.9
1982	13E	2	22	67	234	325	28.6	20.6
1983	13E	2	5	2	43	52	4.6	3.8
1981	13A	61	138	188	642	1,029	29.3	18.3

Source: ADF&G 1983, 1984.

* Unclassified includes unidentified young rams and yearlings of both sexes.

During 1982 and 1983, sheep surveys were flown in Subunit 13E of the Chulitna Mountains portion of the TCW area. Table 3 presents results from these surveys. A total of 325 sheep were observed in 1982, whereas only 52 sheep were observed during 1983 (ADF&G 1984). No explanation for the large decrease in sheep observed is available at this time; however, it is possible that the 1983 survey did not cover all the area surveyed in 1982.

In 1982, sheep surveys were also flown in Subunit 13A of the eastern Talkeetna Mountains. A total of 2,029 sheep were counted (table 3), representing an 8.5% increase from a comparable survey (1,125) conducted in 1977 (ibid.).

Sheep surveys were conducted in the Watana Hills section of Subunit 13E from 1980 through 1983 (table 4). The 1982 survey resulted in a total count of 200 sheep, similar to the 209 sheep observed during 1981 (ibid.). Table 4 presents survey data for the Watana Hills are of Subunit 13E from 1979 through 1983. The 1983 survey indicates a decrease in total number of sheep observed and in the percentage of lambs. The decline in numbers of sheep observed was attributed to the decrease in the number of lambs. No explanation for the poor lamb crop is available (ibid.). The Watana Hills sheep population is relatively small and therefore easily affected by a reduced production rate. A series of poor lamb crops could seriously reduce this population. Overall, the sheep population in the TCW area appears to be stable, with the small flucuations between years in the number of sheep observed probably attributable to differences in survey conditions and/or inexperienced observers (ibid.).

B. Historic Abundance

Historic information on sheep populations in this area is very limited. Sheep populations in the Talkeetna Mountains were estimated at 300 animals in 1950 (Scott et al. 1950). Populations in this area prior to 1950 probably flucutated in abundance similarly to sheep populations throughout the state. (See I. Regionwide Information in this narrative for details.)

V. CHUGACH MOUNTAINS

The Chugach Mountain Range (CMR) contains portions of four game management units or subunits. From west to east, these include Subunit 14C, which extends from Anchorage to the Knik River; Subunit 14A, from the Knik River to the Coal Creek drainage; Unit 13, from Coal Creek to the Copper River near Chitina; and Unit 11, from the Copper River south of the Chitina River to the Yukon border (map 2).

A. Present Abundance

Table 5 presents information for sheep surveys conducted in Subunit 14C from 1979 to 1983. These data indicate that the 14C sheep population has increased approximately 10% per year during the last five years (ADF&G 1984). The similar percentage of lambs in the population illustrates continued excellent lamb production over the last five years, while the relatively low percentage of legal rams reflects a young, growing population in Subunit 14C.

Table 4. Composition of Sheep Observed in the Watana Hills Area - GMU 13E, 1979-83

Year	GMU Area	Legal Rams[a]	Sublegal Rams	Lambs	Unclass.*	Total	Lambs/100 Unclass.	% Lambs
1979	Watana Hills	No survey						
1980	Watana Hills	9	19	42	104	174	40.4	24.1
1981	Watana Hills	2	37	43	127	209	33.9	20.6
1982	Watana Hills	0	19	38	143	200	26.6	19.0
1983	Watana Hills	10	24	19	96	149*	19.8	12.8

Source: ADF&G 1984.

Table 5. Composition of Sheep Observed in the Chugach Mountains - GMUs 14C, 13D, 1979-83

Year	GMU Area	Legal Rams[a]	Sublegal Rams	Lambs	Unclass.*	Total	Lambs/100 Unclass.	% Lambs
1979	14C	85	143	161	514	903	31.3	17.8
1980	14C	70	171	182	740	1,163	24.5	15.6
1981	14C	82	151	239	820	1,292	29.1	18.4
1982	14C	79	231	193	967	1,470	20.0	13.1
1980	All 13D	114	---	246	921	1,281	26.7	19.2
1983	Portions of 13D	31	85	79	508	703	15.6	11.2

Source: ADF&G 1983.

* Unclassified includes unidentified young rams and yearlings of both sexes.

The large number of sublegal rams (17%) indicates a substantial increase in the number of legal rams over the next three to four years (ibid.).

Additional surveys were conducted during 1983 in portions of Subunit 13D of the CMR (table 5). The 1983 surveys covered only a portion of the area surveyed in 1980; therefore, results are not directly comparable. However, the limited data available suggest that Subunit 13D sheep populations experienced a slight decline since 1980. Severe winter weather in portions of Subunit 13D during this period can be related to this apparent decline (ADF&G 1983).

B. Historic Abundance

In 1950, the estimated sheep population for the entire Chugach Range was only 600 animals. Extensive hunting, both legal and illegal, had greatly reduced the sheep populations in areas adjacent to mining activities and population centers. These populations probably suffered winter mortality in the early 1940's similar to areas elsewhere in Alaska. A hunting closure of accessible sheep habitat near Anchorage in the early 1940's probably prevented already depressed sheep populations in those areas from being eliminated (Scott et al. 1950).

REFERENCES

ADF&G. 1983. Annual report of survey-inventory activities. Part IV: Mountain goat and sheep. Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 12.0 and 6.0.

________. 1984. Annual report of survey-inventory activities. Part II: Mountain goat and sheep. Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2, Jobs 12.0 and 6.0.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. Chicago: Univ. Chicago Press. 383 pp.

Heimer, W.E. 1973. Dall sheep movements and mineral lick use. ADF&G, Fed. Aid in Wildl. Rest., final rept. Projs. W-17-2 through 5, Job 6.1R.

________. 1984. Population status and management of Dall sheep in Alaska, 1984. Unpubl. rept., ADF&G, Fairbanks. 22 pp.

________. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Fairbanks.

Heimer, W.E., and T. Smith. 1979. Dall sheep in the Wrangell Mountains. Fed. Aid in Wildl.

Murie, A. 1944. The wolves of Mt. McKinley. Fauna of the National Parks of the United States. Series No. 5. U.S. Government Printing Office. Washington. 81 pp.

Murphy, E.C. 1974. An age structure and reevaluation of the population dynamics of Dall sheep (_Ovis dalli dalli_). M.S. Thesis, Univ. Alaska, College.

Rhodes, C. 1974. Personal communication to L. Nichols, Game Biologist, ADF&G, Cooper Landing.

Scott, R.F., E.F. Chatelain, and W.A. Elkins. 1950. The status of the Dall sheep and caribou in Alaska. Pages 612-626 _in_ Transactions of the fifteenth North American wildlife conference, San Francisco, CA. Wildlife Management Institute. Washington, DC.

Singer, F.J. 1982. Wrangell-St. Elias National Park/Preserve Dall sheep counts, 1981 and 1982. NPS Survey Rept. No. 82-2. NPS, Anchorage, AK. 8 pp.

Spraker, T. 1984. Personal communications. Area Mgt. Biologist, ADF&G, Div. Game, Soldotna.

Tankersley, N.G. 1984. Susitna Hydroelectric Project final report: big game studies. Vol. VIII: Dall sheep. ADF&G, Anchorage. 76 pp.

Moose Distribution and Abundance

I. REGIONWIDE INFORMATION

Information is organized by game management units or subunits within the Southcentral Region (see map 1).

A. Regional Distribution

Moose are found throughout the Southcentral Region mainland primarily below elevations of 4,000 ft (ADF&G 1976a; Ballard and Taylor 1980; Ballard et al. 1982, 1984), except in glaciated areas such as occur in the Wrangell Mountains and western Prince William Sound. Moose are also found on Kalgin Island in Cook Inlet, the result of transplants in 1957, 1958, and 1959 (Burris and McKnight 1973), and on Fire Island near Anchorage.

B. Areas Used Seasonally and for Life Functions

Moose distribution maps at the 1:250,000 scale are on file in the Habitat Division office in Anchorage and area offices of ADF&G. Maps at the 1:1,000,000 scale are presented in the Atlas to the guide for the Southcentral Region. Map categories for moose are as follows:

- General distribution
- Known calving concentrations
- Known rutting concentrations
- Known winter concentrations

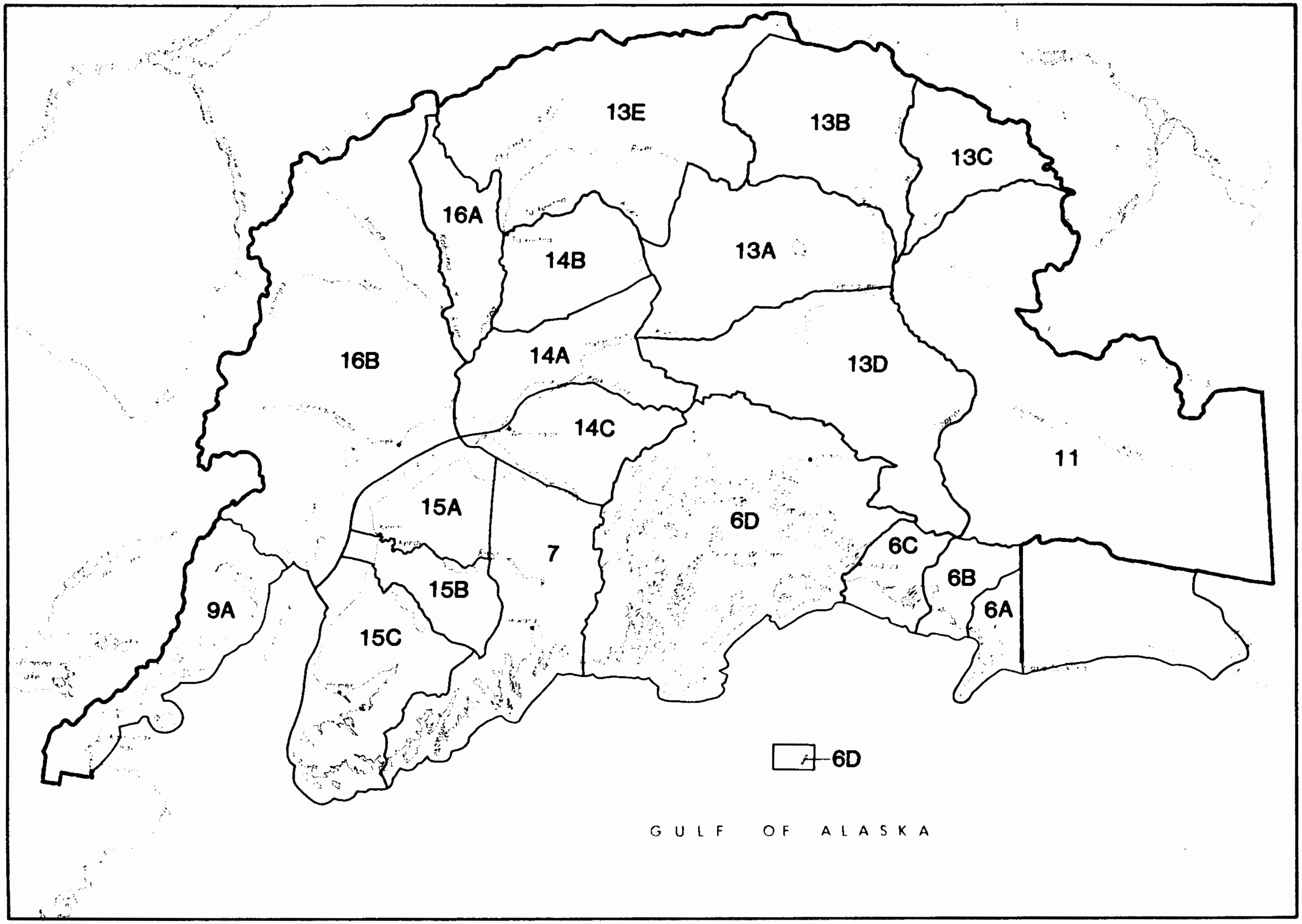
C. Factors Affecting Distribution

Numerous factors can influence seasonal and long-term distribution of moose. Some of these include snow depth during winter, range condition, habitat manipulation, fire, predator density, and land use such as agriculture.

D. Movements Between Areas

Movements by moose can consist of local travel within seasonal ranges, movements or migration between seasonal ranges, or dispersal to new ranges. Variable movements by individuals or segments of moose populations make it difficult to precisely define patterns of movements. Some animals may seasonally migrate during different times to different locations, whereas others may remain resident throughout the year (Coady 1982). Studies conducted in the Southcentral Region indicate that moose exhibited all these types of movements. Ballard and Taylor (1980) found that moose in the upper Susitna Valley were either somewhat sedentary, occupying the same drainage year-round, or highly migratory, moving considerable distances. Modafferi (1982, 1983) found that along the lower Susitna River there were large variations in movements and range sizes among individuals and sexes within years and between years.

During his first year studying moose in GMU 16B near Tyonek, Faro (n.d.) found that radio-collared moose gradually moved uphill from



Map 1. Game management units in the Southcentral Region.

coastal wintering areas from April through September. Individual patterns of movement varied greatly, and local concentrations did not occur during this period. He also found that moose frequently moved parallel to drainages along the higher elevations immediately above the riparian zone.

Bailey et al. (1978) described at least two types of moose populations on the Kenai Peninsula: 1) a migratory population comprised of a number of discrete interbreeding groups that aggregate within the larger mountain drainages during the rutting season but intermix with each other and lowland resident moose during winter and spring, and 2) a resident moose population in the northern peninsula lowlands that remains in the spruce-birch-aspen communities year-round.

Timing of movements in most frequently related to weather, particularly to snow conditions (LeResche 1974). The severity of the winter may also influence the distance moose move and the proportion of animals in a population segment that migrate to different areas. Movements may be related to changes in the quantity or growth stage of forage or to other environmental stimuli or possibly to an internal timing mechanism (ibid.).

Ballard and Taylor (1980) and Ballard et al. (1982, 1984) found that the fall migration in GMU 13 occurred primarily in November but ranged from 5 October to 19 January. Although the fall migration began at the same time for most moose, the speed with which individuals moved to wintering areas was highly variable. Some animals arrived on wintering areas by mid December, whereas others continued to meander in a southerly direction until early spring. Spring migration did not consist of a clearly defined pattern. Some moose began moving toward their summer range in April, while others remained close to the winter area where calving took place, then migrated in mid July. Once the movement to summer ranges began it usually took four to six weeks. Moose tend to exhibit a high degree of fidelity to winter and summer ranges (Ballard and Taylor 1980, Ballard et al. 1984).

Faro (n.d.) found that moose in portions of GMU 16B began to concentrate in certain areas for the rut. There appears to be fidelity to general rutting areas and, with minor shifts, certain areas are annually used for rutting activities. These concentrations were maintained until November or December, when increased snow depth started moose moving toward lower elevations. By January, the moose had moved into winter habitat.

Distances between seasonal ranges vary greatly (LeResche 1974). In the Southcentral Region, distances between ranges have varied from 8 to 94 km (5 50 58 mi) in the eastern portion of GMU 13 (Van Ballenberghe 1978); from 2 to 60 km (1 to 37 mi) on the Kenai Peninsula (Bailey et al. 1978); from 3 to 19 km (2 to 12 mi) in GMU 16 (Didrickson and Taylor 1978); and from 16 to 93 km (10 to 58 mi) in the upper Susitna River basin (Ballard and Taylor 1980). Studies conducted in the Southcentral Region indicate that seasonal ranges are highly variable between individuals and sex classes. Bailey et al. (1978) and Modafferi (1982) found that males tend to maintain ranges of larger size than females. Ballard et al. (1980) noted that cows with calves had smaller ranges for six weeks following parturition than do cows alone. They also determined the predator densities influenced movements and subsequently the range size of cow-calf pairs. In the upper Susitna River basin, Ballard and Taylor (1980) observed that winter ranges varied from 21 to 389 km² (8 to 150 mi²), averaging 102 km² (39 mi²). Summer ranges varied from 8 to 210 km² (3 to 81 mi²) and averaged 72 km² (28 mi²). The total area occupied annually by moose in the upper Susitna River basin ranged from 44 to 1,373 km² (17 to 530 mi²).

Modafferi (1983) monitored moose along the lower Susitna River valley for up to 31 months. Annual ranges varied from year to year, apparently dependent to a large extent on winter snow conditions. During winters of low snow depths, some individual moose maintained smaller annual range sizes than during years of deeper snow depths. Apparently, deeper snow forces the animals to move to areas where snow depths are less and/or browse is more accessible.

E. Population Size Estimation

Abundance estimates are based on several techniques or a combination of techniques. Gasaway et al. (1981) have developed a sampling procedure for estimating moose abundance based on a stratified sampling design, which includes estimating the sightability of moose under different environmental conditions. Such censuses have been conducted in portions of some GMUs within the Southcentral Region. Based on results from censuses combined with fall composition counts in specific areas, gross population estimates can be made for individual composition count areas. In some instances, gross estimates are extrapolated for the subunits in which they are located. Some gross abundance estimates are based on a combination of data from fall composition counts and the experience of area management biologists responsible for the particular GMU or subunit.

Abundance estimates should be interpreted cautiously. There are great differences in sampling intensity, experience of pilots and/or observers, habitats, light conditions, and so forth, all of which can drastically alter estimates and comparisons between areas. Determining the number of moose present but not observed during aerial surveys is a major obstacle to making accurate estimates of a population size (Coady 1982). The sightability of moose is influenced not only by the habitat they are using but also by the climatic conditions prevailing at the time the surveys are made. When the snow cover is not complete, for example, bare patches of vegetation make observation of moose difficult. Or if the snow cover is old, an abundance of tracks may indicate only that moose have been in the area but are necessarily present at the time of the survey, whereas fresh snow would permit an observer to "read" the tracks more clearly and to locate the moose more readily.

F. Regional Abundance

Abundance estimates will be discussed by game management unit and/or subunits.

II. GMU 6

(The data source for the following section is Reynolds, pers. comm., unless otherwise noted.)

Moose are not native to Game Management Subunits (GMS) 6(A), (B), and (C). Their presence there is the result of 20 moose calves having been transplanted along the Copper River Highway during the 1950's. Moose are found in limited numbers and areas in Subunit 6(D) because of habitat constraints (ADF&G 1976b).

A. GMS 6(C)

1. Present abundance. Based on a 1983 fall composition count of 164 moose, the estimated number of moose in Subunit 6(C) is approximately 200. In recent years, the number of moose has been increasing. Currently, the desired number of moose after the hunting season is 175 to 200. The goal is to maintain the herd at this level, with an either-sex hunting season.

   Predation by wolves appears to be minimal; however, the calf predation by brown bears may be significant.

2. Historic distribution and abundance. During the 1950's, 20 moose calves were transplanted along the Copper River Highway (Burris and McKnight 1973). These animals rapidly reproduced and dispersed from Subunit 6(C) to other portions of GMU 6. The population was maintained at 175 to 200 animals by controlled hunter harvest. The 1964 earthquake uplifted portions of the Copper River delta and probably improved moose habitat temporarily. During winter of 1971-1972, approximately 15% of the herd in Subunit 6(C) died. During the spring of 1979, approximately one-third of the herd crossed the Copper River and became permanent residents in Subunit 6(B). Since then, the herd has been allowed to increase to and is maintained at its current level of about 200 animals.

B. GMS 6(B)

1. Present abundance. Based on a fall 1983 composition count of 179 moose, the estimated number of moose in Subunit 6(B) is slightly in excess of 200 animals. Currently, the post-hunting season management goal is to maintain this herd at 150 to 175 animals. Because the herd is currently slightly above this goal, hunting seasons have been liberalized to gradually lower the herd to the desired level. Currently, wolf predation does not appear to be significant. Calf crops have been poor in recent years, however, and predation by brown bears is suspected.

2. Historic distribution and abundance. Moose in Subunit 6(B) are the result of the dispersal of moose transplanted to Subunit 6(C) in the 1950's. This herd grew rapidly until it numbered over 260 animals in 1971. During the 1971-1972 winter, approximately one-third of the herd died (ADF&G 1976b). During the spring of 1979, approximately 75 to 100 moose moved into Subunit 6(B) from 6(C). Since then, harvest from this herd has been increased to 50 to 75 animals per year, to gradually reduce the herd to the desired level of 150 to 175 moose.

C. GMS 6(A)

1. Present abundance. Subunit 6(A) contains two separate moose herds: the Bering River/Controller Bay and Tsiu River herds. The Suckling Hills are the boundary between these two herds.

    a. Bering River/Controller Bay herd. Based on a fall 1983 composition count, there are at least 307 animals in this herd. The herd is above the management goal of 200 animals and increasing. Predation currently does not appear to be a significant factor, and hunter harvest has not been effective in controlling the herd size.

    b. Tsiu River herd. Based on a 1983 fall composition count, there are at least 311 animals in this herd. The herd is increasing and is above the management goal originally set at 150 moose. In view of the suitable habitat in the area, a more realistic goal may be 200 animals. Predation currently does not appear to be significant, and hunting is minimal and has not affected herd growth.

2. Historic distribution and abundance:

    a. Bering River/Controller Bay herd. This herd became viable in the mid 1970's as a result of dispersing animals from Subunit 6(B). It has been continuously increasing.

    b. Tsiu River herd. This herd also became established in the mid 1970's as a result of dispersing animals from Subunit 6(B). A January 1980 composition count revealed 109 animals, but in the fall of 1983 311 animals were observed.

D. GMS 6(D)

1. Present abundance. In Subunit 6(D), moose occur only in the Lowe River valley, Nellie Juan River valley, along the Kings River, and near the south end of Kings Bay (ADF&G 1976b). The current population status is unknown.

III. GMU 7

(The data source for the following section is Spraker, pers. comm. unless otherwise noted.)

A. Present Distribution and Abundance

Based on trend surveys conducted in GMU 7, there are approximately 1,000 to 1,200 moose in this area. At this time, the trend appears to be stable, primarily because of recent mild winters, which have benefited calf survival.

B. Historic Distribution and Abundance

Because of mountainous terrain and limited suitable habitat, densities of moose in GMU 7 have approached those that have occurred in adjacent Subunit 15(A). During the late 1960's, densities increased as a result of the rapidly expanding moose population in Subunit 15(A). That portion of Unit 7 north of Copper Landing (notably Resurrection Creek) had relatively high densities of moose compared to the remainder of Unit 7. Generally, the densities of moose are lower in the southern and eastern portions of the unit, with the exception of the Placer River and Portage Creek drainages, which have supported moderate densities over the past 20 years.

IV. GMU 11

A. Present Abundance

There is insufficient data to estimate the moose population in GMU 11. The population appears to be stable at a low to moderate density (Tobey, pers. comm.).

B. Historic Distribution and Abundance

Historically, moose numbers were probably quite similar to those of GMU 13, peaking in the early 1960's. The relatively high moose population was probably due to habitat improvement caused by fires in the 1920's to 1940's and predator control in the 1950's (Bishop and Rausch 1974).

Moose numbers in GMU 11 declined during the 1970's. During the late 1950's through the 1960's, a mean of 86 moose per hour were observed during composition counts in the Mt. Sanford/Drum area. By the mid-to-late 1970's, this figure had declined to 14 moose per hour. During the fall of 1982, 23 moose per hour were observed (ADF&G 1984a). The decline moose numbers in GMU 11 from the late 1960's to the mid 1970's was apparently the result of several factors. Fire suppression programs have resulted in the succession of plant communities beyond the preferred seral stage and have thus reduced moose browse. Predator control programs ended in 1953, allowing wolf and bear populations to increase at least until the early 1970's. Since then, predator populations have continued to mimic GMU 13. Harvest pressure by humans and several severe winters with deep snow also contributed to the decline (ADF&G 1976b).

V. GMU 13

(The data source for the following section is Tobey, pers. comm., unless otherwise noted.)

A. Present Abundance

As of the fall of 1982, there were an estimated 30,000 moose inhabiting GMU 13 (Ballard et al. 1984; Ballard, pers. comm.). This estimate was based on a combination of census and composition count data incorporated into a moose population dynamics model developed from eight years of field research data. Approximately 2,900 mi^2 of moose habitat (areas less than or equal to 4,000 ft elevations) in Subunits 13A, B, and E have been stratified and censused in 1980 and 1983 by methods discussed by Gasaway, et al. (1981). Areas not censused were stratified on the basis of combinations of moose composition counts, stratification flights, and 24 man-years of experience by five biologists (Ballard, pers. comm.). Because better estimates were obtained in some units in different years, subsequent estimates by subunit when added together will not equal the total unitwide estimate.

B. Historic Distribution and Abundance

The GMU 13 moose population peaked in 1960 (Bishop and Rausch 1974). The high moose population was related to combinations of improved habitat because of major fires in the 1920's through the 1940's, mild winters, low hunting pressure, and predator control during the 1950's (ibid.). The moose population began to decline in the 1960's, and recruitment continued to decline through 1975 (Bishop and Rausch 1974, Ballard and Larsen in press). Reasons for the decline included several winters of deep snow, cessation of predator control, an increase in hunting pressure, and habitat deterioration because of fire suppression (ibid.).

The moose population reached a low in the mid-to-late 1970's of about 20,000 animals. Since then, mild winters, limited hunting, and relatively low numbers of wolves have allowed the population to increase to its current level (Ballard, pers. comm.).

1. GMS 13(A):
    a. Present abundance. In Subunit 13(A) in 1980, there were an estimated 5,700 moose. There are approximately 3,495 sq mi of available moose habitat. Moose densities are high and range from about 0.3 to 3.2 moose/mi^2 and average about 1.6 moose/mi^2. Currently, the number of moose is increasing at a rate of about 3 to 5% annually (ibid.).
    b. Historic distribution and abundance. See GMU 13 summary.
2. GMS 13(B):
    a. Present abundance. In Subunit 13(B) in 1980, there were an estimated 5,100 moose. Total estimated moose habitat in the subunit is 3,972 mi^2. Currently, the number of moose is increasing at a rate of about 3 to 5% annually.
    b. Historic distribution and abundance. See the GMU 13 summary.
3. GMS 13(C):
    a. Present abundance. In Subunit 13(C), there were approximately 2,900 moose in 1983. Total estimated moose habitat in the subunit is about 1,600 mi^2. Currently, the number of moose is increasing at a rate of 3 to 5% annually (ibid.).

b. Historic distribution and abundance. See the GMU 13 summary.

4. GMS 13(D):

a. Present abundance. Based on 1984 stratification surveys combined with 1983 density estimates from Subunits 13A, B, and E, there are an estimated 3,600 moose in Subunit 13D. Total estimated moose habitat in this subunit is about 3,100 mi^2. Currently, moose numbers appear to be increasing.

b. Historic distribution and abundance. See the GMU 13 summary.

5. GMS 13(E):

a. Present abundance. In Subunit 13(E), there are an estimated 7,200 moose. Total moose habitat is about 4,897 mi^2. Moose densities range from 0.4 to 3.3 moose/mi^2. Currently, the number of moose is increasing at a rate of 3 to 5% annually (ibid.).

b. Historic distribution and abundance. See the GMU 13 summary.

VI. GMU 14

A. Present Abundance

Currently, there are an estimated 9,000 to 12,000 moose in GMU 14 (Didrickson, pers. comm.; Harkness, pers. comm.). This estimate is based on a combination of data from fall composition counts conducted within individual subunits (14A through C) and the experience of area biologists.

B. Historic Distribution and Abundance

Severe winters during 1970-1971 and 1971-1972 are the most recent causes of the major population decline in GMU 14. Railroad and highway kills are significant mortality factors in some years and affect local moose populations. Mild winters since 1978 have allowed the moose population to increase. A severe winter with deep snow in the future, however, would likely result in major declines.

Moose numbers and distribution are being affected locally by development as the human population continues to expand. Agricultural development will continue to eliminate or alter moose habitat, causing population declines or shifts in distribution. Habitat enhancement programs in portions of the unit may help offset losses elsewhere.

1. GMS 14(A):

a. Present abundance. Currently, there are approximately 4,000 moose in Subunit 14(A). Numbers of moose may be decreasing in portions of the subunit because of expanding agricultural and residential developments. In the Moose Creek Management Area (MCMA), numbers will likely increase because of habitat enhancement.

b. Historic distribution and abundance. During the 1965 hunting season, over 1,200 moose were reported harvested, the largest number on record for Subunit 14(A) (Rausch 1967). In the early 1970's, severe winters with deep snow significantly reduced the number of moose in the subunit.

c. Habitat enhancement projects. The MCMA, which encompasses approximately 130,000 acres, is located north and east of Palmer between Fishook Road on the west, King's River on the east, the Glenn Highway on the south, and the Talkeetna Mountains on the north. The habitat management objectives in the MCMA is to maintain 3,000 to 5,000 acres of early successional deciduous vegetation for wintering moose (ADF&G 1984b).

2. GMS 14(B):

a. Present abundance. Currently, there are approximately 4,000 to 6,000 moose in Subunit 14B. The number of moose appears to be stable and or near the maximum number this subunit can support (Didrickson, pers. comm.).

b. Historic distribution and abundance. See the GMU 14 summary.

3. GMS 14(C):

(The data source for the following section is Harkness, pers. comm., unless otherwise noted.)

a. Present abundance. A 1983 composition survey revealed 1,243 moose in Subunit 14(C). This figure, minus the known number of moose harvested after the survey, multiplied by a sightability correction factor of 1.45, provides an estimate of about 1,700 moose in the subunit. The number of moose has continued to increase since 1979 because of mild winters. The density of moose in the subunit appears to be high for the available habitat.

b. Historic distribution and abundance. In Subunit 14(C), moose numbers were high during the late 1960's and early 1970's. Severe winters during 1970-1971 and 1972-1973 caused a major decline in moose numbers. Consecutive mild winters since 1979-1980 have allowed moose numbers to increase. Moose densities are high relative to available habitat, and it is likely a severe winter would cause another decline. Because Subunit 14(C) encompasses the Anchorage area, with a heavily travelled road system, many moose are killed by vehicles. In each of the past two years, over 150 moose were killed by vehicles (ADF&G 1984a), a significant mortality factor.

c. Habitat enhancement project. A small-scale habitat enhancement program is now underway on Fort Richardson. The objectives of this project are to cut and scarify 25 to 30 acres annually to promote browse regrowth.

Areas selected for enhancement are removed from the Glenn Highway and are situated with public viewing in mind. It is hoped that moose will be attracted to these areas and that they will wander less across the highway and other roads (ADF&G 1984b).

VII. GMU 15

(The data source for the following section is Spraker, pers. comm., unless otherwise noted.)

A. Present Abundance

Currently there are approximately 6,000 to 7,000 moose in GMU 15. This estimate is based on a census conducted in portions of Game Management Subunits 15(A) and (B) in 1982 and fall composition surveys conducted in Subunit 15(C) and the remainder of the Subunits 15(A) and (B).

Studies conducted on the Kenai National Moose Range indicate predation by black bear (Ursus Americanus) is a significant cause of calf mortality. Over a two-year period with a total calf mortality of 57.4%, 34% was attributed to black bear predation, 6.4% each to wolf (Canus lupus) and brown bear (Ursus arctos), and 4.3% to unknown predators. For both years, total predation accounted for 48.9% mortality of moose calves (Franzmann et al. 1980).

B. Historic Distribution and Abundance

Moose population levels on the Kenai Peninsula have fluctuated over the years in response to changes in vegetation communities (Lutz 1960). Moose numbers peaked in the late 1960's and have since declined, reflecting the changes in habitat suitability (ADF&G 1976b).

Fire has had the most beneficial effect upon the numbers of moose in Game Management Subunits 15A and B. A 350,000 acre fire in 1947 has been the most significant, recent event benefiting moose. The fire was erratic, skipping some areas while burning to the mineral layer in others. This pattern of burning left a patchwork of vegetation over nearly 450,000 acres (ibid.). By the 1970's, the 1947 burn had become marginal winter habitat because of plant succession. Major die-offs occurred as the result of deteriorating winter habitat, high moose densities, and severe winters with deep snow (Oldemeyer et al. 1977).

In 1959, approximately 5,000 acres burned near Kenai Lake in GMU 7. In 1969, 90,000 acres burned in the Swanson River area, as did 450 acres in the Russian River area. These more recent burns still provide excellent winter forage for moose (ADF&G 1976b).

C. Habitat Enhancement Project

Between 1954 and 1978, 15,480 acres of habitat were improved for moose by the USFWS. Of this total, about 10,000 acres were enhanced by mechanical crushing. Mechanical crushing of trees was again initiated in December of 1983 by the ADF&G in the Skilak Loop Road area. The objective for 1984 was to crush 2,000 to 3,000 acres of habitat and burn these crushed areas where possible and practical. The objective in subsequent years is to manipulate at least 30,000 additional acres on a 15-to-20-year rotational basis. The number of acres and rotational period will depend upon stipulations in the final Kenai National Wildlife Refuge Plan and available funding (ADF&G 1984b).

1. GMS 15(A):
    a. Present abundance. There are an estimated 3,000 to 3,500 moose in Subunit 15(A). This estimate is based on a January 1982 census, conducted in Subunits 15(A) and (B) by the USFWS and the ADF&G. In the area of the 1947 burn, average densities of moose were four moose/mi^2, and in the 1969 burn, 14 moose/mi^2. In areas outside these two burns, the density was less than four moose/mi^2. The trend for this subunit appears to be stable to slightly increasing in the 1969 burn, because of recent mild winters, and stable to slightly decreasing in the 1947 burn, because of habitat deterioration as the forest matures.
    b. Historic distribution and abundance. The 1947 and 1969 burns, which are primarily within Subunit 15(A), are the most significant factors related to moose densities in the area. See GMU 15 summary.
2. GMS 15(B):
    a. Present abundance. Currently, there are approximately 1,500 to 2,000 moose in Subunit 15(B). This estimate is based on a January 1982 census conducted in Subunits 15(A) and (B) by the USFWS and the ADF&G. The trend appears to be stable because of a series of mild winters. Moose habitat within the subunit is somewhat limited, composed primarily of small areas of willow (*Salix* spp.) and aspen (*Populus tremuloides*) interspersed among mature spruce (*Picea* spp.).
    b. Historic distribution and abundance. Moose numbers peaked in the early 1960's and remained relatively stable or declined very slowly until the early 1970's. Since then, numbers have declined severely until recent years. Calf mortality was extremely high in 1974 and 1975 because of severe winters, range deterioration, and predation. Habitat conditions have deteriorated because of overbrowsing and plant succession (ADF&G 1976b). See the GMU 15 summary.
3. GMS 15(C):
    a. Present abundance. Based on fall composition trend counts and available habitat, there are an estimated 2,000 to 2,500 moose in Subunit 15(C).

       Lowland habitats within the subunit consist mostly of mature spruce forests, with no recent large fires or other beneficial man-caused habitat changes. During summer and fall periods, moose range from lowland forests up through subalpine meadows and shrublands. In winter, moose are normally found in low elevation (less than or equal to 1,000 ft) riparian habitats of major drainages. The current population trend appears to be stable because of recent mild winters.

b. Historic distribution and abundance. Moose appear to have been most abundant in the early 1960's and remained moderately numerous until 1973. Since then, moose numbers appear to have declined until recent years, when, because of mild winters, the population stabilized. Generally, moose habitat conditions are deteriorating slowly (ibid.). Winter habitats are mostly on privately owned lands and have been seriously diminishing in quality and extent by rapidly expanding human development in the last three decades. See the GMU 15 summary.

VIII. GMU 16

A. Present Abundance

Two aerial moose censuses accomplished during February and March 1984 revealed an estimated 9,000 animals in mainland GMU 16. The population appears to be stable, although in some areas the population structure may be altered by hunting or local winter mortality (ADF&G 1985).

On Kalgin Island in Subunit 16(B), a November 1983 trend survey found 40 moose. Density exceeds two animals/mi^2, which appears to be over the current carrying capacity of the island (ibid.).

B. Historic Distribution and Abundance

Prior to white settlement, moose were relatively scarce over much of GMU 16. Clearing of land and fires, which accompanied exploration and development, created favorable browse conditions conducive to large moose populations. By the 1950's, moose were abundant. Since the 1960's, however, moose numbers have declined (ADF&G 1976b) until recently, when a series of mild winters have allowed good overwinter survival. Major factors causing the decline are believed to be habitat-related, although predators may have had a significant influence on the present rate of population growth. Habitat deficiencies are generally manifested by the scarcity of essential browse during winter months. Fire control programs in Southcentral Alaska have suppressed major burns, allowing plant succession and reducing moose browse (ibid.).

Moose were transplanted to Kalgin Island in 1957, 1958, and 1959 (Burris and McKnight 1973). Little information was available regarding the number of moose on the island until 1981, when 141 moose were observed, a density exceeding seven moose/mi^2. Since then, using ages determined from moose harvested from the island, we can now document a minimum population of 159 moose during the 1981 survey (Faro, pers. comm.). Observations indicated severe overbrowsing had occurred, and significant winter mortality would likely occur even with moderate winter snow depths. A special mid winter hunt was authorized in order to reduce the population

(ADF&G 1984a), and liberalized either-sex seasons have been held each succeeding fall.

Since then, a total of 227 moose have been removed from the island. Because of the potential for high reproductive success in a predator-free environment and low winter mortality because of recent mild winters, the population has maintained a density of at least two moose/mi^2. This density appears to be too great to allow vegetation to recover from overbrowsing (ADF&G 1985).

REFERENCES

ADF&G. 1976a. Alaska's wildlife management plans, Southcentral Alaska: a public proposal for the management of Alaska's wildlife. 238 pp.

________. 1984a. Annual report of survey-inventory activities. Part IV: Moose. Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2, Job 1.0.

________. 1984b. Habitat enhancement programs. Div. Game, Region II. Rept. to Board of Game. Anchorage. 7 pp.

________. 1985. Annual report of survey-inventory activities: moose. Fed. Aid in Wildl. Rest. Vol. 15. Job 1.0.

ADF&G, comp. 1976b. A compilation of fish and wildlife resource information for the State of Alaska. Under contract to Alaska Federal-State Land Use Planning Commission. 873 pp.

Bailey, T.N., A.W. Franzmann, P.D. Arneson, and J.L. Davis. 1978. Kenai Peninsula moose population identity study. ADF&G, Fed. Aid in Wildl. Rest. final rept. Projs. W-17-3, W-17-4, W-17-5, W-17-6, W-17-7, W-17-8, and W-17-9.

Ballard, W.B. 1984. Moose-upstream. ADF&G. Susitna Hydroelectric Proj., ann. rept. Vol. 3: Big game studies. 147 pp.

Ballard, W.B., and K.P Taylor. 1980. Upper Susitna Valley moose population study. ADF&G. Final rept. P-R projs. W-17-9, 10, 11. 102 pp.

Ballard, W.B., C.L. Gardner, and S.D. Miller. 1980. Influences of predators on summer movements if moose in southcentral Alaska. Proc. 16th N. Am. Conf. Workshop, Prince Albert, Sasq. 16:338-359.

Ballard, W.B., C.L. Gardner, J.H. Westlund, and J.R. Davis. 1982. Moose-upstream. ADF&G. Susitna Hydroelectric Proj., Phase I, final rept. Vol. 3: Big game studies. 119 pp.

Ballard, W.B., J.S. Whitman, N.G. Tankersley, L.D. Aumiller, and P. Hessing. 1984. Moose-upstream. ADF&G. Susitna Hydroelectric Proj., Phase 3, proj. rept. Vol. 3: Big game studies. 141 pp.

Ballard, W.B., J.S Whitman, N.G Tankersley, L.D. Aumiller, and P. Hessing. 1984. Moose-upstream. ADF&G. Susitna Hydroelectric Proj. annual rept. Vol. 3: Big game studies. 147 pp.

Ballard, W.B., and D.G. Larsen. In press. Implications of predator-prey relationships to moose management. Presented at the second international moose symposium at Uppsala, Sweden, 1984.

Bishop, R.H., and R.A. Rausch. 1974. Moose population fluctuations in Alaska, 1950-1972. Nat. Can. 101:559-593.

Coady, J.W. 1982. Moose. Pasges 902-922 in J. Chapman and G. Feldhamer, eds. Wild mammals of North America. Baltimore: Johns Hopkins Univ. Press. 1982.

Didrickson, J.C. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Palmer.

Faro, J.B. N.d. Unpublished data. ADF&G, Soldotna.

______. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Soldotna.

Franzmann, A.W., C.C. Swartz, and R.O. Peterson. 1980. Moose calf mortality in summer on the Kenai Peninsula, Alaska. J. Wildl. Manage. 44(3):764-768.

Gasaway, W.C., S.D. Dubois, and S.J. Harbo. 1981. Moose survey procedures development. ADF&G, P-R proj. rept. 66 pp.

______. 1982. Moose survey procedure development. ADF&G, final rept. P-R Proj. 66 pp.

Harkness, D.B. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Anchorage.

LeResche, R.E. 1974. Moose migrations in North America. Nat. Can. 101:393-415.

Lutz, H.J. 1960. History of the early occurrence of moose on the Kenai Peninsula and other sections of Alaska. Misc. Publ. 1. USDA, Alaska Forest Research Center, Juneau. 25 pp.

Modafferi, R.D. 1982. Moose-downstream. ADF&G. Susitna Hydroelectric Proj., Phase 1., final rept. Vol. 2: Big game studies. 114 pp.

______. 1983. Moose-downstream. ADF&G. Susitna Hydroelectric Proj., Phase 2, ann. prog. rept. Vol. 2: Big game studies. 114 pp.

________. 1984. Moose-downstream. ADF&G. Susitna Hydroelectric Proj., Phase 2, ann. prog. rept. Vol. 2: Big game studies. 116 pp.

Oldemeyer, J.L., A.W Franzmann, A.L. Brundage, P.D. Arneson, and A. Flynn. 1977. Browse quality of the Kenai moose population. J. Wildl. Manage. 41:533-542.

Rausch, R.A. 1967. Report on 1965-66 moose studies. Fed. Aid in Wildl. Rest. prog. rept. Ann. proj. segment rept. Vol. 7. Proj. W-15-R-1, Work Plan K.

Reynolds, J.L. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Cordova.

Spraker, T.H. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Soldotna.

Tobey, R.W. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Glennallen.

VanBallenberghe, V. 1978. Final report on the effect of the Trans-Alaskan Pipeline on moose movements. ADF&G. 44 pp.

Birds

Bald Eagle Distribution and Abundance

I. REGIONWIDE INFORMATION

Most data on the location of eagles have been collected by federal agencies. Although data on the location of Bald Eagle nest sites are not collected by game management units (GMUs) because the ADF&G has no managerial authority for this species, information will be presented by GMUs to be consistent with the presentation of the other species narratives in this volume.

A. Regional Distribution

In Southcentral Alaska, the majority of Bald Eagles are found in the highly productive maritime areas. Eagles also nest along major inland water courses and lakes, with densities declining markedly in the more interior portions of the region. Densities likely reflect differences in food abundance. Seabird colonies, waterfowl concentrations, large fish resources, including frequent salmon runs and even garbage dumps in the coastal region, provide a greater concentration and abundance of food than is found in the interior areas (Mindell 1983).

B. Areas Used Seasonally and for Life Functions

See the 1:1,000,000-scale printed index maps found in the Map Atlas to this Southcentral guide or the 1:250,000-scale blueline reference maps in ADF&G offices.

The following categories were mapped:

° Nests

° Known concentration areas

C. Factors Affecting Distribution

Eagle distribution is influenced by the availability of open water containing adequate food resources. In Southeast Alaska, Robards and King (1966) found that spatial distribution of nest sites was dense and almost regularly spaced along open coasts, protected coasts, ice-free bays, islands, and islets but less dense and regular in sheltered bays, active glacial areas, and along unforested shorelines of deep fjords. Beebe (1974) suggested that eagles can utilize many different habitats and climatic zones because of their high level of adaptability to extremely diverse situations. (For more detailed information, see the Life History and Habitat Requirements volume.)

D. Movements Between Areas

Very little pertinent information for Southcentral Alaska is available. However, steady movements of migrating Bald Eagles along Turnagain Arm near Anchorage and over the Copper River Delta have often been observed (ADF&G 1983). During September and October, Isleib and Kessel (1973) observed scores of eagles passing eastward, soaring on the updrafts along the ridges between Mile 21 and Mile 27 of the Copper River Highway. When climatic and feeding conditions in the Chilkat Valley became unfavorable, eagles moved out of the area to coastal (saltwater) habitats (Boeker et al. 1981).

E. Population Size Estimation

Fixed-wing aerial survey techniques are the most common means of censusing Alaskan Bald Eagle populations. A stratified random sampling of preestablished quadrats is used to estimate abundance (King et al. 1972). Shoreline boat surveys of eagles have been conducted in many parts of Alaska (Byrne et al. 1983a, 1983b; Mindell 1983). Helicopter survey techniques have been used in studies of Bald Eagle nest productivity (Hodges 1982).

Some eagle surveys were done in Southcentral Alaska in the 1970's and 1980's by personnel from the raptor management studies section of the USFWS in Juneau. According to Jameson (pers. comm.), population estimates of the number of breeding-age adult Bald Eagles from these surveys are as follows:

Southcentral (Prince William Sound)	3,000
Cook Inlet	250
Alaska Peninsula (south side)	1,500
Kodiak archipelago	1,050

F. Regional Abundance

In Alaska, the number of eagles varies seasonally mainly because of winter migrations to warmer southerly climes. The ADF&G (1978) estimated summer populations in Alaska in excess of 50,000 birds, whereas the USFWS (1980) estimated 35,000 to 40,000 birds. The USFWS (1983), based on much more detailed research and survey data, produced a statewide estimate of 30,000 individuals at fledging time, of which 15,000-20,000 birds were adults. In the past decade, adult populations have increased, but a decrease in the production of young negated this increase and suggests a population stable in overall numbers but instable as to age classes (ibid.). Roughly 25% (7,500 birds) of the total eagle population occurs in Southcentral Alaska (ibid.).

II. GMU 6

Almost two-thirds of all known nests in the Southcentral Region occur in the Prince William Sound-Copper River Delta (PWS-CRD) area. Eagles are abundant throughout the PWS area. Bucaria (1979) reported concentrations of eagles in Martin River Slough, at the south end of Martin Lake, at the north end of Bering Lake, along the Katalla River near Katalla Bay, and around Kushtaka Lake. Other concentration areas along Shepherd Creek and the Bering River have been reported (Wheelabrator Coal Services 1983). From early July to January, feeding concentrations numbering frequently into the hundreds congregate at many localities in the CRD. On 27 December 1969, 416 eagles were counted feeding on dead salmon at Eyak Lake near Cordova (Isleib and Kessel 1973). Isleib and Kessel (1973) believe that approximately 5,000 eagles utilize the North Gulf Coast-PWS area during the summer and that 3,000 to 4,000 eagles use the area in the winter. A USFWS survey conducted during 24 March-4 April 1972 estimated 2,000 eagles in PWS.

III. GMUS 7 AND 15

Bald Eagles commonly occur on the southern Kenai Peninsula coast. According to Bailey (1976), Nuka Island had the highest density of eagles and nest sites within this area. Forty-seven nests were counted along 576 nautical survey miles, which is equivalent to 0.082 nest per nautical mile (0.044 per km). Hodges and Robards (1982) reported an average nest density of 0.8 nest/mi (0.5 per km) in Southeast Alaska. Although only one nest site is known to occur in Resurrection Bay, the head of this fjord may be a wintering area for eagles (Arneson, pers. comm.).

Although the remainder of the Kenai Peninsula seems to offer large potential food resources, population densities are somewhat low. This may be attributed to high levels of human activity and disturbance and loss of nesting habitat due to fires. Bangs et al. (1982) aerially surveyed the Kenai National Wildlife Refuge (KNWR) and found 32 nests. The Moose River drainage contained the highest concentration of nests (25%) of any single river system on the refuge (ibid.). This is probably due in part to the large number of clear lakes containing abundant fish populations near the Moose River system.

IV. GMUS 14 AND 16

Eagle nests are fairly common in the coastal areas of west Cook Inlet and often occur several miles inland. In winter, most rivers freeze over and sea ice covers upper Cook Inlet, forcing many eagles to move south or east. According to Susitna Hydro Project surveys conducted along the Susitna River in 1981, the amount and suitability of eagle nesting habitat increases markedly downstream from the Indian River (Kessel et al. 1982b). Most nest locations were concentrated in three sections of the floodplain: 1) between Talkeetna and the Parks Highway Bridge, 2) from Kashwitna Lake to the Yentna River mouth, and 3) from Bell Island to the mouth of the Susitna River. Bald Eagle densities (approximately 0.07/mi [.04/km]) in the upper Susitna River drainage are somewhat lower than in other interior areas (Kessel et al. 1982a). Roseneau et al. (1981) reported a density of 0.146 nest/mi (0.092/km) in 1980 in the vicinity of the Alaska Highway and Tanana River between Fairbanks and the United States-Canadian border.

V. GMU 13

From 1981 to 1983, BLM biologists inventoried an annual average of 40 eagle nests in the Gulkana River Wildlife Habitat Area (Kuntz et al. 1983). Surveys were conducted mainly in small airplanes and by floating rivers. Rucks (1977) considered eagles to be common throughout the Gulkana River and its tributaries and in the Chitina-McCarthy area. Ludlow (1973) came to a similar conclusion. One hundred seventy miles of the Gulkana River system were surveyed between 1981 and 1983, resulting in an estimated average density of 0.14 eagle nests per mile (0.088 per km) (ibid.).

REFERENCES

ADF&G. 1978. Alaska's wildlife and habitat. Vol. 2 [E.G. Klinkhart, comp.]. Anchorage. 74 pp. + maps.

________. 1983. A guide to wildlife viewing in Alaska. 170 pp.

Arneson, P. 1983. Personal communication. Nongame Biologist, ADF&G, Div. Game, Anchorage.

Bailey, E.P. 1976. Breeding seabird distribution and abundance along the south side of the Kenai Peninsula, Alaska. USFWS/NPS rept. Anchorage, AK. 88 pp.

Bangs, E.E., T.N. Bailey, and J.D. Berns. 1982. Ecology of nesting of Bald Eagles on the Kenai National Wildlife Refuge, Alaska. Pages 47-54 in W.N. Ladd and P.F. Schempf, eds. Proceedings of a symposium and workshop on raptor management and biology in Alaska and western Canada. USFWS, Anchorage, AK. 335 pp.

Beebe, F.L. 1974. Field studies of the Falconiformes of British Columbia, British Columbia Provincial Museum Occasional Papers No. 17. 163 pp.

Boeker, E.L., A.J. Hansen, J.I. Hodges, and K.S. Bollinger. 1981. Second annual progress report: Chilkat River cooperative Bald Eagle study. National Audubon Society, Alaska Regional Office, Anchorage, AK. 26 pp.

Bucaria, G. 1979. Copper River delta area wildlife inventory. USDA, Forest Service, Cordova, AK. 114 pp.

Byrne, L.C., D.W. Daum, M.W. Small, and J.S. Henderson. 1983a. Results of the 1981 Bald Eagle nest survey in the Gulkana River and Delta River Wildlife Habitat Areas. Open File Rept. 4. USDI: BLM. Anchorage, AK. 20 pp.

Byrne, L.C., J.S. Henderson, and M.W. Small. 1983b. Results of the 1982 BLM Bald Eagle (*Haliaeetus leucocephalus* alaskanus) nest survey conducted in the Glennallen Resource Area. Open File Rept. 5. USDI: BLM. Anchorage, AK. 13 pp.

Hodges, J.I. 1982. Bald Eagle nesting studies in Seymour Canal, Southeast Alaska. Condor 84(1):125-127.

Hodges, J.I., and F.G. Robards. 1982. Observations of 3,850 Bald Eagle nests in Southeast Alaska. Pages 37-46 in W.N. Ladd and P.F. Schempf, eds. Proceedings of a symposium and workshop on raptor management and biology in Alaska and western Canada. USFWS, Anchorage, AK. 335 pp.

Isleib, M.E.P., and B. Kessel. 1973. Birds of the north gulf coast - Prince William Sound region, Alaska. Univ. Alaska, Biol. Papers 14:1-149.

Jameson, M. 1984. Personal communication. Wildlife Biologist, USFWS, Juneau, AK.

Kessel, B., S.O. MacDonald, D.A. Gibson, B.A. Cooper, and B.A. Anderson. 1982a. Susitna Hydroelectric Project, phase 1, final rept., birds and non-game mammals. Univ. Alaska Museum, Fairbanks. Prepared for LGL Alaska Environmental Research Associates, Ltd.

Kessel, B., D.D. Gibson, S.O. MacDonald, B.A. Cooper, and K.C. Cooper. 1982b. Avifauna of the lower Susitna River floodplain, Alaska. Univ. Alaska Museum, Fairbanks. Prepared for LGL Alaska Environmental Research Associates, Ltd.

King, J.G., F.C. Robards, and C.J. Lensink. 1972. Census of the Bald Eagle breeding populations in Southwest Alaska. J. Wildl. Manage. 36(4):1292-1296.

Kuntz, R.C., F. Broerman, and M.W. Small. 1983. Results of the 1983 Bald Eagle (*Haliaeetus leucocephalus*) nest survey in the Glennallen Resource Area. BLM, Glennallen, AK. 13 pp.

Ludlow, G. 1973. Trip report of raptor survey 12-15 July, 1973. Unpubl. rept. BLM, Anchorage, AK. 4 pp.

Mindell, D.P. 1983. Nesting raptors in Southwestern Alaska: status, distribution and aspects of biology. BLM, Alaska Tech. Rept. 8. Anchorage, AK. 59 pp.

Robards, F.C., and J.G. King. 1966. Nesting and productivity of Bald Eagles, Southeast Alaska. USFWS, Juneau, AK. 28 pp.

Roseneau, D.G., C.E. Tull, and R.W. Nelson. 1981. Protection strategies for peregrine falcons and other raptors along the proposed Northwest Alaskan Gas Pipeline route. LGL Alaska unpubl. rept. to Northwest Alaskan Pipeline Co. Cited in Kessel et al. 1982a.

Rucks, J. 1977. An inventory of wildlife and wildlife habitat of the Gulkana River, Alaska. BLM, Anchorage, AK.

USFWS. 1980. Terrestrial habitat evaluation criteria handbook-Alaska. USFWS, Anchorage, AK.

________. 1983. Alaska Regional Resource Plan. Anchorage, AK.

Wheelabrator Coal Services. 1983. Assessment of the feasibility and implementation of port and transportation system alternatives for the Bering River Coal Field, draft final rept. Vol. 2, Exhibits 13 and 14. Prepared for the City of Cordova.

Ducks and Geese Distribution and Abundance

I. REGIONWIDE INFORMATION

Estimates of ducks and geese distribution and abundance in Alaska are made annually by the USFWS. Alaska is divided into 11 survey strata, with 224 survey segments (map 1). In the Southcentral Region, there are three USFWS waterfowl survey strata, with 33 segments: Kenai-Susitna with 10 segments, Nelchina with 13 segments, and Copper River Delta (CRD) with 10 segments. Information will be presented by survey strata.

Aerial surveys along standard predetermined flight lines are conducted during mid May to mid June. Because of the consistent nature of these surveys, data obtained are comparable to previous surveys and provide a reliable index of duck abundance in large units of habitat in Alaska.

The USFWS aerial surveys are designed for estimating numbers of ducks, and in most strata goose sightings are too few to make a statistically significant sample. Goose distribution and abundance estimates are therefore not specifically made during these surveys but are generally compiled from USFWS observations in conjunction with the reports of other researchers and observers (King and Conant 1983). Because of this survey design, distribution and abundance data presented in this narrative will be for waterfowl as a group, with area and species-specific information provided where available. The data are obtained primarily from the annual USFWS survey, with other information sources noted.

A. Regional Distribution

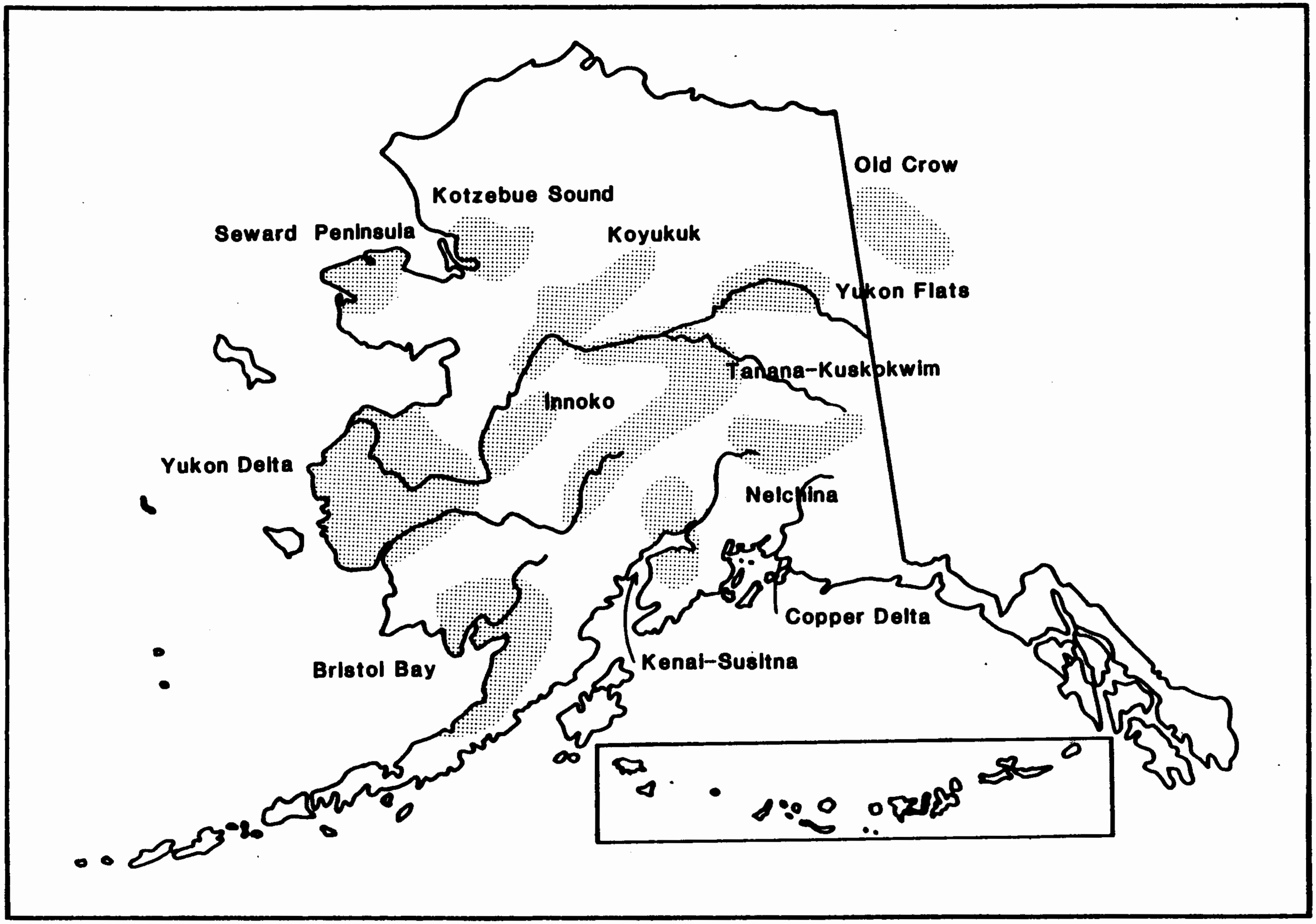
Ducks and geese are present in the Southcentral Region in all areas of suitable habitat, ranging from the lowland ponded areas typical of the northwestern Kenai Peninsula and Nelchina basin area to the extensive tidelands of the CRD, the smaller tideflats and coastal areas of Prince William Sound (PWS), and the large, important coastal salt marshes of Cook Inlet.

Within the general distribution of waterfowl in the Southcentral Region are specific areas that are important to certain species. The west side of Cook Inlet, with its extensive coastal marshes, for example, is the only known breeding area in the world for tule geese (<u>Anser albifrons gambelli</u>). This subspecies numbers approximately 3,500 individuals and winters in the valleys of northern California (Timm 1982).

Similarly, the CRD is the only known breeding area for the world's population of dusky Canada geese (<u>Branta canadensis occidentalis</u>), which numbers approximately 20,000 birds and winters in the Willamette Valley of Oregon (Campbell and Timm 1983).

B. Areas Used Seasonally

The largest concentrations of ducks and geese in the Southcentral Region occur during the spring and fall migrations. The CRD is



Map 1. The USFWS Alaska waterfowl breeding population survey strata (Conant and Hodges 1984).

world famous for its concentrations of migrating waterfowl and shorebirds during these periods (Isleib and Kessel 1973).

A similar migrational influx occurs in Cook Inlet during spring and fall. Migrating waterfowl and other water birds use the many miles of coastal shoreline and mud flats available in Cook Inlet for resting and feeding. The majority proceed to breeding grounds farther north or west, but a large number remain in the coastal and upland habitat of Southcentral Alaska to nest.

For more specific information on waterfowl distribution in Southcentral Alaska, see the 1:1,000,000-scale index maps in the Atlas to the guide for the Southcentral Region and the 1:250,000-scale reference maps in ADF&G offices, which list specific waterfowl use areas. Use categories for these maps include the following:

- General distribution
- Known spring concentrations
- Known fall concentrations
- Known nesting concentrations
- Known molting concentrations
- Known winter concentrations

In 1979, nesting grounds of tule geese were located by ADF&G personnel in Redoubt Bay, Cook Inlet (map 2). In 1980, a field study was initiated to identify and describe the nesting habitat and other use areas of tule geese in Cook Inlet (Timm 1982).

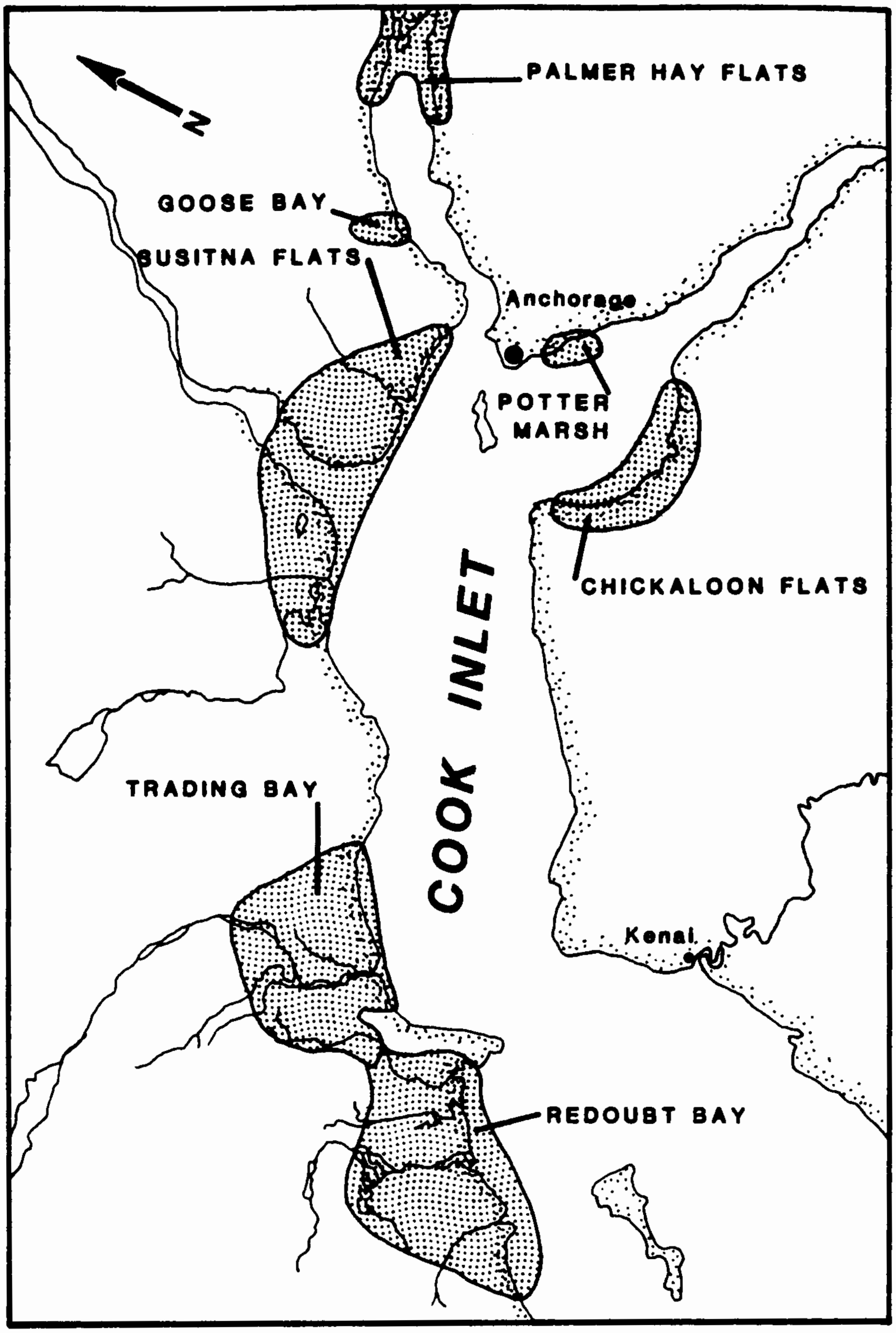
Tule geese favor drier, elevated, ice-free habitat for nesting on the Susitna Flats and in Redoubt Bay. Known specific use areas in Redoubt Bay include the Big River and Johnson Slough-Kustatan River areas. On the Susitna Flats, tule geese use the area between the Beluga and Susitna rivers and also the mouth of the Little Susitna River; areas of concentration appear to be near Lewis River Slough and Stump Lake. Trading Bay has also been searched for tule geese nesting habitat; it appears, however, that only limited nesting habitat occurs there (Campbell and Timm 1983).

During July, flightless, molting tules have been observed in Redoubt and Trading bays and on the Susitna Flats, which suggests that tules may be molting in favorable habitats along much of the west side of upper Cook Inlet. Studies to further delineate molting and nesting habitat are scheduled (Timm 1982).

C. Factors Affecting Distribution

Waterfowl distribution is closely associated with suitable habitat, which is widely available in Southcentral Alaska. The various habitat types in the region, including the coastal areas of Cook Inlet, PWS, and the CRD, and the lowland ponded areas of the Kenai Peninsula, lower Susitna, and Nelchina areas, provide an excellent array of habitat elements required by waterfowl. The general availability of this habitat, however, is sometimes limited in spring and fall by weather conditions.

The progress and timing of the fall migration are largely governed by weather conditions. Early cold in the interior and northern



Map 2. Major coastal marshes of Cook Inlet (Campbell 1984).

areas, for example, can cause ducks and geese to begin migrating early. Fall waterfowl populations in the marshes and tidal areas of Cook Inlet can reach very high concentrations should bad weather prevent ducks and geese from continuing south.

Late spring conditions - cold temperatures and lingering snow and ice - will delay migration to northern and interior breeding areas and may also delay nesting activities upon arrival.

Tule geese, as previously mentioned, are restricted in their distribution to nesting in Cook Inlet and wintering in northern California. It has not been determined why this subspecies has such limited distribution. The ADF&G is conducting studies to determine habitat preferences and other characteristics.

(For detailed information on species habitat requirements and preferences, see the geese, dabbling ducks, and diving ducks Life History and Habitat Requirements narrative in volume 1 of the Alaska Habitat Management Guide for the Southcentral Region.)

D. Movements Between Areas

Tremendous concentrations of migrating waterfowl utilize the coastal areas of Southcentral Alaska during spring. Between late April and mid May, more than 20 million waterfowl and shorebirds use the CRD as a feeding/resting area. Similar use is made of other areas in PWS and Cook Inlet (Isleib and Kessel 1973).

The fall waterfowl migration through the region occurs from September through mid-to-late October. Severe early winter storms, with winds sometimes exceeding 100 mph, occur in September and October. These weather conditions restrict migration, and large numbers of waterfowl can be found at this time in Cook Inlet, PWS, and the CRD waiting for more favorable conditions.

1. Tule geese. Tule geese winter almost exclusively in northern California. Fall departure patterns from Cook Inlet were ascertained in 1981 and 1982 by radio tracking, observations of collared geese, and harvest data analysis. Twenty radio transmitters furnished by the USFWS were placed on tules in 1981 (14 in Redoubt Bay and 6 at Susitna Flats). During August and September 1981, four radio-tracking flights were made over Cook Inlet, and 15 of the radios were heard at least once. All birds remained in the geographical area where they were captured but dispersed coastward to the saline sedge-grass flats in Redoubt Bay and Susitna Flats (Campbell and Timm 1983).

   The decline in the number of radioed birds relocated between August 31 (10) and September 9 (3), coupled with sightings of collared birds in Washington on September 21, 1982, and at Klamath Basin on August 24, 1981, indicated that tules leave Cook Inlet early in the fall (i.e., early September)(ibid.).

   Tule geese arrive at Susitna Flats and Redoubt Bay in Cook Inlet as early as 20 April. Much of the area is still ice-covered at this time. An increase in tule numbers has been documented to occur about 1 May (Campbell 1984).

2. Dusky Canada geese. The majority of the dusky goose population leaves the Willamette Valley, Oregon, by 25 April for northward migration. They usually arrive on the breeding grounds of the CRD by 1 May. The fall migration is initiated early in September, but, as was mentioned, it can be affected by weather conditions. By 1 October, about 95% of the population has left for wintering grounds in Oregon.

E. Population Size Estimation

1. USFWS waterfowl surveys. The USFWS conducts annual breeding population surveys to measure the status of the breeding population of waterfowl, primarily duck species, on the major continental breeding grounds. Currently, the surveys monitor waterfowl population and habitat changes over approximately 1.3 million mi^2 of breeding habitat within Alaska, Canada, and the northcentral states.

The survey period in Alaska is approximately from mid May to mid June, depending upon the date of the spring ice breakup. Alaska is divided into 11 survey strata (fig. 1). A stratum is a specific geographic unit encompassing areas of similar habitat type and waterfowl densities. Based on these descriptions, strata in Alaska are placed into two groups: strata 1-7 in the Interior Alaska Taiga, 8-11 in Coastal Alaska Tundra. Transects within the stratum are a continuous series of segments usually parallel to each other, from 14 to 60 mi apart, and equally spaced over the stratum. Alaska survey segments comprising the transects are 8 or 16 mi long and 1/4 mi wide, giving a sampling area of 2 or 4 mi^2 each. In the Kenai-Susitna stratum, there are 10 segments, totaling 40 mi^2 (16 x .25 x 10); in the Nelchina, there are 13 segments, totaling 52 mi^2 (16 x .25 x 13). The CRD has 10 segments only 8 mi long, totaling 20 mi^2 (8 x .25 x 10) (Conant and Hodges 1984).

The species population index is computed by using the formula $P = A \cdot T/S \cdot V$, where A = the square miles in the stratum, T = the total observed birds, S = the square miles in the sample flown, and V = the species visibility factor.

Waterfowl populations can be adequately censused by techniques designed for large land areas (i.e., continents). Comparisons at the smaller stratum level should be viewed as only part of a total index population (Conant, pers. comm.). Therefore, changes and/or comparisons in waterfowl population should be a over a longer period and at the statewide level.

Table 1 shows the 10-year trend in Alaska-Yukon waterfowl breeding population estimates by species. These data present the waterfowl population estimates on a statewide basis over a longer period and are a better basis from which to make comparisons. The 1984 waterfowl population was slightly above the 10-year trend and compares favorably with previous years. The total population appears to be continuing its slightly increasing trend (table 1).

Table 1. Alaska-Yukon Status of Adjusted Waterfowl Breeding Population Estimates by Species and Strata, Comparing 1984 with 1983 and the 1974-83 Average (Estimates in Thousands)

Ducks	*Strata 1-7	8-11	12	Total 1984	Total 1983	1974-1983 Average	% Change from 1983	% Change from Avg.
Dabblers:								
Mallard	233.3	170.0	29.1	432.4	270.5	263.5	+60	+64
Black duck	0.0	0.0	0.0	0.0	0.0	0.0	---	---
Gadwall	5.2	1.0	0.0	6.2	2.3	2.6	+170	+138
Am. widgeon	456.1	344.3	91.3	891.7	765.7	727.8	+16	+23
G.W. teal	160.3	175.6	8.3	344.2	283.7	300.4	+21	+15
B.W. teal	2.8	2.1	0.0	4.9	1.5	1.6	+227	+206
N. shoveler	165.5	88.1	4.2	257.8	204.2	235.1	+26	+10
Pintail	600.3	663.3	21.0	1,284.6	1,277.5	1,534.0	+1	-16
Subtotal	1,623.5	1,444.4	153.9	3,221.8	2,805.4	3,065.0	+15	+5
Divers:								
Redhead	0.3	0.0	0.0	0.3	1.5	4.2	-80	-93
Canvasback	96.1	17.9	3.7	117.7	108.1	93.4	+9	+26
Scaups	847.4	592.7	111.8	1,551.9	1,398.6	+11	+12	
Ringneck	15.7	11.7	0.9	28.3	3.0	1.7	+840	+1,559
Goldeneyes	80.3	41.3	9.0	130.6	112.0	130.9	+17	no change
Bufflehead	50.1	4.5	0.3	54.9	64.0	83.7	-14	-34
Subtotal	1,089.9	668.1	125.7	1,883.7	1,687.8	1,703.5	+12	+11
Miscellaneous:								
Oldsquaw	51.7	357.2	56.2	465.1	771.8	748.2	-40	-38
Eiders	0.0	15.5	0.0	15.5	19.5	20.1	-21	-23
Scoters	96.6	296.4	59.4	452.4	678.6	466.7	-33	-3
Ruddy duck	0.4	1.8	0.0	2.2	0.0	0.0	---	---
Mergansers	21.5	9.5	0.7	31.7	10.7	9.4	+197	+238
Subtotal	170.2	680.4	116.3	966.9	1,480.6	1,244.4	-35	-22
Total ducks	2,883.4	2,792.7	395.9	6,072.0	5,973.8	6,012.9	+2	+1

Source: Conant and Hodges 1984.

--- means no data were available.

* 1-7 Interior Alaska Taiga; 8-11 Coastal Alaska Tundra; 12 Old Crow Flats, Yukon Territory, Canada.

The 1974-1983 average estimated breeding population is 6,012,900 birds (table 1). The 1984 population estimate shows a 2% increase over the 1983 population and a 1% increase over the 10-year average.

All dabbler species increased, mallards most noticeably, and are 15% above their 10-year average, with the exception of pintail. Pintails continue their slow increase, but are still 16% below the 10-year average (Conant and Hodges 1984). Canvasback and scaup both increased, and are 26% and 12%, respectively, above the 10-average. Bufflehead continues its decline for no apparent reason and is 34% below the 10-year average. Oldsquaw apparently declined by 40% from 1983, and 38% from the average. This apparent decline is related to their absence from the Yukon Flats in 1984, where they are sometimes recorded during migration. Scoter population estimates were also down from 1983. This was probably due to an average migration period compared to an early one in 1983 (ibid.).

2. ADF&G Cook Inlet geese surveys. To determine summer populations of geese, ADF&G biologists conducted aerial surveys in Cook Inlet in the month of July from 1980 through 1983. The areas surveyed and the survey emphasis varied between 1980 and 1983. All species of geese were counted in upper Cook Inlet in 1980, 1981, and 1983, whereas the west side of lower and middle Cook Inlet were surveyed for tules only in 1982.

3. USFWS CRD dusky Canada goose spring surveys. During May 1983 and 1984, the Waterfowl Investigations project of the USFWS at Juneau conducted aerial surveys of the dusky Canada goose breeding grounds on the Copper River Delta (CRD).

   Survey techniques were standard and similar during both years. The survey area was 134 mi^2 in size and was classified into three strata, high, medium, and low. Population estimates were made by stratum and then combined for the total survey area (Conant and Hodges 1984b).

F. Regional Abundance

For regional abundance information, see the specific management areas described below.

II. SURVEY STRATUM 01 - KENAI-SUSITNA

A. Present Abundance

The Kenai-Susitna stratum contains 10 survey segments that cover portions of the low, ponded area on the northern Kenai Peninsula and some coastal-zone marshes of upper Cook Inlet (fig. 1). The 1984 total waterfowl population estimation for this stratum was 32,572 ducks and 990 geese (table 2). This total is higher than the 1983 population estimate and also substantially higher than the 1980-1984 average of 26,980 ducks. Mallards were the most common species observed, followed by pintail, scaup, and wigeon.

Table 3 summarizes ADF&G Cook Inlet goose surveys during 1980-1983. An estimated 1,400 Canada geese were observed in 1983,

Table 2. Kenai-Susitna - Stratum 01, USFWS Breeding Waterfowl Survey Estimates, 1980-84

Species	1980	1981	1982	1983	1984	Five-Year Average
Mallard	5,218	5,566	4,870	7,305	8,349	6,262
Black duck	---	---	---	---	---	---
Gadwall	---	---	---	---	---	---
American wigeon	5,345	1,782	1,188	4,751	3,563	3,326
Green-winged teal	1,048	2,096	3,143	5,239	1,048	1,949
Blue-winged teal	---	---	---	---	---	---
Shoveler	844	422	844	422		633[a]
Pintail	3,410	2,984	7,246	4,262	5,541	4,689
Redhead	---	---	---	---	---	---
Canvasback	---	---	1,868	---	801	1,335[b]
Scaup	3,105	2,366	3,255	1,626	3,992	2,868
Ring-necked duck	---	---	---	---	---	---
Goldeneye	1,815	4,235	3,025	5,445	3,025	3,509
Bufflehead	297	594	1,188	594	594	653
Oldsquaw	---	---	---	---	1,788	1,788[c]
Scoter	286	429	1,144	1,287	3,432	1,316
Ruddy duck	---	---	---	---	---	---
Merganser	---	440	220	1,100	440	550[a]
Eider	---	---	---	---	---	---
Subtotal	21,368	20,941	27,989	32,031	32,572	26,980
Coot	---	---	---	---	---	---
Canada geese	---	330	1,210	220	990	688[a]

Source: USFWS breeding waterfowl surveys, 1980-84.

--- means no data were available.

a Four-year average.

b Two-year average.

c One-year average.

Table 3. Geese Observed During Late July 1980-83 Surveys of Cook Inlet

	Tule												Canada											
	Adult				Immature				Total				Adult				Immature				Total			
	'80	'81	'82	'83	'80	'81	'82	'83	'80	'81	'82	'83	'80	'81	'82	'83	'80	'81	'82	'83	'80	'81	'82	'83
Palmer Hay Flats	---	---	NS[a]	---	---	---	NA	---	---	---	NS	---	480	238	NS	433	45	120	NS	50	525	390	NS	483
Goose Bay	---	---	NS	---	---	---	NS	---	---	---	NS	---	16	---	NS	---	11	---	NS	---	27	---	NS	---
Potter	---	---	NS	---	---	---	NS	---	---	---	NS	---	45	30	NS	32	60	50	NS	55	105	80	NS	87
Chickaloon	---	---	NS	---	---	---	NS	---	---	---	NS	---	47	35	NS	---	68	---	NS	---	115	35	NS	---
Susitna Flats	50	39	25	49	68	49	58	50	118	88	83	99	497	286	NS	635	676	273	NS	195	1,173	559	NS	830
Trading Bay	---	---	---	130	---	---	---	---	---	---	---	130	---	---	NS	---	---	---	NS	----	---	---	NS	---
Redoubt Bay	1,273	927	801	800	146	131	80	201	1,419	1,058	881	820	1	---	NS	---	3	---	NS	---	4	---	NS	---
Kalgin Island	---	---	---	---	---	---	---	---	---	---	---	---	---	NS	NS	---	---	NS	NS	---	---	NS	NS	---
Kenai River delta	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---
Kasilof River delta	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---	---	---	NS	---
Tuxedni Bay	---	---	---	---	---	---	---	---	---	---	---	---	---	---	NS	---	---	---	NS	---	---	---	NS	---
Anchorage area[b]	---	---	---	---	---	---	---	---	---	---	---	---	40	80	NS	NS	40	105	NS	NS	80	185	NS	NS
Totals	1,323	966	826	979	214	180	138	70	1,537	1,146	964	1,049	1,126	669	NS	1,100	903	548	NS	300	2,029	1,217	NS	1,400

Source: Campbell and Timm 1983.

--- means no data were available.

a NS = Not surveyed.

b Estimated number present in Anchorage city proper, military bases, airport, and airport flats.

1,217 in 1981, and 2,029 in 1980, indicating that the upper Cook Inlet population remains 50% above that of the 1970's (Campbell and Timm 1983).

In addition to the areas listed in table 3, McNeil River, Bruin Bay, Ursus Cove, Cottonwood Bay, Iliamna Bay, Iniskin Bay, Chinitna Bay, Shelter Creek, and Johnson River were surveyed in 1982. No geese were seen in these areas (ibid.).

The Susitna Flats appears to be the most productive area in Cook Inlet for Canada geese (table 3). Production there has averaged 854 during July surveys in 1980, 1981, and 1983. Other areas in Cook Inlet favored by Canada geese include the Palmer Hay Flats, Chickaloon Flats, the Anchorage Bowl area, and Goose Bay (fig. 2).

A total of 1,049 tule white-fronted geese were observed in 1983. This observation was similar to 1982 and 1981 (964 and 1,146, respectively) but lower than the 1,537 birds seen in 1980 (ibid.). It is likely that substantial numbers of white-fronts were not seen because flocks comprised of family groups are often small and frequent flooded brush during the molt. White-fronts may also inhabit areas not surveyed, as they have been reported nesting inland. Most of the adults without young were probably seen because they congregate in large, easily observed flocks (ibid.).

III. SURVEY STRATUM 02 - NELCHINA

A. Present Abundance

The USFWS Nelchina survey stratum has 13 segments that cover portions of the lowland, ponded Nelchina Basin. Habitat characteristics for this area favor the diving duck species, and they are more common. Total estimated population for this area was 168,197 ducks and 2,325 geese (table 4).

The most common duck species in this area during 1984 was scaup, followed by the American wigeon, scoter, and mallard. Scoters were down by approximately 33% from 1983 and 3% from the 10-year average. Wigeon and mallard were up 16% and 60%, respectively, from 1983, and up 23% and 64% from the 10-year average.

IV. SURVEY STRATUM 07 - COPPER RIVER DELTA

A. Present Abundance

The CRD has 10 USFWS survey segments that cover portions of the CRD and adjacent mainland. The 1984 estimated population for this area was 28,174 ducks and 8,540 geese, primarily dusky (table 5). The most common duck was the American wigeon, followed by the mallard, scaup, and pintail.

The CRD segments were flown in 1984 for the first time in over 15 years. Table 5 presents the 1984 survey estimates and an average obtained from previous years surveys. The five-year average estimated population is not available.

Table 6 presents dusky Canada goose breeding ground survey information for 1983 and 1984. The estimated breeding ground population, based on these surveys, was 5,320 and 4,194 in 1983 and 1984, respectively. These figures represent minimum values

Table 4. Nelchina - Stratum 02, USFWS Breeding Waterfowl Survey Estimates, 1980-84

Species	1980	1981	1982	1983	1984	Five-Year Average
Mallard	3,795	22,296	2,846	3,321	8,776	8,207
Black duck	---	---	---	---	---	---
Gadwall	---	---	---	---	717	717[c]
American wigeon	20,246	57,497	11,337	11,337	27,534	25,590
Green-winged teal	5,715	22,861	7,144	4,286	4,286	8,858
Blue-winged teal	---	---	---	---	---	---
Shoveler	6,044	9,210	576	2,303	5,757	4,748
Pintail	18,599	7,556	8,137	6,393	3,487	8,834
Redhead	---	1,207	---	---	---	1,207[c]
Canvasback	1,092	---	---	---	728	585[b]
Scaup	43,549	54,436	91,533	35,081	86,090	62,138
Ring-necked duck	---	3,268	1,188	1,188	3,268	2,228[a]
Goldeneye	25,575	10,725	12,375	3,300	7,425	11,880
Bufflehead	13,568	7,290	18,225	7,290	6,480	10,571
Oldsquaw	975	6,825	2,925	4,875	1,950	3,510
Scoter	11,115	7,020	19,110	10,725	11,700	11,934
Ruddy duck	---	---	---	---	---	---
Merganser	600	600	---	---	---	600[b]
Eider	---	---	---	---	---	---
Subtotal	150,873	210,791	175,396	90,099	168,197	159,071
Coot	---	---	---	---	---	---
Canada geese	450	375	150	---	2,325	825[a]

Source: USFWS breeding waterfowl surveys, 1980-84.

--- means no data were available.

a Four-year average.

b Two-year average.

c One-year average.

Table 5. Copper Delta - Stratum 07, USFWS Breeding Waterfowl Survey Estimates, 1984

Species	Previous Survey Average	1984
Mallard	5,600	5,819
Black duck	---	---
Gadwall	200	---
American widgeon	1,200	5,939
Green-winged teal	800	---
Blue-winged teal	---	---
Shoveler	500	2,993
Pintail	6,800	5,270
Redhead	---	322
Canvasback	200	873
Scaup	10,000	5,376
Ring-necked duck	---	---
Goldeneye	1,700	880
Bufflehead	200	---
Oldsquaw	---	260
Scoter	400	---
Ruddy duck	---	362
Merganser	---	80
Eider	---	---
Subtotal	27,700	28,174
Coot	---	---
Canada geese	---	8,540

Source: Conant and Hodges 1984a.

--- means no data were available.

Table 6. Dusky Canada Goose Transect Data for the Copper River Delta in 1983 and 1984

	Stratum							
	Low		Medium		High		Total	
	Geese Seen	Est. for Area	Geese Seen	Est. for Area	Geese Seen	Est. for Area	Geese Seen	Est. for Area
1983 - May 18								
Singles	38	261	38	164	188	476	264	900
Pairs (x2)	84	576	126	544	604	1,528	814	2,649
Flocks	213	1,461	23	99	83	210	319	1,771
Total geese	335	2,298	187	808	875	2,214	1,397	5,320
1984 - May 15								
Singles	16	110	45	194	229	579	290	884
Pairs (x2)	66	453	148	639	646	1,634	860	2,727
Flocks	7	48	28	121	164	415	199	584
Total geese	89	611	221	955	1,039	2,629	1,349	4,194

Source: Conant and Hodges 1984b.

only, because not all geese within the transect are seen (Conant and Hodges 1984b).

Visibility correction factors based on habitat type are being developed for future survey estimates. These will enable observers to estimate the breeding population more reliably and accurately (Campbell, pers. comm.).

B. Historic Abundance - Dusky Geese

Table 7 summarizes dusky Canada goose population data for 1971 through 1983. The mid winter population estimate has declined from 25,500 geese in 1979 to 17,000 in 1983. All factors related to this apparent decline are not yet known; however, habitat change and subsequent decrease in nest density are suspected primary causes.

Habitat on the CRD has been steadily changing since the 1964 Good Friday earthquake. In 1974, a low (12 to 32 inch) shrub habitat characterized by sweetgale (Myrica gale) composed 2.5% of the vegetation on the delta. Dusky Canada geese strongly preferred this type of vegetation for nesting (Bromley 1976). Limited analysis of vegetation in 1982 indicated that brush cover on the delta had increased to at least 11% and is now characterized primarily by 8 to 10 ft alders and willows (Campbell and Timm 1983). This habitat change is detrimental to geese because the taller brush limits their range of vision while providing cover and drier conditions for mammalian predators (ibid.).

Concurrent with a decrease in nest success in the study areas has been a decrease in nest densities. Part of the decrease (table 8) is probably attributable to the greater difficulty observers have locating nests in the brush. This factor, however, could account for only a small portion of the decrease (Timm 1982).

Although the above described changes in nesting habitat have adversely affected dusky production, the 1981 and 1982 production-survey results are cause for some optimism. Geese are nesting in greater numbers in other parts of the delta, particularly on Castle Island in the Copper River, on Egg Island in the southwest corner of the delta, and on the far west delta in the Eyak River-Government Slough area. Based on aerial counts, production was 32% and 23.7% young, respectively, in these areas during 1981 and 1982 (Campbell and Timm 1983). This compares to an overall production rate of only 17.9% and 23.7%, respectively. Therefore, production in some areas of the CRD is above average and should continue as long as nesting habitat is available.

Because of declining dusky goose numbers, new and innovative management techniques are being explored. These include habitat manipulation and predator control on the delta, as well as modification of hunting regulations on the wintering areas. The potential of these techniques presents an optimistic future for the dusky Canada goose.

Table 7. Summary of Population Data for Dusky Canada Geese, 1971 through 1984

Year	Mid Winter Pop.	Breeding Pop.[b]	% Young	% Non-prod. Adults[c]	# Young Prod.	Fall Flight	Harvest[d]
1971	20,850	20,065	16.2	79.7	3,880	23,945	5,995
1972	17,950	17,275	10.6	71.7	2,050	19,325	3,450
1973	15,875	15,280	36.0	64.6	8,595	23,875	4,875
1974	19,000[a]	15,290	51.4	35.7	19,345	37,635	12,070
1975	26,550	25,565	17.9	84.5	5,575	31,140	9,010
1976	22,725[a]	21,870	24.2	54.2	6,890	28,850	6,350
1977	22,500	21,650	44.3	56.9	17,225	38,875	15,100
1978	23,775	23,000	24.8	71.8	7,600	30,600	5,100
1979	25,500	24,500	16.0	87.0	3,700	28,200	6,200
1980	22,000	21,300	23.7	67.4	6,600	27,900	4,900
1981	23,000	22,200	17.9	92.0	4,800	27,000	9,250
1982	17,740	17,000	23.7	79.1	4,000	21,000	4,000
1983	17,000	16,400	15.0	87.7	2,900	19,300	9,200
1984	10,100	9,750	18.3	83.0	2,184	11,934	

Source: Campbell 1984.

a Calculated from spring breeding grounds survey.

b Mid winter, less 0.35 mortality (Chapman et al. 1969).

c Percentage of total adults seen in flocks with no young.

d Fall flight less mid winter inventory.

Table 8. Dusky Canada Goose Nest Densities, Hatching Success, and Average Clutch Size on the West Copper River Delta, 1959-82

Year	$\bar{X}$ Nest Density/Mi²	% Nest Hatching Success (N)	$\bar{X}$ Clutch Size (N)
1959-74	---	82.9	5.0
1975	179	31.6 (215)	4.8 (215)
1976	156	---	4.8 (168)
1977	175	79.0 (229)	5.4 (181)
1978	183	56.2 (390)	---
1979	133	18.8 (409)	5.7 (338)
1980	108	[a]	5.4 (152)
1981[b]	45	---	4.9 (28)
1982	113 (93)[c]	49.3 (151)	4.8 (135)
1983	117 (91)[c]	51.9 (162)	5.5 (87)
1984	107 (95)[c]	75.8 (161)	5.6 (123)

Source: Campbell 1984.

--- means no data were available.

a 35% nest destruction observed 10 days into incubation.

b Incomplete survey.

c Densities include new plots established on far west Delta and Barrier islands in 1982.

d Campbell, pers. comm.

REFERENCES

Bromley, R.G.H. 1976. Nesting and habitat studies of the dusky Canada goose (Branta canadensis occidentalis) on the Copper River Delta, Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 81 pp.

Campbell, B.H., and D.E. Timm. 1983. Annual report of survey-inventory activities. Part V: Waterfowl. Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Job 11.0.

Campbell, B.H. 1984. Annual report of survey-inventory activities. Part V: Waterfowl. Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2, Job 11.0.

________. 1984. Personal communication. Asst. Waterfowl Biologist, ADF&G, Div. Game, Anchorage.

Conant, B., and J.I. Hodges. 1984a. Alaska-Yukon waterfowl breeding pair survey, May 15 to June 12, 1984. USFWS, Juneau, AK. 21 pp.

________. 1984b. Dusky Canada goose breeding population survey. Unpubl. rept., USFWS, Juneau.

Isleib, M.D., and B. Kessel. 1973. Birds of the North Gulf Coast-Prince William Sound region, Alaska. Biol. papers of the Univ. Alaska. No. 14. 149 pp.

King, J.G., and B. Conant. 1983. Alaska-Yukon waterfowl breeding pair survey, May 16 to June 11, 1983. USFWS, Juneau, AK. 23 pp.

Timm, D.E. 1982. Annual rept. of survey-inventory activities. Fed. Aid in Wildl. Rest. Vol. 12. Proj. W-19-2, Job 11.0.

Trumpeter Swan Distribution and Abundance

I. REGIONWIDE INFORMATION

Information on abundance will be organized as it has been collected. For census purposes, King and Conant (1981) divided the nesting range within Alaska into 10 units. The Southcentral Region contains the Cook Inlet, Kenai, Gulkana, and Copper Canyon units and roughly one-third of the Gulf Coast unit (map 1).

A. Regional Distribution

The trumpeter swan, because of heavy human use, had nearly become extinct in the conterminous United States in the early 1930's. Although increasing in recent years and no longer considered endangered, it is still among the rarest of birds in North America (King and Conant 1981).

About 88% of the total world population of trumpeter swans summers in Alaska. Nesting trumpeter swans in Alaska are distributed along the North Pacific coastal plain from Yakutat to Cook Inlet and through the forested valleys of the Copper and Susitna rivers at elevations below 3,000 ft (ibid.).

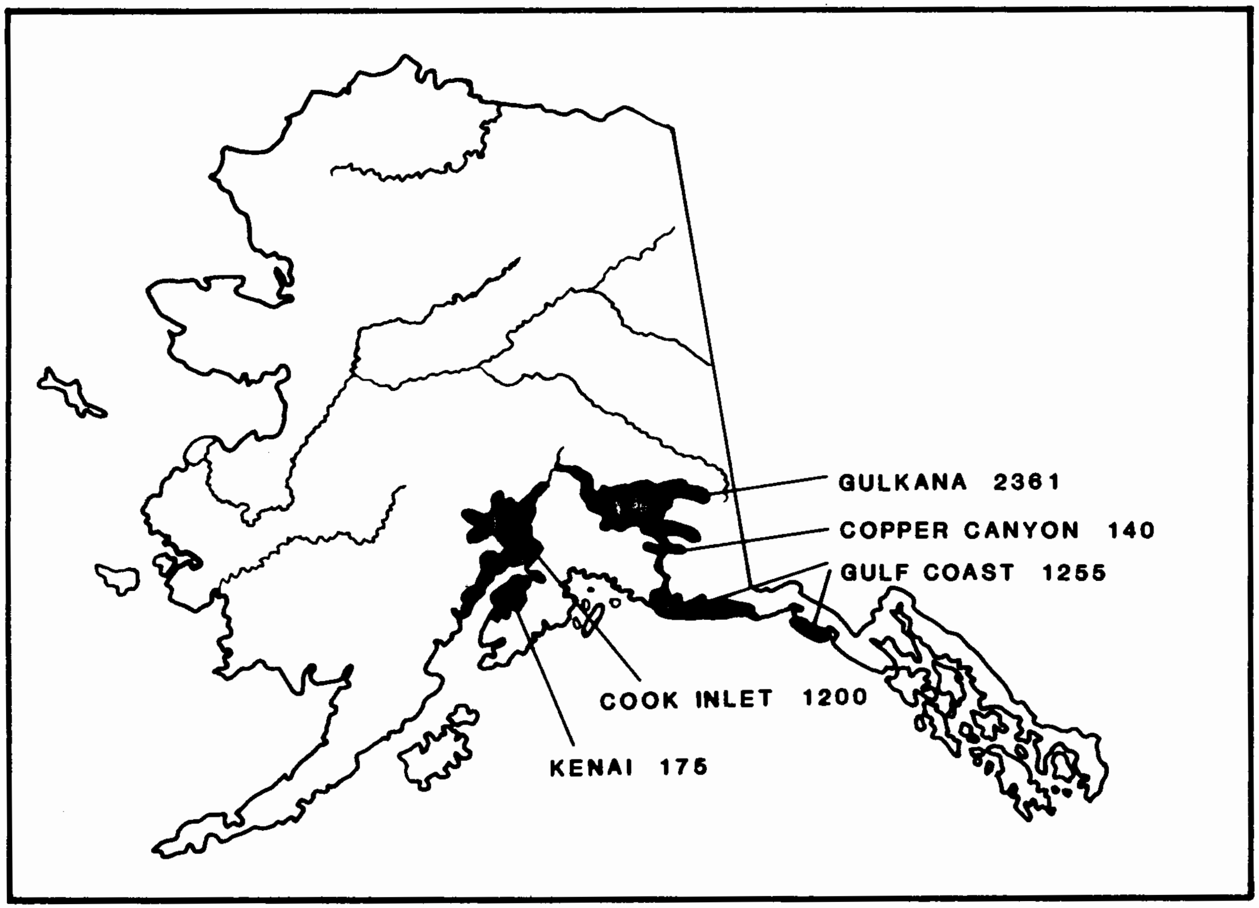
B. Areas Used Seasonally and for Life Functions

The following categories are depicted on the 1:1,000,000-scale trumpeter swan distribution maps in the Atlas to the guide for the Southcentral Region and the 1:250,000-scale blueline reference maps in ADF&G offices:

- Trumpeter swan general distribution
- Known spring and/or fall concentration areas
- Known nesting and brood-rearing concentration areas
- Known dispersed nesting and brood-rearing concentration areas
- Known molting concentration areas
- Known winter concentration areas

C. Factors Affecting Distribution

Nesting areas suitable for trumpeter swans are limited. Only a small percentage of lakes contain a suitable blend of food and protective cover. Successful nest sites may be used by a pair for 20 years or more. Loss of nest or brood may result in desertion of the territory. Although disturbances such as airplanes, boats, proximity of a road, or the establishment of other human recreational activity may not cause a successful, well-established pair to desert their territory, it may well prevent reestablishment of a nest pair at this site when the old pair is gone (Conant 1983). This could result in a substantial loss of otherwise suitable habitat over time as human development proceeds. In spite of an overall increase in the Alaskan swan population, swans are being rapidly excluded from nesting areas around large lakes as a consequence of recreational development, particularly in the Cook Inlet area (King and Conant 1981).



Map 1. Trumpeter swan census, Southcentral Alaska 1980 (adapted from King and Conant 1981).

Weather has been favorable for swan production in Alaska since 1968 and may be partially responsible for the increase in their abundance and distribution (ibid.). Other contributing factors may be protection from hunting, an increase in public interest in trumpeter swans, and a decrease in illegal shooting. In the short term, availability of wintering habitat may be the limiting factor for trumpeter swans nesting in Alaska. Ultimately, human encroachment and modification of swan nesting habitat in Alaska may determine the state's swan population size (Timm, pers. comm.). (See the Life History and Habitat Requirements narrative in volume 1 for further details.)

D. Movements Between Areas

During the last week of March, the first spring migrants usually arrive on the Copper River delta, and they are common by the second week of April. Between mid April and early May, a few flocks of trumpeter swans and mixed flocks of trumpeter and tundra swans migrate across Prince William Sound (Timm 1975). In late summer and early fall, large numbers of trumpeter swans congregate on ponds and marshes along the coast.

In Cook Inlet, swans begin flocking up in September and move south in October. Swans that nest in Alaska winter in fresh water and salt water along the Pacific coast between the Kenai River in Alaska and the Columbia River in Oregon; most winter in coastal British Columbia and Blind Slough south of Petersburg as well as in Prince of Wales Island in Southeastern Alaska. In Southcentral Alaska, trumpeter swans winter on the open, freshwater outlets of Eyak Lake, and Martin Lake near Cordova and near Skilak Lake on the Kenai Peninsula (Timm 1975; Spraker, pers. comm.; Conant 1983; USFWS 1984). Trumpeter swans return to the Cook Inlet basin in April, and nesting birds proceed to their nesting lake at the first sign of open water. Transitory habitat on the Stikine Flats near Yakutat and the Mendenhall Glacier are important areas for resting and feeding during migration (Hughes, pers. comm.).

Most swans depart by mid October, but some years they may remain until freeze-up in November (ibid.).

E. Population Size Estimation

The USFWS flies aerial surveys of known swan habitat every five years. Survey techniques are described in King and Conant (1981).

F. Regional Abundance

The Southcentral Region contains about 4,300 trumpeter swans (King and Conant 1981) and roughly 50% of the total world population during the breeding season. The largest populations in Southcentral Alaska occur in the Cook Inlet, Gulkana, and Gulf Coast areas.

II. TRUMPETER SWAN CENSUS UNITS

A. Present Abundance

1. <u>Gulkana Census Unit</u>. In a 1980 survey, the Gulkana trumpeter swan population was 2,361 known individuals (ibid.). Changes in swan habitat include an increase in recreational cabins in

the Lake Louise area, a trend that to date has had a largely unknown effect on the swans. In this census unit, trumpeter swans increased 127% from the 1975 census (ibid.).

2. Cook Inlet Census Unit. The Cook Inlet trumpeter swan population 1980 census reported 1,200 birds (ibid.). Petroleum, agricultural, residential, and recreational activity continue to expand in this intermontane coastal basin. Despite these activities, however, trumpeter swans increased 94% in five years, and the numbers of young increased 104% (ibid.). Flocked birds showed the greatest increase, 210%, which possibly indicates immigration or difficulty in finding suitable nesting territories. Swan use of large lakes has decreased as these waters become ringed with recreational cabins, and there is a noticeable shift of swan nests to beaver dams and inaccessible boggy lowland flowages (ibid.).
3. Copper Canyon Census Unit. In the 1980 survey, the Copper Canyon trumpeter swan population was reported to contain 140 swans (ibid.). This figure represents a 22% decrease in the swan population in this area since the 1968 survey.
4. Gulf Coast Census Unit. The portion of the Gulf Coast population falling within the Southcentral Region has an estimated 418 swans (ibid.). The swan population in this area has increased 46% since the 1968 survey.
5. Kenai Census Unit. In the 1980 survey, the Kenai trumpeter swan population consisted of 175 individuals (ibid.). The population appears to remain static despite an annual production comparable to areas where swans were rapidly increasing. Major residential, oil field, and refining developments, as well as extensive recreational activity by canoeists and others, have driven swans from additional nesting habitat (ibid.).

REFERENCES

Conant, B. 1983. Trumpeter swan surveys in the Chugach National Forest. USFWS, rept. 8 pp.

Hughes, J. 1985. Personal communication. Nongame Biologist, ADF&G, Div. Game, Anchorage.

King, J.G., and B. Conant. 1981. The 1980 census of trumpeter swans on Alaska nesting habitats. Am. Birds 35(5):789-793.

Spraker, T. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Soldotna.

Timm, D. 1975. Northeast Gulf Coast waterfowl. Pages 264-343 in ADF&G, comp. A fish and wildlife resource inventory of Prince William Sound. Vol. 1: Wildlife. 1978. [Juneau.]

Timm, D. 1984. Personal communication. Regional Mgt. Coordinator, ADF&G, Div. Game, Anchorage.

USFWS. 1984. North American management plan for trumpeter swans. USDI, USFWS Office of Migratory Bird Management, Washington, DC. Unpubl. draft. 61 pp.

Freshwater/Anadromous Fish

Arctic Char/Dolly Varden Distribution and Abundance

I. REGIONWIDE INFORMATION

In this report, distribution and abundance information will be presented by sport fish postal survey areas, which are shown on map 1. Information on the level of char sport harvest is contained in the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Regional Distribution

Dolly Varden/arctic char are distributed throughout the Southcentral Region. In the Prince William Sound (PWS) Area, nearly all freshwater systems support populations of char (ADF&G 1978). Char are also found throughout the Kenai Peninsula and west-side Cook Inlet drainages in both anadromous and nonanadromous forms. Anadromous char are especially abundant in the Kenai River and all larger streams south of the Kenai River draining into Cook Inlet, Kachemak Bay, and Resurrection Bay (ibid.). Anadromous populations are also found in streams flowing into the northwest side of upper Cook Inlet (such as the Lewis and Chuit rivers) and in western tributaries to the Susitna River (such as the Talachulitna River). Anadromous and resident char are found as well in east-side Susitna drainages and Copper River drainages.

B. Areas Used Seasonally and for Life Functions

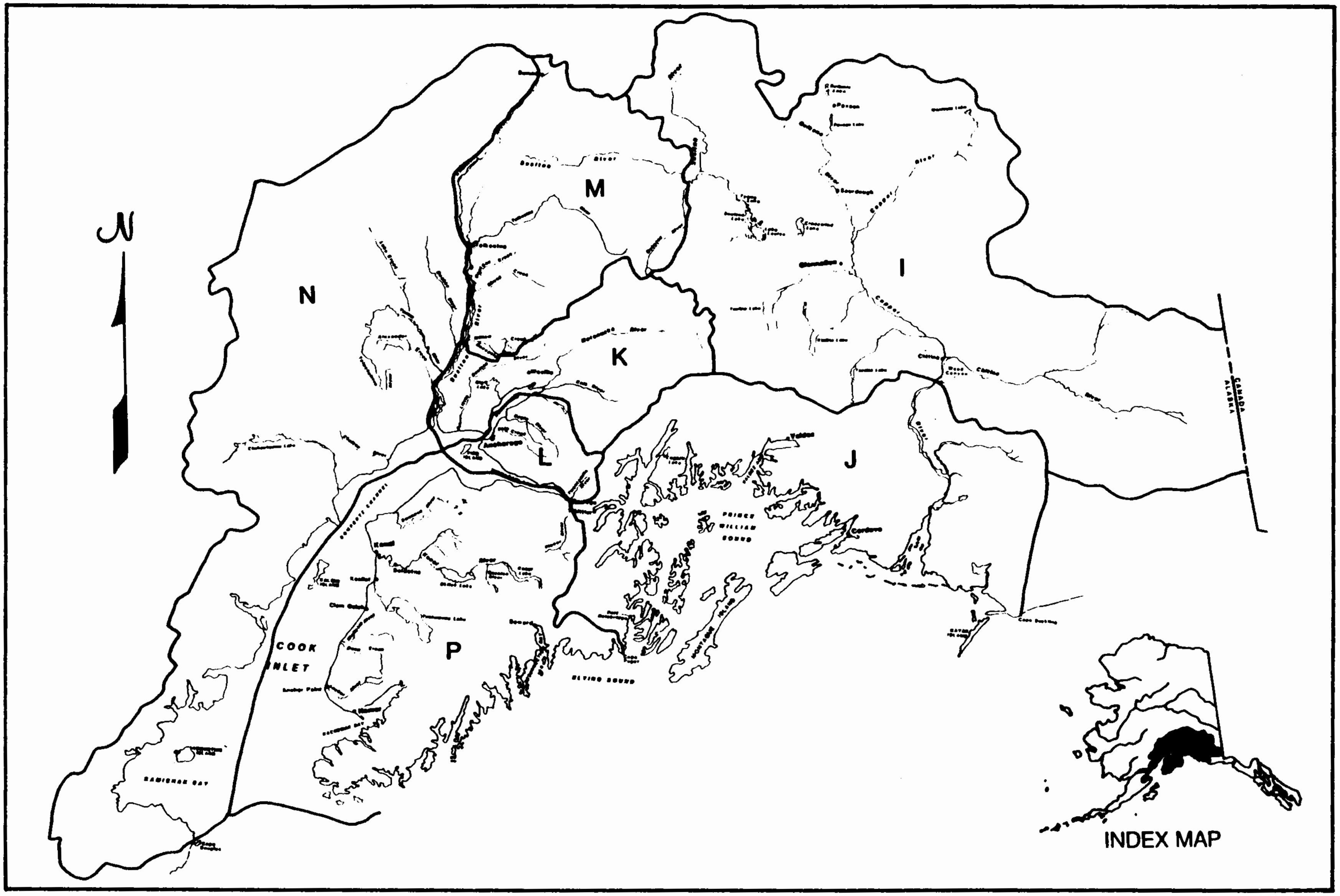
A series of freshwater fish distribution maps at 1:250,000 scale and another series of anadromous fish distribution maps at the same scale have been produced with this report. The categories of information on the freshwater fish maps are as follows:

- General distribution
- Documented presence in stream or lake
- Documented spawning areas
- Undocumented areas

The categories of information on the anadromous fish maps are as follows:

- Documented presence in stream or lake
- Watersheds in which presence of anadromous fish has been documented
- Unsurveyed watersheds (whether or not anadromous fish are present is unknown)
- Watersheds that have been surveyed in which anadromous fish are not present

Char populations included in the anadromous waters catalog (ADF&G 1984) are depicted on the anadromous fish maps. Resident populations of char and populations that may be anadromous but are not included in the anadromous waters catalog are depicted on the freshwater fish maps.



Map 1. ADF&G sport fish postal survey areas.

C. Factors Affecting Distribution

Water quality parameters, such as dissolved oxygen levels and temperature, and physical characteristics of streams and lakes, such as depth, velocity, and substrate type, all influence char distribution. (Details of habitat requirements for char can be found in the arctic char/Dolly Varden Life History portion of volume 1.)

D. Movements Between Areas

Resident lake char move into streams for short periods of time. Studies in the Wood River Lakes system north of Dillingham, Alaska, show that discrete subpopulations of resident lake char concentrate at inlets and outlets of the lakes during early summer to feed on out-migrating sockeye smolt (McBride 1979). During late summer, char move to deeper lake waters, probably in response to a declining availability of sockeye smolt and to escape warming surface waters (Nelson 1966). Mature spawners usually move back to the lake margins to spawn in the fall.

Little is known about the life history of resident stream char. They are common in headwater streams during spring, summer, and fall and may move into lakes for short periods of time, but they also use lower reaches of streams (Morrow 1980). Catch data from studies on the Susitna River below Devil Canyon indicate that char move out of the main stem and into tributaries by late June (Sundet and Wenger 1984). It is thought that char feed in the upper reaches of Susitna River tributaries until fall and then migrate back into the main stem to overwinter (ibid.). The exact timing of the fall out-migration is unknown; however, information from anglers at the mouth of the Talkeetna and Kashwitna rivers indicates that the out-migration occurs sometime before mid September (ibid.). Overwintering occurs in deep pools of streams and rivers (Morrow 1980).

Juvenile anadromous char rear in streams and lakes for two to seven years before out-migrating as smolt (ADF&G 1977a, ADF&G 1977b). Most immature and mature char emigrate from overwintering areas to marine summer feeding areas following ice breakup from April to June. Systems without lakes may support an additional autumn smolt out-migration (Armstrong 1965 and 1970, Armstrong and Kissner 1969, Dinneford and Elliott 1975, and Elliott and Dinneford 1976). Individuals remain at sea feeding in the estuary and along the coast for a period of a few weeks to seven months (Morrow 1980). While in the marine environment, char stay in coastal areas near the estuary and do not usually migrate distances greater than 100 mi (ADF&G 1977a, ADF&G 1977b). Char begin reentering fresh water in July and may continue through December. Both spawning and nonspawning char return to their natal stream or lake to spawn or overwinter (McBride 1979). Emigration of spawned-out char to overwintering areas usually occurs within two weeks after completion of spawning, typically during late October and November. Immature char move to overwintering areas earlier, primarily in July, August, and

September (Blackett and Armstrong 1965, Krueger 1981). Adult char usually remain in fresh water through the winter months to avoid the cooler water temperatures of the marine environment (ADF&G 1977a). Overwintering sites include deep lakes, deep river pools, and groundwater spring areas.

E. Population Size Estimation

Lakes containing resident char are occasionally test-netted by the ADF&G with variable mesh gill nets. The studies, however, are usually in conjunction with stocked lake evaluations, and few lakes containing char are tested.

In 1981 and 1982, nearly 400 char in the Anchor River were tagged in an attempt to generate a population estimate; however, too few tags have been recovered to produce an accurate estimate (Hammarstrom and Wallis 1982, 1983).

F. Regional Abundance

Very little char abundance information is available. Information that has been collected applies only to specific lakes and streams. As a result, abundance cannot be appropriately addressed at the regional level. Abundance information is contained in the management area discussions that follow.

II. GLENNALLEN AND PRINCE WILLIAM SOUND AREAS

The Glennallen and PWS areas (Sport Fish Postal Survey Areas I and J) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Anadromous char are found in nearly all freshwater systems of the PWS Area, with the possible exception of the extremely short glacial systems on the southeast side of the Kenai Peninsula (ADF&G 1978). Anadromous char use freshwater lakes such as Eshamy, Coghill, Shrode, Robe, and Eyak for overwintering habitat (ibid.). Resident char in the PWS Area occur most commonly in landlocked lakes and in streams above barriers to the anadromous species (ibid.).

In the Glennallen Area, char distribution is patchy (ibid.). Anadromous char inhabit portions of the Copper River drainage such as the Little Tonsina, Klutina, and Tonsina rivers (ADF&G 1978; Williams, pers. comm.). Resident char are also found in the Copper River and the upper Susitna River drainages (ADF&G 1978). Char are found as well in a few lakes in the Glennallen Area.

B. Abundance

1. <u>Summary of data</u>. Char abundance appears to be very good in the PWS Area (ibid.); however, very few systematic abundance surveys have been conducted. In the Glennallen Area, at least 10 test-netted lakes have been found to contain char (Williams, pers. comm.).
2. <u>Habitat enhancement efforts</u>. No record of any habitat enhancement efforts directed towards char in the PWS or Glennallen areas was found in the literature.

III. KNIK ARM AREA DRAINAGE AND ANCHORAGE AREA

The Knik Arm Drainage Area and the Anchorage Area (Sport Fish Postal Survey Areas K and L) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Char are found throughout the Anchorage Area and the Knik Arm Drainage Area. In Anchorage, Rabbit Creek, Campbell Creek, Chester Creek, and Spring Creek all support populations of anadromous char (ADF&G 1984). Char harvest is also reported from the Twenty Mile River, Bird Creek, Ship Creek, and Eagle River (Mills 1979-1983).

In the Knik Arm Drainage Area, char harvest has been reported from the Little Susitna River, Wasilla Creek, Big Lake, and the Nancy Lake Recreation Area (ibid.).

B. Abundance

1. Summary of data. No information on char abundance in the Anchorage Area or the Knik Arm Drainage Area was found in the available literature.
2. Habitat enhancement efforts. No record of any habitat enhancement efforts directed towards char in the Anchorage Area or the Knik Arm Drainage Area was found in the literature.

IV. EAST SIDE SUSITNA AREA AND WEST SIDE COOK INLET-WEST SIDE SUSITNA RIVER DRAINAGE AREA

The East Side Susitna Area and the West Side Cook Inlet-West Side Susitna River Drainage Area (Sport Fish Postal Survey Areas M and N) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Anadromous char are found in all major west-side Cook Inlet drainages between Polly Creek and Nickolai Creek (ADF&G 1984). The ADF&G (1978) reported that anadromous populations are also found in the Lewis, Theodore, Chuit, and Talachulitna rivers. Char are found as well in the Susitna River (ADF&G 1983a), and stunted resident char were found in several Susitna River tributaries above Devil Canyon (ADF&G 1983b). Studies involving electrofishing in the Susitna River below Devil Canyon from 1981 to 1983 have yielded very low catches of char. The most productive areas on the Susitna River below Devil Canyon are the Kashwitna River, Lane Creek, Indian River, and Portage Creek (Sundet and Wenger 1984). In 1983, 47 char were captured in the Susitna River using electrofishing and nets. Most of these were taken between the Chulitna River confluence and Devil Canyon. The largest char catches were made at the mouth of Portage Creek and the mouth of the Indian River (ibid.). Two out of nine tagged char recaptured between 1981 and 1983 were recovered in Chunilna (Clear) Creek, suggesting that this tributary creek may be an important producer of char in the lower Susitna (ibid.).

B. Abundance

1. Summary of data. The ADF&G (1978) describes the char population of the Susitna River drainage and the west side of Cook Inlet as not particularly abundant; however, no information on any systematic abundance surveys was found in the available literature.
2. Habitat enforcement efforts. No record of any habitat enhancement efforts directed towards char in the East Side Susitna Area or the West Side Cook Inlet-West Side Susitna River Drainage Area was found in the available literature.

V. KENAI PENINSULA AREA

The Kenai Peninsula Area (Sport Fish Postal Survey Area P) is described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Anadromous char are found in much of the Kenai River drainage, especially in the upper main stem of the Kenai River (ADF&G 1978). Anadromous char are also found in the Kasilof River, Deep Creek, Ninilchik River, Stariski Creek, and Anchor River (ibid.). Most char on the Kenai Peninsula are the Dolly Varden species; however, arctic char are found in a few deep lakes of the Swanson River system (ibid.).

B. Abundance

1. Summary of data. The ADF&G (1978) describes the Kenai Peninsula char population as abundant. Sportfishing harvest information from the Kenai River and peninsula streams south of the Kenai River supports this description. In 1981 and 1982, char in the Anchor River were tagged in an attempt to generate a population estimate; however, too few tags have been recovered to produce an accurate estimate (Hammarstrom and Wallis 1982 and 1983).
2. Habitat enhancement efforts. No record of any habitat enhancement efforts directed towards char in the Kenai Peninsula Area was found in the available literature.

REFERENCES

ADF&G, comp. 1977a. A compilation of fish and wildlife resource information for the State of Alaska. Vol 2: Sport fisheries. 337 pp.

________. 1977b. A fish and wildlife resource inventory of the Alaska Peninsula, Aleutian Islands, and Bristol Bay areas. Vol. 2: Fisheries. 556 pp.

ADF&G. 1978. Alaska's fisheries atlas. Vol 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + 153 maps.

________. 1983a. Susitna Hydro aquatic studies. Phase 2: Basic data rept. Vol. 4: Aquatic habitat and instream flow studies, 1982, part 2. 398 pp.

________. 1983b. Susitna Hydro aquatic studies. Phase 2: Basic data rept. Vol. 5: Upper Susitna River impoundment studies, 1982. 152 pp. + appendices.

________. 1984. An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes. Div. Habitat maps.

Armstrong, R. 1965. Some migratory habits of the anadromous Dolly Varden _salvelinus malma_ (Walbaum) in Southeast Alaska. ADF&G, Res. Rept. 3:1-26.

________. 1970. Age, food and migration of Dolly Varden smolts in Southeast Alaska. J. Fish Res. Bd. Can. 27:991-1,004.

Armstrong, R., and P. Kissner. 1969. Investigations of anadromous Dolly Varden populations in Hood Bay, Southeast Alaska. ADF&G, Fed. Aid. in Fish Rest. Ann. prog. rept. Vol. 10. Proj. F-9-1, Job 2-B.

Blackett, R., and R. Armstrong. 1965. Investigations of anadromous Dolly Varden populations in the Lake Eva-Hanus Bay drainages, Southeastern Alaska. ADF&G, Fed. Aid in Fish Rest. Job completion rept. Vol. 6. Proj. F-5-R-6, Job 2-B.

Dinneford, W.B., and S.T. Elliott. 1975. A study of land use activities and their relationship to the sport fish resources in Alaska. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol 16. Proj. F-9-7, Job D-I-B.

Elliott, S.T., and W.B. Dinneford. 1976. A study of land use activities and their relationship to the sport fish resources in Alaska. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 17. Proj. F-9-8, Job D-I-B.

Hammarstrom, S., and J. Wallis. 1982. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Vol 23. Proj. F-9-14, Job G-I-C.

________. 1983. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid. in Fish Rest. Vol. 24. Proj. F-9-15, Job G-I-C.

Krueger, S.W. 1981. Freshwater habitat relationships: Dolly Varden char (_salvelinus malma_) (Walbaum). ADF&G, Div. Habitat, Resource Assessment Branch. 38 pp.

McBride, D.N. 1979. Homing of arctic char, Salvelinus alpinus (Linnaeus), to feeding and spawning sites in the Wood River sake system, Alaska. M.S. Thesis, Univ. Alaska, Southeastern Senior College, Juneau.

Mills, M. 1979-83. Statewide harvest survey. ADF&G, Fed. Aid in Fish Rest. Vols. 20-24. Projs. F-9-11-F-9-15, Job SW-I-A.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Anchorage, Ak: Alaska Northwest Publishing Company. 248 pp.

Nelson, M.O. 1966. Food and distribution of arctic char in Lake Aleknagik, Alaska, during the summer of 1962. M.S. Thesis, Univ. Washington. 164 pp. Cited in Moriarty 1977.

Sundet, R.L., and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below Devil Canyon. Part 5 in D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, eds. ADF&G Susitna Hydro aquatic studies. Rept. 2: Resident and juvenile anadromous fish investigations (May-October 1983).

Williams, F.T. 1979. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Vol. 20. Proj. F-9-11, Job G-I-F.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Glennallen.

Williams, F.T., and W.D. Potterville. 1980. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. Ann. performance rept. ADF&G, Fed. Aid in Fish Rest. Vol. 21. Proj. F-9-12, Job G-I-F.

Arctic Grayling Distribution and Abundance

I. REGIONWIDE INFORMATION

In this report, distribution and abundance information will be presented by sport fish postal survey areas, which are shown on map 1. Information on the level of grayling sport harvest is contained in the grayling portion of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Regional Distribution

Arctic grayling are found in several clearwater tributaries and lakes within the upper Copper River and Susitna River drainages and in a few clearwater tributaries of the lower Copper River. Grayling are not found on the west side of Cook Inlet south of Tyonek (ADF&G 1978). They are also not native to the Kenai Peninsula but have been stocked in several of its lakes, which now contain self-sustaining populations (Engel 1971).

B. Areas Used Seasonally and for Life Functions

A series of grayling distribution maps at 1:250,000 scale have been produced for use with this report. The categories of mapped information are as follows:

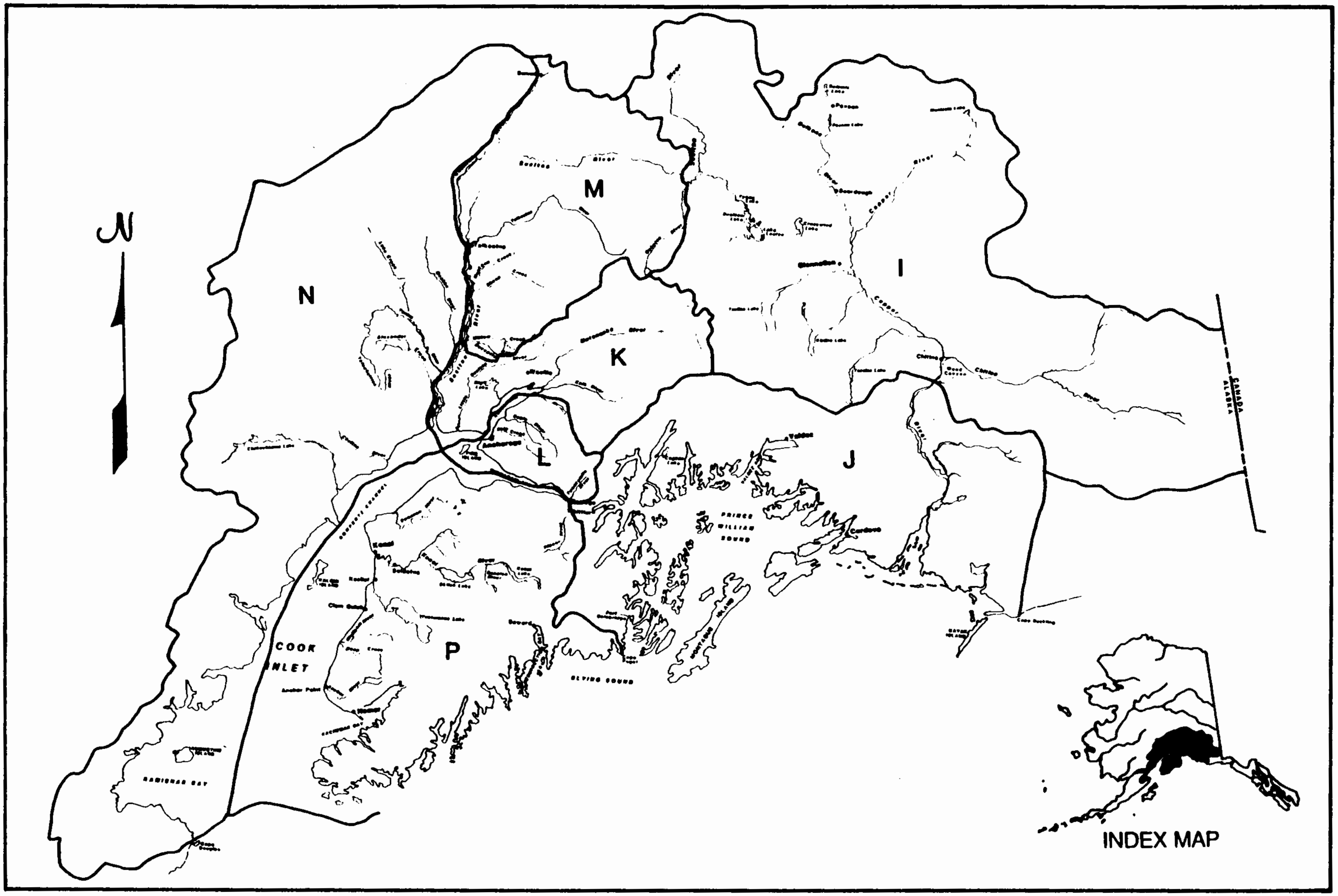
- General distribution
- Documented presence in stream or lake
- Documented spawning areas
- Undocumented areas
- Stocked lakes and streams

C. Factors Affecting Distribution

Water quality parameters, such as dissolved oxygen levels and temperature, and physical characteristics of streams and lakes, such as depth, velocity, and substrate type, all influence grayling distribution. Details of habitat requirements for grayling can be found in the Arctic Grayling Life History narrative in volume 1.

D. Movements Between Areas

In rivers, adults move from overwintering locations to begin an upstream prespawning migration under the ice in late winter or early spring. The prespawning migration typically lasts from two to six weeks, depending upon the distance travelled. Grayling move into smaller tributaries to spawn (avoiding spring-fed streams and silted rapid-runoff streams) as soon as the ice is out and the water temperatures rise to about 1°C, usually in May or June (Armstrong 1982, Sundet and Wenger 1984). Immature fish generally follow closely behind adults. Immediately after spawning, many of the adults move out of the smaller streams to up-river summer feeding areas, but most juveniles remain in small streams until late August or September. From September through December, as temperatures drop and instream flow and food availability deteriorate, there is a general downstream movement



Map 1. ADF&G sport fish postal survey areas.

of all age classes to more favorable overwintering areas (Grabacki 1981, Netsch 1975, Tack 1980). Grayling in the Susitna River drainage move downstream from tributaries into overwintering areas of the mainstem Susitna in late September through early October (ADF&G 1983a). Common overwintering sites include intermittent pools under the ice in large rivers, deep lakes, brackish river deltas, and spring or ground-fed areas (Bendock 1980, Tack 1980). Portions of the grayling populations in Deadman and Portage creeks, tributaries to the Susitna River, overwinter in large pools within the creeks (Sautner and Stratton 1984, Sundet and Wenger 1984).

Lake-dwelling populations move into tributaries to spawn in the spring and may return to the lakes shortly after spawning (Engel 1973), or they may remain in the tributaries until fall (Sautner and Stratton 1984). Grayling leave Deadman Lake in mid June and do not return until early September (ibid.).

E. Population Size Estimation

Managed lakes in the Glennallen area containing natural or stocked populations of grayling are often surveyed using gill nets (Williams and Potterville 1983). The catch rates (number of fish per net hour) from these surveys are used as relative measures of the population size in each lake over time but are not used to generate population estimates.

Mark-and-recapture studies have been conducted on tributaries of the upper Susitna River (ADF&G 1983b). Several sources of bias are associated with mark-and-recapture studies, especially those conducted in areas that are not strictly closed systems (ibid.). These studies have, however, resulted in population estimates for the lower reaches of several tributaries (ibid.) and for nearly the entire length of Deadman Creek (Sautner and Stratton 1984).

F. Regional Abundance

Very little information on grayling abundance in the Southcentral Region is available. The information that has been collected applies only to specific lakes and streams. As a result, abundance cannot be appropriately addressed at the regional level. Abundance information is therefore contained in the more specific management area discussions, which follow.

II. GLENNALLEN AND PRINCE WILLIAM SOUND (PWS) AREAS

The Glennallen and the PWS areas (Sport Fish Postal Survey Areas I and J) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Arctic grayling are found throughout the Glennallen Area, inhabiting all major drainages and many lakes. The largest populations of grayling are found in moderately large, clearwater tributary streams with gravel substrate, such as the Gulkana and Oshetna rivers (ADF&G 1978). Grayling in the Gulkana River are exceptionally abundant in the main stem between Canyon Rapids and Paxson Lake (Williams and Potterville 1983). Large, glacial rivers such as the main stem Copper and Susitna appear to provide favorable overwintering sites for grayling, forced out of smaller tributaries by low dissolved oxygen levels and ice formation (ADF&G 1978, 1983a). Tolsona Lake, about 20 mi west of Glennallen, was used for several years as the source of grayling eggs for stocking programs in lakes throughout Alaska. Tolsona Lake itself was stocked annually to maintain the population; however, the grayling population in the lake declined between 1977 and 1979 (table 1) and is no longer used as a source of eggs (Williams and Potterville 1980, 1982). Several other lakes in the Glennallen Area are now being investigated as potential egg-take sites (Williams and Potterville 1981, 1983). In 1983 and 1984, Jack Lake and Moose Lake were used as egg-take sites (Williams, pers. comm.).

Grayling are found in the northern edge of the PWS Area in tributaries of the Copper River, and in a few stocked lakes, such as Little Echo, Pipeline, and Thompson lakes in the Cordova and Valdez areas (table 2).

B. Abundance

1. Summary of data. Several lakes in the Glennallen Area have been test-netted, using variable mesh gill nets (table 1). Each test-netting was conducted for a minimum of 16 hours, including an overnight period (Williams and Potterville 1983). These surveys provide a relative measure of abundance in each lake; however, they are not exhaustive surveys. The effectiveness of test-netting may vary from year to year, depending upon environmental conditions and upon the location of the net in the lake. Fish species with patchy distributions within a lake may not be detected with a limited number of net sets. As a result, it should not be concluded that lakes with grayling catches per net hour of zero do not contain grayling.

   Some lakes in the PWS Area have been test-netted, using variable mesh gill nets (table 1); however, only those that had been stocked at some time produced grayling.

   The grayling population in the Gulkana River supports an active sport fishery. Annual hook and line surveys are carried out by the Division of Sport Fish to monitor this population. Age and length information is collected to provide information on the structure of the population and to monitor the relative number of fish in each age class. The maximum size of fish caught has declined since 1968 (ibid.); however, the average fork length has changed very little, indicating a fairly stable population. Age III and IV fish dominate the catch (Williams and Potterville 1982).

2. Habitat enhancement efforts. Several lakes in the Glennallen and PWS areas have in the past been stocked with grayling (table 2). Some of these lakes in the Glennallen Area now contain self-sustaining populations. No significant catches of grayling have been reported from the PWS Area since the

Table 1. Surveyed Lakes in the Glennallen and PWS Areas That Had Grayling Catches Greater Than Zero, 1977-82[a]

	Year					
	1977	1978	1979	1980	1981	1982
Arizona[b]	x	---	---	x	---	x
Bell	---	---	---	x	---	---
Caribou[b]	x	---	---	x	0	---
Clarence	x	---	---	---	---	---
Connor	---	---	x	---	x	---
Dadnia[b]	---	---	---	---	---	x
Dick[b]	x	---	---	---	x	---
Elbow[b]	x	---	---	x	---	---
Forgotten[b]	---	---	---	---	x	---
Forty Foot	---	x	---	---	---	---
George[b]	x	---	0	---	---	---
Gergie	x	---	---	---	x	---
Gillespie	---	---	---	---	x	x
Hanagita Middle	---	---	x	---	---	---
Hunter	---	---	---	x	---	---
Jack	---	---	---	x	---	---
Kay	x	---	---	---	---	---
Little Echo[b]	x	---	---	---	---	---
Little Junction	---	---	---	---	x	---
Meiers[b]	x	---	---	---	---	---
Mirror	---	---	---	---	x	---
Moose[b]	---	x	x	---	---	x
Snowshoe	---	---	---	x	---	---
Spring Crk. Lakes	---	---	---	---	x	x
Spruce	---	x	---	---	---	---
Squirrel Crk. Gravel Pit[b]	---	---	---	---	x	---
Three Mile	---	x	---	---	x	---
Thompson[b]	---	---	x	---	---	---
Tolsona[b]	x	x	x	x	x	x
Tom's	---	---	---	x	---	---
Two Mile	---	0	---	---	x	---

Sources: Williams 1979; Williams and Potterville 1978, 1980-83.

x indicates graying caught.

--- indicates lake not sampled.

0 indicates lake sampled but no grayling caught.

a Eleven unnamed lakes in the area of Lake Louise were also sampled in 1982. Nine of these lakes contained grayling; (Williams and Potterville 1983). This list includes only lakes sampled from 1977 through 1982. Many other lakes sampled prior to 1977 also contain populations of grayling. A more complete depiction of grayling distribution in the Glennallen and PWS areas is found on the 1:250,000-scale freshwater fish distribution maps that accompany this report.

b These lakes were stocked with grayling sometime prior to being sampled (see table 2).

Table 2. Glennallen and PWS Area Waters Stocked with Grayling, 1966-83[a]

Water	Location	Year(s) Stocked
Arizona Lake	Lake Louise	1968,72-74,77,83,84
Bear Cub Lake	Mentasta Lake	1984
Caribou Lake	Lake Louise	1968,76,77,84
Dadnia Lake	Kenny Lake	1969
Dick Lake	Paxson	1966,68,69,83,84
8.5 Mile Creek	Valdez	1977
Elbow Lake	Lake Louise	1976,77,83
Forgotten Lake	Lake Louise	1969,77
40-Foot Lake	Lake Louise	1983
George Lake	Lake Louise	1975-77
Grass Lake	Cordova	1983
Jack Lake	Slana	1983,84
Junction Lake	Lake Louise	1966,68-70,72,74,76,77,81,83,84
Kenny Lake	Chitina	1968
Little Echo Lake	Cordova	1968-70,73,74,77,83
Little Junction Lake	Lake Louise	1983
Meiers Lake	Paxson	1976,83
Mirror Lake	Lake Louise	1984
Moose Creek	Glennallen	1983
Moose Lake	Chitina	1969,72
Moose Lake	Tolsona	1968-70,72-75,84
Muskrat Lake	Gakona	1970
Nita Lake	Sourdough	1968
Pipeline Lake	Cordova	1967,68,70,73
Pippen Lake	Tonsina	1967-69
Poplar Grove Creek	Glennallen	1983,84
Quarry Lake	Cordova	1968,69
Ruth Lake	Chitina	1972
Sawmill Lake	Chitina	1969
Squirrel Creek Lake	Tolsona	1968-70,72,73,75-79,81,83,84
Thompson Lake	Valdez	1974,78,81,83
Three Mile Lake	Chitina	1984
Tolsona Lake	Tolsona	1968-70,72,73,75-79,81,83,84
22 Mile Lake	Cordova	1974-77
Two Mile Lake	Chitina	1984
Tonsina Pit	Tonsina	1977

Source: ADF&G 1984b.

a Some 1984 data were available and are included in this table; however, this is not a complete record for 1984.

sportfishing postal survey program was instituted in 1977 (Mills 1983).

III. KNIK ARM DRAINAGE AND ANCHORAGE AREA

The boundaries of the Knik Arm Drainage Area and the Anchorage Area (Sport Fish Postal Survey Areas K and L) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Grayling are found in the upper Matanuska River drainage as far west as Chickaloon River (ADF&G 1978, 1984a). They are also found in several Matanuska Valley lakes, such as Harriet and Canoe lakes in the Kepler-Bradley lake complex in Palmer, Seventeen Mile Lake near Sutton, and Long Lake and Lower Bonnie Lake near mile 85 of the Glenn Highway. Grayling populations in many of these lakes were established or supplemented by stocking programs (Engel 1974, Watsjold 1975, Watsjold 1976).

Grayling were also stocked in some lakes in the Anchorage Area (Mirror Lake, 6-Mile Lake, Delong Lake, Jewel Lake) during this time (Kubik and Riis 1976, Kubik and Chlupach 1975, Redick 1970). A small harvest of grayling had been reported from Mirror Lake annually until 1982, but it is unlikely that any of the other stocked lakes still contain grayling.

B. Abundance

1. Summary of data. Several lakes stocked with grayling in the Matanuska Valley and Anchorage were test-netted annually until 1977. Population fluctuations, however, were related to stocking densities and the survival of stocked fry and so do not provide a measure of the size and viability of the populations after stocking has ceased. Long Lake and Lower Bonnie Lake, which contain wild populations of grayling, were last test-netted in 1975. The catch per net hour in Lower Bonnie was 0.36 per net hour for age I+ grayling and 0.04 per net hour for age II+. The catch per net hour from Long Lake was 0.14 grayling per net hour for ages I-V combined (Watsjold 1976).

2. Habitat enhancement efforts. Grayling are stocked in several lakes in the Matanuska Valley and in the Anchorage Area (table 3). Some of these lakes in the Matanuska Valley now contain self-sustaining populations.

IV. EAST SIDE SUSITNA AND WEST SIDE COOK INLET-WEST SIDE SUSITNA RIVER DRAINAGES

The boundaries of the East Side Susitna Area and the West Side Cook Inlet-West Side Susitna River Drainage Areas (Sport Fish Postal Survey Areas M and N) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Grayling are found in nearly all tributaries of the Susitna River, especially the clearwater tributary systems, most notably Lake

Table 3. Knik Arm Drainage and Anchorage Area Waters Stocked with Grayling, 1966-83[a]

Water	Location	Year(s) Stocked
Bodenburg Pond	Butte	1969
Campbell Creek	Anchorage	1968
Campbell Point Lake	Kulis ANG Base	1967
Canoe Lake	Matanuska	1976-78,81,83,84
Canyon Lake	Ft. Richardson	1966
Connors Lake	Anchorage	1970,72,73
Delong Lake	Anchorage	1969
Gooding Lake	Palmer	1968-70
Goose Lake	Anchorage	1968
Harriet Lake	Palmer	1969,70-78,81
Jewel Lake	Anchorage	1969
Johnson Lake	Matanuska	1984
Klaire Lake	Matanuska	1969,70
Little Susitna River	Houston	1969,77
Long Lake	Chickaloon	1966,69,72,76,78
Long Lake	Matanuska	1981,83,84
Lower Bonnie Lake	Chickaloon	1969
Lower Meadow Creek	Big Lake	1977
Meirs Lake	Palmer	1970,72-78,81,83,84
Mirror Lake	Chugiak	1974-78
Reed Lake	Wasilla	1969
Rocky Lake	Big Lake	1969
6-Mile Lake	Elmendorf AFB	1974
Sliver Lake	Matanuska	1969,70
Twelve Mile Lake	Willow	1968
Twin Island Lake	Point Mackenzie	1969
Upper Bonnie Lake	Chickaloon	1969
Upper Susitna Lake	Willow	1968
Weiner Lake	Chickaloon	1972
Wishbone Lake	Jonesville	1984
Woman Lake	Talkeetna	1970

Source: ADF&G 1984b.

a Some 1984 data were available and are included in this table; however, this is not a complete record for 1984.

Creek, Chunilna Creek (Clear Creek), Peters Creek, and the Talachulitna River (ADF&G 1978). From May to October 1983, large numbers of grayling were captured using electroshockers and nets at miles 137 to 138 of the main stem Susitna, Lane Creek, Indian River, Portage Creek, Whiskers Creek Slough, and mile 150.1 of the mainstem Susitna (Sundet and Wenger 1984). In 1982, large numbers of grayling were also taken at Jack Long Creek (ibid.).

Summer rearing of grayling in the main stem Susitna appears to be limited to younger age class fish, which are apparently unable to maintain territories in the more favorable habitat of the clear-water tributaries (ibid.). Radio-tagging studies indicate that grayling overwinter in the main stem Susitna River, with two apparent areas of concentration, one being a 20-mi reach between Deadman Creek and Kosina Creek and the other between river miles 153.0 and 156.0 in Devil Canyon (ADF&G 1983a). It is also believed that significant numbers of grayling overwinter in Portage Creek, a Susitna River tributary characterized by many deep (6 m) pools (Sundet and Wenger 1984). Many grayling also overwinter in the deep pools in Deadman Creek (Sautner and Stratton 1984).

B. Abundance

1. Summary of data. Little information is available concerning grayling abundance in Areas M and N. Grayling populations in several upper Susitna River streams, however, have been studied; and population estimates for the lower reaches of several streams and for nearly the entire length of Deadman Creek have been produced (ADF&G 1983b, Sautner and Stratton 1984). A discussion of the methods used to produce these estimates is given in section I.E. of this report. The highest number of grayling per acre was found in Deadman Creek, the lowest in Watana Creek (table 4).
2. Habitat enhancement efforts. With the exception of a 1970 stocking in Woman Lake, grayling have not been stocked in any lakes of Areas M or N, nor have any extensive habitat improvement efforts taken place.

V. KENAI PENINSULA AREA

The boundaries of the Kenai Peninsula Area (Sport Fish Postal Survey Area P) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Arctic grayling are not native to the Kenai Peninsula; however, stocking efforts begun by the USFWS at Crescent Lake in 1952 have resulted in a few self-sustaining populations in streams of the upper Kenai River drainage (ADF&G 1978, Nelson 1983). Sizable populations of grayling are also present in Twin, Bench, South Fuller, Grayling, and Paradise lakes (ADF&G 1978, Hammarstrom 1975, Engel 1968).

Table 4. Arctic Grayling Population Estimates for the Lower Reaches of Upper Susitna River Tributaries, 1982

Tributary	Distance Surveyed[a]	Population Estimate	95% Confidence Interval	Grayling/ Acre
Oshetna River[b]	2.2	2,426	1,483-4,085	56
Goose Creek	1.2	949	509-1,943	90
Jay Creek[b]	3.5	1,592	903-3,071	101
Kosina Creek[b]	4.5	5,544	3,792-8,543	69
Watana Creek[b]	11.9	3,925	1,880-6,973	44
Deadman Creek[c,d]	0.3	734	394-1,502	273
Tsusena Creek[e]	0.4	1,000	743-1,530	---
Fog Creek[e]	2.5	176	115-369	---

Source: ADF&G 1983b.

--- means no data were available.

a Miles from the mouth of tributary.

b Sampling effectiveness was low in this tributary, and the resulting population estimate is probably low.

c Recapture information indicates a significant amount of migration into and out of Deadman Creek. For this reason, the 1982 population estimate is probably high.

d The arctic grayling populations in lower (mile 3.7 to 4.6), middle (mile 10.6 to 11.6), and upper (mile 16.6 to 17.5) sections of Deadman Creek were estimated by the original Schnabel method in 1984 to be 358 grayling/mile, 315 grayling/mile, and 858 grayling/mile, respectively. The 95% confidence intervals for the estimates were 194 to 760, 187 to 572, and 550 to 1,417, respectively (Sautner and Stratton 1984). The otal estimate of catchable sized grayling for the 18.5 mi of Deadman Creek between mile 0.6 and the outlet of Deadman Lake (mile 19.1) is 8,000 fish (ibid.).

e 1981 estimates.

B. Abundance

1. Summary of data. Few studies of grayling abundance on the Kenai Peninsula have been conducted in the last 10 years. The increased harvest of grayling at the confluence of the Kenai and Russian rivers, however, may indicate that the upper Kenai River grayling population is expanding (Nelson 1983).

   In 1974, a mark-and-recapture study was carried out to estimate the population size of grayling in Bench Lake, located on a U.S. Forest Service trail 8 mi south of the Granite Creek Campground. In 1967, 240 age I grayling were transplanted from Crescent Lake to Bench Lake. The grayling spawning population in Bench Lake in 1974 was estimated to be 1,931 fish (Hammarstrom 1975).

2. Habitat enhancement efforts. Grayling have been stocked in several lakes on the Kenai Peninsula (table 5); however, not all stocking efforts resulted in self-sustaining populations. Lakes containing self-sustaining populations of grayling are remote, with access only by trail or float plane (ADF&G 1978). In 1973 through 1978, attempts were made to establish harvestable populations in Iceberg, Bernice, Grewink, and Hazel lakes, which are more readily accessible (Wallis and Hammarstrom 1979; Logan, pers. comm.). None of these stocking or transplant efforts, however, have resulted in self-sustaining populations (ibid.). Grayling from Crescent Lake have also been transplanted to Seldovia Lake, near Seldovia (Hammarstrom 1978, Hammarstrom and Wallis 1981).

Table 5. Kenai Peninsula Area Waters stocked with Grayling, 1966-83[a]

Water	Location	Year(s) Stocked
Bernice Lake	Soldotna	1976
Clear Lake	Halibut Cove	1973
Iceberg Lake	Skilak lake	1970
South Fuller Lake	Skilak Lake	1967

Source: ADF&G 1984b; Logan, pers. comm.

a This table does not include transplants of grayling from one lake to another.

REFERENCES

ADF&G. 1978. Alaska's fisheries atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.]. ADF&G. 43 pp. + 153 maps.

________. 1983a. Susitna Hydro aquatic studies. Phase 2: Basic data rept. Winter aquatic studies (October, 1982 - May, 1983). 137 pp. + appendices.

________. 1983b. Susitna Hydro aquatic studies. Phase 2: Basic data rept. Vol. 5: Upper Susitna River impoundment studies, 1982. 152 pp. + appendices.

________. 1984a. An atlas to the fish and wildlife resources element for the Susitna area planning study. Div. Habitat, Anchorage.

________. 1984b. Fish release records for regions 01, 02, and 03. Computer printouts, 07 Aug 1984. Div. FRED, Anchorage. 209 pp.

Armstrong, R.H. A review of arctic grayling studies in Alaska. Contrib. No. 6, Alaska Coop. Fish Res. Unit, Univ. Alaska, Fairbanks. 60 pp.

Bendock, T.N. 1980. Inventory and cataloging of arctic area waters. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-I.

Engel, L.J. 1968. Inventory and cataloging of the sport fish and waters in the Kenai, Cook Inlet-Price William Sound areas. ADF&G, Fed. Aid in Fish Rest. Ann. prog. rept. Vol. 9. Proj. F-5-R-9, Job 7-A.

________. 1971. Evaluation of sport fish stocking on the Kenai Peninsula-Cook Inlet areas. ADF&G, Fed. Aid in Fish Rest. Ann. prog. rept. Vol. 21. Proj. F-9-3, Job G-11-F.

________. 1973. Inventory and cataloging of Kenai Peninsula, Cook Inlet, and Prince William Sound drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. prog. rept. Vol. 14. Proj. F-9-5, Job G-I-C.

________. 1974. Inventory, cataloging, and population sampling of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 15. Proj. F-9-6, Job G-I-D.

Grabacki, S. 1981. Effects of exploitation on the population dynamics of Arctic grayling in the Chena River, Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 118 pp.

Hammarstrom, S. 1975. Inventory and cataloging of Kenai Peninsula, Cook Inlet, and Prince William Sound fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. 5-9-7, Job G-I-C.

_______. 1978. Inventory and cataloging of Kenai Peninsula, Cook Inlet and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. F-9-10, Job G-I-C.

Hammarstrom, S., and J. Wallis. 1981. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-C.

Kubik, S.W., and R.S. Chlupach. 1975. Inventory and cataloging of sport fish and sport fish waters of the Lower Susitna and Central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. F-9-7, Job G-I-H.

Kubik, S.W., and J.C. Riis. 1976. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and Central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 17. Proj. F-9-8, Job G-I-H.

Logan, S.M. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Soldotna.

Mills, M.J. 1983. Statewide harvest survey 1982 data. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job SW-I-A.

Nelson, D.C. 1983. Russian River sockeye salmon study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. AFS-44-9-S.

Netsch, N. 1975. Fishery resources of waters along the route of the trans-Alaska pipeline between Yukon River and Atigun Pass in northcentral Alaska. USFWS. Resource Publication 124. 45 pp.

Redick, R.R. 1970. Inventory and cataloging and population sampling of sport fish and sport fish waters of the Cook Inlet drainage. ADF&G, Fed. Aid in Fish Rest. Ann. prog. rept. Vol 11. Proj. F-9-2, Job 11-A.

Sautner, J.S., and M.E. Stratton. 1984. Access and transmission corridor studies. Part 1 in D.C. Schmidt, C.C. Estes, D.L. Crawford, and D.S. Vincent-Lang, eds. ADF&G Susitna Hydro aquatic studies. Rept. 4: Access and transmission corridor aquatic investigations (July-October 1983).

Sundet, R.L., and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below Devil Canyon. Part 5 in D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, eds. ADF&G Susitna Hydro aquatic studies. Rept. No. 2: Resident and juvenile anadromous fish investigations (May-October 1983).

Tack, S.L. 1980. Distribution, abundance, and natural history of the Arctic grayling in the Tanana River drainage. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job R-I-A.

Wallis, J., and S. Hammarstrom. 1979. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-C.

Watsjold, D.A. 1975. Inventory, cataloging, and population sampling of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. F-9-7, Job G-I-D.

________. 1976. Inventory, cataloging, and population sampling of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 17. Proj. F-9-8, Job G-I-D.

Williams, F.T. 1979. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-F.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Glennallen, Ak.

Williams, F.T., and W.D. Potterville. 1978. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. F-9-10, Job G-I-F.

________. 1980. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and Upper Susitna River drainges. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-F.

________. 1981. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-F.

________. 1982. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainges. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-F.

________. 1983. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainges. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-F.

Burbot Distribution and Abundance

I. REGIONWIDE INFORMATION

The distribution and abundance of burbot will be discussed according to ADF&G, Division of Sport Fish postal survey areas (map 1) in this report. Sport harvest information is presented in the Sport Use and Economic Value narrative of this volume.

A. Regional Distribution

Burbot in the Southcentral Region inhabit waters ranging from shallow, eutrophic lakes to cold, deep, oligotrophic lakes and interconnecting waterways (ADF&G 1978). Burbot occur in many lakes and some rivers of the Copper River-Upper Susitna area (ADF&G 1977a). The main stem Susitna River and some of its tributaries support burbot, as do some lakes in the Matanuska and Susitna valleys (ADF&G 1978).

Burbot are not widely distributed in the Cook Inlet area (ADF&G 1977b). In the Prince William Sound (PWS) area, burbot are present in McKinley Lake (ADF&G 1978).

B. Areas Used Seasonally and for Life Functions

A series of freshwater fish distribution maps at 1:250,000 scale have been produced for this report. The categories of mapped information are as follows:

- ° General distribution
- ° Documented presence in stream or lake
- ° Documented spawning areas
- ° Undocumented areas

C. Factors Affecting Distribution

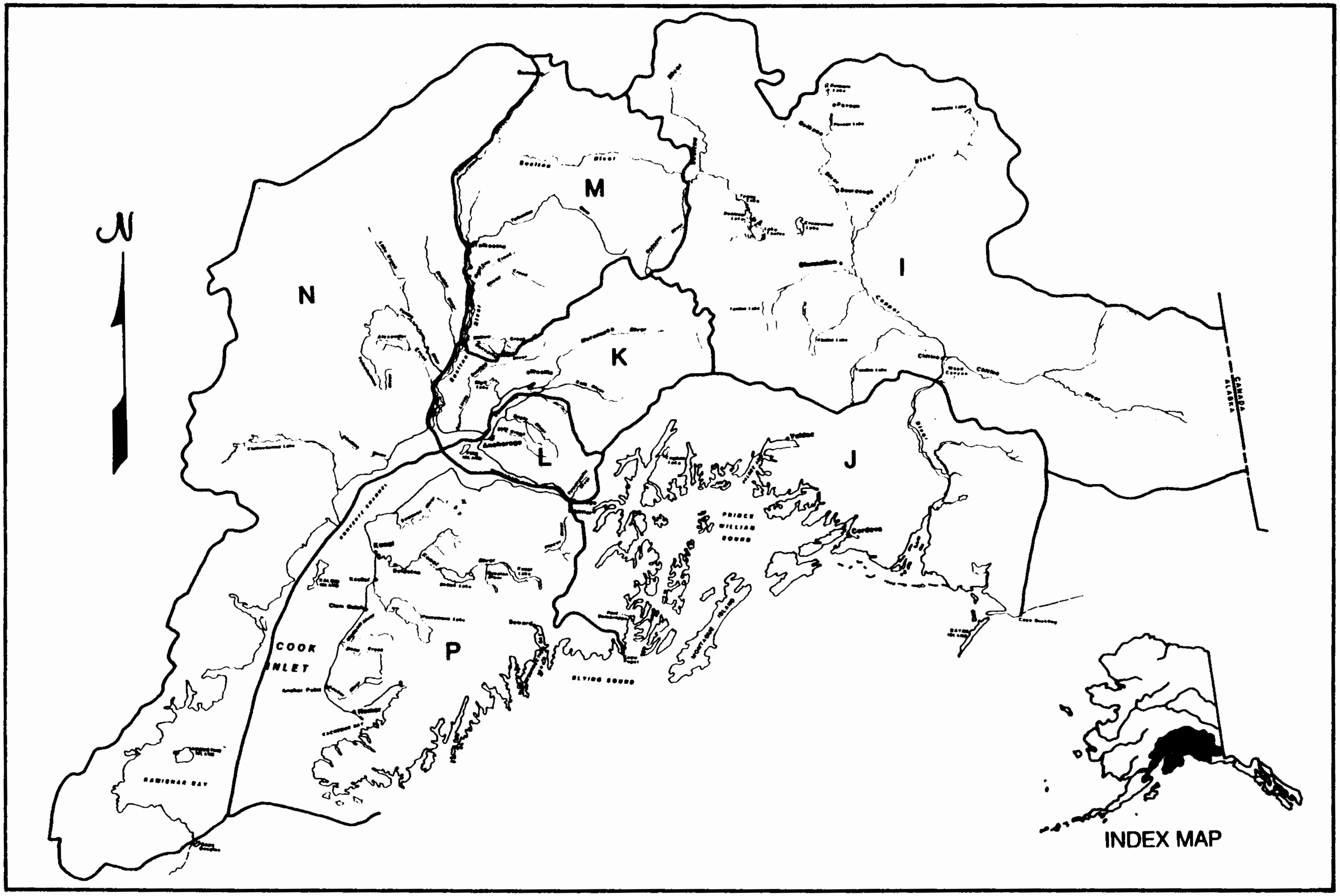
Physical factors such as salinity and temperature influence the distribution of burbot. (For detailed information, see the burbot Life History and Habitat Requirements narrative in volume 1.)

D. Movements Between Areas

During most of their life history, burbot are rather sedentary; however, there appear to be definite movements toward spawning areas. Burbot move to spawning areas individually, rather than in schools, and they may move to a feeding area after spawning (Morrow 1980).

Monitoring radio-tagged burbot over the winters of 1981-1982 and 1982-1983 disclosed that burbot concentrate in specific areas and migrate little during the winter in the Susitna River (ADF&G 1983c). Since burbot are winter spawners and winter monitoring data have shown that burbot utilize the main stem Susitna River more than was formerly believed during the assumed spawning period, burbot may spawn in the main stem as well as in tributaries and sloughs.

Monitoring of radio-tagged burbot throughout the winter has shown that the prespawning migration apparently begins in mid September



Map 1. ADF&G sport fish postal survey areas.

and lasts to mid January (ibid.). Burbot movements that may be attributed to postspawning behavior begin in early February and last until mid March. A slight postspawning movement downriver was observed. The high catches of incidental burbot in areas where radio-tagged fish were overwintering also suggests that burbot concentrate in specific areas to overwinter (ibid.).

E. Population Size Estimation

Populations of burbot have not been well studied in Alaska, and except for a few isolated cases population size has not been estimated.

F. Regional Abundance

Only limited information on burbot is available, most of which applies to specific lakes or rivers. This information will be included in the following management area sections.

II. GLENNALLEN AND PRINCE WILLIAM SOUND AREAS

The boundaries of the Glennallen and PWS areas (Sport Fish Postal Survey Areas I and J) are described in section I.E. of the Sport Use of and Economic Value narrative in this volume.

A. Distribution

Populations of burbot occur throughout the Glennallen Area. The large lakes in the area, Tazlina Lake, Klutina Lake, Lake Louise, Susitna lake, and Crosswind (Charley) Lake, all contain burbot (Mills 1979-1983, ADF&G 1978). Many of the smaller lakes in the area from Lake Louise south to Tazlina Lake and east to the Copper River also support burbot (Mills 1979-1983, ADF&G 1978). Farther north, burbot are present in Paxson Lake and the Tangle Lakes area (Mills 1979-1983, ADF&G 1978).

Burbot are less abundant in the PWS Area. A population is present in McKinley Lake, near Cordova (ADF&G 1978).

B. Abundance

Few abundance estimates for populations of burbot in the Glennallen-PWS areas are available. Lakes in the Glennallen area have occasionally been test netted to determine relative indices of abundance of burbot (Williams 1979; Williams and Potterville 1978, 1980-1983). Experience has shown, however, that test nets do not catch burbot at the same rate as other fishes in relation to their actual abundance (Williams, pers. comm.).

III. KNIK ARM DRAINAGE AREA AND ANCHORAGE AREA

The boundaries of the Knik Arm Drainage and Anchorage areas (Sport Fish Postal Survey Areas K and L) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Burbot have not been reported in the Anchorage Area; however, they are believed to be present in some sections of the Knik River and its tributaries (Mills 1979-1983). Burbot have been found in Red Shirt Lake in the Nancy Lake State Recreation Area (ADF&G 1978), and sport harvest information indicates that they are also present in the Little Susitna River (Mills 1979-1983).

B. Abundance

No abundance estimates for populations of burbot in the Knik Arm Drainage-Anchorage areas are available.

IV. EAST SIDE SUSITNA AREA AND WEST SIDE COOK INLET-WEST SIDE SUSITNA RIVER DRAINAGE AREA

The boundaries of the East Side Susitna Area and the West Side Cook Inlet-West Side Susitna River Drainage Area (Sport Fish Postal Survey Areas M and N) are described in section I.E. of the Sport Use and Economic Value narrative in this volume.

A. Distribution

Many rivers in the Susitna area support populations of burbot. The main stem Susitna River and its larger tributaries, the Yentna, Chulitna, Talkeetna, and Swentna rivers, contain large populations of burbot (ADF&G 1978). Sport harvest information shows that some of the smaller Susitna tributaries, such as Sunshine, Montana, Sheep, and Alexander creeks, also contain burbot (Mills 1979-1983).

B. Abundance

Sites along the Susitna River have been sampled by trotline to determine relative indices of abundance. In 1982, seven sites along the main stem upper Susitna River were sampled, yielding catches that ranged from 0.6 to 3.5 fish/trotline day, with a mean of 0.7 (ADF&G 1983a). In 1981, eight tributaries of the upper Susitna were sampled near the confluence with the main river. The tributaries were Fog, Tsusena, Deadman, Watana, Kosina, Jay, Goose, and Oshetna, and burbot were collected at all locations. The catches by tributary ranged from 0.17 to 1.14 fish/trotline day, with Jay, Watana, and Goose creeks yielding the highest catches (ADF&G 1981a).

In the lower Susitna River, burbot abundance is probably greatest in main stem areas, and catches are usually smaller at tributary mouths above the confluence (ADF&G 1983b). In 1981, burbot were sampled at various sites in the lower Susitna, with the mouth of the Deshka River and the mouth of Alexander Creek yielding relatively high catch rates (ADF&G 1981b).

V. KENAI PENINSULA AREA

The boundaries of the Kenai Peninsula Area (Sport Fish Postal Survey Area P) are described in section I.E. of the Sport Use and Economic Value narrative in this volume.

A. Distribution

Burbot are not widely distributed on the Kenai Peninsula. A population is present in Juneau Lake, where it was probably introduced (ADF&G 1978). Mills (1979-1983) reports the presence of burbot in Trail Creek; however, these fish were probably misidentified (Logan, pers. comm.).

B. Abundance

No abundance estimates for burbot populations on the Kenai Peninsula are available.

REFERENCES

ADF&G. 1978. Alaska's fisheries atlas. Vol 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + maps.

________. 1981a. Resident fish investigation of the upper Susitna River. Susitna Hydro aquatic studies. Phase 1: Final draft rept. Anchorage. 136 pp.

________. 1981b. Resident fish investigation on the lower Susitna River. Susitna Hydro aquatic studies. Phase 1: Final draft rept. Anchorage.

________. 1983a. Upper Susitna River impoundment studies, 1982. Susitna Hydro aquatic studies. Phase II: Basic data rept. Vol. 5. Anchorage. 152 pp.

________. 1983b. Resident and juvenile anadromous fish studies on the Susitna River below Devil Canyon, 1982. Susitna Hydro aquatic studies. Phase II: basic data rept. Vol. 3. Anchorage. 277 pp.

________. 1983c. Winter aquatic studies, October 1982-May 1983. Susitna Hydro Aquatic Studies, Phase II, basic data rept. Anchorage. 137 pp.

ADF&G, comp. 1977a. A compilation of fish and wildlife resource information for the State of Alaska. Vol. 2: Sport fisheries. Juneau. 234 pp.

________. 1977b. A fish and wildlife resource inventory of the Cook Inlet - Kodiak areas. Vol 2: Fisheries. Juneau. 443 pp.

Logan, S. 1984. Personal communication. ADF&G, Area Mgt. Biologist, Div. Sport Fish, Soldotna.

Mills, M.J. 1979 through 1983. Statewide harvest study - 1977 through 1982 data. Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vols. 20-24. Study SW-I-A. ADF&G, Div. Sport Fish, Juneau.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Anchorage: Alaska Northwest Publishing Co. 248 pp.

Williams, F.T. 1979. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-F.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Glennallen.

Williams, F.T., and W.B. Potterville. 1978. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William

Sound and the Upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. F-9-10, Job G-I-F.

________. 1980-1983. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vols. 21-24. Job G.I.F.

Lake Trout Distribution and Abundance

I. REGIONWIDE INFORMATION

The distribution and abundance of lake trout will be discussed by ADF&G, Division of Sport Fish postal survey areas (map 1) in this report. Sport harvest information is presented in the Sport Use and Economic Value narrative of this volume.

A. Regional Distribution

Lake trout are typically found in cold, deep, oligotrophic lakes and rivers throughout the Kenai, Susitna, and Copper river drainages (ADF&G 1978, Mills 1979-1983). Their habitat includes both glacial and clearwater systems (ADF&G 1977). In the upper Copper and Susitna river areas, lake trout are widely distributed and inhabit many lakes and interconnecting waterways (ADF&G 1978). On the Kenai Peninsula, lake trout are limited to deep lakes near the Kenai Mountains (ibid.).

B. Areas Used Seasonally and for Life Functions

A series of freshwater fish distribution maps at 1:250,000 scale have been produced for this report. The categories of mapped information are as follows:

- ° General distribution
- ° Documented presence in stream or lake
- ° Documented spawning areas
- ° Undocumented areas

C. Factors Affecting Distribution

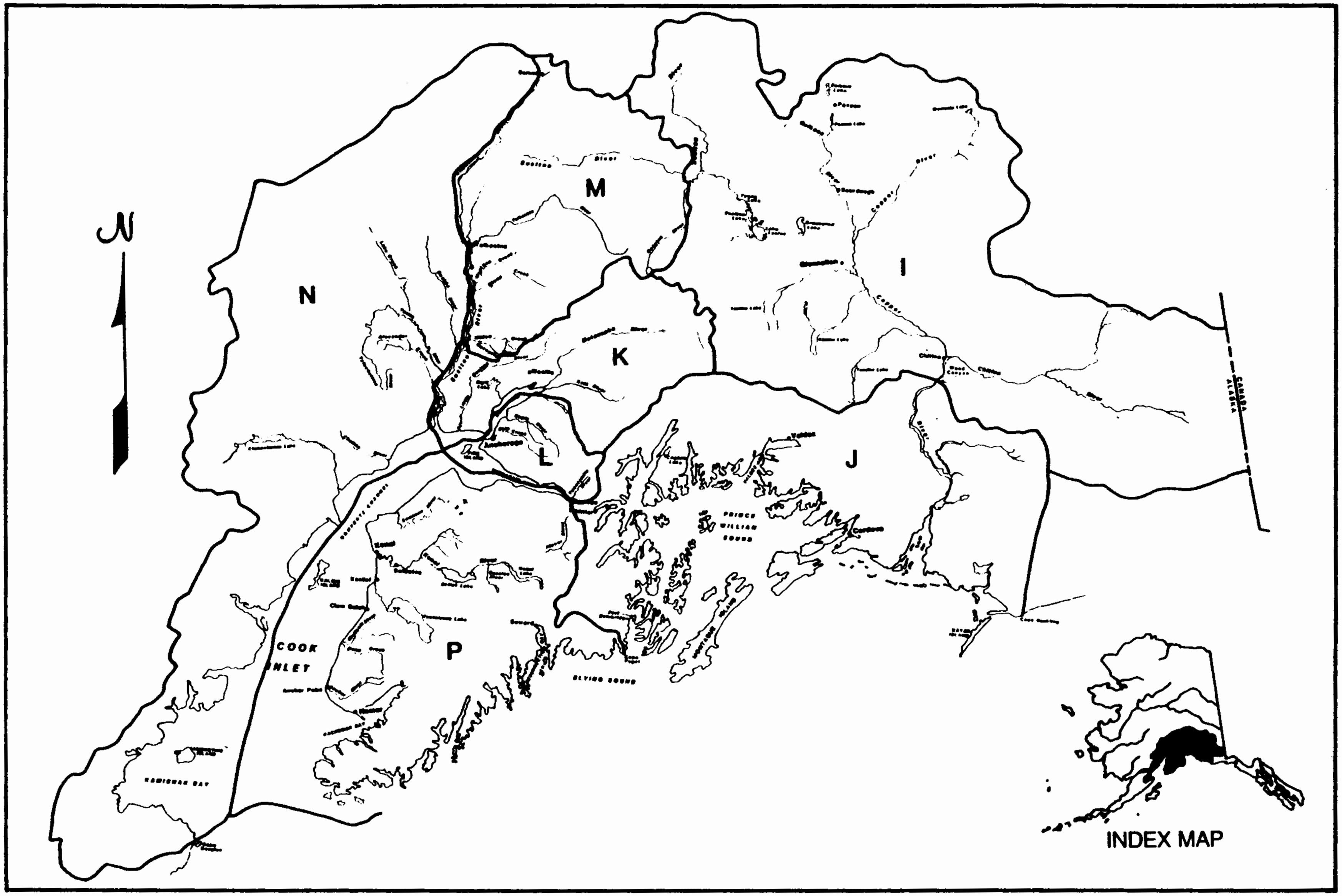
Physical factors such as salinity, temperature, and lake depth influence the distribution of lake trout. (For detailed information, see the Lake Trout Life History and Habitat Requirements narrative.)

D. Movements Between Areas

Lake trout populations do not migrate in definite directions, but tagged individuals have shown extensive wandering (Rawson 1961). The extent of their movements is limited by the size of the body of water; however, small fish move shorter distances than larger fish (Morrow 1980). Lake trout move primarily in response to changing water temperature. In the fall, most of the larger fish move into shallow water to spawn. After spawning, lake trout disperse throughout the lake for the winter months (Rawson 1961). By spring, the fish are widespread, and as the water warms to above 10°C, they move back into deeper, cooler water and congregate below the thermocline during summer (ibid.). Rawson (1961) presents evidence for homing of the fish to the same spawning grounds in the fall.

E. Population Size Estimation

Populations of lake trout have not been well studied in Alaska, and except for a few isolated cases population size has not been estimated.



Map 1. ADF&G sport fish postal survey areas.

F. Regional Abundance

Only limited information on lake trout is available, most of which applies to specific lakes. This information will be included in the following management area sections.

II. GLENNALLEN AND PRINCE WILLIAM SOUND AREAS

The boundaries of the Glennallen and Prince William Sound (PWS) areas (Sport Fish Postal Survey Areas I and J) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Populations of lake trout occur throughout the Glennallen area. The large lakes in this area (Tazlina Lake, Klutina Lake, Lake Louise, Susitna Lake, and Crosswind [Charley] Lake) all contain lake trout (Mills 1979-1983). Many of the smaller lakes in the area from Lake Louise south to Tazlina Lake and east to the Copper River also support lake trout (ibid.). Farther north, lake trout are present in Paxson Lake, Summit Lake, and many smaller lakes in the area (ibid.). Lake trout are found in the Tangle Lakes and surrounding waters along the Denali Highway, portions of which are just outside the Glennallen Area in Sport Fish Postal Survey Area U. Lake trout have also been reported in the Gulkana and Copper rivers (ibid.).

The only known population of lake trout in the PWS area is present in Lake Tokun, a clearwater lake on the east side of the Copper River Delta (ADF&G 1978). The origin of this population is unknown.

B. Abundance

Few abundance estimates for populations of lake trout in the Glennallen and PWS areas are available. Paxson Lake and Lake Louise-Susitna Lake are popular sport fisheries, but aside from limited tagging studies conducted in Lake Louise-Susitna Lake by the ADF&G, Division of Sport Fish, in the late 1960's, only harvest data have been collected.

Lakes in the Glennallen area have occasionally been test-netted to determine relative indexes of abundance of lake trout (Williams 1979, Williams and Potterville 1980-1983). The lakes were not sampled annually, but in 1979 Hanagita Middle Lake yielded .62 lake trout/net hour, and the 1980 sampling at Bell Lake resulted in a catch of .48 lake trout/net hour (ibid.). Other lakes sampled from 1979 through 1982 that yielded lower catch rates than Hanagita, Middle, and Bell lakes were Jack, Little Lake Louise, Octopus, and Roberta lakes.

III. KNIK ARM DRAINAGE AND ANCHORAGE AREAS

The boundaries of the Knik Arm Drainage and Anchorage areas (Sport Fish Postal Survey Areas K and L) are described in section I.E.1. of the Sport Use and Economic Value of Freshwater Fish in this volume.

A. Lake trout have not been reported in the Anchorage area; however, they occur in several systems of the Knik Arm Drainage area. Big

Lake supports a lake trout population (Mills 1979-1983). Lake trout are also found in the Nancy Lake State Recreation Area, including Nancy Lake (ibid.) and Red Shirt Lake (ADF&G 1978). Mills' study (1979-1983) reported lake trout in the Little Susitna River.

B. Abundance

No abundance estimates for populations of lake trout in the Knik Arm Drainage-Anchorage areas are available.

IV. EAST SIDE SUSITNA AND WEST SIDE COOK INLET-WEST SIDE SUSITNA RIVER DRAINAGES

The boundaries of the East Side Susitna and the West Side Cook Inlet-West Side Susitna River drainages (Sport Fish Postal Survey Areas M and N) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Lake trout are present in a few of the large, deep lakes in the area, such as Byers, Shell, Chelatna, and Swan lakes (ADF&G 1978), near the Alaska and Talkeetna mountain ranges. Beluga and Chakachamna lakes, large lakes on the west side of Cook Inlet, also contain lake trout populations (Mills 1979-1983). Several lakes in the Broad Pass area, including Summit Lake (ibid.), and Wonder Lake in Denali National Park (ADF&G 1978) support lake trout. Lake trout also occur in Sally Lake, a clear, oligotrophic tundra lake, which drains into Watana Creek (ADF&G 1983), and in Deadman Lake (Sautner and Stratton 1984).

B. Abundance

The lake trout population of Sally Lake was sampled by hook and line, hoop nets, and gill nets in an attempt to estimate the population size (ADF&G 1983). The captured lake trout were tagged, but too few fish were recaptured to provide a population estimate.

The lake trout in Deadman Lake were sampled by hook and line (Sautner and Stratton 1984). Limited otolith age-length data suggest that the population is very small and comprised of very old fish. The capture of no juvenile lake trout and only one fish under age 15 suggests that mortality is high during the younger age classes and levels off in the older age classes.

V. KENAI PENINSULA

The boundaries of the Kenai Peninsula Area (Sport Fish Postal Survey Area P) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution.

Lake trout are found in the large, deep lakes of the Kenai Peninsula, including Kenai, Tustumena, and Skilak lakes (ADF&G 1978). Smaller, deep lakes, such as Hidden and Trail lakes, also contain lake trout populations (ibid.). Lake trout occur in Juneau, Swan, and Trout lakes; however, these populations were probably introduced, as these lakes lie above barriers to other

Kenai River drainage populations (ibid.). Lake trout have been reported in the Kenai and Kasilof rivers (Mills 1979-1983).
In 1969 and 1970, lake trout were introduced into Upper Summit Lake after studies suggested favorable conditions for establishing a self-sustaining population (Engel 1971). Upper Summit Lake is a cold, oligotrophic lake with an abundant population of small Dolly Varden for forage. In 1969, 204 lake trout were transplanted from Skilak Lake, where fish growth is slow because of its low productivity. Only 12 lake trout were transplanted in 1970 (ibid.). No further information is available on the success of the introduced lake trout population in Upper Summit Lake.

B. Abundance

No abundance estimates for lake trout populations on the Kenai Peninsula are available.

REFERENCES

ADF&G, comp. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol 2: Fisheries. [Juneau.] 443 pp.

________. 1978. Alaska's fisheries atlas. Vol 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + maps.

________. 1983. Upper Susitna River impoundment studies. Susitna Hydro aquatic studies. Phase II: basic data rept. Vol 5. Draft. Anchorage. 152 pp. + appendices.

Engel, L.J. 1971. Evaluation of sport fish stocking on the Kenai Peninsula - Cook Inlet areas. ADF&G, Fed. Aid in Fish Rest. Ann. prog. rept. Vol 12. Proj. F-9-3, Job G-II-F.

Mills, M.J. 1979 through 1983. Statewide harvest study: 1977 through 1982 data. Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vols. 20-24, Study SW-I-A. ADF&G, Div. Sport Fish., Juneau.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Anchorage: Alaska Northwest Publishing Co. 248 pp.

Rawson, D.S. 1961. The lake trout of Lac la Ronge, Saskatchewan. J. Fish. Res. Bd. Can. 18:423-462.

Sautner, J., and M. Stratton. 1984. Access and transmission corridor studies. Part 1 in ADF&G Rept. No. 4., access and transmission corridor aquatic investigation, July-October 1983. Susitna Hydro aquatic studies. Anchorage.

Williams, F.T. 1979. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol 20. Proj. F-9-II, Job G-I-F.

Williams, F.T., and W.D. Porterville. 1980-1983. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vols. 21-24, Job G-I-F.

Rainbow Trout/Steelhead Trout Distribution and Abundance

I. REGIONWIDE INFORMATION

In this report, distribution and abundance information will be presented by Division of Sport Fish postal survey areas, shown on map 1. Information on the level of rainbow-steelhead sport harvest is contained in the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Regional Distribution

Native rainbow trout are found in most drainages of the northern and western Kenai Peninsula from the Anchor River north to the Chickaloon River (ADF&G 1978). Large populations are found in the Kenai River and its tributaries and in the Swanson and Moose rivers on the northern Kenai Peninsula (ibid.). They are found in the lower Susitna River drainage and, to a lesser extent, in the Matanuska drainage and some of the larger rivers flowing into northwestern Cook Inlet. Large rainbow populations are found in clearwater tributaries to the Susitna, Yentna, Talkeetna, and Skwentna rivers (ibid.). Rainbows are also found in some clearwater tributaries of the Copper River, most importantly the Gulkana River (ibid.). In addition to native fish, several lakes in Southcentral Alaska are stocked with rainbow trout on a put-and-take basis.

Steelhead trout are found in several Kenai Peninsula streams between Homer and the Kasilof River, with the largest of these runs in Deep Creek and Anchor River (ibid.). They are also found in the Copper River drainage, notably the Gulkana River (ibid.).

B. Areas Used Seasonally and for Life Functions

A series of freshwater fish distribution maps at 1:250,000 scale and a series of anadromous fish maps at the same scale have been produced and are available at ADF&G offices. The categories of mapped information on the freshwater fish maps are as follows:

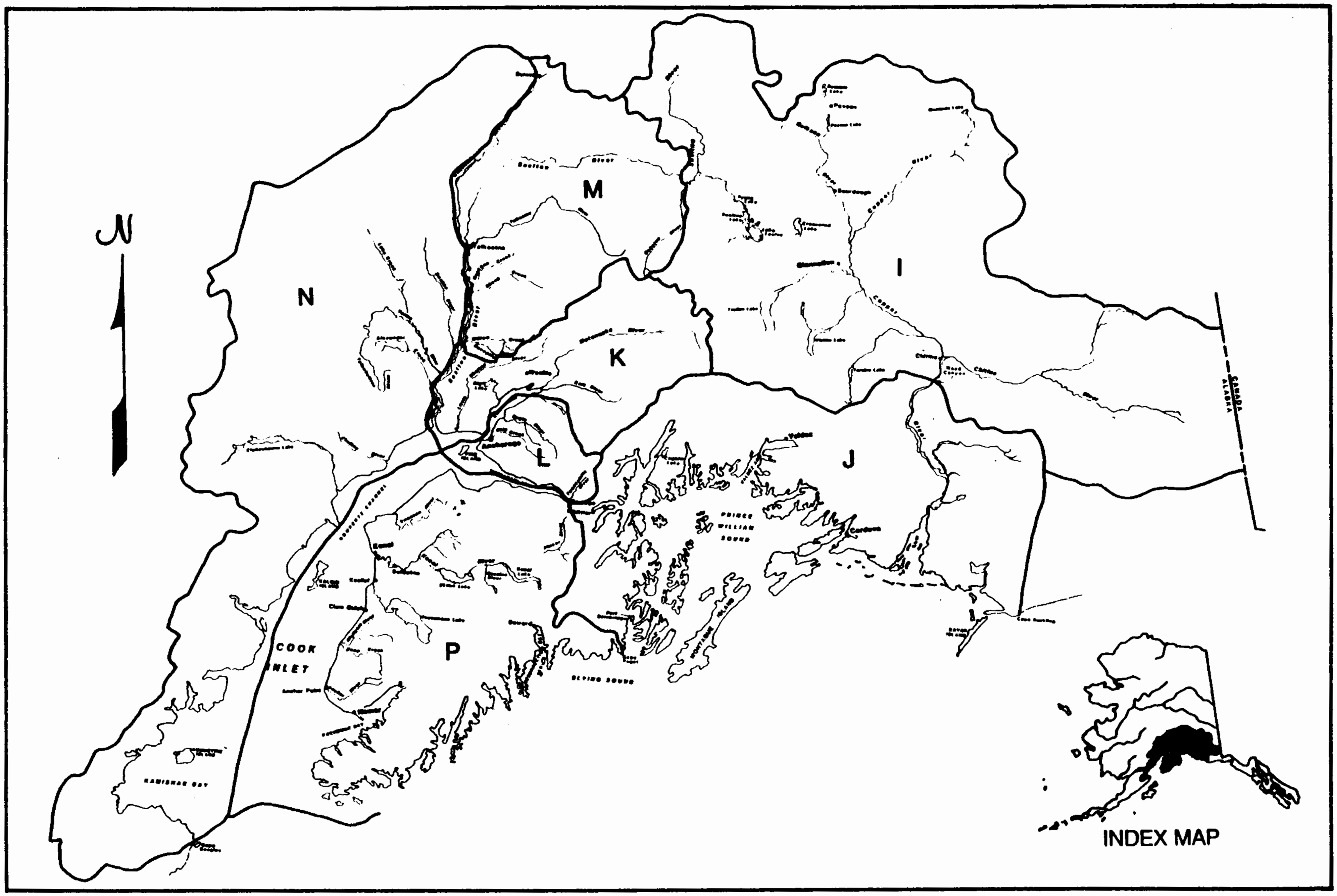
- General distribution
- Documented presence in stream or lake
- Documented spawning areas
- Undocumented areas
- Stocked lakes and streams

The categories of mapped information on the anadromous fish maps are as follows:

- Documented presence in stream or lake
- Anadromous watershed areas
- Unsurveyed watershed areas
- Not present in watershed

C. Factors Affecting Distribution

Water quality parameters, such as dissolved oxygen levels and temperature, and physical characteristics of streams and lakes, such as depth, velocity, and substrate type, all influence rainbow



Map 1. ADF&G sport fish postal survey areas.

trout/steelhead distribution. Details of habitat requirements for rainbow trout/steelhead can be found in the rainbow trout/steelhead Life History in volume 1 of this publication.

D. Movements Between Areas

Rainbow trout and steelhead populations follow several different life history patterns. Some rainbow trout remain in streams for their entire life. Juveniles of other rainbow trout populations move into lakes after a year or more. Rainbows, however, do not spawn in lakes. Most lake-dwelling rainbow trout return to streams to spawn in the spring (Morrow 1980) and usually move back to the lake three to six weeks after leaving it (ibid.). Rainbow in some populations, however, move into streams in the fall, remain in them all winter, and do not return to the lakes until after spawning in the spring (Russell 1977).

Rainbow trout occasionally enter salt water. Rainbows tagged in Noaukta Slough between the Chakachatna and McArthur rivers on the west side of Cook Inlet have been caught by commercial set net fishermen in salt water and by sport fishermen in the Chuitna River, which is accessible only from Noaukta Slough via salt water (Hepler and Delaney, pers. comm.).

Stream-dwelling rainbow trout in the Susitna River overwinter in sloughs and side channels (ADF&G 1983a). After breakup (May to late June) the rainbow move upstream to clearwater tributaries to spawn (ADF&G 1983a, Sundet and Wenger 1984). Preferred summer habitat for Susitna River rainbows are the clearwater tributaries and sloughs upstream from their confluence with the Susitna (ibid.). Beginning in October, rainbow move out of tributary mouths and into suitable overwintering habitat in the main stem of the Susitna (ibid.). Main stem reaches influenced by tributaries may be important overwintering areas (ADF&G 1983b). Results of limited radio telemetry and tag-recapture studies on rainbow trout in the Susitna River indicate that rainbow trout overwinter in relatively short reaches of the main stem Susitna and that their movements are restricted during the winter months (ibid.).

Data indicate that rainbow trout juveniles in the Susitna River rear primarily in the upper reaches of tributaries and move little (Sundet and Wenger 1984).

Steelhead juveniles remain in the stream for generally one to four years (usually two) (Morrow 1980) and then move downstream in the spring and summer to marine waters. Steelhead are found throughout most of the North Pacific Ocean, north of 42° north latitude. Seasonal shifts in distribution of ocean steelhead are associated with changes in water temperature. Ocean steelhead generally move north and west in late winter and early spring and shift to a southeasterly movement in late summer, fall, and early winter (Sutherland 1973).

All steelhead spawn in the spring; their return migration to the streams, however, may take place in spring, summer, or fall (Jones 1978). Spring-run steelhead are nearly ripe when they enter the stream from late February to mid June, and they spawn that same spring, spending about a month in fresh water (Jones 1975). Summer-run steelhead enter the stream in June and July and do not spawn until the following spring (Jones 1978). Fall-run steelhead return from mid September to November and also do not spawn until spring. Steelhead stocks in all streams on the Kenai Peninsula are similar to fall-run fish. Adults enter the streams from late summer through fall and spawn the following spring (Wallis and Ballard 1983). Steelhead in the Copper River drainage are fall-run fish (Burger et al. 1983). Copper River radio-tagging studies indicate that Copper River steelhead overwinter and spawn in the Gulkana and Tazlina river systems the following spring (ibid.). Further studies may document use of other Copper River tributaries for overwintering and spawning (ibid.). Copper River steelhead overwinter in the lower reaches of the Gulkana and Tazlina rivers and move upstream to spawn in May. Limited information from tagged fish indicates that outmigration takes place in June (ibid.).

E. Population Size Estimation

Managed lakes containing stocked populations of rainbow trout are frequently surveyed using gill nets. The catch rates (number of fish per net hour) from these surveys can be used as relative measures of population size in each lake over time but are not used to generate population estimates. These surveys are usually conducted to evaluate the success of rainbow trout stocking programs, and fluctuations in catch per net hour are generally related to variations in the stocking program rather than to natural fluctuations of the population. Tagging studies done by the ADF&G Susitna Hydro Aquatic Studies group in 1984 resulted in a population estimate for rainbow trout in Fourth of July Creek, tributary to the Susitna River (Sundet and Wenger 1984). Rainbow trout at Skilak Lake (Kenai River drainage) have also been tagged (Hammarstrom and Wallis 1981), but too few fish were collected to produce a statistically valid population estimate. Steelhead tagging studies have been conducted on the Anchor River (Wallis and Hammarstrom 1979, Wallis and Ballard 1981), and in 1978 and 1980 these studies resulted in estimates of the Anchor River steelhead run size. These estimates will be discussed in further detail in the following Kenai Area narrative.

F. Regional Abundance

Only a small amount of information on rainbow trout abundance is available. Information that has been collected applies only to specific lakes and streams. As a result, abundance cannot be appropriately addressed at the regional level. Available abundance information is included in the management area discussions that follow.

II. GLENNALLEN AND PRINCE WILLIAM SOUND AREAS

The Glennallen Area and the Prince William Sound (PWS) Area (Sport Fish Postal Survey Areas I and J) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Natural populations of rainbow trout in the Glennallen Area are found in a number of clearwater tributaries of the Copper River, most notably the Gulkana River. Rainbow trout have also been stocked in several Glennallen Area lakes (table 1). Upper, Middle, and Lower Tebay Lakes (68 mi east of Valdez) contain good populations of small rainbow trout that are believed to be the result of stocking programs in the 1950's (Williams and Morgan 1974, Williams 1975).

Steelhead are present in several tributaries of the Copper River drainage. The Gulkana River contains the largest overwintering and spawning population of steelhead in this area (ADF&G 1978). Steelhead trout in the middle fork of the Gulkana River may be the northernmost natural steelhead population in Alaska (Williams, pers. comm.). A cooperative study on the migration habitats of steelhead in the Gulkana River conducted by the BLM, the USFWS, and the ADF&G was initiated in 1982 (ibid.). Migration timing into the Tazlina and Gulkana rivers and spawning areas in the Gulkana River have been located. These fish spawn in the upper middle fork below Dickey Lake (ADF&G 1978), in the main stream of the Gulkana, and in Hungry Hollow (Burger et al. 1983). Steelhead also overwinter and spawn in the Tazlina River system. Tazlina steelhead have been documented spawning in the lower main stem of the Tazlina River and in 8-Mile Creek, Durham Creek, and Kaina Creek (ibid.). Steelhead also spawn in the Hanagita River and Lake system (ADF&G 1978).

In the PWS Area, rainbow trout are generally present only in a few lakes (table 1) that are stocked by the ADF&G (ibid.). Steelhead are found in the lower reaches of the Copper River during the fall and spring as they migrate to and from their more northern spawning areas (ibid.).

B. Abundance

1. Summary of data. Managed lakes in the Glennallen Area and the PWS Area are frequently test-netted. Fluctuations in the populations, however, are usually the result of changes in the stocking program rather than natural population fluctuations.

   No information on the abundance of steelhead in the Copper River system could be found in the available literature.

2. Habitat enhancement efforts. Several lakes in the Glennallen Area and the PWS Area are regularly stocked with rainbow trout (table 1). Generally, naturally reproducing populations have not been established (ADF&G 1978). Until 1971, several lakes that contained char (*Salvelinus malma*), cutthroat trout (*S. Clarki*), and arctic grayling (*Thymallus arcticus*) were periodically stocked with rainbow trout. Test-netting, however, revealed that stocking rainbow trout in these lakes was not successful, and the practice was discontinued (Williams and Morgan 1974). Occasionally, lakes

Table 1. Prince William Sound and Glennallen Area Waters Stocked with Rainbow Trout, 1966-83

Water Body	Location	Year(s) stocked
Beaver Lake	Cordova	1967,69
Blueberry Lake	Thompson Pass	1966,68,70,72,74,76,80
Buffalo Lake	Lake Louise	1971,72,74,75,81,83
Cabin Lake	Cordova	1967,69,71,79,81,83
Caribou Lake	Lake Louise	1966
Cordova City Res. #1	Cordova	1966,67
Cordova City Res. #2	Cordova	1966,67
Crater Lake	Cordova	1968,73,77
Crater Lake	Lake Louise	1966-69,72,77,81
Crescent Lake	Paxson	1966
David Lake	Glennallen	1983
Dick Lake	Paxson	1966
Elbow Lake	Lake Louise	1969
Elsner Lake	Cordova	1973
14 Mile Lake	Paxson	1966
Gergie Lake	Lake Louise	1966,68
Hallie Lake	Paxson	1971,83
Harvey Lake	Lake Louise	1971
Island Lake	Cordova	1968,71
Katherine Lake	Glennallen	1983
Kettle Lake	Slana	1982
Lindy Lake	Lake Louise	1969
Lower Beaver Lake	Cordova	1971
Mary Lou Lake	Glennallen	1983
Middle Lake	Cordova	1967,68,71
Middleton Island Lake	Middleton Island	1968,69,71,76
Mirror Lake	Lake Louise	1966,68,80,82
Moore Lake	Paxson	1966,69,72
Moose Lake	Tolsona	1980
North Jans Lake	Lake Louise	1971,77,80
Old Road Lake	Lake Louise	1980
One Mile Lake	Chitina	1967,69,71,72
Round Lake	Lake Louise	1977,80
Sculpin Lake	Chitina	1968,69,71-73,75,77
Scout Lake	Cordova	1968
Squirrel Creek	Tolsona	1980
Squirrel Creek Lake	Tolsona	1982
Strelna lake	Chitina	1969,71,72
Tex Smith Lake	Lake Louise	1968,72,73,76,79,81
Thompson Lake	Thompson Pass	1966,68,70,72

(continued)

Table 1 (continued).

Water Body	Location	Year(s) stocked
Three Mile Lake	Chitina	1967,69,71,72,74,76,79,82
Tiny Lake	Lake Louise	1977,81
Tolsona Lake	Tolsona	1982,83
22 Mile Lake	Cordova	1968
Two Mile Lake	Chitina	1967,69,71,72,74,76,79
Van Lake	Chitina	1971,72,73,77,82
Worthington Lake	Thompson Pass	1966,68,70,72,74,76,80,83

Source: ADF&G 1984.

to be stocked are first treated with Rotenone to remove possible competitors such as whitefish (coregoninae) and longnose suckers (_Catostomus catostomus_) (Williams and Potterville 1982).

No reference to any steelhead habitat enhancement efforts in the Glennallen Area or the PWS Area was found in the available literature.

III. KNIK ARM DRAINAGE AREA AND ANCHORAGE AREA

The Knik Arm Drainage Area and the Anchorage Area (Sport Fish Postal Survey Areas K and L) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

In the Knik Arm Drainage Area, rainbow trout are found in the Matanuska River drainage and in lakes and streams in the Little Susitna River drainage (ADF&G 1978). In addition to native populations, hatchery-reared rainbow trout are stocked in many lakes around Palmer and Wasilla, such as those in the Kepler Lakes area and in the Nancy Lake Recreation Area (table 2). Rainbow trout are also stocked annually in numerous Anchorage Area lakes (table 3).

There are no steelhead trout populations in the Knik Arm Drainage Area or the Anchorage Area.

B. Abundance

1. _Summary of data_. Stocked lakes in the Anchorage Area and the Knik Arm Drainage Area are test-netted annually to monitor the growth and survival of stocked fish (Hepler and Kubik 1982). The number of rainbow trout in these lakes from year to year is determined by the stocking program. No reference to any other rainbow trout population estimates in the Anchorage Area or the Knik Arm Drainage Area was found in the available literature.
2. _Habitat enhancement efforts_. Rainbow trout are stocked in several Knik Arm Drainage and Anchorage area lakes (tables 2

and 3). The present stocking program relies upon planting catchable-size rainbow trout; however, in 1982 an experimental plant using rainbow trout fingerlings was tried in 6-Mile Lake on Elmendorf AFB (Delaney and Hepler 1983). Additional plants of fingerlings are anticipated in lakes having a good potential for overwintering fish (ibid.). Lakes such as Triangle, Gwen, and Hillberg (Kubik and Wadman 1978) that are small and shallow, with little or no water flow, frequently have winter dissolved oxygen levels too low to overwinter fish and so will not be included in this program. The goal of the fingerling stocking program will be to reduce the amount of catchable-size rainbows needed for lake stocking each year and to establish multiyear-class populations in the lakes (Delaney and Hepler 1983).

Most stocked rainbow trout in the Anchorage Area and the Knik Arm Drainage Area are released into lakes; however, catchablesize rainbow trout were released into Campbell Creek in 1983 (ibid.).

IV. EAST SIDE SUSITNA AREA AND WEST SIDE COOK INLET-WEST SIDE SUSITNA RIVER DRAINAGE AREA

The boundaries of the East Side Susitna Area and the West Side Cook Inlet-West Side Susitna River Drainage Area (Sport Fish Postal Survey Areas M and N) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Native rainbow trout are distributed throughout much of the lower Susitna River drainage and in some of the larger rivers flowing directly into northwestern Cook Inlet, such as the Chuit, Theodore, and Lewis rivers (ADF&G 1978). The largest rainbow trout populations can be found in clearwater tributaries to the Susitna, Yentna, Talkeetna, and Skwentna rivers, such as the Talachulitna River, Alexander Creek, Deshka River, Lake Creek, and Anderson Creek (ADF&G 1978, ADF&G 1981). Portage Creek, a clearwater tributary of the Susitna River, supports the northernmost natural population of rainbow trout in the Susitna drainage (ADF&G 1981). Rainbow trout have been found in High Lake and Little High Lake which drain into Devil Creek, a Susitna River tributary, and are northeast of Portage Creek. These populations, however, are suspected to be the result of an unauthorized stocking effort (Sautner and Stratton 1984). Current data indicates that rainbow trout in the Susitna River between the Chulitna River confluence and Devil Canyon use three primary tributaries for spawning: Whiskers, Lane, and Fourth of July creeks (Sundet and Wenger 1984). Overwintering areas for rainbow trout in the lower Susitna include mainstem areas below Fourth of July, Lane, and Gash creeks (ADF&G 1983b). Rainbow trout may also overwinter in larger Susitna River tributaries such as the Talkeetna River (ibid.).

No steelhead trout populations are found in areas M or N.

B. Abundance

1. Summary of data. Very little abundance information for rainbow trout in areas M or N could be found in the available

Table 2. Knik Arm Drainage and East Side Susitna Area Waters Stocked with Rainbow Trout, 1966-83[a]

Water Body	Location	Year(s) stocked
Big No Luck Lake	Willow	1975,78,80,82,83
Canoe Lake	Matanuska	1969-75,84
Christiansen Lake	Talkeetna	1974,75
Crystal Lake	Palmer	1982,83
Echo Lake	Matanuska	1966,68,77,78
Falk Lake	Butte	1966
Finger Lake	Palmer	1966,68,69,83
Florence Lake	Willow	1969,72,74,77,79,81,83
Gooding Lake	Palmer	1966
Hercules Lake	Goose Bay	1966,67,69,71-78
Irene Lake	Matanuska	1966,68-71,73,75,76,79-81,83,84
Johnson Lake	Matanuska	1970-73,75-83
Juncton Lake	Matanuska	1980,81,83
Kalombough Lake	Palmer	1982
Kepler-Bradly Lake	Matanuska	1966,68-72,74-76,78-80,81,83,84
Knik Lake	Knik	1971,73-81,83
Little No Luck Lake	Willow	1975,78,89,82,83
Long Lake	Matanuska	1966,68,73,75-77,80
Lower Bonnie Lake	Chickaloon	1966,68,70,71,73
Marion Lake	Big Lake	1974-76,78,80,83
Matanuska Lake	Matanuska	1972-76,78-81,83
Meirs Lake	Palmer	1966,84
Memory Lake	Wasilla	1966,74
Milo Lake #1	Willow	1971,72
Ravine Lake	Chickaloon	1966,78,70-73,75,76,78,80-83
Reed Lake	Wasilla	1970-72,74,77,79,81-83
Rockly Lake	Big Lake	1971-75
Seymour Lake	Big Lake	1973-75,77-81,83
Shallow Lake	Chickaloon	1980
Slipper Lake	Palmer	1982,83
Sliver Lake	Matanuska	1980-82
South Rolly Lake	Willow	1971,72,83
Tigger Lake	Talkeetna	1974,79,81-83
Turning Point Lake	Willow	1973
Twin Island Lake	Point Mackenzie	1966
Victor Lake	Matanuska	1968,69
Walby lake	Palmer	1981,83
Weiner Lake	Chickaloon	1966,69,71,79,81,83
Wishbone Lake	Jonesville	1972,74,76,79,83
X Lake	Talkeetna	1980,83
Y Lake	Talkeetna	1980,83

Source: ADF&G 1984.

a Some 1984 data were available and are included in this table; however, this is not a complete record for 1984.

Table 3. Anchorage Area Waters Stocked with Rainbow Trout, 1966-83

Water Body	Location	Year(s) stocked
Beach Lake	Birchwood	1973-84
Campbell Creek	Anchorage	1983-84
Campbell Point Lake	Kulis ANG Base	1967,69,72-84
Cheny Pond	Nunaka Valley	1982-84
Chester Creek	Anchorage	1971-73
Clunie Lake	Ft. Richardson	1971-84
Delong Lake	Anchorage	1966,67,69,71-75,81-84
Derby Pond	Ft. Richardson	1967,69,73-75,77,78,80,82-84
Dishno Lake	Ft. Richardson	1983,84
Fire Island Lake	Fire Island	1969
Fish Lake	Elmendorf AFB	1966,74-79,82-84
Goose Lake	Anchorage	1972
Green Lake	Elmendorf AFB	1969-76-84
Gwen Lake	Ft. Richardson	1969,72-79,81-84
Hillberg Lake	Elmendorf AFB	1969,74-77,79,81-84
Hideaway Lake	Potter	1967,68
Jewel Lake	Anchorage	1966-69,71-84
Little Lake	Fire Island	1966-67
Lower Fire lake	Fire Lake	1968,69,72-84
Mirror Lake	Chugiak	1966,69,72-74,83,84
Old Elmendorf Pond	Elmendorf AFB	1975,77,78,83
Otter Lake	Ft. Richardson	1966-69,71-84
Sand Lake	Anchorage	1975-84
6-Mile Lake	Elmendorf AFB	1982,83
Six Mile Lake	Portage Ft.	1984
Spring Lake	Richardson	1983,84
Sundi Lake	Anchorage	1966,67
Taku Campbell Lake	Anchorage	1982-84
Thompson Lake	Ft. Richardson	1966-69,71-79,81-84
Triangle Lake	Elmendorf AFB	1974-79,82-84

Source: ADF&G 1984.

a Some 1984 data were available and are included in this table; however, this is not a complete record for 1984.

literature. The ADF&G (1978) states that clearwater tributaries to the Susitna, Yentna, Talkeetna, and Skwentna rivers, such as the Talachulitna River, Alexander Creek, the Deshka River, and Lake Creek, support large populations of rainbow trout; however, very few abundance studies have been conducted. Some rainbow trout tagging studies have taken place on the Susitna River, and these studies have resulted in a population estimate for rainbow trout in the lower 0.8 mi of Fourth of July Creek of between 82 and 137 fish (Sundet and Wenger 1984). Hook and line and boat electrofishing effort in May through October 1983 above the Chulitna River confluence on the Susitna River resulted in high rainbow trout catches at Fourth of July Creek and Indian River (ibid.). Other sites where relatively high rainbow trout catches were made include Whiskers Creek Slough, Lane Creek, and Portage Creek (ibid.).

2. Habitat enhancement efforts. Rainbow trout are stocked in a few Talkeetna area lakes (table 2). No reference to any other habitat enhancement efforts could be found in the available literature.

V. KENAI PENINSULA AREA

The boundaries of the Kenai Peninsula Area (Sport Fish Postal Survey Area P) are described in section I.E. of the Sport Use and Economic Value narrative found elsewhere in this volume.

A. Distribution

Native rainbow trout are found in most drainages of the northern and western Kenai Peninsula, extending north from Anchor River to the Chickaloon River, which drains into Turnagain Arm (ADF&G 1978). The Kenai River and its clearwater tributaries, including Moose River and Beaver Creek, contain a large population of rainbow trout (ADF&G 1977; Logan, pers. comm). Numerous rainbows are also found in the Swanson River-Bishop Creek system lakes and in coastal streams of the Kenai Peninsula (ADF&G 1977). Rainbow trout are uncommon in Gulf of Alaska drainages from Kachemak Bay to Resurrection Bay (ADF&G 1978; Logan, pers. comm.).

Several Kenai Peninsula lakes are regularly stocked with rainbow trout (table 4). Some lakes, such as China Poot Lake on the southeast side of Kachemak Bay, that were stocked in the past now contain self-sustaining populations (Wallis and Hammarstrom 1979). Rainbow trout stock from the Swanson River, north of Kenai, is used for lake stocking programs throughout Alaska. Experimental stocking studies concluded that these fish have slower growth rates but better survival than those from other rainbow trout strains and so are considered the best Alaskan strain for stocking (Havens 1980).

Steelhead are found in a limited number of streams along the western coast of the Kenai Peninsula between Homer and Kasilof River, including Anchor River, Stariski Creek, Ninilchik River, Deep Creek, and Crooked Creek (ADF&G 1978).

Table 4. Kenai Peninsula Area Waters Stocked with Rainbow Trout, 1966-83[a]

Water Body	Location	Year(s) stocked
Arc Lake	Soldotna	1966,68,69,71-73
Barbara Lake	Kenai	1983
Barr Lake	Kenai	1982
Cabin Lake	Bernice Lake	1970,71,73,77,83
Carter Lake	Moose Pass	1976,80,83
Douglas Lake	Kenai	1982
Hump Lake	Port Nikishki	1971
Island Lake	Soldotna	1969,71,82,83
Jerome Lake	Quartz Creek	1968-74,76,81,83
Johnson Lake	Tustemena	1973,75,77
Joseph lake	Kasilof	1977
Leisure (China Poot) Lake	Homer	1982
Longmare Lake	Soldotna	1973,74,76,82
Lower Paradise Lake	Lakeview	1968
Musik Lake	Sterling	1970
Rainbow Lake	Cooper Landing	1971,74,77,81
Rock lake	Skilak Lake	1970
Rogue Lake	Kasilof	1973
Scout Lake	Sterling	1966,68
Sport Lake	Soldotna	1966,68,71,78,81
Stickleback Lake	Sterling	1971
Stormy Lake	Kenai	1982
Tirmore Lake	Port Nikishki	1973,75,77,83
Trout Lake	Kenai	1982
Upper Jean Lake	Kenai	1983
Vagt Lake	Moose Pass	1974,77,80,83

Source: ADF&G 1984.

a This table does not include rainbow trout transplanted from one area to another.

B. Abundance

1. Summary of data. Stocked lakes on the Kenai Peninsula are regularly test-netted to monitor the growth and survival of stocked fish. The number of rainbow trout in these lakes from year to year is determined by the stocking program. With the exception of these stocked lake surveys, few studies of rainbow trout abundance on the Kenai Peninsula have been conducted. The ADF&G (1978) states that the largest Kenai Peninsula rainbow trout populations are found in the Kenai River, its clearwater tributaries, and the Swanson and Moose rivers.

   Increased sport harvest of Skilak Lake rainbows resulted in an attempt by the ADF&G to estimate the size of that population. Rainbows at the outlet of Skilak Lake were captured and tagged in 1980 and 1981. Too few fish were captured, however, to conduct a statistically valid population estimate (Hammarstrom and Wallis 1981, 1982).

   In 1978 and 1980, adult steelhead in the Anchor River were captured and tagged (Wallis and Hammarstrom 1979, Wallis and Ballard 1981). Tags recovered from steelhead during random creel census interviews and from voluntary returns were used to establish tagged-to-untagged ratios. These ratios were then used to generate a population estimate, based upon Schaeffer's formula as outlined by Ricker (1975) (ibid.). In the fall of 1978, the estimated total adult steelhead population in the Anchor River was 4,132 (Wallis and Hammarstrom 1979). In 1980, the estimated population was 2,388 (Wallis and Ballard 1981). Steelhead have been tagged in other years; however, inadequate tag recoveries prevented calculation of a population estimate (Wallis and Ballard 1982, 1983).

2. Habitat enhancement efforts. Several lakes on the Kenai Peninsula are stocked with rainbow trout (table 4). Some of these lakes are treated with emulsified rotenone prior to stocking to eliminate competing species such as threespine stickleback and char (*Salvelinus malma*) (Wallis and Hammarstrom 1980, Hammarstrom and Wallis 1983). In 1979, a transplant of rainbow trout also occurred. These trout were taken from China Poot Lake on the southeast side of Kachemak Bay and transplanted into Hazel Lake. A total of 100 fish were transplanted (Wallis and Hammarstrom 1980).

   The stocks of steelhead on the Kenai Peninsula are currently entirely naturally produced. It is questionable, however, that they can sustain any increases in harvest without harm to the stocks unless additional catch restrictions or supplemental measures are undertaken. In 1982, 43 adult steelhead were taken from the Anchor River and transported to Crooked Creek Hatchery in Kasilof to be held for spawning in the spring. Survival of these fish until spring, however, was not good (Wallis and Ballard 1983).

REFERENCES

ADF&G, comp. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. [Juneau.] 443 pp.

ADF&G. 1978. Alaska's fisheries atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + 153 maps.

________. 1981. Resident fish investigation on the lower Susitna River. Susitna Hydro aquatic studies. Phase 1: Final draft report. Subtask 7.10. Anchorage, AK. 147 pp. + appendices.

________. 1983a. Aquatic habitat and instream flow studies, 1982. Susitna Hydro aquatic studies. Phase II: Basic data report. Vol. 4, Part 2. Anchorge, AK. 398 pp. + appendices.

________. 1983b. Winter aquatic studies (October, 1982 - May, 1983). Susitna Hydro aquatic studies. Phase II: Basic data report. 137 pp. + appendices.

________. 1984. Fish release records for regions 01, 02, and 03. 7 August 1984. Unpubl. Div. FRED, Anchorage. 209 pp.

Burger, C., M. Scott, M. Small, and W. Potterville. 1983. Overwintering and spawning areas of steelhead trout (Salmo gairdneri) in tributaries of the upper Copper River, Alaska. USFWS, BLM, and ADF&G. 24 pp.

Delaney, K., and K. Hepler. 1983. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-H.

Hammarstrom, S., and J. Wallis. 1981. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-C.

________. 1982. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-C.

________. 1983. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-C.

Havens, A.C. 1980. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-III-D.

Hepler, K.R., and S.W. Kubik. 1982. Inventory and cataloging of sport fish waters of lower Susitna River and Central Cook Inlet drainages. ADF&G,

Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-H.

Jones, D.E. 1975. Life history of steelhead trout in Southeast Alaska. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol 16. Proj. AFS-42.

________. 1978. A study of cutthroat-steelhead in Alaska. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. AFS-42-6.

Kubik, S., and R. Wadman. 1978. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol.19. Proj. F-9-10, Job G-I-H.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Anchorage, AK: Alaska Northwest Publishing Co. 248 pp.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Bd. Can. Bull. 191. Ottawa, Canada. 382 pp.

Russel, R. 1977. Rainbow trout studies, Lower Talarik Creek-Kvichak. ADF&G, Fed. Aid in Fish Rest. Completion rept. Vol. 18. Proj. F-9-9, Job G-II-E.

Sautner, J.S., and M.E. Stratton. 1984. Access and transmission corridor studies. Part I in D.C. Schmidt, C.C. Estes, D.L. Crawford, and D.S. Vincent-Land, eds. ADF&G Susitna Hydro aquatic studies. Rept. 4: Access and transmission corridor aquatic investigations (July-October 1983).

Sundet, R.L., and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below Devil Canyon. Part 5 in D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, eds. ADF&G Susitna Hydro aquatic studies. Rept. 2: Resident and juvenile anadromous fish investigations (May-October 1983).

Sutherland, D.F. 1973. Distribution, seasonal abundance, and some biological features of steelhead trout, Salmo gairdneri, in the North Pacific Ocean. Fish Bull. 71(3)787-807.

Wallis, J., and D.T. Balland. 1981. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. AFS-48, Segment AFS-48-1.

________. 1982. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. AFS-48-2.

________. 1983. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Segment AFS-48-3.

Wallis, J., and S. Hammarstrom. 1979. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-C.

________. 1980. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-C.

Williams, F.T. 1975. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. F-9-7, Job G-I-F.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Glennallen.

Williams, F.T., and C. Morgan. 1974. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 15. Proj. F-9-6, Job G-I-F.

Williams, F.T., and W.D. Potterville. 1982. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the Upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-F.

Salmon Distribution and Abundance

I. REGIONWIDE INFORMATION

The five species of Pacific salmon native to North America are found in the marine and fresh waters of the Southcentral Region. The discussion of individual species' distribution and abundance will be presented by ADF&G commercial fisheries management area. There are three such management areas within the region: Upper Cook Inlet (UCI), Lower Cook Inlet (LCI), and Prince William Sound (PWS). Each area is divided into districts that in turn may be separated into subdistricts and/or sections for fishery management purposes, such as regulating seasons and weekly fishing periods. Maps found in the Southcentral Region Map Atlas that accompanies this publication show the boundary lines of the management areas. In addition, detailed descriptions of the boundaries and maps depicting the districts are contained in the salmon commercial harvest narrative located in the salmon Human Use portion of this volume.

A. Regional Distribution

Salmon, in one life stage or another, are found within the Southcentral Region's freshwater systems year-round. Their presence is most noticeable, though, during the time that adults return to spawn. Information pertaining to the timing of salmon runs is provided in the management area narratives (sections II., III., and IV. below). It should be noted, however, that within each management area selected salmon species are managed to achieve and maintain populations at a level of maximum sustained yield. Therefore, the distribution, timing, and abundance information needed to manage a given species may be well documented in one area, but little data may be available for the same species in another area.

B. Areas Used Seasonally and for Life Functions

To supplement the distribution information presented in text, a series of 1:250,000-scale reference maps have been produced that depict documented anadromous fish streams and anadromous fish stream watersheds within the Southcentral Region.

The anadromous stream maps show the following:

- Species present and documented upstream migration points
- Unsurveyed areas where it is not known if anadromous fish are found in the system
- Documented nonpresence of anadromous fish (e.g., in glacier fields or in areas above barriers to migration, such as waterfalls or rapids)

The reference maps have been reduced and combined and are included in the 1:1,000,000-scale index maps contained in the Southcentral Region Map Atlas that accompanies this publication.

C. Factors Affecting Distribution

1. Fresh water. Water quality, quantity, and the waterbody's substrate affect salmon as the adults migrate to spawning areas, as spawning occurs, as the eggs incubate, as the fry emerge from the gravel, as the juveniles rear, and as the smolt migrate to the sea. Major components of water quality include temperature, pH, dissolved oxygen, turbidity, and chemical composition. Water quantity includes the factors of velocity and depth. Substrate is important in that it must be composed of the proper size material to allow adult salmon to construct redds. It must also allow intragravel water movement so that dissolved oxygen may be transported to eggs and alevin and, in turn, metabolic wastes may be removed. (For more details of the factors that affect salmon distribution in the freshwater environment, see the Life History and Habitat Requirements narratives for each of the salmon species in volume 1 of this publication.)
2. Salt water. Little is known of the factors that contribute to salmon distribution in the marine environment. Water temperature and the depth of the thermocline, salinity, currents, and the availability or location of food organisms probably all contribute to where salmon move while in estuaries and the high seas. Species-specific information concerning these factors may be found in the Life History and Habitat Requirements narratives found in volume 1 of this publication.

D. Movements Between Areas

Very little information has been documented that addresses juvenile salmon movements, and only general data of smolt migration routes and patterns in marine waters appear in the literature. These data are included in each species life history found in volume 1 of this publication.

Some information has been documented that indicates the routes and timing of the adult salmon return to fresh water. Where appropriate, these data are presented in the management area narratives (section II., III., and IV. below). Additional migration information is also included in each species life history found in volume 1 of this publication.

E. Population Size Enumeration

Salmon abundance, or run-strength, is derived where possible by combining catch numbers (commercial harvest) and escapement figures (number of fish entering fresh water). Escapement estimates are derived using one or a combination of several measurement techniques. Aerial and ground survey counts, weir counts, and hydroacoustic (sonar) equipment counts are among the methods used to enumerate escapement.

The resultant population estimates, however, should be treated as an approximation or estimate of run-size because many factors can influence the harvesting and escapement enumeration of fish. Such factors as weather, current, and type or size of gear can affect the catch. Turbidity and/or glacial silt, weather, light conditions, stream flow, and experience of the persons counting the fish can affect ground and weir counts as well as aerial surveys.

Salmon abundance estimates for an individual stream system are derived, where possible, by combining catch numbers (commercial, subsistence, and/or personal use harvests) and escapement numbers. In some cases, run-strength calculations for an individual stream system are difficult to achieve because the fisheries are harvesting mixed stocks of fish. It is therefore difficult to define what proportion of the catch should be allotted to which stream system unless stock identification techniques are implemented in the fishery (e.g., tagging, scale pattern analysis for stock separation). Therefore, most of the abundance information presented in this narrative is estimated escapement numbers of fish that have passed through the commercial fishery and have been enumerated in freshwater systems.

In the narratives and tables that follow, care has been taken to document locations, if known, and methods used to gather escapement data, so that the approximate level of detail may be deduced (e.g., aerial surveys are generally less precise than weir counts). The data are taken in large part from the annual finfish reports prepared by ADF&G area commercial fishery biologists, who stress that in most cases run-strength assessments are estimates that should not be treated as absolute figures.

II. UPPER COOK INLET (UCI) MANAGEMENT AREA

The UCI Management Area consists of that portion of Cook Inlet north of the latitude of Anchor Point and is divided into two salmon fishing districts, Central and Northern. A map of these areas may be found in the salmon commercial harvest narrative found in the Human Use portion of this volume. The districts are divided into six and two subdistricts, respectively (ADF&G 1984a).

A. Distribution

Within UCI waters are found the five species of Pacific salmon native to North America. Run-timing and migration routes overlap to such a degree that the commercial fishery is largely mixed-stock and mixed-species in nature (Ruesch 1984a). Adult salmon are found in UCI marine and estuarine waters from early May to early November and in fresh waters from mid May to early February. Listed below in tables 1 and 2 is general run-timing information for the different salmon species in the Central and Northern districts, respectively (variations from these times occur in some systems). Figure 1 provides river-specific run-timing information for the Susitna, Kenai, Kasilof, and Crescent rivers, which are the major salmon-producing systems of UCI.

B. Abundance

In terms of the average number of fish harvested by the commercial fishery during a 29-year period (1954 to 1982), sockeye salmon are the most abundant salmon species found within UCI. Pink salmon

Table 1. General Salmon Run-Timing Information, Central District of UCI Area

Species	Nearshore Marine & Estuarine Area[a]	Adults Enter Fresh Water[b]	Adult Spawning[b]	Juvenile Out-migration[b]
Chinook	Early May-late Aug.	Mid May-early Sept.	Late July-early Sept.	Out by mid July
Sockeye	Early May-late Aug.	Mid May-mid Aug.	Mid July-early Nov.	Out by early July
Coho	Early July-mid Nov.	Late July-early Nov.	Early Sept.-late Mar.[c]	Out be mid July
Pink	Mid July-late Aug.	Mid July-mid Sept.[a]	Early Aug.-late Sept.	Out by mid April
Chum	Late June-mid Sept.	Mid July-mid Sept.	Mid Aug.-mid Nov.	No data

Source: a Ruesch 1984; b ADF&G 1977, unless otherwise noted; Logan 1985.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

Table 2. General Salmon Run-Timing Information, Northern District of UCI Area

Species	Nearshore Marine & Estuarine Area[a]	Adults Enter Fresh Water[b]	Adult Spawning[b]	Juvenile Out-migration[b]
Chinook	Early May-early July	Mid May-mid July	Late June-mid Aug.	Mid April-mid July
Sockeye	Late June-mid Aug.	Early July[a]-mid Aug.	Early Aug.-mid Nov.	Mid April-early Aug.
Coho	Early July-early Nov.	Early July-early Nov.	Early Aug.-early Feb.	Mid April-mid July
Pink	Mid July-mid Aug.	Late June-mid Aug.	Early July-early Sept.	Mid April-early June
Chum	Early July-late Aug.	Early July-early Sept.	Early Aug.-early Oct.	Mid April-early July

Source: a Ruesch 1984; b ADF&G 1977, unless otherwise noted.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

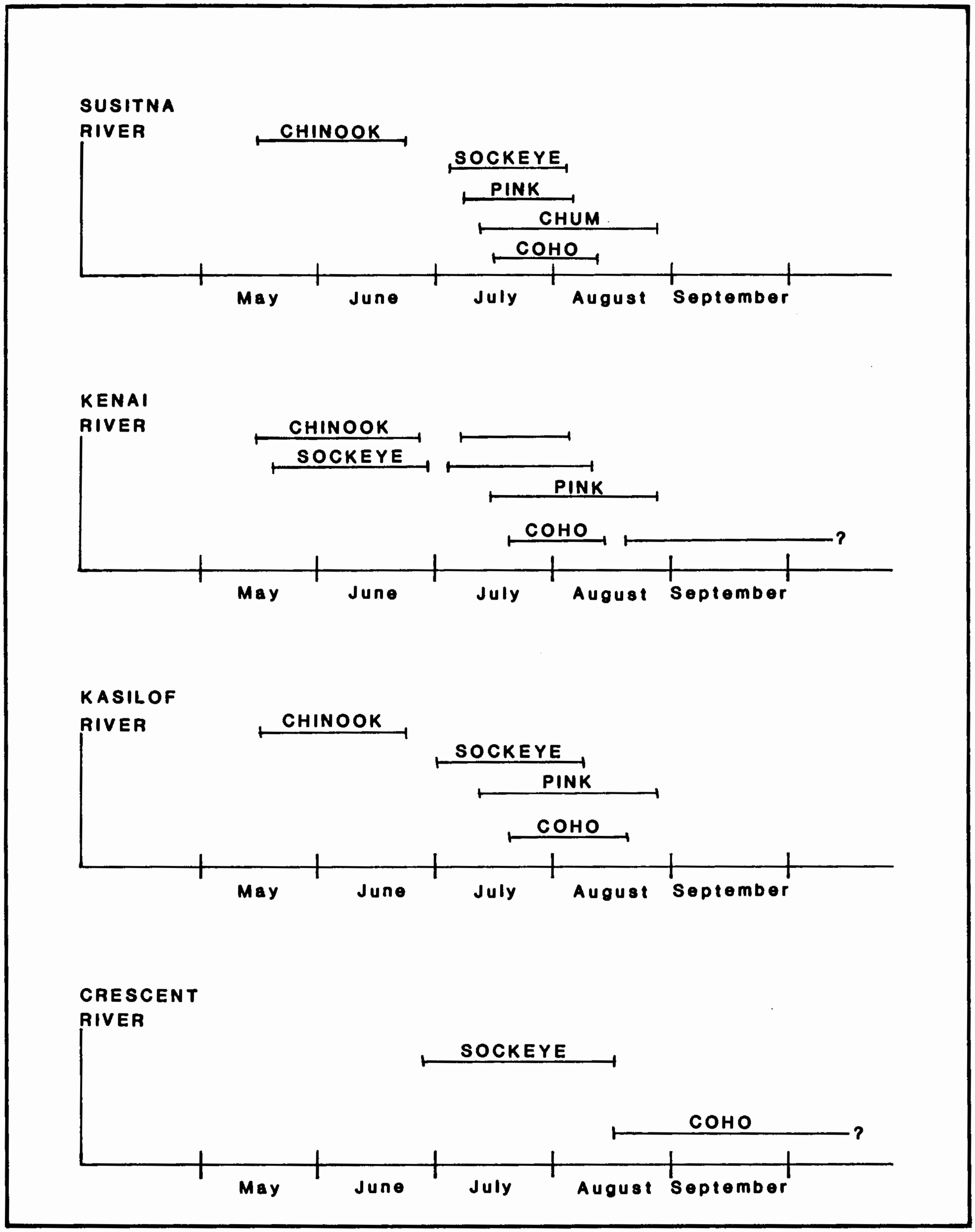


Figure 1. Salmon run-timing for major river systems of the Upper Cook Inlet Management Area (Ruesch 1948a).

are the second most abundant species, although their numbers fluctuate greatly on a two-year cycle. Even-year catches far outnumber odd-year catches by an average of about 1.5 million fish. Chum salmon are the third most abundant species, followed by coho salmon and chinook salmon, respectively (Ruesch 1984a).

The mainstems of the four major river systems (Kenai, Crescent, Kasilof, and Susitna) in UCI are glacially turbid, preventing visual monitoring of escapement. Consequently, hydroacoustic techniques are employed to enumerate salmon moving to their spawning areas. Side scan sonar equipment is used to monitor escapement in the Kenai, Crescent, Kasilof, and Susitna rivers by the ADF&G, Division of Commercial Fisheries. Several other salmon-producing systems are also monitored for salmon escapement. Escapement is enumerated by weirs in Fish Creek (Big Lake area) and Cottonwood Creek (Wasilla area) by the ADF&G, Division of Fisheries Rehabilitation and Enhancement and Development (FRED). Packers Lake (Kalgin Island) and Wolverine Creek (Big River system) have been monitored by weirs operated by the Cook Inlet Aquaculture Association (CIAA) (ADF&G 1982a, Ruesch 1984a). In addition, the ADF&G, Division of Sport Fish, conducts ground and aerial surveys to determine chinook and coho salmon escapements in many of the clearwater stream systems and clearwater tributaries of glacially turbid larger river systems, and operates a weir at the Russian River (Cooper Landing area) to enumerate sockeye salmon.

Because the UCI fishery harvests mixed stocks of salmon and because it is extremely difficult to precisely apportion the catch to its stream of origin, the abundance figures presented below reflect excapement estimates only. At this time, it is not possible to combine catch and escapement numbers to produce total system-specific or even district-specific run estimates. Total run estimates for the entire UCI for sockeye salmon, however, have been made, although the estimates may be low because many systems are not monitored at this time to enumerate escapement. To date, only the 1981 estimate of 2.6 million sockeye is available (Rowell & Middleton 1985). Sections 1. through 5. below are organized according to the abundance of each species, with the most numerous, sockeye salmon, presented first.

1. Sockeye salmon. In summarizing anadromous fish waters of the UCI, the ADF&G (1982a) compiled a list of 87 rivers, streams, creeks, and sloughs and 25 lakes in which sockeye salmon have been observed. It is suspected that many more exist but have yet to be documented.

   Major known sockeye salmon-producing systems in the Central District of UCI include the Kenai, Kasilof, Crescent, and Big rivers and Packers Creek (Kalgin Island). Within the Northern District of UCI the Susitna, Chakachatna, McArthur and Beluga river drainages as well as Fish Creek (Big Lake outlet stream), Cottonwood Creek (Wasilla area) and Nancy Lake are major sockeye salmon producers (Rowell & Middleton

1985). Other systems, particularly those on the west side of Cook Inlet, may have significant returns, but this has yet to be confirmed. Assessment of salmon production in these streams and lakes has been difficult because of the glacial nature of most systems and the remoteness of the area (ibid.).

The Kenai River supports the largest spawning population of sockeye salmon in UCI (table 3). Both early and late runs of sockeye salmon return to the system, and a number of lakes and tributaries in the drainage serve as nursery areas. The early run returns to upper Russian Lake and its tributaries. The estimated escapement for this run has ranged from 14,700 fish in 1976 to 56,080 fish in 1982 (Logan, pers. comm.). Late-run fish spawn throughout the system with Carter-Moose Creek, Ptarmigan Creek, Tern (Mud) Lake, Quartz Creek, Hidden Lake, and the Russian River being the major producing tributaries (Rowell and Middleton 1985). Since 1968, the estimated escapement for this run has ranged from 53,000 fish in 1969 to 708,000 fish in 1977 (King and Tarbox 1983). The portion of the late run spawning in the Russian River is estimated to have ranged from 21,410 in 1977 to 92,660 in 1984 (Logan, pers. comm.).

Based on escapement estimates, the Susitna River has been the second largest sockeye salmon-producing system in UCI during six of the eight years between 1975 and 1982. Areas of high spawner density within the drainage include the Talachulitna River, the West Fork of the Yentna River, and Hewitt-Wiskey and Chulitna lakes. Escapement estimates have ranged from 94,400 fish in 1978 to 340,232 fish in 1981 (table 3) (Middleton and Rowell 1984).

The Kasilof River drainage contains Tustamena Lake, the largest lake on the Kenai Peninsula. Major sockeye salmon-producing tributaries surveyed each year to determine spawner distribution within the system include Nikolai, Clear, Crystal, Glacier Flat, Seepage, Moose, and Bear creeks. Estimated escapements from side scan sonar counts for the system have ranged from a low of 40,000 fish in 1973 to a high of 256,625 fish in 1981 (table 3) (ibid.).

Escapement data for the Crescent River are available only since 1979. Escapement estimates since then have ranged from 41,000 fish in 1981 to 90,863 fish in 1980 (table 3).

The Big Lake watershed drains into the Knik Arm of Cook Inlet via Fish Creek. Unlike other UCI systems, comparative escapement data has been recorded since 1936. Between 1936 and 1960, returns to Fish Creek ranged from 15,630 fish in 1957 to a record escapement of 306,980 fish in 1940. Between 1960 and 1982, escapement ranged from an all time low of 2,705 fish in 1973 to 119,020 fish in 1963. In 1982, 28,164 sockeye salmon passed the weir on Fish Creek (Rowell and Middleton 1985).

Table 3. Escapement Estimates of Sockeye Salmon in Numbers of Fish for Several UCI Systems, 1973-82

Year	Kenai River[a,b]	Kasilof River[a,b]	Crescent River[a,b]	Packers Creek[e,h]	Big River[e,i]	Chakachatna/ McArthur Rivers[d]	Susitna River[a,b]	Fish Creek (Lake)[c,h]	Cottonwood Creek[c,h]	Nancy Lake (Little Susitna R. Drainage)[g]	Coal Creek (Beluga R. Drainage)[a,d,e]
1973	367,000	40,000	---	3,700	---	---	---	2,705	---	---	---
1974	161,000	70,000	---	1,451	---	---	---	16,225	---	---	---
1975	142,000	48,000	---	---	---	---	108,000	29,882	---	---	---
1976	380,000	139,000	---	---	---	---	111,000	14,032	---	---	---
1977	708,000	155,300	---	---	---	---	237,514	5,183	---	---	---
1978	398,900	116,600	---	---	---	---	94,400	3,555		2,050	2,388[j]
1979	285,020	152,179	86,654	---	---	---	156,890	68,739		3,831	500[j]
1980	464,038	187,154	90,863	---	---	---	190,866	62,828		5,683	700[j]
1981	407,639	256,625	41,213	13,024	17,522	---	340,232	50,479	25,180		1,100[j]
1982	619,831	180,239	58,957	15,826	32,980	78,570	215,856-265,332[f]	28,164	18,358		12,240

Source: Rowell and Middleton 1985.

--- means no data were available.

a King and Tarbox 1983.

b Estimates by side scan sonar, unless otherwise noted.

c Chlupach 1982b.

d Stream count.

e Stream survey files, ADF&G, Div. Commer. Fish., Soldotna; Cook Inlet Aquaculture Association 1980, 1981, 1982.

f Includes side scan sonar counts and mark recapture estimates from Susitna Hydroelectric Project Studies.

g Chlupach 1982a.

h Weir counts.

i Weir count at Wolverine Creek.

j Aerial survey.

Limited escapement data exist on several other sockeye salmon-producing systems in UCI. Nancy Lake in the Little Susitna River system and Cottonwood Creek near the town of Wasilla both drain into the Knik Arm of Cook Inlet and support sockeye salmon populations. Escapement estimates made from weir counts at Nancy Lake from 1978 through 1981 enumerated a maximum of 5,683 fish (table 3). Cottonwood Creek runs have been greater, and escapement estimates reached 25,180 fish in 1981 (table 3). Packers Creek, located on Kalgin Island, also supports a small sockeye salmon return. Escapement estimates have been monitored periodically by a weir currently operated by the CIAA. During 1982, nearly 16,000 fish entered the system (table 3). As mentioned earlier, salmon production assessments for systems on the west side of Cook Inlet are difficult because of the glacial nature of the waters and the remoteness of the area. Frequently, the best assessment has been made by obtaining index counts in clearwater tributaries. The Beluga, Chakachatna, and Big rivers all support sockeye salmon runs. Escapement estimates obtained at the CIAA operated weir on Wolverine Creek in the Big River system reached 32,980 fish in 1982 (table 3). Combined escapement counts in 1982 for the Chakachatna and McArthur rivers exceeded 78,500 fish. Aerial surveys of Coal Creek, a clearwater tributary in the Beluga River drainage, estimated 12,240 sockeye salmon in 1982 and serves as an indicator of what may be a much larger population (table 3) (ibid.).

2. Pink salmon. In summarizing anadromous fish waters of the UCI, the ADF&G (1982a) lists 73 rivers, streams, creeks, and sloughs and four lakes in which pink salmon have been observed. It is suspected that many more exist but have yet to be documented.

Escapement estimates of pink salmon in UCI are very limited at this time. The Susitna River system in the Northern District of UCI and the Kenai River system in the Central District support most of the pink salmon returning to UCI. Other systems in which they are found include the Kasilof and Crescent systems in the Central District and the Chuitna, Chakachatna, and McArthur rivers in the Northern District.

The Susitna River is believed to be the largest producer of pink salmon in UCI, and returns have shown even-year run strength (Rowell and Middleton 1985). Side scan sonar data available since 1977 (table 4) indicate that both even and odd-year escapements have been decreasing. The sonar estimates are only an index of run strength because a large number of pink salmon spawn below the sonar counters. Even-year escapement estimates have ranged from about 2.5 million fish in 1978 to about 930,000 in 1982. Odd-year escapement estimates have ranged from almost 1.5 million fish in 1977 to slightly over 113,000 fish in 1981 (ibid.).

Table 4. Escapement Estimates of Pink Salmon in Numbers of Fish for UCI River Systems, 1976-83

	Northern District			Central District
Year	Susitna River*	Chuitna River*	Chakachatna/ McArthur Rivers*	Fitz Creek*
1976	933,000**	---	---	---
1977	1,490,000[a]	---	---	---
1978	2,470,000[b]	---	---	---
1979	124,670[b]	---	---	---
1980	2,047,423[b]	---	---	---
1981	113,349[b]	---	---	---
1982	926,807[c]	20,410[e]	28,040[g]	200g
1983	101,300[d]	7,150[f]	---	---

Sources: * King and Tarbox 1983 and 1984, unless otherwise noted.

--- means no data were available.

a Fish wheel mark-recapture estimate.

b Sidescan sonar estimates.

c Total of Yentna Station (Susitna Hydroelectric Project) and Susitna Station east bank sonar estimates.

d Total of Yentna Station (Susitna Hydroelectric Project) sonar estimate and Sunshine Station (Susitna Hydroelectric Project) mark-recapture estimate.

e Tower count.

f Aerial count.

g Stream count.

Pink salmon escapement is currently not monitored on the Kenai River because most spawning occurs in the lower river below the ADF&G side scan sonar sites. The glacially clouded water of the river also prevents enumeration by aerial survey (ibid.). The presence of a large number of pink salmon carcasses along the river indicates that a good escapement level occurred in 1982 (ibid.).

Escapement estimates of pink salmon in other UCI systems are scarce. Table 4 presents one year's data for Fitz Creek and the Chakachatna-McArthur rivers and two years of data for the Chitina River.

3. Chum salmon. In summarizing anadromous fish waters of the UCI, the ADF&G (1982a) lists 49 rivers, streams, creeks, and sloughs and two lakes in which chum salmon have been observed. It is suspected that many more exist but have yet to be documented.

   The Susitna River system and the Chakachatna-McArthur system in UCI and several drainages of the Central District, including the Chinitna Bay tributaries of Fitz Creek, Clearwater Creek and the Chinitna River, support chum salmon runs. The magnitude and biology of chum salmon returns to systems other than the Susitna River and Chinitna Bay are unknown (Rowell and Middleton 1985).

   The Susitna River has produced most of the chum salmon that return to the UCI. Since 1977, side scan sonar counts have been used to estimate the escapement. The counts, however, have been only an index of the total escapement because of the offshore distribution of chum salmon in the river reach where the sonar substrate is installed. Estimated escapements have fluctuated from a low of 7,939 fish in 1980 to a high of 458,272 fish in 1982 (table 5) (ibid.).

   Chinitna Bay tributary streams in which escapements have been monitored include Fitz and Clearwater creeks, and the Chinitna River. Spawning chum salmon have also been seen in the Chinitna Bay drainages of West Glacier and Middle Glacier creeks. Escapement information in Chinitna Bay has been restricted to counts from aerial surveys flown several times during each commercial fishing season. Clearwater Creek supports the largest spawning population of chum salmon in the Chinitna Bay area. Aerial survey counts have ranged from a low of 1,350 fish in 1979 to a high of between 11,000 and 14,000 fish in 1982 (table 5). Limited escapement estimates for Fitz Creek and the Chinitna River are included in table 5, as are two years' data for the Chakachatna-McArthur rivers system.

4. Coho salmon. In summarizing anadromous fish waters of UCI, the ADF&G (1982a) lists 64 rivers, streams, creeks, and sloughs and 14 lakes in which coho salmon have been observed. It is suspected that many more exist but have yet to be documented.

Table 5. Escapement Estimates of Chum Salmon in Numbers of Fish for UCI River Systems, 1974-83

	Northern District		Central District		
Year	Susitna River*	Chakachatna/ McArthur River*	Fitz Creek*	Clearwater Creek*	Chinitna River*
1974	---	---	---	1,800**[f]	---
1975	---	---	---	4,400**[f]	---
1976	---	---	---	12,500**[f]	---
1977	104,543[a]	---	---	12,700**[f]	---
1978	148,400[b]	---	800**[f]	6,500**[f]	---
1979	49,076[b]	---	700**[f]	1,350**[f]	---
1980	7,939[b]	---	1,000**[f]	5,000**[f]	100**[f]
1981	46,461[b]	---	500**[f]	6,150**[f]	2,200**[f]
1982	458,272[c]	1,949[d]	1,275[d]	11,000-14,000[d]	1,500[e]
1983	276,800[c]	11[e]	850[e]	10,900[e]	350[e]

Sources: * King and Tarbox 1983 and 1984, unless otherwise noted.

** ADF&G 1982a

--- means no data were available.

a Fish wheel mark-recapture estimate.

b Side scan sonar estimate.

c Total of Yentna Station (Susitna Hydroelectric Project) sonar estimate and Sunshine Station (Susitna Hydroelectric Project) mark-recapture estimate.

d Stream count.

e Aerial count.

f Peak count.

With but few exceptions, little information is available regarding the abundance of coho salmon in UCI because their run timing is so late that most enumeration projects have been terminated for the season by the time the coho salmon begin to appear. Major coho salmon-producing systems have been the Susitna and Little Susitna rivers system in the Northern District and the Kenai River in the Central District. Although the magnitude of the run is relatively unknown, coho salmon are also found in drainages entering the west side of the Central District (e.g., Fitz, Clearwater, Polly, Harriet, and Cannery creeks, the Crescent River, and Little Jack Slough), the east side of the Central District on the lower Kenai Peninsula (e.g., the Kasilof and Ninilchik rivers and Stariski and Deep creeks), and other Northern District systems such as the Chakachatna-McArthur rivers system, Fish Creek (Big Lake outlet), Cottonwood Creek (Wasilla area), and the Chuitna River (King and Tarbox 1984). Past escapement estimates of coho salmon in the Susitna River have been accomplished by using both side scan sonar and mark-recapture population estimation methods. Deriving accurate escapement numbers by using side scan sonar, however, has been difficult because of the offshore migration characteristics of the species. Counts, therefore, are an indication of run size and are not absolute. Since 1977, escapement estimates have ranged from 24,100 fish in 1983 to 100,800 fish in 1978 (table 6). Sport harvest data for major Susitna River coho salmon-producing tributaries (e.g., Alexander Creek and the Deshka River) indicate increased abundance of coho salmon in the Susitna drainage in recent years (Rowell and Middleton 1985).

Other systems in the Northern District that have produced significant numbers of coho salmon include the Little Susitna River, Big Lake and its outlet stream, Fish Creek, and Cottonwood Creek (near Wasilla). The Little Susitna River escapement estimates derived from foot surveys of selected index areas range from 6,156 fish in 1978 to 6,800 fish in 1982 (table 6). Coho salmon have been enumerated as they pass through a weir on Fish Creek enroute to Big Lake. Escapements to this system have fluctuated a great deal since 1973, ranging from 710 fish in 1973 to a record high of 8,832 fish in 1980 (table 6). The Cottonwood Creek coho salmon run was in a depressed state during the early 1970's. Weir counts for coho salmon returns to the system are available only for 1981 and 1982, when 2,436 and 2,044 fish were enumerated, respectively (table 7).

Within the Central District of the UCI, the Kenai River supports two coho salmon runs, the early run and the late run. Mainstem Kenai River escapement estimates are not available; therefore, abundance and in-season management of the sport fishery is monitored by harvest rates. The harvest

Table 6. Escapement Estimates of Coho Salmon in Numbers of Fish for UCI Management Area River Systems, 1973-83

	Northern District			Central District	
Year	Susitna River*	Little Susitna River	Fish Creek (Nancy Lake)**	Russian River (Kenai R. Drainage)****	Quartz Creek (Kenai R. Drainage)*
1973	---	---	210[e]	200[h]	---
1974	---	---	1,154[e]	1,508[h]	---
1975	---	---	1,601[e]	4,000[h]	---
1976	---	---	765[e]	1,791[h]	---
1977	49,694[a]	---	930[e,f]	1,884[h]	---
1978	100,800[b]	6,153[d**]	3,121[e]	1,570[h]	---
1979	36,966[b]	---	2,511[e]	2,400[h]	---
1980	42,895[b]	---	8,832[e]	3,189[h]	---
1981	33,468[b]	6,750[d**]	2,444[e]	4,679[h]	---
1982	79,824[c]	6,800[d***]	5,200[e]	2,291[h]	2,522[e]
1983	24,100[c]	2,266[d*]	2,382[e*]	475[eg*]	1,662[e]

Sources: * King and Tarbox 1983, 1984.
** Bentz 1982, unless otherwise noted.
*** Bentz 1983, unless otherwise noted.
**** Nelson 1983, unless otherwise noted.

--- means no data were available.

a Fish wheel mark-recapture estimate.

b Side scan sonar estimate.

c Total of Yentna Station (ADF&G Susitna Hydroelectric Project) sonar estimate and Sunshine Station (ADF&G Susitna Hydroelectric Project) mark-recapture estimate.

d Escapement estimate based on foot surveys of six index areas within the Little Susitna River.

e Weir counts.

f Weir not operated long enough to enumerate entire coho salmon escapement.

g Early run only.

h Weir and counting tower enumeration.

Table 7. Coho Salmon Escapement Observations in Numbers of Fish for Selected Streams of UCI

Northern District			
Stream Name	1981	1982	1983
Chakachatna-McArthur Rivers	---	7,328[a]	---
Chuitna River	---	1,085[a]	1,600-1,000[g]
Cottonwood Creek (Cottonwood-Wasilla lakes)	2,436[c]	2,044[c]	---

Central District		
Stream Name	1982	1983
Cannery Creek (Drift River tributary)	---	252[e]
Clearwater Creek	1,000-1,500[b]	200[d]
Crooked Creek (Kasilof River tributary)	---	1,141[h]
Drift River		822[e]
Fitz Creek	100[b]	
Harriet Creek	---	575[d]
Little Jack Slough	---	5,500[e,f]
Packers Lake (Kalgin Island)	339[h]	---
Polly Creek	---	400[d]

Source: King and Tarbox 1983, 1984.

--- means no data were available.

a Stream count.

b A combination of foot and aerial surveys were conducted on these streams on the following dates in 1982: Fitz Cr., 25 August; Clearwater Cr., 24 August; Chinitna R., 9 August.

c A combination of weir counts and downstream foot surveys used to enumerate fish.

d Aerial counts by ADF&G, Division of Commercial Fisheries.

e Aerial counts by Cook Inlet Aquaculture Association.

f Includes Blue (Elling) Lake.

g Aerial counts by Environment Research and Technology, Inc.

h Weir count.

rates, however, can be affected by several factors, including weather and water conditions, gear type, fishing technique, and the number of anglers participating in the fishery. For these reasons, they are only a gross indicator of the abundance of fish (Logan, pers. comm.). During the period 1976 through 1983, sport harvest rates for the early coho salmon run averaged 0.131 fish per hour and for the late run 0.154 fish per hour. The early run sport harvest rate has ranged from a low of 0.067 fish per hour in 1978 to a high of 0.203 fish per hour in 1980. The late-run sport harvest rate has ranged from 0.095 fish per hour in 1977 to 0.255 fish per hour in 1980. The sport catch rates during 1984 were 0.134 fish per hour and 0.154 fish per hour for the early and late runs, respectively (table 8).

Within the Kenai River drainage, two tributaries, the Russian River and Quartz Creek, have been monitored, and coho salmon escapement data are available. Since 1973, Russian River coho salmon escapement estimates have ranged from 200 fish in 1973 to 4,679 fish in 1981 (table 6). Quartz Creek escapement estimates are available for 1982 and 1983, when 2,522 and 1,662 coho salmon were enumerated, respectively (table 6). Other UCI systems known to have coho salmon but for which only sporadic escapement information is available are included in table 7.

5. Chinook salmon. Chinook salmon are the least abundant of the five salmon species found in UCI and are the first to return each season. In summarizing anadromous fish waters of UCI, the ADF&G (1982a) lists 40 rivers, streams, creeks, and sloughs and seven lakes in which chinook salmon have been observed. It is suspected that many more exist but have yet to be documented.

   Major producing drainages for chinook salmon in UCI are the Susitna River in the Northern District and the Kenai and Kasilof rivers in the Central District. Smaller systems in both the Northern and Central districts also support chinook salmon populations (tables 9 and 10). Escapement estimates have been obtained from aerial, boat, and foot surveys of the clearwater portions or tributaries of these systems (Rowell and Middleton 1985).

   The Susitna River chinook salmon run is the largest in UCI. The migration of chinook salmon bound for the Susitna River is believed to occur along the west side of Cook Inlet, which segregates these fish from early run Kenai and Kasilof river chinook salmon and early run Russian River sockeye salmon (ibid.). Since the 1950's, extensive closures of the sport, subsistence, and commercial fisheries were necessary to enhance the depressed condition of the Susitna River chinook salmon run. The effect of the conservation measures became apparent in 1976 when survey counts increased five-fold from the year before and have since remained at least at that

Table 8. Historical Data from the Kenai River Coho Salmon Recreational Fishery, 1976-84

	Early Run[a]			Late Run[a]			Total[a]		
Year	Harvest[b] (No. Fish)	Effort[c] (Angler-days)	Catch Per Hour	Harvest (No. Fish)	Effort (Angler-days)	Catch Per Hour	Harvest (No. Fish)	Effort (Angler-days)	Catch Per Hour
1976	7,711	21,178	0.091	5,513	11,672	0.135	13,224	32,850	0.105
1977	7,415	13,576	0.124	2,371	5,317	0.095	9,786	18,893	0.116
1978	5,236	17,847	0.067	6,644	16,376	0.116	11,880	34,223	0.088
1979	11,122	12,439	0.163	3,510	7,721	0.120	14,632	20,160	0.150
1980	15,668	22,095	0.203	9,545	10,699	0.255	25,213	32,794	0.220
1981	14,680	25,670	0.138	6,664	13,198	0.126	21,344	38,868	0.167
1982	24,827	41,838	0.148	13,351	16,967	0.219	38,786	58,805	0.167
1983	12,851	27,938	0.111	7,549	8,934	0.163	20,400	36,872	0.126
Mean	12,439	22,823	0.131	6,893	11,361	0.154	19,408	34,184	0.142
1984	28,447[d]	32,522	0.134	32,029	34,655	0.238	60,456	67,217	0.224

Source: Logan, pers. comm.

a Total harvest and effort data: including upstream section (Skilak Lake to Naptowne Rapids), midstream section (Naptowne Rapids to Soldotna Bridge), and downstream section (Soldotna Bridge to Beaver Creek) of the Kenai River.

b Harvest includes those coho salmon taken prior to 1 August during the chinook salmon sport fishery.

c Early run effort is for the period after 1 August.

d Of these, 10,359 were taken during July incidentally to the chinook salmon fishery.

Table 9. Chinook Salmon Escapement Estimates for Selected Northern District Drainages of the UCI Management Area,* 1976-83

Drainage/Tributary	1976[a]	1977[a]	1978[a]	1979	1980	1981	1982	1983
Matanuska River drainage								
Moose Creek	116	153	237	253	---	239	407	452
Susitna River drainage								
Alexander Creek	5,412	9,246	5,854	6,215	---	---	2,546	3,755
Cache Creek	61	100	---	---	---	---	---	497
Chulitna River (East Fork)	112	168	59	---	---	---	119	---
Chulitna River (Middle Fork)	1,870	1,782	900	---	---	---	644	3,845
Chulitna River (below forks)	124	229	62	---	---	---	100	213
Chunilna (Clear) Creek	1,237	769	997	864	---	---	982	938
Deception Creek	---	---	495	239	---	366	229	121
Deshka River (Kroto Creek)	21,693	39,642	24,369	27,385	---	---	16,000	19,237
Goose Creek	160	133	283	---	---	262	140	477
Indian River	537	393	114	386	---	422	1,050	1,193
Kashwitna River (North Fork)	203	236	362	457	---	557	156	297
Lake Creek (Yentna River tributary)	3,735	7,391	8,931	4,196	---	---	3,577	7,075
Little Willow Creek	833	598	436	327	---	459	316	1,042
Montana Creek	1,445	1,443	881	1,094	---	814	887	1,641
Peters/Martin Creeks	2,280	4,102	1,335	---	---	---	---	2,272
Portage Creek	702	374	140	190	---	659	1,111	3,140
Prairie Creek	6,513	5,790	5,154	---	---	---	3,844	3,200
Red Creek (Skwentna River tributary)	---	1,511	385	---	---	749	---	---
Sheep Creek	455	630	1,209	778	---	1,013	527	975
Talachulitna River	1,319	1,856	1,375	1,648	---	2,025	3,101	10,014
Willow Creek	1,660	1,065	1,166	848	---	991	592	777
Beluga River drainage								
Bishop Creek	12	468	---	30	---	174	387	7***
Coal Creek	17	---	1,551	178	---	223	250	---
Drill Creek	---	---	---	---	---	---	697**	1,000***
Olson Creek	247	1,229	94	17	---	116	188	30***
Pretty Creek	---	---	---	---	---	---	---	6***
Scarp Creek	---	---	---	---	---	---	184**	---
Chakachatna River drainage								
Straight Creek	59	24	108	---	---	126	383	---
Chuitna River	1,984	1,981	1,130	1,246	---	1,362	3,438	4,043
Theodore River	1,032	2,263	547	512	---	535	1,368	1,519
Lewis River	380	454	561	546	---	560	606	521***
Nikolai Creek	11	143	---	---	---	26	520	---
Ship Creek****	806	1,011	867	124	---	---	665**	---

Source: * Hepler and Bentz 1984, unless otherwise noted.
** King and Tarbox 1983.
*** King and Tarbox 1984.
**** McBride and Wilcock 1983.

--- means no data were available.

a No sport fishery.

Table 10. Chinook Salmon Escapement Estimates by River System for Selected Central District Drainages of the UCI Management Area, 1973-82

System	1973*	1974*	1975*	1976*	1977*	1978*	1979*	1980*	1981**	1982**
Russian River (tributary of Kenai River)[a]	347	183	134	300	182	418	362	250	121	1,228
Crooked Creek (tributary of Kasilof River)[a,b]	---	280	343	1,778**	3,194	4,832**	3,599**	2,355**	2,980	5,586
Anchor River[c]	1,660	1,000	1,290	3,080	4,170	2,410	2,000	675	1,140***	1,490
Deep Creek[c]	220	740	610	1,680	990	1,010	1,750	475	920	2,670
Ninilchik River[c]	640	510	830	1,180	1,400	990	1,390	715	830	1,430

Source: * McBride and Wilcock 1983, unless otherwise noted.
** Rowell and Middleton 1985, unless otherwise noted.
*** Hammarstrom and Larson 1982.

--- means no data were available.

a Weir counts.

b Includes stream counts below weir.

c Estimates are observed survey counts from combinations of ground and aerial surveys.

level. It is believed that the stocks have rebuilt to the level existing at the height of the commercial fisheries, when 50,000 to 60,000 chinook salmon were harvested (ibid.). From the Division of Sport Fisheries surveys of east side and west side streams between 1973 and 1983, the observed escapement counts of chinook salmon in these northern Cook Inlet systems have ranged from 9,209 fish in 1975 to 84,173 fish in 1977 (Hepler and Bentz 1984). From the escapement counts, population estimates for northern UCI were prepared, which have ranged from 11,500 chinook salmon in 1975 to 118,600 chinook salmon in 1977 (ibid.). In 1983, the escapement count and estimated population of chinook salmon in the northern UCI were 67,723 and 91,800 fish, respectively (ibid.). The vast majority of these fish were found in the Susitna River drainage (table 9).

The Kenai River produces the second largest run of chinook salmon to the UCI. As with sockeye and coho salmon runs in this river system, the chinook salmon run is composed of two segments, early and late. Abundance estimates, however, are not available for the entire Kenai River, and very limited information is available for escapement enumeration of its tributaries. Since 1973, weir counts and ground surveys of chinook salmon for Russian River, a tributary to the Kenai River, have fluctuated between 121 fish in 1981 to 1,228 fish in 1983 (table 10). During 1981, the USFWS estimated from research conducted on the Killey River, another Kenai River tributary, that the early run escapement to that system was 8,000 fish. It is felt that the Killey River is the major producer of early run chinook salmon, and its contribution to the run could approach 60% of the total (Hammarstrom and Larson 1982).

Because mainstem escapement estimates are not available, the Kenai River chinook salmon sport fishery is managed by catch per hour data and comparison with past harvest levels. Fluctuations in harvest and effort, however, are frequently a function of water conditions than of abundance of fish (Logan, pers. comm.). During the period 1974 through 1984 the catch per hour for the early run has ranged from a low of 0.011 in 1975 to a high of 0.037 in 1983. The late-run catch per hour has ranged from a low of 0.018 in 1980 to a high of 0.044 in 1975 (table 11).

The Kasilof River of the Central District supports both wild and hatchery stocks of chinook salmon. Data regarding Kasilof River populations other than the stocks of Crooked Creek, a tributary to the Kasilof River, are nonexistent. Although Crooked Creek is reported to have once supported large natural chinook salmon runs, little historical information is available. In 1974, an ADF&G research and enhancement project directed at chinook salmon was initiated on Crooked Creek. Brood stocks for the hatchery were from the local wild population. Beginning in 1974, escapements to Crooked Creek have been monitored by weir counts and stream counts below the weir. Since that time, escapements to the stream have increased from 280 fish in 1974 to almost 5,600 fish in 1982 (table 10). The contribution of hatchery returns to the total escapement has increased steadily to 74% in 1982 (ibid.). Other Central District chinook salmon-producing systems for which estimated escapement information is available are the Anchor and Ninilchik rivers and Deep Creek. Escapement figures for these systems are detailed in table 10.

C. Habitat Enhancement

See sections V.A. and V.B. of this narrative.

Table 11. Historical Data from the Kenai River Chinook Salmon Recreational Fishery, 1974-84

	Early Run[a]					Late Run[a]				
Year	Harvest (No. of Fish	Effort (Angler-Hours)	Effort (Angler-Days)	Hours/ Angler-Day	Catch/ Hour[b]	Harvest (No. of Fish)	Effort (Angler-Hours)	Effort (Angler-Days)	Hours/ Angler-Day	Catch/ Hour[b]
1974*	1,685	---	11,275	---	0.041	3,225	---	12,335	---	0.037
1975*	615	---	15,047	---	0.011	2,355	---	14,943	---	0.044
1976*	1,554	---	16,430	---	0.024	4,477	---	28,030	---	0.039
1977**	2,173	112,007	35,479	3.2	0.021	5,148	135,082	47,539	2.8	0.038
1978**	1,542	96,624	19,569	4.9	0.017	5,578	212,217	60,633	3.5	0.029
1979**	3,661	139,154	39,665	3.5	0.022	4,634	205,887	58,895	3.5	0.022
1980**	1,946	123,019	32,365	3.8	0.016	3,608	154,435	38,260	4.0	0.018
1981**	4,525	120,881	28,335	4.3	0.031	5,285	149,296	29,905	5.0	0.032
1982**	5,466	166,334	45,723	3.6	0.033	4,810	197,775	43,366	4.6	0.028
1983***	6,360	---	42,716	---	0.037	9,174	---	56,295	---	0.036
1984***	4,956	---	50,455	---	0.025	7,376	---	77,462	---	0.021

Source: * Hammarstrom 1977.
** Hammarstrom and Larson 1983.
*** Logan, pers. comm.

--- means no data were available.

a Total harvest and effort data: including upstream section (Skilak Lake to Naptowne Rapids), midstream section (Naptowne Rapids to Soldotna Bridge), downstream section (Soldotna Bridge to Beaver Creek), and shore anglers.

b Productivity (or catch/hour) of the fishery can be affected by several factors, including water condition, fishing technique, and familiarity with the river. Catch/hour for 1980 is low compared to other years, and during that year water conditions were more turbid than normal. Beginning in 1981, nearly half the anglers used the technique called "tad-pollying," or working a bright diving plug through fishing holes, and it appeared to be quite successful. In addition, during 1981 and 1982, guided anglers harvested nearly half (49.8% and 49.0% in 1981 and 1982, respectively) of fish while accounting for less than 30% of the effort (24.2% in 1981 and 28.9% in 1982) (Hammarstrom 1981, Hammarstrom and Larson 1982 and 1983).

III. LOWER COOK INLET (LCI) MANAGEMENT AREA

The LCI Management Area is comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point. The area is divided into five salmon fishing districts. They are the Southern, Kamishak Bay, Barren Island, Outer, and Eastern districts. The districts are divided into six, seven, zero, seven, and two subdistricts, respectively. The Port Dick subdistrict of the Outer District is further subdivided into two sections (ADF&G 1984a). A map of the districts may be found in the salmon commercial harvest narrative found in the human use portion of this volume. The subdistricts and sections accommodate the geography of LCI, which consists of numerous small bays, and are designed to facilitate management of discrete salmon stocks (Middleton 1981, ADF&G 1983a).

A. Distribution

Although all five species of Pacific salmon that are native to North America may be found in fishing districts simultaneously, each species has a normal period of abundance (ADF&G 1977). Adult salmon are found in LCI marine waters from late April to late September and in fresh waters from late May to late November. Listed below in tables 12 through 15 is general run-timing information for the different salmon species in four of the commercial fishing districts (variations from these times may occur in some systems). The Barren Island District supports no spawning populations of salmon and has therefore been excluded from the following discussions.

B. Abundance

In terms of the average number of fish harvested commercially during a thirty year period (1954 to 1984), pink salmon are the most abundant salmon species found in LCI and account for 79.35% of the harvest. Chum salmon are the second most abundant species at 13.31% of the harvest and are followed in order by sockeye salmon at 6.52%, coho salmon at 0.78%, and chinook salmon at 0.04% (ADF&G 1984c). The number of salmon produced by LCI streams and lakes, as indicated by escapement estimates, reflects the same ranking of species. Annual escapements since 1980 for salmon-producing systems in the Southern, Kamishak Bay, Outer, and Eastern districts have averaged 472,700 pink salmon and 148,100 chum salmon (tables 16 and 17). Sockeye salmon escapements since 1982 have averaged 103,300 fish (table 18). Compared to pink, chum, and sockeye salmon, relatively low numbers of coho salmon are produced in LCI waters, and extremely low numbers of chinook salmon spawn in the area.

Sections 1. through 5. below are organized according to the abundance of each species, with the most numerous, pink salmon, presented first.

1. Pink salmon. There are 26 major pink salmon systems in LCI (table 16) (ADF&G 1982c). Of these, about 18 are consistently surveyed to obtain seasonal escapement estimates. Some systems have not been as consistently surveyed from year to

Table 12. General Salmon Run-Timing Information, Southern District of the LCI Area

	Adults			Juveniles	
Species	Present in Nearshore & Estuarine Areas[a]	Enter Fresh Water[b]	Spawning[b]	Emerge from Gravel	Out-migration[b]
Chinook	Late April-late July*	None[a]	None[a]	None[a]	None[a]
Sockeye	Early May-late July	Late May-mid July[a]	Mid July-late Sept.[a]	?	Out by late June[a]
Coho	Mid July-late Sept.	Mid Aug.-late Oct.	Early Sept.-late Nov.	?	Out by mid July
Pink	Late June-late Aug.	Mid July-late Aug.	Late June-early Sept.	?	Out by early April
Chum	Mid June-mid Aug.	Early July-mid Aug.	Mid July-early Sept.	?	Out be early Apil

Source: a Schroeder 1984; b ADF&G 1977, unless otherwise noted.

* Evidence indicates that rearing chinook salmon are found in the coastal waters of the district year-round (Schroeder 1984).

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

Table 13. General Salmon Run-Timing Information, Kamishak Bay District of the LCI Area

	Adults			Juveniles	
Species	Present in Nearshore & Estuarine Areas[a]	Enter Fresh Water[b]	Spawning[b]	Emerge from Gravel	Out-migration[b]
Chinook	Late June-late July	Late June-late July[a]	Late July[a]	?	?
Sockeye	Early June-mid July	Early June-mid Aug.	Mid July-late Aug.	?	Out by mid July
Coho	Early Aug.-late Sept.	Mid Aug.-late Oct.	Early Sept.-late Nov.	?	Out by mid July
Pink	Mid July-mid Aug.	Mid July-early Sept.	Early Aug.-late Sept.	?	Early Apr.-late May
Chum	Late June-mid Sept.	Late June-mid Sept.	Mid Aug.-late Sept.	?	Early Apr.-late May

Source: a Schroeder 1984, b ADF&G 1977, unless otherwise noted.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

Table 14. General Salmon Run-Timing Information, Outer District of the LCI Area

Species	Adults			Juveniles	
	Present in Nearshore & Estuarine Areas	Enter Fresh Water	Spawning	Emerge from Gravel	Out-migration
Chinook	*	None	None	None	None
Sockeye	Mid June-mid Aug.	Mid June-mid Aug.	Late July-late Aug.	?	Mid May-early July
Coho	Mid July-mid Sept.	Early Aug.-mid Sept.	?	?	?
Pink	Early July-late Aug.	Early July-late Aug.	Late July-early Sept.	Early April-early May	Out be early May
Chum	Late June-mid Aug.	Late June-mid Aug.	Late June-late Aug.	Probably March & April	March & April

Source: Schroeder 1984.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

* Rearing chinook salmon from other areas (e.g., UCI, Pacific Northwest, and Canada) found in district waters year-round.

Table 15. General Salmon Run-Timing Information, Eastern District of the LCI Area

Species	Adults			Juveniles	
	Present in Nearshore & Estuarine Areas	Enter Freshwater	Spawning	Emerge from Gravel	Out-migration
Chinook	Late May-early June	Late May-late June	Mid July-mid Aug.	?	?
Sockeye	Late May-mid July	Late May-mid July	Late July-late Aug.	Early May-late May	Late May-late June
Coho	Early July-mid Sept.	Mid Aug.-early Nov.	Early Oct.-late Nov.	Mid May-early June	Late May-mid July
Pink	Late June-mid Aug.	Mid July-mid Aug.	Late July-early Sept.	Mid April-mid May	Mid April-mid May
Chum	Late June-early Aug.	Early July-early Aug.	Mid July-mid Aug.	Mid April-mid May	Mid April-mid May

Source: McHenry 1985.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

year or for as long as others, especially streams in the Kamishak District where weather is a major deterrent to regular aerial surveys (Middleton 1981).

Within LCI, pink salmon-producing systems are susceptible to environmental conditions that cause unpredictable production. Many of the streams, particularly in the Outer District, are subject to severe flooding or low water freezing conditions (ibid.). Dewatering of streams during summer months has also been observed. In 1982, no visible water flow was observed in Jakalof Creek of the Southern District during late July and early August (ADF&G 1983a). Also during 1982, the outlet stream from Delight Lake in the Outer District dried up (ibid.). Observed levels of escapement to the Kamishak Bay District match or exceed those in either the Outer or Southern districts; however, total run size is probably considerably smaller because a good portion of the Kamishak Bay District runs are not harvested and enter the rivers as escapement (Middleton 1981). Further, spawning streams in the Kamishak Bay District have historically had severe fluctuations in their returns and survival rates (ADF&G 1982c). It is believed that environmental conditions that prevail in this area are much more influential on salmon production than in the more moderate and marine influenced areas of the Kenai Peninsula (Middleton 1981, ADF&G 1982c).

The Southern District has six systems that are surveyed regularly, and escapement observations have been quite consistent since the late 1950's (ibid.). Four of these, Humpy Creek, Seldovia Creek, Port Graham River, and Tutka Lagoon, are the key producing systems for the district (table 16). It should be noted that the Tutka Bay runs are largely due to hatchery returns that began in 1978 (1982b). To provide for optimum spawner density and maximum productivity, escapement goals have been established for each of the major pink salmon-producing systems. When combined the pink salmon escapement goal for the systems in the Southern District is 99,000 to 164,000 spawners per year (ADF&G 1984c). The total estimated escapement to the major producing systems during the period 1980 through 1984 has ranged from 122,900 in 1982 to 239,000 pink salmon in 1981. During 1984 the escapement estimates for these systems totaled 129,200 pink salmon (table 16).

The Outer District has seven major pink salmon spawning systems (table 16), and escapements have been consistently monitored since 1960 (Middleton 1981). The even-year pink salmon return has been severely depressed as a result of both the 1964 earthquake and the extremely cold environmental conditions of the early 1970s (1982b). Rocky River and Port Dick Creek have been the primary producers and Windy Left Creek can at times be a significant producer (Middleton 1981). Windy Right River, Island Creek, South Nuka Creek,

Table 16. Escapement Estimates of Pink Salmon in Thousands of Fish by District and Major Systems in the LCI Management Area, 1980-84

District/System	1980	1981	1982	1983	1984
Southern District					
Humpy Creek	64.4	115.0	31.9	104.8	84.2
Tutka Lagoon	17.3	21.0	18.5	12.9	10.5
Seldovia Creek	65.5	62.7	38.4	27.9	14.2
Port Graham River	40.2	18.4	28.9	4.6	10.9
China Poot Bay	12.3	5.0	3.1	14.1	8.4
Barabara Creek	5.8	16.8	2.1	14.8	1.0
District total	205.5	239.0	122.9	179.1	129.2
Outer District					
Rocky River	6.4	25.0	6.6	16.1	9.0
Windy Left River	10.9	31.3	4.4	11.9	2.5
Windy Right River	3.3	4.7	4.7	4.3	3.4
Port Dick Creek	56.1	106.0	19.9	64.1	44.6
Island Creek	2.2	25.0	15.0	15.3	35.0
South Nuka Creek	.3	16.0	0	22.2	.6
Port Chatham Streams	7.7	11.2	2.0	3.5	7.8
District total	86.9	219.2	52.6	137.4	102.9
Kamishak Bay District					
Big Kamishak River	2.0	---	5.0	0	0
Little Kamishak River	.6	---	2.2	0	.1
Amakdedori Creek	3.8	1.5	6.3	.2	0
Bruin Bay River	400.0	95.0	75.0	4.0	110.0
Sunday Creek	5.2	14.2	12.0	4.7	12.0
Brown's Peak Creek	2.3	17.7	3.5	1.7	6.8
District total	413.9	128.4	104.0	10.6	128.9
Eastern District					
Bear Creek	---	---	7.9	.8	7.7
Salmon Creek	---	---	21.0	.5	10.2
Mayor Creek	---	---	3.4	0	1.5
Clear Creek	---	---	2.2	0	3.4
Thumb Cove	---	---	7.9	4.9	4.2
Humpy Cove	---	---	4.0	2.0	2.5
Tonsina Creek[a]	---	---	7.5	5.4	6.0
District total	---	---	53.9	13.6	35.5
LCI total	706.3	586.6	333.4	340.7	396.5

Source: ADF&G 1982b, 1982c, 1982e, 1984b, 1984c.

--- means no data were available.

a Pink salmon escapement estimates are minimum figures due to glacial water and flooding that occur in late August and September.

and Port Chatham streams are relatively small producers (ibid.). Minor pink salmon spawning systems are found at Port Dick Right Hand Creek, James Lagoon, Desire Lake Creek and several South Nuka Island Creeks (ADF&G 1982b, 1982c; Schroeder 1984). During odd-year returns, Port Dick Creek has two runs of pink salmon. The early run consists of primarily upstream spawners, whereas the later run is composed of primarily intertidal spawners (ADF&G 1982c). To provide for optimum spawner density and maximum productivity, escapement goals have been established for each of the major pink salmon-producing systems. When combined, the pink salmon escapement goal for the systems in the Outer District is 142,000 to 253,000 spawners per year (ADF&G 1984c). The total estimated escapement to the major producing systems during the period 1980 through 1984 has ranged from 52,600 in 1982 to 219,200 in 1981. During 1984, the escapement estimates for these systems totaled 102,900 pink salmon (table 16).

The Kamishak Bay District has three major pink salmon spawning streams from which most of the district's commercial harvest is derived. They are Bruin Bay River, Sunday Creek and Brown's Peak Creek (ADF&G 1982b, 1982c, 1983a). Sunday Creek in Rocky Cove and Browns Peak Creek in Ursus Cove have produced very large pink salmon runs in past years, but the streams appear to be susceptible to flooding, freezing, and dewatering. Thus, pink salmon returns from good spawning escapements have fluctuated wildly (ADF&G 1982c). Pink salmon also spawn in the Big Kamishak and Little Kamishak rivers and Amakdedori Creek (ADF&G 1983a). To provide for optimum spawner density and maximum productivity, escapement goals have been established for the six pink salmon-producing systems mentioned above. When combined, the pink salmon escapement goal for these systems is 90,000 to 115,000 spawners per year (ADF&G 1984c). The total estimated escapement to these systems during the period 1980 through 1984 has ranged from 10,600 fish in 1983 to 413,900 fish in 1980. The 1984 estimated escapement to these systems totaled 128,900 pink salmon (table 16).

The Eastern District pink salmon fishery has been primarily an even-year fishery (ADF&G 1982c), and observations are restricted to schooling fish along the Resurrection Bay shoreline and a few small streams toward the upper end of the bay (Middleton 1981). In terms of harvest, Mayor, Bear, and Salmon creeks have historically been the major producing pink salmon systems in the Eastern District (ADF&G 1982c). Significant returns have occasionally been observed at Thumb Cove, Humpy Cove, and Tonsina Creek in the outer portion of Resurrection Bay and at Spring Creek on the eastern shore of the bay (ADF&G 1982c, Schroeder 1984). Pink salmon are also produced in the Aialik Lake system of Aialik Bay (ADF&G

1983a). To provide for optimum spawner density and maximum productivity, escapement goals have been established for seven of the pink salmon-producing systems of the Eastern District. They include Bear, Salmon, Mayor, and Tonsina creeks and Thumb and Hump coves. The combined escapement goal for these systems is 27,000 spawners per year (ADF&G 1984c). Escapement estimates for these systems are available only since 1982. The estimated escapements to these systems totaled 53,900, 13,600, and 35,500 spawners in 1982, 1983, and 1984, respectively (table 16).

2. Chum salmon. There are 21 chum salmon-producing systems in LCI where annual or frequent escapement counts are made. The systems have been monitored for an average of 13 years (Middleton 1981). During recent years, chum salmon returns to Tutka Creek and the FRED hatchery located there have also been monitored.

   Chum salmon are much less abundant than pink salmon and essentially occur in the same streams and fishing areas as pink salmon. As with pink salmon, chum salmon in LCI are susceptible to environmental conditions that result in unpredictable production. Virtually all of the streams, particularly in the Kamishak Bay District, are subject to severe flooding and winter freezing conditions (ibid.).

   Chum salmon are a relatively minor salmon species in the Southern District (ADF&G 1982b, 1982c, 1983a). Stocks have been very low since the 1964 earthquake, which caused an extensive loss of spawning area due to land subsidence (Middleton 1981). Chum salmon spawn in numerous small streams of the Southern District, with the two largest spawning concentrations occurring in the Port Graham and Seldovia rivers (ADF&G 1982b). Escapement goals for chum salmon in the Southern District have been established only for the Port Graham River, where the range is 4,000 to 8,000 spawners per year (ADF&G 1984c). Escapement estimates to the three systems mentioned above have ranged from 1,400 to 5,300 chum salmon during the period 1980 through 1984. During 1984, the escapement estimate to these systems totaled 3,400 chum salmon (table 17).

   The Outer District has nine streams for which escapement data are available (table 17). Of these, Dogfish (Koyuktolik) Bay stream and Island Creek in Port Dick are the primary chum salmon-producing systems (ADF&G 1982c). Other major chum salmon-producing systems include the Petrof and Rocky rivers and at times Port Dick Head End Creek (ADF&G 1982c, 1983a). To provide for optimum spawner density and maximum productivity, escapement goals have been established for the five systems mentioned above. When combined, the chum salmon escapement goal for these systems is from 41,000 to 54,000 spawners per year (ADF&G 1984c). Escapement estimates for the nine major chum salmon-producing systems of the Outer

Table 17. Escapement Estimates of Chum Salmon in Thousands of Fish by District and Major Systems in the LCI Management Area, 1980-84

District/System	1980	1981	1982	1983	1984
Outer District					
Dogfish (Koyuktolik) Lagoon (streams)	4.0	11.5	8.5	5.3	8.6
Port Chatham (streams)	.2	1.6	.8	.9	.2
Windy Right River	.5	.9	.4	.2	.3
Windy Left River	.5	.3	.1	0	.1
Rocky River	23.0	12.5	2.8	4.0	3.5
Head End Creek	4.2	4.1	1.7	4.5	2.7
Island Creek	10.9	17.5	8.7	36.2	25.6
Middle Creek	---	.1	.1	.2	.6
Petrof River	5.0	2.4	.7	1.8	1.5
District total	48.3	50.9	23.8	53.1	43.1
Kamishak District					
Silver Beach (streams)	3.2	1.2	4.0	2.0	.1
Main Left (streams)	5.6	1.9	2.3	2.2	.6
Big Kamishak River	10.0	11.0	25.0	25.0	19.0
Little Kamishak River	13.0	6.0	18.0	25.0	12.0
McNeil River	8.0	30.0	25.0	48.0	21.0
Cottonwood Creek	4.2	9.0	7.0	8.3	6.5
Iniskin River	9.3	9.0	12.8	12.0	9.8
Bruin River	15.0	10.0	10.0	5.5	8.0
Rocky Cove (Sunday Creek)	.2	.8	4.0	1.0	.5
Ursus Cove (streams)	8.0	10.0	9.0	7.7	7.0
District total	76.5	88.9	117.1	136.6	84.5
Southern District					
Tutka Creek	---	---	1.3	.5	.5
Seldovia River	.3	.5	1.0	.5	.8
Port Graham River	1.1	4.8	2.5	1.9	2.1
District total	1.4	5.3	4.8	2.9	3.4
Lower Cook Inlet total	126.2	145.1	145.7	192.7	131.0

Source: ADF&G 1982 b, 1982c, 1982e, 1984b, 1984c.

--- means no data were available.

District during the period 1980 through 1984 have ranged from 23,800 in 1982 to 53,100 chum salmon in 1983. The 1984 escapement estimate totaled 43,100 chum salmon (table 17).

The Kamishak Bay District has 10 chum salmon systems that are surveyed regularly and represent most of the chum salmon-producing systems in the district (table 17). Spawning streams in the district have historically had large fluctuations in both their returns and survival rates. This has been attributed to the severe environmental conditions that are prevalent in the area (ADF&G 1982c). Eight of the 10 chum salmon systems of the district have had escapement goals established to provide for optimum spawner density and maximum productivity. These systems include the Big Kamishak, Little Kamishak, McNeil, Iniskin, and Bruin rivers, Cottonwood Creek, and the streams draining into Ursus Cove and Main Left. When combined, the chum salmon escapement goal for the Kamishak Bay District is 85,000 to 110,000 spawners per year (ADF&G 1984c). Estimated escapements to the 10 major systems during the period 1980 through 1984 have ranged from 76,500 in 1980 to 136,600 chum salmon in 1983. The 1984 estimated escapement totaled 84,500 chum salmon (table 17).

The Eastern District has very few chum salmon spawning areas. Small spawning areas have been observed in Day Harbor and Aialik Bay, but the two major chum salmon-producing streams in the district are Tonsina and Clear creeks in Resurrection Bay (ADF&G 1982c). No escapement goals for chum salmon in the Eastern District have been established, and escapement estimates are available only for Tonsina Creek. Escapement estimates for 1980 to 1982 have ranged from 1,500 to 6,800 (Schroeder 1984). The 1984 escapement was estimated at 5,100 fish (ibid.).

3. Sockeye salmon. In terms of average number of fish harvested annually, sockeye salmon are a minor species in the LCI. There are about 15 known sockeye salmon-producing systems, and escapement observations cover 20 years or more for most systems (Middleton 1981).

Within the Southern District, there are several minor sockeye salmon-producing systems, but the only natural major producer is the English Bay Lakes system (ADF&G 1982b, 1982c). In 1976, FRED began stocking Leisure Lake with fingerling sockeye salmon in a research program to assess the potential of barren lakes on the Kenai Peninsula to produce and rear juvenile sockeye. Adult sockeye salmon from Leisure Lake stocks return to China Poot Bay but cannot reach the lake because of a series of waterfalls in the outlet stream (ADF&G 1981b, 1981c). Sockeye salmon escapement goals in the Southern District have been established only for the English Bay Lakes system. The goal is 10,000 to 20,000 spawners per year (ADF&G 1984c). Escapement estimates to the English Bay

Lakes system and Clearwater Slough, the two systems for which data are available, totaled 21,100, 12,600 and 11,300 sockeye salmon in 1982, 1983, and 1984, respectively (table 18).

Major sockeye salmon-producing systems of the Outer District include Delight and Desire lakes in the McCarty Fiord portion of Nuka Bay (ADF&G 1983a). During 1981, a minor sockeye salmon fishery occurred for the first time at Anderson Beach, just south of Port Chatham, where a very small lake system supports a population of fish (ADF&G 1982c). To provide for optimum spawner density and maximum productivity, escapement goals have been established for each of these sockeye salmon-producing systems. When combined, the escapement goal for the three systems totals 22,000 spawners per year (ADF&G 1984c). Estimated escapements for the systems totaled 43,600, 19,500, and 26,700 in 1982, 1983, and 1984, respectively (table 18).

Sockeye salmon production in the Kamishak Bay district occurs only in the Bruin Bay, McNeil River and Kamishak-Douglas subdistricts or southern half of the district (ADF&G 1983a). The Mikfik Lake system in the McNeil River subdistrict is the largest producer of sockeye salmon at the present time (1982c). The fish, however, are extremely small, averaging only 4.1 to 4.3 lb per fish (ADF&G 1983a). The Big Kamishak River and the Douglas River in the Kamishak-Douglas subdistrict also produce sockeye salmon. A small sockeye salmon run returns annually to Amakdedori Creek in the Bruin Bay subdistrict (ADF&G 1982c). The Chenik Lake system of the Bruin Bay subdistrict historically had very high sockeye salmon production. Old records report a weir count of 53,000 sockeye salmon escapement in 1932 and a 39,000 escapement in 1933 (Middleton 1981). Natural forces, either accentuated by or caused by the 1964 earthquake, altered the outlet stream to the extent that now only a few sockeye salmon enter the system on certain tides (ibid.). Escapement goals have been established for the Mikfik and Chenik lake systems only. When combined the goal is 15,000 to 25,000 spawners per year (ADF&G 1984c). Escapement estimates for these two systems and the Big Kamishak River, the Douglas River, and the Douglas Beach area totaled 58,800, 23,900, and 21,600 sockeye salmon in 1982, 1983, and 1984, respectively (table 18).

Within the Eastern District, the Aialik Lake system and the Bear Lake system produce sockeye salmon. Escapement goals have been established only for the Aialik Lake system and are 2,500 to 5,000 spawners per year (ADF&G 1984c). Escapement estimates to these systems are limited. For the years 1982, 1983, and 1984, estimated escapements to the Aialik Lake system were 22,400, 20,000, and 22,800 sockeye salmon, respectively. Estimated escapements to the Bear Lake system were 463, 656, and 538 sockeye salmon during 1982, 1983 and 1984, respectively (table 18).

Table 18. Escapement Estimates of Sockeye Salmon by District and Major Systems in the LCI Management Area, 1982-84

District/System	1982 Escapement	1983 Escapement	1984 Escapement
Southern District			
English Bay	20,000	12,000	11,100
Clearwater Slough	1,100	600	200
District total	21,100	12,600	11,300
Outer District			
Desire Lake	18,000	12,000	15,000
Delight Lake	25,000	7,000	10,500
Anderson Beach	600	500	1,200
District total	43,600	19,500	26,700
Eastern District			
Aialik Lake	22,400	20,000	22,000
Bear Lake	463[a]	656[a]	538[ab]
District total	22,863	20,656	22,538
Kamishak District			
Mikfik Lake	35,000	7,000	6,000
Chenik Lake	8,000	11,000	13,000
Big Kamishak River	10,000	5,000	2,500
Douglas River	4,200	500	0
Douglas Beach	1,600	400	100
District total	58,800	23,900	21,600
LCI total	146,363	76,656	82,138

Source: ADF&G 1983a, 1984b, and 1984c unless otherwise noted.

--- means no data were available.

a McHenry 1985.

b Of 3,553 sockeye salmon that returned, 538 were allowed to reach the spawning grounds, because of an ongoing late fertilization project to enhance coho salmon production. The remainder were donated to charitable organizations.

4. Coho salmon. Coho salmon are a very minor species in terms of average annual harvest in the LCI (ADF&G 1984c). Until recently, the English Bay Lakes system and Clearwater Slough both in the Southern District, were the only known coho salmon systems of any consequence in LCI. In 1982, however, returns to the Kamishak-Douglas and McNeil River subdistricts of the Kamishak Bay district were phenomenal (ADF&G 1983a). The district harvest of 38,685 coho salmon was over 20 times the average district catch and over 12½ times the previous record harvest set in 1975 (ibid.). Aerial surveys for coho salmon escapements have never been flown in the past because of lack of funds and the relatively minor importance of the harvest (ibid.). Due to the magnitude of the 1982 return, however, aerial surveys were conducted on August 24 and indicated escapements of 6,550 in the Douglas River, 9,500 in the Big Kamishak River, 1,100 in the Little Kamishak River, and 3,000 in the McNeil River, for a total of 20,250. Large numbers of coho salmon were still present in the area when fishing ceased on August 26, and the escapement to these systems probably exceeded 30,000 fish (ibid.). The harvest in 1982 and 1984 is indicative of excellent freshwater growth and survival presently occurring on all rearing species of salmon in LCI (1984). Escapement data on coho salmon for other districts and streams in LCI is not collected.

5. Chinook salmon. Chinook salmon are not produced in commercial quantities by river systems found in the LCI. Those that are harvested are probably either bound for UCI systems or are "feeder chinooks" that rear in LCI marine waters (Schroeder 1984). From data collected since 1977 on the Kachemak Bay sport fishery (Wallis and Hammarstrom 1983), it is known that chinook salmon from Oregon, Washington, British Columbia, and Southeast Alaska frequent LCI waters. LCI streams known to support chinook salmon populations include the Eastern District system of the Resurrection River and its tributary Salmon Creek. Chinook salmon are also found in the Kamishak Bay District in the Little Kamishak River and its tributary Strike Creek and in the McNeil River (ADF&G 1984d). No escapement figures for these systems are available.

C. Habitat Enhancement

See sections V.A. and V.B. of this narrative.

IV. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

The PWS Management Area includes all of the drainages entering the Gulf of Alaska between Cape Suckling and Cape Fairfield. The area includes the Bering River (Controller Bay), the Copper River and its delta, and PWS. Topographically, the area is characterized by the extensive Copper River drainage and its massive outwash delta and by the intricate island and bay complex of PWS. Within this island-bay complex are thousands of miles of shoreline distributed in a fiord system particularly suited to early stage rearing of juvenile salmon. The Bering and Copper rivers are the only major watersheds; however, approximately 700 short, coastal streams within PWS proper are also important for salmon production. Salmon use of these small streams is so widespread that, unlike other areas of Alaska, no single stream or small group of streams plays a dominant role in salmon production (ADF&G 1978).

The PWS Management Area is divided into 11 districts that conform to the local geography and distribution of the five species of salmon harvested by the commercial fishery. They are the Copper River, Bering River, Unakwik, Coghill, Eshamy, Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts (ADF&G 1984a). The last six are commonly collectively termed the General Purse Seine District. The boundaries of the PWS Management Area are described and illustrated in the salmon commercial harvest portion of the Human Use section of this volume.

A. PWS Management Area Distribution Summary

Although all five species of Pacific salmon native to North America are present in the PWS area, they are not equally distributed. Pink and chum salmon are the dominant species in PWS but are essentially absent in the Copper and Bering rivers (ADF&G 1978). The Copper River is the major producer of sockeye salmon, with only minor populations present in PWS. Chinook and coho salmon populations are relatively small throughout the PWS area, although the Copper River has been a small but consistent producer of chinook salmon. Coho salmon are the dominant salmon species in the Bering River (ibid.).

Adult salmon are found in the PWS Management Area marine and estuarine waters from mid May to late September and in fresh waters from late May to late March. Table 19 presents run-timing information for the different salmon species predominantly found in each district (variations from these times occur in some systems).

In the narratives that follow, the discussion of salmon distribution and abundance will be organized in relation to the management districts. This is done because of the inconsistent distribution of the various salmon species within the PWS Management Area.

B. Copper River District

The Copper River District includes all waters between Cape Martin on the east and Hook Point, Hinchinbrook Island, on the west, and is separated from PWS Eastern District by a boundary line from Boswell Rock, Hinchinbrook Island, to the radio tower at Whitshed Village on the mainland shore southwest of Cordova. The Copper River District is generally divided into the extensive delta of the Copper River and the upper Copper River (ADF&G 1981a).

1. Distribution. Sockeye salmon is the dominant species produced by the Copper River system, and only small runs of chinook and coho salmon are produced. Pink and chum salmon runs are relatively insignificant in the Copper River.

Table 19. General Salmon Run-Timing Information by District(s) for the PWS Management Area

District(s)	Salmon Species	Adults Present in Commercial Fishery	Adults Present in Fresh Water	Peak Period of Spawning
Copper River	Chinook	Mid May-late June	Early June-mid Aug.	Late July-early Aug.
	Sockeye	Mid May-late July	Late May-late Mar.	Early July-late Oct.
	Coho	Early Aug.-early Sept.	Mid Aug.-late Jan.	Early Sept.-mid Oct.
Bering River	Sockeye	Mid June-early Aug.	Early July-mid Aug.	Late July-early Aug.
	Coho	Late Aug.-late Sept.	Mid June-late Sept.	Late Sept.
Coghill & Unakwik	Sockeye	Late June-mid July	Early June-mid Sept.	Late July-mid Sept.
	Pink	Late July-late Aug.	Late June-mid Sept.	Late July-mid Sept.
	Chum	Late July-late Aug.	Late June-mid Sept.	Late July-mid Sept.
Eshamy	Sockeye	Mid June-early Sept.	Late June-late Oct.	Mid Sept.-late Oct.
	Pink	Early July-late Aug.	Late July-early Sept.	Late July-early Sept.
	Coho	Mid July-late Aug.	Mid July-late Oct.	Early Oct.-late Oct.
General Purse Seine[a]	Pink	Early July-late Aug.	Late June-early Sept.	Mid July-early Sept.
	Chum	Early July-late Aug.	Late June-mid Sept.	Mid July-early Sept.
	Sockeye	Mid June-early Sept.	Early July-mid Oct.	Early Aug.-mid Oct.
	Coho	Late July-early Sept.	Mid Aug.-early Nov.	Mid Aug.-early Nov.

Source: ADF&G 1978, 1983b; Fridgen 1984; Pirtle 1978; Randall et al. 1983; Roberson, pers. comm.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month, late = 21st to 30th/31st of month.

a Included are the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

Sockeye salmon spawn in lakes, streams, sloughs, and springs of the delta and upper river. Juvenile sockeye salmon rear in the lakes and sloughs, many of which are glacially occluded (Sharr 1983). Runs returning to the Copper River delta are more evenly distributed over time than upper Copper River stocks, which are concentrated somewhat earlier in the overall run-timing (Roberson, pers. comm.). Chinook salmon runs into the Copper River coincide with the upper river sockeye salmon runs. Thus the king salmon commercial fishery is primarily an incidental catch fishery in the Copper River District (ibid.).

2. Abundance. Because of the size of the Copper River drainage and the glacially occluded nature of many of the streams, it is difficult to prepare a salmon population estimate for the entire system. Since 1978, side scan sonar has been operated at the outlet of Miles Lake, to monitor the sockeye salmon escapement into the upper Copper River. In addition to sockeye salmon, other species of salmon are also enumerated as they pass the sonar site (ADF&G 1983b). The escapement numbers so derived, however, serve only as an indicator of the magnitude of the salmon run. The ADF&G (1981b) cautions that ". . . accuracy of population numbers generated by side scan sonar is dependent upon site location and species enumerated. Sonar counters do not enumerate every fish that migrates upstream. They accurately count those which pass over the counting plane or substrate of the counter but not those which migrate outside or offshore of the sonar substrate. Water depth, velocity, channel configuration and location or absence of obstructions are variables which influence where salmon migrate in the river at a particular time and location." In addition, late-run fish such as coho salmon may migrate upstream after sonar operations are terminated each season, and therefore their numbers are not included in the sonar estimates. Sonar estimates from the Miles Lake site are as follows (ADF&G 1983b):

1978	194,372 salmon (all species)
1979	248,709 salmon (all species)
1980	283,856 salmon (all species)
1981	534,263 salmon (all species)
1982	467,277 salmon (all species)
1983	545,724 salmon (all species)

It must also be noted that, in addition to these estimates, many sockeye and coho salmon of the Copper River spawn downstream of the sonar site in the Copper River delta. During the period 1978 through 1983, escapement estimates prepared from aerial surveys in the delta for these two species have ranged from 98,980 fish in 1978 to 254,834 fish in 1980 (tables 22 and 24).

Age composition analysis of the Copper River sockeye salmon commercial catch shows that the five-year-old (1.3) age group normally dominates the run (ADF&G 1983b). Chinook salmon samples from the Copper River commercial catch show age groups 1.3 and 1.4 as dominant for that species (Sharr 1983). Coho salmon returns are dominated by the 2.1 age group (ADF&G 1983b).

a. Sockeye salmon. Tagging data collected between 1967 and 1972 on upper Copper River sockeye salmon have been analyzed to identify the migration timing of individual stocks (Merritt and Roberson 1983). Fifteen sockeye salmon stocks and their corresponding time densities through Wood Canyon in the upper Copper River were delineated (table 20). This allowed examination of migratory behavior and variation between stocks and years (ibid.). Calculated travel rates over time were used to estimate the mean date of migration of stocks through the Copper River commercial fishing district. This run-timing information is ultimately useful in allocating fishing times in the commercial district and is included in table 21.

Aerial surveys are conducted regularly on major sockeye salmon spawning lake and stream systems and are used as an index to determine spawner distribution both upriver of the sonar site and in the delta area below the sonar site. During the period 1974 through 1983, escapement estimates from peak aerial survey counts of the index systems have ranged from 18,493 in 1974 to 166,500 sockeye salmon in 1980 in the Copper River delta. In the upper Copper River, the escapement estimates have ranged from 11,190 in 1975 to 89,945 in 1982 (table 22). Escapement estimates for the index systems are contained in table 22.

b. Chinook salmon. Aerial surveys are also used to enumerate chinook salmon in the Copper River District. Since 1974, the escapement estimates from index streams of the Copper River have ranged from 1,233 chinook salmon in 1975 to 4,016 in 1982 (table 23).

c. Coho salmon. Aerial surveys of coho spawning systems provide an index to the escapement. Inclement weather and muddy streams make comparable annual estimates difficult. Escapement estimates for the Copper River delta coho salmon index streams during the period 1974 through 1983 have ranged from 7,528 fish in 1976 to 88,334 fish in 1980 (table 24).

d. Pink and chum salmon. No escapement information for pink and chum salmon in the Copper River District is available. Commercial harvest figures of these species are included in table 25. It should be noted, however, that some of the harvested pink and chum salmon may be fish bound for streams in other districts.

C. Bering River District

The Bering River District includes the area between Cape Martin on the west and Cape Suckling on the east, including Controller Bay and Katalla Bay (ADF&G 1981a).

1. Distribution. Sockeye and coho salmon are the primary species found in the Bering River District. During the commercial fishing season, incidental catches of chinook, pink, and chum salmon are taken each season but usually

Table 20. The Mean Passage Date of Upper Copper River Sockeye Salmon Stocks at Wood Canyon, Based on Tagging Data Collected from 1967 through 1972, Grouped into Six Significantly Different Time Spans with the SNK Test

		Mean Date						
		June			July			August
Km[a]	Stock	7	17	27	7	17	27	6
459.2	Fish Creek-Mentasta	*						
456.9	Fish Creek & Lake		*					
455.0	Mentasta Lake		*					
305.2	St. Anne Creek		*					
292.5	Mahlo Creek		*					
419.4	Suslota Creek & Lake		*					
417.1	12 Mile Creek			*				
446.0	Gulkana River: Paxson-Mud Creek			*				
357.6	Mendeltna Creek			*				
446.3	Mud Creek & Lake				*			
288.3	Upper Klutina River				*			
197.6	Lower Tonsina Creek				*			
457.6	Gulkana River: Mud Creek-Summit					*		
219.6	Long Creek & Lake							*
259.4	Tonsina Lake							*

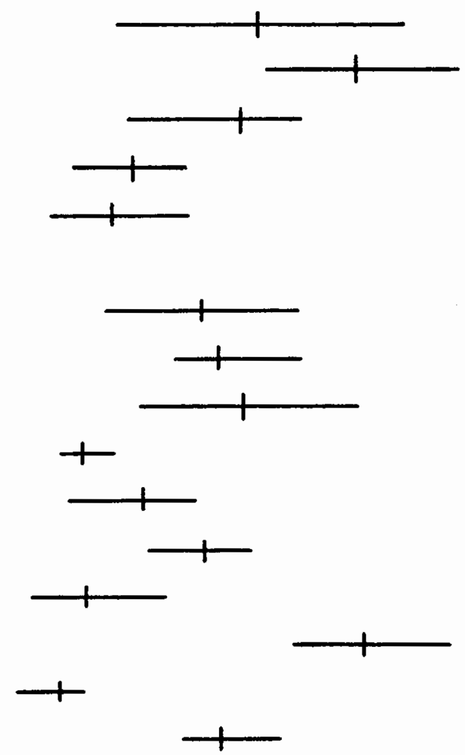
Source: Merritt and Roberson 1983.

a River kilometers to the spawning grounds of each stock.

* Denotes mean passage date of combined years.

Table 21. Estimated Mean Date and Range (80%) of Migration at the Copper River Commercial District Fishery for Upper Copper River Sockeye Salmon Stocks, Ranked by Their Estimated Mean Spawning Population Size, Based on Tagging Data Collected, 1967-72

Stock	Est. Pop. Size	Percent Contribution	May 3 · 15 · 27 · June 8 · 20 · July 2 · 14 · 26
Gulkana River:			
Mud Creek-Summit Lake	28,412	19.8	
Long Creek & Lake	21,662	15.1	
Upper Klutina River	18,476	12.9	
Suslota Creek & Lake	12,313	8.6	
St. Anne Creek	12,285	8.6	
Gulkana River:			
Paxson-Mud Creek	10,766	7.5	
Mendeltna Creek	7,659	5.4	
Mud Creek & Lake	7,584	5.3	
Fish Creek & Lake	6,916	4.8	
Mahlo Creek	5,442	3.8	
12 Mile Creek	3,911	2.7	
Mentasta Lake	3,398	2.4	
Tonsina Lake	1,989	1.4	
Fish Creek-Mentasta Lake	1,552	1.1	
Lower Tonsina Creek	823	0.6	
Total	143,188	100.0	



Source: Merritt and Roberson 1983.

Table 22. Copper River Sockeye Salmon Spawning Escapement Estimates in Number of Fish,[a] 1974-83

Portion of River	System	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Upper Copper River	Salmon Creek	400	0[d]	300	275[b]	50	450	1,500	250	850	1,550
	Tonsina Lake	200	250	900	432[b]	4	775	650	1,725	1,700	2,850
	Mahlo Creek	500	314[c]	600	5,200	300	450	1,000	1,800	3,300	2,400
	St. Anne Creek	2,100	449[c]	1,700	7,000	1,150	730	5,000	4,700	8,800	9,700
	Mendeltna Creek	332	325	900	3,900	725	350	1,125	4,830	400	2,850
	Keg Creek	190	256	125	725	1,050	1,300	2,335	320	495	620
	Dickey Lake	10	25	0	650	75	13	250	20	410	135
	Swede Lake	15	6	10	750	80	155	400	450	1,400	550
	Paxson Lake Outlet	1,000	550	2,100	3,800	2,500	1,900	3,800	1,500	3,800	3,300
	Inlet to Mud Creek	14,300	2,100	4,200	6,000	2,700	5,400	8,200	2,200	1,150	7,500
	Mud Creek & Lake	300	400	1,100	650	150	460	740	810	1,900	470
	Mud Creek-Summit Lake	2,700	1,200	1,900	5,900	800	2,600	3,075	3,400	17,400	5,700
	Fish Lake	800	2,800	900	8,000	2,650	1,700	3,175	8,800	22,560	5,500
	Bad Crossing #1 and #2	650	5	16	8,400	600	650	75	15,000	4,550	2,000
	Fish Creek	450	200	250	6,900	1,300	350	900	10,500	1,700	900
	Mentasta Lake	700	450	600	3,500	3,600	2,500	3,200	7,400	3,250	6,800
	Suslota Lake	400	0	100	300	1,200	1,000	1,700	300	1,800	5,600
	Tanada Lake	3,100	700	6,100	9,100	2,625	5,175	13,700	11,200	11,680	10,900
	Long Lake	750	1,100	2,450	877	1,425	3,100	2,650	1,325	1,700	5,600
	Tana River	520	60	25	404[b]	504	465	2,130	290	1,100	2,485
	Upper Cooper River subtotal	29,417	11,190	24,276	72,763	23,488	29,523	55,595	76,820	89,945	77,410
Copper River delta	Eyak Lake[e]	4,625	20,200	9,450	13,600	16,250	14,500	27,800	17,150	13,800	11,100
	McKinley Lake[f]	2,000	10,600	10,000	16,000	20,819	29,000	32,000	20,800	23,000	20,500
	Tokun Lake[g]	1,468	1,550	11,000	4,900	10,600	11,500	20,500	11,700	7,450	8,145
	Martin Lake[h]	1,500	5,110	12,000	7,044	13,100	14,000	30,700	36,050	16,030	26,000
	Little Martin Lake	1,500	2,000	8,000	1,550	4,500	4,000	8,000	2,500	6,020	6,000
	Martin River	---	1,500	1,500	1,450	3,500	8,200	1,500	5,350	1,000	3,650
	Ragged Pt. Lake[i]	---	3,000	4,000	3,750	5,500	20,000	18,000	9,500	13,500	10,000
	Martin R. Slough	5,000	1,120	2,500	3,100	6,300	4,000	10,000	15,000	9,500	11,000
	39 Mile Creek	2,400	2,500	3,500	4,500	6,500	17,500	18,000	11,000	13,000	13,000
	Copper River Delta subtotal	18,493	47,580	61,950	56,434	87,069	122,700	166,500	129,050	103,300	109,395
	System total	47,910	58,770	86,226	129,197	110,557	152,223	222,095	205,870	193,245	186,805

Source: ADF&G 1983b.

--- means no data were available.

a Peak aerial survey estimates of index spawning areas, unless otherwise noted.

Table 22 (continued).

b Interpolated.

c Ground survey.

d Poor survey conditions.

e Includes Hatchery and Power creeks.

f Includes Salmon Creek.

g Includes Tokun Lake Outlet, Tokun River, and Tokun Springs.

h Includes Martin Lake feeder stream, Pothole Lake, Pothole River, and Martin Lake Outlet.

i Includes Ragged Point Lake Outlet and River.

Table 23. Chinook Salmon Escapement Index of the Copper River in Numbers of Fish, 1974-83

Index Area	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
East Fork										
Chistochina River	137	71	289	132	137	810	575	120	1,260	575
Gulkana River	1,317	741	777	1,090	921	1,380	718	754[a]	1,656	931
Mendeltna Creek	15	38[a]	35	73	52	5	3	51	70	12
Kaina Creek	55	123[a]	37	91	125	279	247	191	200	166
St. Anne Creek	32	26[a]	15	10	24	16	8	19	35	87
Manker Creek	29	19[a]	6	15	20	16	35	23	49	141
Grayling Creek	49	48[a]	17	48[a]	92	153	66	107	127	287
Little Tonsina River	65	161	98	35	285	285	70	191	440	330
Indian River	4	6	61	20[a]	9	29	24	20[a]	179	41
Total without interpolated counts	1,654	979	1,335	1,446	1,665	2,973	1,746	712	4,016	2,570
Counts missing		(5)		(2)				(2)		
Total with interpolated counts	1,654	1,233	1,335	1,514	1,665	2,973	1,746	1,486	4,016	2,570

Source: ADF&G 1983b.

a Interpolated.

Table 24. Copper River Delta Aerial Survey Estimates of Coho Salmon in Numbers of Fish,[a] 1974-83

System	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Eyak Lake	175	7,350	3,000	3,700	903[b]	6,000	9,200	2,750+	7,000	14,600
Hatchery Creek	533[b]	592[b]	108[b]	543[b]	190[b]	568[b]	1,905[b]	2,500	125	1,000
Power Creek	533[b]	592[b]	108[b]	543[b]	190[b]	568[b]	1,905[b]	800	1,500	1,000
Ibek Creek	4,500	3,500	540[b]	3,500	1,575	850	12,110	10,000	1,100	4,200
19 Mile Creek	267[b]	200	54[b]	35	95	500	100	1,500	250	125
McKinley Lake	15	740[b]	135[b]	679[b]	238[b]	500	2,500	1,344[b]	500	5,000
Salmon Creek	733[b]	814[b]	149[b]	1,300	262[b]	781[b]	2,000	1,700	4,650	6,500
26-27 Mile Creek	178[b]	197[b]	36[b]	181[b]	63[b]	189[b]	635[b]	250	50	0
39 Mile Creek	6,500	2,500	342[b]	3,000	4,500	600	7,100	1,900	2,000	6,500
Goat Mt. Creek	1,155[b]	1,500	234[b]	1,177[b]	412[b]	1,230[b]	800	500	50	---
Pleasant Creek	550	100+	185[b]	1,500	325[b]	970[b]	500	1,837[b]	400	350
Tokun Lake	125	370[b]	68[b]	340[b]	119[b]	355[b]	2,000	672[b]	400	125
Tokun River	333[b]	500	122[b]	611[b]	214[b]	639[b]	2,200	800	2,000	225
L. Martin Lake	700	350	203[b]	1,019b	357[b]	1,065[b]	1,500	6,000	150	1,125
Martin River	5,500	525	347[b]	2,000	150	460	12,855	4,000	7,500	3,100
Martin Lake	750	765[b]	140[b]	701[b]	246[b]	250	4,500	1,389[b]	9,000	6,100
Ragged Point	733[b]	814[b]	149[b]	747[b]	262[b]	781[b]	2,619[b]	200	2,500	200
Ragged Outlet	1,800	150	108[b]	300	190[b]	568[b]	1,905[b]	1,000	50	325
Martin Slough	1,600	8,000	1,500	7,300	1,700	14,500	22,000	10,900	1,350	9,700
Total	26,680	29,559	7,528	29,176	11,911	31,374	88,334	50,042	40,575	60,175

Source: ADF&G 1983b.

--- means no data were available.

a Counts were made as weather allowed and may or may not have been made during periods of peak abundance.

b Interpolated.

Table 25. Commercial Harvest of Pink and Chum Salmon in the Copper River District in Number of Fish, 1974-83

Year	Pink[a]	Chum[a]
1974	9,839	664
1975	236	807
1976	3,392	178
1977	23,185	335
1978	3,512	2,233
1979	1,295	107
1980	3,966	198
1981	23,952	1,799
1982	6,843	417
1983	7,345	2,217
10-year average catch	7,672	896

Source: ADF&G 1983b.

a The majority are assumed to be incidental catches (Roberson, pers. comm.).

amount to less than 1% of the district's salmon harvest (Pirtle 1978).

Systems known to support spawning sockeye and coho salmon populations within the district include the Bering, Katalla, Edwards, and Campbell rivers (ADF&G 1984d). Escapement surveys are performed only on the Bering and Katalla river systems.

2. Abundance:
   a. Sockeye salmon. Escapement estimates of sockeye salmon in the Bering River District are obtained by aerial surveillance of key index streams and lakes of the Bering River system. Included in these surveys are Bering Lake and its associated tributaries, which include Dick, Sheppard, Carbon, and Maxwell creeks, and Kushtaka Lake and its associated tributaries, which include Shokum, Clear, and Trout creeks. The escapement estimates during the period 1975 through 1983 have ranged from 5,125 fish in 1975 to 56,000 fish in 1981 (table 26).
   b. Coho salmon. Coho salmon escapements in the district are also estimated by aerial surveys of index streams in both the Katalla and Bering rivers systems. Within the Bering River system, Bering Lake, Dick and Sheppard

Table 26. Bering River Sockeye Salmon Spawning Escapement Estimates in Numbers of Fish,[a] 1975-83

Stream/Lake	1975	1976	1977	1978	1979	1980	1981	1982	1983
Bering Lake[b]	4,750	47,500	9,500	19,300	24,500	31,400	49,000	29,800	40,000
Kushtaka Lake[c]	375	2,500	---	3,500	2,500	2,000	8,000	7,850	5,700
Total	5,125	50,000	9,500	22,800	27,000	33,400	56,000	37,650	45,700

Source: ADF&G 1983b.

--- means no data were available.

a Peak aerial survey counts of key index spawning areas.

b Includes Dick, Shepard, Carbon, and Maxwell creeks.

c Includes Shokum, Clear, and Trout creeks.

Table 27. Bering River District Aerial Survey Estimates of Coho Salmon in Numbers of Fish, 1974-83

Stream/Lake	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Katalla River	4,200	2,500	200	5,000+	3,200	a	8,000	3,000	11,500	4,800
Bering Lake[b]	1,000	50	a	165	a	1,000	700	0	8,000	4,000
Dick Creek[b]	60	1,200	a	500	a	a	1,625	0	5,500	7,100
Shepard Creek[b]	a	a	a	a	a	a	0	600	muddy	muddy
Gandil River[b]	a	a	a	a	a	a	600	a	muddy	muddy
Nichawak River[b]	a	a	a	a	a	a	250	a	5,000	800

Source: ADF&G 1983b.

a Years and streams without counts not surveyed due to weather, high water, or turbulence. It should also be noted that counts were made as weather allowed and may or may not have been made during periods of peak abundance.

b In Bering River system.

creeks, and the Gandil and Nichawak rivers are monitored. Due to typically adverse weather conditions during the fall, coho salmon run and escapement indices are incomplete and difficult to compare between years. Reported coho salmon estimates are therefore considered rough estimates only and are frequently derived from incomplete surveys (table 27).

c. Chinook, pink, and chum salmon. No escapement data are available for chinook, pink, or chum salmon in the Bering River District.

D. Unakwik District

The Unakwik District is located in the north central part of PWS and includes the waters of Unakwik Inlet north of 61°01'north latitude. The district was established to allow the harvest of small runs of sockeye salmon returning to Cowpen Lake and Miners Lake systems (ADF&G 1981a).

1. Distribution:

   a. Sockeye salmon. Sockeye salmon are found in the Cowpen Lake and Miners Lake systems of the Unakwik District (ADF&G 1984d).

   b. Pink salmon. Pink salmon are found in three systems of the Unakwik District; the Miner Lake and Cowpen Lake systems and in a small stream on the west shore of Unakwik Inlet west of Miners Bay (ibid.).

   c. Chum salmon. Within the Unakwik District, chum salmon are found only in the Miners Lake system (ibid.).

   d. Coho salmon. Coho salmon are found only in the Cowpen Lake system (ibid.).

   e. Chinook salmon. No chinook salmon are known to spawn in systems that flow into the Unakwik Districts (ibid.).

2. Abundance. No salmon population estimates based on escapement figures are available for systems of the Unakwik District. Based on commercial harvest figures, Pirtle (1979) concludes that very few pink and chum salmon are caught in the Unakwik District, the catch being primarily sockeye salmon. Chinook and coho salmon harvests are insignificant, the 10-year average annual catch (1974 through 1983) for these species being six and three fish, respectively (ADF&G 1983b).

E. Coghill District

The Coghill District, located in northwestern PWS, includes all of the water of Port Wells north of 60°48'30" north latitude and all the water within one nautical mile of the south shore of Esther Island, including Esther Passage. (Prior to 1976, the western one-half of Port Wells was included in the Northwestern District). The Coghill District was established primarily to allow the harvest of the sockeye salmon returning to Coghill Lake; however, significant numbers of pink and chum salmon are taken, and the numbers of these species commonly exceed the sockeye salmon catch (ADF&G 1981a).

1. Distribution:
   a. Sockeye salmon. Within the Coghill District, only Coghill Lake and Esther Pass (Red) Lake are known to support populations of sockeye salmon (Pirtle 1981).
   b. Pink salmon. Pink salmon are found in many of the stream and lake systems of the Coghill District. Thirteen systems used to calculate the annual escapement for pink salmon comprise most of the known spawning streams of the district (Pirtle 1980). These systems are comprised of Triple, Village, Hobo, Mill, Old, Hummer, Pirate, Meacham and Swanson creeks, Avery River, Coghill Lake and River, Golden Lagoon (stream number 310), and Harrison Lagoon (stream number 414) (McCurdy 1984; McCurdy and Pirtle 1980a, 1980b, 1980c, 1980d). An index map of the PWS stream numbering system may be found in Pirtle (1977).
   c. Chum salmon. Seven streams are known to be used by chum salmon for spawning (Pirtle 1980). These same streams are monitored to prepare chum salmon escapement estimates for the district. They are comprised of the Coghill River and Harrison, Mill, Old, Hummer, Meacham, and Swanson creeks (McCurdy 1984; McCurdy and Pirtle 1980a, 1980b, 1980c, 1980d).
   d. Coho salmon. Coho salmon are known to spawn in the Coghill River system and have been reported in the streams at the head of Pigot Bay. No other spawning areas are known, although small numbers probably spawn in other streams in the district (Pirtle 1980).
   e. Chinook salmon. Spawning chinook have yet to be found in the Coghill District.
2. Abundance. Escapement estimates for the Coghill District are prepared only for sockeye, pink, and chum salmon.
   a. Sockeye salmon. Intermittent peak aerial counts of Esther Pass Lake made prior to 1977 show that sockeye salmon estimated escapements to that system varied from 200 fish in 1975 to 1,800 fish in 1973 (Pirtle 1981). The Coghill River and Lake system is the major sockeye salmon producer in the Coghill District. In recent years, escapements to this system alone have been used to prepare the district sockeye salmon escapement estimate. During the period 1974 through 1983, weir counts on the Coghill River have ranged from a low of 9,056 sockeye salmon in 1976 to a high of 180,314 in 1982 (table 28).
   b. Pink salmon. During the period 1974 through 1983, pink salmon escapement estimates for the Coghill District have ranged from 42,660 fish in 1974 to 570,950 in 1975. During 1983, the estimated escapement was 311,200 pink salmon. Within the district, the Coghill River is the

Table 28. Salmon Escapement Estimates by Species in the Coghill District of PWS in Numbers of Fish, 1974-83

Year	Sockeye[a]	Pink[c,d]	Chum[c,e]
1974	22,333	42,660	39,700
1975	34,855	570,950	7,100
1976	9,056	50,930	35,750
1977	31,562	338,750	41,640
1978	42,284	75,270	13,550
1979	48,281	66,230	13,150
1980	142,253	182,430	12,610
1981	156,112[b]	444,700	30,740
1982	180,314[b]	264,420	24,150
1983	38,783[b]	311,200	62,800
10-yr avg.	70,583	234,754	28,119

Source: ADF&G 1983b.

a Coghill River only. Total weir count beginning in 1974.

b Includes jacks.

c Includes aerial and ground surveys.

d Estimates derived from surveys of the following systems: Triple, Village, Hobo, Mill, Old, Hummer, Pirate, Meacham, and Swanson creeks, Avery River, Coghill Lake and River, Golden Lagoon stream #310, and Harrison Lagoon stream #414. An index map of the PWS numbered streams can be found in Pirtle 1977 (McCurdy 1984, McCurdy and Pirtle 1980a-d).

e Estimates derived from surveys of the following systems: Coghill River, and Harrison, Mill, Old, Hummer, Meacham and Swanson creeks (McCurdy 1984, McCurdy and Pirtle 1980a-d).

major producer of pink salmon, particularly during the odd-year cycle (Pirtle 1980).

c. Chum salmon. As with pink salmon, the Coghill River is the major chum salmon producing system in the Coghill District and contributes about 90% to the commercial harvest (ibid.). During the period 1973 through 1983, the chum salmon escapement estimates have ranged from 7,100 fish in 1975 to 62,800 fish in 1983 (table 28).

d. Coho and chinook salmon. Escapement estimates are not available for coho salmon in the Coghill District. Chinook salmon do no spawn in Coghill District waters (ibid.).

F. Eshamy District

The Eshamy District is located on the western central mainland shore of PWS. The district includes the water within one nautical mile of the mainland shore from the outer point on the north shore of Granite Bay on the south end of the district to the light on the south shore of the entrance to Port Nellie Juan on the north end of the district. The district was established to manage the run of sockeye salmon returning to the Eshamy Lake system (ADF&G 1981a).

1. Distribution. Although all five species of Pacific salmon native to North America may be found in Eshamy District waters, only sockeye and pink salmon return to spawn in any significant numbers.

   a. Sockeye salmon. The Eshamy Lake and River system supports the only run of sockeye salmon in the Eshamy District (Pirtle 1981).

   b. Pink salmon. Several small streams are surveyed by foot to enumerate pink salmon escapement in the Eshamy District. Since 1974, these streams have included Loomis, Gumboot, and Elishansky creeks and North Shore Eshamy Lagoon (stream no. 508). In addition, both weir counts and foot surveys are conducted on the Eshamy River (McCurdy 1984, McCurdy and Pirtle 1980, Pirtle 1977).

   c. Chum salmon. Very few chum salmon spawn in the Eshamy District (Pirtle 1979). Foot surveys to determine chum salmon escapement are conducted on the same streams used for pink salmon escapement enumeration. In addition stream no 515 on the south shore of Eshamy Lagoon is observed (McCurdy 1984; McCurdy and Pirtle 1980a, 1980b, 1980c, 1980d).

   d. Coho salmon. Coho salmon are known to spawn in only the Eshamy River (Pirtle 1978).

   e. Chinook salmon. Chinook salmon do not normally spawn in PWS area streams (west of the Copper River), although occasional strays have been recorded at the Eshamy River weir (Pirtle 1976, ADF&G 1983b).

2. Abundance. In addition to weir counts and foot surveys on the Eshamy River, foot surveys are also conducted on several small streams in the district.
    a. Sockeye salmon. Sockeye salmon is the major spawning species of the Eshamy District. During the period 1974 through 1983, annual escapement estimates have ranged from 633 fish in 1974 to 44,263 fish in 1980 (table 29).
    b. Pink salmon. Pink salmon escapement estimates during the period 1974 through 1983 have ranged from 5,500 fish in 1976 to 32,080 fish in 1977. The 1983 estimated escapement was 9,280 pink salmon (table 29).
    c. Chum salmon. The numbers of chum salmon that spawn in the district are low, and returns are sporadic. During five of the years between 1974 and 1983 no chum salmon escapement was observed (table 29). For the years that chum salmon were observed, the escapement estimates have ranged from 2 fish to 440 fish (table 29).
    d. Coho salmon. Production of coho salmon in the Eshamy District is very low. Estimated escapements to the Eshamy River during the period 1974 through 1983 have ranged from 20 fish in 1978 to 249 fish in 1981 (table 29).
    e. Chinook salmon. For all practical purposes chinook salmon do not spawn in the Eshamy District (table 29). Those observed at the Eshamy River weir are strays (Pirtle 1980).

G. General Purse Seine District

For purposes of management of the commercial harvest of salmon in the PWS Management Area, 6 of the 11 districts are combined and are collectively termed the General Purse Seine District or the General Districts. Included in this category are the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts. Within the General Districts, pink and chum salmon are the primary target species, although several systems are also monitored for their sockeye salmon production.

Pre-emergent alevin indices have historically provided the basis for annual forecasts of adult abundance of pink and chum salmon. The chum salmon alevin indices values, however, have not provided an accurate indicator of chum salmon production. This has been compensated for by the use of adult age composition and their interrelationships (McCurdy 1984). Pre-emergent sampling for 1977 through 1983 brood year stocks of pink and chum salmon has been conducted on 38 streams (McCurdy 1984; McCurdy and Pirtle 1980b, 1980c, 1980d). Of these streams, 26 have been used consistently since 1977 for conducting the samples (table 30).

1. Distribution:
    a. Pink salmon. ADF&G (1984d) documents 525 first order streams within the General Purse Seine District in which pink salmon are found. Because first order streams are only those whose mouths are located at salt water, the

Table 29. Salmon Escapement Estimates for the Eshamy District of PWS in Numbers of Fish, 1974-83

Year	Chinook[a]	Sockeye[a]	Coho[a]	Pink[b]	Chum[c]
1974	0	633	0	6,330	0
1975	0	1,724	41	5,720	440
1976	0	19,367	125	5,500	0
1977	0	11,746	230	32,080	0
1978	0	12,580	20	5,690	0
1979	0	12,169	0	12,860	0
1980	5	44,263	128	13,813	2
1981	0	23,048[d]	249	21,490	13
1982	1	6,782	79	14,080	79
1983	0	10,348	58	9,280	100
10-yr avg.		14,266	126	12,021	134

Source: ADF&G 1983b.

a Weir count at Eshamy River.

b Includes a combination of foot surveys at Loomis, Gumboot and Elishansky creeks, and North Shore Eshamy Lagoon stream #508, and combined weir and foot counts of the Eshamy River. The number of streams surveyed each year ranges for three to five of these systems (McCurdy 1984, McCurdy and Pirtle 1980a-d). An index map of PWS numbered streams may be found in Pirtle 1977.

c Includes a combination of foot surveys at Loomis and Elishansky creeks, North Shore Eshamy Lagoon stream #508, South Shore Eshamy Lagoon stream #515, and the Eshamy River. Usually two to four of these streams are surveyed each year (McCurdy 1984, McCurdy and Pirtle 1980a-d). An index map of PWS numbered streams may be found in Pirtle 1977.

d Assuming the run was 90% complete, an additional 2,600 sockeye are estimated to have escaped following the removal of the weir.

Table 30. PWS Streams Used to Collect Pre-emergent Pink and Chum Salmon Fry Data, 1977-83 Brood Years

District	Stream Name	Stream Number[a]	Stream Number[b]	Brood Year[c] 1977	1978	1979	1980	1981	1982	1983
Eastern	Humpback Creek	11	221-10-10110	X	X	X	X	X	X	X
	Rogue Creek	21	221-0-10210	X						
	Koppen Creek	35	221-20-10350	X	X	X	X	X	X	X
	Control Creek	52	221-30-10520	X	X	X	X	X	X	X
	Whalen Creek	80	221-40-10800		X	X	X	X	X	X
	Sunny River	87	221-40-10870		X	X	X	X	X	X
	Gladhough Creek	106	221-50-11060	X	X	X				
	Duck River	116	221-50-11160	X	X	X	X	X	X	
	Indian Creek	117	221-50-11170	X	X	X	X	X	X	X
	Gregorieff Creek	123	221-60-11230		X	X	X	X	X	X
	Gorge Creek	131	221-60-11310		X	X				
	Sawmill Creek	133	221-60-11330	X	X	X				
	Stellar Creek	153	221-50-11530	X	X	X	X	X	X	X
Northern	Eickelberg Creek	221	221-10-12210		X					
	Cannery Creek	241	222-50-12410	X						
	Unakwik Creek	265	222-20-12650	X	X	X	X	X	X	X
	Blackbear Creek	276	222-30-12750	X	X	X	X	X	X	X
Coghill	Coghill River	322	223-30-13220	X	X	X	X	X	X	X
	Mill Creek	421	224-10-14210	X	X	X	X	X	X	X
	Pirate Creek	428	224-10-14280	X						
	Meacham Creek	430	224-10-14300	X	X	X	X	X	X	X
North-western	Paulson Creek	455	224-10-14550	X	X	X	X	X	X	X
	Mink Creek	480	224-10-14800	X	X	X	X	X	X	X
Eshamy	None									
South-western	Erb Creek	604	226-20-16040	X	X	X	X	X	X	X
	Totemoff Creek	621	226-20-16210	X	X	X				
	Bainbridge Creek	630	226-20-16300	X	X	X				
	Claw Creek	632	226-20-16320	X	X	X	X	X	X	X
	Falls Creek	673	226-40-16730	X	X	X	X	X	X	X
	Hayden Creek	677	226-40-16770	X	X	X				
Montague	McLeod Creek	707	227-10-17070	X		X				
	Wilby Creek	744	227-20-17440	X	X	X	X	X	X	X
	Cabin Creek	747	227-20-17470	X	X	X				
	Shad Creek	749	227-20-17490	X	X	X	X	X	X	X
	Pautzke Creek	775	227-20-17750	X	X	X	X	X	X	X
South-eastern	Constantine Creek	815	228-60-18150	X	X	X	X	X	X	X
	Cook Creek	828	(Anderson Creek) 228-40-18280	X	X	X	X	X	X	X
	Canoe Creek	850	228-30-18500	X	X	X	X	X	X	X
	Bernard Creek	861	(Windy Creek) 228-30-18610	X	X	X	X	X	X	X

Sources: McCurdy and Pirtle 1980 b-d, McCurdy 1984, ADF&G 1984d.

a Stream numbers in this column refer to those used by Division of Commercial Fisheries for management purposes.

b Stream numbers in this column refer to those contained in the Atlas to the Catalog of Waters Important for Spawning, Rearing, and Migration of Anadromous Fishes for regulatory purposes.

c An "x" indicates that pre-emergent pink and chum salmon surveys were conducted on the stream for the brood year listed.

number does not include the many tributaries or branches of streams where pink salmon are also found. No single stream or group of streams plays a dominant role in pink salmon production.

b. Chum salmon. ADF&G (1984d) documents chum salmon in 188 first order systems of the General Districts. Again, this number does not include tributaries or branches of these systems where chum salmon may be found. No single stream or group of streams plays a dominant role in chum salmon production.

c. Coho salmon. ADF&G (1984d) documents 44 first order streams in which coho salmon spawn and rear in the General Districts. This number does not include many tributaries, sloughs, and branches of the systems in which coho salmon may be found.

d. Sockeye salmon. Twenty-one first order systems located within the General Districts contain populations of sockeye salmon (ADF&G 1984d).

e. Chinook salmon. No chinook salmon are known to spawn in systems of the General Districts (Pirtle 1980).

2. Abundance:

a. Pink salmon. Annual escapement estimates for pink salmon are prepared by conducting weekly aerial counts and periodic ground surveys throughout the fishing season. Counts usually begin during June and terminate in September (Pirtle 1978). During the period 1977 through 1983, an average of 179 General District pink salmon systems (including some in the Coghill and Eshamy districts) were surveyed to provide information on run strength (McCurdy 1984; McCurdy and Pirtle 1980b, 1980c, 1980d). During the period 1974 through 1983, the escapement estimates have ranged from 858,740 pink salmon in 1974 to 2,927,290 fish in 1979 (including estimates from the Coghill and Eshamy districts). During the same time frame, the total run (escapement plus commercial harvest) has averaged 11,345,897 pink salmon (table 31).

b. Chum salmon. Chum salmon escapement estimates are prepared using the same methods as those employed for pink salmon enumeration. During the period 1977 through 1983, an average of 84 General District chum salmon systems (including some from the Coghill and Eshamy districts) were surveyed to provide escapement estimates (ibid.). During the period 1974 through 1983, chum salmon escapement estimates have ranged from 46,790 fish in 1975 to 359,900 fish in 1983 (including estimates from the Coghill and Eshamy districts). Total run estimates (escapement plus commercial harvest) during the same period averaged 818,493 chum salmon (table 32).

Table 31. Pink Salmon Run Estimates in Numbers of Fish for the General Purse Seine Districts of PWS Including Escapement Estimates from the Coghill and Eshamy Districts, 1974-83

	District Escapement Estimates[a]								
Year	Eastern	Northern	North-western & Coghill	South-western & Eshamy	Montague	South-eastern	Total	Commercial Catch	Total Run Estimate
1974	229,370	186,130	200,520	141,750	11,800	89,170	858,740	448,773	1,307,513
1975	570,830	44,270	580,170	77,860	110,950	234,210	1,618,290	4,452,805	6,071,095
1976	446,470	123,380	116,730	51,200	12,260	115,560	865,600	3,018,994	3,884,594
1977	465,970	62,150	426,670	226,060	196,970	315,510	1,693,330	4,514,431	6,207,761
1978	268,940	159,870	200,950	220,610	48,680	156,830	1,055,610	2,780,073[b]	3,835,683
1979	782,420	223,580	241,120	264,710	323,490	1,091,970	2,927,290	15,393,223[b]	18,320,513
1980	515,380	171,410	338,100	134,860	114,170	302,190	1,576,110	13,434,024[b]	15,010,134
1981	768,000	259,850	588,880	193,750	506,140	594,890	2,911,510	19,286,542[b]	22,198,052
1982	566,530	325,890	429,750	189,190	125,870	470,000	2,107,330	18,936,631[b,c]	21,043,961
1983	504,480	180,040	521,010	182,520	247,260	634,890	2,270,200	13,309,461[b,c]	15,579,661
10-Yr avg.	511,839	173,657	364,390	168,251	169,759	400,522	1,788,401	9,557,496	11,345,897

Source: ADF&G 1983b.

a Escapement estimates derived from weekly inseason aerial surveys and periodic ground surveys.

b Does not include hatchery returns.

c Preliminary data.

Table 32. Chum Salmon Run Estimates in Numbers of Fish for the General Purse Seine Districts of PWS Including Escapement Estimates from the Coghill and Eshamy Districts, 1974-83

	District Escapement Estimates[a]								
Year	Eastern	Northern	North-western & Coghill	South-western & Eshamy	Montague	South-eastern	Total	Commercial Catch	Total Run Estimate
1974	92,840	53,830	45,010	200	90	2,910	194,880	88,544	283,424
1975	28,220	7,820	7,410	580	0	2,760	46,790	100,479	147,269
1976	17,870	26,520	38,460	90	0	950	83,890	370,478	454,368
1977	53,200	36,360	41,640	4,480	560	8,370	144,610	575,839	720,449
1978	102,290	25,410	27,650	500	0	6,030	161,880	485,147	647,027
1979	57,450	17,040	18,660	80	0	4,450	97,680	324,040	421,720
1980	32,160	34,250	14,460	40	280	6,230	87,420	412,948[b]	500,368
1981	92,240	39,740	47,590	770	0	21,890	202,230	1,745,869[c]	1,948,099
1982	175,950	80,200	42,750	1,670	0	26,090	326,480	1,345,288[d]	1,671,768
1983	145,670	91,770	95,850	3,700	0	22,900	359,900	1,030,546[d]	1,390,436
10-Yr avg.	79,789	41,294	37,948	1,211	310	10,258	170,575	647,918	818,493

Source: ADF&G 1983b.

a Escapement estimates derived from weekly inseason aerial surveys and periodic ground surveys.

b Does not include 6 chum salmon harvested at San Juan hatchery.

c Does not include 118 chum salmon harvested at San Juan hatchery.

d Preliminary data. No chum salmon reported from hatchery sales.

c. Coho salmon. Although coho salmon are produced in numerous small streams, their escapements are not monitored. The most notable production areas for coho salmon are Twin Lakes Creek in Simpson Bay, Coho Creek at Hell's Hole in Port Gravina, and the Lowe River at the head of Port Valdez (Pirtle 1977 and 1980).

d. Sockeye salmon. Sockeye salmon spawning escapements are regularly recorded for selected stream and lake systems of the General Districts. Peak counts or the highest days count from surveys throughout the season are used as the estimated spawning escapement (Pirtle 1980). Systems for which escapement data are available include Bainbridge, Billy's Hole, Jackpot Lakes, Shrode Lake, and Robe Lake. Between 1974 and 1983, combined estimated escapements to these systems have ranged from a low of about 3,000 sockeye salmon in 1979 to a high of 27,321 fish in 1983 (table 33).

Table 33. Sockeye Salmon Estimated Escapements for Selected Systems of the General Purse Seine Districts of PWS,[a] 1974-83

System	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Bainbridge	250	350	400	500	800	600	600	650	1,500	1,500
Billy's Hole	50	200	3,600	100	800	100	0	0	3,200	4,000
Jackpot Lakes	4,000	3,000	1,000	7,000	3,000	650	6,000	4,800	3,000	6,500
Shrode Lake	1,500	500	600	200	1,700	---	1,200	800	2,500	15,000
Robe Lake	5,000	1,000	1,000	3,500	850	1,500	993[b]	450[b]	6,278[c]	321
Total estimate	10,800	5,050	6,600	11,300	7,150	2,850	8,795	6,700	16,478	27,321

Source: Pirtle 1978, 1979, 1980, 1981; Randall 1985; ADF&G 1982d, 1983b, 1983c.

--- means no data were available.

a Escapements represent peak counts from aerial surveys, unless otherwise noted.

b Ground count of Robe River.

c Combination of ground count in Brownie Creek and Robe River, along with aerial count of schooled fish in Robe Lake.

e. Chinook salmon. No chinook salmon are known to spawn in systems of the General Districts (Pirtle 1980).

H. Habitat Enhancement

See sections V.A. and V.C. of this narrative.

V. SALMON ENHANCEMENT

A. Introduction

Fisheries managers use many methods to manipulate salmon populations. The goal is usually to maintain or increase production as measured by the number of fish harvested by subsistence, commercial, personal, and sport users. Two of the methods used to supplement production are enhancement and rehabilitation of salmon stocks. The term "stock enhancement" generally refers to procedures used to build stocks to production levels beyond their former or natural capacity. The term "stock rehabilitation" refers to procedures employed to restore depressed stocks to previously existing natural, harvestable levels of abundance.

Specific techniques used to supplement production for either stock enhancement or stock rehabilitation purposes may be grouped into two broad categories: artificial propagation and habitat modification or enhancement. Artificial propagation includes the use of fish hatcheries and the subsequent release or stocking of juvenile salmon in selected streams and lakes. Habitat enhancement includes several activities whose goal is to improve or increase the quality and the quantity of spawning and rearing area available for natural salmon reproduction. Included are such activities as stream clearance, construction of fish passes, lake enrichment or fertilization, stream improvement (e.g., construction of spawning channels and creation of resting pools, channel containment and flow control structures, and predator/competitor control) (CIRPT 1981, PWSRPT 1983).

Between 1966 and 1984, 26 waterbodies within the Southcentral Region have been stocked by FRED with chinook salmon (table 34). Twenty-four lakes have been stocked with sockeye salmon (table 35), and 108 lakes have been stocked with coho salmon (table 36) during the same period. Many of the lakes may no longer support salmon because they are landlocked and a self-sustaining population has not developed.

B. Cook Inlet

Within the Cook Inlet (both UCI and LCI combined) portion of the Southcentral Region, several agencies are involved with efforts aimed at the increased production of the salmon resource. At the present time, active research and enhancement programs are being conducted by the ADF&G, the Cook Inlet Aquaculture Association, the USFS, and the USFWS (CIRPT 1981).

The planning effort is led by the Cook Inlet Regional Planning Team (CIRPT), a group formed in accordance with AS16.10.380 and composed of members from the ADF&G and the Cook Inlet Aquaculture Association. Their purpose is the enhancement of salmon

Table 34. Waterbodies of the Southcentral Region Stocked with Chinook Salmon, 1966-84

Waterbody	Vicinity	Year(s) Stocked
Big Lake	Big Lake	1984
Centennial Lake*	Kasilof	1984
Cheny Pond*	Anchorage	1981
Clunie Lake*	Ft. Richardson	1984
Cooper Lake	Cooper Landing	1984
Cove Creek	Whittier	1980,81, 83,84
Crooked Creek	Kasilof	1976-84
Echo Lake*	Palmer	1984
Engineer Lake*	Cooper Landing	1984
Halibut Cove	Homer	1974-84
Homer Spit	Homer	1984
Kettle Lake*	Slana	1967
Loon Lake*	Big Lake	1984
Lower Fire Lake*	Chugiak	1966
Lowell Lake	Seward	1984
Lucille Lake*	Wasilla	1984
Memory Lake*	Wasilla	1981,84
Portage Lake*	Sterling	1984
Prator Lake*	Houston	1984
Rocky Lake*	Big Lake	1981,84
Rogue Lake*	Kasilof	1984
Scout Lake*	Sterling	1981,84
Ship Creek	Anchorage	1984
Six Mile Creek	Hope	1984
South Jans Lake*	Lake Louise	1984
Strelna Lake*	Chitina	1984
Thumb Cove	Seward	1984
Upper Fire Lake	Chugiak	1966
Upper Summit Lake	Seward	1984
Victor Lake*	Palmer	1981,84

Source: ADF&G unpubl.; Hansen, pers. comm.

* Lakes identified by Div. FRED as land-locked (some have intermittent outlets or man-made barriers). Self-sustaining populations of salmon may not be present.

Table 35. Waterbodies of the Southcentral Region Stocked with Sockeye Salmon, 1966-84

Waterbody	Vicinity	Year(s) Stocked
Big Lake	Big Lake	1977,78,81
Blodgett Lake	Big Lake	1982,83
Chenik Lake	Kamishak Bay	1979
Echo Lake*	Palmer	1984
Gulkana River	Paxson	1980,81,82,83,84
Hidden Lake	Cooper Landing	1977,78,79,83,84
Island Lake*	Nikishka	1977
Leisure (China Poot) Lake*	Homer	1977,78,80,81,82,83,84
Memory Lake*	Big Lake	1983,84
Memory Lake	Wasilla	1984
Nancy Lake	Willow	1978,80,82,83
Portage Lake*	Sterling	1984
Ptarmigan Creek	Kenai Lake	1983
Quartz Creek	Kenai Lake	1983
Rocky Lake*	Big Lake	1984
Strelna Lake*	Chitina	1984
South Jans Lake*	Lake Louise	1984
Summit Lake	Paxson	1980,81,82,83,84
Sunken Island Lake*	Sterling	1977
Taku Campbell (C St.) Lake*	Anchorage	1984
Ten Mile Lake	Paxson	1974,75,76,77,78,79
Tustemena Lake	Kasilof	1978,84,79,80,81,82,83,84
Upper Jean Lake	Cooper Landing	1977
Victor Lake*	Palmer	1984

Source: ADF&G unpubl.; Hansen, pers. comm.

* Lakes identified by FRED as land-locked (some have intermittent outlets or man-made barriers). Self-sustaining populations of salmon may not be present.

production. The planning process has two phases: Phase I, which is the creation of a long-range plan, and Phase II, which is composed of a number of specific projects consistent with the plan. Phase I sets a framework in which Phase II projects of varying natures and dimensions can be implemented (ibid.).

The CIRPT in its Phase I plan identified 47 existing or potential projects for salmon population enhancement in the Cook Inlet watershed. These projects will be briefly summarized below; for greater detail of each project the reader should consult CIRPT

Table 36. Waterbodies of the Southcentral Region Stocked with Coho Salmon, 1966-84

Waterbody	Vicinity	Year(s) Stocked
Anderson Lake	Wasilla	1980,81,82,83,84
Arc Lake*	Soldotna	1974,76,78,81
Barkley Lake	Kasilof	1977
Beach Lake*	Birchwood	1980
Bear Lake	Seward	1966,67,72,73,74,75, 76,77,78,79,80,81,82,83,84
Bear Cub Lake*	Mentasta	1974,75,77,79
Benka Lake*	Talkeetna	1978,81
Bernice Lake*	Nikishka	1973,74
Beverly Lake*	Wasilla	1967
Big Lake	Big Lake	1978,80,81
Big Benka Lake	Talkeeetna	1967,70,74,76
Blodgett Lake	Big Lake	1978,82
Buffalo Lake*	Lake Louise	1976,78
Burnt Lake	Lake Louise	1966,67
Cabin Lake*	Nikishka	1979
Caribou Lake	Homer	1975,76,84
Caribou Lake*	Lake Louise	1967,72,73,74
Centennial Lake*	Kasilof	1969,71,72,75,77,79,81
Cheny Pond*	Anchorage	1976,77,78,79,80
Christianson Lake*	Talkeetna	1976,78,81
Clunie Lake*	Ft. Richardson	1968,69
Cottonwood Lake	Wasilla	1968,78,79,80,81,82,83,84
Cornelius Lake	Wasilla	1979,80,81,82,83,84
Cove Creek	Whittier	1980,81,82,83,84
Crator Lake*	Lake Louise	1970,73,76,78
Crooked Creek	Kasilof	1983
Culross Lake	Whittier	1984
Delong Lake*	Anchorage	1980
Derby Lake*	Ft. Richardson	1980
Dick Lake*	Paxson	1970,72
Echo Lake*	Palmer	1968,71,72,73,74,75,79,81,83
Elbow Lake	Lake Louise	1967,73,74
Engineer Lake*	Cooper Landing	1975,77,79,81,83,84
Finger Lake*	Palmer	1967,68,69,70,74,75, 76,77,78,79,80,81
First Lake	Seward	1975
Fish Lake*	Elmendorf AFB	1980,81
Forty Foot Lake*	Lake Louise	1973
Grant Lake	Seward	1983,84
Grouse Lake	Seward	1976,77,78,79,80,83,84

(continued)

Table 36 (continued).

Waterbody	Vicinity	Year(s) Stocked
Gwen Lake*	Ft. Richardson	1980
Hallie Lake*	Paxson	1979
Hillberg Lake*	Elmendorf AFB	1980
Hump Lake	Nikishki	1976
Island Lake*	Nikishki	1976
Jans Lake	Lake Louise	1967,69,73,76
Johnson Lake*	Kasilof	1967,68,79
Kepler-Bradley Lake*	Palmer	1968,71,80
Kettle Lake*	Slana	1976,79
Kings Lake	Wasilla	1981,82,83,84
Knik Lake*	Wasilla	1967,68
Lake 478A	Whittier	1983
Little Crator Lake	Glennallen	1984
Long Lake*	Palmer	1978
Longmare Lake*	Soldotna	1978
Loon Lake*	Big Lake	1973,75,77,79,81
Lower Fire Lake*	Chugiak	1966,67,69
Lower Summit Lake	Seward	1984
Lucille Lake*	Wasilla	1966,67,68,73,75, 1976,77,78,79,81,83
Lynda Lake	Big Lake	1978
Matanuska Lake*	Palmer	1967
Meadow Creek	Big Lake	1983,84
Meirs Lake*	Palmer	1967
Memory Lake*	Wasilla	1976,78,80,81,83
Mirror Lake*	Chugiak	1967,68,80,81
Moose Lake*	Tolsona	1966,67
Nancy Lake	Willow	1983,84
Neklason Lake	Palmer	1978,79,80,82,83,84
Never-Never Lake	Big Lake	1967
Old Road Lake*	Lake Louise	1977
Otter Lake	Cordova	1983
Otter Lake*	Ft. Richardson	1981
Paddle Lake	Soldotna	1979
Peanut Lake*	Lake Louise	1973,76,77,79
Portage Lake*	Sterling	1973,75,77,79
Prator Lake*	Houston	1971,73,76,78,81
Quartz Creek	Kasilof	1981,82,83,84
Reed Lake*	Wasilla	1967
Rock Lake	Cooper Landing	1971,73,74,76
Rocky Lake*	Big Lake	1967,76,78,79,81,83
Rouge Lake*	Kasilof	1974,76,78,81
Round Lake*	Lake Louise	1979
Russian Lake	Moose Pass	1983
Scout Lake*	Sterling	1969,72,76,78

(continued)

Table 36 (continued).

Waterbody	Vicinity	Year(s) Stocked
Sculpin Lake*	Chitina	1979
Seldovia Lake	Seldovia	1967,77,84
Seward Lagoon	Seward	1968,69,70,71,72,73,74,75 76,77,78,79,80,81,82,83,84
Sink Hole*	Seward	1977
Six Mile Lake*	Elmendorf AFB	1969,76,77,78,79,80,81
Six Mile Lake	Portage	1983
South Jans Lake*	Lake Louise	1981
South Rolly Lake*	Willow	1976,77,79,81
Strelna Lake*	Chitina	1970,73,75,77,79
Sunken Island Lake*	Sterling	1971,73,75,79
Taku Campbell (C St.) Lake*	Anchorage	1976,77,78,79,80,81
Tern Lake	Cooper Landing	1983,84
Tex Smith Lake	Lake Louise	1970,75
Thompson Lake*	Ft. Richardson	1980
Tolsona Lake*	Tolsona	1966,67,76
Tolsona Mtn. Lake*	Tolsona	1975,77
Triangle Lake*	Elmendorf AFB	1980,81
Twin Island Lake*	Port McKenzie	1967
Union Lake*	Soldotna	1984
Upper Fire Lake*	Chugiak	1966,67,69
Upper Jean Lake*	Cooper Landing	1969,73,75,79
Van Lake*	Chitina	1973,75,77,79,80
Victor Lake*	Palmer	1968,70,71,72,73,74,75 76,78,79,81,83
Virgina Lake*	Kasilof	1976
Wasilla Lake	Wasilla	1968,78,79,80,81,82,83,84
Wick Lake*	Kenai	1984

Source: ADF&G unpubl.

(1981) and any Phase II plans or updated project reports available.

1. Hatcheries and stocking. Seven hatcheries are presently in operation in the Cook Inlet area. They are located at Big Lake, Fort Richardson, Elmendorf AFB, Kasilof, Tutka Bay, Eklutna, and Trail Lakes (CIRPT 1981 and 1983). CIRPT (1981) identified six additional potential hatchery locations; however, feasibility studies must be conducted before a final determination of suitability may be made. These potential hatchery sites are located at English Bay, Birch Hill,

Ninilchik, Bradley Lake, Delight Lake, and Nuka Bay. The National Park Service advised the CIRPT that the Delight Lake and Nuka Bay hatcheries require actions that would "constitute an inappropriate and unacceptable change to National Park Service lands and waters and are directly contrary to law and policy." The CIRPT understands this present limitation but will continue to carry the projects representing potential resources that would be available for realization should law and policy change during the life of the plan (ibid.).

During 1982, it was determined that what had been listed as the Nuka Bay Hatchery site did, in fact, refer to a site in Tonsina Bay on the west side of the Nuka Passage. This placed it outside the Kenai Fjords National Park and thereby resolved that conflict. The Tonsina Bay site, however, is within the Kachemak Bay State Wilderness Park. A preliminary private nonprofit hatchery application was filed for that site, but permission was denied initially by the Alaska Division of Parks. Subsequently, the Division of Parks has sought the assistance of the Attorney General's office to clarify the definition of wilderness and therefore what is permissable within a wilderness (CIRPT 1983).

Observations at the Birch Hill site indicate that there is insufficient outflow from the lake for a hatchery operation; however, the lake might have potential as a rearing or nursery area. Additional work will be needed to refine this concept and evaluate its feasibility (ibid.).

Eighteen systems have been identified for potential lake or stream stocking to supplement or create salmon runs. Seven of these systems also require habitat enhancement work such as fish pass construction, fertilization, stream clearance, or flow control projects to fully realize their potential (ibid.).

2. Habitat modification/enhancement. Habitat enhancement has a long history in Cook Inlet, with stream improvement through clearance of obstructions on the Salmon River, Bear Creek, and Grouse Creek recorded in 1922, and in 1930 in the Susitna, Little Susitna and Knik Arm tributaries (CIRPT 1981). The use of fish passes (fish ladder or fishway) exists on Ship Creek and at the Russian River Falls. Spawning channels of recent construction are located at Portage Creek and at Daves Creek, the outlet stream from Tern Lake.

   In addition to these projects, the CIRPT (1981, 1983) has identified 33 potential sites where one or more habitat enhancement techniques may be useful for increasing salmon production. Included are 10 fish pass sites, 3 channelization projects, 9 stream clearance sites, 14 lake fertilization projects, 1 spawning channel location, 1 rearing pond location, and 3 flow control projects (ibid.).

C. Prince William Sound

Several federal and state agencies and private organizations are directly involved in the salmon fisheries of the PWS area. These include the ADF&G, the Alaska Board of Fisheries, the Alaska Commercial Fisheries Entry Commission, the Alaska Division of Fish and Wildlife Protection, the North Pacific Fisheries Management Council, the USFS, the BLM, the Prince William Sound Aquaculture Corporation (PWSAC), the Valdez Fisheries Development Association, and Nerka Inc. (PWSRPT 1983).

As in Cook Inlet, a planning team serves to guide these agencies and organizations in fisheries matters through recommendations made to the commissioner of the ADF&G. The Prince William Sound Regional Fisheries Planning Team (PWSRPT) has been organized as per AS 16.10.380 and is composed of members from the ADF&G and the PWSAC for the purpose of enhancing salmon production. During 1983, the team published its Phase I (1983-2002) plan for PWS and the Copper River. The plan integrates and assembles all relevant information regarding the development and protection of the salmon resources into a long-range strategic plan and establishes the 20-year objectives and erects the framework upon which the more detailed Phase II planning will take place (ibid.).

The PWSRPT in its Phase I plan identified 231 existing or potential projects for salmon population enhancement. Included in this figure are hatchery sites, lake stocking locations, stream stocking locations, fish pass sites, channelization projects, and stream clearance projects. These projects are briefly summarized below; for greater detail on each project, the reader should consult PWSRPT (1983) and any Phase II plans or updated project reports available.

1. Hatcheries and stocking. Five hatcheries are presently in operation in the PWS area. They are located at Main Bay, Cannery Creek, Gulkana, Solomon Gulch, and Port San Juan. Twenty additional potential hatchery locations have been identified (PWSRPT 1983).

   A total of 64 systems have been identified for potential lake, stream, or lake and stream stocking efforts to supplement or create salmon runs. Of these, 43 lakes have been identified as candidates for stocking of salmon fry. Fifteen of these also require habitat enhancement such as the construction of fish passes or stream channelization work to reach their full potential. Twelve streams have been identified for stocking of salmon fry, and six of these require habitat enhancement work. Nine lake and stream systems would benefit from stocking of salmon fry and only one of these systems requires habitat enhancement work (ibid.).

2. Habitat modification/enhancement. The USFS has completed fish pass or stream improvement projects in more than 50 locations during the period 1962 through 1982. It is estimated that 13 of the more significant projects (table 37)

Table 37. Significant Habitat Enhancement Projects completed in PWS, 1967-82

Type of Project	Stream Name	Year Completed	Salmon Species
Fish pass	Control Creek	1974	Pink
Fish pass	Red Creek	1978	Sockeye
Fish pass	Hobo Creek	1978	Pink
Fish pass	Sockeye Creek	1982	Sockeye, coho
Fish pass	Otter Creek	1982	Pink
Fish pass	Boswell Bay	1981	Sockeye
Fish pass	Forest Service Trail Creek	1980	Coho, pink
Rock removal	Billy's Hole	1981	Sockeye
Log/gabion diversion	Harrison Lagoon Creek	1972-73	Pink, chum
Fish pass and wood gate	Paulson Creek	1981	Pink
Fish pass and weir	Shrode Creek	1962-72	Pink, sockeye
Defector dam and channel	Constantine Creek	1967-71	Pink, chum
Stream grading	Hawkins Creek	1969	Pink

Source: PWSRPT 1983.

will annually contribute 120,600 pink salmon, 12,000 chum salmon, 25,800 sockeye salmon, and 1,100 coho salmon to the commercial harvest by the year 2002 (PWSRPT 1983). Two additional projects were completed during 1983 and 1984. One at Rocky Creek includes a steep pass and an overflow device, and the other is a spawning channel at mile 18 of the Copper River (Frigden 1984).

In addition to the projects listed above, the PWSRPT (1983) has identified 116 potential habitat enhancement sites. They include 26 fish pass locations, 85 channelization locations, and 5 stream clearance sites.

REFERENCES

ADF&G. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. Juneau. 443 pp.

________. 1978. Alaska's fisheries atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.] 43 pp. + maps.

________. 1981a. PWS area annual finfish management report, 1980. Div. Commer. Fish., Cordova. 110 pp.

________. 1981b. Subtask 7.10, phase I final draft report, adult anadromous fisheries project. Susitna Hydro aquatic studies. Anchorage. 136 pp. + appendices.

________. 1982a. Stock separation feasibility report, Adult Anadromous Fisheries Project, Su-Hydro. Anchorage. 19 pp. + appendices.

________. 1982b. Annual finfish management report - 1980 - Lower Cook Inlet. Div. Commer. Fish., Homer. 66 pp.

________. 1982c. Annual finfish management report - 1981 - Lower Cook Inlet. Div. Commer. Fish., Homer. 97 pp.

________. 1982d. Prince William Sound annual finfish management report, 1981. Div. Commer. Fish., Cordova. 135 pp.

________. 1982e. Lower Cook Inlet salmon fishery - 1982 - rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 29 pp.

________. 1983a. Annual finfish management report - 1982 - Lower Cook Inlet. Div. Commer. Fish., Homer. 96 pp.

________. 1983b. Prince William Sound area annual finfish management report - 1983. Div. Commer. Fish., Cordova. 135 pp.

________. 1983c. Prince William Sound annual finfish management report - 1982. Div. Commer. Fish., Cordova. 122 pp.

________. 1984a. Regulations of the Alaska Board of Fisheries for commercial fishing in Alaska: commercial finfish regulations. Juneau. 118 pp.

________. 1984b. Lower Cook Inlet Salmon Fishery - 1983 - report to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 16 pp.

________. 1984c. Lower Cook Inlet Salmon Fishery - 1984 - report to the Board of Fisheries. Lower Cook Inlet Data Rept. No. 84-5. Div. Commer. Fish., Homer. 17 pp.

________. 1984d. An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes, Southcentral Region, Resource Management Region II. Div. Habitat., Anchorage. 5 pp. + maps.

________. Unpublished. Fish release records for regions 01, 02, and 03. Computer printouts, 07 Aug 1984 and February 1985. Div. FRED, Anchorage. 209 pp.

________. 1981b. Subtask 7.10, phase I final draft report, adult anadromous fisheries project. Susitna Hydro aquatic studies. Anchorage. 136 pp. + appendices.

________. 1982a. Stock separation feasibility report, Adult Anadromous Fisheries Project, Su-Hydro. Anchorage. 19 pp. + appendices.

________. 1982b. Annual finfish management report - 1980 - Lower Cook Inlet. Div. Commer. Fish., Homer. 66 pp.

________. 1982c. Annual finfish management report - 1981 - Lower Cook Inlet. Div. Commer. Fish., Homer. 97 pp.

________. 1982d. Prince William Sound annual finfish management report, 1981. Div. Commer. Fish., Cordova. 135 pp.

________. 1982e. Lower Cook Inlet salmon fishery - 1982 - rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 29 pp.

________. 1983a. Annual finfish management report - 1982 - Lower Cook Inlet. Div. Commer. Fish., Homer. 96 pp.

________. 1983b. Prince William Sound area annual finfish management report - 1983. Div. Commer. Fish., Cordova. 135 pp.

________. 1983c. Prince William Sound annual finfish management report - 1982. Div. Commer. Fish., Cordova. 122 pp.

________. 1984a. Regulations of the Alaska Board of Fisheries for commercial fishing in Alaska: commercial finfish regulations. Juneau. 118 pp.

________. 1984b. Lower Cook Inlet Salmon Fishery - 1983 - report to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 16 pp.

________. 1984c. Lower Cook Inlet Salmon Fishery - 1984 - report to the Board of Fisheries. Lower Cook Inlet Data Rept. No. 84-5. Div. Commer. Fish., Homer. 17 pp.

________. 1984d. An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes, Southcentral Region, Resource Management Region II. Div. Habitat., Anchorage. 5 pp. + maps.

________. Unpublished. Fish release records for regions 01, 02, and 03. Computer printouts, 07 Aug 1984 and February 1985. Div. FRED, Anchorage. 209 pp.

Bentz, R.W. 1983. Inventory and cataloging of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 24. Proj. F-9-15, Job G-I-D.

________. 1982. Inventory and cataloging of the sport fish and sport fish waters in upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies, Vol. 23. Proj. F-9-15, Job G-I-D.

Chlupach, R.S. 1982a. Evaluation of returning hatchery adult sockeye and coho salmon 1980-81. ADF&G, Div. FRED, Big Lake. 25 pp.

________. 1982b. Evaluation of returning hatchery adult sockeye salmon. ADF&G, Div. FRED, Big Lake. 21 pp.

CIRPT (Cook Inlet Regional Planning Team). 1981. Cook Inlet regional salmon enhancement plan, 1981-2000. Soldotna. 71 pp. + appendices.

________. 1983. Cook Inlet regional planning team project planning documents notebook. Unpubl. progress status repts. Soldotna.

Fridgen, P. 1984. Personal communication. PWS Asst. Area Mgt. Biologist, ADF&G, Div. Commer. Fish, Cordova.

Hammarstrom, S. 1977. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 18. Proj. F-9-9, Job-II-L.

________. 1981. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 22. Proj. F-9-13, Job G-II-L.

Hammarstrom, S., and L. Larson. 1982. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 23. Proj. G-9-14, Job G-II-L.

________. 1983. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 23. Proj. F-9-15, Job G-II-L.

________. 1984. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 24. Proj. F-9-15, Job G-II-L.

Hansen, J. 1985. Personal communication. Fisheries Biologist, ADF&G, Div. FRED, Juneau.

Hepler, K.R., and R.W. Bentz. 1984. Chinook salmon population and angler user studies of Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 25. Proj. F-9-16, Job G-II-M.

King, B.E., and K.E. Tarbox. 1983. Upper Cook Inlet salmon (Oncorhynchus spp.) escapement studies - 1982. ADF&G Tech. Data Rept. No. 93. Div. Commer. Fish., Soldotna. 139 pp.

________. 1984. Upper Cook Inlet salmon (Oncorhynchus spp.) escapement studies - 1983. ADF&G Tech. Data Rept. No. 122. Div. Commer. Fish., Soldotna. 152 pp.

Logan, S. 1985. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish, Soldotna.

McBride, D.N., and J. Wilcock. 1983. Alaska chinook salmon (Oncorhynchus tshawytscha Walbaum) catch and escapement, 1961-1980, with age, size and sex composition estimates. ADF&G Informational Leaflet No. 212. Div. Commer. Fish., Anchorage. 181 pp.

McCurdy, M.L. 1984. PWS general districts pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon aerial and ground escapement surveys and pre-emergent alevin index surveys, brood years 1980 through 1983. ADF&G Tech. Data Rept. No. 116. Div. Commer. Fish., Cordova. 116 pp.

McCurdy, M.L., and R.B. Pirtle. 1980a. PWS general districts 1976 brood year pink (Oncorhynchus gorbuscha) and chum salmon (O. keta) aerial and ground escapement surveys and consequent egg deposition and pre-emergent fry index programs. ADF&G Tech. Data Rept. No. 51. Div. Commer. Fish., Cordova. 62 pp.

________. 1980b. PWS general districts 1977 brood year pink (Oncorhynchus gorbuscha) and chum salmon (O. keta) aerial and ground escapement surveys and consequent egg deposition and pre-emergent fry index programs. ADF&G Tech. Data Rept. No. 52. Div. Commer. Fish., Cordova. 60 pp.

________. 1980c. PWS general districts 1978 brood year pink (Oncorhynchus gorbuscha) and chum salmon (O. keta) aerial and ground escapement surveys and consequent egg depostion and pre-emergent fry index programs. ADF&G Tech. Data Rept. No. 53. Div. Commer. Fish., Cordova. 43 pp.

________. 1980d. PWS general districts 1979 brood year pink (Oncorhynchus gorbuscha) and chum salmon (O. keta) aerial and ground escapement surveys and consequent egg depostion and pre-emergent fry index programs. ADF&G Tech. Data Rept. No. 54. Div. Commer. Fish., Cordova. 44 pp.

McHenry, E.T. 1985. Personal communication. Fishery Biologist III, ADF&G, Div. Sport Fish, Seward.

Merritt, M., and K. Roberson. 1983. Migratory timing of Copper River sockeye salmon (Oncorhynchus nerka) stocks, and its management implications to the commercial fishery. ADF&G Informational Leaflet No. 225. Juneau. 39 pp.

Middleton, K.R. 1981. Cook Inlet stock status report. ADF&G, Div. Commer. Fish., Anchorage. Unpubl. rept. 108 pp.

Mills, J.J. 1979 - 1983. Statewide harvest study. Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vols. 20 through 24. ADF&G, Div. Sport Fish., Juneau.

Nelson, D.C. 1983. Russian River sockeye salmon study. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 24. Proj. AFS-44-9.

Pirtle, R.B. 1976. Historical catch, escapement and related commercial fisheries statistics of fish and shellfish, Prince William Sound area, Alaska. ADF&G Tech. Data Rept. No. 26. Div. Commer. Fish., Juneau. 93 pp.

________. 1977. Historical pink and chum salmon estimated escapements from Prince William Sound, Alaska streams. ADF&G Tech. Data Rept. No. 35. Div. Commer. Fish., Cordova. 332 pp.

________. 1978. Annual management report: PWS area - 1977. ADF&G, Div. Commer. Fish., Cordova. 111 pp.

________. 1979. Annual management report: PWS area - 1978. ADF&G, Div. Commer. Fish., Cordova. 103 pp.

________. 1980. Annual management report: PWS area - 1978. ADF&G, Div. Commer. Fish., Cordova. 77 pp.

________. 1981. A compilation of historical sockeye salmon spawning escapement estimates from Prince William Sound. ADF&G Tech. Data Rept. No. 51. Div. Commer. Fish., Cordova. 23 pp.

PWSRPT (Prince William Sound Fisheries Planning Team). 1983. Prince William Sound-Copper River comprehensive salmon plan, phase I, 20 year plan (1983-2002). Cordova. 176 pp.

Randall, R.C. 1985. Personal communication. PWS Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Cordova.

Roberson, K.R. 1985. Personal communication. Research Project Leader. ADF&G, Div. Commer. Fish., Glennallen.

Rowell, K.A., and K.R. Middleton. 1985. Upper Cook Inlet stock status report: summary of salmon, herring and razor clam fisheries through 1982. ADF&G, Div. Commer. Fish., Anchorage. Draft rept.

Ruesch, P.H. 1984a. Annual management report - 1982 - Upper Cook Inlet. ADF&G, Div. Commer. Fish., Soldotna. 83 pp.

________. 1984b. Personal communication. UCI Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Soldotna.

Schroeder, T.R. 1984. Personal communication. LCI Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Sharr, S. 1983. Catch and escapement statistics for Copper and Bering river sockeye (Oncorhynchus nerka), chinook (O. tshawytscha), and coho salmon (O. kisutch) - 1982. ADF&G Tech. Data Rept. No. 98. Div. Commer. Fish., Anchorage. 45 pp.

Wallis, J., and S. Hammarstrom. 1983. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. ADF&G. Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-C.

Marine Fish

Pacific Cod Distribution and Abundance

I. REGIONWIDE

Information on the distribution of Pacific cod in the Southcentral Region, as with other groundfish species, is derived from commercial fishery information and a limited number of surveys conducted by the research and management agencies. Areas that have not been subject to commercial harvest and have not yet been surveyed may contain significant populations of Pacific cod that remain undocumented.

Allowable biological catch and optimum yield estimates are currently made by three regions of the Gulf of Alaska. Two of these regions, Chirikof-Kodiak (Central Gulf), and Yakutat-Southeastern (Eastern Gulf), fall partially within the Southcentral Region covered in this guide (see map 1 of the groundfish commercial harvest narrative found elsewhere in this volume).

A. Regional Distribution

In the Gulf of Alaska, cod are most abundant in the western (Kodiak and Peninsula) regions (Reeves 1972, Hughes 1974, Ronholt et al. 1977). In the 1973-1976 National Marine Fisheries Service (NMFS) surveys of the Gulf of Alaska from Cape Spencer to Chignik Bay, only 4.5% of the total cod biomass was found in the Prince William Sound area (148°W to 144°30'W) and 11.4% in the Kenai area (roughly, from the tip of the Kenai Peninsula to 148°W and north of 58°10'N) (Ronholt et al. 1977).

B. Areas Used Seasonally and For Life Functions

Summer concentrations of adult cod are found in Cook Inlet and in the Barren Islands area. Small cod are frequently caught in Kachemak Bay trawl fisheries, indicating that Kachemak Bay may be a rearing area for cod (Blackburn et al. 1983). These rearing and concentration areas are depicted on a 1:1,000,000-scale map of groundfish distribution and may be found in the reference map series that supplements this text.

C. Factors Affecting Distribution

Pacific cod are mostly benthic and are found at depths ranging from 15 to 550 m (Moiseev 1953). Research vessel surveys carried out in the Gulf of Alaska from summer 1980 to late winter 1982 found that the highest Pacific cod density was in the 51-to-100-m depth interval (Zenger and Cummings 1982). Their depth distribution varies, however, with the location of the stock and time of year.

Water temperature is very important to the hatching success and survival of cod eggs and may in that way determine the limits of Pacific cod distribution (Alderdice and Forrester 1971). More details of temperature tolerance can be found in the Pacific Cod Life History and Habitat Requirements narrative in volume 1.

D. Movements Between Areas Used Seasonally and For Life Functions

Cod generally move into deep water in late winter (January to

April) to spawn and back to shallow water in the spring after spawning (Salveson and Dunn 1976).

E. Population Size Estimation

Current estimated total exploitable biomass is based on the results of six research vessel surveys conducted during 1981, one in 1980, and one in 1982 (Zenger and Cummings 1982). The standing stock for each INPFC area (map G1) was estimated. Surveys in the Kodiak INPFC area offered good areal coverage; however, surveys in the Yakutat area were limited to NMFS rockfish and flatfish abundance indexing sites and thus may have resulted in less accurate biomass estimates. Total exploitable biomass for the Kodiak area is estimated to be 42,375 metric tons and for the Yakutat area, 5,682 metric tons (ibid.).

F. Regional Abundance

Maximum sustainable yield (MSY) for Pacific cod in the entire Gulf of Alaska is estimated to be 88,000 to 177,000 metric tons (NPFMC 1984). Pacific cod, however, is a relatively short-lived and fast growing species. Thus only a few year classes contribute to the population, and large fluctuations in population size occur, depending upon whether strong or weak year classes are present (Natural Resources Consultants 1981). Because of this, MSY estimates, which are based on long-term population stability, do not have much meaning when applied to cod.

Cod stocks off Alaska declined in the mid 1970's but have recently increased in abundance (ibid.). The increase is due to the presence of relatively strong 1977 and 1978 year classes (Bakkala 1981, Natural Resources Consultants 1981). Optimum yield for the Gulf of Alaska has been set at 60,000 metric tons, with 33,540 metric tons coming from the Central Gulf (159°W to 147°W) and 9,900 metric tons from the Eastern (147°W to Dixon Entrance) Gulf (NPFMC 1984).

Current harvest levels of Pacific cod in the Gulf of Alaska and in the Bering Sea are below MSY. Thus, cod stocks have apparently not been reduced by fishing pressure. The cod population, however, is expected to decrease in the next two to three years, following the decline of the strong 1977 and 1978 cohorts in the population (Bakkala 1981, McNair 1984).

REFERENCES

Alderdice, D.F., and C.R. Forrester. 1971. Effects of salinity, temperature, and dissolved oxygen on early development of the Pacific cod (Gadus macrocephalus). J. Fish. Res. Bd. Can. 28:883-902.

Bakkala, R. 1981. Pacific cod of the eastern Bering Sea. USDC: NWAFC, NMFS, NOAA, Seattle, WA. 49 pp.

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska- Bering Sea groundfish investigations. Commercial Fisheries Research and

Development Act Proj. No. 5-49-R-1. ADF&G. Prepared for NOAA, NMFS, Washington, DC. 85 pp.

Hughes, S.E. 1974. Groundfish and crab resources in the Gulf of Alaska - based on International Pacific Halibut Commission trawl surveys, May 1961 - March 1963. USDC: NOAA, NMFS, Seattle, WA. Data Rept. 96.

McNair, D. 1984. Cod: the Alaskan resource. Pacific Fishing 5(1):37.

Moiseev, P.A. 1953. Cod and flounders of far-eastern seas. Izvestiya TINRO 40: 1-287. (Transl. from Russian by Fish. Res. Bd. Can. Transl. Ser. No. 119). Cited in Alderdice and Forrester 1971 and in Salveson and Dunn 1976.

Natural Resources Consultants. 1981. The Pacific cod (_Gadus macrocephalus_) opportunities for the 1980's. Report prepared for the Economic Development Council of Puget Sound. Feb. 1981. 44 pp.

NPFMC. 1984. Summary of Gulf of Alaska groundfish fishery management plan (through amendment 12). Revised 1 January 1984. 21 pp.

Reeves, J.E. 1972. Groundfish of the Gulf of Alaska. Pages 411-445 _in_ D. Rosenberg, ed. A review of the oceanography and renewable resources of the northern Gulf of Alaska. Univ. Alaska. Inst. Mar. Sci. Rept. R72-23, Alaska Sea Grant Rept. 73-3.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1977. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976. A historical review. Vol. 3. Pages 624-955 _in_ Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Vol. 2: Biological sutides. USDC: NOAA, ERL, OCSEAP.

Salveson, S.J., and J.R. Dunn. 1976. Pacific cod (family Gadidae). Pages 303-405 _in_ W.T. Pereyra, J.E. Reeves, and R.G. Bakkala (principal investigators) Demersal fish and shellfish resources of the eastern Bering Sea in the Baseline year 1975. USDC: NOAA, NMFS, NWAFC processed rept. 619 pp.

Zenger, H.H., and N.J. Cummings. 1982. Pacific cod. Pages 88-110 _in_ J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. USDC: NWAFC, NMFS, NOAA. 198 pp.

Pacific Halibut Distribution and Abundance

I. REGIONWIDE INFORMATION

Pacific halibut in the Gulf of Alaska are managed by the International Pacific Halibut Commission (IPHC). For management purposes, the IPHC has divided the northeast Pacific and Bering Sea into large regulatory areas (see map 1 of the halibut commercial harvest narrative found elsewhere in this volume). The Southcentral Region covered in this guide is included in regulatory Area 3A. Biomass and surplus production estimates from IPHC are made by regulatory area; consequently, distribution and abundance will be discussed at that level in this account.

A. Regional Distribution

Halibut are found throughout the Southcentral Region; however, in the Gulf of Alaska, halibut abundance is highest in the Kodiak Island area (Ronholt et al. 1977, Webber and Alton 1976).

B. Areas Used Seasonally and For Life Functions

Spawning occurs along the continental shelf at depths from 228 to 456 m (Bell 1981). In the central Gulf of Alaska, halibut spawn along the outer edge of Portlock Bank, in Amatuli Trough, and along the 200 m depth contour between Cape Cleare and Cape St. Elias (St. Pierre in press). These areas are mapped on a 1:1,000,000-scale groundfish distribution map and may be found in the reference map series that supplements this text. text.

Halibut eggs have been recovered throughout the northeast Gulf of Alaska from 40 to 935 m of water, with highest densities at depths of 100 to 200 m near the edge of the continental slope, between Yakutat and Portlock Bank (Thompson and VanCleve 1936).

C. Factors Affecting Distribution

Halibut are concentrated in areas with bottom water temperatures ranging from 3 to 8°C (IPHC 1978). Best and Hardman (1982) noted that catches in juvenile halibut surveys were usually larger when bottom water temperatures were near 4°C. The bathymetric range for adult halibut is between 27 and 1,100 m (ibid.).

D. Movements Between Areas Used Seasonally and for Life Functions

Tagging studies indicate that adult halibut migrate annually from their shallow (27 to 274 m) summer feeding grounds, such as Portlock Bank and Cook Inlet, to deeper (up to 1,097 m) winter spawning grounds (Science Applications, Inc. 1980; IPHC 1978). More information on movements between areas can be found in the Halibut Life History and Habitat Requirements narrative in volume 1 of this publication.

E. Population Size Estimation

In the early management of the fishery, the IPHC relied almost completely on measures of catch per unit effort (CPUE) to assess the size of the halibut population (IPHC 1978). Until recently, fishing gear and conditions were relatively stable in the fishery, and CPUE was considered a reliable, consistent measure of population size (Hoag 1984). Recently, however, several factors have caused a change in the relationship between catch and effort. These factors include the increasing use of snap gear (which is replacing the traditional fixed-hook gear), the high abundance in some areas of dogfish (*Squalus acanthias*), the conversion to circle hooks, and short fishing seasons (ibid.). There has been a strong increase in CPUE since the mid 1970's. Stocks have increased but probably not to the degree indicated by the rise in CPUE. Until the IPHC can standardize CPUE measurement under the new conditions, assessment techniques using catch and age data (cohort analysis) are being used to evaluate the population, with CPUE information being used to stabilize the estimates (Hoag 1984, Quinn 1984).

The current method of population assessment is to evaluate catch at age data for each regulatory area separately; however, the estimates for each regulatory area are linked to other areas by migration rate and population abundance information (Quinn 1984). The major assumption of this method is that estimates of migration rates are reliable (ibid.). Population estimates for each regulatory area are not as reliable as the total population estimate (ibid.); however, it is necessary to evaluate the population in each regulatory area to manage the fishery.

F. Regional Abundance

Annual surplus production is defined as the catch that can be taken in a given year without changing biomass (IPHC 1982). The estimated surplus for halibut in the North Pacific in 1983 was 64.8 million pounds (29.4 thousand metric tons). Of this, however, 12 million pounds (5.4 thousand metric tons) was expected to be lost to incidental catch, leaving 52.8 million pounds (23.9 thousand metric tons) available to the commercial catch (Quinn 1984).

Surplus production for Area 3 in 1983 was estimated to be 28.0 million pounds (12.7 thousand metric tons), and the 1984 recommended catch limit for Area 3 is set at 90% of that level, or 25 million pounds (11.3 thousand metric tons), with 18 million pounds (8.2 thousand metric tons) allocated to Area 3A (Deriso 1984, Mhyre 1984).

IPHC juvenile surveys have suggested that the abundance of young halibut is increasing. These fish will begin to contribute to the fishery when they reach age eight in the late 1980's (IPHC 1982). The stock now appears near optimum levels in areas of the central Gulf of Alaska (Deriso 1984).

REFERENCES

Bell, R.H. 1981. The Pacific halibut: the resource and the fishery. Anchorage, AK: Alaska Northwest Publishing Company. 267 pp.

Best, E.A., and W.H. Hardman. 1982. Juvenile halibut surveys, 1973-1980. IPHC Tech. Rept. No. 20. 38 pp.

Deriso, R.B. 1984. Stock assessment 1983. B. Rationale of catch limit recommendations. Pages 25-29 in IPHC 1984 annual meeting documents. 42 pp.

Hoag, S.H. 1984. Recent problems affecting CPUE data. Pages 11-18 in IPHC 1984 annual meeting documents. 42 pp.

IPHC. 1978. The Pacific halibut: biology, fishery, and management. IPHC Tech. Rept. No. 16 (revision of No. 6). 57 pp.

________. 1982. Annual report 1981. 48 pp.

Mhyre, R.J. 1984. Staff regulatory proposals for the 1984 halibut fishery. Pages 30-33 in IPHC 1984 annual meeting documents. 42 pp.

Quinn, T.J., II. 1984. Stock assessment 1983. A. Evaluation of population condition. Pages 19-24 in IPHC 1984 annual meeting documents. 42 pp.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1977. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976, a historical review. Vol. 3. RU-174. Pages 624-955 in Environmental assessment of the Alaska continental shelf. Final reports of principal investigators. Vol. 2: Biological studies. USDC: NOAA, ERL, OCSEAP. June 1978.

Science Applications, Inc. 1980. Environmental assessment of the Alaskan continental shelf. Northeast Gulf of Alaska interim synthesis rept. USDC: NOAA, ERL. Prepared by Science Applications, Inc. under the guidance of OCSEAP. 313 pp.

St. Pierre, G. In press. Locations and times of spawning for Pacific halibut. IPHC sci. rept.

Thompson, W.F., and R. VanCleve. 1936. Life history of the Pacific halibut (2) Distribution and early life history. Int. Fish. Comm. Rept. No. 2. Victoria, BC. Cited in Science Applications, Inc. 1980.

Webber, R.A., and M.S. Alton. 1976. Pacific halibut (family Pleuronectidae). Pages 511-521 in W.T. Pereyra, J.E. Reeves, and R.G. Bakkala, eds. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. USDC: NOAA, NMFS. 619 pp.

Pacific Herring Distribution and Abundance

I. REGIONWIDE INFORMATION

Pacific herring are found throughout the Southcentral Region, which is divided into three areas for management of the herring commercial fishery: Upper Cook Inlet (UCI), Lower Cook Inlet (LCI), and Prince William Sound (PWS). The boundaries of these management areas are mapped in the herring Human Use narrative in this volume. Distribution and abundance information specific to each management area is presented following the regional information.

A. Regional Distribution

Pacific herring are distributed throughout UCI, LCI, and PWS. Herring spawn on the rocky beaches and fiords of PWS and in the Kamishak, Southern, Outer, and Eastern districts of LCI (ADF&G 1977, 1978). Little is known about the offshore marine life of herring in the Southcentral Region.

Herring in Alaska generally mature at age three or four and at lengths of 15 to 20 cm. Fecundity is related primarily to body length and secondarily to age; therefore, large, old herring produce more eggs. Females may produce between 10,000 and 134,000 eggs (Macy et al. 1978). In LCI, the current management strategy is to wait until herring are four or five years old before harvesting them (ADF&G 1984a).

B. Areas Used Seasonally and for Life Functions

A series of herring distribution maps have been produced to supplement this text. The categories on these maps are 1) known spawning areas at 1:250,000 scale, 2) known feeding concentrations at 1:1,000,000 scale, and 3) general distribution at 1:1,000,000 scale.

C. Factors Affecting Distribution

General factors affecting distribution, such as temperature and salinity, are summarized in the Herring Life History and Habitat Requirements narrative found in volume 1. More detailed information follows in the management area narratives.

D. Movement Between Areas Used Seasonally and for Life Functions

Little is known about specific migration patterns in the Southcentral Region. Adults winter in offshore feeding grounds, and, in the spring, large schools of mature fish move into sheltered bays, along steep or shelving rocky beaches, or along open sand beaches to spawn (Macy et al. 1978). Some populations of herring winter in PWS (Fridgen, pers. comm.).

E. Population Size Estimation

Aerial surveys performed during the spawning season are the only method presently used to assess in-season herring abundance in the Southern, Outer, Kamishak, and Eastern districts of LCI (ADF&G 1982). Aerial survey estimates in LCI are affected by the presence of other species of schooling fish, such as pollock, sand lance, or juvenile salmon (ibid.), the frequency of surveys, and visibility. Herring research in PWS includes biological sampling of the commercial harvest to assess the overall population condition and recruitment into both the spring sac roe and winter food/bait fisheries. Hydroacoustic surveys are conducted by the ADF&G to help locate prespawning concentrations of herring and to monitor their movements prior to the commercial sac roe season. Activities have also included ground and aerial surveys of spawning areas to document the extent and magnitude of spawning. The ground observations included pre-and post-season underwater surveys to evaluate the effects of past kelp harvests and growth and recruitment of the kelp in harvested areas (ADF&G 1983a). These surveys were used to determine the guideline harvest levels for kelp that are currently used. In the past two years, postseason underwater surveys have been used to estimate the biomass of spawning populations (Fridgen, pers. comm.).

F. Regional Abundance

Detailed abundance information for herring follows in narratives for the UCI, LCI, and PWS management areas.

II. UCI MANAGEMENT AREA

Boundary descriptions and a map of the UCI area are included in the herring commercial harvest narrative found elsewhere in this volume.

A. Distribution

Little biological information is available for UCI herring populations. Glacially clouded water prevents assessment of abundance, spawning areas, and migration routes. Though currently managed as discrete stocks, the relationship of herring populations harvested in Chinitna, Tuxedni, and east-side areas to each other, as well as to LCI stocks, has yet to be documented (Middleton and Rowell 1984). There is no documentation of spawning areas anywhere in UCI, and the integrity of the stocks is only conjectural (Ruesch 1982).

B. Abundance

The data base for UCI herring is small but growing. Harvest records, while poor in the past, are becoming more reliable (Ruesch, pers. comm.). The glacial waters of Cook Inlet prevent any estimate of biomass or spawning success (Middleton and Rowell 1984).

III. LCI MANAGEMENT AREA

Boundary descriptions and a map of the LCI area are included in the herring commercial harvest narrative found elsewhere in this volume.

A. Distribution

Very little is known about the offshore marine life or the migratory habits of herring in the Cook Inlet area. It is not presently known whether Cook Inlet herring are a distinct population separate from other Alaskan herring. The degree of separation or intermingling of stocks within the area is also unknown (ADF&G 1977).

Aerial surveys are conducted each year by the ADF&G to locate concentrations of feeding and spawning herring. Pacific herring concentrations occur in coastal waters from East Foreland, south along the Kenai Peninsula, and from Redoubt Point to Kamishak Bay along the Alaska Peninsula. It is likely that herring spawn in all the bays on the west side of Cook Inlet from Tuxedni Bay south. Critical spawning grounds are located from Oil Bay to Douglas Reef, where the majority of the spawning occurs (Schroeder, pers. comm.). Spawning occurs on many of the reefs exposed at extreme low tides in Kamishak Bay west of the line connecting Ursus Head and Douglas Reef (ibid.).

Herring are found throughout the Kamishak District. Spawning has been observed in Oil Bay, Dry Bay, Ursus Cove, Bruin Bay, off Augustine Island, and along reefs located in the southern portion of Kamishak Bay. It appears that herring also spawn in deep water areas along the southern portion of Kamishak Bay.

In the Southern District, herring schools have been noted in several bays, and spawning has been observed in Mallard Bay, Bear Cove, along the Homer Spit, and along Glacier Spit (ibid.).

Herring spawning occurs intermittently throughout the Outer District. Concentrations have been observed in Aialik, Harris, Two Arm, Nuka, Tonsina, West Arm of Port Dick, and Rocky bays (ibid.).

In the Eastern District, heaviest concentrations of spawning herring occur in the Seward small boat harbor, Thumbs Cove, and off Fourth of July Creek in Resurrection Bay. Spawning also occurs in Safety Cove and Killer Bay in Day Harbor (ibid.).

B. Abundance

Aerial surveys to estimate herring biomass have been conducted in the Kamishak, Southern, Eastern, and Outer districts. Peak estimates for 1981 through 1983 are shown in table 1. The estimates are compared to historic harvest levels, which are used as an indicator of healthy stocks. With the exception of the Eastern District in 1981 and 1982, all the estimates are below historic harvest levels. Samples from the Eastern District in 1981 and 1982 indicated that herring in the area from Aialik Bay to Day Harbor were mostly one and two years old (ADF&G 1982; Schroeder, pers. comm.). Young fish from PWS may use the area for rearing (ibid.). Samples from the Southern District in 1982 showed that the fish were mostly four to five years old (ADF&G 1982), and stocks in the Kamishak District in 1983 were mainly age three and four herring (ADF&G 1984a).

IV. PWS MANAGEMENT AREA

Boundary descriptions and a map of the PWS area are included in the herring commercial harvest narrative found elsewhere in this volume.

A. Distribution

Large numbers of herring are distributed throughout the PWS area. Significant spawning populations have been observed in the Bligh

Table 1. Peak Estimates of Herring Biomass in Tons From Aerial Surveys for Fishing Districts in Lower Cook Inlet, 1981-83

Districts	1981[a]	1982[b]	1983[c]	Historic Harvest Level[c]
Kamishak	4,220	4,835	4,500-5,000	8,000
Southern	1,100	1,382	120	2,000
Eastern	2,000	9,923	205	2,000
Outer	N.E.[d]	1,400	165	N.E.[d]

a ADF&G 1981.

b ADF&G 1982.

c ADF&G 1984a.

d N.E. = no estimate.

Island, Columbia Bay, Green Island, and Montague Island areas (ADF&G 1978).

B. Abundance

Aerial surveys to estimate herring biomass have been conducted in the Northern, General, Montague, and Eastern districts, where the sac roe fishery occurs. Peak estimates for each of the years from 1974 to 1984 (table 2) show that the biomass has fluctuated considerably in all districts. Aerial surveys, age analysis studies, and current harvest trends indicate that the herring stocks in the PWS area are above average, with about 80% of the 1984 stocks comprised of three- and four-year-olds (Fridgen, pers. comm.). A majority of the production during 1984 has come from the 1980 and 1981 year classes (ibid.). Three-year-old stocks contributed significantly to the fishery in 1983 for the first time in several years, indicating a positive recruitment trend for the near future (ADF&G 1984b).

Table 2. Peak Estimates of Herring Biomass in Metric Tons From Aerial Surveys for Fishing Districts in Prince William Sound, 1974-84

Year	Northern District	Montague District	Eastern District
1974	35,000	9,110	0[a]
1975	1,200	0[a]	0[a]
1976	7,830	70	90
1977	16,790	120	0[a]
1978	8,310	60	0[a]
1979	9,830	1,000	17,860
1980	24,550	20,400	260
1981	16,430	23,670	6,240
1982	26,100[b]	5,260	260
1983[c]	10,360	19,760	540
1984[d]	14,800	20,520	6,090

Source: ADF&G 1983a.

a Surveys flown, no herring schools observed.

b The Northern District became the Northern/General District in 1982 and following years.

c ADF&G 1983b.

d ADF&G 1984c.

REFERENCES

ADF&G. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. Juneau. 443 pp.

________. 1978. A fish and wildlife resource inventory of the Prince William Sound area. Vol. 2: Fisheries. Juneau. 241 pp.

________. 1981. Summary of the 1981 Cook Inlet herring fishery. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 4 pp.

________. 1982. Cook Inlet herring fishery. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Anchorage. 7 pp.

________. 1983a. Prince William Sound Area annual finfish management report 1982. Div. Commer. Fish., Cordova. 128 pp.

________. 1983b. Prince William Sound Area annual finfish management report. Div. Commer. Fish., Cordova. 135 pp.

________. 1984a. Lower Cook Inlet herring fishery. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 11 pp.

________. 1984b. Prince William Sound preliminary review of the 1983 herring fishery. Management rept. to the Alaska Board of Fisheries. Div. Commer. Fish, Cordova. 21 pp.

________. 1984c. Prince William Sound Area annual finfish management report. Div. Commer. Fish., Cordova. Unpubl.

Fridgen, P. 1984. Personal communication. Asst. Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Cordova.

Governor's Agency Advisory Committee on Leasing. 1981. A social, economic, and environmental analysis of a proposed oil and gas lease sale in Lower Cook Inlet. October 1981. 150 pp.

Macy, P.T., J.M. Wall, N.D. Lampsakis, and J.E. Mason. 1978. Resources of non-salmonoid pelagic fishes of the Gulf of Alaska and eastern Bering Sea. NOAA/NMFS/NWAFC, processed rept., Seattle, WA. 714 pp., data appendices, 329 pp. Cited in B.J. Rogers, M.E. Wangerin, K.J. Garrison, and D.E. Rogers, Epipelagic meroplankton, juvenile fish and forage fish: distribution and relative abundance in coastal waters near Yakutat. Interim rept. to OCSEAP. Vol. 17. Feb. 1983. NOAA, MMS. 658 pp.

Middleton, K.R., and K.A. Rowell. 1984. Upper Cook Inlet stock status report: a summary of commercial salmon, herring, and razor clam fisheries through 1982. ADF&G, Div. Commer. Fish. Informational leaflet in press.

Ruesch, P. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Soldotna.

________. 1982. Upper Cook Inlet herring management summary. Memo dated Oct. 8, 1982. ADF&G, Div. Commer. Fish., Soldotna. 2 pp.

Schroeder, T. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Pacific Ocean Perch Distribution and Abundance

I. REGIONWIDE INFORMATION

Information on the distribution of Pacific ocean perch in the Southcentral Region, as with other groundfish species, is derived from commercial fishery information and a limited number of surveys conducted by research and management agencies. Areas that have not been subject to commercial harvest and have not yet been surveyed may contain significant populations of Pacific ocean perch that remain undocumented.

Allowable biological catch and optimum yield estimates are currently made by three management areas of the Gulf of Alaska: Western (Shumagin), Chirikof-Kodiak (Central Gulf), and Yakutat-Southeastern (Eastern Gulf). In this narrative, distribution and abundance information will be discussed for the Eastern Gulf and Central Gulf together because both areas fall partially within the Southcentral Region covered in this guide. For a map of the management areas and boundary descriptions, see the narrative on the human use of groundfish that is found elsewhere in this volume.

A. Regional Distribution

In the May-August 1975 National Marine Fisheries Service (NMFS) surveys of the northeastern Gulf of Alaska from Yakutat Bay to Cape Cleare, highest Pacific ocean perch catch rates were in the outer shelf area both east and west of Middleton Island (Ronholt et al. 1976).

B. Areas Used Seasonally and for Life Functions

A concentration of Pacific ocean perch was noted by Lyubimova (1964) in waters southwest of Middleton Island. During fishing trials sponsored by the Alaska Department of Commerce and Economic Development in 1979, two fishermen also found large concentrations of perch south of Middleton Island in 270 m of water (ADCED 1979). Subsequent foreign fishing in this area, however, may have depleted this population (Morrison, pers. comm.). The approximate location of this concentration area is depicted on a 1:1,000,000-scale groundfish distribution map and may be found in the reference map series that supplements this text.

C. Factors Affecting Distribution

Pacific ocean perch are generally found in outer shelf and upper continental slope zones (Ronholt et al. 1977). Commercial quantities usually occur between 100 to 500 m (Quast 1972). Reeves (1972) noted that ocean perch occur in large concentrations around submarine canyons.

D. Movements Between Areas Used Seasonally and for Life Functions

Larval perch are planktonic, with their distribution largely controlled by ocean currents. In their first year, the juveniles become demersal and are found near the ocean bottom in areas 110 to 140 m deep (Carlson and Haight 1976, Buck et al. 1975). When they become sexually mature, they move into deeper waters (up to 320 to 370 m or deeper)(Buck et al. 1975).

Adults do not migrate long distances (Fadeev 1968, Chikuni 1975). Seasonal movements are largely between deep and shallow bottoms within a limited area (ibid.).

E. Population Size Estimation

Assessments of Pacific ocean perch stocks have been based primarily on changes in catch per unit effort (CPUE) in the trawl fishery (Ito 1982). Trends in relative abundance have also been identified through demersal resource assessment surveys periodically conducted in the Gulf of Alaska.

The accuracy of population assessments based on CPUE data is affected by the ability to correctly estimate effective fishing effort. Identifying a standard unit of effort in the Pacific ocean perch fishery has been difficult because of the multispecies and multigear nature of the fishery (ibid.). Rapid changes in fishing technology have also made it difficult to standardize measures of effort over the years (ibid.). Ito (1982) used cohort analysis techniques applied to catch at age data to calculate numbers of perch in the Gulf of Alaska and Bering Sea. This method does not rely on fishing effort statistics. Ito concluded that perch stocks had been more seriously depleted than previously estimated. Stocks in the Gulf of Alaska were estimated to have declined 94.5% during 1963-1976 (ibid.).

F. Regional Abundance

Prior to 1960, Pacific ocean perch stocks in the Gulf of Alaska were unexploited and probably at the level of maximum abundance. Quast (1972) estimated the total catchable biomass for the area off western North America at that time to be about 1.75×10^6 tons (1.58×10^6 metric tons), a high fraction of which was in the Gulf of Alaska (OCS Socioeconomic Studies Program 1980).

Perch are slow-growing and do not become sexually mature until around age seven. Adult perch form dense schools that are easily accessible to trawls (Quast 1972). These factors, combined with periodic extreme variations in year-class strength, made perch stocks particularly vulnerable to unregulated fishing (OCS Socioeconomic Studies Program 1980).

Intensive foreign fishing for perch began in the 1960's, and harvests exceeding the reproductive potential of the population continued for several years. Perch stocks in the Central Gulf may now be no higher than 5% of their virgin abundance (Ito 1982). The maximum sustainable yield for the Gulf of Alaska is estimated to be 125,000 to 150,000 metric tons, but catches now are far below that level (NPFMC 1983). Optimum yield from the Central Gulf (159°W to 147°W) is now set at 7,900 metric tons and for the Eastern Gulf (147°W to Dixon Entrance), at 875 metric tons (ibid.).

Quast (1972) predicted that decades may be required for even a moderate recovery of Pacific ocean perch stocks. Perch are frequently caught incidentally in the pollock trawl fishery conducted by foreign fleets in the Gulf of Alaska. This incidental catch may be large enough to prevent the recovery of depressed perch stocks (Blackburn et al. 1983).

The potential for recovery is lessened by the concurrent increase in pollock stocks. Juvenile perch and pollock occupy approximately the same trophic position; thus it is possible that competition with pollock will prevent perch stocks from recovering even if fishing pressure is released. Surveys of rockfish resources conducted in 1979 and 1981, however, suggest that there have been some increases in the relative abundance of Pacific ocean perch in recent years (Shippen and Stark 1982).

REFERENCES

ADCED. 1979. Cordova fish trials, March 1979. 5 pp.

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska-Bering Sea groundfish investigations. Commercial Fisheries Research and Development Act. Project No. 5-49-R-1. ADF&G. Prepared for NMFS, NOAA, Washington, DC. 85 pp.

Buck, E.H., W.H. Wilson, L.S. Lau, C. Liburd, and H.W. Searby. 1975. Kadyak, a background for living. Arctic Environmental Information and Data Center, Univ. AK, Anchorage. 326 pp.

Carlson, H.R., and R.E. Haight. 1976. Juvenile life of Pacific ocean perch, _Sebastes alutus_ in coastal fiords of Southeastern Alaska: their environment, growth, food habits, and schooling behavior. Trans. Am. Fish. Soc. 105:191-201.

Chikuni, S. 1975. Biological study on the population of the Pacific ocean perch in the North Pacific. Bull. Far Seas Fish. Res. Lab. 12:1-119. (In Japanese, English abstract.)

Fadeev, N.S. 1968. Migration of Pacific ocean perch. Proc. Pac. Sci. Res. Inst. of Fish. and Ocean. 65:170-177. (Transl. Series No. 1447, Fish. Res. Bd. Can.). 14 pp. Cited in Shippen and Stark 1982.

Ito, D.H. 1982. A cohort analysis of Pacific ocean perch stocks from the Gulf of Alaska and Bering Sea regions. USDC: NOAA, NMFS, NWAFC Processed Rept. 82-15. 157 pp.

Lyubimova, T.G. 1964. Biological characteristics of the school of Pacific rockfish (_Sebastes alutus_ Gilbert) in the Gulf of Alaska. Pages 208-216 _in_ P.A. Moiseev, ed. Soviet fisheries investigations in the northeastern Pacific, Part III. (Transl. Israel Prog. Sci. Transl., Jerusalem, 1968.)

NPFMC. 1983. Summary of Gulf of Alaska Groundfish Fishery Management Plan (through Amendment 12). Revised 3 May 1983. 21 pp.

OCS Socioeconomic Studies Program. 1980. Northern and western Gulf of Alaska petroleum development scenarios: commercial fishing industry analysis. Tech. Rept. No. 30, Appendix A. Prepared for BLM, Alaska OCS Office. 164 pp.

Quast, J.C. 1972. Reduction in stocks of the Pacific ocean perch, an important demersal fish off Alaska. Trans. Am. Fish. Soc. 101:64-74.

Reeves, J.E. 1972. Groundfish of the Gulf of Alaska. Pages 411-455 in D. Rosenberg, ed. A review of the oceanography and renewable resources of the northern Gulf of Alaska. Univ. Alaska, Inst. Mar. Sci., Rept. R72-23, Alaska Sea Grant Rept. 73-3. February 1972.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1976. An assessment of the demersal fish and invertebrate resources of the northeastern Gulf of Alaska, Yakutat Bay to Cape Cleare May-August 1975. NEGOA ann. rept. Processed rept. NMFS, NWAFC, Seattle, WA. 184 pp.

Ronholt, L., H.H. Shippen, and E.S. Brown. 1977. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976. A historical review. Vol. 3. Pages 62-955 in Environmental assessment of the Alaskan continental shelf. Final rept. of principal investigators. Vol. 2: Biological studies. USDC: NOAA, ERL, OCSEAP. June 1978.

Shippen, H., and J.W. Stark. 1982. Pacific ocean perch. Pages 147-168 in J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept. NOAA, NMFS, NWAFC, Seattle, WA.

Sablefish Distribution and Abundance

I. REGIONWIDE INFORMATION

Information on the distribution of sablefish in the Southcentral Region, as with other groundfish species, is derived from commercial fishery information and from a limited number of surveys conducted by the research and management agencies. Areas that have not been subject to commercial harvest and have not been surveyed may contain significant populations of sablefish remaining undocumented.

Optimum yield estimates are currently made by three INPFC regions of the Gulf of Alaska. Two of these regions, Chirikof-Kodiak (Central Gulf), and Yakutat-Southeastern (Eastern Gulf), fall partially within the Southcentral Habitat Management Region covered in this guide. For sablefish, the Eastern Gulf is further subdivided into West Yakutat (147°W to 140°W), East Yakutat (140°W to 137°W), Southeast Outside, and Southeast Inside districts. The West Yakutat District falls within the area covered in this guide. A map of the area is found in the groundfish Human Use narrative found elsewhere in this volume.

A. Regional Distribution

Sablefish are found throughout the Gulf of Alaska, with a band of high abundance stretching from the Shumagin Islands southeastward to Northern Queen Charlotte Sound (Low et al. 1976).

B. Areas Used Seasonally and For Life Functions

Juvenile sablefish (less than 340 mm in length) are caught in the commercial trawl shrimp fishery in Kachemak Bay (Blackburn 1983), indicating that Kachemak Bay is a sablefish rearing area. This area is illustrated on a 1:1,000,000-scale groundfish distribution map and may be found in the reference map series that supplements this text.

C. Factors Affecting Distribution

Sablefish occupy a wide range of depths, with pelagic eggs and larvae found in surface waters, juveniles from one to four years of age in surface and inshore waters down to 150 m, and adults from 150 m down to 1,200 m (Low et al. 1976).

In studies done in the Gulf of Alaska from 1979 to 1980, highest average density in the Kodiak area (154°W to 147°W) was in the 200 to 400 m depth zone and in the Yakutat (147°W to 137°W) area in the 600 to 800 m depth zone.

D. Movements Between Areas Used Seasonally and for Life Functions

Small fish inhabit shallow nearshore areas, moving to deep water in their third or fourth year. From there, a significant portion of the fish migrate to open ocean and move westward until they reach maturity (Bracken 1982).

Tagging studies indicate that many of the mature adult sablefish (larger than 60 cm) in the western and central Gulf of Alaska then migrate eastward toward the southeastern gulf. Bracken (1982) suggested that the southeastern gulf may be a major spawning area that draws sablefish from throughout the gulf.

E. Population Size Estimation

Maximum sustainable yield for sablefish is estimated using the general production model (Schaefer 1954, Pella and Tomlinson 1969, NPFMC 1978).

Until 1977, catch and effort statistics from the Japanese North Pacific longline fishery provided consistent information for assessing the condition of sablefish stocks in the Gulf of Alaska. In 1977, regulations affecting Japanese longliners were established that resulted in their catch per unit effort (CPUE) statistics no longer correctly representing trends in sablefish abundance (Balsiger 1982, Sasaki 1981). Catch per unit effort in the Japanese longline fishery is now calculated using information from the NMFS observer program. Longlines set at depths greater than 500 m are considered to be directed at sablefish and are used to calculate CPUE (Balsiger 1982).

Sablefish stock conditions are also assessed using information from longline surveys conducted jointly by the United States and Japan each year since 1978. These surveys result in an index of abundance which is the summation of the CPUE of the longline gear for each of several depth categories multiplied by the area of the fishing grounds that lie in those depth categories (ibid.).

F. Regional Abundance

Maximum sustainable yield (the largest catch which could be taken continuously from a stock - usually based on historic catch data) for sablefish in the Gulf of Alaska has been estimated to be 22,000 metric tons (NPFMC 1984). Catches now, however, are held well below that value. Catch per unit effort statistics indicate that sablefish abundance throughout the Gulf of Alaska and Bering Sea declined in the 1970's. The North Pacific Fishery Management Council (NPFMC) has set optimum yield (that harvest level which providing greatest overall benefit) for sablefish in the central gulf (159°W to 147°W) at 3,060 metric tons and for the West Yakutat area (147°W to 140°W) at 1,670 metric tons. This level is less than equilibrium yield (yield that would maintain stock at its current level over several years) and is thus intended to increase sablefish abundance in the gulf (ibid.).

Research survey data indicate that stock abundance of sablefish in the 100 to 1,000 depth zone increased by 22% in the Gulf of Alaska from 1979 to 1980 (Sasaki 1981). This increase was caused by the recruitment of juvenile sablefish with a mode of 50 cm fork length (1977 year class). It is hoped that, as these juvenile fish grow and reach catchable size, the allowable catch can gradually be raised from the present level (ibid.). However, because many (50%) of the female fish will not reach maturity until after age seven (1984 or later) there is some concern that continued harvest of that year class could affect the future reproductive potential of the population (Blackburn et al. 1983).

REFERENCES

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska-Bering Sea groundfish investigations. Commercial fisheries research and development act. Project No. 5-49-R-1. ADF&G. Prepared for NOAA, NMFS, Washington, DC. 85 pp.

Balsiger, J.W. 1982. Sablefish. Pages 64-87 in J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept. NWAFC, NMFS, NOAA, Seattle, WA. 198 pp.

Bracken, B.E. 1982. Sablefish (*Anoplopoma fimbria*) migration in the Gulf of Alaska based on gulf-wide tag recoveries, 1973-1981. ADF&G Informational Leaflet No. 199. 24 pp.

Low, L.L., G.K. Tanonaka, and H.H. Shippen. 1976. Sablefish of the northeastern Pacific Ocean and Bering Sea. Processed rept. USDC: NOAA, NMFS. 115 pp.

NPFMC. 1978. Fishery management plan for the Gulf of Alaska groundfish fishery during 1978. 220 pp.

________. 1984. Summary of Gulf of Alaska Groundfish Fishery Management Plan (through Amendment 12). Revised 16 January 1984. 21 pp.

Pella, J.J., and P.K. Tomlinson. 1969. A generalized stock production model. Bull. Inter-Am. Trop. Tuna Comm. 13:419-496.

Sasaki, T. 1981. Changes in relative population numbers and size composition of sablefish in the Aleutian Region and Gulf of Alaska, 1979 to 1981. (Document submitted to INPFC). 16 pp.

Schaefer, M.B. 1954. Some aspects of the dynamics of populations important to the management of the commercial marine fisheries. Inter-Am. Trop. Tuna Comm. Bull. 1(2):27-56.

Walleye Pollock Distribution and Abundance

I. REGIONWIDE INFORMATION

Information on the distribution of pollock in the Southcentral Region, as with other groundfish species, is derived from commercial fishery information and a limited number of surveys conducted by the management agencies. Areas that have not been subject to commercial harvest and have not yet been surveyed may contain significant populations of pollock that remain undocumented.

Allowable Biological Catch and Optimum Yield estimates are currently made by three regions of the Gulf of Alaska. Two of these regions, Chirikof-Kodiak (Central Gulf) and Yakutat-Southeastern (Eastern Gulf) fall partially within the Southcentral Region covered in this guide. A map of the area is found in the groundfish Human Use narrative found elsewhere in this volume.

A. Regional Distribution

Walleye pollock are found in the Gulf of Alaska and Bering Sea from surface waters to depths below 370 m, although most catches are between 50 and 300 m (Rogers et al. 1980).

About 91% of the Gulf of Alaska pollock biomass lies in the western gulf from approximately Prince William Sound to 170° west longitude. In a 1975 National Marine Fisheries Service (NMFS) survey of the northeast Gulf of Alaska from Yakutat Bay to Cape Cleare, highest catch rates (800 to 2300 kg/std.tow) occurred in the western area near Cape Cleare at the south end of Montague Island (Ronholt et al. 1976).

B. Areas used Seasonally and for Life Functions

A large concentration of pollock (possibly spawning) was found in April 1983 by a fisherman in the area southwest of Middleton Island (Blackburn 1983).

Large incidental catches of juvenile pollock in Kachemak Bay trawl fisheries indicate that Kachemak Bay may be a nursery and rearing area for pollock (Blackburn et al. 1983). These areas are illustrated on a 1:1,000,000-scale map of groundfish distribution and may be found in the reference map series that supplements this text.

C. Factors Affecting Distribution

Concentrations of adult walleye pollock in the Bering Sea are usually found in water temperatures between 2 and 4°C (Serobaba 1970). Spawning has been recorded in the Bering Sea at temperatures of from 1 to 3°C (Serobaba 1968).

Temperature is, however, probably not an important habitat requirement. Pollock consistently return to Shelikof Strait and spawn, though the temperature varies from 3.5 to 6.5°C (Blackburn, pers. comm.; NMFS 1983).

D. Movements Between Areas Used Seasonally and for Life Functions

In the Bering Sea, pollock follow a circular pattern of migration, moving inshore to the shallow (90 to 140 m) waters of the continental shelf to breed and feed in the spring (March) and moving to warmer, deeper areas of the shelf (160 to 300 m) in the winter (December-February)(Chang 1974). Hughes (1974) noted a similar movement of pollock in the Gulf of Alaska.

Pollock spawning concentrations appear in Shelikof Strait in early spring (March-April), and schools disperse to unknown locations after spawning (Alton and Deriso 1982).

E. Population Size Estimation

The results of NMFS bottom trawl surveys conducted during 1973-1977 were used to estimate the pollock biomass and its distribution in the Gulf of Alaska (ibid.). The resulting estimate of exploitable biomass is assumed to be virgin (unexploited) biomass, although Gulf of Alaska pollock were under some fishing pressure at the time the estimate was made (ibid.). Reliable estimates of biomass and maximum sustainable yield will probably be available only after many additional years of data on pollock abundance have been collected (ibid.).

F. Regional Abundance

Surveys conducted by the NMFS in 1973-1975 found pollock to be the dominant groundfish species in the Gulf of Alaska, making up 45% of the total fish catch (Gusey 1978). This is in marked contrast to its abundance in 1961, when trawl survey data demonstrated that pollock contributed only 5% of the total fish catch in the Gulf of Alaska (ibid.). This increase in pollock abundance appears to be related to the concurrent population decline of other heavily exploited groundfish species, especially Pacific ocean perch (OCS Socioeconomic Studies Program 1980). Juvenile pollock and Pacific ocean perch occupy approximately the same trophic position. Pollock are apparently acting as a replacement species, filling in the position formerly occupied by Pacific ocean perch (ibid.).

Pollock are a strongly cannibalistic species; young pollock may constitute over 50% of the stomach contents of pollock over 50 cm in length (Takahashi and Yamaguchi 1972). The intensity of cannibalism tends to be greatest when the adult population is large. Thus, large adult pollock populations feed heavily on juvenile pollock, reducing the numbers of the younger age classes. This pattern gives rise to periodic fluctuations in adult abundance, with peaks occurring approximately at intervals of 12 years (OCS Socioeconomic Studies Program 1980). Heavy commercial exploitation, however, tends to reduce these cycles. The fishery removes older age-groups, thus reducing cannibalism on juveniles. Increased recruitment and the eventual return of the adult biomass to preharvest levels results.

Catch data indicate that the exploitable biomass of pollock in the Central Gulf of Alaska was higher in 1979-1981 than in 1976-1979. Maximum sustainable yield for the Central Gulf has been estimated to be 95,2000 to 191,000 metric tons and for the Eastern Gulf

14,000 to 29,000 metric tons. This yield is estimated to be attainable with stocks at their present level of abundance. Because of current high abundance, optimum yield for the western (Shumagin area) and central gulf (Chirikof and Kodiak areas) combined has been set at 400,000 metric tons and for the Eastern Gulf (Yakutat and Southeastern areas) at 16,600 metric tons (NPFMC 1984).

The large pollock stocks in the Gulf of Alaska in 1978-1980 have been attributed to the relatively large 1975 and 1976 year classes (NPFMC 1983). Preliminary catch at age data for the 1982 fishery suggest that the 1977, 1978, and 1979 classes are of average abundance rather than weak, as first indicated by 1981 surveys (Stauffer 1983). Surveys conducted in 1982, however, also found few pollock smaller than 35 cm, suggesting that no strong year classes were recruiting to the 1983 spawning stock (NPFMC 1983). This may indicate a decline in the stocks available to fishermen in 1984 (Alaska Fishermans Journal 1983).

REFERENCES

Alaska Fisherman's Journal. 1983. Missing pollock off Shelikof. September 1983.

Alton, M.S., and R.B. Deriso. 1982. Pollock. Pages 1-63 _in_ J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept., USDC: NWAFC, NMFS, NOAA. Seattle, Wa. 198 pp.

Blackburn, J. 1983. Groundfish biologist, ADF&G. [Memorandum to distribution concerning domestic groundfish fishery activities April, 1983]. June 14, 1983. 1 p.

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska-Bering Sea groundfish investigations. Commercial Fisheries Research and Development Act. Proj. No. 5-49-R-1. ADF&G. Prepared for NOAA, NMFS, Washington, DC. 85 pp.

Chang, S. 1974. An evaluation of the eastern Bering Sea fishery for Alaska pollock (_Theragra chalcogramma_ Pallas): population dynamics. Univ. Wash. Dissert. 279 pp.

Gusey, W.F. 1978. The fish and wildlife resources of the Gulf of Alaska. Shell Oil Company, Environmental Affairs. 580 pp.

Hughes, S.E. 1974. Groundfish and crab resources in the Gulf of Alaska - based on International Pacific Halibut Commission trawl surveys, May 1961-March 1963. USDC: NOAA, NMFS. Data Rept. 96. Seattle, Wash.

NMFS. 1983. Cruise results. NOAA RV Miller Freeman and RV Chapman. Cruise MF83-01, Leg III and IV and CH83-02, Leg II. 18 pp.

NPFMC. 1983. Availability of pollock for commercial harvest in the central and western Gulf of Alaska in 1983. Gulf of Alaska groundfish plan maintenance team report, May 4, 1983. 21 pp.

_______. 1984. Summary of Gulf of Alaska Groundfish Fishery Management Plan (through Amendment 12). Revised 1/16/84. 21 pp.

OCS Socioeconomic Studies Program. 1980. Northern and western Gulf of Alaska petroleum development scenarios: commercial fishing industry analysis. Tech. Rept. No. 30, Appendix A. Prepared for BLM, Alaska OCS Office. 164 pp.

Rogers, B.J., M.E. Wangerin, K.J. Garrison, and D.E. Rogers. 1980. Epipelagic meroplankton, juvenile fish, and forage fish: distribution and relative abundance in coastal waters near Yakutat. RU-603. Pages 1-106 in Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Vol. 17: Biological studies. USDC: NOAA.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1976. An assessment of the demersal fish and invertebrate resources of the northeastern Gulf of Alaska, Yakutat Bay to Cape Cleare May-August 1975. NEGOA ann. rept. Processed rept. USDC: NOAA, NMFS, NWAFC, Seattle, WA. 184 pp.

Salveson, S.J., and M.S. Alton. 1976. Pollock (family Gadidae). Pages 369-391 in W.T. Pereyra, J.E. Reeves, and R.G. Bakkala, eds. Demersal fish and shellfish resources of the eastern Bering Sea in the base line year 1975. USDC: NOAA.

Serobaba, I.I. 1968. Spawning of the Alaska pollock, Theragra chalcogramma (Pallas), in the northeastern Bering Sea. Probl. Ichthyol. 8:789-798. Cited in Rogers et al. 1980.

_______. 1970. Distribution of walleye pollock Theragra chalcogramma (Pallas) in the eastern Bering Sea and prospects of its fishery. Pages 442-451 in P.A. Moisseev, ed. Soviet fisheries investigations in the northeastern Pacific, Part V. (Transl. Israel Prog. Sci. Transl., Jerusalem, 1972).

Stauffer, G.D. 1983. A review of the status report on the Alaska pollock in the Gulf of Alaska. Attachment I to: NPFMC 1983. Gulf of Alaska groundfish plan maintenance team report. Availability of pollock for commercial harvest in the central and western Gulf of Alaska in 1983. May 4, 1983. 2 pp.

Takahashi, Y., and H. Yamaguchi. 1972. Stock of the Alaskan pollock in the eastern Bering Sea. Bull. Jap. Soc. Sci. Fish. 38:418-419. Cited in Salveson and Alton 1976.

Yelloweye Rockfish Distribution and Abundance

I. REGIONWIDE INFORMATION

Information on the distribution of rockfish in the Southcentral Region, as with other groundfish species, is derived from commercial fishery information and a limited number of surveys conducted by the managerial agencies. Areas that have not been subject to commercial harvest and have not yet been surveyed may contain significant populations of rockfish that remain undocumented. Very little information is available concerning the distribution and abundance of rockfish in Prince William Sound (PWS) and Cook Inlet (see the rockfish Human Use narrative for a map of these areas). As a consequence, these topics will be discussed in this report at the regional level, rather than by management areas.

A. Regional Distribution

In the Southcentral Region, yelloweye rockfish are found in nearshore and offshore areas of PWS and the Outer Cook Inlet area (Morrison 1982, Rosenthal 1983).

B. Areas Used Seasonally and For Life Functions

The Outer and Eastern districts of the Lower Cook Inlet Management Area are the only two portions of Cook Inlet where commercial quantities of rockfish exist in the nearshore zone. Several isolated schools have also been found in the rocky kelp areas on the southeast side of Kachemak Bay near Seldovia, Port Graham, and English Bay (Blackburn et al. 1983).

In the PWS area, department index surveys have not been conducted; however, large numbers of rockfish have been taken in the newly developed domestic sablefish fishery in 270 to 370 m waters around Middleton Island and areas due south of Resurrection Bay (Morrison, pers. comm.). Areas where the domestic sablefish fishery occurs are mapped on a 1:1,000,000-scale groundfish human use map; however, exact locations of rockfish harvests within this fishery are not known. Known areas of rockfish concentration in the Southcentral Region are mapped on a 1:1,000,000-scale groundfish distribution map. Both maps are included in the reference map series that supplements this text.

C. Factors Affecting Distribution

Yelloweye rockfish are found in the commercial rockfish catch in Southeast Alaska at depths from 20 to 130 m, with the greatest number found at depths from 75 to 130 m (Rosenthal et al. 1982). Large numbers of rockfish are also caught in 270 to 370 m waters of PWS (Morrison, pers. comm.). They are found around steep cliffs, rocky reefs, offshore pinnacles, and boulder fields (Rosenthal et al. 1982, Rosenthal 1983, Carlson and Straty 1981).

D. Movements Between Areas Used Seasonally and for Life Functions

The average length of yelloweye rockfish in the commercial catch increases with the depth at which they are found (Rosenthal et al.

1982). This fact indicates that yelloweye move to progressively deeper areas as they grow (ibid.).

Adult nearshore rockfish do not undertake any extensive migrations, though evidence indicates that their depth distribution may change in the winter (Rosenthal et al. 1982).

E. Population Size Estimation

Few index surveys have been conducted on nearshore rockfish and the sporadic nature of the nearshore fishery makes the data on catch-per-unit data of limited use. Thus, estimates of population size for nearshore rockfish are difficult to attain. Some information on relative population size and trends in abundance, however, can be gained from the commercial and sport fisheries and from data on the average length of fish in the catch.

F. Regional Abundance

Rockfish stocks throughout the PWS area are considered to be at or near virgin biomass levels (Morrison 1982). Department index surveys have not been conducted on nearshore rockfish species in PWS; consequently information on status of these rockfish stocks is not available (ibid.). Some commercial catch sampling was done in 1984 on rockfish taken incidentally in the PWS sablefish fishery; however, these data have not yet been processed (Morrison, pers. comm.).

Stock status of rockfish along the outer coast of Cook Inlet appears to vary from one portion of this area to another (ibid.). The area that has received the greatest fishing pressure is Resurrection Bay and the northeast portions of Aialik Bay. Heavy fishing in this area has greatly reduced and in some cases eliminated localized rockfish populations (McHenry, pers. comm. to Morrison 1982).

Commercial fishing for rockfish in outer Cook Inlet has taken place since 1980 in the Nuka Bay-Pye Islands area. Commercial catch and ADF&G data indicate that the average length of many rockfish species in the catch from this area has declined slightly (Morrison 1982). Such a decline in length of the catch may be an early indication of overfishing, which may be removing large fish faster than they can be replaced by younger year classes.

REFERENCES

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska-Bering Sea groundfish investigations. Commercial Fisheries Research and Development Act. Proj. No. 5-49-R-1. ADF&G. Prepared for NMFS, NOAA, Washington, DC. 85 pp.

Carlson, H.R., and R.R. Straty. 1981. Habitat and nursery grounds of Pacific rockfish, Sebastes spp., in rocky coastal areas of Southeastern Alaska. Mar. Fish. Rev. 43:13-19.

Morrison, R. 1982. Groundfish investigations in the Cook Inlet, Prince William Sound portions of Region II. Prepared for NMFS, Seattle, WA. Draft copy. 47 pp.

Morrison, R. 1984. Personal communication. Central Region Groundfish Biologist, ADF&G, Div. Commer. Fish., Homer.

Rosenthal, R.J. 1983. Shallow water fish assemblages in the northeastern Gulf of Alaska: habitat evaluation, species composition, abundance, spatial distribution and trophic interaction. Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Vol. 17: Biological studies. USDC: NOAA, USDI, Minerals Management, OCSEAP. February 1983.

Rosenthal, R.J., L. Haldorson, L.J. Field, V.M. O'Connel, M.G. LaRiviere, J. Underwood, and M.C. Murphy. 1982. Inshore and shallow offshore bottomfish resources in the southeastern Gulf of Alaska. Prepared for ADF&G, Div. Commer. Fish. December 1982. 166 pp.

Shellfish

Dungeness Crab Distribution and Abundance

I. REGIONWIDE INFORMATION

Dungeness crabs are found throughout much of the Southcentral Region. The region is divided into two areas for management of the species: Lower Cook Inlet (LCI), and Prince William Sound (PWS). The boundaries of these management areas are mapped in the Dungeness crab Human Use narrative found elsewhere in this volume. Little is known about Dungeness crab in Upper Cook Inlet; therefore, the available information is included in the LCI Management Area narrative. Distribution and abundance information specific to the management areas is presented following the regional information.

A. Regional Distribution

Dungeness crabs inhabit bays, estuaries, and the open coast from the intertidal zone to depths of 90 m. The favored substrate is a sand or mud bottom. In LCI, Dungeness crabs are distributed south of Anchor Point, through Kamishak Bay, and along the Kenai Peninsula coast (ADF&G 1977, 1978b). Dungeness crabs in PWS are distributed throughout the shallow, nearshore waters of the Copper River/Bering River area and Orca Inlet. There is a sparsely scattered subpopulation in the deeper waters (up to 180 m) of Orca Bay and to a lesser extent in the remainder of PWS (Kimker, pers. comm.).

Male Dungeness crabs reach sexual maturity in two years and females in three years, corresponding to a carapace width (CW) of 110 to 140 mm for males and 100 mm for females (Mayer 1972). The minimum legal size for male Dungeness crab in the Southcentral commercial fisheries is 165 mm (6.5 inches) CW (ADF&G 1982).

B. Areas Used Seasonally and for Life Functions

A Dungeness crab distribution map at 1:1,000,000 scale has been produced to supplement the text of the Southcentral Guide. The categories of mapped information are 1) general distribution, 2) known concentration areas, and 3) known mating concentration areas.

C. Factors Affecting Distribution

Dungeness crab distribution is affected by various factors, including temperature and salinity. For detailed information see the Dungeness Crab Life History and Habitat Requirements narrative in volume 1.

D. Movements Between Areas Used Seasonally and for Life Functions

Adult Dungeness crabs migrate offshore during the winter and return to nearshore waters in the early spring and summer. Low temperatures and salinities in nearshore water in the winter may trigger the winter movement to deeper water (Mayer 1972).

E. Population Size Estimation

Estimates of Dungeness crab populations are difficult to obtain because of their high mobility and their habit of burying into sand. No biological assessment program for Dungeness crab is conducted by the ADF&G in LCI. In PWS, the ADF&G has conducted Dungeness crab studies sicne 1977 in Orca Inlet (Kimker, pers. comm.)

F. Regional Abundance

Detailed abundance information for Dungeness crab follows in the narratives for the LCI and PWS management areas.

II. LCI MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the Dungeness crab Human Use narrative found elsewhere in this volume.

A. Distribution

Dungeness crabs are distributed in LCI south of Anchor Point, and a major concentration of adults is found in the shallow, nearshore waters along the north shore of outer Kachemak Bay (Hamilton et al. 1977). Presently, little is known about Dungeness crab distribution in Upper Cook Inlet because fishermen have not developed gear capable of fishing north of Anchor Point or in the center of Cook Inlet. It is known that Dungeness crabs occur as far north as Kalgin Island during the summer. Observations of Dungeness crabs caught in gill nets are frequently reported by fishermen (Davis 1980).

Younger, smaller crabs are more abundant in inner Kachemak Bay. Throughout LCI, juvenile Dungeness crabs are usually associated with stands of eelgrass or attached algae (Hamilton et al. 1979). Reproductive concentrations in western Cook Inlet are found along the Kamishak Bay coast (Alaska OCS 1981). Spawning areas have not been identified in eastern Cook Inlet (Blackburn et al. 1980), and the timing of spawning has also not been documented (Hamilton et al. 1979). Tagging studies were conducted on Dungeness crab in Cook Inlet in 1978 and 1979 (Davis 1981). Tag returns from 1978 suggested a northward movement of crabs during August and September. Observations in 1979 indicated that Dungeness crab moved from southern Cook Inlet into central Cook Inlet through the summer and back towards the south in the fall.

Migration of Dungeness crabs within Kachemak Bay appears to be somewhat limited. Based on summer tagging operations, Dungeness crabs released just northeast of Homer Spit moved up the bay, whereas crabs released southwest of the spit (Barabara Point, Seldovia Bay) moved in a southwesterly direction (ADF&G 1977). The majority of the returns were located at release points, indicating no movement. These data, however, are limited and not conclusive. There also appears to be a seasonal movement of the Bluff Point stock, with crabs moving from south to north into the shallow waters off Bluff Point in spring and summer for molting and mating, then south into deeper waters in fall and winter.

Isolated bay stocks of Dungeness crab appear to be relatively stationary, apparently not migrating out of the bays (ibid.). Most of these bays, in cross-sectional profile, contain both a shallow shelf along the shoreline and a deep basin. The entire seasonal migration appears to occur within the bays, between the deep and shallow areas. In shallow bays, without deep basins for overwintering, Dungeness crabs may overwinter by burrowing into the bottom mud.

B. Abundance

Little work has been done estimating the abundance of Dungeness crab populations in LCI. Exploratory trawls done by the NMFS from 1950 through 1968 show low catches from 18 to 53 m depths, with very few crabs caught deeper than 53 m (Maturgo 1972). Sampling in these surveys, however, was not done in nearshore waters shallower than 18 m, where Dungeness crab may be more abundant.

Index pot surveys of Dungeness crab in the Bluff Point area have been hampered by the migratory patterns of the crabs there and the extreme tidal action and currents (Davis 1981). Dockside sampling during the commercial fishery showed the highest numbers of legal size males per pot in 1978, with an average of 15.4, declining in 1979 to 6.5 crabs per pot (Davis 1980).

III. PWS MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the Dungeness crab Human Use narrative found elsewhere in this volume.

A. Distribution

The major concentrations of Dungeness crab in PWS occur in Orca Inlet and Orca Bay (ADF&G 1978a; Kimker, pers. comm.). Offshore trawl surveys showed the greatest concentrations between Hinchinbrook and Kayak islands near the mouth of the Copper River Delta (Maturgo 1972).

B. Abundance

In-season surveys of Dungeness crab are conducted by the ADF&G in the Copper River/Bering River area (Kimker, pers. comm.). Exploratory otter trawls were conducted by the NMFS from 1950 through 1968 (ibid.). Data summarized over this 18-year period show the highest catches in the 18 to 53 m depth zone. Nearshore waters shallower than 18 m, however, were not sampled in this study.

The ADF&G has studied the population of Dungeness crab in Orca Inlet, near Cordova, and the results of index pot surveys from 1977 to 1982 are summarized in table 1. A decline in the abundance of crabs was noticed after the 1964 earthquake, which caused an uplift of 6-7 ft in Orca Inlet (Kimker 1982). This uplift resulted in a loss of habitat for Dungeness crab. The crab population stabilized by the early 1970's and began another decline in 1979. The average number of legal-size males per pot decreased from 27.8 in 1978 to .03 in 1982. This decline has been correlated with the arrival of sea otters in the area (ibid.). Studies by Garshelis (1983) indicated that sea otters were a major factor in the recent decline of Dungeness crabs in PWS. Studies in California have shown that sea otters can reduce the availability of their prey species (Johnson 1982).

Table 1. Results of the Orca Inlet Dungeness Crab Index Pot Surveys in the PWS Management Area, 1977-82

Year	Average No. Legal Males/Pot (Index Number)	Average No. Sublegal Males/Pot	Average No. Females/Pot	Total Average No. Crabs/Pot
1977	11.4	5.7	3.4	20.5
1978	27.8	2.5	3.0	33.3
1979	7.2	11.2	4.6	23.0
1980	3.0	3.0	0.5	6.5
1981	1.1	2.8	0.7	4.5
1982	0.03	1.9	0.7	2.7

Source: Kimker 1982.

REFERENCES

ADF&G, comp. 1978a. A fish and wildlife resource inventory of Prince William Sound area. Vol. 2: Fisheries. 241 pp.

ADF&G. 1978b. Alaska's fisheries atlas. Vol. 1. [R.F. McLean and K.J. Delaney, comps.] 40 pp. + maps.

________. 1977. A fish and wildlife resource inventory of the Cook Inlet - Kodiak areas. Vol. 2: Fisheries. 443 pp.

ADF&G. 1982. Commercial shellfish regulations of the Alaska Board of Fisheries. Div. Commer. Fish., Juneau. 110 pp.

Alaska OCS. 1981. Lower Cook Inlet - Shelikof Strait final environmental impact statement. Sale No. 60. Graphics. USDI: BLM.

Blackburn, J.E., K. Anderson, C.I. Hamilton, and S.J. Starr. 1980. Pelagic and demersal fish assessment in the Lower Cook Inlet estuary system. Pages 107-450 in Environmental assessment of the Alaskan continental shelf. Final reports of principal investigations. Vol. 17. Feb. 1983. NOAA/MMS. 658 pp.

Davis, A.S. 1980. Shellfish investigations in Lower Cook Inlet. Completion rept. for period July 1, 1976, to June 30, 1979. Project No. 5-38-R, Commercial Fisheries Research and Development Act, NMFS. 59 pp.

________. 1981. Dungeness crab of the Lower Cook Inlet area, 1979-1980 seasons. ADF&G Information Leaflet No. 192. Div. Commer. Fish., Homer. 25 pp.

Garshelis, D.L. 1983. Ecology of sea otters in Prince William Sound, Alaska. Univ. Minn., Ph.D. Thesis. 321 pp.

Hamilton, C.I., S.J. Starr, and L.L. Trasky. 1979. Recommendations for minimizing the impacts of hydrocarbon development on the fish, wildlife, and aquatic plant resources of Lower Cook Inlet. Vol. 2: Marine/coastal habitat management. ADF&G. 420 pp.

Johnson, A.M. 1982. Status of Alaska sea otter populations and developing conflicts with fisheries. Pages 293-299 *in* Trans. of the 47th North American Wildlife & Natural Resources Conf. Wildlife Mgmt. Inst., Washington, DC.

Kimker, A. 1982. Orca Inlet Dungeness crab survey. Prince William Sound Management Area Data Rept. 17. ADF&G, Div. Commer. Fish., Cordova. 10 pp.

________. 1984, 1985. Personal communication. Prince William Sound Shellfish Biologist, ADF&G, Div. Commer. Fish., Cordova.

Maturgo, Z.D. 1972. Exploratory fishing drags for demersal fish and shellfish - Gulf of Alaska. Shell Oil Co., Environmental Conservation Dept. Feb. 1972.

Mayer, D.L. 1972. Synopsis of biological data on the Dungeness crab *Cancer magister* (Dana 1852) with emphasis on the Gulf of Alaska. Pages 287-312 *in* D. Rosenberg, ed. A review of the oceanography and renewable resources of the northern Gulf of Alaska. IMS Rept. R72-23.

King Crab Distribution and Abundance

I. REGIONWIDE INFORMATION

King crabs are found in Cook Inlet south of Anchor Point and throughout the rest of the Southcentral Region. The region is divided into two areas for management of the species: Lower Cook Inlet (LCI) and Prince William Sound (PWS). The boundaries of these management areas are mapped in the king crab Human Use narrative found elsewhere in this volume. Distribution and abundance information specific to the two management areas is presented following the regional information.

A. Regional Distribution

Three species of king crab are present in the Southcentral Region, with red king crab (Paralithodes camtschatica) being the most common. Red king crab occurs in both LCI and PWS (ADF&G 1977, 1978). Brown or golden king crabs (Lithodes aquispina) usually occur in water deeper than 180 m, and a population is found in deeper waters in PWS (ADF&G 1978, Kimker, pers. comm.). Brown king crabs are also found in small concentrations in the Outer and Eastern districts of LCI (Kyle and Merritt, pers. comm). Blue king crab (Paralithodes platypus) occurs in localized areas in PWS (ibid.). Because red king crab is most abundant and is the target species in the commercial fishery, this narrative will emphasize red king crab.

Information on the age of king crabs at maturity is scanty. Red king crabs in the Gulf of Alaska have been estimated to mature sexually at five to seven years when carapace length is 100 to 139 mm for males and 90 to 119 mm for females (Gray & Powell 1966). Male king crabs are recruited into the commercial fishery at 145 to 163 mm carapace length (Davis 1983). The minimum legal size for king crab in the commercial fishery is given in carapace width (CW) as 178 mm (7 inches) except by emergency order in LCI, when the limit can be increased to 203 mm (8 inches) CW. The legal size for blue king crab in PWS is 150 mm (5.9 inches) CW (ADF&G 1982, 1983b) and for brown king crab is 178 mm (7 inches) CW (Kimker, pers. comm.).

B. Areas Used Seasonally and for Life Functions

A king crab distribution map at 1:1,000,000 scale has been produced for the Southcentral Guide and may be found in the reference map series that supplements this text. The mapped categories are 1) general distribution; red king crab, blue king crab, brown king crab, king crab (not specified), 2) known summer concentrations, 3) known mating areas, and 4) known historical concentrations.

C. Factors Affecting Distribution

The favored bottom habitat of king crab appears to be a mud or sand substrate with accumulations of organic debris (ADF&G 1978). King crabs have been found in depths to 360 m, although the commercial fishery is generally confined to depths of less than 180 m. Females and smaller males appear to be most abundant in intermediate depths. Juveniles are most abundant in inshore waters as shallow as 10 m, although they have been found to depths of 100 m (Powell and Reynolds 1965). Juveniles live solitarily on rock substrates until they are two to three years old. (For more details of criteria affecting distribution see the King Crab Life History and Habitat Requirements narrative in volume 1.)

D. Movements Between Areas Used Seasonally and for Life Functions

General information on king crab migration is discussed in the Life History and Habitat Requirements narrative in volume 1. More detailed information follows in the narratives on the Cook Inlet and PWS management areas.

E. Population Size Estimation

Crab abundance has been estimated by trawl surveys, mark-recapture experiments, and index pot surveys. Otter trawl surveys usually use standardized tows within a survey, but comparing catch rates between surveys may be difficult. The sampling design may plan tows at depth intervals or may use predetermined locations by grid coordinates. The sizes and species captured by trawls are influenced by the mesh size, bottom type, and speed of tow.

Population estimates have been made for legal-size male crabs at the start of the commercial fishing season. These estimates have been made by applying tag return information to the Peterson mark-recapture formula. Estimates are usually given with a 95% confidence interval. The accuracy is dependent on the tagging method used and how well tags are returned.

The ADF&G used trawl survey estimates for two years, but currently the index pot survey is used exclusively to estimate the relative abundance of legal-size male crabs (Kyle and Merritt, pers. comm.). Standard pots are fished on systematically selected sampling locations for a period of 24 hours. The index number of legal-size male crabs per pot is compared to the number harvested in the fishery for an abundance estimate (Davis 1980).

F. Regional Abundance

Detailed information on king crab follows in the narratives on the LCI and PWS management areas.

II. LOWER COOK INLET MANAGEMENT AREA

A map of this area and a description of boundaries are provided in the king crab Human Use narrative found elsewhere in this volume.

A. Distribution

King crabs are common throughout LCI south of Anchor Point. Areas of abundance vary with the time of year because Cook Inlet king crabs undergo seasonal migrations. Observations of the commercial fishery show that mature male and female king crabs travel in segregated but not widely separated groups, except during the spawning season (Powell and Reynolds 1965).

During late winter and early spring, adult male crabs move from the depths to shallow water and appear to use the valleys or depressions in the ocean floor as travel routes. This movement is termed the "spawning migration" because it is correlated with breeding, which is known to occur in shallower water during March, April, and early May. The direction of the spawning migration depends upon the location of the shallow areas and the distance upon bottom configurations of each particular area involved (ibid.).

The inshore migration of Kachemak Bay king crabs begins in late December, peaks in early March, and extends through May. Migration of females may be slightly later (February to May). Migration of king crabs into Kamishak Bay begins in February. Mating and release of larvae occur in the nearshore areas. Large numbers of king crabs spawn in outer Kachemak Bay and around Augustine Island in Kamishak Bay in waters 18 to 85 m deep. In Kachemak Bay, spawning begins in February, peaks in April, and continues through May. Spawning in Kamishak Bay may be slightly later. The Kamishak Bay stock and the Kachemak Bay stock may be discrete populations. No common wintering area is known, and there is probably no mixing in the postlarval stages (Kyle, Merritt, and Kimker, pers. comm.). Offshore winter migration begins in August and continues through November (ADF&G 1977).

Juvenile king crabs appear to be quite abundant in shallow, nearshore water in the Gulf of Alaska (Eldridge 1972). Young crabs that have settled to the seabed begin their existence as solitary individuals living under rocks and debris. In their second and third year of life, crabs begin to congregate and move actively. After reaching maturity in five to seven years, crabs are believed to extend their range and begin an annual cycle of movements typical of the adult (Powell and Reynolds 1965).

Areas used by juvenile king crabs are not as well known as the areas utilized by the adults. The Bluff-Anchor Point area is a major nursery for juvenile king crabs in LCI. Juveniles are also common at the mouth of Iniskin Bay, at Spring Point (Chinitna Bay), Koyuktlik Bay Lagoon (Dog Fish Lagoon), and along the south shore of Kachemak Bay (Hamilton et al. 1979). Juvenile king crabs may be, however, common throughout the lower inlet in any area with a boulder field in the lower intertidal or subtidal zone. Although juvenile king crabs remain solitary for the first two years of life, two-to-three-year-old and older king crabs are known to aggregate at various times of the year into "pods." These pods consist of a few to several thousand individuals piled upon one another. Pods have been observed in the bays along the southern shoreline of Kachemak Bay but may occur elsewhere as well (ibid.).

King crab larvae are abundant in outer Kachemak Bay and Kamishak Bay. The larvae, after being released by the female, remain planktonic, drifting with the tides and currents for 40 to 60 days before settling to the bottom (Hamilton et al. 1979). A distribution study of king crab larvae in Kachemak Bay indicated that outer Kachemak Bay was a major release area because of the high abundance of larvae in this area (Haynes 1983). Larvae appeared in other parts of Kachemak Bay, but they were less abundant.

After two months in the plankton, the larvae settle. Outer Kachemak Bay and Iliamna Bay are major spawning and settling areas for king crab (Science Applications Inc. 1977). Sundberg and Clausen (1977) sampled postlarval king crabs in Kachemak Bay, and they found crabs only in samples taken from the rocky perimeter of the bay. Largest catches were in the Anchor Point to Bluff Point region. Diamond Gulch to Mutnaia Gulch had the highest abundance, and Peterson Point, Glacier Spit, and Eldred Passage had lesser concentrations of newly settled crabs. The samples indicated that postlarval king crabs live on hard substrates coarser than gravel and may be associated with certain types of epifaunal cover.

B. Abundance

The NMFS conducted otter trawl surveys in LCI from 1950 through 1968 in depths from 18 to 163 m (Maturgo 1972). Data summarized from the 18 years show that the CPUE was highest in the 127 to 163 m depth zone, but the sampling was not extensive. The ADF&G has conducted an index sampling program to estimate the population of legal-size males in the Southern District, which includes Kachemak Bay, and in the Kamishak District, which includes the Kamishak Bay area (tables 1 and 2). Data from the ADF&G crab index program conducted from 1974 through 1982 show a reduced abundance of legal-size males in the Southern District in 1982 (ADF&G 1983a). The average catch per pot of legal males was 0.43 crabs in 1982, whereas the previous year's catch averaged 2.2 crabs. The 1984 Southern District index showed an average of 1.8 legal males per pot, suggesting that the king crab population in Kachemak Bay may be rebuilding, due in part to the recent commercial fishery closures (Kyle and Merritt, pers. comm.). The 1984 Kamishak District index indicated an average of 0.4 legal male king crabs per pot, suggesting that the population in Kamishak Bay is still repressed (ibid.). In both districts, the estimated number of crabs was highest in 1975 and has declined since then.

III. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the king crab Human Use narrative found elsewhere in this volume.

A. Distribution

Little information is available for king crab distribution and migrations in PWS. Populations are found in scattered locations throughout the sound (ADF&G 1978). Brown king crabs are the most abundant species and are found in much of the water deeper than 275 m in central and western PWS (Kimker, pers. comm.). Blue king crabs are located primarily in the Port Wells and College Fiord area (ADF&G 1978).

B. Abundance

Little information is available on the abundance of king crabs in the PWS area, but king crab populations are small in the northeast

Table 1. Population Estimates of Legal-Size Male King Crabs at the Start of Season in the Southern District of Lower Cook Inlet, 1974-81

Year	Estimated No. of Crabs (Millions)	Estimated No. of Pounds (Millions)
1974	.33	2.55
1975	.40	3.26
1976	.21	1.69
1977	.19	1.34
1978	.19	1.26
1979	.31	2.10
1980	.14	0.92
1981	.08	.53

Source: Based on Peterson mark-recapture experiments from August through December (Davis 1982). No fishery has occurred since 1981, making estimates from recapture data impossible to obtain.

Table 2. Population Estimates of Legal-Size Male King Crabs at the Start of Season in the Kamishak District of Lower Cook Inlet, 1975-82

		Pounds (Millions)	
Year	Estimated No. of Crabs (Millions)	Estimate	95% Confidence Interval
1975	2.32	18.59	15.7 - 21.5
1976	.95	7.61	7.1 - 8.1
1977	.52	4.34	3.7 - 5.0
1978	.28	2.03	1.7 - 2.3
1979	.23	1.51	1.3 - 1.7
1980	.79	5.40	4.6 - 6.2
1981	.69	4.96	4.4 - 5.6
1982	.32	2.30	1.9 - 2.7

Source: Based on Peterson mark-recapture experiments (Davis 1983).

Gulf of Alaska (Eldridge 1972). The NMFS conducted otter trawl surveys in PWS from 1950 through 1968 in depths from 18 to 730 m (Maturgo 1972). Data summarized from the 18 years show that the CPUE was highest in the 127-163 m depth zone, but the sampling in the area was not extensive.

The abundance of red king crabs in the Orca Bay-Hinchinbrook entrance portion of the management area has been so low that the commercial fishery has been closed since the 1982-1983 season (ADF&G 1983b). The ADF&G currently has no way of empirically assessing prerecruit abundance; however, there has been no indication from fishermen that they have been handling significant numbers of prerecruits. Analysis of 1982-1983 commercial catch samples of brown king crab shows a small proportion of the legal-size crabs near minimum size of 150 mm for both new shell and old shell males. This indicates that the brown king crab recruitment was relatively poor in 1982 (ibid.).

Both red and blue king crab catches have decreased 50% from the 1982-1983 harvest levels because of poor recruitment (Kimker 1984). It is not known whether this poor recruitment is a function of natural population fluctuations or perhaps indicative of a declining population, as may be the case with the blue king crab. Two factors may have adversely affected the blue king crab: it is a geographically isolated small population, which makes it very susceptible to environmental changes that may affect larval and postlarval survival, and prior to 1978 many prerecruit males were commercially harvested because of a misinterpretation of the minimum legal size. This harvest removed males that were essential to the reproductive segment of the population (ibid.).

REFERENCES

ADF&G. 1982. Commercial shellfish regulations of the Alaska Board of Fisheries. Div. Commer. Fish., Juneau. 110 pp.

________. 1983a. Lower Cook Inlet shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 22 pp.

________. 1983b. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 39 pp.

ADF&G, comp. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. Juneau. 443 pp.

________. 1978. A fish and wildlife resource inventory of the Prince William Sound area. Vol. 2: Fisheries. Juneau. 241 pp.

Davis, A.S. 1983. Studies of king and Tanner crab in Lower Cook Inlet during 1982. Lower Cook Inlet Data Rept 83-5. ADF&G, Div. Commer. Fish., Homer. 39 pp.

________. 1982. King and Tanner crab studies - Cook Inlet. Project No. 5-44-5, Commercial Fisheries Research and Development Act. Completion rept. for period July 1, 1979, to June 30, 1981. NMFS. 45 pp.

________. 1980. Shellfish investigations in Lower Cook Inlet. Project No. 5-38-R, Commercial Fisheries Research and Development Act. Completion rept. for period July 1, 1976, to June 30, 1979. NMFS. 59 pp.

Eldridge, P. 1972. The king crab fisheries in the Gulf of Alaska. Pages 211-216 in D.H. Rosenberg, ed. A review of the oceanography and renewable resources of the northern Gulf of Alaska. IMS Rept. R72-23, Fairbanks, Ak.

Gray, G.W., and G.C. Powell. 1966. Sex ratios and distribution of spawning king crabs in Alitak Bay, Kodiak Island, Alaska (Decapoda Anomura, Lithodidae). Crustaceana 10:303-309.

Hamilton, C.I., S.J. Starr, and L.L. Trasky. 1979. Recommendations for minimizing the impacts of hydrocarbon development on the fish, wildlife, and aquatic plant resources of Lower Cook Inlet. Vol. 2: Marine/coastal habitat management. ADF&G. 420 pp.

Haynes, E. 1983. Distribution and abundance of larvae of king crab Paralithodes camtschatica, and Pandalid shrimp in the Kachemak Bay area, Alaska, 1972 and 1976. NOAA Tech. Rept. NMFS SSRF - 765. 64 pp.

Kimker, A. 1984, 1985. Personal communication. Prince William Sound Shellfish Biologist, ADF&G, Div. Commer. Fish., Cordova.

________. 1984. Shellfish report to the Alaska Board of Fisheries. PWS Area Management Rept. 84-5. ADF&G, Div. Commer. Fish., Cordova. 54 pp.

Kyle, S. 1984. Personal communication. Asst. Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Maturgo, Z.D. 1972. Exploratory fishing drags for demersal fish and shellfish - Gulf of Alaska. Shell Oil Co., Environmental Conservation Dept. Feb. 1972.

Merritt, M. 1984. Personal communication. Lower Cook Inlet Area Research Biologist, ADF&G, Div. Commer. Fish., Homer.

Powell, G.C., and R.E. Reynolds. 1965. Movements of tagged king crabs Paralithodes camtschatica (Tilesius) in the Kodiak Island - Lower Cook Inlet Region of Alaska, 1954-1963. Informational Leaflet No. 55, ADF&G, Kodiak. 10 pp.

Science Applications, Inc. 1977. Interim Lower Cook Inlet Synthesis Report. Prepared under contract to OCSEAP. December 1977. 169 pp.

Sundberg, K.A., and D. Clausen. 1977. Post-larval king crab (*Paralithodes camtschatica*) distribution and abundance in Kachemak Bay, *Lower Cook Inlet, Alaska*, 1976. Vol. 5 *in* L.L. Trasky, L.B. Flagg, and D.C. Burbank, eds. *Environmental studies of Kachemak Bay and Lower Cook Inlet*. ADF&G, MCHM, Anchorage. 36 pp.

Tanner Crab Distribution and Abundance

I. REGIONWIDE INFORMATION

Tanner crabs are found in Cook Inlet south of Anchor Point and throughout the rest of the Southcentral Region. The region is divided into two areas for management of the species: Lower Cook Inlet (LCI) and Prince William Sound (PWS). The boundaries of these management areas are mapped in the Tanner crab Human Use narrative found elsewhere in this volume. Distribution and abundance information specific to the two management areas is presented following the regional information.

A. Regional Distribution

Three species of Tanner crabs occur in the Gulf of Alaska, *Chionoecetes bairdi*, *C. tanneri*, and *C. angulatus* (NPFMC 1978). *C. bairdi* is the most common crab in the area (Ronholt et al. 1977), and since it is also the target species of the commercial fishery, this discussion will emphasize *C. bairdi*. Tanner crabs are distributed widely throughout Cook Inlet south of Anchor Point, around the Kenai Peninsula, and in PWS. Tanner crabs are found from the littoral zone to depths of 550 m and generally occupy waters deeper than 90 m (ADF&G 1977 and 1978).

The age of Tanner crabs is difficult to assess. Studies in Kodiak, PWS, and the northern Gulf of Alaska have shown an average size at sexual maturity for males of 110 to 115 mm and for females of 83 mm carapace width (CW)(Donaldson et al. 1980). A proposed growth/age relationship predicts that females molt to maturity at about age five, whereas males become mature at about six years of age. Recruitment to the fishery occurs at seven to eight years for males (ibid.). The minimum legal size for male Tanner crab in Cook Inlet is 140 mm (5.5 inches) and in PWS is 135 mm (5.3 inches) CW (ADF&G 1982).

B. Areas Used Seasonally and for Life Functions

A Tanner crab distribution map at 1:1,000,000 scale has been produced for the Southcentral Guide. The categories of mapped information are 1) general distribution, 2) known concentrations, 3) known mating concentrations, and 4) known rearing concentrations.

C. Factors Affecting Distribution

Many factors affect the distribution of adult Tanner crabs, including low salinity and high temperatures. For more detailed information see the Tanner Crab Life History and Habitat Requirements section in volume 1.

D. Movements Between Areas Used Seasonally and for Life Functions

Migratory movements of Tanner crabs have not been well studied. Tanner crab migrations are more local than those observed for king crab (Kyle, pers. comm.). Tanner crabs appear to migrate seasonally, moving into deeper water in the fall and winter and into shallower water, for molt and spawning, in spring and summer

(ADF&G 1977). Depth preferences in the Gulf of Alaska have not been reported, but on the Aleutian Shelf, Tanner crabs are found at depths of 50 to 130 m during their reproductive period (Science Applications Inc. 1980). Tanner crabs migrate into Cook Inlet from March through September, with the peak of spawning occurring from May to June (Kyle and Merritt, pers. comm.).

E. Population Size Estimation

Crab abundance can be estimated by catch per unit effort of trawl surveys. Otter trawl surveys generally use standardized tows within a survey, but comparing catch rates between surveys may be difficult. The sampling design may plan tows at depth intervals or may use predetermined locations by grid coordinates. The sizes and species captured by trawls are influenced by the mesh size, bottom type, and speed of tow. Tanner crab biomass estimates from the NMFS surveys reported in the following sections should be considered minimal because of the inability of the otter trawl to capture larger male crabs at the towing speed used (Ronholt et al. 1977). Trawl surveys for Tanner crab are not conducted in LCI.

Population estimates have been made for legal-size male crabs at the start of the commercial fishing season. These estimates have been made by applying tag return information to the Peterson mark-recapture formula. Estimates are usually given with a 95% confidence interval. The accuracy is dependent on the tagging method used and how well tags are returned.

Another method for estimating relative abundance of legal-size male crabs is the index pot survey used by the ADF&G (Davis 1980). Standard pots are fished on systematically selected sampling locations for a period of 24 hours. The index number of legal-size male crabs per pot is compared to the number harvested in the fishery for an index of relative abundance.

F. Regional Abundance

Detailed abundance information for Tanner crab follows in the narratives for LCI and PWS management areas.

II. LOWER COOK INLET MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the Tanner crab Human Use narrative found elsewhere in this volume.

A. Distribution

Tanner crab, Chionoecetes bairdi, is distributed throughout Cook Inlet south of Anchor Point, around the Kenai Peninsula to the south and west, and in Kamishak Bay. Tanner crabs are found from the littoral zone to 550 m. Based on exploratory trawls by the NMFS, adult Tanner crabs appear to be most abundant in the deepwater region midway between Augustine Island and the Barren Islands (ADF&G 1977).

Concentrations of juveniles have been found in several areas. Blackburn et al. (1980) report concentrations near Cape Douglas and Iniskin Bay, and Paul (1982) reports a nursery in Kamishak Bay. Early benthic stages of Tanner crab have been mainly found at depths below 50 m in Cook Inlet and were most abundant at stations 150 m and 166 m deep (ibid.). Paul reports an absence of Tanner crabs of less than 20 mm CW in Kachemak Bay.

Tanner crab larvae appear to be widespread throughout LCI and are most abundant in outer Kachemak Bay (ibid.). Within Kachemak Bay, Tanner crab larvae are most abundant from late May through mid June, with the area of greatest abundance extending due east to Homer Spit from a point due south of Anchor Point (ADF&G 1977). Inner Kachemak Bay does not appear to be a major nursery area. Spawning areas of Tanner crab in Cook Inlet are not known (Blackburn et al. 1980).

B. Abundance

Exploratory otter trawl surveys conducted by the NMFS from depths of 18 to 730 m are summarized by Maturgo (1972) for the years from 1950 through 1968. These surveys found that the CPUE was highest in the 91 to 126 m depth zone, with the next highest catch rates from 127 to 163 m.

The population of legal-size male Tanner crabs has been estimated for the Southern District of Cook Inlet, which includes Kachemak Bay, using mark-recapture experiments (table 1). Tag recoveries ranged from 29 to 55% during the years studied (Davis 1983). The estimates indicate that the population peaked in 1977, with over 2 million legal-size males, and declined to 690,000 in 1982.

III. PRINCE WILLIAM SOUND MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the Tanner crab Human Use narrative found elsewhere in this volume.

A. Distribution

Tanner crabs are found throughout PWS at all depths except in areas of rocky substrate. The heaviest concentrations of legal-size males, 135 mm CW or larger, are found in Orca Bay, Hinchinbrook Entrance, the 180 m trench (100 fathom) east of Montague Island, Montague Strait, and the western side of Kayak Island (Kimker 1983). ADF&G surveys have shown Hinchinbrook Entrance and Orca bays to be important mating and rearing habitat (Kimker, pers. comm.).

Tagging studies conducted by the ADF&G show that crabs in the Northern, Hinchinbrook, and Western districts are closely related to each other (ibid.). Tag recovery shows no interchange between the Eastern District and the other districts. It is possibly that Eastern District crabs originate as larvae from the waters of Southeast Alaska, perhaps in the bays adjacent to Cross Sound and Icy Strait, where sexually mature male and female Tanners have been identified. Since larval Tanners can stay in the water column for up to six months, it is quite likely then that unusual physical environmental phenomena such as storms or changes in water temperature may result in situations whereby in some years larval Tanners may settle out at the Cape St. Elias gyre, and in other years may settle elsewhere or not survive at all while traversing the 250 to 300 mi distance from Southeast Alaska (ibid.).

Table 1. Population Estimates of Legal-Size Male Tanner Crabs at the Start of Season in the Southern District of LCI, 1976-82

Year	Estimated No. of Crabs (Millions)	Pounds (Millions) Estimate	Pounds (Millions) 95% Confidence Interval
1976	1.32	3.69	3.4 - 4.0
1977	2.30	6.09	5.3 - 6.9
1978	1.63	4.32	3.8 - 4.9
1979	1.49	3.89	3.2 - 4.6
1980	.78	2.14	1.9 - 2.4
1981	.51	1.27	1.1 - 1.4
1982	.69	1.69	1.4 - 1.9

Source: Based on Peterson mark-recapture experiments (Davis 1983).

B. Abundance

Exploratory otter trawl surveys conducted by the NMFS from depths of 18 to 739 m from 1950 through 1968 are summarized by Maturgo (1972). These surveys found that CPUE was high in depths from 90 to 272 m and was highest in the 237 to 272 m depth zone. Ronholt et al. (1977) found the highest densities of Tanner crab in the Gulf of Alaska on the upper continental slopes (200 to 400 m) and, in particular, in the area south of the Copper River Delta, where catch rates averaged 215 kg/hr. Ronholt et al. (1976) reported catches from the Montague Island to Kayak Island area as averaging 127 kg/hr for 1 to 100 m depths, 110 kg/hr for 101 to 200 m depths, and 218 kg/hr for 201 to 400 m depths.

Annual surveys by the ADF&G have shown a continued decline in the abundance and distribution of all segments of the PWS Tanner crab population in recent years. The continued decline in the Sound itself is due to overfishing, and environmental phenomena may be responsible for the decline in the Gulf of Alaska. Data show that 1984 recruitment will be at a historical low (Kimker 1984).

REFERENCES

ADF&G. 1982. Commercial shellfish regulations of the Alaska Board of Fisheries. Div. Commer. Fish., Juneau. 110 pp.

ADF&G, comp. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. Juneau. 443 pp.

________. 1978. A fish and wildlife resource inventory of the PWS area. Vol. 2: Fisheries. Juneau. 241 pp.

Blackburn, J.E., K. Anderson, C.I. Hamilton, and S.J. Starr. 1980. Pelagic and demersal fish assessment in the lower Cook Inlet estuary system. Pages 107-450 In Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Vol 17. Feb. 1983. NOAA/MMS. 658 pp.

Davis, A.S. 1980. Shellfish investigations in LCI. Completion rept. for period July 1, 1976, to June 30, 1979. Project No. 5-38-R, Commercial Fisheries Research and Development Act, NMFS, Washington, DC. 59 pp.

________. 1983. Studies of king and Tanner crab in LCI during 1982. LCI Data Rept. 83-5. ADF&G, Div. Commer. Fish., Homer. 39 pp.

Donaldson, W.E., J.R. Hilsinger, and R.T. Cooney. 1980. Growth, age & size at maturity of Tanner crab, Chionoecetes bairdi, in the northern Gulf of Alaska. ADF&G Informational Leaflet No. 185. 52 pp.

Kimker, A. 1983. Tanner crab tagging and index survey. PWS Management Area Data Rept. 83-5. ADF&G, Div. Commer. Fish., Cordova. 35 pp.

________. 1984. Shellfish report to the Alaska Board of Fisheries. PWS Management Area Data Rept. 84-5. ADF&G, Div. Commer. Fish., Cordova. 54 pp.

________. 1984. Personal communications. PWS Shellfish Biologist, ADF&G, Div. Commer. Fish., Cordova.

Maturgo, Z.D. 1972. Exploratory fishing drags for demersal fish and shellfish - Gulf of Alaska. Shell Oil Co., Environmental Conservation Dept. Feb. 1972.

NPFMC 1978. Fishery management plan for the commercial Tanner crab fishery off the coast of Alaska (Final). Anchorage.

Paul, J.M. 1982. Distribution of juvenile Chionoecetes bairdi in Cook Inlet. Pages 175-184 In Proceedings of the international symposium on the genus Chionoecetes. May 3-6, 1982, Anchorage, Ak. Alaska Sea Grant Rept. 82-10.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1977. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976. A historical review. Vol. 3. Pages 624-955 in Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Vol. 2: Biological studies. USDC: NOAA, ERL, OCSEAP. 1978.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1976. An assessment of the demersal fish and invertebrate resources of the northeastern Gulf of Alaska, Yakutat Bay to Cape Cleare, May-August 1975. NEGOA ann. rept. NOAA/NWAFC processed rept. Seattle, Wa. 184 pp.

Science Applications, Inc. 1980. Environmental assessment of the Alaskan Continental Shelf. Northeast Gulf of Alaska interim synthesis rept. USDC: NOAA, ERL. July 1980.

Razor Clam Distribution and Abundance

I. REGIONWIDE INFORMATION

In the Southcentral Region, razor clams are found on beaches of both Cook Inlet and Prince William Sound (PWS). In this narrative, regionwide distribution information is followed by distribution and abundance information specific to Cook Inlet and Prince William Sound.

A. Regional Distribution

In the Southcentral Region, razor clams are found on surf-swept sandy beaches of PWS and Cook Inlet.

B. Areas Used Seasonally and for Life Functions

A series of reference maps at 1:250,000 scale for razor clam distribution have been prepared for the Southcentral guide. The mapped category is known concentrations and depicts areas where concentrations of razor clams have been observed. These maps may be found in the reference map series that supplements this text.

C. Factors Affecting Distribution

Razor clams inhabit open beaches consisting of fine or coarse sand with some glacial silt and/or gravel (Amos 1966). (For more details of factors affecting distribution see the Razor Clam Life History and Habitat Requirements narrative in volume 1.)

D. Movements Between Areas Used Seasonally and for Life Functions

Clam veligers are dependent upon water currents to carry them to desirable habitat (McLean and Delaney 1978).

Young razor clams up to 10 mm (valve length) are capable of voluntary lateral movement along the beach surface to about 60 cm (Nickerson 1975). Large razor clams are believed to be incapable of voluntary lateral movement, though relocations may occur as a consequence of rapidly shifting substrate or washout (ibid.). Razor clams are, however, capable of very rapid vertical movements (several feet per minute).

E. Population Size Estimation

In Cook Inlet and PWS, the ADF&G carries out regular sampling trips to test clams for paralytic shellfish poisoning on beaches approved for commercial harvest of clams to be used for human consumption. Aside from these sampling trips, very little is done to monitor the razor clam population on commercially harvested beaches. The razor clam populations on the east side of Cook Inlet, on beaches designated for recreational harvest only, have been more extensively monitored. Samples of clams from the east-side beaches are periodically dug to determine the age composition of the population and to assess the relative survival of different year classes. Research associated with population estimation of even the east-side beaches, however, has been very limited (Nelson 1982).

Studies from the Cook Inlet beaches indicate that success of year classes varies greatly and that the occurrence of dominant year classes is irregular and infrequent (ibid.). Razor clams suffer high mortality in the larval and juvenile stages due to adverse weather conditions, unfavorable currents that carry them away from suitable beaches, predation, and possibly competition with larger adults. Because of this, it appears that environmental factors rather than the size of the parent spawning population determine the size of each year class (ibid.).

F. Regional Abundance

Razor clam abundance varies from beach to beach, and cannot be appropriately discussed at the regional level. Abundance information is contained in the Cook Inlet and PWS discussion in II. B. and III. B., respectively.

II. COOK INLET

A. Distribution

Razor clams are found on the east side of Cook Inlet from the Homer Spit northwest to Anchor Point and thence northeast to Cape Kasilof, a total distance of approximately 65 mi (Nickerson 1975). On the west side of Cook Inlet, razor clams are found from Kustatan, at the west Foreland, southwest to Tuxedni Bay, a distance of about 55 mi (ibid.). Razor clam beds are also found along the north shore of Chinitna Bay, and on the south shore of Augustine Island (ibid.).

B. Abundance

The abundance of clams on the east side of Cook Inlet is qualitatively described by Nelson (pers. comm. to Nickerson 1975) as "subsistence level" from Homer to Anchor Point and "sparse" to "very abundant" from Anchor Point to Cape Kasilof. On the west side of Cook Inlet, abundance varies, and is qualitatively described as "subsistence level" from Kustatan to the mouth of the Drift River and as "sparse" to "very abundant" from the mouth of the Drift River to Tuxedni Bay (ibid.). The bed of razor clams at Chinitna Bay is reported to be "fairly abundant" (Nelson, pers. comm. to Nickerson 1975), as is the bed on the south shore of Augustine Island (Baxter, pers. comm. to Nickerson 1975).

III. PRINCE WILLIAM SOUND

A. Distribution

From Cape Suckling to Orca Inlet, including the adjacent beaches of Kayak, Kanak, and Hichinbrook Islands, are historically important commercial razor clam growing areas, with a productive extent of approximately 140 mi (Nickerson 1975).

B. Abundance

The population on beaches of Orca Inlet began to decline in 1958, possibly due to heavy siltation from spring breakup of the Copper River (ibid.). The 1964 earthquake, followed by tsunamis and seiches, furthered the decline of these valuable clam beds (ibid.). An increase in the sea otter population in this area may now be preventing the recovery of these clam beds (ADF&G 1983, Johnson 1982). Abundant clam beds are still found in the Copper River-Controller Bay area (ADF&G 1983).

REFERENCES

ADF&G. 1983. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries.

Amos, M.H. 1966. Commercial clams of the North American Pacific Coast. USFWS. Circ. 237. 18 pp. Cited in Nosho 1972.

Johnson, A.M. 1982. Status of Alaska sea otter populations and developing conflicts with fisheries. Pages 293-299 in Transactions of the 47th North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, DC.

McLean, R.F., and K.J. Delaney. 1978. A fish and wildlife resource inventory of the Prince William Sound area. Vol. 2: Fisheries, compiled by ADF&G under contract to Alaska Coastal Mgmt. Prog. 241 pp.

Nelson, D.C. 1982. A review of Alaska's Kenai Peninsula east side beach recreational razor clam (Silqua patula Dixon) fishery, 1965-1980. Unpubl. M.S. ADF&G, Div. Sport Fish. 266 pp.

Nickerson, R.B. 1975. A critical analysis of razor clams (Siliqua patula Dixon) populations in Alaska. ADF&G, Div. FRED. 194 pp.

Nosho, T.Y. 1972. The clam fishery of the Gulf of Alaska. Pages 351-360 in D.H. Rosenberg, ed. A review of the oceanography and renewable resources of the Northern Gulf of Alaska. Univ. Alaska, Inst. Mar. Sci. Rept. No. R72-23 (Alaska Sea Grant Rept. 73-3).

Paul, A.J., and H.M. Feder. 1976. Clam, mussel, and oyster resources of Alaska. Alaska Sea Grant Rept. No. AK-56-76-6. 41 pp.

Shrimp Distribution and Abundance

I. REGIONWIDE INFORMATION

Shrimp are found in Cook Inlet south of Anchor Point and throughout the rest of the Southcentral Region. The region is divided into two areas for management of the species: Lower Cook Inlet (LCI) and Prince William Sound (PWS). The boundaries of these management areas are mapped in the shrimp Human Use narrative found elsewhere in this volume. Distribution and abundance information specific to the two management areas is presented following the regional information.

A. Regional Distribution

Fourteen species of shrimp in the family Pandalidae occur in the Gulf of Alaska (Fox 1972), and five of these species are caught by commercial fisheries: pink shrimp (Pandalus borealis); humpy shrimp (P. goniurus); spot shrimp (P. platyceros); coonstripe shrimp (P. hypsinotus); and sidestripe shrimp (Pandalopsis dispar). Of these species, pink shrimp dominates the catch in trawl surveys (Davis 1982, Ronholt et al. 1977). Adult pandalid shrimp inhabit waters from the intertidal zone to beyond the continental shelf. Pink shrimp are most abundant in depths from 73 to 183 m (Fox 1972).

Age at sexual maturity varies by species and by geographical location within a species. Pandalid shrimp normally mature first as males and then later transform into females. The age at first maturity as males is usually 1.5 years for pink, coonstripe, and sidestripe shrimp. In colder water, however, pink shrimp may mature at two or three years (ibid.). It is suspected that spot shrimp are also older at maturity in more northern waters (Kimker, pers. comm.). Most shrimp function two years as males before transforming into females and may become sterile after six years (Fox 1972).

B. Areas Used Seasonally and for Life Functions

A shrimp distribution map at 1:1,000,000 scale has been produced for the Southcentral Guide and may be found in the reference map series that supplements this text. The categories of mapped information are 1) general distribution 2) known concentrations, and 3) known spawning concentrations.

C. Factors Affecting Distribution

General factors affecting distribution include temperature and salinty. Details of this data may be found in the Shrimp Life History and Habitat Requirements section. More detailed information follows in the narratives for the Cook Inlet and PWS management areas.

D. Movements Between Areas Used Seasonally and for Life Functions

The ADF&G began a spot shrimp-tagging program in Unakwik Inlet, in northern PWS, in 1983. No significant movement of adult spot shrimp has yet been observed (Kimker 1984a).

Diel vertical migrations are common among some pandalids. The period of time shrimp remain away from the vicinity of the bottom varies directly with the season's number of hours of darkness. Diel migrations are possibly related to feeding behavior, since shrimp feed mainly on euphausiids and copepods, which also make diel migrations (Fox 1972).

E. Population Size Estimation

Pink and humpy shrimp abundance has been estimated by catch per unit effort of trawl surveys (Kimker, pers. comm.). Trawl surveys generally use standardized tows within a survey, but comparing catch rates between surveys may be difficult. The sampling design may plan tows at depth intervals or may use predetermined locations by grid coordinates. The size and species captured by trawls are influenced by the mesh size, bottom type, and speed of tow.

The ADF&G conducts a trawl index survey program in LCI. Fishable areas are selected, and tows are conducted over a 1 mi distance for about 30 minutes. Commercial species of shrimp are weighed, giving an index of the relative abundance of shrimp available to the commercial fishery (Davis 1982).

F. Regional Abundance

Detailed information for shrimp follows in the narratives for the LCI and PWS management areas.

II. LCI MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the shrimp Human Use narrative found elsewhere in this volume.

A. Distribution

Pandalid shrimp are distributed in all districts of LCI. Major concentrations occur in Kachemak Bay and in the deep waters off Cape Douglas (ADF&G 1977). Shrimp are also abundant in the region between Augustine Island and the Barren Islands, although densities do not reach Kachemak Bay levels (Hamilton et al. 1979). Within Kachemak Bay there are over 75 sq mi of habitat with commercial quantities of pandalid shrimp. Shrimp are distributed throughout the area but are found in quantity in waters deeper than 18 m. A migrational movement within Kachemak Bay occurs, with shrimp moving into a deep-water hole, 145 m deep, off Yukon Island in February and March. They remain here until March and April, while the females drop their eggs, and then disperse throughout the bay (ADF&G 1977).

Four species of pandalid shrimp (pink, humpy, coonstripe, and sidestripe) are the major species harvested in LCI, with pink shrimp comprising most of the trawl harvest. Coon shrimp comprise most of the pot shrimp harvest (Kyle and Merritt, pers. comm.). Spot shrimp are found in nearshore waters along rocky substrate, and some concentrations occur in the entrances of Tutka Lagoon and Sadie Cove (ibid.). Trawl surveys in Kachemak Bay have shown that humpy shrimp are more abundant in the fall than in the spring and that the most abundant species overall is the pink shrimp (Davis 1982).

B. Abundance

Trawl survey abundance indexes have been conducted by the ADF&G for commercial species of shrimp in the Southern District of LCI, which includes the Kachemak Bay area (table 1). Spring indexes have ranged from a low of 2.9 million pounds in 1983 to a high of 16.9 million pounds during 1973. Two peak population abundances have occurred in the 11 years of sampling. The first peak occurred from 1973 to 1975, and the next increase happened during 1978 and 1979. Both these peaks were associated with large increases in the humpy shrimp population. Humpy shrimp always comprised a higher percentage of the trawl survey in the fall, as compared to the spring survey of the same year. Overall, the most abundant shrimp has been the pink shrimp, and its population appears more stable than the humpy shrimp population (ibid.). The ADF&G also conducts pot shrimp surveys three times per year (March, May, October) to obtain relative trends, primarily on coonstripe shrimp (Merritt, pers. comm.).

Other trawl surveys have been conducted by the NMFS from 1950-1968 in Cook Inlet (Maturgo 1972)). Data summarized over the 18 years show that shrimp were caught as deep as 550 m, with the highest catches in the 54 to 90 m depth zone.

III. PWS MANAGEMENT AREA

A map of this area and a description of the boundaries are provided in the shrimp Human Use narrative found elsewhere in this volume.

A. Distribution

Little information for shrimp species in PWS is available. Most of the pot shrimp commercial harvest occurs in central and western PWS, whereas nearly all the commercial trawl harvest has occurred in Icy Bay, a glacial-fed body of water in southwestern PWS (Kimker 1984b). Two species of shrimp - spot shrimp and coonstripe shrimp - are harvested in the commercial pot fishery (Kimker, pers. comm.). In the trawl fishery, pink and sidestripe shrimp are the dominant species, with pink shrimp the most abundant (ibid.).

B. Abundance

Little information is available on the shrimp populations in PWS. In 1982, the ADF&G began a tagging project with spot shrimp to study stocks, migration, and growth (ibid.). Trawl surveys were conducted by the NMFS from 1950-1968 in depths from 18 to 550 m (Maturgo 1972). Data summarized over the 18 years show the highest concentrations of shrimp in the 54 to 126 m depth range.

Table 1. Abundance Index Estimates of Shrimp from Summer and Winter Trawl Surveys in the Southern District of Cook Inlet

Year	Month	Abundance Index (Millions of Pounds)	Range (Millions of Pounds)
1971	May	3.71	2.97 - 4.45
1972	May	7.72	4.98 - 10.46
1973	May	16.88	12.19 - 21.58
1974	June	13.58	10.48 - 16.67
1975	May	16.19	11.67 - 20.71
1976	May	7.71	5.53 - 9.89
1977	June	5.81	4.82 - 6.80
1978	May	11.55	8.64 - 14.46
1979	May	10.59	8.38 - 12.81
1980	May	7.32	5.89 - 8.74
1981	May	6.92	5.65 - 8.20
1982	May	4.37	3.41 - 5.32
1983[a]	May	2.9	2.2 - 3.6
1984[a]	May	4.1	3.0 - 5.2
1976	Oct.-Dec.	10.25	8.04 - 12.46
1977	Nov.	10.51	7.47 - 13.55
1978	Oct.	16.52	12.31 - 20.74
1979	Oct.	16.14	12.38 - 19.90
1980	Oct.	24.06	19.42 - 28.70
1981	Oct.	7.88	5.76 - 9.99
1982[a]	Oct.	7.4	5.4 - 9.3
1983[a]	Oct.	6.9	4.9 - 8.8

Source: Based on pounds of commercial species of shrimp only (Davis 1982).

a Merritt, pers. comm.

REFERENCES

ADF&G, comp. 1977. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 2: Fisheries. Juneau. 443 pp.

ADF&G. 1983. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 39 pp.

Davis, A.S. 1982. The commercial otter trawl shrimp fishery of Cook Inlet. ADF&G, Div. Commer. Fish. Informational Leaflet No. 205. Homer. 91 pp.

Fox, W.W. 1972. Shrimp resources of the northeastern Pacific Ocean. Pages 313-337 in D.H. Rosenberg, ed. A review of the oceanography and renewable resources of the northern Gulf of Alaska. IMS Rept. R72-23. Fairbanks.

Hamilton, C.I., S.J. Starr, and L.L. Trasky. 1979. Recommendations for minimizing the impacts of hydrocarbon development on the fish, wildlife, and aquatic plant resources of Lower Cook Inlet. Vol. 2: Marine/coastal habitat management. ADF&G. 420 pp.

Kimker, A. 1984, 1985. Personal communication. Prince William Sound Shellfish Biologist, ADF&G, Div. Commer. Fish., Cordova.

________. 1984a. Summary of the 1983 streamer tag application of spot shrimp (Pandalus platyceras Brandt) in Prince William Sound. PWS Data Rept. 84-3. ADF&G, Div. Commer. Fish., Cordova. 16 pp.

________. 1984b. Shellfish report to the Alaska Board of Fisheries. PWS Management Area Data Rept. 84-5. ADF&G, Div. Commer. Fish., Cordova. 54 pp.

Kyle, S. 1984. Personal communication. Asst. Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Merritt, M. 1984. Personal communication. Lower Cook Inlet Area Research Biologist, ADF&G, Div. Commer. Fish., Homer.

Maturgo, Z.D. 1972. Exploratory fishing drags for demersal fish and shellfish - Gulf of Alaska. Shell Oil Co., Environmental Conservation Dept. Feb. 1972.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1977. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976. A historical review. Vol. 3. Pages 624-955 in Environmental assessment of the Alaskan continental shelf. Final reports of the principal investigators. Vol. 2: Biological studies. USDC: NOAA, ERL, OCSEAP. June 1978.

Sitka Black-tailed Deer Human Use

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Within the Southcentral Region, deer are found only in the Prince William Sound (PWS) area in Game Management Unit (GMU) 6. Information will be presented and discussed on the basis of this GMU, as harvest data by subunit are not available. The Prince William Sound subregion, as defined in the Alaska Habitat Management Guides, is equivalent to the western portion of GMU 6. Deer do not occur in the eastern portion of GMU 6, east of Cape Suckling.

B. Regional Summary of Hunting

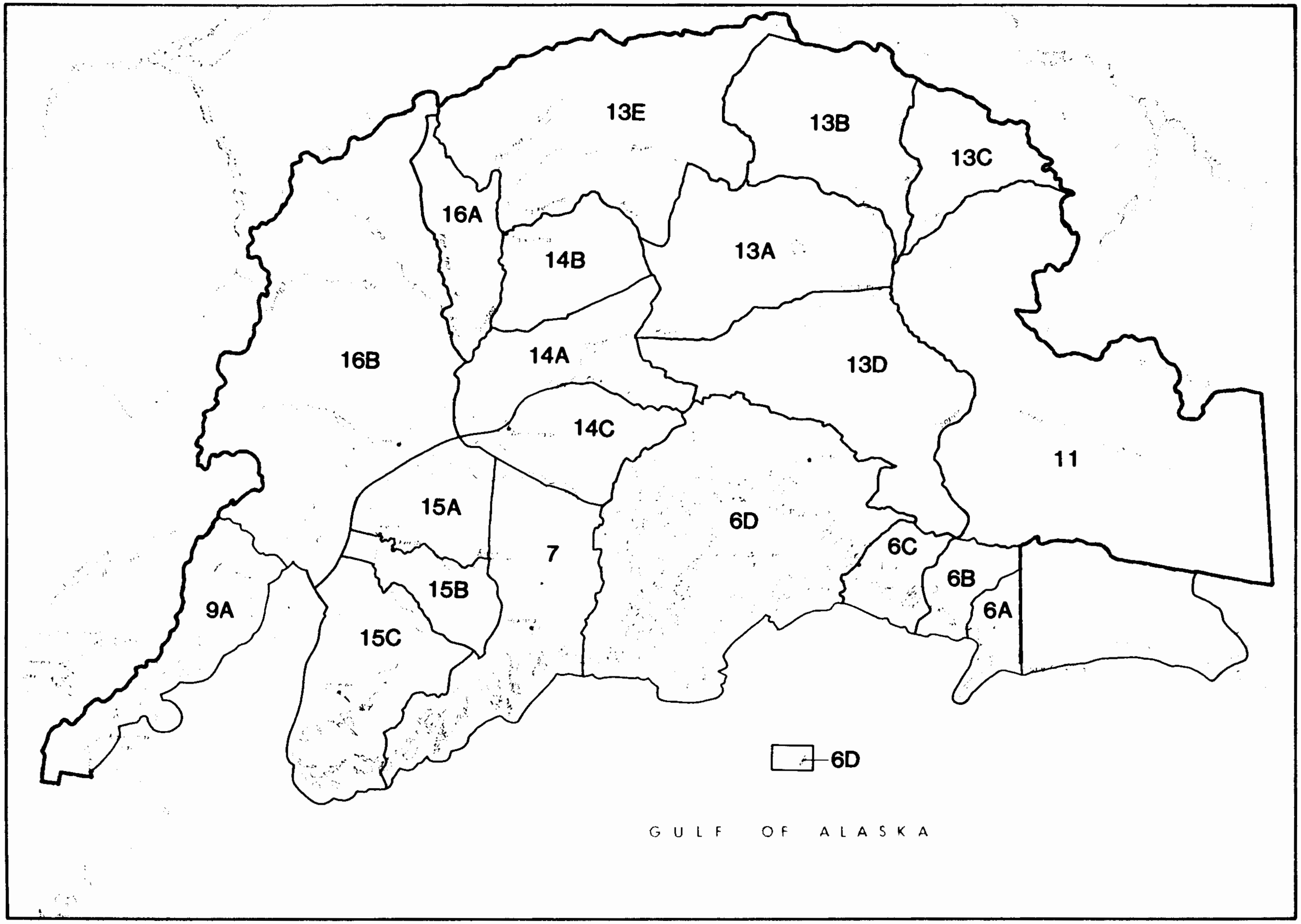
1. Brief regional summary of human use information. Although important to residents of the PWS area, the reported harvest of deer from the Southcentral Region is a small percentage of the statewide deer harvest. In typical years, this region contributes 4 to 7% of the statewide harvest. A maximum of 16% was reported for 1977, a year in which weather conditions were highly favorable for deer hunting in PWS and unfavorable in Southeast Alaska. The PWS deer harvest probably fluctuates between 500 and 1,500 deer annually. Except for 1980, harvest data are poor.

2. Managerial authority. In 1925, the Alaska Game Commission was established by an act of Congress "to protect game animals, land furbearing animals, and birds in Alaska, and for other purposes." This was the beginning of formal wildlife management in Alaska. Concurrent with statehood in 1959, under authority of Article VIII of the State Constitution, the legislature established the Department of Fish and Game. The Division of Game and Board of Fish and Game were given jurisdiction over deer. In 1975, separate boards of game and fish were created by legislative act (ADF&G 1976). Deer hunting is controlled under the Alaska Game Regulations.

II. GMU 6

A. Boundaries

GMU 6, as defined according to AS 16.05.250(1) and (7), includes that area draining into the Gulf of Alaska and PWS between Icy Bay and Cape Fairfield, excluding the Nellie Juan and Kings River drainages but not extending above Miles Glacier on the Copper River; and including Kayak, Hinchinbrook, Montague and adjacent islands, and Middleton Island (see map 1). The eastern boundary of the Southcentral Region, as defined for the Alaska Habitat Management Guides, extends north from Cape Suckling and excludes



Map 1. Game management units in the Southcentral Region.

the eastern portion of GMU 6. Deer do not occur in the excluded area, so no corrections are necessary to the harvest data.

B. Management Objectives

As described in the Prince William Sound Deer Management Plan (ADF&G 1976), the management goal is to provide the public with the greatest sustained opportunity to participate in hunting deer.

C. Management Considerations

1. Matching harvest and population levels. Deer harvests vary from year to year, primarily in response to snow accumulation during the hunting season. Snow depths in excess of 18-24 inches in climax forests force the deer to concentrate along the beach fringe (ADF&G 1980), where they are highly vulnerable to hunting by boat (ADF&G 1976). A potential for overharvest can occur under a specific combination of conditions: when a series of severe winters (deep snow persisting for several weeks) results in low recruitment; when the deer population is low; when snow is deep enough to concentrate deer along the beach fringe early in the hunting season; and when favorable weather causes heavy hunting pressure (Reynolds 1975). Such conditions led to emergency closure of the season in mid December 1973. If deep snow had occurred in the fall of 1978, a similar closure would have been necessary.

   At the other extreme, the lack of predators and restricted winter range for deer on the islands of PWS can result in population increases beyond the carrying capacity of the winter range and cause high winter mortality. In this situation, liberalization of bag limits may be necessary to increase harvest, as was recommended for the 1982 season (Reynolds 1983).

2. Predation. The larger islands in the PWS area, where most deer occur, are essentially free of natural predators. Wolves and coyotes are not present on these islands. Bears are found on the islands but hibernate during the winter when deer are most vulnerable to predation. When bears emerge in the spring they utilize the carcasses of deer winter kills. In summer, deer are more widely dispersed in alpine areas and can escape from bears more easily, as their movements are not restricted by snow. From the eastern side of PWS to the Copper River, coyotes and low habitat quality limit deer populations on the mainland (ADF&G 1976). The lack of mortality due to natural predators on the larger islands of PWS allows deer populations to rapidly increase beyond the limited carrying capacity of the winter range. Massive mortality due to winter kills then takes place, as occurred between 1945 and 1950 and three more times in the following three decades (ibid.). Harvest of deer by man, based on careful management practices, can take the place of natural predation.

3. Illegal harvest. Harvest of more than the legal limit of deer occurs commonly in GMU 6. In 1968, 16% of 100 hunters interviewed in Cordova admitted to taking more than the legal limit of four deer (Reynolds 1974). In 1973, Reynolds (1975) estimated that, because of unreported harvest above the legal limit, the realistic harvest by Cordova hunters was close to 1,000 deer, 39% greater than the reported harvest of 720. For details, see II.E.3. below. Under normal circumstances, winter weather conditions rather than harvest have the most significant impact on deer populations in the PWS area. The illegal harvest is usually insignificant to the deer population. Unusual circumstances that can lead to overharvest were discussed in II.C.1. above.
4. Changes in land ownership. Timber lands on critical winter deer range in PWS are being transferred to private ownership under the Alaska Native Claims Settlement Act. To date, most logging has occurred in relatively small blocks and in areas of little importance to deer. Climax forests in which the age distribution of the trees is uneven are critical to deer in winter, and cutting of such stands, whether as large or small clearcuts, will reduce deer populations, as has occurred in Southeast Alaska (ADF&G 1980).
5. Oil pollution. Oil tanker traffic through PWS raises the possibility of oil spills. If a spill were to reach a critical deer beach and cover the kelp and dead grasses and sedges at the time when they were the only winter food source for deer, cleanup would be impossible and substantial deer morality could occur (ADF&G 1976). For details on deer nutritional and feeding patterns, see the Life History and Habitat Requirements narrative.

D. Period of Use

Utilization of the deer herd in GMU 6 began in 1935, 12 years after the last of 24 deer had been transplanted to the islands, when a hunting season for bucks was begun. In 1953, sport harvest of all deer except fawns was made legal, and in 1960 the restriction on fawns was lifted. Prior to 1964, seasons and bag limits varied greatly from year to year. Since then, the season and bag limits have remained liberal, running from August 1 through December 31, with a limit of four deer through 1981 and five thereafter. Sport hunters seek deer early in the season, in alpine areas, while hunters more interested in meat tend to hunt late in the season after deep snow forces deer to low elevations. In years of light snowfall, the latter may not hunt deer (ADF&G 1976, 1980).

E. Human Use Data

1. Reported human use data. Table 1 summarizes the data available on harvest of deer under general harvest regulations. Deer are the most important source of big game meat in regions in which they occur (ADF&G 1980). They are also taken by sport hunters as trophies. The hides can be

Table 1. Deer Harvest Data for GMU 6 (PWS Area), 1972-81

	1972		1973		1974		1975				1976			
	Cordova Interview		Cordova Interview		Cordova Interview		Harvest Report Data		Cordova Interview		Harvest Report Data		Cordova Interview	
Item	No.	%*	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
License buyers	600	100	600	100	---		---		743	100.0	---		807	100.0
License buyers not hunting	306	51	144	24	---		---		334	45.0	---		428	53.0
Hunters afield	294	49	456	76	354		514		409	55.0	219		379	47.0
Successful hunters	97	33	301	66	188	53	206	40.1	252	61.6	100	45.7	186	23.0
Deer harvested	180		720		414		437		631		189		412	
Males harvested	77	43	338	47	---		254	58.1	379	60.1	109	57.7	218	53.0
Deer per hunter afield	0.6		1.6		1.2		0.85		1.54		2.2		1.1	
Days per deer	5.2		2.5		4.2		---		2.6		---		3.7	
Total days hunted	942		1,800		1,740		---		1,672		---		1,541	
Harvested:														
1 deer	43	44	274	38	---		85	41.3	73	29.0	48	48.0	65	35.0
2 deer	30	31	101	14	---		54	26.2	68	27.0	26	26.0	57	30.7
3 deer	18	19	130	18	---		24	11.6	22	8.7	15	15.0	24	12.9
4 deer	6	6	215	30	---		43	20.9	89	35.3	11	11.0	40	21.5
Harvest location:														
Mainland	0	0	43	6	---		7	1.6	22	3.5	4	2.1	16	3.9
Hawkins Is.	126	70	173	24	---		74	16.9	163	25.8	51	27.0	202	49.0
Hinchinbrook Is.	23	13	389	54	---		43	9.8	104	16.5	24	12.7	113	27.4
Montague Is.	18	10	101	14	---		242	55.4	89	14.1	83	43.9	49	11.9
Other Is.	13	7	14	2	---		51	11.7	253	40.1	15	7.9	32	7.8
Unknown							20	4.6	0	0	12	6.4	0	0
Statewide deer harvest	4,500	4	9,700	7	11,000	4	6,496	6.7	---	---	---	---	3,200	5.9

(continued)

Table 1 (continued).

Item	1977 Harvest Report Data No.	%	1977 Cordova Interview No.	%	1978 Harvest Report Data No.	%	1979 Harvest Report Data No.	%	1980 Unit 6 Hunter Questionnaire No.	%	1981 Cordova Interview No.	%
License buyers	---		800	100	---		---		---		700	100.0
License buyers not hunting	---		352	44	---		---		---		210	30.0
Hunters afield	795		448	56	445		368		1,251		490	70.0
Successful hunters	501	63	360	45	198	44.5	204	55.4	610	48.8	329	67.1
Deer harvested	1,347		992		391		452		1,337		784	
Males harvested	777	58	592	60	257	65.7	273	60.4	860	64.3	476	60.7
Deer per hunter afield	1.7		2.2		0.9		1.2		1.1		1.6	
Days per deer	---		1.6		---		---		---		2.8	
Total days hunted	---		1,584		---		---		---		2,212	
Harvested:												
1 deer	134	27	80	22	95	48.0	79	38.7	650	48.6	119	36.2
2 deer	88	18	72	20	42	21.2	51	25.0	349	26.1	63	19.1
3 deer	79	16	64	18	32	16.2	25	12.3	179	13.4	49	14.9
4 deer	200	40	144	40	29	14.7	49	24.0	159	11.9	98	29.8
Harvest location:												
Mainland							9	2.0	26	1.9	21	2.7
Hawkins Is.	150	11	296	30	40	10.2	55	12.2	250	18.7	329	42.0
Hinchinbrook Is.	267	20	456	46	40	10.2	49	10.8	170	12.7	175	22.3
Montague Is.	737	55	192	19	208	53.2	248	54.9	593	44.4	217	27.7
Other Is.	154	12	48	5	92	23.5	86	19.1	232	17.4	42	5.4
Unknown	39	3			11	2.8	5	1.1	66	4.9	---	
Statewide deer harvest	---	---	6,111	16.2	---	---	---	---	---	---	---	---

(continued)

Table 1 (continued).

* Key to percentage figures:

- License buyers: base figure, 100% of sample interviewed.
- License buyers not hunting, as percentage of license buyers.
- Hunters afield, as percentage of license buyers.
- Successful hunters, as percentage of hunters afield.
- Males harvested, as percentage of deer harvested.
- Harvested, number of deer, as percentage of successful hunters.
- Harvest location, as percentage of deer harvested.
- Statewide deer harvest, as percentage of statewide deer harvest contributed by GMU 6.

Sources: ADF&G survey and inventory reports.

--- means no data were available.

1972: Personal interviews with 100 Cordova hunting license holders. Harvest figures extrapolated from 17% sample of Cordova license buyers.

1973: Interviews as for 1972; season closed as of December 16, 1973, by field announcement. Other seasons ran August 1-December 31. Harvest by Cordova hunting license holders under general harvest regulations, including deer taken beyond the legal limit but not reported, was probably close to 1,000 deer.

1974: Other data not available.

1975: Personal interviews with 100 Cordova hunting license holders. Harvest figures extrapolated from 13% sample of Cordova license buyers.

1976: As 1975, with 100 license holders, 12% sample.

1977: As 1975, with 100 license holders who obtained deer harvest tickets, 12.5% sample. The number of Cordova license buyers was estimated.

1978: Statewide deer harvest not available from 1978 through 1981 because of difficulties with the harvest report system.

1980: A questionnaire was mailed to each hunter in GMU who obtained a deer harvest ticket and was followed by two reminder letters. Response was 900 out of an estimated 1,251 hunters.

1981: As 1977, corresponding figures 100 license holders and 14.3%.

utilized to make garments or rawhide lacing, or they can be used for other purposes.

Quantitative data on residency of hunters who utilize deer in the Southcentral Region are available only for 1980 (table 2). Residents of GMU 6, interested primarily in obtaining meat, accounted for 43% of the reported harvest. Harvest by Anchorage residents was a close second at 34%. Hunting deer for sport as well as for meat by nonlocal residents has increased over the past 10 to 15 years until it now accounts for most of the harvest. The locals use fish boats or small aircraft for transport to hunting areas, while the nonlocals travel by recreational boats or small aircraft (ADF&G 1976) to several USFS cabins.

Reported harvests of deer in the Southcentral Region over the past 10 years are compiled in table 1 and compared to statewide totals for years in which the latter are available. The estimated number of deer harvested per year, however, ranges from a low of 500 to a high of 1,500, with an average of about 1,000. The relative importance of harvest from each of the major islands varies from year to year. Harvests have been generally increasing throughout the base period, because of a series of mild winters that have allowed the deer population to increase, rather than because of habitat recovery (Reynolds 1983). The contribution of southcentral deer to the statewide harvest is very low, 4 to 7% from 1972 through 1976. In 1977, a year of exceptionally high harvest in GMU 6 and of average harvest statewide, the regional contribution was 16%. More recent data are not available because of lack of statewide deer harvest estimates.

2. Historical use levels. Although historical deer harvest data for the state as a whole are available (e.g., Courtright 1968), no sources specific to GMU 6 were found.

3. Qualifications and limitations of data. Data on deer harvest from GMU 6 and statewide are poor throughout the 10-year base period. Lack of cooperation by hunters in returning harvest report cards and lack of funds for extensive questionnaires or surveys and for evaluating data collected are major limitations. No single data collection method was used throughout the base period. Interviews by J. Reynolds with a subsample of 100 Cordova residents who obtained deer harvest tickets were conducted from 1972 through 1977 and in 1981. Harvest tickets were required from 1969 through 1979 and the results analyzed from 1975 through 1979. Severe under-reporting in harvest reports is obvious in comparing those data with the Cordova interviews. Only in 1980 was a thorough questionnaire survey performed. The realistic harvest in 1980 was considered average, as was that in 1979, yet the 1980 harvest determined through use of the question-

Table 2. 1980 PWS Deer Harvest by Residency

Residency	Total Hunters	Success. Hunters	Deer	% Deer	% Hunters	% Hunters Success.	Deer Per Success. Hunter	Deer Per Hunter
Anchorage area	353	148	317	33.7	39.3	41.9	2.1	.9
Unit 6[a]	305	134	407	43.2	33.9	43.9	3.0	.3
(Cordova)	(227)	(114)	(354)	(37.6)	(25.3)	(50.2)	(3.1)	(1.6)
Kenai Peninsula	79	35	63	6.7	8.8	44.3	1.8	.8
Palmer area	46	20	40	4.3	5.1	43.5	2.0	.9
Fairbanks area	41	11	26	2.8	4.6	26.8	2.4	.6
Glennallen area	13	7	12	1.3	1.5	53.9	1.7	.9
Kodiak	21	11	40	4.3	2.3	52.4	3.6	1.9
Other Alaska	14	6	7	.7	1.6	42.9	1.2	.5
"Lower 48"	6	1	1	.1	.7	16.7	1.0	.2
Unknown	21	12	29	3.1	2.3	57.1	2.4	1.4
Totals	899	385	942	100.2	100.1	42.8	2.5	1.1

Source: Reynolds, pers. comm.

a Includes Cordova, Valdez, Tatitlek, and Whittier.

naire was double that determined from harvest reports in the previous year (Reynolds 1982 and 1983). Similar problems pertain to deer harvest records elsewhere in the state. Statewide harvest has been estimated only through 1977.

F. Significance of Particular Use Areas

See the 1:250,000-scale reference maps available in area offices of ADF&G and the 1:1,000,000-scale maps in the Atlas to the guide for the Southcentral Region. These maps show areas consistently used for hunting of deer under general harvest regulations (including hunting primarily for meat as well as primarily for trophies). The more important use areas are the beach fringe and road system near Cordova and the beach fringes of the following islands: Hawkins and Hinchinbrook islands, the northern and southern ends of Montague Island, and the east side of Knight Island (Reynolds, pers. comm.). Hunting is concentrated on Hawkins Island early in the season. If snow forces deer to the beach fringe, hunters interested mainly in meat utilize primarily Hinchinbrook and Montague islands and take a larger total number of deer (ADF&G 1976).

G. Projected Change in Demand

Hunting pressure, particularly from sport hunters outside the PWS area, is expected to increase gradually (ibid.). Harvest levels cannot be accurately projected because of the overriding influence of weather conditions on deer survival, deer movement patterns, and hunting effort. Fluctuations within the base period range can be expected in the near future.

REFERENCES

ADF&G. 1976. Alaska wildlife management plans, draft proposal: southcentral Alaska. Financed in part by Fed. Aid in Wildl. Rest. Proj. W-17-R.

________. 1980. Alaska wildlife management plans: species management policies. Financed in part by Fed. Aid in Wildl. Rest. Proj. W-20-2.

Courtright, A.M. 1968. Game harvests in Alaska. A Fed. Aid in Wildl. Rest. rept. Juneau.

Reynolds, J. 1974. Deer survey-inventory progress report, 1972. Pages 14-20 in D.E. McKnight, ed., comp. Annual report of survey-inventory activities. Part 1: Deer, brown/grizzly bear, sheep, bison, elk, and muskoxen. ADF&G, Fed. Aid in Wildl. Rest. Vol. 4. Proj. W-17-5, Jobs 2, 4, 6, 9, 13, 16, and 22.

________. 1975, Deer survey-inventory progress report, 1973. Pages 21-24 in D.E. McKnight, ed., comp. Annual report of survey-inventory activities. Part 1: Deer, brown/grizzly bear, sheep, bison, elk, and muskoxen. ADF&G, Fed. Aid in Wildl. Rest. Vol. 5. Proj. W-17-6, Jobs 2, 4, 6, 9, 13, 16, and 22.

________. 1982. Deer survey-inventory progress report, 1980-1981. Pages 25-27 in R.A. Hinman, ed., comp. Annual report of survey-inventory activities. Part 3: Bison, deer, elk, muskoxen, and sheep. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12. Projs. W-19-1 and W-19-2, Jobs 9.0, 2.0, 13.0, 16.0, and 6.0.

________. 1983. Deer survey-inventory progress report, 1981-1982. Pages 21-23 in J.A. Barnett, ed., comp. Annual report of survey-inventory activities. Part 6: Deer, bison, small game, elk, musk-oxen, and walrus. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 2.0, 9.0, 10.0, 13.0, and 16.0.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Cordova.

Caribou Human Use

I. POPULATION MANAGEMENT HISTORY

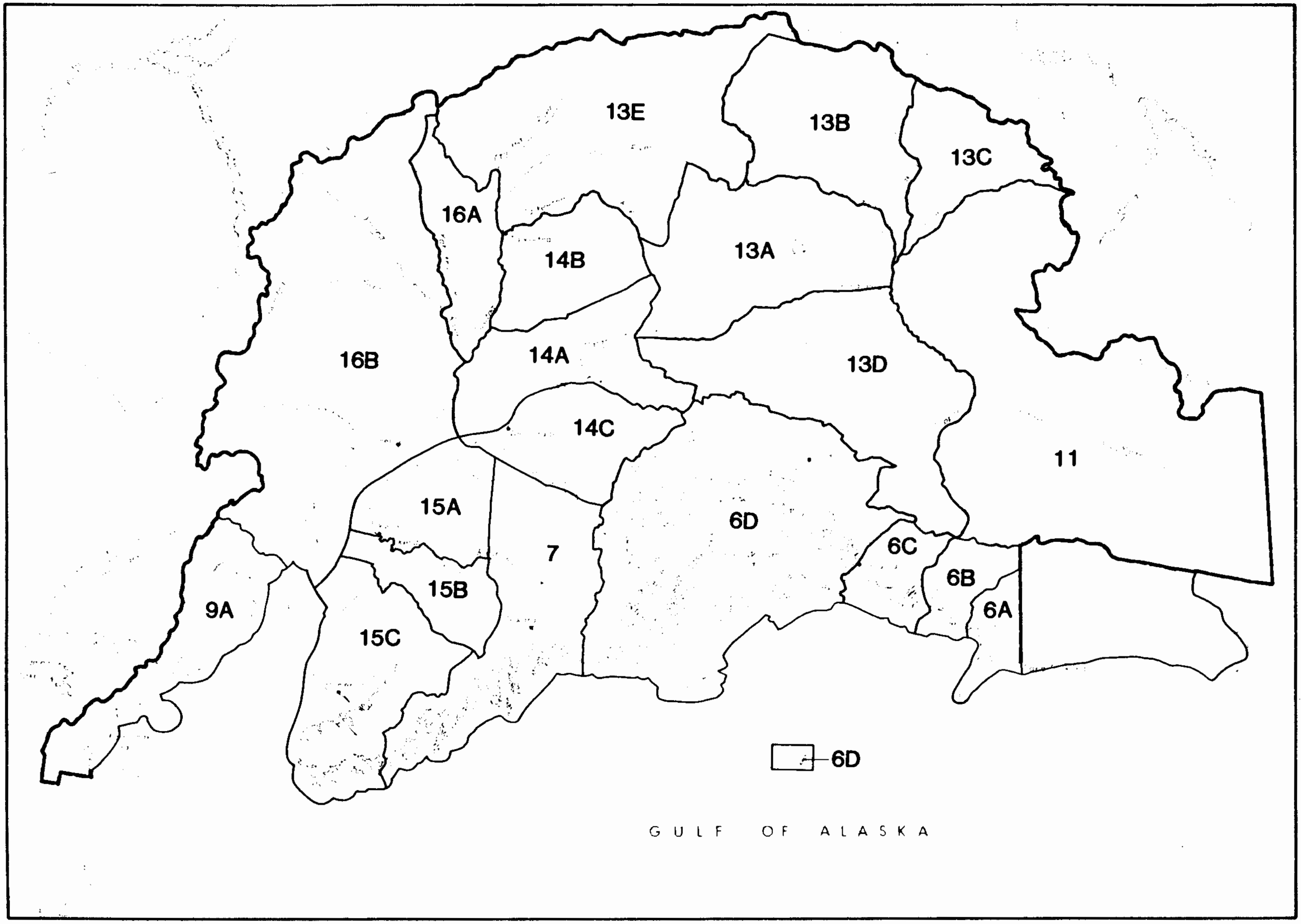
A. Introduction

Caribou range throughout most of the Southcentral Region. Because of their general affinity for certain migration routes and calving areas, and the common nature of their behavioral patterns, most caribou groupings are sufficiently discrete to be recognized by managers as herds. In Southcentral Alaska, most herds range within one game management unit (GMU), except the Nelchina herd. Information will be presented and discussed on the basis of the following GMUs (see map 1): GMU 7 (Kenai Mountains herd), GMU 15A (Kenai Lowlands herd), GMU 11 (Mentasta herd), GMUs 13, 14A, 14B (Nelchina herd), and GMU 16 (part of Mulchatna herd). Harvest data, when available, will be presented at the subunit level in GMUs 13 and 16. GMUs 7 and 11 have no subunits; data from GMUs 14A and 14B will be combined with GMU 13. Reported human use data will also be presented at the minor tributary level within each GMU.

B. Regional Summary of Hunting

1. Brief regional summary of human use information. Human use of caribou in Southcentral Alaska has fluctuated widely because of the cyclical nature of caribou population numbers and their distributional patterns, which, along with weather conditions and access, determine the availability of caribou to hunters. The reported harvest of caribou from the Southcentral Region is probably an accurate representation of human use of caribou in the region, because all hunts have been based on a permit-drawing system since 1977. The reported harvest for several herds in Alaska underestimates the actual take, because of the widespread failure to report all takes on harvest tickets, particularly in rural areas. Thus, it is difficult to compare caribou human use data of the Southcentral Region with those of other regions or of the state as a whole.

   Within the Southcentral Region, the reported harvest of caribou has increased from 475 in 1977 to 1,116 in 1983. In this period, the mean annual harvest was 861 animals (s.d. = 231.1). The reported harvest of caribou in the Southcentral Region has averaged approximately 25% of the reported statewide caribou harvest over the last three years and approximately 10-12% of the estimated total statewide harvest. The amount of hunter effort as indicated by the minimal number of hunter-days reported was only available for most GMUs for 1981, 1982, and 1983, and measured 5,775, 7,061, and 6,603 days, respectively. The number of hunters



Map 1. Game management units in the Southcentral Region.

in this period more than doubled, from 822 in 1977 to 1,718 in 1983 (BGDIF 1977-1983).

Human use of caribou in Southcentral Alaska is largely determined by accessibility. In the past, movements of some caribou along or across road systems resulted in large harvests. With the development and widespread use of snowmachines, harvests of accessible caribou became excessive. Early hunting seasons during the mid 1970's, which limited hunting to snow-free periods, have held harvests at desirable levels. Access to Nelchina caribou in the fall is now available from the Denali Highway, from the Glenn Highway at Eureka, from the Lake Louise and Oilwell roads, the Richardson Highway between Paxson Lake and Glennallen, and from the Tok cut off. Access to the Mentasta herd is possible by ORVs and 4WD vehicles on the Nabesna Road. There is a trail system that radiates from the Nabesna Road and extends back to fall caribou habitat. Aircraft access is limited to a few scattered bush strips located on the western slopes of the Wrangell Mountains. Access to Kenai caribou is regulated by the U.S. Forest Service, which prohibits use of off-road vehicles during snow-free periods (ADF&G 1977).

2. Managerial authority. In 1925, the Alaska Game Commission was established by an act of Congress "to protect game animals, land furbearing animals, and birds in Alaska, and for other purposes." This was the beginning of formal wildlife management in Alaska. Concurrent with statehood in 1959, under authority of Article VIII of the State Constitution, the legislature established the Department of Fish and Game. The Division of Game and the Board of Fish and Game were given jurisdiction over caribou. In 1975, separate boards of game and fish were created by legislative act (ADF&G 1976). Caribou hunting is controlled under the Alaska Game Regulations.

II. GMU 7

A. Boundaries

GMU 7, as defined according to 5 AAC 90.010, includes that portion of the Kenai Peninsula draining into the Gulf of Alaska between Point Gore and Cape Fairfield and including the Nellie Juan and Kings River drainages, the drainages into the Kenai River upstream from the Russian River from the east, and the drainages into Turnagain Arm south of the Twentymile River drainage and east of the Chugach National Forest boundary of GMU 15(A). (See map 1.)

B. Management Objectives

According to the Kenai Mountains Caribou Management Plan (State of Alaska 1984a), the management objective is primarily to protect, maintain, and enhance the caribou population in concert with other ecosystem components, thereby ensuring its capability to provide sustained opportunities for caribou hunting under aesthetically pleasing conditions, and secondarily to provide sustained opportunities to view and photograph caribou.

Management guidelines include the following:

- ° Maintain a posthunting season population of 250-300 caribou, with an adult sex ratio of 25 bulls per 100 cows
- ° Control access, number, and distribution of hunters and methods of hunter transport, if necessary, to maintain desired harvest levels
- ° Encourage public viewing and photography of caribou in a wilderness situation

C. Management Considerations

1. Limited public access. The area where caribou are normally found is closed to off-road vehicles in snow-free months by the U.S Forest Service and is difficult to reach by airplane. Access is generally by foot from the Resurrection Trail. Because of this low accessibility, hunters could fail to harvest the annual population growth, which could cause the population to exceed the carrying capacity and thereby damage the range.
2. Predation. Wolf numbers have increased throughout the herd's range, and wolf predation on caribou is apparently increasing (Spraker 1981).
3. Overpopulation. The range occupied by this herd contains luxuriant lichen growth. Because the caribou utilize the same range summer and winter and lichens are extremely vulnerable to trampling, some risk of forage depletion exists if numbers increase too high.

D. Period of Use

In May 1965, a group of 15 caribou originally from the Nelchina herd were released near the Chickaloon River and by 1969 had established itself in the mountainous area west of the headwaters of Resurrection Creek. The herd grew rapidly, and by 1971 the area biologist recommended that a hunting season be established to control the rapid growth of the herd. The initial season was designed to harvest approximately 20 caribou on a permit basis (Leroux and Davis 1973).

In the first caribou hunting season on the Kenai Peninsula since prior to 1910, 46 hunters applied for permits. Twenty-one permittees harvested six bulls. Table 1 shows a summary of harvest season length since 1972. Prior to 1977, seasons varied but the bag limit was constant. Since then, season length (August 10-October 31) and bag limits (one caribou) have remained constant.

Hunters generally harvest caribou early in the season, with 67 to 84% of the harvest occurring before August 31 (ADF&G 1976, Leroux 1979).

E. Human Use Data

1. Reported annual human use. Table 2 summarizes the available data, describing the harvest of caribou under the general harvest regulations. Most hunters (around 95%) are Alaskan

Table 1. Caribou Season Length, Number of Permits Issued, and Harvest Totals for GMU 7, 1972-84

Year	Season	Permits Issued	Total Harvest
1972-73	Aug. 10-Nov. 30	20	6
1973-74	Aug. 10-Mar. 31	250	12
1974-75	Aug. 10-Nov. 30		44
	Jan. 1-Mar. 31	573[a]	
1975-76	Aug. 10-Nov. 30[b]		87
	Jan. 1-Mar. 31[b]	869[a]	
1976-77	Aug. 10-Mar. 31[b]	457[a]	49
1977-78	Aug. 10-Oct. 31	100	26
1978-79	Aug. 10-Oct. 31	100	30
1979-80	Aug. 10-Oct. 31	100	33
1980-81	Aug. 10-Oct. 31	100	21
1981-82	Aug. 10-Oct. 31	100	21
1982-83	Aug. 10-Oct. 31	150	28
1983-84	Aug. 10-Oct. 31	150	29

Source: ADF&G 1973-84.

a Unlimited permits available.

b Closed early by emergency order when harvest goal was reached.

residents and, in particular, live in the Anchorage area (40%) or on the Kenai Peninsula (55%) (ADF&G 1984). Although the number of permits was raised from 100 to 150 in 1982, the number of hunters has not increased significantly, reflecting the limited access to the herd.

Considering the difficulties of access to the area, strong recreational values are implied as the primary harvest motive, although very limited trophy hunting and some nonconsumptive use do occur.

Guiding is of minor importance, with only a few guides operating in this area (ADF&G 1977). Nonconsumptive use is primarily incidental to hiking on the Resurrection Trail; a few people occasionally hike to the area primarily to view and photograph caribou. Some incidental viewing also occurs in conjunction with hunting for other species. Most nonconsumptive use takes place in the summer, whereas hunting occurs primarily in the late summer and fall (ibid.). Almost all the harvest is taken between August 10 and the latter

Table 2. Total Reported Human Use of Caribou in GMU 7, 1977-83

		By Mode of Access							By Hunter Origin							
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	Total Appli-cation	No. Permits	% Success	Avg. Days Hunted
1977																
No. hunters	59	6	38	0	0	12	0	3	---	---	0	---				
Days hunted	---	---	---	---	---	---	---	---	---	---	0	---	236	100	44	---
Harvest	26	0	19	0	0	7	0	0	---	---	0	---				
1978																
No. hunters	73	4	49	0	0	18	0	2	70	1	0	2				
Days hunted	---	---	---	---	---	---	---	---	---	---	---	---	212	100	41	---
Harvest	30	2	18	0	0	10	0	0	30	0	0	0				
1979																
No. hunters	69	8	43	0	1	17	0	0	67	1	0	1				
Days hunted	---	---	---	---	---	---	---	---	---	---	0	---	354	100	48	---
Harvest	33	3	22	0	1	7	0	0	32	0	0	1				
1980																
No. hunters	61	8	40	0	0	13	0	0	59	2	0	0				
Days hunted	---	---	---	---	---	---	---	---	---	---	0	0	391	100	34	---
Harvest	21	1	15	0	0	5	0	0	19	2	0	0				
1981																
No. hunters	63	10	30	0	1	20	0	2	59	2	0	2				
Days hunted	253	36	123	0	2	82	0	10	237	10	0	6	315	100	33	4.0
Harvest	21	0	12	0	0	9	0	0	21	0	0	0				
1982																
No. hunters	81	6	37	2	0	31	0	5	78	3	0	0				
Days hunted	282	20	122	8	0	107	0	25	272	10	0	0	449	150	35	3.5
Harvest	28	0	17	0	0	11	0	0	28	0	0	0				
1983																
No. hunters	69	5	52	0	0	9	0	3	66	2	0	1				
Days hunted	224	---	---	---	---	---	---	---	212	12	0	0	459	150	42	3.2
Harvest	29	3	21	0	0	5	0	0	28	1	0	0				

Source: ADF&G 1984; BGDIF 1977-83.

--- means no data were available.

part of September. Horses provide the easiest access, although most hunters backpack to the area above the Resurrection Trail. Some aircraft can land at Swan Lake, but hunters still have to hike several hours to reach areas where caribou might be located.

As previously mentioned, this herd has been hunted only since 1972. The number of caribou harvested from this herd has ranged from 6 in 1972 to 87 in 1975-1976 (table 2), but since management changed to a permit-drawing system in 1977, the harvest has averaged 27 animals (s.d. = 4.5).

F. Significance of Particular Use Areas

The reader is referred to the 1:1,000,000-scale human use maps in the Atlas to the guide for the Southcentral Region and to the 1:250,000-scale reference maps available in area offices of the ADF&G. These maps show the levels of reported harvest and numbers of hunters and hunter-days in 1983 by minor tributary.

Some of the more important use areas include the alpine portions of the Big Indian and Little Indian creeks, Resurrection Creek-Trail, Resurrection Pass-Afanasa Creek area, Wolf Creek, Cannonball Creek, Hungry Creek, American Creek, and Colorado Creek. Table 3 summarizes hunter effort and success in these areas in 1982. Sixty-five percent of all hunters shot 85% of the total harvest in 71% of the total time expended in these eight areas.

Table 3. Hunter Effort and Success by Geographic Area in GMU 7 in 1982[a]

Area	Total Days	Harvest	No. Hunters
Resurrection Creek - Trail	54	6	12
Resurrection Pass - Afanasa Creek	39	1	9
Big Indian Creek	22	4	7
Wolf Creek	17	3	4
Cannonball Creek	25	1	7
Hungry Creek	16	4	5
Colorado Creek	10	3	4
American Creek	18	2	5
Total	201	24	51
Unit 7 total	282	28	82

Source: BGDIF 1982.

a 1982 data were used instead of 1983 because they were more specific in describing location of effort.

VI. GMU 11

A. Boundaries

GMU 11, as defined according to 5 AAC 90.010, includes that area draining into the headwaters of the Copper River south of Suslota Creek and the area drained by all tributaries into the east bank of the Copper River between the confluence of Suslota Creek and the Slana River and Miles Glacier.

B. Management Objectives

According to the North Wrangell Caribou Management Plan (State of Alaska 1984b), which applies to the area bounded by the Cheshnina River north along the Copper River to the Nabesna Glacier, the primary management objective of this plan is to provide sustained opportunities to hunt caribou under aesthetically pleasing conditions.

Management guidelines include the following:

- Control access, number, and distribution of hunters and methods of hunter transport, if necessary, to maintain aesthetic hunting conditions
- Maintain early-season use of caribou
- Maintain a minimum precalving caribou population of 2,500
- Maintain a minimum posthunting season population sex ratio of 35 bulls per 100 cows
- Encourage a natural fire regime on caribou range
- Discourage land use practices that adversely affect the wilderness character of the area

C. Management Considerations

1. Predator management. Predation and accidents probably account for the majority of adult natural mortality (Bos 1974). The distribution and abundance of wolves on the Mentasta caribou range is not well known. However, during survey flights, wolves have often been observed in association with caribou. Much of the caribou range lies within the Wrangell-St. Elias National Park and Preserve. Predator control measures are not permitted on park or preserve lands. Decreased wolf harvests have resulted from the creation of the park and preserve and associated NPS regulations. Wolf predation could limit caribou populations (State of Alaska 1984b).
2. Access. The harvest of Mentasta caribou has traditionally been limited by poor access. Since 1980, hunters using aircraft or off-road vehicles have accounted for 80-95% of the harvest. Animals are often taken incidentally to hunts for other species. The greater availability of caribou in the west (Nelchina herd) and to the north (Fortymile herd), coupled with limited access to the Wrangell Mountains, have served to limit hunter pressure on the Mentasta herd.

D. Period of Use

According to Skoog (1968), after the winter of 1931-1932, seasonal movements of the Fortymile herd south of the Alaska Range ceased. Some remnant groups formed the Mentasta herd (upper Copper River area) and the Chisana herd (White and Chisana rivers area). However, Bos (1974) proposed that caribou probably occupied these areas prior to the Fortymile herd's migrations. Nevertheless, very little human use of the Mentasta herd probably occurred during the 1930's and 1940's because of the scarcity of caribou in the upper Copper River area. Scott et al. (1950) reported that only a small number of caribou were harvested in the Mt. Sanford-Upper Copper River area and were taken incidentally to sheep or brown bear hunting.

In the past, periods of human use corresponded with those established for the Nelchina herd. From 1946 to 1955, split seasons were used to manage this herd. Animals could be harvested generally from August 10 to September 30. A short second season occurred during the first two weeks of December or the last 10 days of November. In 1956, the season was lengthened to last from August 10 to December 31.

From 1963 until the winter of 1971-1972, the season was extended even further and lasted until March 31. In 1972, bag limits and season length were drastically cut in response to indications that a drastic decline in caribou numbers had occurred. (See table 4 for 1973-1984 seasons, bag limits, and permits.)

E. Human Use Data

1. Reported human use data. Table 5 summarizes human use data available for caribou in GMU 11. Most hunters of Mentasta caribou have been Alaskan residents. Almost 60% of the permits issued annually since 1977 have been used, and almost 60% of those who did hunt bagged a caribou. In 1983, hunters spent an average of four days afield.

   Roughly 58% of all hunters since 1978 used aircraft, 21% used a highway vehicle and/or walked, and 15% used ORVs. Almost 72% of all successful hunters flew into their hunting area, 11% by foot/highway vehicle, and 13% by ORV. Hunters transported by aircraft showed a 75.8% success rate, with hunters by highway vehicle at 33.3% and ORV hunters at 55%.

   In GMU 11, the caribou harvest since 1977 has averaged 126 animals and ranged from 52 in 1977 to 149 in 1978. This harvest generally removes roughly 5% of the total population and about 7-8% of the adult population. Alaska residents have been responsible for 86 to 97% of the kill over the past six years, or approximately 116 caribou per year. Most residents sought to obtain meat for their families (Stratton 1983). This type of hunting, where most hunters use aircraft to reach areas that they then hunt on foot, frequently provides a high level of enjoyment per animal harvested.

   Hunters in GMU 11 in 1983 were primarily residents of the Nelchina Basin-Valdez area (43%), Anchorage area (37%), Southeast Alaska (8%), and the Palmer-Wasilla area (7%) (ADF&G 1984).

2. Historical use levels. Prior to 1968, when the harvest report program was instituted, the size of the harvest was

Table 4. Mentasta Caribou Herd Seasons, Bag Limits, Permits, and Harvest in GMU 11, 1973-84

Year	Season	Bag Limit	Permits	Harvest	
				Known	Estimated[a]
1973	Aug. 10-Sept. 30	1 caribou	---	81	99
1974	Aug. 10-Sept. 30	1 caribou	---	90	105
1975	Aug. 10-Sept. 30	1 caribou	---	143	162
1976	Aug. 10-Sept. 30	1 caribou	---	236	250
1977	Aug. 10-Sept. 30	1 caribou	150	52	---
1978	Aug. 10-Sept. 30	1 caribou	350	149	---
1979	Aug. 10-Sept. 30	1 caribou	350	99	---
1980	Aug. 10-Sept. 30	1 caribou	350	144	---
1981	Aug. 10-Sept. 30	1 caribou	350	135	---
1982	Aug. 10-Sept. 30	1 caribou	350	141	---
1983	Aug. 10-Sept. 30	1 caribou	350	91	---
1984	Aug. 10-Sept. 30	1 caribou	350		

Source: ADF&G 1973-84.

--- means no data were available.

a Estimated harvests based on herd-specific extrapolation formula developed by ADF&G.

not documented. In 1968 and 1969, the reported harvest of about 300 animals, although numerically small, may have amounted to 10 or 15% of the total herd size, assuming a population of 2,000-3,000 animals. Seasons ran from August 10 until March 31. Aircraft was essentially the only access means because the Nabesna road was not maintained in winter in those years (Bos 1974). In 1970 and 1971, winter maintenance of the Nabesna road allowed easy access for many hunters on snowmachines. The reported harvests of 846 in 1970 and 1,693 in 1971 probably consisted mainly of Nelchina caribou that wintered in large numbers in the Slana-Nabesna road area, where they overlapped elements of the Mentasta herd. Undoubtably, the harvest of Mentasta caribou increased substantially in those years because of the increased access (ibid.).

Table 5. Total Reported Human Use of Caribou in GMU 11, 1977-83

		By Mode of Access							By Hunter Origin							
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	Total Appli-cation	No. Permits	% Success	Avg. Days Hunted
1977																
No. hunters	93	---	---	---	---	---	---	---	---	---	---	---				
Days hunted	---	---	---	---	---	---	---	---	---	---	---	---	277	150	56	---
Harvest	52	37	3	0	8	4	0	0	---	---	---	---				
1978																
No. hunters	217	143	29	0	33	4	0	8	203	12	0	2				
Days hunted	---	---	---	---	0	---	---	---	---	---	0	---	363	350	69	---
Harvest	149	102	14	0	28	4	0	1	139	9	0	1				
1979																
No. hunters	184	106	43	1	18	2	0	14	178	5	0	1				
Days hunted	---	---	---	---	---	---	0	---	---	---	0	---	408	350	54	---
Harvest	99	84	8	0	4		0	3	96	3	0	0				
1980																
No. hunters	226	142	31	1	36	3	0	13	222	4	0	0				
Days hunted	---	---	---	---	---	---	---	---	---	---	0	---	421	350	64	---
Harvest	144	108	11	1	22	1	0	1	140	4	0	0				
1981																
No. hunters	224	139	55	3	24	0	0	3	206	14	0	4				
Days hunted	714	420	174	9	106	0	0	5		45	0	9	619	350	60	3.2
Harvest	135	103	20	0	11	0	0	1	124	8	0	3				
1982																
No. hunters	215	124	48	2	26	5	0	10	198	13	0	4				
Days hunted	790	426	165	15	125	19	0	40		46	0	8	732	350	66	3.7
Harvest	141	99	18	1	20	2	0	1	126	11	0	4				
1983																
No. hunters	181	71	51	4	44	8	0	3	162	16	0	3				
Days hunted	673	---	---	---	---	---	0	---	---	---	0	---	757	350	50	3.8
Harvest	91	52	12	0	19	6	0	2	78	10	0	3				

Source: ADF&G 1984, 1973-84.

--- means no data were available.

In 1972 and 1973, bag limits were reduced from three to one caribou and the season shortened to end in late September, eliminating the winter hunting period. Also, Nelchina caribou did not move eastward in these years during the open season (ibid.), thus not inflating the reported kill of the Mentasta herd as in past years. Harvests of 89 and 46 animals were reported for 1972 and 1973, respectively.

Most hunters in GMU 11 from 1969 to 1972 chartered local aircraft or hunted with guides. Almost one-third of the reporting hunters in 1972 were nonresidents, which reflects the guided component of hunters. Seventeen percent of the successful hunters hunted from highway vehicles or on foot from major roads, and hunters using aircraft, ORVs, or snowmachines were 31%, 25%, and 16% successful, respectively (ibid.).

Human use of the Mentasta caribou herd in GMU 11 remained fairly static throughout the mid 1970's and was comparable to the 1977-1983 permit draw period. Since the beginning of shorter seasons, lower bag limits, and a random permit drawing, GMU 11 hunters have been almost exclusively Alaskan residents.

3. Qualifications and limitations of data. The value of data describing the caribou harvest in GMU 13 and statewide is diminished by the lack of cooperation of rural residents, especially in the area of the northern and southwestern herds, in completing their harvest report forms. This results in severe underreporting in harvest data reports. Even in a permit-drawing hunt, the exact number of caribou harvested is never known. No consistent data collection format was used over time. This is understandable, however, in light of the changing data needs for management. Some hunters report more than one means of transportation used; therefore, data describing transport means may not indicate the actual number of either successful or unsuccessful hunters afield. Unsuccessful caribou hunters are not required to mark the method of transportation on the harvest report card. Until 1981, data describing hunter effort in the form of days hunted was not collected for the caribou herds in the Southcentral Region. A small number of hunters annually fail to report days hunted, which makes the data summarization process more difficult. In GMU 13, data broken down to the subunit level were not available until 1981.

F. Significance of Particular Use Areas

The reader is referred to the 1:1,000,000-scale maps in the Atlas to the guide for the Southcentral Region and to the 1:250,000-scale reference maps available in area offices of the ADF&G. These maps will show areas used for the hunting of caribou under the general harvest regulations. The more important use areas are summarized in table 6.

Table 6. Significant Harvest Areas for the Mentasta Caribou Herd in GMU 11 by Minor Tributary, 1983

Location	No. Hunters[a]	No. Days Hunted	Successful Hunters (Harvest)[a]	No. Days Hunted
Copper River east-side drainage between Nadina R. and Sanford R.	36	118	25	65
Tanada Creek	24	54	18	45
Copper River east-side drainages between Sanford R. and Boulder Cr.	18	44	15	35
Boulder Creek to drainage east of Drop Cr.	13	30	8	16
Copper River area above Slana River, excluding Tanada Cr.	11	60	6	29
Total (% of total GMU 11)	102(58)	306(45)	72(80)	190(71)
Total for GMU 11	175	673	90	66

Source: ADF&G 1984.

a Includes only those hunters who report days hunted.

V. GMU 13

A. Boundaries

According to 5 AAC 90.010, GMU 13 is defined as that area westerly of the east bank of the Copper River and drained by all tributaries into the west bank of the Copper River from Miles Glacier and including the Slana River drainages north of Suslota Creek; the drainages into the Delta River upstream from Clear Creek and Black Rapids Glacier; the drainage into the Nenana River upstream from the southeast corner of Mt. McKinley National Park at Windy; the drainage into the Susitna River upstream from its junction; the drainage with the Chulitna River; the drainage into the east bank of the Chulitna River upstream to its confluence with Tokositna River; the drainages of the Chulitna River (south of Mt. McKinley National Park) upstream from its confluence with the Tokositna River; the drainages into the north bank of the Tokositna River upstream to the base of the Tokositna Glacier; the drainage into the east bank of the Susitna River between its confluence with the Talkeetna and Chulitna rivers; the drainage into the north bank of the Chickaloon River drainages of the Matanuska River above its confluence with the Chickaloon River.

B. Management Objectives

According to the Nelchina Caribou Management Plan, the primary management objective is to provide the greatest sustained opportunity to participate in hunting caribou (State of Alaska 1984b). A secondary objective is to provide sustained opportunities to hunt caribou under aesthetically pleasing conditions.

Management guidelines include the following:

- Restrict harvest until the population increases to 30,000 caribou; thereafter harvest the annual increment
- Control access and methods of hunter transport, if necessary, to distribute hunter effort
- Maintain a minimum posthunting season population sex ratio of 25 bulls per 100 cows
- Encourage a natural fire regime on caribou range

C. Management Considerations

1. Susitna Hydroelectric Dam Project. The Susitna-Hydroelectric Dam Project on the upper Susitna River will affect only the Nelchina caribou herd. The primary effects upon caribou would be the interruption of movement patterns by the presence of the reservoirs and construction access routes. Some permanent loss of habitat will occur due to the creation of the impoundments, construction areas, borrow pits, and access routes. Pitcher (1982, 1983) considered the area to be low-quality range, used by some bulls in the summer. However, the Watana impoundment intersects a historically important migration pathway and could partially impede caribou migrations, especially spring movements from wintering grounds north of the Susitna River to traditional calving grounds in the upper Oshetna and Kosina creek drainages. Pitcher (1983) reported that many caribou are using the impoundment area as a travel route during spring migration in recent years. Natural impediments, such as floating ice, unstable ice conditions, open mud flats, snow drifts, and frigid waters could hinder movements, increase the probability of mortal injuries, and increase the risk of predation.

   Construction of the access road to the dam site area will directly affect caribou in the area. The potential for collisions with caribou will be high along the access route from the Denali Highway (FERC 1984). This road is expected to bisect a major migration route of the Nenana-Upper Susitna subherd of caribou, which ranges from the Parks Highway south of the Nenana River to Coal Creek. Pitcher (1983) estimated that 35 to 50% of this subherd use that pathway to reach high quality summer range in the Chulitna Mountains and return to the area east of the proposed road to spend the winter/spring season.

Postconstruction use of the road by the public is possible. This will lead to increased disturbance to caribou and increased hunting pressure.

Presence of the road could also influence movements to the higher quality range area by the main herd if this herd should return to wintering north of the Susitna as in past years. There are many behavioral, reproductive, and nutritional consequences that could directly affect the maintenance of the size of the Nelchina herd.

2. Predation. There is significant evidence from various wolf removal programs in Canada, Alaska, and in GMU 13 indicating that wolf predation can negatively influence caribou populations (Bergerud 1980, 1983, 1984; Gasaway et al. 1983).
3. Changing land ownership patterns. A very basic caribou habitat management problem has developed recently in the Southcentral Region, as well as in other parts of Alaska. With a rapidly increasing population, demands for human use of caribou have increased. Most of this demand is focused only on the Nelchina caribou herd. However, the amount of available land under public jurisdiction and ownership is declining with the rapidly increasing rate of land resource development (agriculture, forestry, minerals). State and borough land disposal programs are expected to shift large amounts of land into private control through outright sales or leasing arrangements. These actions will reduce opportunities for public use of wildlife resources, such as the Nelchina caribou herd. Some of these resource development programs may affect the capability of the caribou population to perpetuate itself at a level sufficient to accommodate current and future levels of human use.

D. Period of Use

The historical use of caribou within the Nelchina range is best summarized by Skoog (1968). Due to the scarcity of caribou in the Nelchina Basin during the 1930's and 1940's, very little human use occurred in this period. Table 7 summarizes season lengths, bag limits, and harvest data from 1946 to the present. With increasing numbers of caribou available, season lengths and bag limits increased rapidly, peaking in 1964 with a four caribou limit in an almost eight-month season. In 1972, sharp restrictions in bag limits and season lengths were instituted as a result of the 1972 Nelchina census (Bos 1974). In 1976, in an attempt to limit the harvest to 500 animals, the season was closed by emergency order September 10 after being open for only five days. ADF&G check station personnel had reported approximately 250 caribou taken by September 8.

Because the legal reported kill since 1972 had exceeded the management goal of harvesting 5% of the Nelchina herd, it was recommended that caribou hunting be put on a drawing permit basis.

Table 7. Nelchina Caribou Herd Seasons, Bag Limits, Harvests, and Sex Composition in the Harvest in GMU 13, 1946-83

Year	Season	Bag Limit	Harvest		Males in Harvest		Appli- cations	Permits Issued
			Reported	Estimated[a]	Number	% Total		
1946	8/20-9/30; 12/01-12/15	Resident-two caribou except calves Nonresident-one caribou	192	200	---	---		
1947	8/20-9/30; 12/01-12/15	Resident-two caribou except calves Nonresident-one caribou	162	200	---	---		
1948	8/20-9/30; 12/01-12/15	Resident-two caribou except calves Nonresident-one caribou	184	300	175	96.6		
1949	8/20- 9/30; 12/01-12/15	One caribou except calves	---	350	---	---		
1950	9/01- 9/30	One caribou except calves	431	500	---	---		
1951	9/01- 9/30	One caribou except calves	486	525	---	---		
1952	9/01- 9/30	One male only w/forked antlers	424	450	291	93.4		
1953	9/01- 9/30	One male only w/forked antlers	500	700	445	84.5		
1954	8/20- 9/30; 11/20-11/30	One caribou except calves	1,271	2,000	1,271	71.8		
1955	8/20-11/30	Two caribou	1,076	4,000	1,076	72.5		
1956	8/20-12/31	Two caribou	844	3,500	844	71.8		
1957	8/20-12/31	Three caribou	1,637	2,500	1,125	75.0		
1958	8/20-12/31	Three caribou	---	3,500	---	---		
1959	8/20-12/31	Three caribou	1,400	4,000	922	69.6		
1960	8/20-12/31	Three caribou	3,259	5,500	2,535	66.1		
1961	8/20-12/31	Three caribou	4,525	8,000	3,923	58.0		
1962	8/20-12/31	Three caribou	2,796	3,500	2,640	68.7		
1963	8/10- 3/31	Three caribou	3,709	6,300	3,709	60.8		
1964	8/10- 3/31	Four caribou	2,997	8,000	1,850	66.0		
1965	8/10- 3/31	Three caribou	1,222	7,100	1,222	67.0		
1966	8/10- 3/31	Three caribou	849	5,500	849	71.0		
1967	8/10- 3/31	Three caribou	740	4,000	740	65.0		
1968	8/10- 3/31	Three caribou	4,670	5,974	2,334	57.1		
1969	8/10- 3/31	Three caribou	5,422	7,814	5,332	49.3		
1970	8/10- 9/30; 11/1- 3/31	Three caribou	4,106	6,399	4,018	63.2		
1971	8/10- 3/31	Three caribou	6,857	8,125	6,743	46.6		
1972[b]	8/10- 9/20*	One caribou	555	---	388	71.7		
1973	8/10- 9/20	One caribou	631	810	412	67.1		
1974	8/10- 9/20	One caribou	1,036	1,193	656	65.6		
1975	8/10- 9/20	One caribou	669	806	441	68.7		
1976	9/05- 9/20[d]	One caribou	776	822	560	73.6		
1977[c]	9/01- 9/20	One caribou	360	---	275	78.1	1,383	750
1978	9/01- 9/20	One caribou	539	---	416	78.9	2,775	1,000
1979	8/20- 9/20	One caribou	630	---	509	85.0	5,600	1,300

(continued)

Table 7 (continued).

Year	Season	Bag Limit	Harvest Reported	Harvest Estimated[a]	Males in Harvest Number	Males in Harvest % Total	Applications	Permits Issued
1980	8/20- 9/20	One caribou	621	---	453	79.5	6,841	1,300
1981	8/20- 9/20	One caribou	901	---	704	81.9	6,819	1,601
	1/01/82- 2/28/82[e]	One antlerless caribou						
1982	8/20- 9/20	One caribou	861	---	702	86.3	9,110	1,750
	1/01/83- 3/31/83[e]	One antlerless caribou						
1983	8/20- 9/20	One caribou	971	---	827	85.7	9,720	1,750
	1/01-84- 3/31/84[e]	One antlerless caribou						

Source: Unpublished data in ADF&G caribou files and ADF&G 1973-85.

--- means no data were available.

* Season dates changed from Aug. 10-Dec. 31 to Aug. 10-Sept. 20 and bag limits from three to one caribou by authority of field announcement issued July 27, 1972.

a Estimated harvests based on herd-specific extrapolation formulas developed by ADF&G.

b Percentage of males in reported harvest based only on animals sexed from 1972 to the present.

c Harvest data from 1977 to present include harvests from GMUs 14A and 14B.

d Closed by emergency field order.

e Special subsistence hunt.

The three-week season length for 1977 and 1978 was extended to a month in 1979 and 1980. In 1981, the Board of Game created a special subsistence hunt and authorized that 150 of the 1,600 permits be issued to qualified "subsistence" hunters. Only antlerless caribou (bulls) could be taken by subsistence hunters in a second hunting period between January 1 and February 28. In 1982, essentially the same regulations were in place, except 1,750 permits were issued by drawing, which included 450 subsistence permits. Subsistence permits not allocated in the drawing were issued on a first come-first served basis to those meeting the hunt residency requirements. Since 1981, nonresidents have been excluded from these hunts.

E. Human Use Data

1. Reported human use data. Table 8 summarizes human use data available for caribou in GMUs 13, 14A, and 14B, which include the range of the Nelchina caribou herd. Tables 9 through 14 break these data down further by GMU 13 subunits for the years 1981 to 1983.

   Since 1981, the harvest of Nelchina caribou has been restricted to Alaska residents. From 1977 to 1981, more than 90% of the hunters were Alaskan residents. Between 1977 and 1983, 77% of the available permits have been used, and of those who did hunt 66% were successful, with a low of 62% in 1977 and a high of 72% in 1978. For the years 1981, 1982, and 1983, the total number of hunters averaged 3.5, 4.6, and 3.9 days in the field, with an overall average of 4.0 days for the entire period. The statewide average for 1983 was 4.3 days.

   In 1983, 14.7% of those who applied for a Nelchina caribou permit actually hunted, whereas in 1977 41.9% of those who applied for a permit actually hunted. These figures reflect a seven-fold increase in applicants and a 233% increase in the number of available permits. The proportion of individuals utilizing their permits remained fairly constant in this period. The probability of drawing a Nelchina permit, however, has declined rapidly. In 1977, an applicant had a 54% probability, or one chance out of less than two of receiving a permit, but by 1983 this probability had dropped to 18%, or one chance out of five or six. These statistics point out the tremendous increase in hunter interest to utilize this herd and also its high accessibility.

   In 1983, approximately 51% of the Nelchina caribou hunters lived in the Anchorage Bowl area, 19% in the Glennallen-Cantwell area, 18% in the Mat-Su Valley (mainly Palmer and Wasilla), 8% from the Fairbanks area, and the remainder from various parts of the state (ADF&G 1984).

   Since 1978, 24.6% of all hunters used aircraft, 31.4% used a highway vehicle and/or walked, and 29.5% used an ORV. In this period, the number of hunters using aircraft seemed to remain within a narrow range while the total number of

Table 8. Total Reported Human Use of Caribou in GMUs 13, 14A, and 14B, 1977-83

		By Mode of Access							By Hunter Origin							
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	Total Appli-cations	No. Permits	% Success	Avg. Days Hunted
1977																
No. hunters	580	---	---	---	---	---	---	---	---	---	---	---	1,383	750	62	
Days hunted	---	---	---	---	---	---	---	---	---	---	---	---				---
Harvest	360	---	---	---	---	---	---	---	---	---	---	---				
1978																
No. hunters	747	226	173	50	281	12	0	5	710	30	0	7	2,775	1,000	72	
Days hunted	---	---	---	---	---	---	0	---	---	---	0	---				---
Harvest	539	190	88	31	222	8	0	0	510	25	0	4				
1979																
No. hunters	972	268	257	59	328	29	0	31	912	50	0	10	5,600	1,300	65	
Days hunted	---	---	---	---	---	---	0	---	---	---	0	---				---
Harvest	630	230	110	37	228	22	0	3	585	41	0	4				
1980																
No. hunters	981	302	275	71	276	19	0	38	933	45	0	3	6,841	1,300	63	
Days hunted	---	---	---	---	---	---	0	---	---	---	0	---				---
Harvest	621	245	124	44	188	13	0	7	578	41	0	2				
1981																
No. hunters	1,286	313	431	139	341	22	8	32	1,232	50	0	4	6,819	1,600	70	
Days hunted*	4,501	916	1,328	593	1,356	83	10	215	4,255	226	0	20				3.5
Harvest	901	274	250	101	243	18	6	9	858	40	0	3				
1982																
No. hunters	1,334	237	555	123	295	13	65	46	1,331	0	0	3	9,110	1,750	65	
Days hunted*	5,818	2,738	760	415	970	69	524	342	5,805	0	0	13				4.6
Harvest	861	204	276	89	227	12	41	12	756	0	0	1				
1983																
No. hunters	1,431	240	507	153	411	13	63	44	1,429	0	0	2	9,720	1,750	68	
Days hunted*	5,458	---	---	---	---	---	---	---	---	0	0	---				3.9
Harvest	971	214	268	121	319	8	33	8	969	0	0	2				

Source: ADF&G 1984; unpublished data in caribou files, ADF&G, Anchorage.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 9. Total Reported Human Use of Caribou in GMU 13A, 1981-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1981														
No. hunters	643	163	181	99	180	10	2	8	612	29	0	2	72	
Days hunted*	2,057	491	531	390	580	30	4	31	1,941	100	0	16		3.2
Harvest	462	145	100	70	136	7	1	3	440	21	0	1		
1982														
No. hunters	697	143	227	105	175	7	32	8	696	0	0	1	70	
Days hunted*	2,730	469	991	340	497	26	376	31	2,728	0	0	2		3.9
Harvest	487	124	110	78	144	6	23	2	487	0	0	0		
1983														
No. hunters	860	155	241	125	290	7	32	10	858	0	0	2	72	
Days hunted*	3,115	---	---	---	---	---	---	---	---	0	0	---		3.7
Harvest	617	135	128	97	231	5	17	4	615	0	0	2		

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 10. Total Reported Human Use of Caribou in GMU 13B, 1981-83

		By Mode of Access								By Hunter Origin			
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied
1981												
No. hunters	256	33	130	30	46	6	2	9	243	12	0	1
Days hunted*	967	81	439	131	250	21	4	41	914	51	0	2
Harvest	171	29	75	25	32	6	2	2	163	7	0	1
1982												
No. hunters	192	21	114	8	26	4	10	9	191	0	0	1
Days hunted*	862	60	497	22	123	21	99	40	856	0	0	6
Harvest	106	18	52	4	18	4	9	1	106	0	0	0
1983												
No. hunters	148	25	73	17	23	3	0	7	148	0	0	0
Days hunted*	535	---	---	---	---	---	---	---	---	0	0	0
Harvest	105	21	49	16	15	2	0	2	105	0	0	0

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 11. Total Reported Human Use of Caribou in GMU 13C, 1981-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1981														
No. hunters	21	6	5	1	7	0	0	2	20	1	0	0	52	
Days hunted*	121	17	44	23	32	0	0	5	107	14	0	0		5.8
Harvest	11	5	2	1	3	0	0	0	11	0	0	0		
1982														
No. hunters	107	1	87	0	4	0	11	4	107	0	0	0	59	
Days hunted*	723	3	647	0	32	0	17	24	723	0	0	0		6.8
Harvest	63	0	56	0	1	0	5	1	63	0	0	0		
1983														
No. hunters	60	0	41	0	7	0	8	4	41	0	0	0	58	
Days hunted*	406	---	---	---	---	---	---	---	---	0	0	0		7.1
Harvest	35	0	22	0	5	0	8	0	35	0	0	0		

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 12. Total Reported Human Use of Caribou in GMU 13D, 1981-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1981														
No. hunters	36	3	7	0	22	0	0	4	34	2	0	0	69	
Days hunted*	215	4	37	0	94	0	0	80	203	12	0	0		6.0
Harvest	25	2	6	0	16	0	0	1	23	2	0	0		
1982														
No. hunters	31	2	10	0	15	1	1	2	31	0	0	0	71	
Days hunted*	206	5	107	0	50	2	5	37	206	0	0	0		6.6
Harvest	22	2	5	0	13	1	0	1	22	0	0	0		
1983														
No. hunters	5	0	0	0	4	0	1	0	5	0	0	0	100	
Days hunted*	11	---	---	---	---	---	---	0	11	0	0	0		2.2
Harvest	5	0	0	0	4	0	1	0	5	0	0	0		

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 13. Total Reported Human Use of Caribou in GMU 13E, 1981-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1981														
No. hunters	237	71	81	4	66	6	3	6	223	13	0	1	76	
Days hunted*	797	196	196	29	302	32	2	40	751	44	0	2		3.4
Harvest	180	65	57	1	47	5	3	2	170	9	0	1		
1982														
No. hunters	184	39	71	4	61	0	7	2	183	0	0	1	68	
Days hunted*	630	98	286	22	205	0	17	2	625	0	0	5		3.4
Harvest	126	33	42	2	46	0	2	1	126	0	0	0		
1983														
No. hunters	198	49	73	5	58	1	9	3	198	0	0	0	82	
Days hunted*	682	---	---	---	---	---	---	---	---	0	0	0		3.5
Harvest	162	48	55	4	47	0	6	2	162	0	0	0		

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

Table 14. Total Reported Human Use of Caribou in GMU 13 Where No Subunit Location Was Reported, 1981-83

		By Mode of Access								By Hunter Origin				
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1981														
No. hunters	82	30	25	5	19	0	0	3	79	3	0	0	60	
Days hunted*	298	92	73	20	95	0	0	18	293	5	0	0		3.6
Harvest	49	25	10	4	9	0	0	1	48	1	0	0		
1982														
No. hunters	111	24	43	6	13	0	4	21	111	0	0	0	45	
Days hunted*	622	59	255	31	59	0	10	208	622	0	0	0		5.6
Harvest	50	21	11	5	5	0	2	6	50	0	0	0		
1983														
No. hunters	151	5	78	6	28	1	13	20	151	0	0	0	27	
Days hunted*	679	---	---	---	---	---	---	---	---	0	0	0		4.8
Harvest	41	5	14	4	17	0	1	0	41	0	0	0		

Source: ADF&G 1984.

--- means no data were available.

* Does not represent total days hunted by all hunters because a small number of hunters did not report this information.

hunters had almost doubled. ORV hunters and those on foot have increased greatly, especially in the last few years. This probably reflects the increased use of three-wheelers and newly developed ATVs and track ORVs. Of the successful hunters, 31.2%, 23.5%, and 32.3% used aircraft, highway vehicle and/or foot, and ORVs, respectively. Hunters using aircraft to transport them to caribou hunting areas were 85.6% successful in bagging a caribou, while those using highway vehicles and walking were 49.8% successful, and ORV hunters were 73.7% successful.

In GMUs 13, 14A, and 14B, the caribou harvest since 1978 has ranged from 539 in 1978 to 971 in 1983, with an average of 754 animals for the period 1978-1983. This harvest generally removes less than 5% of the total estimated population.

Results from a 1973 survey of 611 hunters encountered on the Denali Highway and Nabesna Road indicated that 88% of the hunters considered themselves meat hunters (ADF&G 1976).

2. Historical use levels. Human use of the Nelchina caribou herd in GMUs 13, 14A, and 14B was first documented in 1946. At approximately this time, the Nelchina herd began a phase of rapid expansion of numbers, tripling in size between 1948 and 1954. Reported harvests of caribou rose from 192 in 1946 to 1,271 in 1954. Hunters responded to liberalized bag limits, the increased season length, and the increased number of Nelchina caribou. Estimated harvests exceeded 3,500 caribou in most years from 1955 to 1971, reaching an estimated annual maximum of 8,125 animals, when 6,857 caribou were actually reported harvested. After 1971, sharp reductions in season length and bag limits also reduced hunter accessibility and motivation, and the hunter take was less than 600 caribou. The estimated harvest continued to increase to 1,193 by 1974 (BGDIF 1975). Further reductions of harvest length and bag limits held the harvest in check, while the herd began to recover in numbers.

From 1959 to 1962, 93.6% of the hunters were Alaskan residents, whereas 82.7% were residents between 1969 and 1971. This can probably be explained by the greater activity of guides in the area. Interest by nonresidents was probably heightened by reports of large harvests occurring at that time. As the harvest amounts declined in the 1970's relative to previous years, likewise the percentage of nonresident hunters declined.

In the early 1950's, 70 to 80% of successful hunters used a highway vehicle and their feet or an ORV to reach hunting areas, with the remainder flying. By 1971, the predominant means of transport had become the snowmachine. For the period 1969 through 1971, 32.6% of the successful hunters had relied on a snowmachine, 25.4% used aircraft, 26.4% were on foot, and 10.9% used ORVs. Because of the effectiveness of snowmachines in providing increased access, seasons were ultimately shortened to that time period without snow in order to limit harvest pressure.

3. Qualifications and limitations of data. See section III.E.3. The same data problems associated with GMU 11 were evident in GMUs 13, 14A, and 14B.

F. Significance of Particular Use Areas

See the 1:1,000,000-scale human use maps in the Atlas to the guide for the Southcentral Region and the 1:250,000-scale reference maps available in area offices of the ADF&G. These maps will show areas used for hunting of caribou under the general harvest regulations.

The more important use areas in 1983 are summarized in table 15.

VI. GMU 15(A)

A. Boundaries

GMU 15, as defined according to 5 AAC 90.010, includes that portion of the Kenai Peninsula draining into the Gulf of Alaska, Cook Inlet, and Turnagain Arm from Point Gore to the Chugach National Forest (CNF) boundary near Big Indian Creek and lying west of the CNF boundary from Turnagain Arm to the upper end of Upper Russian Lake, and including the drainages into upper Russian Lake west of the CNF boundary.

Subunit 15(A) includes that portion of GMU 15 bounded on the south by the Kenai River and Skilak Lake.

B. Management Objectives

According to the Kenai Lowland Caribou Management Plan (State of Alaska 1984a), the primary objective is to protect, maintain, and enhance the caribou population in concert with other components of the ecosystem and take large animals under aesthetically pleasing conditions. The secondary objective is to provide sustained opportunities to view and photograph caribou.

Management guidelines for the Kenai Lowland Caribou Plan include the following:

- Consider the ecological relationships of caribou and the human benefits derived from caribou and other wildlife in the formulation and implementation of management programs for caribou
- Protect caribou from excessive unnatural disturbances and harassment to maintain a minimum spring population of 50 adult caribou with a sex ratio of at least 25 bulls per 100 cows
- Sport hunting should be allowed only by permit to restrict harvest and ensure an aesthetically pleasing hunt
- Protect caribou range from development or other unnatural disturbance
- Encourage public viewing and photography of caribou to increase the human benefits from the resource
- Maintain inventory and assessment programs that provide the information necessary to protect the caribou population and manage the various public uses of caribou in the area

Table 15. Significant Harvest Areas for the Nelchina Caribou Herd in GMU 13 by Minor Tributary, 1983

Location	Total No. Hunters[a]	Total Days Hunted	Successful Hunters (Harvest)[a]	No. Days Hunted
GMU 13A				
Tyone River-Tyone Creek	272	1,101	184	617
Little Nelchina River	221	587	164	353
Caribou Creek	87	283	73	241
Oshetna River	50	167	43	131
Subtotal (% of subunit total)	630(76)	2,138(69)	494(78)	1,342(69)
Subunit total	829	3,115	598	1,940
GMU 13B				
Gulkana River-Middle Fork	40	184	23	69
MacLaren River	25	96	20	66
Clearwater Creek	14	43	6	17
Valdez Creek-Windy Creek	11	26	11	26
Susitna River (Clearwater Creek-Butte Creek)	10	35	9	32
Subtotal (% of subunit total)	100(69)	384(72)	69(66)	210(67)
Subunit total	145	535	104	313
GMU 13C				
Copper River(Chistochina River-Slana River)	13	47	11	41
Copper River (Gakona River-Chistochina River)	21	150	8	97
Subtotal (% of subunit total)	34(60)	197(49)	19(58)	138(59)
Subunit total	57	406	33	232
GMU 13E				
Butte Creek	29	72	26	63
Jack River	30	226	17	126
Susitna River (Butte Creek to the forks)	20	41	16	26
Nenana River-Monaban Creek area	39	107	30	76
Deadman Creek	11	37	11	37
Subtotal (% of subunit total)	129(68)	483(71)	100(64)	328(64)
Subunit total	190	682	156	516

Source: ADF&G 1984.

a Includes only those hunters who report days hunted.

- ° Maintain an active cooperative management program with the USFWS (Kenai NWR)

C. Management Considerations

1. Marginal range quality. The range utilized by the Kenai Lowlands herd is very limited in size and is considered atypical caribou habitat. In addition, the quality of the habitat used by this herd is difficult to assess. The Moose River Flats, the currently used range, does not contain significant amounts of lichens. Other food items, such as sedges, are believed to be the primary winter foods. The herd has shown a very slow growth rate over the years, which may indicate low range quality (Holdermann 1983).
2. Predation. Because of the close proximity of the herd's traditional calving area to the City of Kenai and the well-documented occurrence of dog packs in that area, it has been strongly suspected that predation of young calves (less than 30 days old) by free-ranging dogs and wild carnivores may be limiting population growth (Spraker 1984).

D. Period of Use

The Kenai Lowland herd has experienced negligible population growth since the 1966 transplant. By 1980, however, this herd had increased to a level that could support a limited sport harvest (Spraker 1981). The first hunt of the herd occurred between September 11 and October 15, 1981. Five permitees were allowed to shoot one bull. The ADF&G recommended closure of the 1982 hunt to allow additional recruitment of males into the older age classes (Holdermann 1983). After reviewing 1982 survey data, the ADF&G proposed a hunt by drawing permit for four bulls in the fall of 1983. The Board of Game denied the request.

E. Human Use Data

Table 16 presents data describing results from the first and only year that caribou were harvested in GMU 15A. According to the ADF&G (1977), the present uses of this herd are solely for viewing and photography. Almost all use is incidental to some other pursuit. Most caribou are observed by persons flying to or from the Kenai Airport during the summer. Occasionally, caribou are seen along the road system or by snowmobilers. Most use is by residents of the Kenai Peninsula.

F. Significance of Particular Use Areas

See the 1:1,000,000-scale maps in the Atlas to the guide for the Southcentral Region and the 1:250,000-scale reference maps available in area offices of the ADF&G. These maps show those areas consistently used for hunting of caribou under the general harvest regulations.

VII. GMU 16

A. Boundaries

GMU 16, as defined according to 5 AAC 90.010, includes the drainage into the west side of Cook Inlet from and including Redoubt Creek, including Kalgin Island, northward to and including

Table 16. Total Reported Human Use of Caribou in GMU 15A, 1977-81

	Total	By Mode of Access: Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	By Hunter Origin: Res.	Non-res.	Alien	Unspeci-fied	Total Appli-cations	No. Permits	% Success	Avg. Days Hunted
1981																
No. hunters	5	0	3	2	0	0	0	0	5	0	0	0	236	5	80	
Days hunted	---	---	---	---	---	---	---	---	---	---	---	---				---
Harvest	4	0	2	2	0	0	0	0	4	0	0	0				

Source: BGDIF 1981.

--- means no data were available.

the Susitna River; the drainage from the west and including the Susitna River upstream to its junction with the Chulitna River; the drainage from the west into and the including the Chulitna River below its confluence with the Tokositna River; the drainage from the south into and including the Tokositna River upstream to the base of the Tokositna Glacier, which includes the drainage of the Kanitula Glacier.

B. Human Use Data

Caribou found in GMU 16 are mainly associated with the Mulchatna herd in GMUs 17 and 19. Because this herd has already been dealt with in detail in the Alaska Habitat Management Guide for the Southwest Region, data describing only a very small number of animals, which seasonally inhabit a very small area barely within the GMU 16 boundary, will be presented in tables 17 through 20. It would be impossible to draw any conclusions from these data, because they have been derived from only a small portion of the Mulchatna caribou herd. The data are presented here only to maintain some degree of data-reporting consistency.

Table 17. Total Reported Human Use of Caribou in GMU 16, 1977-83

		By Mode of Access								By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1977														
No. hunters	90	39	22	0	13	0	1	15	79	11	0	0	41	
Days hunted	---	---	---	---	---	---	---	---	---	---	0	0		---
Harvest	37	30	1	0	2	0	2	2	30	7	0	0		
1978														
No. hunters	50	19	17	3	7	0	0	4	36	9	0	5	28	
Days hunted	264	130	72	15	33	0	0	14	150	64	0	50		5.3
Harvest	14	10	0	0	0	0	0	4	3	6	0	5		
1979														
No. hunters	46	21	10	2	4	5	0	4	19	9	11	7	48	
Days hunted	306	191	38	8	9	43	0	17	68	77	121	40		6.6
Harvest	22	16	0	0	0	5	0	1	4	7	11	0		
1980														
No. hunters	39	19	12	1	4	1	0	2	30	2	2	5	31	
Days hunted	200	108	53	10	14	2	0	13	129	12	31	28		5.1
Harvest	12	10	0	0	1	1	0	0	10	1	0	1		
1981														
No. hunters	51	24	13	1	3	6	0	4	36	8	4	3	39	
Days hunted	307	153	62	2	25	55	0	10	154	74	34	45		6.0
Harvest	20	15	0	0	0	5	0	0	10	7	3	0		
1982														
No. hunters	34	20	3	1	3	3	0	4	17	7	0	10	47	
Days hunted	171	97	19	1	20	18	0	16	77	49	0	45		5.0
Harvest	16	12	0	0	0	3	0	1	5	5	0	6		
1983														
No. hunters	39	25	1	1	1	4	0	7	24	14	0	1	46	
Days hunted	248	---	---	---	---	---	---	---	---	---	0	---		6.4
Harvest	18	12	0	0	0	4	0	2	6	11	0	1		

Source: ADF&G 1984.

--- means no data were available.

Table 18. Total Reported Human Use of Caribou in GMU 16A, 1978-83

	Total	By Mode of Access: Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	By Hunter Origin: Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1978														
No. hunters	23	0	17	0	6	0	0	0	23	0	0	0	0	
Days hunted	102	0	72	0	30	0	0	0	102	0	0	0		4.4
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		
1979														
No. hunters	12	0	7	0	4	0	0	1	9	0	0	3	0	
Days hunted	44	0	31	0	9	0	0	4	25	0	0	19		3.7
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		
1980														
No. hunters	14	0	12	0	1	0	0	1	10	0	0	4	7	
Days hunted	55	0	53	0	1	0	0	1	39	0	0	16		3.9
Harvest	1	0	0	0	1	0	0	0	0	0	0	1		
1981														
No. hunters	15	0	11	0	3	0	0	1	15	0	0	0	0	
Days hunted	80	0	52	0	25	0	0	3	80	0	0	0		5.3
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		
1982														
No. hunters	7	1	3	0	2	0	0	1	4	0	0	3	0	
Days hunted	47	8	19	0	13	0	0	7	28	0	0	19		6.7
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		
1983														
No. hunters	11	7	0	0	1	0	0	3	11	0	0	0	0	
Days hunted	46	22	0	0	3	0	0	21	46	0	0	0		4.6
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		

Source: ADF&G 1984.

Table 19. Total Reported Human use of Caribou in GMU 16B, 1978-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1978														
No. hunters	27	19	0	3	1	0	0	4	13	9	0	5	52	
Days hunted	162	130	0	15	3	0	0	14	48	64	0	50		6.0
Harvest	14	10	0	0	0	0	0	4	3	6	0	5		
1979														
No. hunters	27	19	0	0	0	5	0	3	7	8	11	1	78	
Days hunted	229	173	0	0	0	43	0	13	32	69	121	7		8.5
Harvest	21	15	0	0	0	5	0	1	4	6	11	0		
1980														
No. hunters	17	16	0	0	0	1	0	0	15	0	2	0	53	
Days hunted	93	91	0	0	0	2	0	0	62	0	31	0		5.5
Harvest	9	8	0	0	0	1	0	0	9	0	0	0		
1981														
No. hunters	31	21	0	1	0	6	0	3	18	7	3	3	55	
Days hunted	206	142	0	2	0	55	0	7	59	68	34	45		6.6
Harvest	17	12	0	0	0	5	0	0	9	6	2	0		
1982														
No. hunters	24	17	0	1	0	3	0	3	12	7	0	5	63	
Days hunted	115	87	0	1	0	18	0	9	42	49	0	24		4.8
Harvest	15	11	0	0	0	3	0	1	5	5	0	5		
1983														
No. hunters	26	18	0	0	0	4	0	4	11	14	0	1	69	
Days hunted	190		0	0	0		0				0			7.3
Harvest	18	12	0	0	0	4	0	2	6	11	0	1		

Source: ADF&G 1984.

Table 20. Total Reported Human Use of Caribou in GMU 16, Where No Subunit Location Was Indicated, 1979-83

		By Mode of Access							By Hunter Origin					
	Total	Air-plane	Hwy. Vehicle	Boat	ORV	Horse	Snow-machine	Unspeci-fied	Res.	Non-res.	Alien	Unspeci-fied	% Success	Avg. Days Hunted
1979														
No. hunters	7	2	3	2	0	0	0	0	3	1	0	3	14	
Days hunted	33	18	7	8	0	0	0	0	11	8	0	14		4.7
Harvest	1	1	0	0	0	0	0	0	0	1	0	0		
1980														
No. hunters	8	3	0	1	3	0	0	1	5	2	0	1	25	
Days hunted	52	17	0	10	13	0	0	12	28	12	0	12		6.5
Harvest	2	2	0	0	0	0	0	0	1	1	0	0		
1981														
No. hunters	5	3	2	0	0	0	0	0	3	1	1	0	60	
Days hunted	21	11	10	0	0	0	0	0	15	6	0	0		4.2
Harvest	3	3	0	0	0	0	0	0	1	1	1	0		
1982														
No. hunters	3	2	0	0	1	0	0	0	1	0	0	2	33	
Days hunted	9	2	0	0	7	0	0	0	7	0	0	2		3.0
Harvest	1	1	0	0	0	0	0	0	0	0	0	1		
1983														
No. hunters	2	0	1	1	0	0	0	0	2	0	0	0	0	
Days hunted	12	0	2	10	0	0	0	0	12	0	0	0		6.0
Harvest	0	0	0	0	0	0	0	0	0	0	0	0		

Source: ADF&G 1984.

REFERENCES

ADF&G. 1973-84. Annual reports of survey-inventory activities. Fed. Aid in Wildl. Rest.

ADF&G, comp. 1976. A fish and wildlife resource inventory of the Cook Inlet-Kodiak areas. Vol. 1: Wildlife. [Juneau.] 265 pp.

________. 1977. Alaska wildlife management plans: public proposal for the management of Alaska's wildlife. Fed. Aid in Wildl. Rest. Proj. W-17-R.

________. 1984. Southcentral Regional big game harvest data - computer output. January, 1984. Caribou harvest and permits.

BGDIF (Big Game Data Information Files). 1977-1983. Data on file, ADF&G, Div. Game, Anchorage.

Bergerud, A.T. 1980. A review of the population dynamics of caribou and wild reindeer in North America. Pages 556-581 _in_ E. Reimers, E. Gaare, and S. Kjenneberg, eds. Proceedings of the second international reindeer/caribou symposium. Roros, Norway.

________. 1983. The natural population control of caribou. Pages 14-61 _in_ F.L. Bunnell, D.S. Eastman, and J.M. Peek, eds. Symposium on natural regulation of wildlife populations, March 10, 1978, Vancouver, B.C. Proc. No. 14, Forest, Wildlife, and Range Experimental Station, Univ. Idaho, Moscow.

________. 1984. The buffalo of the north: caribou (_Rangifer tarandus_) and human developments. Arctic 37(1):7-22.

Bos, G.N. 1974. Nelchina and Mentasta caribou reports. ADF&G, Fed. Aid in Wildl. Rest. Projs. W-17-5 and W-17-6. Juneau. 50 pp.

FERC (Federal Energy Regulatory Commission). 1984. Susitna Hydroelectric Project, FERC No. 7114. Draft environ. impact statement. Vol. 5: Appendices J & K.

Gasaway, W.C., R.O. Stephenson, J.L. Davis., P.E.K. Shephard, and O.E. Burris. 1983. Interrelationships of wolves, prey, and man in interior Alaska. Wildl. Monog. 84:1-50.

Holdermann, D.A. 1983. Caribou survey-inventory progress report, 1981-1982. Pages 22-23 _in_ R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1.

Leroux, P.A. 1979. Caribou survey-inventory progress report, 1977-78. Pages 133-136 _in_ R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 9, Part 3. Proj. W-17-4.

Leroux, P.A., and J.L. Davis. 1973. Caribou survey-inventory progress report-1971. Pages 3-8 in D.E. McKnight, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 3, Part 2. Proj. W-17-4.

Pitcher, K.W. 1982. Susitna Hydroelectric Project. Phase 1: final rept., big game studies. Vol. 4: Caribou. ADF&G, submitted to the Alaska Power Authority. Anchorage. 101 pp.

________. 1983. Susitna Hydroelectric Project. Phase 2: 1982 ann. rept., big game studies. Vol. 4: Caribou. ADF&G, submitted to the Alaska Power Authority. Anchorage. 43 pp.

Scott, R.F., E.F. Chatelain, and W.A. Elkins. 1950. The status of the Dall sheep and caribou in Alaska. Trans. N. Am. Wildl. Conf. 15:612-626.

Skoog, R.O. 1968. Ecology of the caribou (Rangifer tarandus grant) in Alaska. Ph.D. Thesis, Univ. California, Berkeley. 699 pp.

Spraker, T.H. 1981. Caribou survey-inventory progress report, 1980-81. Pages 1-4 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12, Part 2. Projs. W-19-1 and W-19-2.

________. 1984. Caribou survey-inventory progress report, 1982-83. Pages 1-2, 22-23 in R.A. Hinman, ed. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 14, Part 6. Proj. W-22-2.

Stratton, L. 1983. Copper River Basin caribou use: a research update. ADF&G, Div. Subsistence, Anchorage. 29 pp.

State of Alaska. 1984a. Resource management recommendations for Kenai National Wildlife Refuge and surrounding area. 20 pp.

________. 1984b. Resource management recommendations for Wrangell-St. Elias National Park and Preserve and surrounding area. 26 pp.

Dall Sheep Human Use

I. POPULATION MANAGEMENT HISTORY

A. Introduction

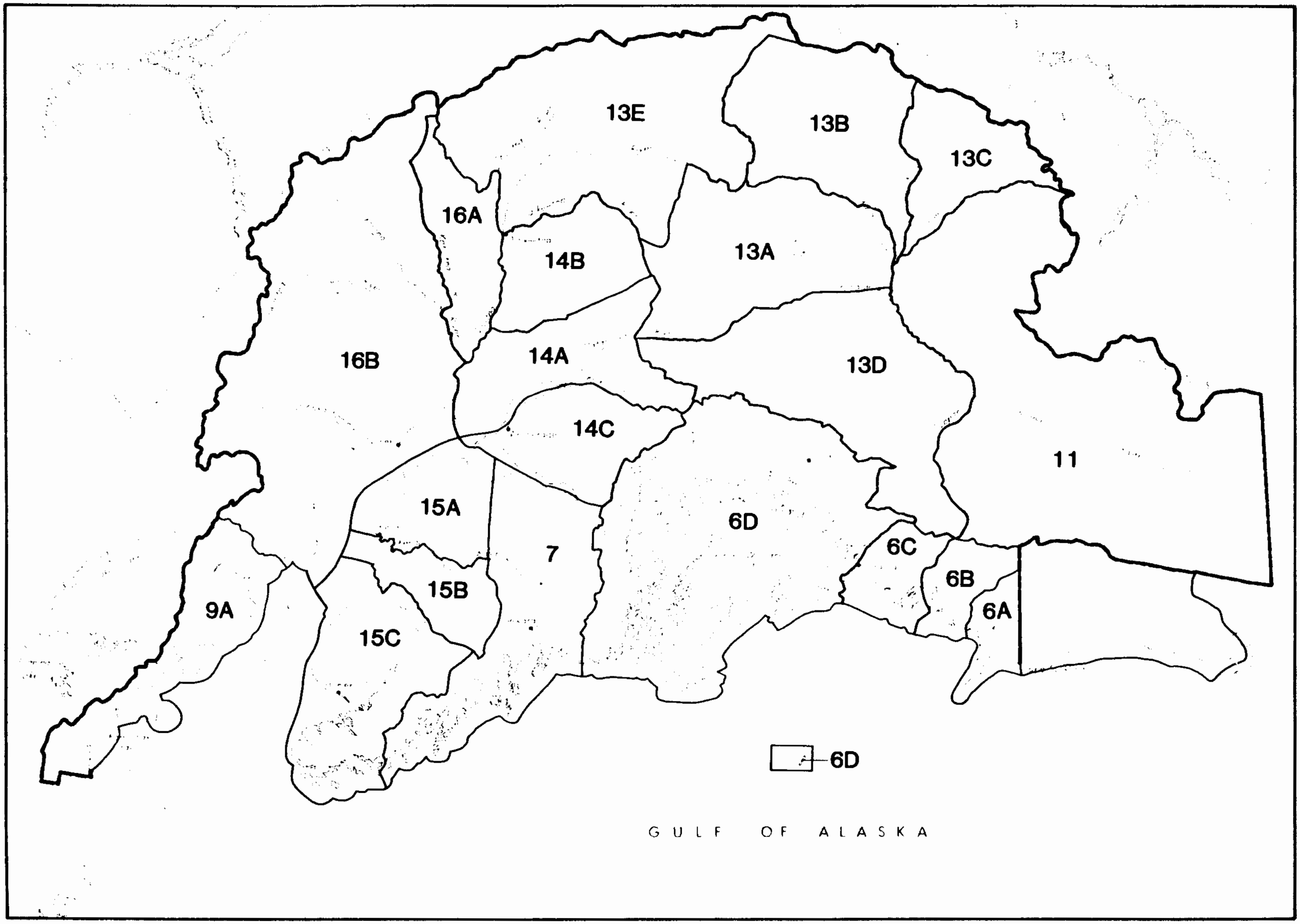
In Southcentral Alaska, Dall sheep inhabit mountainous terrain in Game Management Units (GMUs) 7, 11, 13, 14, 15, and 16. Harvest information for GMU 16 will be addressed in the Interior Region narratives. Information on harvests by subunit or smaller area prior to 1983 is not consistently available; therefore, use information will be presented on a GMU basis (map 1), and subunit information will be presented where available. Reference maps depicting sheep-hunting areas are available at 1:250,000 scale in ADF&G offices and at 1:1,000,000 scale in the Atlas to the guide for the Southcentral Region.

1. Brief regional summary of human use information. The Southcentral Region provides excellent Dall sheep hunting opportunities. Relatively easy and inexpensive access to sheep-hunting areas is provided by the Southcentral Region's road system and numerous small plane access sites. About 1,100 sheep are reported harvested annually in Alaska (Heimer 1984). The Southcentral Region contributes about 285 sheep annually to the statewide harvest (ADF&G 1984).

   Since 1979, the harvest in Southcentral Alaska has ranged from 254 in 1980 to 318 in 1981, with effort (expressed in hunter-days) ranging from 3,948 days in 1982 to 5,374 days in 1983 for the same period (ibid.).

2. Managerial authority. Dall sheep in Alaska have been managed by the ADF&G as a big game animal since 1960. Most state or federal lands not designated as parks, preserves, or closed areas have open hunting seasons, with harvest regulations established by the Board of Game. Some areas receiving especially heavy use have been restricted to permit hunts, and others have been designated for special access only, consistent with specific management objectives. Portions of GMU 14C, for example, allow hunting by permit only, and the Tonsina Management Area in GMU 13D is limited to foot access only. For specific information on open areas, seasons, and permit restrictions, see the most recent edition of the Alaska Game Regulations.

   In 1980, large areas of Alaska were placed in new national park and national park/preserves. Management of game resources on national park lands is subject to congressional mandate and the National Park Service's (NPS) policy. Some national park lands are closed to hunting completely, and some remain open for subsistence hunting by local residents. National park preserve lands are currently managed to allow consumptive use of game resources under regulations established by the Board of Game.



Map 1. Game management units in the Southcentral Region.

II. GMUS 7 and 15 (KENAI MOUNTAINS)

A. Boundaries

GMUs 7 and 15 together comprise the mountainous regions of the Kenai Peninsula. See the most recent edition of the Alaska Game Regulations or the latest GMU map for the exact legal boundary description.

B. Management Objectives

The ADF&G has developed two management plans for Dall sheep in the Kenai Mountains: the Eastern Kenai Peninsula and the Cooper Landing sheep management plans.

The Eastern Kenai Peninsula Sheep Management Plan has a primary objective to protect, maintain, and enhance the Dall sheep population in concert with other components of the ecosystem and thereby to ensure its capability of providing the greatest sustained opportunity to participate in hunting sheep. The secondary objective is to provide sustained opportunities to view and photograph sheep.

The Cooper Landing Sheep Management Plan covers an area in GMU 7 that has been closed to hunting since 1960. The major objective of the Cooper Landing plan is to provide sustained opportunities to view and photograph sheep. Management guidelines for these plans are available in the Southcentral Alaska Wildlife Management Plans (ADF&G 1977).

C. Management Considerations

Because of the accessibility of the Kenai Peninsula, hunting pressure in this area may eventually become too intense for sheep populations to tolerate. Few trophy size rams are taken because generally rams are harvested as soon as they become legal. Present use patterns are not expected to decline in the future, and a reevaluation of management objectives may be necessary to meet these use requirements.

Portions of the Kenai Peninsula Mountains were placed within the Kenai Fjords National Park in 1980. Dall sheep range was not included in this withdrawal and therefore had little effect on the use of sheep in this area.

D. Period of Use

The hunting season since 1960 has been from 10 August through 20 September. Dall rams with 7/8 curl or larger horns have been legal since 1979. Prior to that, 3/4 curl or larger horns were legal. (See the latest edition of the Alaska Game Regulations for current seasons and restrictions.)

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU they hunted; in 1967, they were required to report the specific area they hunted. Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter reports.

Table 1 presents Dall sheep harvest information for GMUs 7 and 15 from 1979 through 1983. Data are presented by year and indicate the total harvest, number of hunters, and number of hunter-days.

Table 1. Dall Sheep Harvest Information, GMUs 7 and 15, 1979-83

Year	GMU	Harvest	No. of Hunters	No. of Hunter-Days
1979	7	13	94	372
	15	19	106	516
		32	200	888
1980	7	5	95	368
	15	18	66	473
		23	161	841
1981	7	1	53	198
	15	11	56	264
		12	109	462
1982	7	5	44	183
	15	18	66	323
		23	110	506
1983	7	10	66	231
	15	15	91	430
		25	157	661

Source: ADF&G 1979-84.

The largest reported harvest occurred in 1979, when 32 animals were taken, with a hunter success ratio of 16%. That year also had the largest effort, with 200 hunters spending 888 hunter-days in the field. Harvest decreased sharply in 1980 (23), although total hunters (161) and hunter-days (841) remained fairly high. Hunter success (8%) was low, only half the 1979 level. Severe winters during the early 1980's probably reduced the number of available legal rams, influencing hunter success. Harvest (12), total hunters (109), and hunter-days (462) decreased again in 1981, with effort in hunter-days about 50% less than in 1980. This decrease is probably a reflection of the previous year's low success rate and a depleted number of legal rams. During 1982, the number of hunters and hunter-days remained similar to 1981 (110 and 506, respectively); however, the harvest (23) almost doubled. The success rate was 21%. Harvest figures for 1983 show a small increase in hunters (157) and hunter-days (661), with a slight increase in harvest (25) and a decrease in the success rate (16%) over 1982.

Table 2 presents data showing mode of access and place of origin for sheep hunters in GMUs 7 and 15 for 1980. This information is recorded from harvest reports returned by hunters and is only as accurate as they report. Only one year of data was compiled due to the difficulty in tabulating the harvest data by mode of access and hunter residency. The 1980 data, however, are thought to be representative of the general type of use occurring in these areas.

As seen in table 2, 147 of 161 hunters (91%) originated within the Southcentral Region (map 1), with only 4 hunters coming from other regions of the state. Nine hunters were from outside Alaska, with one of those originating from outside the United States.

The most frequently used type of access for sheep hunting in GMU 7 was a highway vehicle (54%), which demonstrates the relatively easy access to sheep hunting within this GMU. In GMU 15, 40 of 66 hunters (61%) used an airplane for access to sheep-hunting areas. This use reflects the more difficult access available to hunters in this GMU.

F. Significance of Particular Use Areas

Beginning in 1983, the ADF&G introduced a new system for coding the hunter's harvest, the Uniform Coding System (UCS), designed to identify specific areas where harvest occurs. The system is hierarchical and identifies blocks of land in a progressively smaller subdrainage format. Hunters record the specific hunting locations on their harvest report, which is changed into a 12-character identifying code and entered into the computer. Information from the computer can be compared to permanent 1:250,000-scale maps identifying each UCS minor tributary.

Information in table 3 demonstrates that two areas on the Kenai Peninsula received most of the 1983 sheep-hunting pressure: 1) the mountainous area in GMU 7 surrounding Kenai Lake (07) and extending northwest to Trail Glacier and 2) the upper Kasilof River drainage (07) in GMU 15B. The Kenai Lake area had 7 of 10 successful hunters and 39 of 66 total hunters who spent 124 of 231 total days in the field. This represents 70% of the GMU 7 sheep harvest, 59% of the hunters, and 54% of the total effort for GMU 7.

The Kasilof River drainage in GMU 15B (which includes Indian Creek and the Tustumena Glacier) had 9 of 15 successful hunters, with 29 of 91 total hunters and 157 of 430 hunter-days. This represents 60% of the sheep harvest, 32% of the hunters in the field, and 37% of the total effort in GMU 15.

III. GMU 11

A. Boundaries

GMU 11 includes the southern Wrangell Mountains from the Copper River east to the Canadian border. The northern Wrangell Mountains are included in GMU 12 and will be discussed in the Alaska Habitat Management Guide for the Interior Region. (See the

Table 2. GMUs 7 and 15 Dall Sheep Harvest by Mode of Access and Hunter Origin, 1980

		By Mode of Access								By Hunter Origin								
	Total	Motor Bike	Air-plane	Hwy. Vehic.	Boat	ORV	Horse	Snow-mach.	Un-spec.	SC*	SE*	SW*	W*	Int.*	Arc.*	Non-res.	Alien	Un-spec.
GMU 7																		
No. of hunters	95	0	11	51	14	0	3	0	16	93	0	0	0	1	0	1	0	0
Days hunted	372																	
Harvest	5																	
GMU 15																		
No. of hunters	66	1	40	6	9	0	7	0	3	54	0	1	0	2	0	7	1	1
Days hunted	473																	
Harvest	18																	

Source: ADF&G 1979-84.

* SC = Southcentral Alaska
SE = Southeast Alaska
SW = Southwest Alaska
W = Western
Int. = Interior Alaska
Arc. = Arctic Alaska

Table 3. Sheep Harvest and Hunter Data for GMUs 7 and 15, 1983-84

Unit	Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
07	Z	07*	124	39	7
07	Z	06	63	15	2
07	Z	00	26	7	1
07	Z	03	12	3	0
07	Z	04	3	1	0
07	Z	05	3	66	10
Subunit total			231	66	10
Unit total			231	66	10
15	A	01	18	9	2
15	A	00	4	2	0
15	A	07	3	1	0
Subunit total			25	12	2
15	B	07*	157	29	9
15	B	04	62	10	1
15	B	05	61	15	2
15	B	06	3	2	0
Subunit total			296	59	12
15	C	07	57	12	1
15	C	01	42	6	0
Subunit total			99	18	1
15	Z	00	10	2	0
Subunit total			10	2	0
Unit total			430	91	15

Source: ADF&G 1979-84.

* Areas receiving most use by hunters.

recent edition of the Alaska Game Regulations or the latest GMU map for the legal boundary description.)

B. Management Objectives

In 1980, almost all of GMU 11 was placed in the new Wrangell-St. Elias National Park/Preserve. The NPS is mandated by federal law to manage game resources utilizing plans developed by the ADF&G unless those plans are incompatible with NPS policy. The management plan for Wrangell-St. Elias Park/Preserve is in preparation by the NPS, and final decisions concerning management policy will be determined at a future date.

The ADF&G has developed three management plans that apply to Dall sheep in GMU 11: the Wrangell-Mentasta Mountains, the Upper Chitina Valley, and the Nelchina Basin sheep management plans. The Wrangell-Mentasta Mountains Sheep Management Plan has a primary objective to provide the greatest opportunity to participate in hunting sheep. The Upper Chitina Valley Sheep Management Plan has a primary objective to provide sustained opportunities for harvesting large-horned sheep and a secondary objective to provide opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977). The Nelchina Basin Sheep Management Plan has a primary objective to provide opportunities to hunt sheep under aesthetically pleasing conditions. Management guidelines for the Wrangell-Mentasta plan, the Upper Chitina Valley plan, and the Nelchina Basin plan can be found in the Southcentral Alaska Wildlife Management Plans (ibid.).

C. Management Considerations

The Wrangell Mountains have been a popular sheep-hunting location since at least the early 1930's (Scott et al. 1950). Record-class sheep are available, and the world-record animal was taken in this area (Nesbitt and Wright 1981). Increasingly crowded hunting conditions are possible in the future, and changes in regulations may have to be adopted to aleviate this situation and protect heavily harvested sheep populations (ADF&G 1977).

The nature of the NPS's policy regarding future hunting opportunities within the park and preserve is undetermined. Until now, the NPS has allowed area residents of the defined subsistence zone to hunt within the park and others to hunt within the preserve. The continuation of this policy should allow ample hunting opportunities for hunters in this area.

D. Period of Use

Except for 1942 and 1949, there has been a general hunting season in GMU 11 for 3/4 curl horn or larger rams every year since 1935 (table 4).

Since 1961, the hunting season has been from August 10 through September 20. In 1979, the harvest was limited to rams with 7/8 curl horn or larger. Most hunting activity takes place in the earlier portion of the season, because of the relatively high elevation of this mountainous region and the possibility of bad

Table 4. Sheep Hunting Seasons and Bag Limits, Wrangell Mountain Range, 1935-84

Year	Season	Limit	Restrictions
1935-37	Aug. 20-Dec. 31	2 rams	No closed areas
1938-39	Aug. 20-Nov. 30	2 rams	No closed areas
1940-41	Aug. 20-Nov. 15	2 rams	No closed areas
1942-43			No open season in Wrangell Mountains
1944		Mountain sheep	No listed regulations
1945	Aug. 20-Sept. 5	1 ram	No closed areas
1946-48	Aug. 20-Aug. 31	1 ram	No closed areas
1949			No open season in Wrangell Mountains
1950	Aug. 20-Aug. 31	1 ram	No closed areas
1951-53	Aug. 20-Aug. 31	1 ram, 3/4 curl or larger	No closed areas
1954-59	Aug. 20-Sept. 10	1 ram, 3/4 curl or larger	No closed areas
1960	Aug. 20-Aug. 31	1 ram, 3/4 curl or larger	No closed areas
1961-78	Aug. 20-Sept. 20	1 ram, 3/4 curl or larger	No closed areas
1979	Aug. 10-Sept. 20	1 ram, 7/8 curl or larger	No closed areas
1980	Aug. 10-Sept. 20	1 ram, 7/8 curl or larger	No closed areas
1981	Aug. 10-Sept. 20	1 ram, 7/8 curl or larger	Parts of GMU 11 closed to nonlocal residents
1982	Aug. 10-Sept. 20	1 ram, 7.8 curl or larger	Parts of GMU 11 closed to nonlocal residents
1983	Aug. 10-Sept. 20	1 ram, 7.8 curl or larger	Parts of GMU 11 closed to nonlocal residents
1984	Aug. 10-Sept. 20	1 ram, 7/8 curl or larger	Parts of GMU 11 closed to nonlocal residents

Source: Heimer 1984, ADF&G 1979-84.

weather conditions. (See the latest edition of the Alaska Game Regulations for current seasons and restrictions.)

E. Human Use Data

Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter reports. Table 5 presents Dall sheep harvest information for GMU 11 from 1979 through 1983. Data are presented by year and indicate total harvest, number of hunters, and number of hunter-days.

Table 5. Dall Sheep Harvest Information, GMU 11, 1979-83

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	34	88	510
1980	48	106	591
1981	96	204	1,097
1982	111	214	1,023
1983	96	255	1,470

Source: ADF&G 1979-84.

In 1979, this area was designated by presidential order as a national monument. Under this designation, hunting was allowed during 1979 and 1980 only by subsistence hunters that met certain residence requirements. General hunting was curtailed, hunters were displaced into other areas and harvest subsequently dropped. In December 1980, the area's status was changed to national park and preserve under ANILCA legislation, which allows subsistence hunting under certain restrictions in park areas and general hunting in preserve areas.

As can be seen from table 5, the harvest, number of hunters, and hunter-days almost doubled from 1980 to 1981 and remained relatively stable in 1982.

The largest reported harvest from 1979 through 1983 occurred in 1982, with 111 rams harvested by 214 hunters during 1,023 hunter-days. This represents a very good success rate of 52%. The success rate in this GMU is one of the highest in the state (Heimer, pers. comm.).

Table 6 presents information on the mode of access and origin of hunters for the 1981 sheep harvest in GMU 11. Airplanes were the most frequently used type of access to sheep-hunting areas in GMU 11. GMU 11 is contained within the Wrangell-St. Elias Park/Preserve, where only specified preserve areas are available for general hunting. There are few roads in the preserve area, and airplanes therefore provide the most practical means of access.

The Southcentral Region was the area of origin for 148 of 204 hunters (72%). At least 20 hunters were from other regions of the state, and another 31 came from outside Alaska.

F. Significance of Particular Use Areas

See section II.F. for a brief discussion of the Uniform Coding System (UCS).

In 1983, 5 of 17 reported harvest areas in the Wrangell Mountains accounted for 72% of the GMU 11 harvest: UCS minor tributary areas 13, 23, 07, 04, and 16 (see table 7). These areas are within portions of the Wrangell-St. Elias National Park/Preserve still open to hunting.

Area 13 (Chitina River above Gibralter Hill) received more use than all other areas, with 26 hunters spending 249 days in the field. Area 07 (Kennicott River) had the most reported hunters, with 39, and Areas 04 and 16 (Chitina River and Copper River East Side, respectively) had the highest reported harvest, with 17 rams each. Area 23 (Tanada Creek Drainage) was also heavily used, with 214 hunter-days, 35 hunters, and 12 animals harvested (table 7).

IV. GMU 13

A. Boundaries

GMU 13 is commonly referred to as the Nelchina Basin and contains Subunits A through E. This area is bordered on the north by the Alaska Range, on the south by the Chugach Mountains, on the east by the Copper River and Glenn Highway, and on the west by the eastern Talkeetna Mountains. Sheep occur in this GMU along the Chugach Mountains and in the eastern Talkeetna Mountains. (See the latest edition of the Alaska Game Regulations or the latest GMU map for the legal boundary description.)

B. Management Objectives

Three management plans apply to portions of this GMU: the Nelchina Basin Sheep Management Plan, the Tonsina Sheep Management Plan, and the Sheep Mountain Sheep Management Plan. The Nelchina Basin and the Tonsina sheep management plans have a management objective to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions. The Tonsina area was designated a controlled use area (no mechanized vehicles or pack animals from August 5 to September 30) in 1975. Sheep Mountain, a well-known sheep area close to the Glenn Highway, has been closed to sheep hunting since statehood. The Sheep Mountain Management Plan applicable to this area has a management objective to provide sustained opportunities to view, photograph, and enjoy sheep.

Table 6. GMU 11 Dall Sheep Harvest by Mode of Access and Hunter Origin, 1981**

		By Mode of Access								Hunter Origin								
	Total	Motor Bike	Air-plane	Hwy. Vehic.	Boat	ORV	Horse	Snow-mach.	Un-spec.	SC*	SE*	SW*	W*	Int.*	Arc.*	Non-res.	Alien	Un-spec.
GMU 11																		
No. of hunters	204	0	137	30	1	11	10	0	15	148	3	3	0	14	0	30	1	5
Days hunted	1,097																	
Harvest	96																	

Source: ADF&G 1979-84.

* SC = Southcentral Alaska
SE = Southeast Alaska
SW = Southwest Alaska
W = Western Alaska
Int. = Interior Alaska
Arc. = Arctic Alaska

** Because of land status changes, 1981 data, rather than 1980 data, are more representative of human use patterns in GMU 11.

Table 7. Sheep Harvest and Hunter Data for GMU 11, 1983-84

Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
Z	13*	249	26	10
Z	23*	214	35	12
Z	07*	186	39	13
Z	04*	184	32	17
Z	00	178	31	7
Z	16*	116	22	17
Z	15	104	18	2
Z	24	46	14	3
Z	05	43	11	3
Z	08	34	8	6
Z	17	34	5	1
Z	22	22	3	1
Z	12	20	3	0
Z	03	14	2	2
Z	10	10	3	0
Z	18	10	2	2
Z	19	6	1	0
Total		1,470	255	96
Unit total		1,470	255	96

Source: ADF&G 1979-84.

* Areas receiving most use by hunters.

Management guidelines for these plans are available in the Southcentral Alaska Wildlife Management Plans (ADF&G 1977).

C. Management Considerations

Land management policies and regulations by government and private landowners may limit or preclude human activities, which may, in turn, affect important sheep habitat or the aesthetic qualities of sheep hunting in the area. Cooperative land use planning and management among the department, land-managing agencies, and private landowners may resolve conflicts through mutually acceptable solutions (ibid.).

D. Period of Use

The hunting season since 1960 has been from 10 August through 20 September. Dall sheep rams with 7/8 curl or larger horns have been legal since 1979. Prior to that, 3/4 curl or larger horns were legal. (See the latest edition of the Alaska Game Regulations for current seasons and restrictions.)

E. Human Use Data

Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter reports. Table 8 presents Dall sheep harvest information for GMU 13 from 1979 through 1983. Data are presented by year and indicate the total harvest, number of hunters, and number of hunter-days.

Table 8. Dall Sheep Harvest Information, GMU 13, 1979-83

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	119	436	2,277
1980	105	368	1,994
1981	123	357	1,764
1982	107	346	1,735
1983	108	400	2,033

Source: ADF&G 1979-84.

Harvest figures for GMU 13 have remained relatively constant for the period, averaging 112 animals. The largest reported harvest occurred in 1981, with 123 rams harvested by 357 hunters, a success rate of 34%. The greatest effort occurred in 1979, with 436 hunters spending 2,277 hunter-days in the field. This large effort was probably related to the land status change occurring in GMU 11 (Wrangell Mountains) that prohibited general hunting and displaced hunters from that area. Effort, in both numbers of hunters and hunter-days, decreased in 1980, 1981, and 1982. This is related to the establishment of park and preserve areas in GMU 11, which allowed general hunting to again take place in areas of GMU 11 with preserve status. Effort increased considerably in 1983, in both number of hunters and hunter-days.

Table 9 presents data for the 1980 GMU 13 sheep harvest indicating hunter mode of access and hunter origin. Access to the most frequently used GMU 13 sheep-hunting areas was almost equally distributed between airplane (39%) and highway vehicle (34%).

Table 9. GMU 13 Dall Sheep Harvest by Mode of Access and Hunter Origin, 1980

		By Mode of Access								Hunter Origin								
	Total	Motor Bike	Air- plane	Hwy. Vehic.	Boat	ORV	Horse	Snow- mach.	Un- spec.	SC*	SE*	SW*	W*	Int.*	Arc.*	Non- res.	Alien	Un- spec.
GMU 13																		
No. of hunters	416	4	166	143	9	36	22	0	36	284	4	1	0	26	0	62	3	36
Days hunted	1,994																	
Harvest	105																	

Source: ADF&G 1979-84.

* SC = Southcentral Alaska
SE = Southeast Alaska
SW = Southwest Alaska
W = Western Alaska
Int. = Interior Alaska
Arc. = Arctic Alaska

GMU 13 has good highway access for hunters who prefer to walk in to their hunting area, and it also contains large areas where airplanes are the preferred access type. ORVs and horses were reported as access types more in GMU 13 (9% and 5%, respectively) than in other Southcentral GMUs (tables 2, 6, 9, and 12).

In 1983, the majority of GMU 13 sheep hunters (284 of 416, 68%) were from the Southcentral Region, while only 31 (8%) were from other regions of Alaska. A total of 65 hunters (16%) were from outside of Alaska, indicating high national interest in this region. GMU 13 has many guiding outfitters operating in the region, and they provide sheep-hunting opportunities for residents and nonresidents alike.

F. Significance of Particular Use Areas

See section II.F. for a brief discussion of the Uniform Coding System (UCS).

Data presented in table 10 demonstrate that one area in Subunit 13A (Area 10 - Boulder Creek Drainage) and three areas in Subunit 13D (Area 10 - Klutina River; Area 13 - Tazlina Glacier/Lake; and Area 08 - Tonsina River) received most of the 1983 sheep-hunting use. These four areas (out of 40 reporting areas) accounted for 45 of 108 harvested rams (42%), 150 of 400 hunters (38%), and 910 of 2,033 total hunter-days (45%) (ADF&G 1984).

V. GMU 14

A. Boundaries

GMU 14, including Subunits A, B, and C, encompasses the Talkeetna Mountains and western Chugach Range and is bordered by the Talkeetna River on the north, the Susitna River on the west, Turnagain Arm and Cook Inlet on the south, and the Chickaloon River and Knik River drainage divide on the east. (See the recent edition of the Alaska Game Regulations or the latest GMU map for the legal boundary description.)

B. Management Objectives

Two sheep management plans have been developed by the ADF&G for portions of GMU 14: 1) the Western Talkeetna Mountains Sheep Management Plan and 2) the West Chugach Sheep Management Plan. The Western Talkeetna Mountains Sheep Management Plan has a primary objective to protect, maintain, and enhance the population in concert with other components of the ecosystem and to ensure its capability of providing sustained opportunities to participate in hunting sheep. The West Chugach Sheep Management Plan has a primary objective to protect, maintain, and enhance the population in concert with other components of the ecosytem and to ensure its capability of providing sustained opportunities to hunt sheep under aesthetically pleasing conditions, and a secondary objective to provide opportunities to be selective in hunting sheep and to view and photograph sheep (ADF&G 1977). Management guidelines for these plans can be found in the Southcentral Alaska Wildlife Management Plans (ibid.).

Table 10. Sheep Harvest and Hunter Data for GMU 13, 1983-84

	Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
	A	10*	148	38	12
	A	9	114	22	6
	A	13	90	27	5
	A	14	49	8	3
	A	12	34	10	1
	A	11	29	9	0
	A	07	26	4	0
	A	00	18	7	1
	A	21	14	1	1
	A	15	5	1	0
	A	16	2	1	0
	A	18	1	1	0
Total			530	129	29
	B	09	67	16	1
	B	00	21	3	0
	B	03	10	1	0
Total			102	21	1
	C	03	33	8	3
	C	05	19	3	2
	C	00	12	2	0
Total			64	13	5
	D	10*	287	41	13
	D	13*	257	41	13
	D	08*	218	30	10
	D	16	82	15	5
	D	06	69	11	4
	D	21	50	10	5
	D	17	41	9	6
	D	22	39	6	0
	D	00	29	5	3
	D	07	23	8	0
	D	19	9	2	0
	D	18	8	2	0
	D	05	6	2	0
	D	14	4	1	0
	D	23	3	1	0
Total			1,125	184	59

(continued)

Table 10 (continued).

Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
E	30	48	11	2
E	22	22	2	2
E	28	16	2	2
E	19	14	2	2
E	29	13	2	1
E	00	11	4	2
E	08	10	2	0
E	11	10	3	0
E	27	7	1	1
E	12	6	2	0
E	13	5	1	1
Unit total		2,033	450	108

Source: ADF&G 1974-84.

* Areas receiving most use by hunters.

C. Management Considerations
A large portion of Subunit 14C is within the boundaries of the Chugach State Park. This area is managed by the Alaska State Park System for multiple use purposes. Conflicts have developed in recent years between different user groups regarding hunting of Dall sheep within the park. State park officials and some user groups stated that excessive use of some areas of the park by hunters created aesthetically unpleasant and dangerous conditions. Therefore, in 1981, a management plan was developed between the ADF&G and state park officials to maintain a specific number of hunters in certain areas of the park.

D. Period of Use
A general hunting season for 3/4 curl horn or larger rams has been in effect since statehood, usually occurring in late August and September. In 1979, the harvest was limited to 7/8 curl horn or larger rams. (See the latest edition of the Alaska Game Regulations for current restrictions.)
Beginning in 1982, in response to the conditions mentioned in C. above, a permit system was initiated in Subunit 14C to limit the number of sheep hunters to 120 individuals, 60 to be allowed to

hunt from the day after Labor Day to 18 September and 60 from 19 September to 30 September.

Because of the trend of the 14C sheep population to increase and the lack of success of permit hunters, a special registration hunt was provided for in 1984, after the permit hunt was over. This hunt was designed to provide additional sheep-hunting opportunities in Subunit 14C after most other user groups had finished their use of the park and to increase the ram harvest in this dense population.

E. Human Use Data

Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter reports.

Table 11 presents harvest information for GMU 14 from 1979 through 1983. The largest harvest (76) occurred in 1979, when 309 hunters spent 1,343 days in the field, an average of 4.3 days. The harvest in 1980 was similar (70), although the number of hunters decreased almost 33% to 208. Effort, expressed in hunter-days, increased in 1980, indicating that the smaller number of hunters spent a longer period in the field, an average of 7.6 days. The number of hunters increased in 1981 to 241, although the number of hunter-days decreased by over 600 days. The 1981 harvest was similar to those of previous years, indicating that hunters were successful in a relatively short period of time, an average of only 4.0 days. The lowest harvest and effort in GMU 14 occurred in 1982, with only 44 rams harvested by 208 hunters spending 684 hunter-days. This low effort is probably related to adverse weather conditions during the 1982 hunting season (ADF&G 1984).

Table 11. Dall Sheep Harvest Information, GMU 14, 1979-83

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	76	309	1,343
1980	70	208	1,587
1981	75	241	973
1982	44	208	684
1983	58	247	1,021

Source: ADF&G 1979-84.

Table 12 presents the reported 1980 GMU 14 sheep harvest, indicating mode of access and hunter origin. Only one year of data was compiled; however, the data are thought to be representative of the general type of use occurring in this area. (See the Division of Game's statistical reports for more complete information.)

Table 12 shows that at least 49% (102 of 208 hunters) of the GMU 14 sheep hunters used a highway vehicle as their mode of access during 1980. Highways intersect or border large areas of good sheep habitat in GMU 14, and hunters take advantage of this opportunity.

Over 83% (172 of 208 hunters) of all GMU 14 sheep hunters were from the Southcentral Region. This use reflects the close proximity of most of GMU 14 to the Anchorage area and, again, the easy highway access available to this area.

F. Significance of Particular Use Areas

See section II.F. for a brief discussion of the Uniform Coding System (UCS).

In 1983, Subunit 14A accounted for most of the harvest, total hunters, and effort in hunter days for all of GMU 14. Table 13 identifies specific areas in Subunit 14A that were most used by sheep hunters. Three out of 25 reported UCS areas in 14A (Area 08 - Matanuska River above Moose Creek; Area 09 - Kings River Drainage; and Area 12 - Jim/Friday Creek) provided 34%, 30%, and 28% of the hunter-days, total number of hunters, and total harvest, respectively, for all of GMU 14.

Table 12. GMU 14 1980 Dall Sheep Harvest by Mode of Access and Hunter Origin

		By Mode of Access								By Hunter Origin								
	Total	Motor Bike	Air-plane	Hwy. Vehic.	Boat	ORV	Horse	Snow-mach.	Un-spec.	SC*	SE*	SW*	W*	Int.*	Arc.*	Non-res.	Alien	Un-spec.
GMU 14																		
No. of hunters	208	0	33	102	16	11	7	0	39	172	1	2	0	6	0	27	0	0
Days hunted	1,587																	
Harvest	70																	

Source: ADF&G 1979-84.

* SC = Southcentral Alaska
SE = Southeast Alaska
SW = Southwest Alaska
W = Western Alaska
Int. = Interior Alaska
Arc. = Arctic Alaska

Table 13. Sheep Harvest and Hunter Data for GMU 14, 1983-84

	Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
	A	08	124*	24	7
	A	09	114*	21	5
	A	12	113*	28	4
	A	11	99	17	5
	A	00	69	19	7
	A	06	41	11	1
	A	13	41	12	2
	A	03	13	2	0
	A	10	13	2	2
	A	07	7	3	1
	A	14	1	1	1
Total			635	140	35
	B	02	24	5	2
	B	00	14	4	0
	B	07	14	4	1
	B	03	12	2	0
	B	01	10	3	2
	B	04	3	1	0
Total			77	19	5
	C	04	68	18	2
	C	03	50	13	3
	C	08	46	14	3
	C	10	33	7	1
	C	06	31	9	3
	C	07	23	9	2
	C	05	20	7	3
	C	09	14	5	0
	C	00	9	1	1
	C	11	2	1	0
Total			296	84	18
	Z	00	13	4	0
Total			13	4	0
Unit total			1,021	247	58

Source: ADF&G 1979-84.

* Areas receiving most use by hunters.

REFERENCES

ADF&G. 1977. Alaska wildlife management plans - southcentral. Fed. Aid in Wildl. Rest. Proj. W-17-R. 291 pp.

_______. 1979-1984. Unpublished statistical reports, 1979 through 1984. Div. Game, Anchorage.

_______. 1984. Alaska game regulations No. 25: July 1, 1984 through June 30, 1985. Juneau. 77 pp.

Heimer, W.E. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Fairbanks.

_______. 1984. Population status and management of Dall sheep in Alaska, 1984. Unpubl. rept., ADF&G, Fairbanks. 21 pp.

Nesbitt, W.H., and P.H. Wright, eds. 1981. Records of North American big game. 8th ed. Boone and Crockett Club, Alexandria, VA.

Scott, R.F., E.F. Chatelain, and W.A. Elkins. 1950. Transactions of the fifteenth North American wildlife conference, San Francisco, CA. Wildlife Institute, Wash., DC.

Moose Human Use

I. POPULATION MANAGEMENT HISTORY

A. Introduction

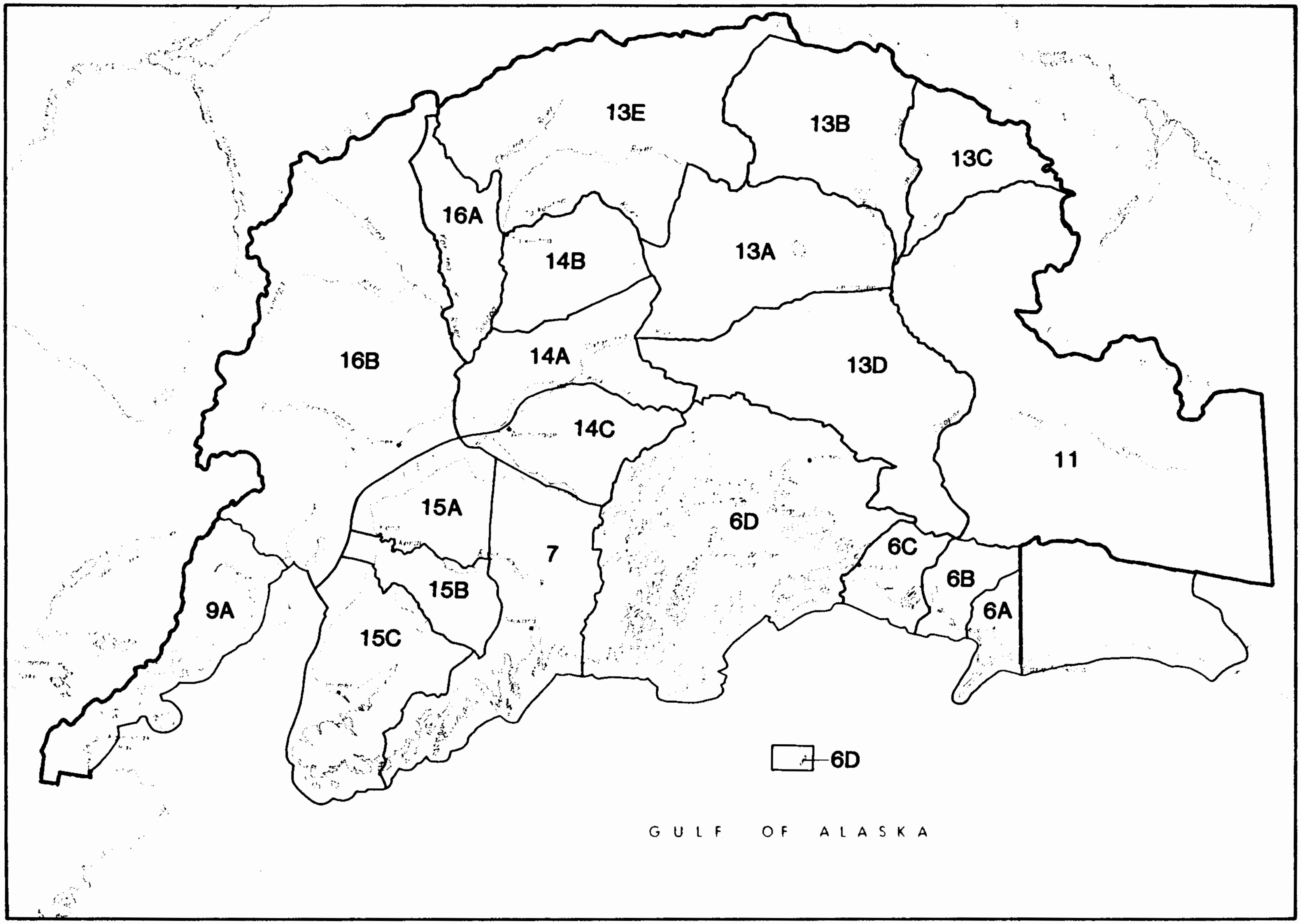
Human use data in the following sections are presented by game management subunit (GMS) with the exception of Game Management Units (GMUs) 7 and 11, which have no subunits (see map 1). In GMS 16(B), the data are further separated by mainland, 16(B), and Kalgin Island, 16(B). Where available, the data are presented for the years 1978 through 1983 and include number of hunters, hunter days, and harvest by mode of access for each unit or subunit.

Beginning in 1983, the Division of Game began using the Uniform Code System (UCS) to record harvest-ticket and permit-hunt data. The UCS is hierarchical and identifies blocks of land in a progressively smaller subdrainage format. A 12-character code identifies the GMU and subunit; the major river drainages, ocean drainage, or archipelago; drainages or islands shared by adjacent GMUs or subunits; drainage of a minor tributary or island group; specific harvest unit (Uniform Code Unit [UCU]) within the minor tributary; mountain range (for sheep); and herd (for caribou).

Data for 1983 are presented in tables within the Significance of Particular Use Areas section for each unit or subunit. These data are ordered by number of hunter-days by minor tributary. Location accuracy is currently greatly diminished at the UCU level, and data are therefore presented at the minor tributary level. Harvest and hunter data by minor tributary are displayed on 1:1,000,000-scale maps in the Atlas to the guide for the Southcentral Region and on 1:250,000-scale reference maps in ADF&G offices.

B. Regional Summary of Hunting

1. Brief regional summary of human use information. On a regionwide basis, the number of hunters and the harvest have increased since 1978. Including both permit and harvest ticket data, the total number of hunters reported afield was 10,632, and the harvest was 2,646 moose in 1978 (ADF&G 1980). During the 1983 season, 16,076 hunters reported hunting, and 3,428 moose were taken. Substantial fluctuations in the harvest and the number of hunters afield have occurred prior to 1978 on a regional basis and both prior to and after 1978 on a GMU and/or GMS basis (ibid.). There are numerous reasons for these fluctuations, including moose population increases and declines, regulatory restrictions and relaxations, weather conditions during the hunting season, errors or inadequacies in the reporting, and others. Every year a number of hunters fail to return moose harvest tickets even though it is a requirement under the game regulations. Normally, 65 to 70% of those who obtained harvest tickets report after one reminder letter is sent. In 1979, no



Map 1. Game management units in the Southcentral Region.

reminder letters were sent, and the harvest ticket data were based on 37% reporting (Taylor, pers. comm.). Overall, the number of hunters afield has increased.

2. Managerial authority. Wildlife management in Alaska was formally established in 1925, when Congress created the Alaska Game Commission. Prior to 1925, protection of wildlife had been undertaken by the Departments of Treasury, Commerce, and Agriculture, and by the territorial governor. After statehood in 1959, the State of Alaska assumed administration of its wildlife and established the Department of Fish and Game. Moose hunting is controlled under the Alaska Game Regulations.

II. GMS 6(A)

A. Boundary

GMS 6(A) is located along the Gulf of Alaska, primarily between Icy Bay and Katalla. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Within Subunit 6(A), there are two relatively distinct moose herds, the Bering River-Controller Bay herd and the Tsiu River herd.

For the Bering River-Controller Bay herd the management objective is to maintain 200 moose in the herd. A fall 1983 trend survey revealed at least 307 animals in the herd. Because the number of moose is above the management objective, liberal seasons (four months) and bag limits (either sex) are being maintained (Reynolds, pers. comm.).

For the Tsiu herd, the current management objective is to maintain 200 animals in the herd. This herd has experienced dramatic growth recently. A January 1980 trend survey revealed 109 animals, whereas a December 1984 count revealed 311 animals. As with the Bering River/Controller Bay herd, liberal seasons and bag limits are being maintained (ibid.).

C. Management Considerations

The areas moose occupy in Subunit 6(A) are relatively inaccessible to hunters (especially the Tsiu herd), and predation by wolves and bears does not appear to be significantly affecting the growth of the population. Although range conditions appear good at this time, should the two herds continue to increase and/or remain above current population management goals, range conditions may deteriorate (ibid.).

Because weather conditions are often not suitable to conduct accurate trend surveys, it is difficult to obtain adequate information for management purposes.

D. Period of Use

Since the 1980-1981 hunting season, a liberal four-month (Sept. 1 through December 31), either-sex registration permit hunt subject to emergency closure has been held in Subunit 6(A). As the number of moose has increased, hunting seasons have been gradually liberalized since hunting began in the area in 1965. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Because moose hunting is controlled under a registration permit system, reported data provide an accurate summary of harvest. Use data (see table 1) have been hand-tabulated by area staff in Cordova and have not been summarized by computer. Beginning in 1984, however, Unit 6 permit-hunt data will be summarized by computer and thus will provide more detailed use information.

Successful hunters in Subunit 6(A) primarily use airplanes or airboats for transportation. Riverboats and ATVs are also used, though to a much lesser extent.

The increase in harvest during the 1982 and 1983 seasons is, in part, likely related to the increased number of moose available.

Table 1. Harvest Data in GMS 6(A), 1978-83

Year	No. Permits Issued	Harvest	Length of Season
1978	99	18	91
1979	142	32	39[a]/91[b]
1980	254	31	122
1981	219	28	122
1982	217	58	38
1983	270	56	122

Source: BGDIF.

a Bull season.

b Cow season.

F. Significance of Particular Use Areas

Currently, the significance of particular use areas within Subunit 6(A) is difficult to describe since human use data are not available through computer runs. Beginning in 1984, all harvest and human use data obtained through harvest and permit reports will be computerized and coded to the new UCS.

III. GMS 6(B)

A. Boundaries

GMS 6(B) is located along the Gulf of Alaska, with the west bank of the Copper River bordering its west side, and including the drainages into the Copper River or the gulf west of Palm Point near Katalla. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Currently, the management objective is to maintain a posthunting season herd of 150 to 175 moose. In 1979, approximately 75 to 100 moose immigrated to Subunit 6(B) from Subunit 6(C), increasing the herd above the management objective. Since then, hunting seasons have been maintained to harvest 50 to 75 animals per year, in order to gradually reduce the herd size to within the management objective (ibid.).

C. Management Considerations

Since 1980, relatively low calf/cow ratios have been observed in Subunit 6(B). Range condition does not appear to have deteriorated, even though the herd has been above its management objective since 1979. It is suspected that there may be significant predation by brown bears upon moose calves (ibid.).

Predation by wolves is not significant at this time; however, should the wolf population increase, they may begin affecting the moose population in the area (Reynolds, pers. comm.; ADF&G 1976).

D. Period of Use

Regulatory season dates have begun from mid August to early September and have run until mid September to late November. Because of established harvest quotas, the season has been closed by emergency order, when the quota has been reached prior to the regulatory closing date. The number of days the seasons have run has varied considerably, depending on the quotas set and the success of hunters. The 1984-1985 regulations establish season dates of 8 September through 20 September, with a quota of 25 antlerless moose. (See the latest Alaska Game Regulations for current seasons.) These dates reflect a desire to allow maximum participation by local hunters. The harvest quota, a reduction from 35 antlerless moose from previous years, reflects the need to compensate for poor calf production in previous years (ADF&G n.d.).

E. Human Use Data

Fluctuations in harvest (see table 2) generally reflect fluctuations in herd size. The truncated 1979 four-day season is indicative of higher hunter success. The high success was a direct result of ideal airboating conditions, caused by heavy rain and high water, which substantially improved access to hunting areas (ADF&G 1981). The high harvest that occurred in 1980 reflects the substantial increase in the moose herd, which resulted from immigration of 75 to 100 animals into the area from Subunit 6(A).

The most successful means of transport used by hunters is airboats. Hunters using other means are at a comparative disadvantage (ADF&G 1976).

Ninety to 100% of the yearly harvest of moose is by Unit 6 residents. Local residents generally hunt primarily to obtain meat and secondarily to enjoy the recreational dimensions of the hunt (Reynolds, pers. comm.).

F. Significance of Particular Use Areas

Currently, the significance of particular use areas within Subunit 6(B) is difficult to describe because human use data are not available through computer runs. Beginning in 1984, all harvest and human use data obtained through harvest and permit reports will be computerized and coded to the new UCS.

Table 2. Harvest Data in GMS 6(B), 1978-83

Year	No. Permits Issued	Harvest	Length of Season
1978	241	23	13 days
1979	229	43	4 days
1980	566	100	21 days
1981	455	60	26 days
1982	---	---	---
1983	487	74	13 days

Source: BGDIF.

--- means no data were available.

IV. GMS 6(C)

A. Boundaries

GMS 6(C) is located in the Cordova area along the Gulf of Alaska. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

The management objective is to maintain a posthunting herd size of 175 to 200 animals (ibid.).

C. Management Considerations

During 1979, 75 to 100 animals immigrated from Subunit 6(C) into Subunit 6(B), reducing the herd size to below its management objective. Since then, a small harvest of about 20 bulls has been taken annually to allow herd growth (ibid.).

The Copper River Highway and Alagnik Road are within Subunit 6(C) and provide good access for hunters. Because of this, hunting pressure has been such that in recent years only one-half day seasons could be allowed. It became necessary to limit the number of permits issued for moose hunting. The 1984 season was the first conducted under a drawing permit regulation, allowing only 35 permits to be issued. In previous years, 90 to 100% of the moose harvest was by GMU 6 residents (ibid.). The drawing permit hunt is not limited to Unit 6 residents, however, and provides equal opportunities to all those who desire to hunt moose in Subunit 6(C). Because of its location, most applications for the permit hunt were from GMU 6 residents, who received 32 of the 35 permits issued (Timm, pers. comm.).

Predation of moose by wolves appears to be insignificant at this time (Reynolds, pers. comm.). Predation by brown bears may be significant, and on-going studies will help determine its significance.

D. Period of Use

The hunting season is during September. (For current hunting season dates and restrictions, see the latest Alaska Game Regulations.)

E. Human Use Data

The drop in harvest (see table 3) during the 1980 season from the previous two seasons was the result of a decline in herd size. The decline was the result of the immigration of 75 to 100 moose from Subunit 6(C) to adjacent Subunit 6(B) (ibid.). The increase in the number of permits issued in 1983 has required that the moose hunting season be regulated under a limited number of drawing permits.

Table 3. Harvest Data for GMS 6(C), 1978-83

Year	No. Permits Issued	Harvest
1978	240/35[a]	60
1979	357/30[a]	51
1980	373	17
1981	373	17
1982	359	21
1983	573	30

Source: BGDIF.

a Antlerless drawing permits.

V. GMU 7

A. Boundaries

GMU 7 is located along the north and east sides of the Kenai Peninsula. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

In GMU 7, the primary management objective is to provide the greatest sustained opportunity to participate in hunting moose. The secondary objective is to provide sustained opportunities to view and photograph moose (State of Alaska 1984).

C. Management Considerations

Habitat conditions in portions of GMU 7 have been deteriorating. Encroachment of spruce forest is suppressing important moose food species.

Portions of the unit are located within the Chugach National Forest. Use of motorized ground vehicles is prohibited off maintained roads during snow-free periods (ADF&G 1976).

Nonconsumptive uses are high in this area and are considered in its management.

D. Period of Use

Moose hunting occurs during the first two to three weeks of September. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 4 presents 1978-1983 human use data for GMU 7. The number of hunters in 1978 was the lowest recorded since 1965 for GMU 7, probably because of shortened seasons and lower hunter effort. Since 1965, the number had averaged 511 (ADF&G 1980). Following 1978, the number of hunters declined through the 1980 hunting season and remains low because of more restrictive regulations.

Transportation used by hunters is primarily by highway vehicles, because of the road system in the area. Aircraft, boats, and horses are used about equally.

F. Significance of Particular Use Areas

Unit 7 data for 1983 are presented in table 5 and ordered by number of hunter-days by minor tributary (see I.A. above).

In GMU 7, note that although Minor Tributary Area No. 04 (Placer River drainage) did not receive the greatest number of hunter-days, it did have the highest reported harvest. This area is regulated under a permit drawing hunt, which limits the number of hunters; the remainder of GMU 7 is regulated by general hunting season regulations. Minor tributary code number 00 denotes GMU 7 only. Harvest reports that contain insufficient location information to code below the GMU level are reported here.

VI. GMU 11

A. Boundaries

GMU 11 is located in the Wrangell Mountains-Chitina River area. (See the current Alaska game management units maps and boundary descriptions.)

B. Management Objectives

Most of GMU 11 is within the Wrangell-St. Elias National Park and Preserve. Moose hunting by local residents only is allowed within the park portion of this Conservation System Unit (CSU). Within the preserve and those portions of GMU 11 not within this CSU,

Table 4. GMU 7 Human Use Data, 1978-83

Year	By Mode of Access: Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	By Hunter Origin: South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	400	44	182	39	6	29	1	99	377	3	1	0	4	0	8	1	6
Days hunted	1,710	245	651	149	39	144	7	475	1,587	5	1	0	29	0	39	15	34
Harvest	58	10	22	10	0	13	0	3	54	0	0	0	0	0	3	0	1
1979[a]																	
No. hunters	214	20	89	25	9	23	0	48	195	1	1	0	2	0	6	1	8
Days hunted	1,016	98	359	129	57	139	0	234	913	3	13	0	4	0	33	6	44
Harvest	38	10	11	5	3	9	0	0	31	0	0	0	1	0	3	0	3
1980[a]																	
No. hunters	192	12	79	22	7	20	0	52	182	0	1	0	1	0	4	0	4
Days hunted	777	60	331	69	31	103	0	183	723	0	5	0	4	0	30	0	15
Harvest	28	4	7	6	1	6	0	4	25	0	1	0	0	0	1	0	1
1981[a]																	
No. hunters	256	18	110	23	11	21	0	73	240	0	1	0	2	0	5	1	7
Days hunted	1,103	76	472	99	52	55	0	349	1,002	0	1	0	17	0	33	13	37
Harvest	48	8	19	5	1	14	0	1	43	0	0	0	1	0	1	1	2
1982[a]																	
No. hunters	244	21	96	16	8	29	0	74	225	2	1	0	1	0	8	0	7
Days hunted	1,057	120	339	72	50	131	0	345	964	10	5	0	9	0	34	0	35
Harvest	36	5	15	2	1	11	0	2	28	0	0	0	0	0	5	0	3
1983[b]																	
No. hunters	307	18	185	68	60	38	0	63	---	---	---	---	---	---	8	---	8
Days hunted	1,155	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	82	5	37	21	0	12	0	1	---	---	---	---	---	---	5	---	2

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

management objectives are to provide the greatest opportunity to hunt moose (Lieb, pers. comm.).

Table 5. GMU 7 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
06	218	55	14
07	182	51	10
03	165	47	8
00	146	33	6
08	116	33	6
04	100	37	25
02	94	23	9
14	72	14	2
01	32	6	1
15	18	5	1
05	7	1	0
13	3	1	0
09	2	1	0
Unit total	1,155	307	82

Source: ADF&G 1984a.

C. Management Considerations

Because most of GMU 11 is within the Wrangell-St. Elias National Park and Preserve, hunting within the park is prohibited to all but local residents. Not only does this limit the opportunity to hunt moose, but it also severely reduces the ability of the ADF&G to actively manage the resource. Lands within the park and preserve are under the control of the NPS, which, under current polices, does not allow habitat manipulation. There is also a need to investigate and verify the controlling factors on the moose population within GMU 11.

D. Period of Use

Moose hunting occurs during the month of September. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 6 presents 1978-1983 human use data for GMU 11. The decline in the number of hunters during 1978 from previous years was primarily due to the creation of Wrangell-St. Elias National

Table 6. GMU 11 Human Use Data, 1978-83

Year	By Mode of Access: Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	By Hunter Origin: South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	157	47	39	3	26	8	0	34	99	4	10	0	16	2	17	0	9
Days hunted	824	201	202	27	221	33	0	140	453	12	83	0	139	5	83	0	49
Harvest	40	18	9	0	9	3	0	1	23	0	4	0	2	1	8	0	2
1979[a]																	
No. hunters	72	18	24	0	9	6	0	15	52	1	5	0	4	0	7	0	3
Days hunted	401	91	147	0	50	22	0	91	308	6	24	0	17	0	29	0	17
Harvest	21	8	5	0	2	6	0	0	12	0	1	0	1	0	7	0	0
1980[a]																	
No. hunters	151	25	63	4	35	3	0	21	100	3	16	0	12	2	11	1	6
Days hunted	993	105	457	18	231	27	0	155	715	12	93	0	54	10	80	20	9
Harvest	42	10	14	2	13	2	0	1	26	1	4	0	3	0	5	0	3
1981[a]																	
No. hunters	212	40	73	0	40	7	0	52	151	5	19	0	12	1	12	2	10
Days hunted	1,291	185	480	0	279	52	0	295	897	22	143	0	85	20	66	20	38
Harvest	76	26	20	0	18	4	0	8	46	3	7	0	3	0	9	2	6
1982[a]																	
No. hunters	178	24	56	0	43	8	0	47	140	5	10	0	11	0	5	0	7
Days hunted	1,182	101	446	0	286	55	0	294	944	33	70	0	62	0	20	0	53
Harvest	42	9	10	0	18	4	0	1	25	2	3	0	6	0	4	0	2
1983[b]																	
No. hunters	195	40	58	6	47	5	0	39	---	---	---	---	---	---	6	---	4
Days hunted	1,381	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	48	18	12	3	12	2	0	1	---	---	---	---	---	---	4	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Monument, which, under federal regulations, prohibited hunting by nonlocals in the park. Since then, with the establishment of Wrangell-St. Elias National Park and Preserve, hunting has increased. Hunting by locals and nonlocals is allowed in the preserve, and hunting by local residents is allowed in the park. Highway vehicles are the most used means of access, followed by airplanes and ORVs. Horses and boats are used to some extent, but generally their use is limited.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 7 and ordered by number of hunter-days by minor tributary (see I.A. above). Minor tributary code number 00 denotes GMU 11 only. Harvest reports that contain insufficient location information to code below the GMU level are recorded here.

Table 7. GMU 11 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
00	299	45	5
15	252	22	2
24	173	20	2
04	148	23	5
22	129	21	12
05	56	11	1
21	54	10	5
23	53	7	1
19	49	8	5
18	43	9	3
07	37	6	1
17	35	4	2
03	20	3	1
16	13	1	1
20	9	1	0
08	5	2	2
01	3	1	0
02	3	1	0
Unit total	1,381	195	48

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

VII. GMU 13

A. Boundaries

GMU 13 includes much of the Upper Susitna and Nelchina basins. (See the current Alaska game management unit map and boundary descriptions.)

B. Management Objectives

Throughout most of GMU 13 the primary management objective is to provide the greatest sustained opportunity to hunt moose. In portions of Subunits 13(E) and (A), the primary management objective is to provide the greatest sustained opportunity to be selective in hunting moose, and the secondary management objective is to hunt moose under aesthetically pleasing conditions. In portions of Subunit 13(D) along the Matanuska River, the primary management objective is to provide the greatest sustained opportunity to hunt moose under aesthetically pleasing conditions. In the Paxson closed area in Subunit 13(B), the primary management objective is to provide the greatest sustained opportunity to view and photograph moose (Bos 1980, ADF&G 1976).

C. Management Considerations

During the mid-to-late 1970's, the bull/cow ratio had declined markedly in much of GMU 13. As a result of this decline during 1980, a regulation was implemented allowing only bull moose with antler spreads of 36 inches or greater to be taken. Since then, the bull/cow ratio has increased; however, although this ratio has increased, the mean age and number of mature bulls has decreased (ADF&G 1984). Because of the declining age structure a season was implemented in portions of Subunits 13(B) and (E) allowing only the take of spike or forked antlered bull moose. The intent of this regulation is to direct hunting pressure toward younger age-class moose. Animals with spike or forked antlers are generally yearling bulls. Many yearling bulls, however, have larger antlers and thus are protected under this regulation, allowing them to become older age-class animals.

Unit 13 has several highways that border or bisect it and numerous trails, which are used extensively by hunters with ORVs. This circumstance, coupled with the unit's proximity to the major population center of Anchorage, subjects it to high hunting pressure. Because of this, it has become increasingly difficult to maintain a general hunting season open to all hunters.

The fact that brown bears can be a significant cause of moose calf mortality has been demonstrated in the Nelchina Basin (Ballard et al. 1982). Predation appears to remain a major factor in controlling herd numbers (ADF&G n.d.).

Effective fire suppression has greatly reduced the frequency and extent of fires in the area. Moose often prefer early seral stage plant communities, which grow after fires, because of their increased forage production or availability. Fire suppression has thus decreased the amount of forage available to moose (ADF&G 1976).

The proprosed Susitna hydroelectric project is located within GMU 13. Should the dam(s) be built, a large portion of the unit's moose population may be affected to varying degrees.

D. Period of Use

Moose hunting generally occurs during the first three weeks of September. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

1. GMS 13(A). Table 8 presents 1978-1983 human use data for Subunit 13(A). The number of hunters and harvest appear to have declined from the 1978 to the 1979 hunting season. Because reminder letters were not sent to harvest ticket holders in 1979, it is likely the actual harvest was higher. During the 1980 season, a more restrictive season was implemented, allowing the take of only bull moose with an antler spread of 36 inches or greater. Because of this restriction, hunting pressure and harvest declined. The decline noted from the 1981 and 1982 season may have been the result of adverse weather during the last 10 days of the hunting season (ADF&G 1984b).

   The most popular method of access used is the ORV, because of the extensive trail system that exists in the area. Airplane and highway vehicle are the second most popular methods of access, followed by boat. Boat access is facilitated because of the presence of launch sites on Lake Louise within the subunit. There is limited use of horses because of competition with other means of access.

2. GMS 13(B). Table 9 presents 1978-1983 human use data for Subunit 13(B). (See the Subunit 13(A) human use data discussion concerning fluctuations in hunting pressure.)

   Highway vehicles and ORVs are the most popular means of transport in Subunit 13(B). Again, as in Subunit 13(A), highway access and an extensive trail system and flat terrain provide for these two means of access. The Sourdough and Clearwater creeks controlled use areas are within Subunit 13(B). Within these controlled areas, transportation by motorized vehicles is prohibited for hunting, except on highways. This would account for the lower percentage of ORV use compared to Subunits 13(A) and 13(C). Boats and airplanes are used to a lesser extent than highway vehicles or ORVs. Both the MacLaren and Susitna rivers are used by boaters.

3. GMS 13(C). Table 10 presents 1978-1983 human use data for Subunit 13(C). (See the Subunit 13(A) human use data discussion concerning fluctuations in hunting pressure.) ORVs are the most frequently used means of transport for hunting within this subunit because of its relatively flat terrain and trail system. Boat access is limited because of the lack of rivers and lakes accessible to boats.

4. GMS 13(D). Table 11 presents 1978-1983 use data for Subunit 13(D). (See the Subunit 13(A) human use data discussion concerning fluctuations in hunting pressure.)

   Access within this subunit for hunting moose is primarily by highway vehicle. ORV use is somewhat limited because of the

Table 8. Game Management Subunit 13(A) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	781	153	175	72	263	13	0	105	677	4	12	0	22	2	34	0	30
Days hunted	3,961	726	748	423	1,511	62	0	491	3,461	18	37	0	92	8	184	0	161
Harvest	231	67	31	18	109	5	0	1	185	2	2	0	3	0	23	0	16
1979[a]																	
No. hunters	631	124	133	84	189	15	0	86	536	5	7	0	13	0	32	7	31
Days hunted	3,646	586	590	601	1,297	100	0	472	3,070	33	20	0	80	0	208	66	169
Harvest	204	62	31	13	84	9	0	5	165	2	1	0	3	0	19	6	8
1980[a]																	
No. hunters	694	142	149	119	157	11	1	115	600	7	2	0	29	0	33	3	20
Days hunted	3,980	773	795	737	1,118	68	5	484	3,402	50	23	0	145	0	215	14	131
Harvest	118	43	8	16	40	4	1	6	86	2	0	0	4	0	20	3	3
1981[a]																	
No. hunters	807	150	165	133	151	10	1	197	697	9	12	1	28	0	41	1	18
Days hunted	4,563	694	892	880	910	39	11	1,137	3,830	69	54	2	239	0	216	3	150
Harvest	160	58	15	11	66	3	0	7	129	1	2	0	5	0	18	1	4
1982[a]																	
No. hunters	756	140	144	85	197	9	1	180	665	2	3	0	17	0	26	1	42
Days hunted	4,528	833	748	622	1,335	38	20	932	3,907	9	30	0	153	0	196	10	223
Harvest	122	31	15	12	56	5	0	3	101	1	0	0	1	0	8	0	11
1983[b]																	
No. hunters	837	132	204	143	217	6	0	135	---	---	---	---	---	---	19	---	14
Days hunted	4,760	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	171	44	16	11	98	2	0	0	---	---	---	---	---	---	5	---	4

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 9. Game Management Subunit 13(B) Human Use Data, 1978-83

Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
	By Mode of Access								By Hunter Origin								
1978[a]																	
No. hunters	576	64	201	65	137	19	0	90	325	10	21	2	180	1	17	0	20
Days hunted	3,346	311	1,140	460	886	132	0	417	1,784	64	115	7	1,129	3	142	0	102
Harvest	181	31	50	25	57	13	0	5	94	4	3	1	59	0	11	0	9
1979[a]																	
No. hunters	420	44	128	47	121	15	0	65	220	7	8	0	138	0	18	2	27
Days hunted	2,491	235	696	322	815	92	0	331	1,381	52	41	0	726	0	98	21	172
Harvest	185	27	47	18	71	11	0	11	100	4	3	0	56	0	11	2	9
1980[a]																	
No. hunters	492	49	154	72	123	14	0	80	268	11	3	0	145	2	21	3	39
Days hunted	2,717	295	747	392	806	61	0	416	1,444	73	32	0	774	---	172	19	203
Harvest	127	18	23	23	52	6	0	5	63	4	1	0	39	1	10	1	8
1981[a]																	
No. hunters	640	77	182	72	178	11	0	120	365	9	13	0	207	2	30	0	14
Days hunted	3,753	368	924	404	1,252	117	0	688	2,147	43	86	0	1,246	5	172	0	54
Harvest	204	37	46	24	84	6	0	7	120	2	3	0	56	1	18	0	4
1982[a]																	
No. hunters	687	61	176	90	175	23	2	160	417	17	15	0	186	8	16	0	28
Days hunted	4,135	305	1,029	488	1,084	159	18	1,052	2,447	101	102	0	1,186	34	116	0	149
Harvest	209	36	47	33	75	8	0	10	118	5	6	0	53	4	10	0	13
1983[b]																	
No. hunters	827	85	289	94	214	16	0	129	---	---	---	---	---	---	32	---	19
Days hunted	4,804	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	285	45	68	36	127	5	0	4	---	---	---	---	---	---	22	---	8

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 10. Game Management Subunit 13(C) Human Use Data, 1978-83

Year	By Mode of Access: Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	By Hunter Origin: South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	272	32	72	7	109	10	0	42	177	11	27	0	35	0	12	0	10
Days hunted	1,775	186	563	27	729	64	0	206	1,080	102	143	0	263	0	129	0	58
Harvest	113	17	25	1	65	3	0	2	78	5	6	0	13	0	6	0	5
1979[a]																	
No. hunters	207	34	52	6	74	5	0	36	106	15	29	0	37	0	8	2	10
Days hunted	1,444	186	389	27	529	34	0	279	670	150	222	0	269	0	63	18	52
Harvest	98	21	25	3	43	3	0	3	50	8	15	0	14	0	4	2	5
1980[a]																	
No. hunters	253	27	76	3	100	7	0	40	165	19	15	1	28	0	13	0	12
Days hunted	1,745	135	543	38	729	28	0	272	1,123	172	95	3	212	0	79	0	61
Harvest	92	16	21	1	47	4	0	3	58	11	2	1	5	0	10	0	5
1981[a]																	
No. hunters	270	28	69	4	107	11	0	51	153	27	35	1	32	0	14	0	8
Days hunted	1,882	191	538	8	763	43	0	339	979	292	251	5	207	0	98	0	50
Harvest	116	13	25	3	61	6	0	8	66	16	9	1	15	0	6	0	3
1982[a]																	
No. hunters	256	28	49	5	96	12	0	66	158	13	35	0	27	1	10	0	12
Days hunted	2,001	161	346	39	799	69	0	587	1,162	208	299	0	200	4	66	0	62
Harvest	80	14	8	3	42	3	0	10	46	5	6	0	11	0	4	0	8
1983[b]																	
No. hunters	280	39	70	4	124	4	0	39	---	---	---	---	---	---	10	---	1
Days hunted	2,032	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	126	23	20	2	70	3	0	4	---	---	---	---	---	---	7	---	1

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 11. Game Management Subunit 13(D) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	264	34	98	14	57	6	0	55	231	0	6	0	7	0	7	0	13
Days hunted	1,360	159	462	77	301	28	0	333	1,211	0	34	0	31	0	32	0	52
Harvest	56	10	15	4	21	3	0	3	43	0	2	0	2	0	3	0	6
1979[a]																	
No. hunters	222	35	96	11	40	2	0	38	190	1	1	0	8	0	10	2	10
Days hunted	1,339	226	541	81	286	7	0	198	1,187	5	6	0	64	0	28	4	45
Harvest	68	19	23	1	21	2	0	2	53	0	1	0	2	0	5	2	5
1980[a]																	
No. hunters	271	31	118	16	38	6	0	62	214	3	1	0	14	2	14	5	18
Days hunted	1,271	146	477	90	234	26	0	298	998	8	20	0	52	6	74	12	101
Harvest	54	14	11	4	19	3	0	3	38	0	0	0	3	0	6	4	3
1981[a]																	
No. hunters	285	34	109	6	44	15	0	77	256	0	2	0	9	1	8	3	6
Days hunted	1,442	164	590	24	219	72	0	373	1,291	0	10	0	42	8	32	19	40
Harvest	69	17	16	0	19	9	0	8	56	0	1	0	3	0	5	2	2
1982[a]																	
No. hunters	256	34	79	4	30	13	0	96	217	4	1	0	5	1	8	2	18
Days hunted	1,574	215	486	24	167	104	0	578	1,325	2	20	0	35	5	54	4	110
Harvest	42	17	6	0	13	3	0	3	28	1	0	0	0	0	7	2	4
1983[b]																	
No. hunters	374	42	151	23	64	11	0	83	---	---	---	---	---	---	1	---	0
Days hunted	2,079	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	83	23	31	3	19	6	0	1	---	---	---	---	---	---	0	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Tonsina Controlled Use Area and steep terrain. Aircraft are used to a lesser extent, followed by boat and horse.

5. GMS 13(E). Table 12 presents 1978-1983 human use data for Subunit 13(E). (See the Subunit 13(A) human use data discussion concerning fluctuations in hunting pressure.) Generally, airplanes, highway vehicles, and ORVs are used nearly equally as the major modes of access in Subunit 13(E). ORV use is somewhat restricted compared to Subunits 13(A) and 13(C) because of steep terrain within Subunit 13(E). Boat access is used to some extent and is generally limited to portions of the Susitna, Chulitna, and Tokositna rivers. Horse access, as in all other subunits of GMU 13, is used to a limited extent.

6. GMU 13, subunit unknown. Table 13 presents data for GMU 13 from harvest tickets that do not indicate within which subunit the hunter hunted. Therefore, a substantial amount of hunting pressure cannot be attributed to a particular subunit. Use or interpretation of these data should be made only on a GMU-wide basis in combination with all subunit data.

F. Significance of Particular Use Area

Data for 1983 are presented in tables 14-18 for Subunit 13(A-E), ordered by number of hunter-days by minor tributary (see I.A. above).

Minor tributaries receiving the highest use are generally those most accessible to hunters. Note that the code 00 indicates that there was insufficient information on the harvest ticket to determine within which minor tributary a hunter hunted within a particular subunit.

Table 19 presents 1983 data for GMU 13, where particular subunits cannot be determined from harvest ticket reports. These data are additive to the combined totals for all subunit data only.

VIII. GMS 14(A)

A. Boundaries

GMS 14(A) includes the Willow, Wasilla, and Palmer area bounded on the south by Cook Inlet and the Knik Arm and on the north by Willow and Peters creeks. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Management objectives for GMS 14(A) include providing an opportunity to hunt moose under aesthetically pleasing conditions, providing for an optimum harvest of moose, and providing an opportunity to view, photograph, and enjoy moose (Bos 1980).

C. Management Considerations

Development, including residential and agricultural, is decreasing the amount of habitat available to moose in Subunit 14(A). Efforts are being made to improve moose habitat in the Moose Creek Moose Management Area; however, gains realized in that area may be offset by losses to increasing development elsewhere (ADF&G 1984b).

Table 12. Subunit 13(E) Human Use Data, 1978-83

Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
	By Mode of Access								By Hunter Origin								
1978[a]																	
No. hunters	423	73	123	40	132	4	0	51	257	2	4	1	111	4	30	0	14
Days hunted	2,100	413	517	207	730	22	0	211	1,217	6	26	4	533	8	235	0	71
Harvest	161	38	38	16	58	3	0	8	90	1	3	1	37	2	21	0	6
1979[a]																	
No. hunters	362	62	92	32	118	10	0	48	203	3	5	0	98	2	36	1	14
Days hunted	2,003	317	476	158	713	44	0	295	1,197	26	33	0	479	4	175	6	83
Harvest	169	38	35	10	70	8	0	8	85	2	4	0	37	1	29	1	10
1980[a]																	
No. hunters	437	93	113	34	112	4	0	81	268	1	3	0	100	0	34	6	25
Days hunted	2,438	527	596	199	688	25	0	403	1,511	1	2	0	535	0	187	24	178
Harvest	118	46	16	7	36	4	0	9	58	1	0	0	26	0	20	5	8
1981[a]																	
No. hunters	554	121	140	47	130	8	0	108	327	5	7	1	139	3	49	9	14
Days hunted	3,006	642	729	256	765	35	0	579	1,722	42	29	3	769	15	289	55	82
Harvest	191	66	40	17	47	6	0	15	93	1	3	1	43	0	33	8	9
1982[a]																	
No. hunters	517	120	126	33	116	2	0	120	321	13	1	1	122	2	39	0	18
Days hunted	2,972	675	656	192	700	21	0	728	1,698	101	14	3	785	18	239	0	114
Harvest	135	51	26	13	38	2	0	5	81	5	0	0	24	0	20	0	5
1983[a]																	
No. hunters	614	121	224	54	127	6	1	81	---	---	---	---	---	---	86	---	9
Days hunted	3,609	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	194	68	38	19	58	3	1	7	---	---	---	---	---	---	22	---	1

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 13. Game Management Unit 13 Human Use Data for Unspecified Subunits, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	718	78	262	47	124	16	0	191	488	5	22	0	144	4	31	0	24
Days hunted	4,015	439	1,476	319	745	83	0	953	2,655	33	151	0	798	38	181	0	159
Harvest	121	37	27	6	38	5	0	8	60	2	4	0	25	1	23	0	6
1979[a]																	
No. hunters	535	56	194	40	110	8	0	127	368	3	5	0	108	1	15	7	28
Days hunted	3,069	314	1,114	243	728	36	0	634	2,047	15	17	0	696	---	96	46	152
Harvest	124	38	25	10	47	1	0	3	69	0	1	0	28	0	11	7	8
1980[a]																	
No. hunters	711	51	280	47	111	15	0	207	519	6	22	0	117	2	20	0	25
Days hunted	4,072	277	1,527	312	769	86	0	1,101	2,935	30	149	0	698	10	139	0	111
Harvest	47	12	8	6	16	3	0	2	24	1	0	0	11	0	7	0	4
1981[a]																	
No. hunters	600	34	238	20	90	13	0	205	400	8	12	0	132	7	23	0	18
Days hunted	3,709	245	1,509	128	602	40	0	1,185	2,404	49	27	0	821	64	236	0	108
Harvest	58	14	12	3	22	2	0	5	31	0	0	0	15	0	10	0	2
1982[a]																	
No. hunters	447	46	137	21	66	2	0	175	326	1	15	1	69	3	13	0	19
Days hunted	3,020	249	1,006	126	484	3	0	1,152	2,187	1	143	3	424	14	84	0	164
Harvest	35	13	4	4	11	0	0	3	28	0	1	0	2	0	2	0	2
1983[b]																	
No. hunters	311	36	115	20	51	3	1	85	---	---	---	---	---	---	9	---	6
Days hunted	1,798	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	45	14	10	0	20	2	0	1	---	---	---	---	---	---	6	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 14. GMS 13(A) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
20	1,521	261	12
07	477	108	22
18	313	51	27
05	299	48	14
00	293	44	8
11	287	52	8
02	285	40	3
21	235	34	18
06	183	39	10
14	141	30	2
13	133	33	6
08	121	17	6
19	87	10	9
10	76	18	12
04	72	8	2
01	69	6	1
03	47	11	2
15	42	8	5
12	29	9	2
17	24	4	1
09	20	5	0
16	6	1	1
Subunit total	4,760	837	171

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

Table 15. GMS 13(B) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
03	1,123	174	56
17	885	154	33
04	559	96	26
15	316	50	26
12	312	65	20
18	310	49	31
00	290	51	24
16	224	49	27
14	216	38	11
05	111	19	1
06	104	24	8
09	85	12	3
13	85	11	1
11	67	15	6
02	37	5	3
07	32	6	5
01	26	5	1
08	22	4	3
Subunit total	4,804	827	285

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

Table 16. GMS 13(C) Minor Tributary Human Use Data Ordered by Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
03	814	106	60
05	489	74	28
02	267	32	4
01	198	29	15
04	165	24	14
00	99	15	5
Subunit total	2,032	280	126

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

Table 17. GMS 13(D) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
08	660	115	17
05	283	50	9
10	262	50	5
16	165	32	11
00	122	17	5
09	109	17	2
07	97	14	4
18	87	20	9
12	61	12	7
21	56	9	0
20	45	5	1
13	42	7	1
22	26	6	6
19	19	5	0
03	12	6	2
06	10	1	0
11	9	3	1
23	8	3	1
14	6	1	1
15	---	1	1
Subunit total	2,079	374	83

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 18. GMS 13(E) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
30	734	124	13
00	369	73	17
01	254	36	16
29	227	40	17
10	210	29	8
25	207	21	4
02	186	32	8
32	173	31	10
17	146	27	15
13	119	22	11
24	118	18	15
26	110	24	8
15	84	18	3
03	68	11	1
28	68	11	2
23	64	7	7
12	61	11	3
21	59	11	2
18	55	12	4
11	50	8	4
09	49	9	1
31	44	9	7
27	30	6	5
22	29	3	3
08	24	7	2
16	23	3	0
14	17	4	4
20	16	4	1
19	15	3	3
Subunit total	3,609	614	194

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

Table 19. GMU 13, Subunits Unknown, Moose Harvest and Permit Report Data, 1983

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
00	1,798	311	45
Unit total	1,798	311	45

Source: ADF&G 1984a.

Mortality caused by collisions with highway vehicles and trains occurs each year, primarily during winter. Mortality is highest during winters of moderate-to-heavy snowfall, when moose are forced to move to wintering areas near portions of the subunit populated by humans (ADF&G 1984b, ADF&G n.d.).

D. Period of Use

Moose hunting generally is allowed during the first three weeks of September. (See latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 20 presents 1978-1983 human use data for Subunit 14(A). The vast majority of hunters use highway vehicles as the mode of access for moose hunting, primarily because of the road system and the subunit's proximity to Anchorage and the Matanuska Valley.

The decline in reported hunters and harvest between the 1978 and 1979 seasons likely reflects the fact that reminder letters were not sent to harvest ticket holders for the 1979 season, rather than a real decline in number of hunters afield.

F. Significance of Particular Use Areas

Subunit 14(A) 1983 data are presented in table 21 and ordered by number of hunter-days by minor tributary (see I.A. above). Note that a substantial number of hunters reported hunting in Subunit 14(A) whose harvest reports did not provide sufficient information to record the hunt location more precisely than at the subunit level (minor tributary code 00).

IX. GMS 14(B)

A. Boundaries

GMS 14(B) is located north of the Wasilla/Palmer area. It is bordered in the south by Willow and Peters creeks and to the north by the Talkeetna River. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Throughout most of Subunit 14(B), the primary management objective is to provide the greatest sustained opportunity to hunt moose. In the northeastern portion of the subunit, the management objective is to provide an opportunity to be selective in hunting moose and secondarily to hunt moose under aesthetically pleasing conditions (Bos 1980).

C. Management Considerations

Loss of winter range is the most important factor jeopardizing the moose population within Subunit 14(B). Effective fire suppression has allowed habitat to mature beyond the early seral stages preferred by moose during winter. Development along the Parks Highway is increasing, as is the habitat loss associated with it (ADF&G 1976).

Mortality of moose caused by collision with highway vehicles and trains can be substantial during some years, depending on winter snow conditions. Years with heavy snow force moose into traditional winter range and in close contact with the human

Table 20. Game Management Subunit 14(A) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	1,574	60	823	82	233	44	0	332	1,475	7	13	3	4	0	10	0	62
Days hunted	7,432	254	3,768	367	1,312	216	0	1,515	6,946	41	85	8	27	0	80	0	245
Harvest	332	20	173	28	68	18	0	25	303	1	5	1	1	0	4	0	17
1979[a]																	
No. hunters	1,053	32	543	54	144	19	0	261	989	2	1	0	5	0	10	1	45
Days hunted	5,349	122	2,742	257	843	104	0	1,281	5,006	1	12	0	31	0	64	3	232
Harvest	201	12	118	11	40	6	0	14	189	0	0	0	1	0	1	0	10
1980[a]																	
No. hunters	1,735	55	930	88	258	12	1	391	1,674	2	9	0	8	0	20	0	22
Days hunted	8,562	241	4,564	524	1,324	66	8	1,835	8,230	4	58	0	78	0	113	0	79
Harvest	289	14	153	25	68	4	0	25	271	0	5	0	0	0	8	0	5
1981[a]																	
No. hunters	2,034	54	983	113	286	42	1	555	1,952	4	7	0	15	3	16	0	37
Days hunted	10,011	209	4,563	531	1,589	235	0	2,884	9,646	23	36	0	48	15	77	0	166
Harvest	365	20	189	35	71	20	0	30	340	1	4	0	2	0	6	0	12
1982[a]																	
No. hunters	2,219	74	929	121	319	32	1	743	2,078	6	10	4	11	0	28	0	82
Days hunted	11,779	451	4,642	598	1,851	204	15	4,018	10,961	35	47	20	73	0	191	0	452
Harvest	310	23	154	32	71	13	0	17	289	1	0	1	2	0	7	0	10
1983[b]																	
No. hunters	2,667	71	1,423	210	419	41	2	501	---	---	---	---	---	---	23	---	44
Days hunted	13,607	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	531	24	295	52	120	18	1	21	---	---	---	---	---	---	9	---	7

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 21. GMS 14(A) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
03	2,623	549	121
00	1,934	348	29
04	1,713	322	61
02	1,443	304	56
07	1,059	197	40
08	1,046	192	42
05	931	177	42
01	921	186	45
12	742	170	37
09	423	85	22
11	327	43	13
13	272	56	20
06	169	37	3
10	4	1	0
Subunit total	13,607	2,667	531

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

population. This contact increases the incidence of vehicle and train mortality (ADF&G n.d.).

Much of Subunit 14(B) is inaccessible to hunters, thus concentrating harvest along the Parks Highway and the few access trails in the subunit (ibid.). Local overharvest of subpopulations may occur in some areas, while other areas receive very little hunting pressure (ADF&G 1976).

D. Period of Use

Most harvest of moose occurs during the month of September; however, in recent years a late (between December 15 and February 15) two-week drawing-permit season has been held. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 22 presents human use data for the 1978 through 1983 season. The apparent decline in the number of reported hunters from the 1978 to 1979 season likely reflects the fact that reminder letters were not sent out after the 1979 season. It is difficult to determine what the real magnitude of increase was in the number of hunters during the 1980 season compared to the 1979 season. There likely was a substantial increase in response to a minimum antler

Table 22. Game Management Subunit 14(B) Human Use Data, 1978-83

	By Mode of Access								By Hunter Origin								
Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	368	35	158	40	58	3	0	74	332	2	6	0	8	0	7	0	13
Days hunted	2,055	183	901	222	317	25	0	407	1,822	14	35	0	39	0	64	0	81
Harvest	65	15	26	4	17	0	0	3	55	2	0	0	0	0	3	0	5
1979[a]																	
No. hunters	285	22	109	23	54	4	0	73	257	5	2	0	6	0	4	0	11
Days hunted	1,502	111	626	114	203	25	0	423	1,342	32	12	0	27	0	26	0	63
Harvest	52	12	19	3	17	1	0	0	37	4	2	0	0	0	4	0	5
1980[a]																	
No. hunters	560	59	224	41	97	3	2	134	517	4	1	0	5	0	16	2	15
Days hunted	3,068	291	1,216	205	609	18	6	723	2,755	23	---	0	18	0	92	25	155
Harvest	108	31	29	12	27	2	1	6	95	1	1	0	1	0	7	1	2
1981[a]																	
No. hunters	687	51	256	56	125	6	0	193	638	2	0	0	9	1	19	1	17
Days hunted	4,141	272	1,631	266	771	27	0	1,174	3,873	9	0	0	42	10	137	2	68
Harvest	128	24	30	20	39	3	0	12	117	0	0	0	1	0	3	1	6
1982[a]																	
No. hunters	934	79	302	103	166	10	0	274	864	4	3	1	4	0	27	0	31
Days hunted	5,222	361	1,764	552	1,009	72	0	1,464	4,834	22	18	18	13	0	166	0	151
Harvest	192	26	69	12	76	3	0	6	175	2	1	0	1	0	8	0	5
1983[b]																	
No. hunters	2,299	121	1,117	242	415	7	0	393	---	---	---	---	---	---	32	---	26
Days hunted	11,337	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	460	32	231	57	123	7	0	8	---	---	---	---	---	---	9	---	3

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

size restriction imposed in adjacent GMU 13. Because of this restriction, some hunters probably elected to hunt in other areas (ADF&G 1981).

The tremendous increase that occurred between the 1982 and 1983 seasons was the direct result of a 30-day-either-sex nonpermit season in Subunit 14(B). The expanded bag limit encouraged more hunters to hunt moose in this subunit (ADF&G n.d.).

Highway vehicles are the most frequently reported means of transportation because of the road system existing in this subunit. Although access trails are somewhat limited in most of Subunit 14(B), ORV use has continued to increase and has remained the second most reported means of access. Boat access has generally been the third most reported access method, followed by aircraft and horse.

F. Significance of Particular Use Areas

Subunit 14(B) data for 1983 are presented in table 23 and ordered by number of hunter-days by minor tributary (see I.A. above).

Note that a substantial number of hunters reported hunting in Subunit 14(B) whose harvest reports did not provide sufficient information to record the hunt location more precisely than at the subunit level (minor tributary code 00).

Table 23. GMS 14(B) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
04	2,839	587	82
06	1,911	371	61
05	1,708	327	65
00	1,369	275	37
09	1,300	270	91
07	830	181	47
08	582	116	38
01	538	109	34
02	163	41	0
03	94	21	5
10	3	1	0
Subunit total	11,337	2,299	460

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

X. GMS 14(C)

A. Boundaries

GMS 14(C) encompasses the Anchorage area between Knik Arm and Turnagain Arm. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Within most of Subunit 14(C), the primary management objective is to provide sustained opportunities to view and photograph moose and secondarily to hunt moose under aesthetically pleasing conditions and to protect human life and property (Bos 1980).

C. Management Considerations

Extensive urbanization within the Anchorage lowlands and hillside area has eliminated large tracts of moose winter range (ADF&G 1976). Although the number of moose has increased in Subunit 14(C) over the past five years because of mild winters, a severe winter with heavy snowfall could likely cause severe winter losses (Harkness, pers. comm.). Not only has the extensive urbanization caused habitat losses; it has also increased the likelihood of potentially dangerous moose/human conflicts.

Mortality of moose as the result of collisions with vehicles is high. This mortality often exceeds that of the hunting mortality (BGDIF).

D. Period of Use

Hunting generally occurs during September and, in some portions of the subunit, during mid winter. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 24 presents 1978 through 1983 Subunit 14(C) human use data. Because most of the hunting and harvest in this subunit occur during permit hunts rather than during the general open season, 1978-1982 data, which represent general harvest report information only, should be interpreted cautiously.

A large portion of Subunit 14(C) is within the boundaries of Chugach State Park, where motorized vehicles are restricted to roads and currently designated areas (see the current Chugach State Park regulations). Because of these restrictions, most access is limited to use of highway vehicles on roads.

The 1983 harvest of 220 moose was the second highest on record (ADF&G n.d.). This increase in harvest is indicative of the increasing number of moose in the subunit and an increase in the number of permits and permit hunts available to hunters.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 25 and ordered by number of hunter-days by minor tributary (see I.A. above).

Minor tributary code number 00 refers to information obtained from harvest reports that could not be coded beyond the subunit level.

Table 26 presents 1978 through 1983 human use data for GMU 14 where the subunit could not be determined from the returned harvest reports. These data are additive to all subunits of

Table 24. Game Management Subunit 14(C) Human Use Data, 1978-83

	By Mode of Access								By Hunter Origin								
Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	155	5	78	5	17	6	0	44	147	0	0	0	1	1	1	0	5
Days hunted	661	14	365	8	67	16	0	191	608	0	0	0	10	1	20	0	22
Harvest	18	0	10	1	1	4	0	2	17	0	0	0	0	1	0	0	0
1979[a]																	
No. hunters	101	5	57	4	6	10	0	19	97	1	0	0	0	0	0	0	3
Days hunted	372	15	192	23	27	26	0	89	353	6	0	0	0	0	0	0	13
Harvest	28	1	18	1	0	6	0	2	27	1	0	0	0	0	0	0	0
1980[a]																	
No. hunters	208	9	104	9	9	16	0	61	202	0	0	0	0	0	4	0	2
Days hunted	934	57	444	32	42	101	0	258	902	0	0	0	0	0	26	0	6
Harvest	50	5	30	0	0	8	0	7	46	0	0	0	0	0	4	0	0
1981[a]																	
No. hunters	259	6	131	8	21	12	1	80	243	0	1	0	4	0	2	1	8
Days hunted	1,103	20	573	31	88	36	10	345	1,044	0	10	0	12	0	14	5	18
Harvest	60	1	39	1	6	6	0	7	57	0	0	0	0	0	0	0	3
1982[a]																	
No. hunters	203	8	92	7	12	10	0	74	184	0	2	0	2	0	3	0	12
Days hunted	835	33	339	38	60	67	0	298	745	0	5	0	11	0	14	0	60
Harvest	38	5	21	2	1	6	0	3	35	0	0	0	0	0	1	0	2
1983[b]																	
No. hunters	803	27	599	46	25	22	0	84	---	---	---	---	---	---	7	---	26
Days hunted	3,058	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	220	7	172	15	6	11	0	9	---	---	---	---	---	---	3	---	7

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 25. GMS 14(C) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
04	755	149	50
05	470	91	22
03	445	109	55
06	253	71	10
02	233	205	44
00	205	37	2
08	199	17	6
11	135	14	1
07	121	25	6
01	89	38	5
12	68	22	12
09	49	14	4
10	36	11	3
Subunit total	3,058	803	220

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

GMU 14 combined and should be included when evaluating GMU 14 as a whole.

XI. GMS 15(A)

A. Boundaries

GMS 15(A) is located in the northeast portion of the Kenai Peninsula. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Throughout most of Subunit 15(A), the primary management objective is to provide the greatest sustained opportunity to participate in hunting moose and secondarily to provide sustained opportunities to view and photograph moose. The Kenai Moose Research Center has as its primary management objective to provide opportunities for scientific and educational study of moose (State of Alaska 1984b).

C. Management Considerations

Habitat conditions in much of the subunit (except that portion which burned in 1969) have deteriorated as a result of natural plant succession. Calf mortality has been high during years when deep snow has persisted late into spring. In order to meet the public demand to provide for both consumptive and nonconsumptive

Table 26. GMU 14 Human Use Data from Unspecified Subunits, 1978-83

Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
	By Mode of Access								By Hunter Origin								
1978[a]																	
No. hunters	152	10	70	8	14	1	0	49	146	1	0	0	1	0	2	0	2
Days hunted	814	60	394	38	52	12	0	258	794	4	0	0	6	0	5	0	5
Harvest	8	1	3	1	2	0	0	1	7	0	0	0	0	0	1	0	0
1979[a]																	
No. hunters	81	4	40	0	7	2	0	28	75	0	0	0	0	0	1	0	5
Days hunted	458	22	264	0	40	4	0	128	431	0	0	0	0	0	3	0	24
Harvest	4	1	2	0	1	0	0	0	3	0	0	0	0	0	1	0	0
1980[a]																	
No. hunters	168	9	58	12	24	1	0	64	161	0	0	0	1	0	1	0	5
Days hunted	1,210	43	427	102	193	5	0	440	1,147	0	0	0	7	0	6	0	50
Harvest	4	2	1	0	1	0	0	0	4	0	0	0	0	0	0	0	0
1981[a]																	
No. hunters	121	13	39	5	13	1	0	50	114	0	1	0	1	0	2	0	3
Days hunted	588	57	176	38	67	1	0	249	570	0	4	0	0	0	7	0	7
Harvest	7	2	1	1	2	0	0	1	7	0	0	0	0	0	0	0	0
1982[a]																	
No. hunters	111	8	32	6	10	0	0	55	98	3	0	0	0	0	3	0	7
Days hunted	660	44	167	52	68	0	0	329	590	30	0	0	0	0	13	0	27
Harvest	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1983[b]																	
No. hunters	95	2	43	8	6	1	0	35	---	---	---	---	---	---	0	---	2
Days hunted	667	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	3	1	1	1	0	0	0	0	---	---	---	---	---	---	0	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

use, it has become necessary to rehabilitate moose winter ranges (ADF&G 1976). GMS 15(A) has some of the highest moose densities in the state. This subunit has the potential, with proper habitat management, to produce high numbers of moose.

Predation of calves by black bears during summer months has been documented on the Kenai Peninsula. This predation is high and in combination with other natural mortality may be a major factor affecting the moose population (Franzmann et al. 1980).

Increased public awareness of high moose densities in the area of the 1969 burn has tended to concentrate hunters in that portion of the subunit. Habitat improvement elsewhere in the subunit is necessary to stimulate the growth of the moose population and distribute hunting pressure (ADF&G 1984b).

Low bull/cow ratios exist in the subunit. At this time, this low ratio does not appear to be affecting pregnancy rates; however, the situation requires close monitoring.

D. Period of Use

Moose hunting seasons generally occur during the first three weeks of September. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 27 presents 1978 through 1983 human use data for Subunit 15(A). Table 28 presents 1978 through 1983 human use data for unspecified subunits. Highway vehicles are the most frequently used means of transport in 15(A) because of the comparatively extensive road system within the subunit. Boat access is the second most used means of transport, followed by ORV and aircraft. Much of Subunit 15(A) is within the Kenai National Moose Range, where off-road motorized vehicle use is prohibited. Much of the subunit is also within the Kenai Controlled Use Area, where aircraft use for hunting moose is restricted.

The decline in the reported number of hunters and harvest during the 1979 season compared to the 1978 season may not have actually occurred. Reminder letters were not sent to those hunters who failed to return their moose harvest report after the 1979 season. The increase in effort and harvest during the 1980 season is, in part, related to reminder letters not being sent for the 1979 season. It also may be the result of increased public awareness of the favorable status of moose in the 1969 burn area (ADF&G 1981).

The substantial increase in effort and harvest from the 1982 to 1983 season may be indicative of the increased calf survival resulting from improved habitat in the 1969 burn and mild winters since 1979. Also during the 1983 season, weather was favorable for hunting 18 of the 20-day season (ADF&G n.d.).

F. Significance of Particular Use Areas

Data for 1983 are presented in table 29 and ordered by number of hunter-days by minor tributary (see I.A. above).

Minor tributary code number 00 refers to information obtained from harvest reports that could not be coded beyond the subunit level.

Table 27. Game Management Subunit 15(A) Human Use Data, 1978-83

Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
	By Mode of Access								By Hunter Origin								
1978[a]																	
No. hunters	1,045	51	584	131	60	33	0	186	991	1	22	0	5	0	12	1	13
Days hunted	5,825	244	3,377	621	477	164	0	942	5,526	1	77	0	23	0	108	14	76
Harvest	180	25	91	26	13	9	0	16	171	0	2	0	1	0	2	1	3
1979[a]																	
No. hunters	629	25	323	89	21	18	0	153	589	2	9	0	1	0	7	2	19
Days hunted	3,667	92	2,051	506	140	89	0	789	3,414	7	45	0	7	0	56	40	98
Harvest	121	11	65	23	5	9	0	8	108	0	0	0	0	0	3	0	10
1980[a]																	
No. hunters	1,230	46	647	151	48	46	1	291	1,164	3	9	0	5	2	19	2	26
Days hunted	6,883	203	3,735	670	360	212	1	1,702	6,442	21	53	0	41	14	131	15	166
Harvest	228	23	102	48	17	18	1	19	210	2	1	0	1	0	5	1	8
1981[a]																	
No. hunters	1,532	60	762	196	61	38	1	414	1,431	6	22	0	11	0	25	2	35
Days hunted	9,103	257	4,657	1,010	410	187	4	2,578	8,418	56	137	0	54	0	204	22	212
Harvest	278	25	141	51	15	21	1	24	255	0	4	0	1	0	7	2	9
1982[a]																	
No. hunters	1,409	40	640	143	57	35	0	494	1,312	5	13	0	10	0	34	0	35
Days hunted	8,307	188	3,830	775	445	199	0	2,870	7,688	28	62	0	54	0	275	0	200
Harvest	211	19	105	38	16	18	0	15	187	0	1	0	5	0	9	0	9
1983[b]																	
No. hunters	1,870	78	1,060	180	84	49	0	419	---	---	---	---	---	---	33	---	31
Days hunted	10,560	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	394	35	251	53	18	19	0	18	---	---	---	---	---	---	16	---	4

Source: ADF&G 1983a; BCDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 28. GMU 15 Human Use Data from Unspecified Subunits, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	227	16	98	25	21	6	0	61	206	0	11	0	2	0	2	0	6
Days hunted	1,303	91	524	172	113	26	0	377	1,193	0	41	0	27	0	17	0	25
Harvest	7	0	5	0	2	0	0	0	0	0	1	0	0	0	0	0	0
1979[a]																	
No. hunters	108	4	34	12	5	4	0	49	94	1	5	1	0	1	1	0	5
Days hunted	640	16	259	42	31	26	0	266	525	2	50	0	0	6	20	0	37
Harvest	4	0	0	0	0	0	0	4	3	0	1	0	0	0	0	0	0
1980[a]																	
No. hunters	199	4	80	21	17	6	0	71	183	3	6	0	0	1	1	0	5
Days hunted	1,107	26	440	105	104	39	0	395	1,007	11	35	0	0	3	4	0	47
Harvest	9	0	4	0	1	2	0	2	7	0	1	0	0	0	1	0	0
1981[a]																	
No. hunters	131	3	51	6	12	4	0	55	122	0	6	0	1	1	0	0	1
Days hunted	592	2	171	45	61	13	0	300	562	0	20	0	0	6	0	0	4
Harvest	10	0	4	0	2	3	0	1	10	0	0	0	0	0	0	0	0
1982[a]																	
No. hunters	116	4	30	4	8	3	0	67	108	0	6	0	0	0	0	0	2
Days hunted	791	10	174	32	102	13	0	460	755	0	14	0	0	0	0	0	22
Harvest	5	0	4	0	0	0	0	1	4	0	1	0	0	0	0	0	0
1983[b]																	
No. hunters	61	0	25	1	5	1	0	29	---	---	---	---	---	---	0	---	0
Days hunted	533	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	5	0	3	0	1	1	0	0	---	---	---	---	---	---	0	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 29. GMS 15(A) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
03	4,765	826	178
05	2,689	474	108
06	806	160	27
00	734	113	18
01	643	120	21
07	399	75	8
04	359	65	15
02	165	37	19
Subunit total	10,560	1,870	394

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

XII. GMS 15(B)

A. Boundaries

GMS 15(B) is located in the mid western portion of the Kenai Peninsula. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Throughout much of 15(B), the primary management objective is to provide the greatest opportunity to be selective in hunting moose, and the secondary objective is to hunt moose under aesthetically pleasing conditions. In portions of the subunit, the primary management objective is to provide the greatest opportunity to participate in hunting moose, and the secondary objective is to provide sustained opportunities to view and photograph moose (State of Alaska 1984).

C. Management Considerations

Similar management considerations apply to Subunit 15(B) as were discussed for Subunit 15(A). Maturing vegetation and lack of good browse is a serious problem throughout all of this subunit.

D. Period of Use

Moose hunting seasons generally occur during the first three weeks of September. A limited drawing-permit hunt, however, is allowed during the last week of September and the first two weeks of October. (See the latest Alaska Game Regulations for current seasons.)

E. Human Use Data

Table 30 presents 1978-1983 human use data for Subunit 15(B). Because much of the moose hunting in Subunit 15(B) is controlled under a drawing-permit hunt, data for 1978-1982, which do not

Table 30. Game Management Subunit 15(B) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	187	7	92	10	7	23	0	48	169	0	9	0	4	0	3	0	2
Days hunted	956	40	450	51	27	117	0	271	835	0	67	0	10	0	30	0	14
Harvest	38	3	17	1	2	8	0	7	36	0	1	0	1	0	0	0	0
1979[a]																	
No. hunters	136	4	55	12	6	20	0	39	125	1	1	0	0	0	0	2	7
Days hunted	818	25	336	81	23	115	0	238	749	7	10	0	0	0	0	9	43
Harvest	28	0	19	1	1	6	0	1	25	0	0	0	0	0	0	1	2
1980[a]																	
No. hunters	267	5	122	26	12	17	0	85	258	2	2	0	0	0	2	1	2
Days hunted	1,389	48	629	111	69	80	0	452	1,333	21	16	0	0	0	7	4	8
Harvest	51	1	25	6	1	8	0	10	49	0	0	0	0	0	1	1	2
1981[a]																	
No. hunters	273	7	110	22	13	33	0	88	264	1	1	0	0	0	6	0	1
Days hunted	1,653	29	624	135	63	244	0	558	1,584	15	4	0	0	0	40	0	10
Harvest	49	2	23	6	2	12	0	4	47	0	0	0	0	0	2	0	0
1982[a]																	
No. hunters	292	9	108	15	12	14	0	134	277	1	4	0	1	0	2	0	7
Days hunted	1,742	32	625	58	90	56	0	881	1,663	2	10	0	7	0	5	0	55
Harvest	50	5	34	1	0	5	0	5	45	0	0	0	0	0	2	0	3
1983[b]																	
No. hunters	414	19	208	46	6	48	0	87	---	---	---	---	---	---	15	---	8
Days hunted	2,502	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	116	6	54	13	2	30	0	11	---	---	---	---	---	---	8	---	5

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

include permit-hunt information, under-represent both hunting effort and harvest.

The decline in reported effort and harvest during the 1979 season are likely the result of fewer hunters returning their harvest reports because reminder letters were not sent out for that season. The subsequent increase during the 1980 season also reflects this fact.

Highway vehicles are the most frequently used means of transport by moose hunters; however, those hunters who use horses are the most successful. Because off-road use of motorized vehicles is prohibited on the Kenai NWR, which comprises much of the subunit, this means of transport is limited. Use of aircraft is also restricted to certain landing areas within the refuge, which limits their use.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 31 and ordered by number of hunter-days by minor tributary (see I.A. above). Minor tributary code number 00 refers to information obtained from harvest tickets that could not be coded beyond the subunit level.

Table 31. GMS 15(B) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
07	683	102	37
03	600	94	29
02	438	66	13
00	303	47	9
05	276	61	17
01	123	23	7
06	40	10	3
04	39	11	1
Subunit total	2,502	414	116

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

XIII. GMS 15(C)

A. Boundaries

GMS 15(C) is located in the southwestern portion of the Kenai Peninsula. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

The primary management objective in Subunit 15(C) is to provide the greatest sustained opportunity to participate in hunting moose, and the secondary objective is to provide the greatest opportunity to view and photograph moose (State of Alaska 1984).

C. Management Considerations

In addition to management considerations discussed for Subunit 15(A), there are several others in Subunit 15(C). Nonfederal lands between Tustemena Lake and Kachemak Bay are a very important habitat for moose. In this area, the long-term major threat to moose will stem from gradual deterioration of this habitat because of human-related development (ibid.).

There is a need for accurate information concerning the moose population size, seasonal habitat use, and movements. Delineation of calving areas, rutting areas, and winter range is especially important (ADF&G n.d.).

D. Period of Use

Moose hunting seasons generally occur during the first three weeks of September. (See the latest Alaska Game Regulations for current season.)

E. Human Use Data

Table 32 presents 1978-1983 human use data for Subunit 15(C). No permit hunts for moose have been held during this reporting period, and data for all years are generally comparable. Note, however, that reminder letters were not sent to hunters who obtained moose harvest tickets and failed to return them during the 1979 season. The decrease in reported harvest and effort from 1978 and the subsequent increase for the 1980 season reflect this fact.

The increase in harvest and effort during the 1981 season may reflect favorable hunting weather during the season and increased calf survival from the preceding winter (ADF&G 1983b).

Highway vehicles are the most frequently used means of transport within the subunit. Compared to other subunits of GMU 15, Subunit 15(C) receives substantially more ORV use. A large portion of this subunit is composed of state lands, where off-road motorized vehicular use is not restricted. Overall, horses and boats are about equally used, with those hunters using horses and aircraft generally being the most successful.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 33, by number of hunter-days by minor tributary (see I.A. above). Minor tributary code number 00 refers to information obtained from harvest tickets that could not be coded beyond the subunit level.

XIV. GMS 16(A)

A. Boundaries

GMS 16(A) is located in the Peters-Dutch Hills area of the lower Susitna basin bounded by the Susitna and Chulitna rivers on the

Table 32. Game Management Subunit 15(C) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	590	27	210	38	149	26	0	140	468	1	88	10	3	0	6	0	14
Days hunted	3,054	150	1,067	219	795	138	0	685	2,355	1	453	97	13	0	22	0	113
Harvest	126	13	36	7	48	10	0	12	104	0	11	2	0	0	3	0	6
1979[a]																	
No. hunters	432	19	144	43	94	21	0	111	320	2	44	0	1	0	7	0	58
Days hunted	2,277	108	781	185	545	111	0	547	1,600	18	280	0	3	0	63	0	313
Harvest	128	11	41	10	44	11	0	11	95	0	10	0	0	0	3	0	20
1980[a]																	
No. hunters	708	24	239	29	180	45	1	190	535	0	101	0	3	0	6	2	61
Days hunted	4,105	110	1,418	131	1,060	221	10	1,155	3,169	0	556	0	26	0	43	8	303
Harvest	165	8	56	6	66	11	0	18	111	0	26	0	3	0	2	1	22
1981[a]																	
No. hunters	933	20	322	52	192	57	1	289	744	1	125	1	1	1	16	0	44
Days hunted	5,312	101	1,818	285	948	323	10	1,827	4,166	14	690	3	2	7	139	0	291
Harvest	227	13	74	11	82	22	0	25	187	0	26	0	0	0	3	0	11
1982[a]																	
No. hunters	886	22	283	33	190	49	1	308	708	1	131	2	1	1	13	1	28
Days hunted	5,222	114	1,697	189	1,043	283	4	1,892	4,144	2	821	4	5	20	78	8	140
Harvest	197	8	72	13	70	20	0	14	160	1	25	1	0	0	3	1	6
1983[b]																	
No. hunters	1,154	37	413	75	281	60	0	287	---	---	---	---	---	---	6	---	14
Days hunted	6,859	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	245	13	76	12	94	30	0	14	---	---	---	---	---	---	5	---	2

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

Table 33. GMS 15(C) Minor Tributary Human Use Data Ordered by Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
05	2,047	365	61
03	1,443	238	84
01	1,075	163	23
02	923	119	21
06	626	125	30
00	259	46	9
07	174	41	8
04	169	30	3
08	85	19	4
10	41	4	0
09	17	4	2
Subunit total	6,859	1,154	245

Source: ADF&G 1984a.

a Figures based on general harvest ticket data only; no permit hunts were held in GMS 15(C) during the 1983 season.

east and the Kahiltna and Yentna rivers on the west. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

The primary management objective in Subunit 16(A) is to provide the greatest sustained opportunity to hunt moose (Bos 1980).

C. Management Considerations

Land disposals both for agriculture and settlement, which have occurred and are likely to continue to occur in the area, pose a threat to moose habitat. Gold mining occurs in the Peters-Dutch Hills area and may increase, also affecting moose habitat (ADF&G 1976). Roads and landing strips associated with such development may increase access into the area for hunting; but should these lands be posted not only access but use of the moose resource could be curtailed (ibid.). With increased settlement within the subunit, it is likely local demand for moose will also increase. River access along the Susitna and Yentna rivers and Kroto Creek tends to concentrate hunters along these corridor (ibid.). Highway vehicle access is mainly concentrated along the Petersville Road.

Should the proposed Susitna hydroelectric project be developed in GMU 13, it may impact moose and moose habitat along the Susitna River in Subunit 16(A) (Modafferi 1983).

Table 34. Game Management Subunit 16(A) Human Use Data, 1978-83

	By Mode of Access								By Hunter Origin								
Year	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	808	76	348	120	141	3	1	119	734	0	3	2	23	1	12	1	32
Days hunted	3,924	321	1,562	512	868	6	10	645	3,612	0	17	7	76	7	61	5	139
Harvest	170	21	68	33	40	1	1	6	147	0	2	1	4	1	6	1	8
1979[a]																	
No. hunters	585	57	244	85	94	2	1	102	532	1	1	0	13	1	10	5	22
Days hunted	3,101	245	1,225	468	604	3	12	544	2,851	10	3	0	49	2	60	29	97
Harvest	137	21	50	26	34	1	1	4	125	0	1	0	1	0	2	2	6
1980[a]																	
No. hunters	946	77	461	127	132	2	1	146	883	6	2	0	19	2	11	1	2
Days hunted	5,187	330	2,622	665	757	5	5	803	4,849	42	9	0	103	2	92	0	90
Harvest	186	15	81	40	45	1	0	4	172	2	0	0	5	0	3	0	4
1981[a]																	
No. hunters	983	88	401	126	162	0	0	206	917	2	3	1	29	1	16	3	11
Days hunted	5,533	483	2,171	790	1,021	0	0	1,068	5,084	4	11	3	209	12	121	30	59
Harvest	192	28	63	40	51	0	0	0	179	0	1	0	8	0	3	0	1
1982[a]																	
No. hunters	829	71	278	110	161	1	0	208	743	5	2	0	14	1	22	0	42
Days hunted	4,852	465	1,472	588	1,121	4	0	1,202	4,333	58	15	0	67	6	138	0	235
Harvest	165	30	53	37	41	1	0	3	141	1	0	0	4	0	12	0	7
1983[b]																	
No. hunters	1,076	98	457	176	202	1	2	140	---	---	---	---	---	---	19	---	23
Days hunted	5,929	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	228	27	69	60	66	1	1	4	---	---	---	---	---	---	10	---	8

Source: ADF&G 1983a; BCDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

D. Period of Use

Moose hunting generally occurs during the month of September. A limited drawing-permit hunt may be held in that portion of the subunit within 1 mi of the Parks Highway should weather conditions concentrate moose along the highway. (See the current Alaska Game Regulations.)

E. Human Use Data

Table 34 presents 1978-1983 human use data for Subunit 16(A). Note that reminder letters were not sent to hunters who had obtained moose harvest tickets and failed to return them during the 1979 season. The decrease in reported harvest and effort from 1978 and the subsequent increase for the 1980 season reflect this fact. The decrease from the 1981 to the 1982 season was the result of inclement weather during the 1982 season.

Highway vehicles are the most frequently used means of transport for hunting moose in the area, followed by ORV, boat, and aircraft. Access is relatively good in portions of the subunit, with a number of roads, trails, rivers, and landing areas.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 35, ordered by number of hunter-days by minor tributary (see I.A. above.).

Minor tributary code number 00 refers to information obtained from harvest tickets that could not be coded beyond the subunit level.

Table 35. GMS 16(A) Minor Tributary Human Use Data Ordered by Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
05	2,133	394	65
07	1,067	193	46
01	554	102	43
00	540	106	12
09	338	62	10
10	283	43	7
11	279	37	13
04	264	45	15
06	224	51	11
08	108	15	1
03	80	16	4
12	33	6	0
02	26	6	1
Subunit total	5,929	1,076	228

Source: ADF&G 1984a.

a Figures based on general harvest - ticket and permit hunt data

XV. GMS 16(B) (except Kalgin Island)

A. Boundaries

GMS 16(B) is located along the west side of Cook Inlet and the lower Susitna River valley and is bounded by the Yentna drainage on the north and Redoubt Bay on the south. (See the Alaska game management units maps and boundary descriptions.)

B. Management Objectives

In the Chelatna Lake-Yenlo Hills area, the primary management objective is to provide the greatest sustained opportunity to be selective in hunting moose, and the secondary objective is to hunt moose under aesthetically pleasing conditions. In the Skwentna area, the primary management objective is to provide the greatest sustained opportunity to hunt moose (Bos 1980).

C. Management Considerations

Similar management considerations as were discussed for Subunit 16(A) concerning development apply to Subunit 16(B). In addition, the proposed Beluga coal development, oil and gas development, and timber harvest would also impact moose and their habitat.

In the Redoubt Bay portion of the subunit, bull/cow ratios have declined. A census of the area, conducted in February 1984, produced an estimate of approximatley 300 moose. This is significantly lower than the 421 moose actually observed during fall surveys, conducted in 1981, indicating a population decline (Faro, pers. comm.).

Winters with deep snow can cause significant winter mortality. Winter ranges appear to be in limited supply. Means of enhancement are somewhat limited because of private property and the remoteness of the area (ADF&G 1976).

Hunting opportunity is limited because access is restricted to a few airstrips, lakes, rivers, gravel bars, and a road system in the Beluga, Tyonek, and Chakachatna areas (ibid.). These conditions tend to concentrate hunters in those areas where access is available.

D. Period of Use

Most moose hunting occurs during the month of September. In recent years, a limited permit-drawing hunt also has taken place during the first two weeks of November. Also a limited registration hunt has been held during mid winter for residents of the subunit. (See latest Alaska Game Regulations for current season.)

E. Human Use Data

Table 36 presents 1978-1983 human use data for Subunit 16(B). Note that reminder letters were not sent to hunters who obtained moose harvest tickets and failed to return them for the 1979 season. The decrease in reported harvest and effort from the 1978 to 1979 season and subsequent increase during the 1980 season reflect this fact. The decrease from the 1981 to 1982 season was the result of inclement weather during the 1982 hunting season.

Aircraft is the most frequently used means of transport for hunting moose in the subunit because of the lack of access for ground transportation.

Table 36. Game Management Subunit 16(B) Human Use Data, 1978-83

Year	By Mode of Access								By Hunter Origin								
	Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	1,436	926	55	265	27	9	0	154	1,277	9	5	1	17	1	61	0	65
Days hunted	7,291	4,330	359	1,567	155	42	0	838	6,379	66	35	2	111	3	325	0	370
Harvest	589	429	20	110	10	7	0	13	502	4	2	0	5	0	38	0	38
1979[a]																	
No. hunters	888	569	27	166	9	4	0	113	727	9	4	0	13	1	60	14	60
Days hunted	4,828	3,031	206	951	74	14	0	552	3,829	52	33	0	63	4	401	100	346
Harvest	361	274	12	56	5	3	0	11	277	5	1	0	6	0	34	11	27
1980[a]																	
No. hunters	1,269	770	58	234	28	5	0	174	1,143	6	5	0	8	1	40	27	39
Days hunted	7,302	4,214	428	1,453	197	19	0	991	6,436	29	18	0	63	4	281	205	266
Harvest	384	277	18	63	10	4	0	12	327	5	1	0	1	1	13	17	19
1981[a]																	
No. hunters	1,360	777	62	268	22	9	0	222	1,203	7	6	0	12	0	87	16	29
Days hunted	7,607	4,111	378	1,693	185	38	0	1,202	6,619	39	23	0	78	0	540	100	208
Harvest	441	291	24	96	15	5	0	10	365	6	2	0	4	0	41	12	11
1982[a]																	
No. hunters	1,135	626	33	256	22	14	0	184	945	10	7	0	12	1	64	8	88
Days hunted	6,908	3,636	269	1,662	199	66	0	1,076	5,594	57	45	0	74	0	442	132	564
Harvest	362	237	11	90	9	7	0	8	283	5	1	0	5	0	29	5	34
1983[b]																	
No. hunters	1,825	1,015	131	434	50	10	25	160	---	---	---	---	---	---	71	---	358
Days hunted	9,901	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	545	402	38	104	7	5	14	6	---	---	---	---	---	---	37	---	106

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Permit and harvest-ticket data also includes data for Kalgin Island.

--- means no data were available.

Boat access is the second most used means. Several major rivers and Cook Inlet provide for this means of access.

F. Significance of Particular Use Areas

Data for 1983 are presented in table 37, ordered by number of hunter-days by minor tributary (see I.A. above). Minor tributary code number 00 refers to information obtained from harvest tickets that could not be coded beyond the subunit level.

Table 37. Game Management Subunit 16(B) Minor Tributary Human Use Data Ordered by Number of Hunter-Days, 1983[a]

Minor	No. of Days	No. of Hunters	No. of Success. Hunters
06	1,606	268	77
05	1,176	240	75
03	996	168	55
15	906	149	36
16	710	101	23
02	698	119	50
14	692	132	38
17	570	101	41
19	533	211	57
00	483	85	13
01	395	60	22
04	381	74	17
09	220	38	16
13	174	20	8
08	134	20	1
07	120	21	3
11	50	9	7
12	28	5	3
18	15	2	2
10	14	2	1
Subunit total	4,368	1,614	779

Source: ADF&G 1984a.

a Figures based on general harvest-ticket and permit-hunt data.

Table 38 presents 1978 through 1983 human use data for GMU 16 where the subunit could not be determined from the returned

Table 38. GMU 16 Human Use Data for Unspecified Subunits, 1978-83

Year	By Mode of Access: Total	Airplane	Highway Vehicle	Boat	ORV	Horse	Snow-machine	Un-spec.	By Hunter Origin: South-central	South-east	South-west	West	Interior	Arctic	Non-res.	Alien	Un-spec.
1978[a]																	
No. hunters	165	46	32	22	12	4	0	49	148	0	4	0	1	0	7	0	5
Days hunted	873	213	142	137	122	6	0	253	756	0	26	0	6	0	33	0	52
Harvest	19	9	5	0	2	3	0	0	12	0	0	0	0	0	4	0	3
1979[a]																	
No. hunters	111	32	27	15	5	0	0	32	90	0	0	0	3	0	2	4	12
Days hunted	725	219	202	107	3	0	0	194	584	0	0	0	17	0	3	42	79
Harvest	18	10	3	3	1	0	0	1	10	0	0	0	0	0	1	4	3
1980[a]																	
No. hunters	155	38	28	33	15	0	0	41	140	1	1	0	1	0	5	2	5
Days hunted	737	201	119	150	81	0	0	186	653	2	5	0	4	0	44	9	20
Harvest	20	12	0	6	0	0	0	2	14	1	0	0	1	0	3	1	0
1981[a]																	
No. hunters	108	33	20	11	7	1	0	36	91	0	0	1	2	0	10	1	3
Days hunted	616	159	153	42	32	5	0	225	520	0	0	4	6	0	60	2	24
Harvest	13	7	1	3	1	0	0	1	7	0	0	1	0	0	1	1	3
1982[a]																	
No. hunter	78	21	11	12	5	0	0	29	71	0	1	0	1	0	2	0	3
Days hunted	478	146	71	70	38	0	0	153	449	0	1	0	6	0	15	0	7
Harvest	5	2	0	3	0	0	0	0	4	0	0	0	1	0	0	0	0
1983[b]																	
No. hunters	67	19	10	20	2	---	0	16	---	---	---	---	---	---	2	---	0
Days hunted	410	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Harvest	6	3	1	2	0	---	0	0	---	---	---	---	---	---	0	---	0

Source: ADF&G 1983a; BGDIF.

a Figures are based on general harvest data only; permit hunts are not included.

b Figures based on general harvest-ticket and permit-hunt data.

--- means no data were available.

harvest reports. These data are additive to all subunits of GMU 16 combined and should be included when evaluating GMU 16 as a whole.

XVI. GMS 16(B) - KALGIN ISLAND

A. Boundaries

Kalgin Island is within GMS 16(B) and is located in Cook Inlet south and west of Kenai. (See the current Alaska game management unit maps and boundary descriptions.)

B. Management Objectives

Current management objectives are to reduce the number of moose on Kalgin Island to maintain about one moose per mi^2 (20 to 23 moose) (ADF&G n.d.).

C. Management Considerations

Kalgin Island was documented as being overpopulated by moose in December 1980. A total of 70 moose were observed at that time. The island encompasses approximately 23 mi^2, not all of which is suitable moose habitat (ADF&G 1981). Since then, 237 moose have been harvested from the island (through the 1984 season). Because of the potential for high reproductive success in a predator-free environment and because of low natural mortality during recent mild winters, the population has maintained a density of at least two moose per square mile in spite of heavy hunting pressure. This density of moose appears excessive to allow vegetation to recover from past overbrowsing. It is likely that should a severe winter with snow depths in excess of 2 ft occur early and persist a substantial mortality will occur (ADF&G n.d.).

D. Period of Use

Until 1979, Kalgin Island hunting seasons conformed to those of the remainder of Subunit 16(B). In 1979, however, in response to public opinion, the season was closed. Because of the documented overpopulation, a permit hunt was allowed in September of 1981. In November 1981, however, 141 moose were observed on the island and an emergency registration hunt was approved and held in December 1981 and January 1982 (ADF&G 1983b). During the 1982 season, the registration hunt began on 1 September and was closed by emergency order on 17 September. During the 1983 season, the registration hunt began on 1 September and was closed by emergency order on 8 September (ADF&G 1984b). The 1984 season was limited to the first four days of September. (See latest Alaska Game Regulations for current season.)

E. Human Use Data

During the September 1981 drawing-permit season, 15 hunters harvested 10 moose. During the 15 December 1981 to 20 January 1982 registration-permit hunt, 203 hunters harvested 70 moose. During the 1-17 September 1982 season, 245 hunters harvested 71 moose. During the 1-8 September 1983 season, 204 hunters harvested 56 animals. During the 1-4 September 1984 season, 30 animals were taken by 146 hunters.

REFERENCES

ADF&G. 1976. Alaska's wildlife management plans, Southcentral Alaska: a public proposal for the management of Alaska's wildlife. 238 pp.

________. 1980. Annual report of survey-inventory activities. Part II: Bison, caribou, moose, and muskoxen. Fed. Aid in Wildl. Rest. Vol. 10. Proj. W-17-11, Jobs 9.0, 3.0, 1.0, 16.0, and 22.0.

________. 1981. Annual report of survey-inventory activities. Part II: Caribou, moose, and mountain goat. Fed. Aid in Wildl. Rest. Vol. 12. Projs. W-19-1 and 2, Jobs 3.0, 1.0, and 2.0.

________. 1983a. Southcentral Regional big game harvest data - computer output for the years 1978 through 1982. December, 1983. Moose harvest and permit reports. (unpubl.).

________. 1983b. Annual report of survey-inventory activities. Part III: Moose. Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Job 1.0.

________. 1984a. Statewide big game harvest data - computer output by minor tributary for the 1983-84 hunting season. August, 1984. Moose harvest and permit reports. (unpubl.).

________. 1984b. Annual report of survey-inventory activities. Part IV: Moose. Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2, Job 1.0.

________. n.d. Annual report of survey-inventory activities: moose (draft).

BGDIF. Big Game Data Index Files. ADF&G, Div. Game, Anchorage.

Ballard, W.B., C.L. Gardner, and S.D. Miller. 1982. Nelchina yearling moose mortality study. ADF&G, Fed. Aid in Wildl. Rest. Projs. W-21-1 and W-21-2. Juneau.

Bos, G. 1980. [Memo to R.J. Somerville, Director, Div. Game, ADF&G, Juneau].

Faro, J.B. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Anchorage.

Franzmann, A.W., C.C. Schwartz, and R.O. Peterson. 1980. Moose calf mortality in summer on the Kenai Peninsula, Alaska. J. Wildl. Manage. 44(3):764-768.

Harkness, D.B. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Anchorage.

Lieb, J.W. 1984. Personal communication. Ass. Area Mgt. Biologist, ADF&G, Div. Game, Glennallen.

Modafferi, R.D. 1983. Moose-downstream. ADF&G, Susitna Hydroelectric Proj. Ann. prog. rept. Phase 2: Big game studies. Vol. 2. 114 pp.

Reynolds, J.L. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Game, Cordova.

State of Alaska. 1984. Resource management recommendations for Kenai National Wildlife Refuge and surrounding area. Anchorage. 20 pp.

Taylor, W.P. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Anchorage.

Timm, D.E. 1984. Personal communication. Regional Mgt. Coordinator, Div. Game, ADF&G, Anchorage.

Ducks and Geese Human Use

I. POPULATION MANAGEMENT HISTORY

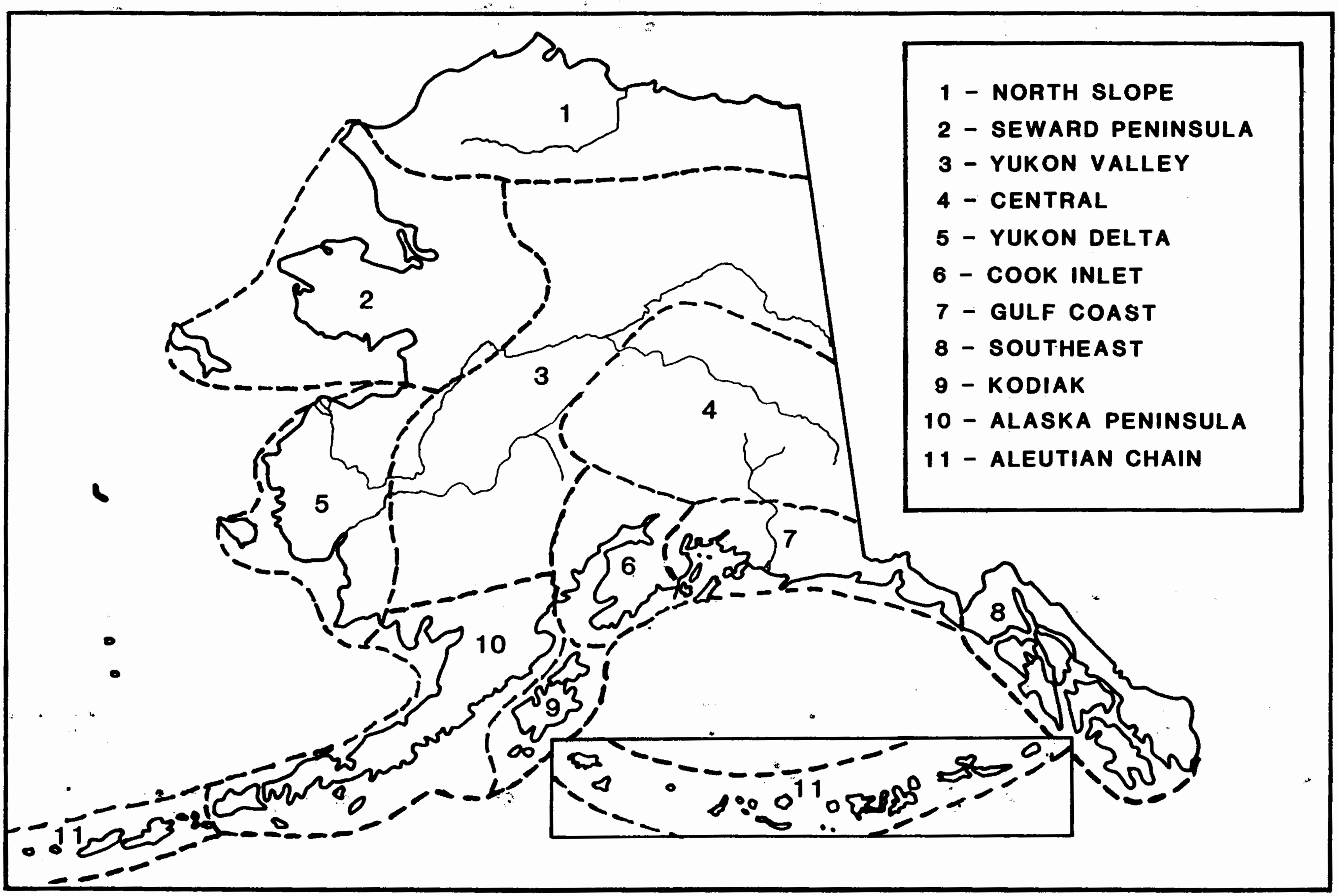
A. Ducks and geese populations in Alaska are managed by the ADF&G under guidelines established by the USFWS. Information used to estimate the use and harvest of these populations is gathered by the ADF&G through a mail questionnaire and through a questionnaire and parts collection survey conducted by the USFWS.

All harvest information presented here is obtained from these sources and represents a general harvest. Subsistence harvest figures are not included in this narrative.

From 1971 to 1976, the ADF&G conducted a separate mail survey to determine waterfowl harvest and hunter activity. Although this survey was judged to be an accurate assessment of hunter activity and harvest in Alaska, in some respects it was a duplication of the USFWS surveys. Discussions with the USFWS during 1976 and 1977 resulted in modifications to their harvest coding system, an increased sample size of Alaskan hunters, and the sharing of harvest data. As a further result of these discussions, the partially duplicative annual ADF&G survey was discontinued. The department believed that the major compromise made when the state survey was dropped was the loss of annual estimates of harvest and hunter-days by specific location. It was believed, however, that three-year average estimates of these data, based on state surveys made during 1974-1976, would be adequate until a need for more precise data arose. But because of anomalies in the USFWS surveys and the need for very specific estimates of harvest and use areas within Alaska, which the USFWS surveys do not provide, an ADF&G mail survey was reinstituted in 1982. The ADF&G believes that this survey, used in conjunction with the USFWS survey, again provides the most accurate estimate of waterfowl hunter harvest and activity in Alaska (Campbell 1984).

The state is divided into 11 harvest areas to facilitate data analysis and interpretation for the federal survey (map 1). These areas are similar to regions developed for data analysis of previous state mail surveys. Harvest locations by region and specific location were recoded for the new system, and a summary of those codes is presented in table 1.

Waterfowl harvest areas in the Southcentral Region include all of 6-Cook Inlet, portions of 7-Gulf Coast (mainly Copper River Delta [CRD] and Prince William Sound [PWS]), and portions of 4-Central (map 1). The major areas of waterfowl harvest in Area 4-Central are Minto Flats, Delta, and Tok-Northway. These major harvest areas occur outside the Southcentral Region's boundary and accounted for over 81% of the reported Central harvest during 1982. Therefore, since only limited harvest occurs within



Map 1. Harvest areas used in data analysis (USFWS).

Table 1. Summary of USFWS Codes Used to Assign Harvest Locations in Alaska

Old Code	New Code	ADF&G Region (R) and Place Names	Original FWS "County" Name	Harvest Zone
0001	0000	Unknown	Unknown	Unknown
0011	0101	North Slope (R)	Arctic Slope	N. Slope-1
0031	0301	Seward Peninsula (R)	Seward Peninsula	"
0051	0502	Yukon Valley (R)	Upper Yukon-Kuskokwim	Central-4
0051	0512	Yukon Flats	"	"
0071	0702	Central (R)	Fairbanks-Minto	"
0071	0712	Minto Flats	"	"
0071	0722	Eielson AFB	"	"
0071	0732	Salchaket Slough	"	"
0071	0742	Healy Lake	"	"
0071	0752	Delta Area	"	"
0071	0762	Tok-Northway	"	"
0091	0901	Yukon Delta (R)	Yukon-Kuskokwim Delta	5
0111	1103	Cook Inlet (R)	Anchorage-Kenai	Cook Inlet-6
0111	1113	Susitna Flats	"	"
0111	1123	Palmer Hay Flats	"	"
0111	1133	Goose Bay	"	"
0111	1143	Potter Marsh	"	"
0111	1153	Chickaloon Flats	"	"
0111	1163	Portage	"	"
0111	1173	Trading Bay	"	"
0111	1183	Redoubt Bay	"	"
0111	1193	Kachemak Bay	"	"
0131	1303	Gulf Coast (R)	Cordova-Copper River	Gulf Coast-7
0131	1313	Copper River Delta	"	"
0131	1323	Yakutat Area	"	"
0131	1333	Prince William Sound	"	"
0151	1503	Southeast Coast (R)	Juneau-Sitka	SE-8
0151	1513	Chilkat River	"	"
0151	1523	Blind Slough	"	"
0151	1533	Rocky Pass	"	"
0151	1543	Duncan Canal	"	"
0151	1553	St. James Bay	"	"
0151	1563	Mendenhall Wetlands	"	"
0151	1573	Farragut Bay	"	"
0151	1583	Stikine River Delta	"	"
0171	1704	Kodiak (R)	Kodiak Island	Kodiak-9
0171	1714	Kalsin Bay	"	"
0191	1904	AK Peninsula (R)	Cold Bay-AK Peninsula	AK Pen.-10
0191	1914	Cold Bay	"	"
0191	1924	Pilot Point	"	"
0191	1934	Port Moller	"	"
0191	1944	Port Heiden	"	"
0211	2104	Aleutian Chain (R)	Aleutians-Pribilofs	Aleutians

portions of the Central harvest area included in the Southcentral Region, this harvest area will be discussed in the guide for the Interior Region. In this narrative, waterfowl harvest data will be presented for areas 6-Cook Inlet and 7-Gulf Coast only.

As discussed, differences in data collection and presentation between the ADF&G and USFWS surveys do not allow for area-specific use and harvest figures for some years. Therefore, in those periods waterfowl harvest and use information will be discussed on a statewide basis. Discussion on a harvest area basis will be made where that information is available.

B. Regional Summary of Hunting

1. Brief regional summary of human use information. The large coastal marshes along Cook Inlet, the numerous bays and associated tidal flats of PWS, and the extensive tidal areas of the CRD, along with the proximity of these areas to the relatively large Southcentral Region's human population, combine to make Southcentral Alaska the most heavily utilized waterfowl harvest area in the state.

   As seen in table 2, the 1982-1983 estimated harvest of waterfowl in Cook Inlet totaled 63,616 ducks and geese, or 50.9% of the statewide harvest. This figure is calculated from the questionnaire return, which does possess some inherent bias. However, the totals represent the best available estimates and clearly show the importance of Cook Inlet for waterfowl harvest in the state.

   The other area of Southcentral Alaska that receives use by waterfowl hunters is the Gulf Coast, primarily PWS and the CRD. This area accounted for 4,596 harvested waterfowl, representing 3.7% of the 1982-1983 statewide harvest (table 2). Although this area receives less pressure than Cook Inlet, it still contributes a substantial amount to the total state harvest.

2. Managerial authority. Waterfowl are protected under international treaties with Canada (Great Britain) 1916, Mexico 1936, Japan 1972, and the Soviet Union 1976.

   Waterfowl in the United States are managed by the U.S. Fish and Wildlife Service (USFWS) in cooperation with individual state governments.

II. HARVEST AREA 6 - COOK INLET

A. Boundaries

Waterfowl Harvest Area 6-Cook Inlet includes all the coastal areas of Cook Inlet and some adjacent portions of the mainland (see map 1.). All major coastal marshes of Cook Inlet and some additional tidal and upland use areas are included. (See table 1 for specific harvest locations included in Harvest Area 6.)

B. Management Objectives

The ADF&G manages waterfowl within the state under guidelines developed by the USFWS. These guidelines are set to ensure that

Table 2. Calculated Duck and Goose Fall Harvests and Hunter Activity by Harvest Area, 1982-83

	Hunter-Days		Game Duck		Nongame Duck		Geese		Total Harvest
Harvest Area	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	No.
North Slope	---	---	---	---	---	---	---	---	---
Seward Peninsula	553	0.9	840	0.8	246	3.5	586	4.5	1,672
Yukon Valley	921	1.5	2,729	2.6	49	0.7	608	4.6	3,386
Central	10,504	17.1	18,057	17.2	330	4.7	1,251	9.5	19,638
Yukon Delta	2,641	4.3	2,939	2.8	1,195	17.0	2,821	21.5	6,955
Cook Inlet	29,853	48.6	56,899	54.2	2,369	33.7	4,348	33.1	63,616
Gulf Coast	3,133	5.1	3,779	3.6	408	5.8	409	3.1	4,596
Southeast	9,889	16.1	15,642	14.9	1,090	15.5	1,744	13.3	18,476
Kodiak	2,150	3.5	2,415	2.3	1,244	17.7	92	0.7	3,751
Alaska Peninsula	1,167	1.9	1,365	1.3	---	---	1,228	9.4	2,593
Aleutian chain	553	0.9	210	0.2	105	1.5	23	0.2	338
Statewide	61,364	99.9	104,875	99.9	7,036	100.1	13,125	99.9	125,021

Source: Campbell 1984.

--- means no data were available.

waterfowl are present in sufficient numbers to allow for all public consumptive and nonconsumptive uses.

The ADF&G has developed waterfowl management plans that apply to the Southcentral Region and specific use areas within the region. All these plans provide for opportunities to use waterfowl for hunting, viewing and photography, and scientific and educational study. For area plans and objectives, see Alaska Wildlife Management Plans, Southcentral volume (ADF&G 1976).

In addition to the above-mentioned general waterfowl plans, the recently (1979) discovered nesting grounds of the tule goose in Cook Inlet has necessitated formulation of management objectives for the subspecies. These objectives are currently being developed by the ADF&G in cooperation with the USFWS and the State of California.

C. Managerial Considerations

The high level of use of waterfowl harvest areas in Cook Inlet by the large number of Anchorage bowl residents has led to conflicts between user groups concerning methods of access. Access to most of the coastal marsh harvest areas is limited to airplanes only; however, areas near the road system, such as Palmer Hay Flats, are accessed by hunters using boats, ATVs, air boats, and by walking. These different access modes have created conflict between user groups to the point where the Board of Game has prohibited the use of air boats for transportation of waterfowl hunters within the Palmer Hay Flats State Game Refuge and restricted use of ATVs on the Susitna Flats Game Refuge.

An additional access problem being addressed by the ADF&G concerns foot access to the west side of Palmer Hay Flats via Cottonwood Creek. The ADF&G has developed plans to build a bridge across Cottonwood Creek to facilitate access for hunters. Negotiations with private landowners regarding access are currently being conducted, and the bridge will be constructed after these discussions are concluded.

Numerically small populations tend to spark public attention and concern. The tule white-front, with an estimated population of about 3,500 birds (late 1981 estimate), has already influenced land use in upper Cook Inlet and has complicated harvest management of white-fronts in California. Tule geese will continue to receive special consideration until the tentative population objective of the Pacific flyway management plan for a population of 5,000 birds or the full utilization of summering habitat is realized (Timm et al. 1982).

Redoubt Bay and Susitna Flats are on the south and north ends, respectively, of Alaska's second largest producing oil field, and Susitna Flats is in the middle of the state's largest producing gas field. Nearly the entire area has been leased for oil, gas, and coal exploration, although many leases have expired. However, State Lease Sale No. 33 (1981) originally would have allowed the sale of expired and unleased land in most of Redoubt Bay and Susitna Flats. Upon advice from the ADF&G and in response to a request from the Audubon Society, the Alaska Department of Natural Resources (ADNR) agreed to delete all of Redoubt Bay from the impending sale and future sales at least until 1983.

However, State Lease Sale No. 40 (August 1983) allowed the sale of four tracts of land immediately offshore of Redoubt Bay. Additionally, in February 1985, the ADNR received bids on four more tracts of offshore land near the northern end of Redoubt Bay (Sale No. 46A, tracts 50-53). Drilling leases for these areas are scheduled to be issued.

The Beluga coal fields, located between Susitna Flats and Trading Bay, may be the world's largest single deposit of coal. A methanol plant, a city of up to 3,000 people, coal export facilities, and a road down the west side of Cook Inlet are all under active consideration. These developments would undoubtedly open the west side of Cook Inlet to other developments, at least as far south as Trading Bay.

D. Period of Use

The waterfowl season in Alaska can be 107 days within the guidelines established by the USFWS. In the Southcentral Region, this period usually runs from 1 September through 16 December. The actual length of the hunting period available in Southcentral Alaska depends on weather conditions. The major human use period occurs from the beginning of the season, usually 1 September, and lasts until cold weather persists, approximately 15 October. Earlier or later cold weather conditions would influence this use period accordingly. After mid October, cold weather has forced most waterfowl to migrate south. For current use-period dates, see the most recent Alaska waterfowl harvest regulations or the summary available in the ADF&G annual report of survey and inventory activities.

E. Human Use

Reported annual human use and harvest data are available by harvest region from the USFWS questionnaire and collection part survey and the ADF&G waterfowl hunter questionnaire. These surveys do not include information on residency or mode of access to hunting areas.

Table 3 presents statewide harvest figures from 1973 through 1982. This table shows that the statewide duck harvest has ranged from 71,813 in 1974 to 122,431 in 1978, with a 10-year average of 97,924. The statewide goose harvest during that period has ranged from 10,203 in 1981 to 18,654 in 1974, with a 10-year average of 14,762. Statewide hunter effort during 1973-1982, represented by hunter-days, ranged from 53,650 in 1974 to 96,824 in 1974, with a 10-year average of 72,169 days. The total number of statewide active hunters has ranged from 10,480 in 1975 to 13,811 in 1978, with a 10-year average of 11,889.

The Southcentral Region consistently provides the largest waterfowl harvest in Alaska, with Cook Inlet accounting for the majority of that harvest. Tables 4 and 5 show the percentages of the statewide harvest by area for ducks and geese, respectively.

Table 3. Statewide Waterfowl Fall Hunting Trends, 1973-82

Category	Hunting Season										
	1973[b]	1974[b]	1975[b]	1976[b]	1977[a]	1978[a]	1979[a]	1980[a]	1981[a]	1982[b]	10-yr. avg.
Duck stamp sales	16,449	15,750	16,100	18,501	19,222	19,468	18,946	17,260	15,885	17,600	17,518
Percent active hunters[d]	68.57	67.57	69.26	66.76	70.0	73.2	70.3	73.3	70.1	63.0	69.2
No. active hunters	11,150	10,499	10,480	12,308	13,222	13,811	13,065	12,425	10,862	11,070	11,889
No. days per hunter	11,150	10,499	10,480	12,308	13,222	13,811	13,065	12,425	10,862	11,070	11,889
Total hunter-days	57,868	53,650	66,832	82,571	88,680	96,824	85,294	85,294	71,538	61,425	72,169
No. ducks per hunter	8.0	6.8	8.4	8.3	7.9	8.9	8.7	7.7	7.2	10.1	8.2
Total duck harvest	89,534	71,813	87,822	102,033	104,639	122,431	114,634	96,117	78,209	112,010	97,924
No. geese per hunter	1.65	1.27	1.78	1.17	1.32	1.0	1.2	1.0	0.9	1.2	1.2
Total goose harvest	18,397	13,334	18,654	14,400	17,433	13,932	15,116	13,030	10,203	13,125	14,762

Source: 1978-82, Campbell 1984; 1973, Timm 1974; 1974, Timm 1975; 1975, Timm 1976; 1976, Timm 1977; 1977, Timm 1978.

a Based on USFWS mail questionnaires and parts collection surveys.

b Based on Alaska waterfowl hunter mail questionnaire survey.

c Included estimated juvenile hunter-days (hunters under 16 years of age).

d Some persons purchasing duck stamps are not active hunters.

Table 4. A Comparison Between Reported Duck Harvest from 1978-79, 1979-80, and 1980-81 USFWS Parts Collection Survey and ADF&G Mail Surveys, 1974-76 Three-year Average and 1982

	Percentage of Statewide Harvest					
	ADF&G	USFWS				ADF&G
Harvest Area	1974-76	1978	1979	1980	1981	1982
North Slope	0.2	0.0	0.0	0.0	0.1	0.0
Seward Peninsula	1.4	0.0	0.0	0.8	0.0	0.8
Yukon Valley	2.5	0.0	0.0	0.0	0.1	2.6
Central	18.0	14.6	25.0	15.3	18.0	17.2
Y-K Delta	1.4	1.5	1.2	0.6	0.6	2.8
Cook Inlet	39.2	50.1	49.4	46.1	62.6	54.2
Gulf Coast	8.4	6.6	2.9	2.5	0.4	3.6
Southeast	20.6	14.6	11.5	25.1	8.8	14.9
Kodiak	2.7	3.6	7.3	4.7	1.3	2.3
Alaska Peninsula	5.1	9.0	2.7	4.9	8.2	1.3
Aleutian chain	0.5	0.0	0.0	0.0	0.0	0.2
Totals	100.0	100.0	100.0	100.0	100.1	99.9

In 1982, the Cook Inlet area accounted for 54.2% of the statewide duck harvest and 33.1% of the statewide goose harvest. Between 1974 and 1981, percentage of the statewide duck harvest for Cook Inlet has ranged from 39.2 to 62.6% and for geese from 10.1 to 35.6%.

F. Significance of Particular Use Areas

A breakdown of hunter use by specific area for Southcentral Alaska is available for the 1982 harvest period (table 6). These figures are probably representative of the average waterfowl harvest by area in the Southcentral Region. The most heavily used area in Cook Inlet was Susitna Flats (table 6), which accounted for 6,325 hunter-days, 16,710 ducks, and 1,170 geese. Susitna Flats represents the single most heavily utilized waterfowl harvest area in the whole state. Other important Cook Inlet harvest areas are listed in table 6. For additional information on specific use areas in Southcentral Alaska, see the 1:1,000,000-scale index maps in the Atlas to the Southcentral Region or the 1:250,000-scale reference maps in ADF&G offices.

Table 5. A Comparison Between Reported Retrieved Goose Harvest from 1978-81 USFWS Parts Collection Surveys and ADF&G Mail Surveys, 1974-76 Three-year Average and 1982

	Percentage of Statewide Harvest					
	ADF&G	USFWS				ADF&G
Harvest Area	1974-76	1978	1979	1980	1981	1982
North Slope	0.4	1.2	0.0	0.0	0.0	0.0
Seward Peninsula	4.4	0.0	0.0	2.4	0.0	4.5
Yukon Valley	4.4	0.0	0.0	0.0	0.0	4.6
Central	8.1	6.7	7.7	1.4	1.0	9.5
Y-K Delta	7.3	1.8	1.9	2.9	0.0	21.5
Cook Inlet	10.1	16.0	35.6	22.5	26.1	33.1
Gulf Coast	13.6	4.9	0.0	0.5	2.5	3.1
Southeast	13.1	16.6	23.1	22.0	11.1	13.3
Kodiak	0.2	0.0	0.0	0.0	0.0	0.7
Alaska Peninsula	38.2	52.8	31.7	48.3	59.8	9.4
Aleutian chain	0.1	0.0	0.0	0.0	0.0	0.2
Totals	99.9	100.0	100.0	100.0	100.5	99.9

III. HARVEST AREA 7 - GULF COAST

A. Boundaries

Waterfowl Harvest Area 7-Gulf Coast includes the coastal area from Cape Fairweather west to eastern PWS (map 1). The CRD is included, along with the many bays and tidal flats of PWS. The majority of the reported harvest is coded to either PWS or the CRD. A small portion of the Gulf Coast waterfowl harvest takes place in the Yakutat area, which is outside the Southcentral Regional boundaries. This minor harvest will be addressed in the Southeast Alaska narratives.

B. Managerial Objectives

The ADF&G has developed a waterfowl management plan for the CRD. This plan provides for opportunities to hunt, view, and photograph waterfowl. The CRD is gaining worldwide recognition for its unique seasonal concentrations of waterfowl and other birds. For further details on the state's managerial objectives in Southcentral Alaska, see the ADF&G Southcentral Alaska Wildlife Management Plans (ADF&G 1976).

Table 6. Locations of Greatest Hunting Activity and Waterfowl Harvest in Alaska, 1982-83

	Estimated Duck Harvest and Hunter-Days				Estimated Goose Harvest		
	Ducks		Hunter-Days			Geese	
Location	No.	% of State Total	No.	% of State Total	Location	No.	% of State Total
Susitna Flats**	16,710	14.9	6,325	10.3	Cold Bay	1,490	11.4
Minto Flats	10,265	9.2	3,625	5.9	Susitna Flats**	1,170	8.9
Palmer Hay Flats**	9.940	8.9	5,650	9.2	Minto Flats	685	5.2
Trading Bay**	5,570	5.0	1,475	2.4	Delta area	615	4.7
Redoubt Bay**	3,605	3.2	1,350	2.2	Chickaloon Flats**	405	3.1
Portage Flats**	3,385	3.0	1,965	3.2	Prince William Sound*	335	2.6
Prince William Sound*	3,385	3.0	1,475	2.4	Copper R. Delta*	235	1.8
Copper River Delta*	2,730	2.4	2,765	4.5	Palmer Hay Flats**	140	1.1
Kachemak Bay**	2,730	2.4	980	1.6	Pilot Point	125	1.0
Potter Marsh**	2,400	2.1	2,150	3.5	Kachemak Bay**	110	0.8
Kalsin Bay	2,075	1.9	800	1.3	Portage Flats**	95	0.7
Goose Bay**	1,855	1.7	1,170	1.9	Cinder River	85	0.6
Chickaloon Flats**	1,640	1.5	675	1.1	Potter Marsh**	70	0.5
Healy Lake	1,310	1.2	615	1.0	Trading Bay**	55	0.4
Cold Bay	1,200	1.1	800	1.3	Redoubt Bay**	30	0.2
Eielson AFB	875	0.8	1,045	1.7	Goose Bay**	15	0.1
Tok-Northway	875	0.8	245	0.4	Healy Lake	15	0.1
Delta area	765	0.7	1,410	2.3	Salchaket Slough	15	0.1
Salchaket Slough	545	0.5	555	0.9	Eielson AFB	15	0.1
Pilot Point	330	0.3	185	0.3	Yukon Flats	15	0.1
Yakutat area	220	0.2	---	---			
Yukon Flats	110	0.1	60	0.1			
Subtotals	72,520	64.9	35,320	57.5		5,720	43.5
Statewide totals	112,010	100.0	61,425	100.0		13,125	100.0

Source: Campbell 1984.

--- means no data were available.

* Southcentral Region.

** Cook Inlet.

1. Dusky Canada goose. A cooperative agreement providing guidelines for dusky Canada goose population management was signed in 1973 by the states of Alaska and Oregon and the USFWS. This plan is regularly revised to coordinate with the dusky goose situation, and the most recent version was drafted in 1984. Objectives of the plan include the following:

   - Maintain a dusky goose breeding population, consistent with the production capacity of the breeding grounds, recognizing that long-term ecological changes are in effect
   - Maintain a three-year average wintering population of 20,000 dusky Canada geese as part of a population of Canada geese in western Oregon and southwestern Washington
   - Maintain the present traditional production, migration, and wintering habitats in sufficient quantity and quality to meet population requirements
   - Seek to distribute the wintering population throughout a wider range
   - Manage the dusky population on a sustained yield basis for both consumptive and nonconsumptive uses

   For more specific information on this management plan, see the current Pacific Flyway Management Plan for dusky Canada geese (Pacific Flyway Council 1984).

   Because nearly all the breeding habitat of the dusky is under the managerial authority of the U.S. Forest Service (USFS) within the Chugach National Forest, their cooperation in management of the species was requested.

   In 1962, the USFS and the ADF&G entered into the Copper River Delta Cooperative Management Agreement, recognizing wildlife and fisheries as the most important resources of the delta and clarifying agency roles in management. In 1978, the State of Alaska created the Copper River Delta Critical Habitat Area, encompassing federal, state, and private lands, to facilitate sound management of biological resources and habitats. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) provided that "the conservation of fish and wildlife and their habitat shall be the primary purpose for the management of the Copper/Rude River addition [to the Forest] and the Copper River-Bering River portion of the existing Chugach National Forest." These actions have established policy direction and frameworks for cooperative management of dusky Canada goose habitat. The cooperative management agreement is being drafted and will be in effect in 1985.

REFERENCES

ADF&G. 1976. Alaska's wildlife management plans, Southcentral Alaska: a public proposal for the management of Alaska's wildlife. 238 pp.

Campbell, B.H. 1984. Annual report of survey-inventory activities. Part 5: Waterfowl. ADF&G, Fed. Aid in Wildl. Rest. Vol. 14. Proj. W-22-2, Job 11.0.

Pacific Flyway Council. 1984. Pacific flyway draft management plan for dusky Canada geese. Unpubl. rept.

Timm, D.E. 1974. Annual report of survey-inventory activities. Waterfowl. ADF&G, Fed. Aid in Wildl. Rest. Vol V. Proj. W-17-6, Jobs 11.0 and 22.

________. 1975. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 6: Waterfowl. Proj. W-17-7, Jobs 11.0, 11.1, 11.2, 11.3.

________. 1976. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 7. Proj. W-17-8, Jobs 11.0, 11.1, 11.2, 11.3.

________. 1977. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 8. Proj. W-17-9, Jobs 11.0, 11.1, 11.2, 11.3.

________. 1978. Annual report of survey-inventory activities. ADF&G, Fed. Aid in Wildl. Rest. Vol. 9. Proj. W-17-10, Job. 10.0.

Timm, D.E., M.E. Wege, and D.S. Gilmer. 1982. Current status and management challenges for Tule white-fronted geese. Transactions of the 47th North American wildlife and natural resources conference. Wildl. Manage. Inst., Washington, DC.

Furbearers Human Use

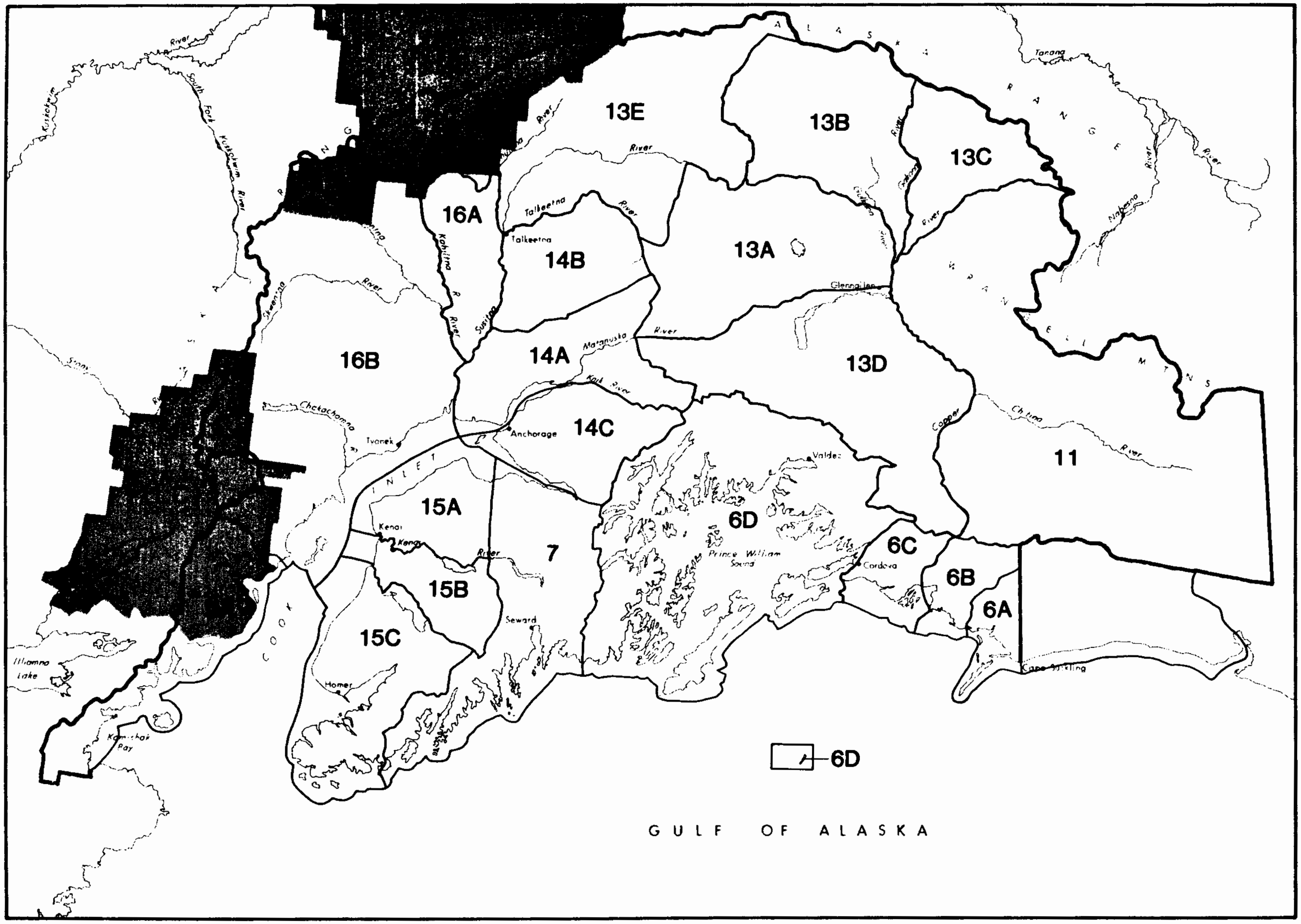
I. POPULATION MANAGEMENT HISTORY

A. Introduction

Information on human use of furbearers in the Southcentral Region is presented by groups of game management units (GMUs) with similar management objectives and management considerations. There are two groups: 1) the majority of the Southcentral Region, to which no special local objectives or considerations are applicable; and 2) areas within and in the vicinity of Katmai, Lake Clark, Wrangell-St. Elias, and Denali national parks and preserves, including portions of GMUs 9A and 16 and essentially all of GMU 11 (see map 1). Within each group, periods of use and human use data are discussed by GMU when possible at that level of detail. Tabular reported annual harvest data are listed by GMU.

B. Regional Summary of Furbearer Harvest

1. Brief regional summary of human use information. Although total furbearer harvest in the Southcentral Region is relatively low compared with that of more northerly regions, wolf and wolverine harvests have contributed significantly to statewide totals. On the average over the past 10 years, less than 10% of the statewide harvest of mink, muskrat, marten, river otter, and red fox is attributed to the Southcentral Region. Roughly 10% of the beavers harvested statewide are taken from this region. Sealing records indicate that the number of beavers harvested in Southcentral has ranged from 528 in 1978-1979 to 1,907 in 1979-1980. The number of beaver trappers ranged from 101 to 253 in the same years. Lynx harvests also varied widely. From 1973-1974 through 1975-1976, 20 to 26% of the statewide trade in lynx pelts (3,842 to 2,265 reported pelts statewide) was by trappers in the Southcentral Region, but since 1976-1977 the figure has dropped sharply to about 10%. From 1972-1973 through 1982-1983, the Southcentral harvest has contributed significantly, on the average, to the statewide take of two large furbearers, wolf (14-28%) and wolverine (22-40%). High and low numbers of pelts sealed for wolf range from 1,243 in 1975-1976 to 679 in 1979-1980 and for wolverine from 1,048 in 1973-1974 to 567 in 1980-1981. Harvest of two small furbearers, although of less economic importance, is also proportionately high in Southcentral. On the average, 8-54% of the statewide harvest of weasels and 28-97% of the statewide harvest of red squirrels is taken from Southcentral. Pelts from red squirrels are of low value and saleable to Canadian but not to United States markets (Melchior, pers. comm.). Although their pelts are used, red



Map 1. Game management units in the Southcentral Region and Lake Clark (LC) and Denali (D) national parks.

squirrels are usually considered a nuisance species by trappers in other regions.

2. Managerial authority. In 1925, the Alaska Game Commission was established by an act of Congress "to protect game animals, land furbearing animals, and birds in Alaska, and for other purposes," and was the beginning of formal wildlife management in Alaska. However, this does not mean that there was no attempt at monitoring harvests prior to 1925. For example, there has been a regulation in effect since 1910 requiring that furs exported from Alaska must be reported by the shipper (Courtright 1968). Concurrent with statehood in 1959, under authority of Article VIII of the State Constitution, the legislature established the Department of Fish and Game. The Division of Game and Board of Fish and Game were given jurisdiction over furbearers. In 1975, the Board of Game became separated from the Board of Fish by an act of the legislature (ADF&G 1976). The harvest of furbearers is controlled by the Alaska Trapping Regulations and Alaska Game Regulations.

II. MANAGEMENT AREA: GMUS 6, 7, 9A, 13, 14, 15, AND 16, EXCEPT NATIONAL PARKS AND PRESERVES IN ANY OF THESE GMUS

A. Boundaries

The portion of the Southcentral Region considered in this section includes GMUs 6, 7, 9A, 13, 14, 15, and 16, excepting the portions of those units included within national parks and preserves. The Kenai NWR in GMU 7 is included. Boundaries of this area can be determined by referring to the Alaska game management unit map at the beginning of this section. Reynolds (pers. comm.) recommended correcting data for the Southcentral Region, which splits GMU 6, as follows: assume that 98% of beavers from GMU 6 are taken west of the regional boundary at Cape Suckling and that about one-third of the take of other sealed furbearers (lynx, otter, wolf, and wolverine) from GMU 6A are taken within the Southcentral Region. All of the take from GMU 6B is assumed to be from within the Southcentral Region.

B. Management Objectives

No management plans for furbearers apply specifically to GMUs 6, 7, 9A, 13, 14, 15, and 16. This area is covered by the Alaska Wildlife Management Plans, Species Management Policies, for wolves and furbearers (ADF&G 1980). For wolves, the species use management policies are to manage wolves on the sustained yield principle, encourage hunting and trapping of wolves (and may manage them for optimum sustained yields in selected areas with intensive hunting and trapping), provide maximum opportunities for consumptive and nonconsumptive recreational use of wolves in areas of the state where these uses are important, encourage recreational observation of wolves, discourage domestication, and issue permits for capturing, holding, importing, and exporting wolves for stocking, public education, and scientific study only if suitable habitat or holding facilities and substantial benefits consistent with the department's goals and policies can be demonstrated.

For furbearers, the species use management policies are to manage furbearers on the sustained yield principle for the benefit of the resource and people of the state; manage furbearers in most areas of the state for optimum sustained yield of economic benefits, provide maximum opportunities for consumptive and nonconsumptive recreational use of furbearers in areas of the state where these uses are important, encourage recreational observation and photography of furbearers, and issue permits for capturing, holding, importing, or exporting furbearers only if suitable habitat or holding facilities are available to the permittee and if substantial benefits consistent with the department's goals and policies can be demonstrated. Within the Kenai NWR, commercial trapping should be maintained and access not restricted (ADF&G 1983).

C. Management Considerations

1. Changes in harvest levels. Trapping effort varies from year to year and among furbearer species primarily in response to pelt prices, weather conditions, and fluctuations in furbearer populations due to natural causes. Many furbearer species are not susceptible to overharvest. Exceptions include beaver, wolverine, and lynx (Tobey, pers. comm.). Beavers are relatively easily trapped, and accessible colonies can be overharvested. When the proportion of kits (young of the year) harvested exceeds 20% in a given tributary (i.e., beaver population), overharvest may be occurring, depending on local conditions (Libby and Buckley 1955, Taylor 1981). Restrictions on bag limits and seasons may then be necessary.

   Wolverine pelts bring high prices and are currently in high demand. In tundra areas in which wolverines can be tracked by snowmachine or aircraft, overharvest may occur (ADF&G 1976). Harvests of wolverine in GMU 13 decreased in the late 1970's, possibly due to a decrease in the wolverine population (Tobey 1980), but have increased in the last two years. The population is now believed to be recovering (Tobey, pers. comm.). Marten and wolves may be overharvested in pockets of heavy trapping (ibid.).

2. Species populations. Data on the population status of furbearers other than beaver and wolf have not been gathered, because of a combination of lack of methodology and restriction on funding (ADF&G 1976). Beaver populations in the Southcentral Region are in general stable-to-increasing, and wolf populations are healthy and are being maintained at desired levels by trapping pressure (ADF&G 1976, 1980; Lieb 1983b; Machita 1981; Spraker 1982, 1983; Tobey 1982 and pers comm.). Reports from trappers responding to questionnaires provide qualitative estimates of the abundance of other

furbearers, but in this area they are available only for the 1980-1981 season (Machita 1981). At that time, trappers reported increasing or stable beaver and otter populations, stable populations of coyote, mink, and weasel, and declining or stable red fox, marten, muskrat, lynx, wolf, and wolverine populations in the region as a whole. No data were gathered on other furbearers in the region: marmot, ground squirrel, red squirrel, and sea otter. The abundance of food, diseases such as rabies, level of harvest, and predation primarily determine furbearer population levels. The few furbearer species that rely on one or a few prey species (lynx, e.g.) are more subject to population fluctuations than are other furbearers that utilize a variety of prey species or are herbivorous. Severe glaciering, deep freezing, and flooding can result in widespread mortality of beaver, mink, and muskrat by eliminating foraging areas (ADF&G 1980).

3. Predation. Predation is rarely a limiting factor to populations of small mammals; however, furbearers such as beaver, red squirrel, muskrat, marmot, and weasel are subject to significant levels of predation by larger mammals and by raptors (ADF&G 1976, 1980).
4. Illegal harvest. Illegal aerial wolf hunting is a continuing problem in the Southcentral Region (ADF&G 1976, 1980). It is believed that it is still occurring in GMUs 13 and 16 (Timm, pers. comm.). It contributes to the overall number of wolves taken, but the effect of the total harvest is to maintain the wolf population at a desired level (Tobey, pers. comm.).
5. Changes in land ownership. With the transfer of large areas of land in the Southcentral Region to private ownership substantial public trapping opportunities may be lost directly or through prohibition of snowmachine use (ADF&G 1980). Reservation of easements to remaining public lands is mitigating the former loss to some extent.
6. Wildfire suppression. Successional changes in vegetation resulting from fire suppression are currently the most significant source of furbearer habitat loss, through loss of favorable habitat for prey species and loss of hardwood stands used by beavers along waterways. The high human population in the Southcentral Region, however, severely restricts the use of wildfire for habitat rehabilitation (ADF&G 1976 and 1980).
7. Resource and human development activities. Urban development, agriculture, and recreational development will eliminate or degrade lowland habitat utilized by beaver, land otter, mink, and muskrat and decrease usable habitat for wide-ranging furbearers such as wolf and wolverine (ADF&G 1976). The long-term trend in furbearer populations in areas of Southcentral undergoing rapid development can only be downward, due to habitat destruction (Steen, pers. comm.).

For some furbearer species, habitat improvement (e.g., by clearing or controlled burning) could slow or reverse the trend.

8. <u>Human/furbearer conflicts</u>. Feeding of wolves, coyotes, foxes, and other furbearers causes the animals to become accustomed to humans. People may be bitten by such animals, or the animals may become nuisances, requiring destruction or other forms of control. Feeding of foxes, wolves, or wolverines is prohibited by state law (5AAC 81.218). Predation of livestock and pets by wolves and foxes; felling of trees, flooding of private land, and blocking of culverts by beavers; and property destruction by red squirrels are among other conflicts that may require local control of furbearers (ADF&G 1976).
9. <u>Oil pollution</u>. Oil pollution can potentially cause serious and extensive damage to the habitats of aquatic furbearers. Development of outer continental shelf leases will almost certainly result in some detrimental pollution of marine coastal habitats utilized by sea otters. On land, accidental oil spills in the vicinity of riparian habitats have the potential to affect beaver, land otter, mink, and muskrat.

D. Period of Use

For most furbearer species, trapping seasons and bag limits have not changed substantially since statehood in 1959. The liberal seasons vary by GMU and are coincidental with the months when pelts are prime, generally from November through March. Except for beaver, there are no bag limits. Eight furbearer species may be taken under hunting regulations as well as under trapping regulations. Red squirrel may be legally hunted throughout the year; hunting seasons for other furbearers that may legally be hunted generally begin a month or two prior to the trapping season and end at the same time in early spring as the trapping season. Beaver trapping seasons and bag limits are conservative in the Cook Inlet area, GMUs 7, 14, and 15, due to ease of access. Much of GMU 14C, including Chugach State Park, is closed to beaver trapping. Within Chugach State Park, there is also no open season for trapping wolf, wolverine, or land otter (5AAC 84.200). (For details, see the latest trapping and hunting regulations covering furbearers.)

E. Human Use Data

1. <u>Reported human use data</u>. Harvest of furbearers from the Southcentral Region during the 10-year base period is summarized in tables 1-8. More detailed information for the 1980-1981 trapping season, from Machita (1981), is reported in tables 9 and 10. Comparisons of the harvest levels among GMUs is possible only for those furbearers for which sealing of pelts has been required: beaver, land otter, lynx, wolf, and wolverine. Within the Southcentral Region, by far the greatest numbers of lynx, wolf, and wolverine are taken in GMU 13. Beaver harvests are highest by far in GMU 16, with

Table 1. Number of Reported Raw Pelts Entering Fur Trade for 1972-73 through 1982-83; Excluding 1981-82

Year 1972-73

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Southcentral Totals: Trapper Export	Southcentral Totals: Personal Use Export	Southcentral Totals: Total	% of Statewide	Statewide Total
Beaver	155	162	3	320	9.5	3,356
Mink	62	265	16	343	9.1	3,765
Muskrat	193	164	2	359	3.1	11,473
Marten	215	393	0	608	13.3	4,563
Otter	7	63	1	71	5.4	1,323
Arctic fox[a]	0	22	0	22	5.7	387
Other fox[b]	111	96	4	211	10.8	1,957
Weasel	11	64	0	75	33.8	222
Lynx	142	56	3	201	8.9	2,263
Red squirrel	576	149	0	725	68.9	1,053

(continued)

Table 1 (continued).

Year 1973-74

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	42	206	0	248	8.3	3,006
Mink	217	524	0	741	11.9	6,210
Muskrat	248	57	0	305	1.6	18,788
Marten	111	418	27	556	7.1	7,790
Otter	21	31	1	53	3.4	1,573
Arctic fox[a]	3	9	1	13	1.4	908
Other fox[b]	515	291	13	819	10.3	7,941
Weasel	250	166	0	416	36.0	1,155
Lynx	727	272	5	1.004	26.1	3,842
Red squirrel	224	166	0	390	70.3	555

(continued)

Table 1 (continued).

Year 1974-75

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	89	69	9	167	6.8	2,469
Mink	113	188	7	308	8.9	3,458
Muskrat	305	93	0	398	2.8	14,402
Marten	150	34	1	185	2.9	6,412
Otter	7	21	7	35	3.0	1,166
Arctic fox[a]	0	3	5	8	4.2	190
Other fox[b]	101	38	1	140	4.7	2,978
Weasel	24	93	0	117	22.6	515
Lynx	569	48	1	618	21.4	2,889
Red squirrel	166	2	0	168	97.1	173

(continued)

Table 1 (continued).

Year 1975-76

Fur Species	Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
	Southcentral Totals					
Beaver	73	83	40	199	5.9	3,364
Mink	145	63	12	220	3.0	7,366
Muskrat	273	416	19	708	2.7	25,975
Marten	219	53	12	284	4.2	6,804
Otter	91	11	1	103	6.0	1,704
Arctic fox[a]	4	6	10	20	0.7	2,745
Other fox[b]	176	150	12	338	4.4	7,746
Weasel	41	5	2	48	13.6	354
Lynx	351	220	4	575	25.4	2,265
Red squirrel	75	60	0	135	69.9	193

(continued)

Table 1 (continued).

Year 1976-77

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	322	316	26	664	10.5	6,322
Mink	318	197	3	518	4.3	11,945
Muskrat	1,676	386	0	2,044	5.4	37,874
Marten	839	317	6	1,162	7.1	16,392
Otter	215	25	0	240	9.3	2,570
Arctic fox[a]	36	63	6	105	3.1	3,439
Other fox[b]	295	221	0	516	5.8	8,925
Weasel	58	13	3	74	8.3	891
Lynx	131	98	1	230	15.1	1,522
Red squirrel	85	1	0	86	27.5	313

(continued)

Table 1 (continued).

Year 1977-78

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	80	211	6	297	7.0	4,255
Mink	166	180	0	346	3.9	8,866
Muskrat	714	738	0	1,452	4.3	34,136
Marten	313	419	3	735	4.2	17,312
Otter	68	31	2	101	6.9	1,461
Arctic fox[a]	6	20	8	34	3.0	1,117
Other fox[b]	214	244	2	460	8.7	5,258
Weasel	81	45	0	126	16.8	752
Lynx	79	94	0	173	11.6	1,491
Red squirrel	45	59	0	104	40.3	258

(continued)

Table 1 (continued).

Year 1978-79

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	179	131	0	310	10.2	3,046
Mink	376	186	0	562	7.7	7,276
Muskrat	2,170	1,616	93	3,879	11.0	35,305
Marten	1,529	418	0	1,947	7.5	25,888
Otter	76	24	0	100	7.4	1,351
Arctic fox[a]	41	30	39	110	7.0	1,571
Other fox[b]	493	436	0	929	10.9	8,519
Weasel	144	97	0	241	31.7	671
Lynx	121	86	2	209	10.5	1,998
Red squirrel	121	108	0	229	27.5	833

(continued)

Table 1 (continued).

Year 1979-80

	Southcentral Totals					
Fur Species	Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	682	447	0	1,129	12.0	9,437
Mink	462	332	3	797	10.7	7,478
Muskrat	1,338	1,804	222	3,364	9.9	34,092
Marten	1,116	797	0	1,913	8.5	22,469
Otter	64	66	0	130	9.0	1,448
Arctic fox[a]	10	69	2	81	10.3	787
Other fox[b]	270	314	13	597	6.8	8,798
Weasel	135	140	0	275	53.8	511
Lynx	53	78	0	131	7.8	1,690
Red squirrel	421	130	0	551	41.5	1,329

(continued)

Table 1 (continued).

Year 1980-81

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	285	554	20	859	9.8	8,758
Mink	543	988	5	1,536	10.2	15,042
Muskrat	1,732	1,509	0	3,241	7.8	41,316
Marten	777	647	1	1,425	5.7	24,891
Otter	51	73	1	125	8.4	1,486
Arctic fox[a]	14	29	5	48	3.1	1,558
Other fox[b]	274	290	27	591	8.0	7,396
Weasel	38	45	2	85	33.7	252
Lynx	68	162	0	230	9.1	2,526
Red squirrel	116	27	0	143	32.3	443

(continued)

Table 1 (continued).

Year 1981-82

	Southcentral Totals					
Fur Species	Dealer Export[c]	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	859	104	33	996	16.7	5,961
Mink	1,247	255	14	1,516	8.0	18,922
Muskrat	1,247	567	0	1,814	10.0	18,147
Marten	(6,901)	162	2	(7,065)	(28.0)	25,251
Otter	146	36	12	64	4.4	1,470
Arctic fox[a]	166	30	8	204	13.8	1,478
Other fox[b]	(1,402)	402	25	(1,829)	(17.7)	10,309
Weasel	52	12	0	64	34.0	188
Lynx	951	61	1	1,013	25.4	3,984
Red squirrel	247	7	0	254	49.5	513

* Dealer purchase from trapper not available. Dealer export substituted. ( ) = unusually high values.

(continued)

Table 1 (continued).

Year 1982-83

Fur Species	Southcentral Totals: Dealer Purchase From Trapper	Trapper Export	Personal Use Export	Total	% of Statewide	Statewide Total
Beaver	183	172	73	428	10.3	4,134
Mink	105	179	2	286	3.0	9,667
Muskrat	118	303	0	421	40.0	1,052
Marten	759	374	2	1,135	7.6	14,906
Otter	19	91	13	123	12.8	964
Arctic fox[a]	79	28	2	109	24.9	438
Other fox[b]	277	197	15	489	11.8	4,159
Weasel	9	39	0	48	26.8	179
Lynx	260	120	9	389	11.2	3,465
Red squirrel	1	81	52	82	36.8	223

Source: ADF&G Furbearer Program Files.

a Not taken within Southcentral Region. For limitations of data, see II.E.5.a.

b Red fox, including its various color phases (cross, silver, and black).

Table 2. Average Number of Reported Raw Pelts Entering Fur Trade for 1972-73 through 1982-83; Excluding 1981-82 (Means and Their Standard Errors)

Fur Species	Total	% of Statewide
Beaver	462 ± 101	9.0 ± .62
Mink	566 ± 124	7.3 ± 1.08
Muskrat	1,617 ± 448	7.9 ± 3.7
Marten	894 ± 216	6.8 ± .92
Otter	108 ± 18	7.2 ± .93
Arctic fox[a]	55 ± 13	7.3 ± 2.0
Other fox[b]	509 ± 78	8.2 ± .86
Weasel	151 ± 38	27.7 ± 4.2
Lynx	376 ± 88	14.7 ± 2.2
Red squirrel	261 ± 70	51.2 ± 7.5

Source: ADF&G Furbearer Program Files.

a Not taken within Southcentral Region. For limitations of data, see II.E.5.a.

b Red fox, including its various color phases (cross, silver, and black).

Table 3. Statewide Number of Pelts Sealed Per Pelt Recorded as Entering the Fur Trade, for 1972-73 through 1982-83

Year	Furbearer Species			
	Beaver	Lynx[a]	Otter[a]	Average
1972-73	3.24	---	---	---
1973-74	2.79	---	---	---
1974-75	3.04	---	---	---
1975-76	1.68	---	---	---
1976-77	1.75	---	---	---
1977-78	1.86	1.35	1.55	1.59
1978-79	1.82	1.21	1.63	1.55
1979-80	1.33	1.62	1.55	1.50
1980-81	1.36	1.30	1.60	1.42
1981-82[b]	1.40	1.31	1.25	1.32
1982-83	1.70	1.63	1.65	1.66

Source: Derived from data in ADF&G Furbearer Program Files.

--- means no data were available.

a Sealing began in 1977-78.

b Fur trade data not comparable to other years; see table 1.

Table 4. Sealed Lynx Pelts from the Southcentral Region, 1977-78 Through 1982-83

GMU and Subunit	Year					
	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
6[ab]	7	1	0	0	1	0
7	19	12	6	10	3	4
9A[b]	0	0	0	0	0	0
11	42	51	58	62	58	137
13	104	68	36	40	122	88
14	8	9	5	6	7	22
15	32	31	15	3	21	37
16	6	8	6	2	2	5
Southcentral total	218	180	126	123	214	85
% of statewide	10.8	7.5	4.6	3.7	4.1	11.7
Statewide total	2,014	2,416	2,743	3,285	5,221	5,652

Source: ADF&G Furbearer Program Files.

a Harvest for GMU 6A reduced to 1/3 to account for estimated take outside the subregion, east of Cape Suckling.

b 1977-78 values estimated as described in text.

Table 5. Sealed Land Otter Pelts from the Southcentral Region, 1977-78 Through 1982-83

GMU and Subunit	Year					
	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
6[a,b]	122	95	117	73	44	35
7	3	2	6	8	5	2
9A[b]	2	4	6	0	5	0
11	11	11	4	5	3	1
13	10	17	23	25	18	40
14	5	5	21	20	33	11
15	18	28	28	49	40	43
16	25	28	72	42	49	38
Southcentral total	196	190	277	222	197	170
% of statewide	8.7	8.6	12.3	9.3	10.7	10.7
Statewide total	2,265	2,199	2,243	2,382	1,834	1,591

Source: ADF&G Furbearer Program Files.

a Harvest for GMU 6A reduced to 1/3 to account for estimated take outside the subregion, east of Cape Suckling.

b 1977-78 values estimated as described in text.

Table 6. Sealed Wolf Pelts from the Southcentral Region, 1972-73 Through 1982-83

GMU and Subunit	Year										
	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
6[ab]	3	6	4	7	4	3	3	0	2	1	1
7	closed	1	1	9	3	19	12	6	10	12	4
9A[b]	0	0	0	0	0	0	0	0	0	0	0
11	46	27	34	18	15	51	40	7	18	8	26
13	80	75	103	110	102	128	69	57	48	55	90
14	18	12	24	19	15	24	4	4	3	7	17
15	closed	1	5	12	9	20	44	38	32	50	42
16	14	15	41	34	27	11	31	44	23	20	13
Southcentral total	161	137	212	209	175	256	203	156	136	153	193
% of statewide	14.1	13.9	19.4	16.8	16.3	27.9	22.4	23.0	18.4	22.4	23.6
Statewide total	1,142	987	1,090	1,243	1,076	916	906	679	740	683	819

Source: ADF&G Furbearer Program Files.

a Harvest for GMU 6A reduced to 1/3 to account for estimated take outside the subregion, east of Cape Suckling.

b 1977-78 values and those for prior years estimated as described in text.

Table 7. Sealed Wolverine Pelts from the Southcentral Region, 1972-73 Through 1982-83

GMU and Subunit	Year										
	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
6[a,b]	31	51	19	28	12	30	16	12	16	6	7
7	25	12	19	24	6	18	22	17	11	12	10
9A[b]	2	3	3	4	2	3	4	7	0	1	0
11	58	67	29	34	20	29	15	23	16	16	21
13	140	121	96	105	85	58	59	84	34	62	97
14	37	15	22	27	14	26	15	17	9	12	12
15	20	15	15	8	13	15	4	8	9	6	6
16	68	52	45	83	76	45	63	58	38	39	26
Southcentral total	381	336	248	313	228	224	198	226	133	154	169
% of statewide	39.2	32.1	30.7	31.8	24.2	24.6	24.5	31.6	23.5	24.4	22.0
Statewide total	973	1,048	809	984	944	909	807	716	567	631	768

Source: ADF&G Furbearer Program Files.

a Harvest for GMU 6A reduced to 1/3 to account for estimated take outside the subregion, east of Cape Suckling.

b 1977-78 values and those for prior years estimated as described in text.

Table 8. Sealed Beaver Pelts and Number of Trappers in the Southcentral Region, 1972-73 Through 1982-83

	Year							
	1972-73		1973-74		1974-75		1975-76	
GMU and Subunit	No. of Pelts	No. of Trappers	No. of Pelts	No. of Trappers	No. of Pelts	No. of Trappers	No. of Pelts	No. of Trappers
6[a]	184	11	107	13	97	9	56	12
7	126	12	57	6	37	9	76	13
9A	30	3	15	1	31	2	0	0
11	6	2	3	1	12	5	12	5
13	117	26	59	17	78	12	56	16
14	159	46	106	20	153	31	70	26
15	133	20	92	13	33	5	136	17
16	620	49	377	41	783	76	267	33
Southcentral total	1,375	169	816	112	1,224	149	673	122
% of statewide	12.7	13.5	9.7	11.2	16.3	16.6	11.9	15.8
Statewide total	10,864	1,248	8,396	1,003	7,516	899	5,641	770

(continued)

Table 8 (continued).

GMU And Subunit	1976-77 No. of Pelts	1976-77 No. of Trappers	1977-78 No. of Pelts	1977-78 No. of Trappers	1978-79 No. of Pelts	1978-79 No. of Trappers	1979-80 No. of Pelts	1979-80 No. of Trappers
6[a]	197	12	32	6	9	3	240	33
7	87	11	39	9	39	8	44	8
9A	1	1	0	0	0	0	36	3
11	20	3	10	4	9	3	22	6
13	175	27	33	8	43	13	126	34
14	236	15	45	12	77	14	234	38
15	131	17	65	13	43	9	168	26
16	531	49	440	64	308	51	1,037	105
Southcentral total	1,378	135	664	116	528	101	1,907	253
% of statewide	12.5	10.5	8.4	12.7	9.5	12.9	15.2	15.7
Statewide total	11,033	1,283	7,902	914	5,532	784	12,515	1,615

(continued)

Table 8 (continued).

GMU and Subunit	Year: 1980-81 No. of Pelts	No. of Trappers	1981-82 No. of Pelts	No. of Trappers	1982-83 No. of Pelts	No. of Trappers
6[a]	112	16	3	2	35	9
7	52	8	19	5	50	8
9A	0	0	3	1	0	0
11	16	5	5	3	0	0
13	92	22	67	21	40	20
14	224	42	74	16	103	24
15	169	30	79	17	140	23
16	886	89	639	70	409	37
Southcentral total	1,551	212	889	135	777	121
% of statewide	13.1	15.3	10.6	13.5	11.1	14.3
Statewide total	11,871	1,388	8,359	997	7,011	846

Source: ADF&G Furbearer Program Files.

a Reduced by 2% for estimated harvest outside Southcentral Region, East of Cape Suckling.

Table 9. General Statistics from 1980-81 Southcentral Trapper Questionnaire

GMU And Subunit	Area	No. of Trappers	Average No. of Years Trapping in Area	Range of Years Trapping in Area	Average Length of Trapline (Mi.)	Range of Length
6	Cordova, Valdez	8	10.4	3 - 30	24.8	3 - 60
7	Seward, Portage Cooper Landing	6	10.3	2 - 40	15.8	2 - 45
9A	No data collected					
11;13A, C,D	McCarthy, Nabesna Chitina	8	13.5	3 - 33	46.4	6 - 70
13A-D	Glennallen, Paxson Lake Louise	20	11.3	2 - 50	81.6	2 - 250
13E	Cantwell, Denali	5	7.4	3 - 35	35.6	15 - 58
13E,14 16	Talkeetna, Petersville	6	6.5	2 - 15	19.2	2 - 50
14	Palmer, Wasilla	9	7.0	1 - 22	29.1	2 - 115
15	Kenai, Sterling, Homer	16	8.4	2 - 27	30.1	1 - 160
16	Skwentna	8	11.8	2 - 34	61.8	1 - 125
---	Miscellaneous[a]	9	5.0	1 - 13	54.0	10 - 120

Source: from table 1 in Machita 1981.

a Results from individuals who trapped outside Southcentral Alaska or who did not specify an area were grouped here.

Table 10. Harvest Reported for 1980-81 from the Southcentral Trapper Questionnaire

GMU And Subunit	Area	Total Harvest Reported/ Average Per Trapper[a]	Furbearers										
			Beaver	Muskrat	Mink	Land Otter	Fox	Marten	Lynx	Coyote	Wolf	Wolverine	Weasel
6	Cordova, Valdez	Total	79	5	116	19	---	26	---	4	---	9	50
		Average	13	3	15	4	---	5	---	4	---	5	8
7	Seward, Portage	Total	28	19	35	8	---	2	---	7	3	3	2
	Copper Landing	Average	7	6	12	8	---	2	---	2	2	3	2
9A	No Data Collected												
11;13A,C,D	McCarthy, Nabesna	Total	5	40	8	1	5	33	42	6	2	7	22
	Chitina	Average	3	20	3	1	2	11	7	2	1	2	11
13A-D	Glennallen, Paxson	Total	22	426	199	15	220	157	16	21	13	15	95
	Lake Louise	Average	7	47	17	3	18	13	3	3	3	3	10
13E	Cantwell, Denali	Total	34	10	10	---	50	31	1	5	7	2	11
		Average	9	10	5	---	10	16	1	5	2	2	11
13E,14,16	Talkeetna,	Total	98	59	14	3	11	61	---	4	---	3	13
	Petersville	Average	20	20	4	1	3	15	---	2	---	2	8
14	Palmer, Wasilla	Total	64	680	44	7	7	12	---	13	2	2	21
		Average	16	136	6	4	2	4	---	8	2	1	7
15	Kenai, Sterling	Total	56	143	88	14	---	10	---	19	6	2	14
	Homer	Average	6	20	8	3	---	5	---	2	1	1	4
16	Skwenta	Total	168	173	90	17	4	276	---	4	3	8	116
		Average	24	35	15	4	2	46	---	1	3	3	21
---	Miscellaneous[b]	Total	12	4	61	12	178	141	10	4	62	19	---
		Average	4	4	15	3	30	71	3	2	15	4	---

Source: from table 2 in Machita 1981.

--- means no data were available.

a Averages were calculated only for those trappers reporting a harvest.

b Results from individuals who trapped outside Southcentral Alaska or who did not specify an area were grouped here.

moderately high harvests from GMU 14. In the Southcentral Region as a whole, beaver harvests per trapper are lower than the statewide averages. This is probably a result of the higher proportion of recreational trappers in the Southcentral Region. In GMUs 9A and 16, however, the average of 11 beavers harvested per trapper equals the statewide average. Harvest of land otters is highest from GMU 6 and relatively high from GMU 16. For all five furbearer species listed above, harvests from GMU 9A are very low, a reflection of the lack of permanent settlements in that area and the small size of the area. Trapline length is roughly related to overall furbearer harvest in each GMU. Traplines are longer in GMUs 13 and 16, averaging roughly 50 mi, than in GMU 6, where 25 mi is the average.

Averaged over the 6-to-10-year base period, harvests of lynx, land otter, and wolf are quite high in GMU 15, second only to harvests from GMU 13 for lynx and wolf, and GMUs 6 and 16 for land otter. Beaver harvests from GMU 14 are also high, second only to those from GMU 16. In GMU 7, harvests of all five furbearers for which data by GMU are available are low. The number of beavers harvested annually per beaver trapper is low throughout the Cook Inlet area, averaging six to eight. Traplines are relatively short, averaging 16 to 30 mi in length.

2. Types of use. Commercial and recreational harvest of furbearers remains the most important use in this region. Although most furs are sold (representative values are in table 11), some, particularly those not in prime marketable condition, are kept for domestic use in parkas, mukluks, or as garment trim. Even furs for the latter uses are now usually sent to commercial tanneries rather than being processed by the trapper (Melchior, pers. comm.). Wolverine pelts and to a lesser degree wolf pelts are in high demand for local use as parka ruffs; muskrat and beaver are also commonly used in the domestic manufacture of garments. Wolf and wolverine are also taken opportunistically by hunters as trophies. Beaver, muskrat, ground squirrel, red squirrel, lynx, and marmot are also taken and utilized for food (ADF&G 1976, 1980).

3. Origins of users and modes of access. Throughout the Southcentral Region, the proportion of the furbearer harvest taken by commercial trappers who obtain a substantial part of their income from trapping continues to decrease (ADF&G 1976). The majority of trapping pressure radiates from population centers along routes providing relatively easy access, and trapping is becoming recreational in nature (ADF&G 1976).

   Snowmachines are the primary means of transport for some trappers, with highway vehicles being used for recreational trapping near roads and aircraft being used for more remote

Table 11. Pelt Market Values ($), 1972-73 through 1982-83*

Species	1972-73+	1973-74+	1974-75+	1975-76+	1976-77+	1977-78++	1980-81+++	1981-82+++	1982-83+++
Beaver	35.00	35.00	40.00	40.00	50.00	30.00	---	---	---
Muskrat	2.50	2.50	3.00	4.00	4.50	4.00	4.00	3.05	2.80
Mink	35.00	30.00	40.00	45.00	50.00	30.00	49.00	46.43	31.19
Marten	25.00	30.00	35.00	40.00	45.00	35.00	38.00	42.34	56.61
River Otter	55.00	45.00	60.00	60.00	65.00	55.00	44.00	41.43	39.10
White Fox	30.00	35.00	40.00	45.00	50.00	45.00	---	---	---
Other Fox	35.00	40.00	60.00	75.00	90.00	85.00	90.00	88.86	51.66
Lynx	115.00	125.00	150.00	175.00	200.00	240.00	235.00	275.86	263.07
Weasel	1.00	1.20	1.50	1.75	1.75	1.50	---	---	---
Squirrel	.50	.75	.75	.75	.75	0.50	---	---	---
Wolf	---	---	---	---	---	140.00	255.00	227.50	180.38
Wolverine	---	---	---	---	---	140.00	171.00	232.24	203.00
Coyote	---	---	---	---	---	40.00	99.00	61.87	27.46

* Approximate average value paid to trappers per pelt for all sizes and qualities, based on fur market reports, fur auction reports and occasional reports from trappers and dealers.

\+ from Ernest 1978. --- means no data were available.

++ from Van Ballenburghe 1979.

+++ from ADF&G furbearer files.

sites. Near roads and trails, beaver, mink, and muskrat are trapped more intensively than other furbearers. Trapping of land otter, lynx, wolf, and wolverine usually requires longer traplines in more remote areas and the use of snowmachines or aircraft (ADF&G 1976, 1980). Boats and aircraft are important modes of access in coastal areas, especially in GMUs 6 and 9A and in coastal areas of the Kenai Peninsula (ADF&G 1976).

4. Historical levels of use. Although historical use data on furbearers are available for the state as a whole (e.g., Courtright 1968), no sources specific to the Southcentral Region nor for specific GMUs were found.
5. Qualifications and limitations of data:
   a. Fur trade data (tables 1 and 2). These data were taken from computer-processed summaries produced by the Statistics Section, Division of Game, ADF&G, Anchorage. The original sources are fur export permits and fur dealer purchase reports. There are significant limitations to this database as described below (Courtright 1968; Melchior, pers. comm.). Only the residence of the trapper or dealer is recorded on the original permits and reports, not the area in which trapping activity occurred. The results indicate total trapping activity by Southcentral residents, whether or not the traplines are within the Southcentral Region. For this reason, no breakdown by GMU or subregion was attempted. Permits and reports are not filed for a substantial proportion of transactions. Penalties for not reporting are mild and detection is difficult. Correction factors estimated from sealing records are presented in table 3. Furs used locally or processed for domestic use within the state are exempt from these reporting requirements. For species used for garments, ruffs, and trim, local use may be substantial. Therefore, the total reported harvest of some species is low.

      A small number of pelts are coded as of unknown origin in the summaries. Assuming some of these were from the Southcentral Region, the ratio of the number of pelts of known Southcentral origin to the number of known-origin pelts statewide was calculated and used to estimate the number of pelts of unknown origin attributable to the Southcentral Region. This method relies on the quality of reporting and degree of nonreporting being similar throughout the state, an unproven assumption. For 1981-1982, no summary of dealer purchases from trappers by GMU is available. An attempt to substitute dealer exports by GMU was made, but dealer purchases from trappers outside the Southcentral Region resulted in anomalous values. These data are not comparable and are not included in the 10-year summary. The number of active trappers in a given year could be calculated by cross-checking for duplication of names and license numbers among the three categories of data used (dealer purchases from trappers, trapper export, and personal use export, all by GMU). This was not done because of the time required for manual processing and the need for new programming for computer processing.

Fur trade data were not available for wolf, wolverine, or coyote. Sealing certificate data are available for the former two species, however (see II.E.5.c. below). Furs exported for personal use are those sent by trappers to tanneries outside Alaska. These are sent back to the trapper after processing.

b. Fur trade data correction factors (table 2). For the five species of furbearers that are sealed, sealing data provide a fairly reliable record of actual harvest. For unsealed furbearers, estimates of harvest from fur trade records (tables 1 and 2) can be improved by multiplying by the average factor by which sealing totals exceed fur trade totals statewide for the three species for which both records exist (beaver, lynx, and otter) (Melchior 1982). Prior to the start of sealing of lynx and otter in 1977-1978, this method was less reliable (ibid.). This method does not correct for the possibility that Southcentral trappers may fill out export and purchase reports more or less regularly than do trappers statewide. Factors were calculated for the Southcentral Region alone, but fur trading between regions made those ratios even less reliable (less than 1.0 for lynx, e.g.).

c. Sealing records for lynx, otter, wolf, and wolverine (tables 4-7). Sealing of wolf and wolverine pelts has been mandatory since 1971-1972, and of lynx and otter beginning in 1977-1978. Among other data, the specific location of take as well as GMU and subunit are recorded on the certificates. From 1978-1979 through 1982-1983, the number of pelts sealed has been computer-summarized by GMU and subunit. The printouts do not list the number of trappers. A substantial number of coding errors exists in all years (Melchior, pers. comm.). Hand-tabulated data prior to 1978-1979 were retrieved from ADF&G Furbearer Program Files. In the hand-tabulated data, harvest from GMUs 6 and 9 had not been separated by subunit. It was assumed that the proportion of harvest for each species from those subunits within the Southcentral Region was the same as the average proportion from 1978-1979 through 1982-1983 and the harvest correspondingly adjusted.

d. Sealing records for beaver (table 8). Sealing of beaver pelts has been required since 1927 (Courtright 1968).

In 1957, a detailed system of sealing and measuring beaver pelts in order to quantify the harvest and determine the age classes of the animals taken was instituted (Burris 1974). As for the above species, these records reflect actual harvest fairly accurately. Computer-processed summaries and tabulations in the ADF&G Furbearer Program Files were used to obtain the data reported here, including number of trappers. Three sources of error were noticed. As in sealing records for other species, coding errors are fairly frequent; obvious ones were corrected. Two original totals are recorded on the certificates: number of pelts measured for size (written on one side of the form) and total number of pelts taken (written on the other side). These often disagree. Unless a data entry error was obvious, the higher of these totals was used, assuming the sealer or trapper miscounted or forgot to record one or the other number. Location of harvest is recorded by drainage and tributary, not by GMU. In order to convert the data to the required GMU and subregion format, tributaries were located on maps and the harvest and number of trappers for those that form GMU boundaries divided arbitrarily in half (or, rarely, at the intersection of three GMUs, in thirds) and assigned to the appropriate GMU.

e. 1980-1981 Southcentral trapper questionnaire (tables 9 and 10). The data from tables 1 and 2 in Machita (1981) were reorganized to correspond to GMUs as far as possible. Direct correspondence would not be possible without reanalyzing the original responses. This is the only regionwide questionnaire during the years of interest. Of 430 questionnaires mailed to Southcentral trappers, 27 (6.3%) were returned as undeliverable, 201 (46.7%) elected no response, 70 (16.3%) were returned stating that the mild winter and lack of snow had prevented the individual from trapping that winter, and 132 (30.7%) reported that the individual had trapped and supplied trapping information.

F. Significance of Particular Use Areas

Trapping of furbearers takes place throughout the Southcentral Region. Trappers in some areas utilize different drainages or portions of drainages from year to year to allow furbearer populations to recover after a season of trapping. For example, most of GMU 6 is trapped over a 5- or 10-year period, as trappers come and go (Reynolds, pers. comm.). This area of Southcentral differs from most of the rest of the state, where trappers maintain traditional traplines, sometimes for several decades (Melchior, pers. comm.). Trappers in other areas of Southcentral, for example GMU 13, use established trails and traplines every year, sometimes varying the intensity of trapping from year to year (Tobey, pers. comm.). In addition, trappers are usually reluctant to have specific information on their trapping areas published. For these reasons, maps of trapping areas were not developed. Areas that have very good access are the places most likely to be consistently trapped.

In GMUs 6, 13, and 16, these areas include the shorelines of Prince William Sound between Valdez and Cordova and the northern (protected) shores of Hawkins, Hinchinbrook, and Montague islands (Reynolds, pers. comm.) and areas along the Richardson, Glenn, and Parks highways. Beaver sealing data show general areas of comparatively intensive harvest along the Parks Highway north to Talkeetna and Petersville and along the Glenn Highway within GMU 14 and in the vicinity of Chickaloon Pass. Drainages in other areas close to Anchorage and open to beaver trapping also are comparatively intensively harvested. Good access is not available in GMU 9A.

G. Economic Value of Trapping Under General Harvest Regulations

See the Economics Overview volume of this series.

H. Projected Change in Demand

Because of the variable factors of weather, pelt prices, and availability of alternate sources of income discussed in II.C. above, it is not possible to make accurate predictions of future furbearer harvest. In general, trapping of small furbearers in remote watersheds is expected to decrease, while pressure on accessible areas near population centers is expected to increase (ADF&G 1976). High pelt prices may lead to increased trapping of valuable species (ADF&G 1980).

In the near term, as trapping effort increases adjacent to the road system in heavily populated areas, particularly around Anchorage, some restrictions on seasons and bag limits for species other than beaver may become necessary or a permit system may be instituted to control trapper distribution (ibid.). Otter, mink, marten, lynx, wolf, and wolverine could potentially be overharvested if pelt prices rise (ADF&G 1980).

III. MANAGEMENT AREA: GMU 11, AND THOSE PORTIONS OF GMU 9A AND 16 WITHIN NATIONAL PARKS AND PRESERVES

A. Boundaries

The portion of the Southcentral Region considered in this section includes GMU 11 and those portions of GMUs 9A and 16 within Lake Clark or Denali national parks or preserves. Boundaries of this area can be determined by referring to map 1.

B. Management Objectives

Within national parks and preserves, the resource management recommendations prepared by the ADF&G (1982) list the primary management objective for furbearers as providing sustained opportunities for commercial use of furbearers and the secondary objectives as providing the greatest sustained opportunity to participate in hunting and trapping and sustained opportunities for subsistence use of, viewing, and photographing furbearers.

C. Management Considerations

All of the management considerations discussed in II.C. of this report, except agriculture and urban development, apply to national parks and preserves. The two topics in need of amplification are discussed below.

1. Species populations. Wolves are abundant and population levels stable in GMU 11 (Martin 1982).
2. Changes in land ownership. With the transfer of large areas of land in the Southcentral Region into federal parks and preserves under ANILCA, substantial public trapping opportunities may be lost directly or through prohibition of snowmachine use (ADF&G 1980). Management recommendations for federal parks and preserves (ADF&G 1982) acknowledge that adequate use of the furbearer resource is prevented by current restrictions on access and commercial trapping. Access is limited both because of restrictions on snowmachine and aircraft use and because of the unconsolidated pattern of Native lands selections. In GMU 11, trapping effort and harvest of wolf and wolverine has declined in recent years, apparently due to changes in land use regulations rather than to decreased furbearer populations (Lieb 1983).

D. Period of Use

See II.D. for general information on periods of use. Beaver trapping seasons and bag limits are liberal in GMU 11.

E. Human Use Data

See II.E. for a general overview of human use data and discussion of GMU 16. Additional information that applies to GMU 11 is presented under the applicable headings below.

1. Reported human use data. Averaged over the 6-to-11-year base period, harvests of lynx, wolf, and wolverine in the Southcentral Region are highest in GMU 11, second only to harvests from GMU 13 and 16. In contrast, harvests of beaver and land otter from GMU 11 are among the lowest of any of the GMUs in the Southcentral Region. The average number of beavers harvested annually per trapper, 3.1, is also the lowest of the GMUs in the Southcentral Region. Traplines in GMU 11 are long, averaging 50 mi, as is necessary for effective harvest of large terrestrial furbearers.

F. Significance of Particular Use Areas

In GMU 11, the Chitina-McCarthy Road, Nabesna Road, and several trails from Copper River crossing points have traditionally provided snowmachine access for trappers. Ski-equipped aircraft have utilized gravel bars along braided rivers and also lakes. Within other national parks and preserves, rivers and trails have traditionally provided ground and air access and acted as focal points for trapping effort (ADF&G 1982).

G. Economic Value of Trapping Under General Harvest Regulations

See the Economics Overview volume of this series.

H. Projected Change in Demand

See II.H. for a general discussion of variables related to demand.

REFERENCES

ADF&G. 1976. Alaska Wildlife Management Plans draft proposal: Southcentral Alaska. Funded in part by Fed. Aid in Wildl. Rest., Proj. W-17-R. Juneau. 291 pp.

________. 1980. Alaska Wildlife Management Plans: Species Management Policies. Funded in part by Fed. Aid in Wildl. Rest., Proj. W-20-2. Dec. Juneau. iii + 113 pp.

________. 1982. Resource management recommendations for national parks and preserves. Sept. 13.

________. 1983. Furbearer program files.

________. 1983. State of Alaska resource management recommendations for Kenai National Wildlife Refuge and surrounding area. April 27. 20 pp.

Burris, O.E. 1974. Beaver survey-inventory progress report, 1972. Pages 148-149 in D.E. McKnight, ed., comp. Annual report of survey-inventory activities. Part 3: Furbearers, small game and raptors, wolf, wolverine, and black bear. ADF&G, Fed. Aid in Wildl. Rest. Vol. 4. Proj. W-17-5, Jobs 7, 10, 14, 15, 17, and 22. Juneau.

Courtright, A.M. 1968. Game harvests in Alaska. A Fed. Aid in Wildl. Rest. rept. Juneau. 70 pp. June.

Ernest, J.R. 1978. Furbearer survey-inventory progress report, 1975-1977. Pages 30-32 in R.A. Hinman, ed., comp. Annual report of survey-inventory activities. Part 4: Bison, furbearer, wolf, wolverine, seal, and walrus. ADF&G, Fed. Aid in Wildl. Rest. Vol. 7. Proj. W-17-9, Jobs 7, 8, 9, 14, 15, and 22. Juneau.

Libby, W.L., and J.L. Buckley. 1955. Beaver management studies. Alaska Coop. Wildl. Res. Unit Qtr. Rept. 6(4):7-28.

Lieb, J.W. 1983a. Wolf survey-inventory progress report. Page 89 in J.A. Barnett, Annual report of survey-inventory activities. Part 7: Beaver, furbearers, lynx, wolf, and wolverine. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 7.0, 14.0, and 15.0. Juneau.

________. 1983b. Wolf survey-inventory progress report. Pages 92-93 in J.A. Barnett, Annual report of survey-inventory activities. Part 7: Beaver, furbearers, lynx, wolf, and wolverine. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 7.0, 14.0, and 15.0. Juneau.

________. 1983c. Wolverine survey-inventory progress report. Page 120 in J.A. Barnett, Annual report of survey-inventory activities. Part 7: Beaver, furbearers, lynx, wolf, and wolverine. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 7.0, 14.0, and 15.0. Juneau.

Machita, S. 1981. Results of the 1980-81 Southcentral Alaska trapper questionnaire. ADF&G unpubl. rept. 26 pp.

Martin, P. 1982. Wolf survey-inventory progress report. Pages 80-81 in R.A. Hinman, Annual report of survey-inventory activities. Part 4: Furbearers, small game, walrus, and wolverines. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12. Proj. W-19-1 and W-19-2, Jobs 7.0, 10.0, 15.0, and 14.0. Juneau.

Melchior, H. 1982. Alaska tracks. Alaska Trapper, February (no vol.):18-19.

________. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Fairbanks.

Reynolds, J. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Cordova.

Spraker, T. 1982. Wolf survey-inventory progress report. Page 86 in R.A. Hinman, Annual report of survey-inventory activities. Part 4: Furbearers, small game, walrus, and wolverines. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12. Projs. W-19-1 and W-19-2, Jobs 7.0, 10.0, 15.0, and 14.0. Juneau.

Spraker, T. 1983. Wolf survey-inventory progress report. Pages 87-88 in J.A. Barnett, Annual report of survey-inventory activities. Part 7: Beaver, furbearers, lynx, wolf, and wolverine. ADF&G, Fed. Aid in Wildl. Rest. Vol. 13. Proj. W-22-1, Jobs 7.0, 14.0, and 15.0. Juneau.

Steen, N. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Palmer.

Taylor, K. 1981. Beaver survey-inventory progress report, 1979-1980. Pages 82-85 in R.A. Hinman, ed., comp. Annual report of survey-inventory activities. Part 4: Wolf, furbearers, wolverine, small game, and walrus. ADF&G, Fed. Aid in Wildl. Rest. Vol. 11. Proj. W-17-12, Jobs 14.0, 7.0, 15.0, 10.0, and 22.0. Juneau.

Timm, D. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Anchorage.

Tobey, R.W. 1980. Wolverine survey-inventory progress report, 1978-1979. Pages 103 in R.A. Hinman, ed., comp. Annual report of survey-inventory activities. Part 4: Furbearers, upland game, wolf, and wolverine. ADF&G, Fed. Aid in Wildl. Rest. Vol. 10. Proj. W-17-11, Jobs 7.0, 10.0, 14.0, 15.0, and 22.0. Juneau.

________. 1982. Wolf survey-inventory progress report. Pages 91-93 in R.A. Himan, Annual report of survey-inventory activities. Part 4: Furbearers, small game, walrus, and wolverines. ADF&G, Fed. Aid in Wildl. Rest. Vol. 12. Projs. W-19-1 and W-19-2, Jobs 7.0, 10.0, 15.0, and 14.0. Juneau.

________. 1984. Personal communication. Game Biologist, ADF&G, Div. Game, Glennallen.

Van Ballenberghe, V. 1979. Furbearer survey-inventory progress report, 1977-1978. Pages 1-3 in R.A. Hinman, ed., comp. Annual report of survey-inventory activities. Part 2: Furbearers, wolf, wolverine, and small game. ADF&G, Fed. Aid in Wildl. Rest. Vol. 9. Proj. W-17-10, Jobs 7.0, 14.0, 15.0, and 22.0. Juneau.

Commercial Harvest of Groundfish

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Commercially exploited groundfish species within the 200-mi limit in the Gulf of Alaska are all managed by the North Pacific Fishery Management Council (NPFMC) and are subject to similar environmental and population stresses. For this reason, management and harvest information for all groundfish species as a group will be addressed together in this section, followed by species-specific narratives. Selected species included in this account are Pacific cod, Pacific ocean perch, sablefish, walleye pollock, and yelloweye rockfish.

Population estimates and harvest quotas for groundfish catches are usually presented by large regulatory and statistical areas in the Gulf of Alaska. These are known as International North Pacific Fisheries Commission (INPFC) areas. The boundary for the Alaska Habitat Management Guide of the Southcentral Region includes part of both the Kodiak and the Yakutat INPFC statistical areas (map 1). For this document, catches reported by the foreign fleets within an area approximately corresponding to the Southcentral Region (map 2) have also been tabulated.

Domestic groundfish catches in the Lower Cook Inlet (LCI) Management Area are reported by ADF&G statistical areas, which are the same for all finfish and shellfish.

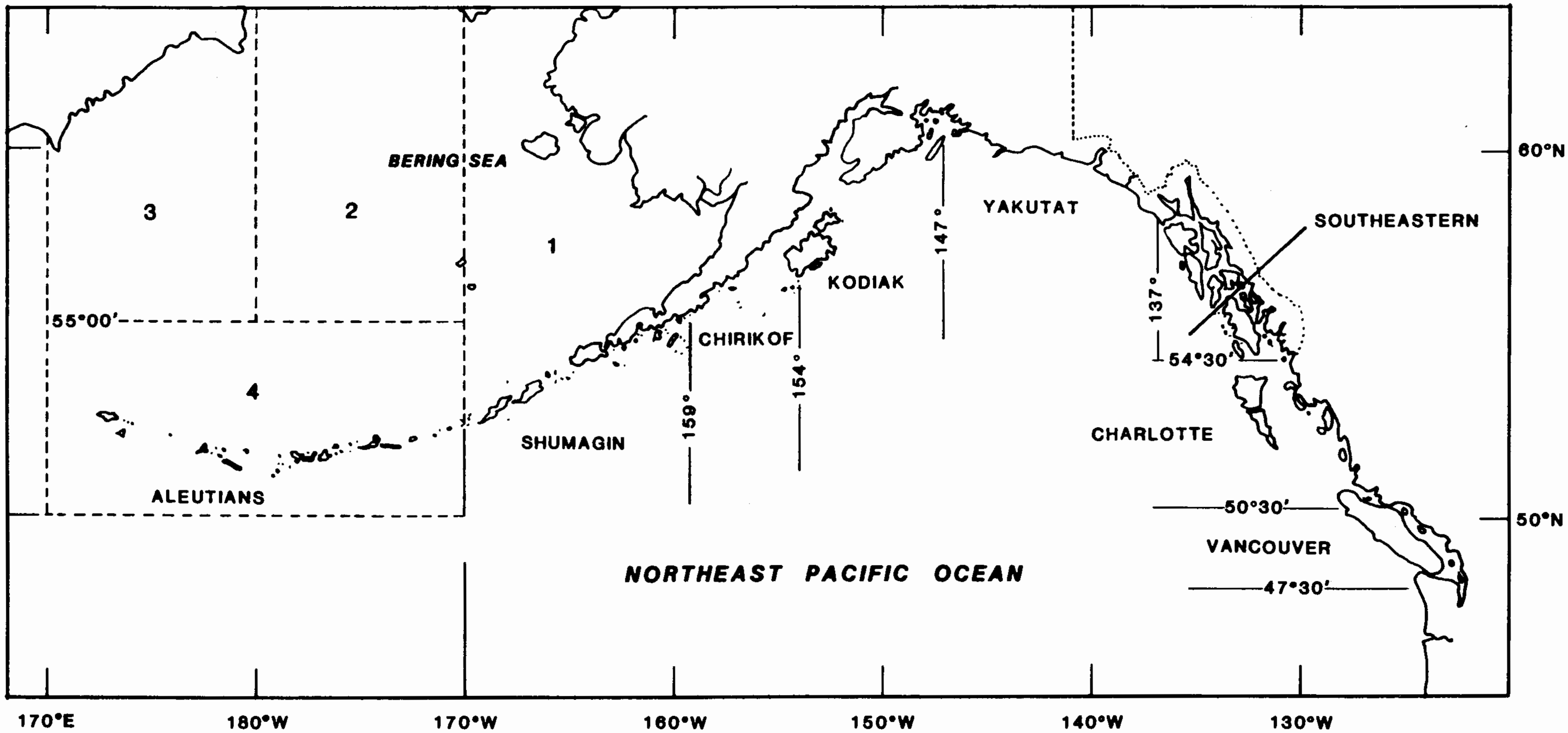
Domestic groundfish catches for the Prince William Sound (PWS) Management Area are reported by shellfish statistical areas.

Fishing effort in domestic groundfish fisheries in Cook Inlet and PWS has been very low. As a result, annual catches by statistical area or district are usually the compilation of fewer than four boats' effort and are therefore confidential. To avoid presenting confidential information, domestic groundfish catches in this report are presented by ADF&G management areas (LCI and PWS) (map 3).

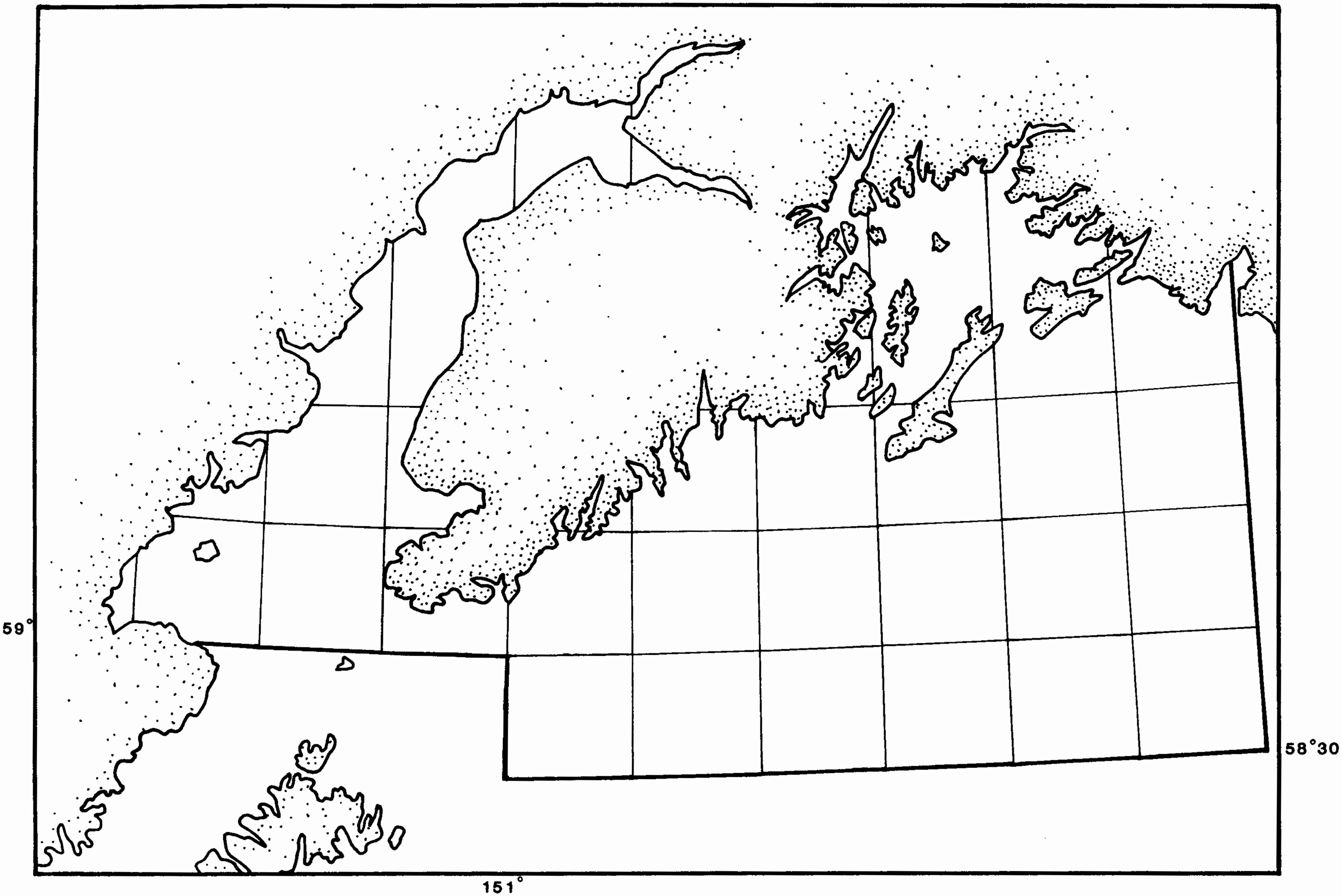
In the species-specific narratives that follow in II. through VI., human use information will be organized at the regional level; and, where appropriate, data specific to INPFC areas or ADF&G management areas will be highlighted in text.

B. Summary of Regional Fishery

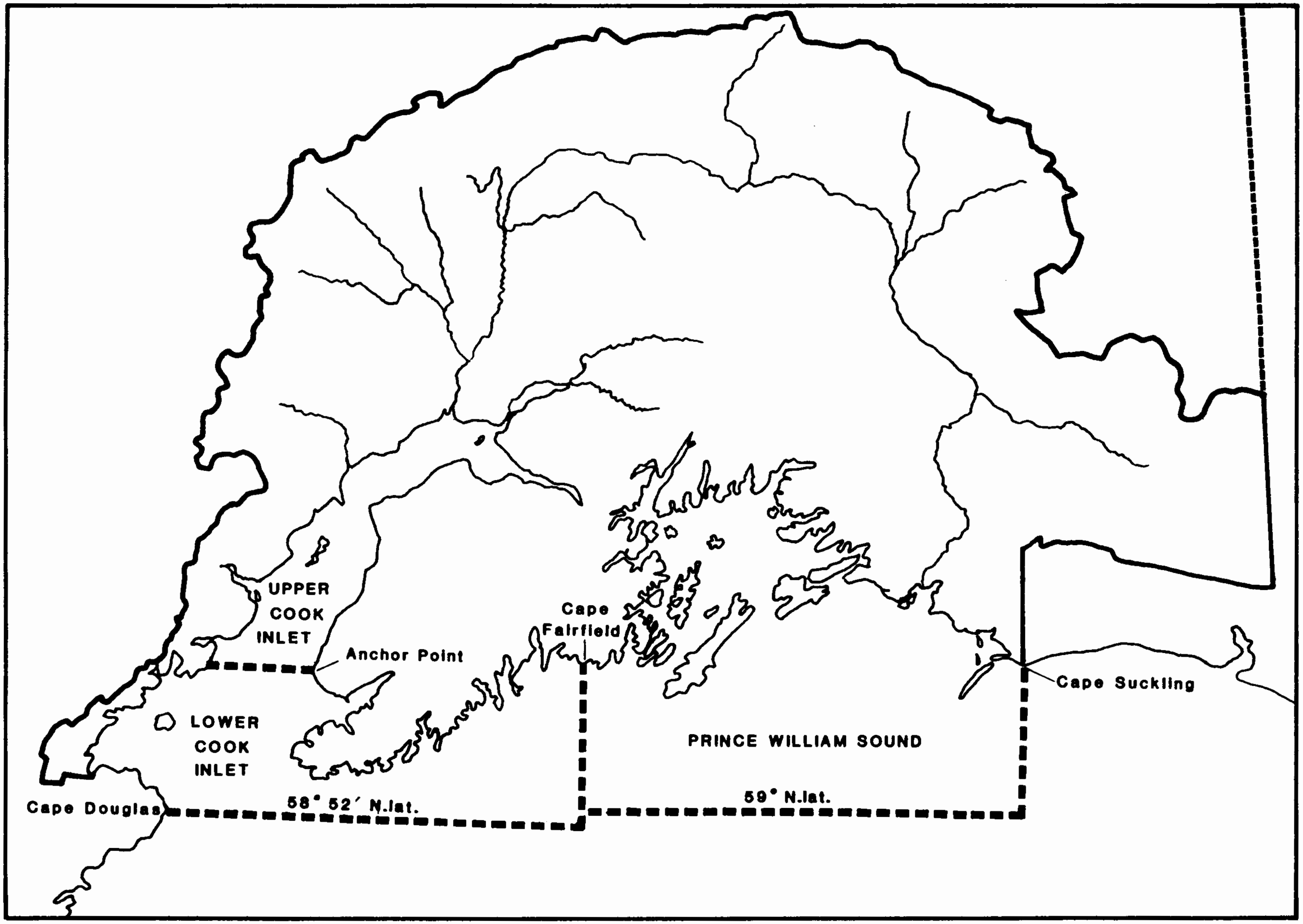
1. Harvest summary. Groundfish exploitation in the Gulf of Alaska has long been dominated by foreign fishing vessels. In the Gulf of Alaska, first the USSR in 1962 and then Japan in 1963 began large-scale fisheries targeting on Pacific ocean perch. By 1965, perch stocks had begun to decline, probably as a result of overfishing. As these stocks declined, fishing effort expanded to include pollock, sablefish, flounders, and Atka mackerel (OCS Socioeconomic Studies Program 1980).



Map 1. INPFC statistical areas for groundfish in the Gulf of Alaska and Bering Sea. For some management purposes, Gulf of Alaska areas have been designated as Western (Shumagin), Central (Chirikof and Kodiak), and Eastern (Yakutat and Southeastern) areas.



Map 2. Area used in this report to tabulate groundfish catches reported by foreign fleets.



Map 3. Management areas used in this report to present domestic groundfish harvests (ADF&G 1984).

Domestic groundfish fisheries have never been conducted on the same scale as foreign ventures, though cod and sablefish have historically been harvested by United States fleets in Alaskan waters. Since the passage of the Magnuson Fishery Conservation act in 1977, however, domestic interest in the groundfish industry has increased. Joint-venture fisheries, which involve American trawlers delivering groundfish catches to foreign processing vessels, have been the fastest-growing domestic groundfish operations to date (Natural Resources Consultants 1982).

In Cook Inlet, targeted landings normally account for only 25% of yearly groundfish catches (Morrison 1984). The remainder are caught incidentally in LCI longline halibut fisheries, Cook Inlet Tanner and king crab pot fisheries, and the Kachemak Bay trawl shrimp fishery. These fish may be discarded, used immediately as hanging bait while the boats are still on the grounds, sold to the canneries to be used as hanging bait, or marketed for human consumption (Blackburn et al. 1983).

Targeted landings account for approximately 80% of yearly groundfish removals in PWS (Morrison 1984). The major targeted groundfish fisheries consist of a trawl fishery in Orca Bay supplying hanging bait for the Tanner crab fleet, a longline fishery in the Knight Island Passage area that catches lingcod, rockfish, and sablefish, and a growing sablefish fishery offshore in the waters east of Middleton Island (Blackburn et al. 1983).

2. Managerial authority. The Magnuson Fishery Conservation and Management Act, implemented in 1977 and amended in 1980, provides for the conservation and exclusive United States management of all fishery resources within the United States Fishery Conservation Zone (3 to 200 nautical miles from shore).

   As a result of this act, management plans for the marine fisheries of Alaska within the Fishery Conservation Zone are developed by the NPFMC. These plans are submitted to the United States secretary of commerce for review and implementation (Frank Orth and Associates, Inc. 1980). The Fishery Conservation and Management Act gives preference to domestic fishermen; however, when domestic fishermen are unable to harvest the entire allowable catch, foreign fleets may harvest the remainder.

   Foreign catch allocations are awarded by the assistant administrator for fisheries of the National Marine Fisheries Services (NMFS), following recommendations of the NPFMC, the U.S. Coast Guard, and the general public, and after consultation with the U.S. Department of State and the U.S. Coast Guard (USDC 1982).

   Management of fisheries in state waters (0 to 3 nautical miles from shore) is the responsibility of the State of Alaska; however, federal regulations generally apply because the state has not promulgated any groundfishing regulations in this region. The NPFMC works closely with the state to avoid disrupting ongoing fisheries (Frank Orth and Associates, Inc. 1980).

3. Management objectives. The objectives of the NPFMC's groundfish management plan for the Gulf of Alaska area are as follows:
   - To provide for the rational and optimal biological and socioeconomic use of the resource
   - To protect halibut
   - To provide for the orderly development of domestic groundfisheries consistent with the criteria listed above at the expense of foreign participation
   - To provide for foreign fisheries consistent with the criteria listed above
   - In the Gulf of Alaska, for sablefish only, to manage groundfish gulfwide for the benefit of the domestic fishery (NPFMC 1984)

   The Gulf of Alaska plan covers all foreign and domestic fisheries for all finfish except salmon, steelhead, halibut, herring, and tuna.

   State of Alaska program goals for groundfish management as stated in the Westward Region's 1984 budget request are 1) to promote orderly development of the domestic groundfish fishery while protecting other marine resources and 2) to develop biological information to improve management and promote recovery of badly depleted groundfish resources (ADF&G 1984a).

4. Management considerations. Management of groundfish is complicated by the fact that no one species can be managed independently of others occurring with it. Interception of nontarget species by fisheries directed towards others may be unavoidable and may have a significant effect on the nontarget species population. A strong example of this is the incidental catch of juvenile halibut in the foregin trawl fishery. Many of the regulatory measures pertaining to foreign groundfish fisheries in the Gulf of Alaska were implemented for conservation of halibut stocks and also to prevent gear conflicts between foreign mobile gear (trawls) and domestic fixed gear (crab pots and halibut set lines) (NPFMC 1978).

5. Gear types. Groundfish are generally harvested using longlines or trawls. Gear types used in directed fisheries are discussed for each species in sections II. to VI. of this account.

6. Period of use. Domestic groundfish harvest is unrestricted (except by catch quotas) year-round. Foreign trawling in 1984 in the area between 147 and 157°W is closed from 16 February to 31 May, unrestricted 1 June to 31 November, and open to pelagic trawls only from 1 December to 15 February. Foreign trawling in the area between 140 and

147°W is open all year to pelagic trawls only. Foreign longlining is allowed in the area between 140 and 169°W beyond 12 mi all year, with the following exceptions: the Pacific cod fishery is closed inside the 400 m isobath 1 May to 30 September and inside the 500 m isobath 1 October to 30 April (NPFMC 1984). Details of seasonal use for each species are discussed in sections II. to IV. of this account.

7. Economic value. Information concerning the value of groundfish within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

II. PACIFIC COD HUMAN USE

A. Fishery Description and Reported Harvest

1. Harvest summary. A United States fishery for Pacific cod began in Alaskan waters in 1864 and continued to the 1950's. This fishery, however, was confined to the Bering Sea/Aleutian Islands area (Natural Resources Consultants 1981).

Foreign exploitation of cod in the Gulf of Alaska began with Japan and the USSR in the 1960's, and they were in later years joined by Poland, Korea, and Mexico (Zenger and Cummings 1982). The catch of cod from the Gulf of Alaska is small compared to the numbers taken from the Bering Sea but has increased in importance in recent years because of the removal of the 500 m depth restriction and increased catch quotas from NPFMC (Natural Resources Consultants 1981, Blackburn et al. 1983). Japan increased its longline effort in the gulf in 1979, targeting on cod, sablefish, and Greenland turbot (Natural Resources Consultants 1981). There has also been a tendency in recent years for trawlers to target on cod (ibid.).

The boundary between the Kodiak and Yakutat INPFC areas splits the Southcentral Region at 147°W (map 1). Catches reported by INPFC area (table 1) include areas within the Kodiak and Yakutat INPFC areas outside the Southcentral Region addressed in this report. Catches as reported by foreign fleets for an area corresponding to the Southcentral Region (map 2) range from approximately 2 to 29% of the total Yakutat plus Kodiak Pacific cod catch by foreign fleets in 1977-1982 (table 2).

Since 1981, United States joint-venture fisheries, which involve domestic fishermen delivering their catches to foreign boats for processing, have been taking cod in the Gulf of Alaska. Domestic processors on the Aleutian Islands and Alaska Peninsula are also buying cod from fishermen (Natural Resources Consultants 1982). Most of this activity, however, has taken place in the western gulf. Domestic catches of cod in the Southcentral Region remain relatively low (tables 1 and 3).

Table 1. Pacific Cod Foreign (F), Domestic (D), and Joint-Venture (JV) Catch in the Kodiak and Yakutat INPFC Areas[a] in Metric Tons (Round Weight), 1977-82

	Kodiak			Yakutat		
Year	F	D	JV	F	D	JV
1977	855	140	0	288	6	0
1978	983	443	0	206	3	0
1979	25,404	606	683	344	27	1
1980	5,227	415	230	2,000	4	0
1981	2,359	676	0	2,247	1	0
1982	3,668	1,869	5	2,070	38	0

Sources: Foreign catch 1977-79 are foreign reports from data on file, NWAFC, Seattle; 1979-82 are best-blend reports from Nelson et al. 1980, French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983. Domestic catch 1977 from Rigby 1984, 1978-82 from ADF&G 1983. Joint-venture catch 1979 from Rigby 1984; 1980-82 are best-blend reports from French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983.

a INPFC areas are illustrated on map 1.

In 1982, approximately 76% of the reported Pacific cod removals in the Cook Inlet area (approximately nine metric tons) were taken incidentally in halibut longline fisheries. The catch of cod in the halibut fishery, however, is probably larger because an unknown percentage of cod caught incidentally are sold on the grounds as hanging bait for crab pots and thus are never landed or reported (Blackburn et al. 1983).

Large incidental catches of Pacific cod are also taken in the Kamishak and Southern districts king crab fisheries in Cook Inlet. Virtually all fish taken by crabbers are immediately used as hanging bait and so are also not technically landed or reported (ibid.). Morrison has calculated that yearly removals of incidentally caught Pacific cod in the 1980-1982 Kamishak and Southern districts king crab fisheries ranged from 39 to 171 metric tons (ibid.). Groundfish are also taken incidentally in the Lower Cook Inlet trawl shrimp fishery, but cod are not a significant part of this catch (Morrison 1983).

Table 2. Reported Harvest of Pacific Cod by Foreign Fleets Within the Southcentral Region[a] in Metric Tons (t), 1977-82

Year	Catch (t)[b]
1977	249
1978	89
1979	555
1980	1,173
1981	1,344
1982	1,565

Source: Data on file, NWAFC, Seattle.

a The harvest area included in the Southcentral Region is illustrated on map 2.

b These numbers are catch as reported by the foreign fleets and are usually lower than adjusted "best-blend" catch totals reported by the NMFS observer program.

2. Harvest methods. Cod are taken by trawls and by longlines. Longline vessels accounted for approximately 90% of the total Japanese cod catch in the Gulf of Alaska from 1979 to 1981 (Zenger and Cummings 1982). Cod harvested in directed fisheries by domestic fishermen in Cook Inlet in 1982 were taken mainly by longline and jigging.
   After passage of the Magnuson Fishery Conservation and Management Act, the area east of 157°W and landward of the 500 m isobath was closed to foreign setline (including longline) fishing to prevent taking of juvenile sablefish (NPFMC 1978). This restriction was significant to foreign cod harvest as most Pacific cod is taken by longline gear. In 1979, the Gulf of Alaska Groundfish Management Plan was amended to allow a directed Pacific cod longline fishery between 140° and 157°W beyond 12 mi from shore, except as prohibited within the 400 m isobath during halibut season (NPFMC 1983a).
3. Period of use. Foreign harvest of groundfish (including cod) in the Gulf of Alaska is restricted during the early part of the year and therefore takes place mainly during June to November. Domestic cod harvest in Cook Inlet took place in May and June in 1982 (ADF&G Commercial Fisheries Catch Reporting System 1983).

Table 3. Southcentral Domestic Pacific Cod Harvest in Pounds and Metric Tons (t), 1974-82

	Cook Inlet		Prince William Sound		Total	
Year	lb	t	lb	t	lb	t
1974	86,299[a]	3.3	1,422	0.6	8,610	3.9
1975	5,454	2.5	0	0	5,454	2.5
1976	9,175[b]	4.2	5,127	2.3	14,302[b]	6.5
1977	[b]		2,806	1.3	2,806[b]	1.3
1978	28,597	13.0	11,650	5.3	40,247	18.3
1979	858	0.4	36,744	16.7	37,602	17.1
1980	965	0.4	7,891	3.6	8,856	4.0
1981	8,460	3.8	8,902	4.0	17,362	7.9
1982	25,677	11.6	32,858	14.9	58,535	26.6

Sources: ADF&G 1983, Blackburn et al. 1983.

a In 1974, large lingcod catches were reported from Cook Inlet. From the information available it appears that most of the lingcod were misreported and were actually Pacific cod. To correct this error, 90% of the reported lingcod catches for that year have been added to the reported Pacific cod catch (Blackburn et al. 1983, Rigby 1984).

b 1976 and 1977 Pacific cod catches in Cook Inlet are combined to maintain confidentiality.

B. Management Objectives
Pacific cod in the Fishery Conservation Zone (3 to 200 mi from shore) are managed as one of a number of groundfish species under the Gulf of Alaska Groundfish Management Plan. Management objectives for Pacific cod are discussed with other groundfish species in the groundfish Human Use section of this report.

C. Management Considerations
Cod stocks in the Gulf of Alaska are at near virgin levels (NPFMC 1983a), and recent harvests have not approached the established catch quotas (Zenger and Cummings 1982). A restriction to the expansion of the cod industry, however, is that a gear or strategy must be devised to reduce the incidental catch of prohibited species (such as Pacific halibut) in the cod harvest (ibid.).

D. Significance of Particular Use Areas

No major cod fishing banks are located in the Southcentral Region (Jewett 1977); however, cod is harvested by foreign fleets along the 200 m depth contour (Smith and Hadley 1979, Smith et al. 1980).

A domestic cod fishery began in 1982 in the Harris Bay portion of the Outer Cook Inlet District (Blackburn et al. 1983). A small domestic harvest of cod also takes place in areas near population centers (such as Kachemak Bay and Orca Inlet). Cod are landed incidentally to the domestic longline fishery for halibut in the Kamishak, Southern, Outer, and Eastern districts of Cook Inlet; and in the Kamishak and Southern districts king crab fisheries (ibid.). Important fishing areas are illustrated on a 1:1,000,000-scale groundfish harvest map in the reference map series for the Southcentral Region.

E. Economic Value

The economic value of Pacific cod within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. PACIFIC OCEAN PERCH

A. Fishery Description and Reported Use

1. Harvest summary. Soviet ships began fishing in the Central Gulf of Alaska in 1960. By 1965 there were 160 Soviet ships fishing in the Gulf of Alaska (Shippen and Stark 1982). No records from these early fisheries are available, but a substantial part of the catch was Pacific ocean perch (ibid.). Japan started fishing in the gulf in 1963, and their catch of Pacific ocean perch peaked in 1964 at 64,000 tons (58,000 metric tons)(ibid.). The Republic of Korea also began fishing in the gulf in 1966, but records of their catch of Pacific ocean perch do not begin until 1976 (ibid.). Poland and West Germany have also participated in the fishery in recent years (ibid.).

   Foreign groundfish catches in the Gulf of Alaska are usually reported by INPFC areas (map 1). The boundary between the INPFC areas of Kodiak and Yakutat splits the Southcentral Region at 147° west longitude. Catches from the Southcentral Region are therefore difficult to compile from the actual catches taken in the Kodiak and Yakutat INPFC areas. Catches reported by foreign fleets within the Southcentral Region covered by this guide are listed in table 4; however, these reported catches are usually lower than adjusted catches from the NMFS observer program. Most notably, the USSR catch from 1977 through 1980 is not available for this small area, but their catch from the Kodiak INPFC area, as reported by the NMFS observer program, averaged 601 metric tons in those years (Shippen and Stark 1982).

Table 4. Reported Harvest of Pacific Ocean Perch by Foreign Fleets Within the Southcentral Region,[a] 1977-82

Year	Catch (Metric Tons)[b]
1977	2,089
1978	358
1979	405
1980	824
1981	1,054
1982	494

Source: Data on file, NWAFC, Seattle.

a The harvest area included in the Southcentral Region is illustrated on map 1.

b These numbers are catch as reported by the foreign fleets and are usually lower than adjusted "best-blend" catch totals reported by the NMFS observer program. USSR catch not available for 1977-80. Data as reported by the NFMS observer program for the Kodiak INPFC area in these years averaged 601 metric tons (Shippen and Stark 1982).

Domestic Pacific ocean perch catches are minimal (table 5), and are usually reported together with other species of rockfish on fish ticket statistics.

Two catches of perch have been recorded in Prince William Sound (PWS) since 1970. One of these, in 1979, was the result of a fishing trial sponsored by the State of Alaska Department of Commerce and Economic Development (ADCED). Two boats prospected for harvestable populations of Pacific ocean perch in PWS for several days. The boats harvested approximately 100 metric tons of perch (ADF&G Commercial Fisheries Catch Reporting System 1983), most of which were caught in the Middleton Island area (ADCED 1979). Another catch of perch from PWS was recorded in 1981; this catch, however, is confidential. No catches of Pacific ocean perch have been reported separately from rockfish in the Cook Inlet Management Area (ADF&G Commercial Fisheries Catch Reporting System 1983).

In 1981 and 1982, processors in Kodiak offered to buy Pacific ocean perch from domestic fishermen. Domestic vessels, however, were unable to catch significant numbers of large-size perch (Blackburn et al. 1983).

Table 5. Pacific Ocean Perch Foreign (F), Domestic (D), and Joint-Venture (JV) Catch in the Kodiak and Yakutat INPFC Areas[a] in Metric Tons (Round Weight), 1977-82

	Kodiak			Yakutat		
Year	F	D	JV	F	D	JV
1977	5,565	0	0	5,536	0	0
1978	1,287	0	0	1,344	0	0
1979	2,112	b	22	2,217	5	25
1980	3,333	100[b]	8	4,704	0	0
1981	1,898	c	0	4,377	0	0
1982	2,275	9[c]	0	17	0	0

Sources: Foreign catch 1977-78 are foreign reports from Shippen and Stark 1982; 1979-82 are best-blend reports from Nelson et al. 1980, French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983.
Domestic catch 1977 from Rigby 1984; 1978-82 from ADF&G 1983.

Joint-venture catch 1979 from Rigby 1984; 1980-82 are best blend reports from French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983.

a INPFC areas are illustrated on map 1.

b Kodiak catches for 1979 and 1980 are combined to maintain confidentiality.

c Kodiak catches for 1981 and 1982 are combined to maintain confidentiality.

Small catches of perch appear in the United States joint-venture fisheries (eight metric tons in the Kodiak INPFC area in 1980) (French et al. 1981), but they are incidental to the larger pollock joint-venture catch.

2. Harvest methods. Pacific ocean perch are fished with bottom trawls (Major and Shippen 1970). Most of the Japanese catch in the Gulf of Alaska is taken by small trawlers and large freezer trawlers (Shippen and Stark 1982). Perch are also frequently taken as incidental harvest in the foreign trawl fishery for pollock (Blackburn et al. 1983).
3. Period of use. The majority of the Pacific ocean perch catch in the Gulf of Alaska takes place in the summer and fall (June to November) (Shippen and Stark 1982). This seasonal

fishing pattern is probably influenced by NPFMC trawl restrictions in effect earlier in the year to protect the United States halibut fishery (ibid.).

B. Management Objectives

Pacific ocean perch in the Fishery Conservation Zone (3 to 200 nautical miles from shore) are managed as one of a number of groundfish species under the Gulf of Alaska and Bering Sea/Aleutians groundfish management plans prepared by the NPFMC. General groundfish management objectives can be found in the groundfish Human Use section of this report (section I., above).

C. Management Considerations

Trawl surveys conducted in 1961 before the beginning of intensive foreign fishing and again in 1973-1976 documented the decline in abundance of Pacific ocean perch during this time (Shippen and Stark 1982, Ronholt et al. 1976). Perch stocks in the Central Gulf may now be no higher than 5% of their virgin abundance (Ito 1982). Management measures are now directed at holding the catch at a low level to allow the stocks to recover from the earlier period of overfishing.

D. Significance of Particular Use Areas

Harvest of Pacific ocean perch in the Gulf of Alaska and Aleutian region takes place along the 200 m depth contour. Smith and Hadley (1979) and Smith et al. (1981) have mapped productive foreign fishing locations in the Gulf of Alaska. These maps are based on data collected by United States observers on foreign vessels. All trawling locations with a catch rate greater than or equal to 500 lb/hr are marked. A 1:1,000,000-scale map of groundfish harvest areas in the reference map series that supplements this text shows the approximate location of foreign trawl and longline efforts.

E. Economic Value

The economic value of Pacific ocean perch within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

IV. SABLEFISH

A. Fishery Description and Reported Harvest

1. Harvest summary. Sablefish have been harvested by United States fisheries since the early part of this century. Catches in the early fishery, however, were relatively small, with peaks occurring during the war years (1917 and 1942) (Heiser 1967, Balsiger 1982, Bracken 1983). Fishing effort in Alaska was generally confined to the Southeast Region (Bracken 1983). Japanese longliners began sablefish operations in the Gulf of Alaska in 1963, and catches rapidly increased until the record all-nation catch from the northeast Pacific reached 67,000 tons (68,072 metric tons) in 1972 (Balsiger 1982). The northeast Pacific total catch averaged about 50,000 tons (50,800 metric tons) from 1973

until catch quotas were imposed in 1977 (ibid.). Foreign catches have declined since 1977 (tables 6 and 7).

Evidence of declining sablefish stock abundance has led to significant fisheries restrictions since 1977 (ibid.). Regulations affecting Gulf of Alaska sablefish fisheries consist of maximum catch quotas derived from estimates of equilibrium yield (ibid.). From 1977 through 1981, a catch quota for the entire gulf of 13,000 tons (13,208 metric tons) was in effect for foreign and domestic fisheries. For 1982 that catch quota was reduced to 8,230 tons (8,362 metric tons) (ibid.). More details of catch quotas can be found in the Distribution and Abundance section of this account.

It had been hoped that, with the establishment of the 200 mi Fishery Conservation Zone in 1977 and the designation in 1978 of the waters off southeastern Alaska as a domestic preserve in which foreign fishing for sablefish is prohibited, the domestic sablefish fishery would expand greatly (Natural Resources Consultants 1982). This expansion, however, did not take place as quickly as expected; in fact, the all-Alaska domestic catch dropped from 1,590 metric tons in 1980 to 410 metric tons in 1981. This drop was apparently caused by a scarcity in 1981 of large sablefish (ibid.). Difficulties in gaining access to Japanese markets and a lack of United States demand for sablefish are also blamed for the slow growth of the domestic fishery (Natural Resources Consultants 1982, Hughes 1980).

In 1982, the Southeastern Fishery Conservation Zone, including adjacent state waters, was closed by joint state/federal action in early August to prevent overharvest of juvenile fish (Blackburn et al. 1983). This resulted in a westward shift of the southeast domestic longline effort into the western Yakutat area (ADF&G 1984f, Blackburn et al. 1984c). In 1982 and 1983, the Japanese longline fleet agreed to stay out of the area from 140° west longitude to 147° west longitude between 2 August and 16 October to eliminate gear conflicts with the United States fishermen (ibid.). In 1982, United States fishermen caught approximately 45 metric tons of sablefish from waters between Middleton Island and Cape Suckling (table 8) (ADF&G Commercial Fisheries catch Reporting System 1983).

In 1984, the Japanese North Pacific Longline Gillnet Association promised to abstain from any directed sablefish longlining in the Gulf of Alaska between 140° and 159° until October 7 (NPFMC 1983b). In 1984, the domestic longline fleet took the entire Central Gulf of Alaska sablefish quota of 3,060 metric tons, and the fishery was closed before October 7, when the Japanese could have begun fishing.

Table 6. Sablefish Foreign (F), Domestic (D), and Joint-Venture (JV) Catch in the Kodiak and Yakutat INPFC Areas[a] in Metric Tons,[b] 1977-82

Year	Kodiak F	Kodiak D	Kodiak JV	Yakutat F	Yakutat D	Yakutat JV
1977	3,588	3	0	5,222	147	0
1978	2,254	1	0	2,616	87	0
1979	2,051	54	18	2,633	516	Tr
1980	1,641	25	13	1,638	190	0
1981	1,776	12	0	2,913	62	0
1982	1,516	52	0	1,266	518	0

Sources: Foreign catch 1977-78 are foreign reports from data on file, NWAFC, Seattle; 1979-82 are best-blend reports from Nelson et al. 1980, French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983. Domestic catch 1977 from Rigby 1984; 1978-82 from ADF&G 1983. Joint-venture catch 1979 from Rigby 1984; 1980-82 are best-blend reports from French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983.

a INPFC areas are illustrated on map 1.

b Foreign and joint-venture catches are in metric tons round weight; domestic catch is in metric tons dressed weight but can be converted to round weight by dividing by 0.7 (ADF&G 1984).

Tr: Trace-less than 0.5 metric tons.

2. Harvest methods. Fishing for sablefish in the Gulf of Alaska is by hook and line gear. Trap gear was used extensively during 1971-1976 but since 1977 has been replaced almost entirely by longlining (Morris et al. in press). The directed foreign fishery in the Gulf of Alaska is limited by regulations to longline gear (NPFMC 1984).
3. Period of use. Domestic harvest of sablefish in Prince William Sound (PWS) in 1982 took place June through November, peaking in August (Morrison 1982). Harvest in Cook Inlet in 1982 took place in August and October (ADF&G Commercial Fisheries Catch Reporting System 1983).

Table 7. Reported Harvest of Sablefish by Foreign Fleets Within The Southcentral Region[a] in Metric Tons (t), 1977-82

Year	Catch (t) [b]
1977	1,473
1978	916
1979	1,071
1980	553
1981	920
1982	735

Source: Data on file, NWAFC, Seattle.

a The harvest area included in the Southcentral Region is illustrated on map 2.

b These numbers are catch as reported by the foreign fleets and are usually lower than adjusted "best-blend" catch totals reported by the NMFS observer program.

The foreign-directed fishery for sablefish in the area between 147° to 157° W is closed inside the 400 m isobath between 1 May and 30 September and inside the 500 m isobath from 1 October to 30 April (NPFMC 1984).

B. Management Objectives

Sablefish in the Fishery Conservation Zone (3 to 200 nautical miles from shore) are managed as one of a number of groundfish species under the Gulf of Alaska Groundfish Fishery Management Plan (Povolny 1983). Sablefish are managed in state waters of the Southeast Region with seasons and guideline harvest levels. Throughout the rest of the state, federal regulations for the fishery conservation zone apply in as much as the state has not promulgated regulations for this fishery (Blackburn et al. 1983). Sablefish management objectives are discussed along with those for other groundfish species in section I.3., Groundfish Management Objectives.

C. Management Considerations

An important question to be answered for sablefish management is concerns the degree of intermingling of stocks from different regions. Several studies have indicated that, though some sablefish undergo extensive migrations, the majority of fish are localized and do not migrate great distances (Low et al. 1976, Wespestad 1981). This would indicate that regional stocks in the Gulf of Alaska can be successfully managed as separate units

Table 8. Southcentral Domestic Sablefish Harvest 1974-83 in Pounds and Metric Tons (t) (Dressed Weight)[a]

	Cook Inlet		Prince William Sound		Total	
Year	lb	t	lb	t	lb	t
1974	[b]		---		[b]	
1975	[b]		---		[b]	
1976	---		---		---	
1977	[b]		[d]		[bd]	
1978	[b]		4,725[d]	2[d]	4,725[bd]	2
1979	23,818[c]	11[c]	13,824	6	37,642[c]	17
1980	[c]		31,773[e]	14[e]	31,773[ce]	14
1981	---		[e]		[e]	
1982	14, 608	7	83,658	38	98,266	45

Source: ADF&G 1983.

a Dressed weight can be converted to round weight by dividing by 0.7 (ADF&G 1984).

b Cook Inlet catches for 1974, 1975, 1977, and 1978 are confidential; however, the average catch for these years was 201 lb (0.1 t).

c Cook Inlet catches from 1979 and 1980 are combined to maintain confidentiality.

d PWS catches from 1977 and 1978 are combined to maintain confidentiality.

e PWS catches from 1980 and 1981 are combined to maintain confidentiality.

having little influence on each other. Recent studies by Bracken (1982), however, indicate that a significant number of fish do migrate long distances (over 185 km) and that extensive intermingling of stocks does occur. Bracken recommended that sablefish be managed as a single stock gulfwide and suggested that extensive fishing in the Charlotte and Vancouver INPFC areas in recent years, coupled with continued high harvest levels in the central and western gulf, is slowing the recovery of stocks that have been overharvested in the eastern gulf.

D. Significance of Particular Use Areas

Foreign harvest of sablefish takes place along the edge of the continental shelf, generally in waters between 200 and 2,000 m deep.

In 1984, domestic harvest of sablefish in the Southcentral Region occurred in the area around Middleton Island and in areas due South of Resurrection Bay (Morrison, pers. comm.).

Smith et al. (1980) have mapped productive foreign fishing locations in the Gulf of Alaska. These maps are based on data collected by United States observers on foreign vessels. All longline locations with a catch rate greater than or equal to 0.0001 lb per hook are marked. A map of groundfish harvest areas may be found in the reference map series for the Alaska Habitat Management Guide of the Southcentral Region. It shows the approximate location of foreign longline efforts, along with the location of domestic sablefish fisheries in 1983 and 1984.

E. Economic Value

The economic value of sablefish within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

V. WALLEYE POLLOCK

A. Fishery Description and Reported Harvest

1. Harvest summary. Foreign trawlers first began operations in the Gulf of Alaska in 1962, targeting on Pacific ocean perch. Perch stocks soon declined, however, and effort shifted to pollock. From 1962 to 1971, pollock were either taken in an intermittently directed fishery by Japan or as by-catch in the Japanese and USSR rockfish (perch) fisheries (Alton and Deriso 1982). In 1972, the foreign pollock catch rose to 34.1 thousand tons (34.6 thousand metric tons) and continued to rise, with an annual catch of 130.3 thousand tons (132.4 thousand metric tons) in the Gulf of Alaska in 1981 (ibid.). In 1981, approximately 5,500 metric tons of pollock were taken from the southcentral Region (table 9). Boats from the Republic of Korea in 1974 and Poland in 1975 joined the foreign effort for pollock in the gulf.

   The directed United States fishery for pollock in the Central Gulf is insignificant (tables 10 and 11); however, the catch in United States joint-venture fisheries has grown rapidly (table 10). At present, these fisheries operate mainly in the Shelikof region west of Kodiak.

2. Harvest methods. Pelagic and bottom trawls are used to harvest pollock. The Japanese use large trawlers that process pollock into minced fish (surimi) and freezer trawlers that freeze whole or dressed pollock and pollock fillets. The Japanese harvest fish mainly with bottom trawls (ibid.).

Table 9. Reported Harvest of Walleye Pollock by Foreign Fleets within the Southcentral Region[a] in Metric Tons (t), 1977-82

Year	Catch (t)[b]
1977	2,882
1978	1,916
1979	2,713
1980	2,899
1981	5,519
1982	983

Source: Data on file, NWAFC, Seattle.

a The harvest area included in the Southcentral Region is illustrated on map 2.

b These numbers are catch as reported by the foreign fleets and are usually lower than adjusted "best-blend" catch totals reported by the NMFS observer program.

The Polish fleet uses exclusively pelagic trawls. Large fish are processed into fillets, intermediate fish are headed and gutted, and small pollock go into fish meal (ibid.). The United States catcher vessels involved in the Shelikof Strait joint-venture fisheries are small stern trawlers that range in length between 25 and 50 m. In this fishery, pelagic trawls are used. The individual catches are not taken aboard the catcher vessel but are transferred via detached cod ends to the foreign processing vessels (ibid.). Currently in the Southcentral Region, only pelagic trawling is allowed for foreign vessels between 140°W and 147°W. The area from 147°W to 157°W is unrestricted from 1 June to 31 November, limited to pelagic trawls only from 1 December to 15 February, and closed to all trawling 16 February to 1 June (NPFMC 1984). Certain areas are also closed to trawling during the United States halibut and king crab seasons (ibid.).

3. Period of use. Foreign trawling in recent years has occurred mainly during June to November, probably because of time-area closures and gear restrictions during the early part of the year (ibid.). Harvest by some nations in some years does take place earlier in the year, however (ibid.).

Table 10. Walleye Pollock Foreign (F), Domestic (D), and Joint-Venture (JV) Catch in the Kodiak and Yakutat INPFC Areas[a] in Metric Tons, 1977-82

Year	Kodiak			Yakutat		
	F	D	JV	F	D	JV
1977	28,157	44	0	6,247	0	0
1978	17,524	490	0	3,312	0	0
1979	38,414	1,507	506	4,816	0	14
1980	26,616	482	527	4,198	0	0
1981	9,095	544	0	7,574	0	0
1982	8,077	2,049	3,135	26	0	0

Sources: Foreign catch 1977-79 are foreign reports from data on file, NWAFC, Seattle; 1979-82 are best-blend reports from Nelson et al. 1980, French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983. Domestic catch 1977 from Rigby 1984; 1978-82 from ADF&G 1983. Joint-venture catch 1979 from Rigby 1984; 1980-82 are best-blend reports from French et al. 1981, Nelson et al. 1982, and Nelson et al. 1983.

a INPFC areas are illustrated on map 1.

B. Management Objectives

Pollock in the Fishery Conservation Zone (3 to 200 nautical miles from shore) are managed as one of a number of groundfish species under the Gulf of Alaska and Bering Sea/Aleutians Groundfish Fishery Management Plans prepared by the NPFMC. General groundfish management objectives can be found in the groundfish human use narrative.

The abundance of walleye pollock in Alaskan waters is currently good. Management and research is directed at maintaining pollock abundance, evaluating the future status of pollock stocks, and improving the current information upon which management decisions are based (ibid.).

C. Management considerations

In the early 1970's, bilateral agreements between the United States and other nations were introduced that limit the amount of pollock that could be harvested, restricted access to pollock and

Table 11. Southcentral Domestic Walleye Pollock Harvest in Cook Inlet and PWS Management Areas[a] in Pounds and Metric Tons (t), 1974-82

	Cook Inlet		PWS		Total	
Year	lb	t	lb	t	lb	t
1974	4,935	2.2	0	0	4,935	2.2
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	0	0	c	c	c	c
1979	0	0	153,315[c]	69.5[c]	153,315[c]	69.5[c]
1980	b	b	d	d	bd	bd
1981	0	0	12,572[d]	5.7[d]	12,572[d]	5.7[d]
1982	108[b]	Tr[e]	1,075	0.5	1,183[b]	0.5[b]

Source: ADF&G 1983.

a Cook Inlet and PWS management areas illustrated on map 3.

b 1980 and 1982 Cook Inlet catches combined to maintain confidentiality.

c 1978 and 1979 PWS catches combined to maintain confidentiality.

d 1980 and 1981 PWS catches combined to maintain confidentiality.

e Tr: Trace - less than 0.05t.

other groundfish on certain fishing grounds during certain periods of the year, and regulated the way trawls could be fished (ibid.). Since the implementation of the Magnuson Fishery Conservation and Management Act in 1977, licensing, catch quotas and time-area closures, and gear restrictions have been placed on foreign vessels within the Fishery Conservation Zone (ibid.). A summary of 1982 catch quotas can be found in the pollock Distribution and Abundance narrative.

D. Significance of Particular Use Areas

Most foreign fishing effort takes place in the Shumagin and Chirikof-Kodiak INPFC areas (Alton and Deriso 1982, Smith and Hadley 1979), though some harvest does take place along the 200 m depth contour in the Southcentral Region (Smith and Hadley 1979). Smith and Hadley (1979), and Smith et al. (1981) have mapped productive foreign fishing locations in the Gulf of Alaska. These maps are based on data collected by United States observers on foreign vessels. All trawling locations with a catch rate greater than or equal to 500 lb/hr are marked. A map of groundfish human use found in the reference map series that supplements this text shows the approximate location of foreign trawl and longline efforts.

E. Economic Value

The economic value of walleye pollock within the Southcentral Region is presented in the Economic Overview of Fish and Wildlife volume.

VI. YELLOWEYE ROCKFISH

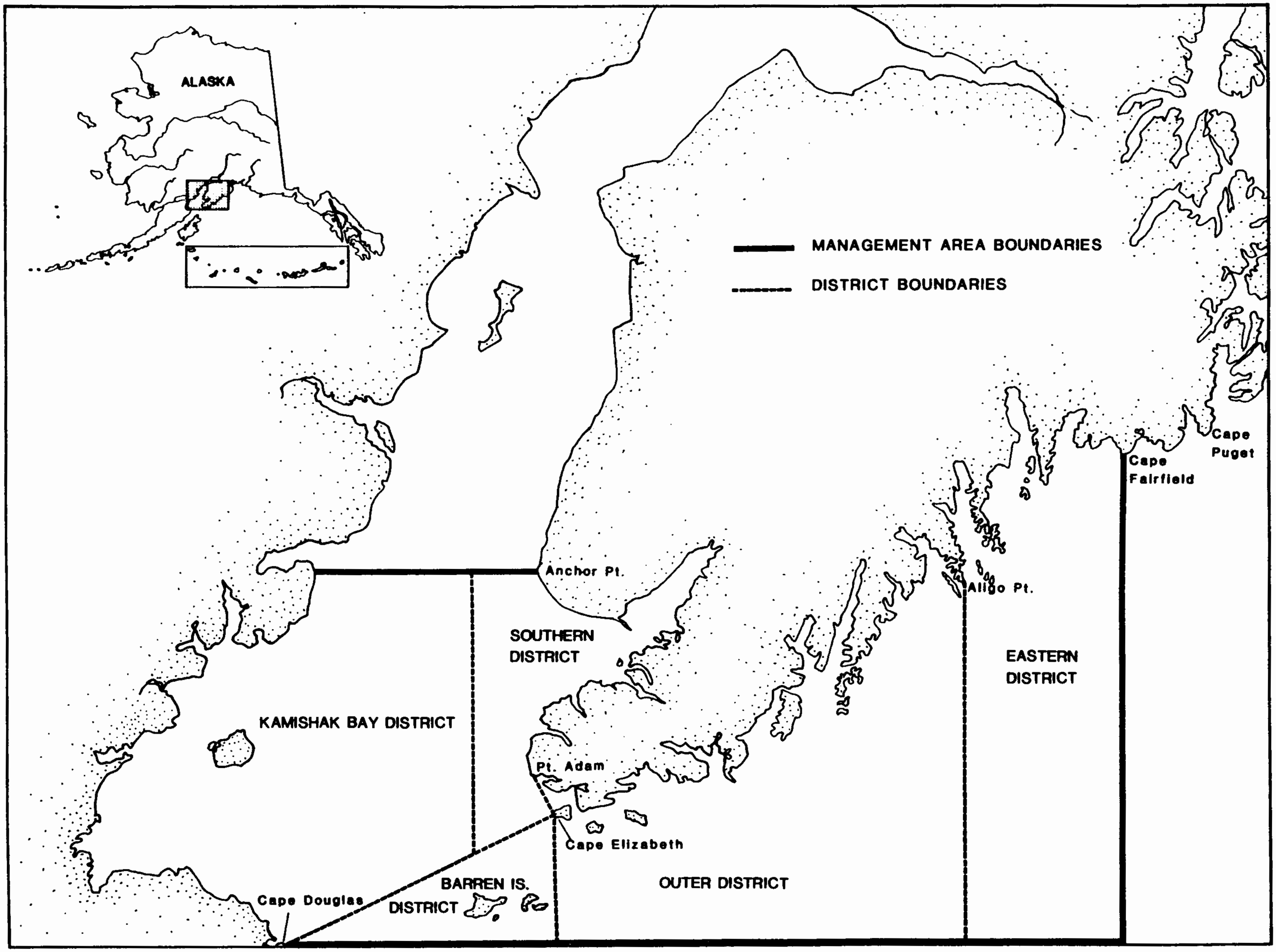
A. Fishery Description and Reported Harvest

1. Lower Cook Inlet Management Area. The fishery for nearshore rockfish, including yelloweye, takes place mainly within the 3-mi. limit and so is regulated by the ADF&G. The Southcentral Region is divided into three management areas by the ADF&G: Upper Cook Inlet (UCI), Lower Cook Inlet (LCI), and Prince William Sound (PWS). Rockfish harvest occurs only in the LCI and PWS management areas (map 3) and will be discussed for each of these areas in the flowing narrative. Management objectives and considerations are similar for the entire Southcentral Region and so will be discussed at the regional level.

The LCI Management Area includes all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point (map 3).

a. Harvest summary. Targeted domestic fisheries for rockfish began to develop in the Outer and Eastern districts of Lower Cook Inlet (map 4) in the latter part of 1980. Rockfish harvest peaked in 1981, with eight boats harvesting 57 metric tons (table 12) (Blackburn et al. 1983, Morrison 1984). This harvest was predominantly black rockfish (Sebastes melanops) (Morrison, pers. comm.). In 1982, however, Cook Inlet rockfish landings fell to only 6 metric tons because of transportation and marketing problems (Morrison 1984).

b. Harvest methods. In Cook Inlet and PWS, rockfish are harvested in a small directed fishery using longlines or automatic jigging machines (Morrison 1982a). Boats in the Outer and Eastern districts of the Cook Inlet rockfish fishery in 1980 and 1981 ranged in size from 28 to 34 ft (ibid.).



Map 4. Districts of the Lower Cook Inlet Management Area.

Table 12. Southcentral Domestic Rockfish Harvest 1974-83 in Pounds and Metric Tons (t)

	Cook Inlet		Prince William Sound		Total	
Year	lb	t	lb	t	lb	t
1974	2,651	1.2	74,040	33.6	76,691	34.8
1975	b		c		b,c	
1976	754	0.3	0	0	754	0.3
1977	994[b]	0.5	0	0	994[b]	0.5
1978	2,148	1.0	754[c]	0.3	2,902[c]	1.3
1979	4,772	2.2	4,092	1.8	8,864	4.0
1980	44,965	20.4	6,690	3.0	51,655	23.4
1981	126,511	57.4	123,692	56.1	250,203	113.5
1982	13,360	6.1	9,027	4.1	22,387	10.2
1983	12,625	5.7	24,088	10.9	36,713	16.6

Sources: ADF&G 1983; Morrison, pers. comm.

a Approximately 98% of the total Cook Inlet harvest from 1975 through 1982 has come from the Outer and Eastern districts.

b Cook Inlet catches for 1975 and 1977 are combined to maintain confidentiality.

c Prince William Sound catches for 1975 and 1978 are combined to maintain confidentiality.

c. Period of use. There is no closed season for nearshore rockfish, and in LCI harvest took place throughout the year in 1981 and 1982 (Morrison 1982).

2. Prince William Sound Management Area. The PWS Management Area includes all waters between Cape Fairfield and Cape Suckling (map 3).

a. Harvest summary. In PWS, a small domestic fishery for rockfish, sablefish, and lingcod has been conducted sporadically since 1979 in the Knight Island Passage, Prince of Wales Pass area (Blackburn et al. 1982, ADF&G Commercial Fisheries Catch Reporting System 1983).
Large numbers of rockfish have been taken in the newly developed domestic sablefish longline fishery in PWS. It has not been uncommon to see 15-20% of a 30,000-

40,000 lb sablefish delivery consist of rockfish. This incidental harvest accounts for almost all the rockfish landed in the Southcentral Region in 1984 (Morrison, pers. comm.).

b. Harvest methods. In Cook Inlet and PWS, rockfish are harvested in a small directed fishery using longlines or automatic jigging machines (Morrison 1982).

c. Period of use. There is no closed season for nearshore rockfish. In PWS, the 1982 harvest of rockfish took place from May to November (ADF&G Commercial Fisheries Catch Reporting System 1983).

B. Management Objectives

The fishery for yelloweye rockfish takes place mainly within the 3-mi limit and so is regulated by the ADF&G. This is a new fishery, and there are currently no regulations that apply specifically to rockfish (Rosenthal et al. 1981, ADF&G 1982).

State of Alaska program goals for groundfish (including rockfish) management as stated in the Westward Region's 1984 budget request are 1) to promote orderly development of the domestic groundfish fishery while protecting other marine resources and 2) to develop biological information to improve management and promote recovery of badly depleted groundfish resources (ADF&G 1984a).

C. Management Considerations

Foreign fisheries for Pacific ocean perch catch many other species of rockfish. The North Pacific Fishery Management Council (NPFMC) includes several species of *Sebastes* in their estimates of Pacific ocean perch optimum yield. There are *S. alutus* (Pacific ocean perch), *S. polyspinus* (northern rockfish), *S. aleutianus* (rougheye rockfish), *S. borealis* (shortraker rockfish), and *S. Zacentrus* (sharpchin rockfish). The NPFMC has also set an optimum yield for "other rockfish," which includes all species of *Sebastes* not included in the Pacific ocean perch optimum yield, and a separate optimum yield for thornyhead rockfish, *Sebastolobus* sp., which are frequently caught incidentally in the foreign sablefish fishery (NPFMC 1984, Blackburn et al. 1983). These rockfish species are, however, generally not the same ones that are taken in the nearshore domestic fisheries (Blackburn et al. 1983, Rosenthal et al. 1982).

Until 1984, the fishing pressure on stocks of shallow offshore rockfish has been light in most areas. These fish, however, are generally long-lived and slow-growing - both characteristics that are usually incompatible with high fishing effort and sustained yields (Rosenthal et al. 1982). In 1984, large numbers of rockfish were harvested incidentally in the PWS domestic sablefish fishery. As interest in bottom fishing increases in Alaska, it will be imperative that the fishing industry as well as the state take an active role in managing and preserving the resource (ibid.). Local depletions of stocks have already occurred in areas such as Resurrection Bay, where fishing effort has been concentrated (McHenry, pers. comm. to Morrison 1982a). Without careful management, stocks will be depleted in larger areas, and a sustained fishery will be impossible.

D. Significance of Particular Use Areas

1. Cook Inlet. The domestic fishery for rockfish in the Cook Inlet Management Area takes place in the Outer and Eastern districts, from Nuka Bay to the Chiswell Islands, and from Day Harbor to Port Bainbridge (Blackburn et al. 1983; Morrison, pers. comm.). Areas important to the commercial harvests of rockfish in Cook Inlet are depicted on a 1:1,000,000-scale groundfish harvest area map in the reference map series that supplements this text.

2. Prince William Sound. In PWS, directed commercial fishery for rockfish occurs in Knight Island Passage and Prince of Wales Passage (Blackburn et al. 1983; Morrison, pers. comm.). The domestic sablefish fishery, which takes a large incidental harvest of rockfish, occurs in areas around Middleton Island and due south of Resurrection Bay (Morrison, pers. comm.). Areas important to the commercial harvest of rockfish in PWS are depicted on a 1:1,000,000-scale groundfish harvest area map in the reference map series that supplements this text.

E. Economic Value

The economic value of yelloweye rockfish within the Southcentral Region is presented in the Economic Overview of Fish and Wildlife volume.

REFERENCES

ADCED. 1979. Cordova fish trials. 5 pp.

ADF&G. 1982. Commercial finfish regulations. 181 pp.

________. 1984a. Summary and description of the program and component projects included in the Commercial Fisheries Division FY84 operational budget request. 637 pp.

________. 1984b. Commercial shellfish regulations. Div. Commer. Fish. Juneau. 115 pp.

________. 1984c. Central Region groundfish report to the Alaska Board of Fisheries. Div. of Commer. Fish., Homer. 8 pp.

________. 1983. Commercial Fisheries Catch Reporting System. Computer printouts.

Alaska Fisheries Development Foundation, Inc. 1981. Exploratory fishing for rockfish in Southcentral Alaska using jigging machines. Anchorage, AK.

Alton, M.S., and R.B. Deriso. 1982. Pollock. Pages 1-63 in J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept., USDC: NWAFC, NMFS, NOAA, Seattle, WA. 198 pp.

Balsiger, J.W. 1982. Sablefish. Pages 64-87 in J.W. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept. NWAFC, NMFS, NOAA, 2725. Seattle, WA. 198 pp.

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska - Bering Sea groundfish investigations. Commercial Fisheries Research and Development Act. Proj. No. 5-49-R-1. ADF&G. Prepared for NMFS, NOAA, Washington, DC. 85 pp.

Bracken, B.E. 1982. Sablefish (Anoplopoma fimbria) migration in the Gulf of Alaska based on gulf-wide tag recoveries, 1973-1981. ADF&G Informational Leaflet No. 199. 24 pp.

________. 1983. The history of the U.S. sablefish fishery in the Gulf of Alaska, 1906-1982. Page 4 in International sablefish symposium abstract book, the second Lowell Wakefield fisheries symposium. 29-31 March 1983, Anchorage, AK. 37 pp.

Frank Orth and Associates, Inc. 1980. Alaska commercial fisheries directory. Prepared for ADCED, Off. Commer. Fish. Devel., Anchorage, AK. 100 pp.

French, R., R. Nelson, Jr., J. Wall, J. Berger, and B. Gibbs. 1981. Summaries of provisional foreign groundfish catches (metric tons) in the northeast Pacific Ocean and Bering Sea, 1980. USDC: NOAA, NMFS, NWAFC, Seattle, WA. 188 pp.

Heizer, S.R. 1967. Age and growth of the sablefish Anoplopoma fimbria (Pallas) in Alaskan waters. M.S. Thesis, Univ. Alaska, Fairbanks. 56 pp.

Hughes, S. 1980. NMFS experience with longline and pot fishing. Pages 5-10 in C. Henry, ed. Black cod: boom or bust? Proceedings of a seminar, 27 February 1980, Seattle, Wash. Washington Sea Grant Publication No. WSG-WO 81:1.

Ito, D.H. 1982. A cohort analysis of Pacific ocean perch stocks from the Gulf of Alaska and Bering Sea regions. USDC: NOAA, NMFS, NWAFC, Processed Rept. 82-15. 157 pp.

Jewett, S.C. 1977. Alaska's latent fishery - Pacific cod. Alaska Seas and Coasts 5(1):6-8.

Low, L.L., G.K. Tanonaka, and H.H. Shippen. 1976. Sablefish of the northeastern Pacific Ocean and Bering Sea. Processed rept. USDC: NOAA, NMFS. 115 pp.

Major, R.L., and H.H. Shippen. 1970. Synopsis of biological data on Pacific ocean perch, Sebastes alutus. USDC: NOAA, NMFS. Circular 347. 38 pp. Also FAO Fisheries Synopsis No. 79.

Morris, B.F., M.S. Alton, and H.W. Braham. In press. Living marine resources of the Gulf of Alaska: a resource assessment of the Gulf of Alaska/Cook Inlet proposed oil and gas lease Sale 88. NMFS tech. memo. 232 pp.

Morrison, R. 1982. Groundfish investigations in the Cook Inlet, Prince William Sound portions of Region II. Prepared for NMFS, Seattle, WA. Draft copy. 47 pp.

________. 1983. Incidental bottomfish in Lower Cook Inlet trawl shrimp fishery. ADF&G Lower Cook Inlet Data Rept. No. 83-3. 23 pp.

________. 1984. Central Region groundfish report to the Alaska Board of Fisheries, February 1984. ADF&G, Div. Commer. Fish. 8 pp.

________. 1984. Personal communication. Central Region Groundfish Biologist, ADF&G, Div. Commer. Fish., Homer.

Murai, S., H.A. Gangmark, and R.R. French. 1981. All-nation removals of groundfish, herring and shrimp from the eastern Bering Sea and Northeast Pacific Ocean, 1964-1980. USDC: NOAA. NOAA Technical Memo. NMFS F/NWC-14. 40 pp.

Natural Resources Consultants. 1981. The Pacific cod (Gadus macroencephalus) opportunities for the 1980's. Report prepared for the Economic Development Council of Puget Sound. Feb. 1981. 44 pp.

________. 1982. Fisheries of Alaska. 1981. Prepared for Alaska Fisheries Development Foundation. Anchorage, AK. 46 pp.

Nelson, R., Jr., R. French, J. Wall, and J. Berger. 1980. Summaries of provisional 1979 foreign groundfish catches in the northeast Pacific Ocean and Bering Sea. USDC: NOAA, NMFS, NWAFC, Seattle, WA. 188 pp.

Nelson, R., Jr., J. Wall, J. Berger, and B. Gibbs. 1982. Summaries of provisional foreign and joint-venture groundfish catches (metric tons) in the northeast Pacific Ocean and Bering Sea, 1981. USDC: NOAA, NMFS, NWAFC, Seattle, WA. 183 pp.

________. 1983. Summaries of provisional foreign and joint-venture groundfish catches (metric tons) in the northeast Pacific Ocean and Bering Sea, 1982. USDC: NOAA, NMFS, NWAFC, Seattle, WA. 167 pp.

NPFMC. 1978. Fishery management plan for the Gulf of Alaska groundfish fishery during 1978. Final. 220 pp.

_______. 1983a. Summary of Gulf of Alaska Groundfish Fishery Management Plan (through amendment 12). Revised 3 May 1983. 21 pp.

_______. 1983b. Newsletter #7-83. 12 pp.

_______. 1984. Summary of Gulf of Alaska Groundfish Management Plan (through Amendment 12). Revised 1/16/84. 21 pp.

OCS Socioeconomic Studies Program. 1980. Northern and western Gulf of Alaska petroleum development scenarios: commercial fishing industry analysis. Tech. Rept. No. 30, Appendix A. Feb. 1980. Prepared for BLM, Alaska OCS Office. 164 pp.

Povolny, J. 1983. Management strategies for the sablefish fishery off the coast of Alaska. Page 3 in International sablefish symposium abstract book, the second Lowell Wakefield fisheries symposium, 29-31 March 1983. Anchorage, AK. 37 pp.

Rigby, P. 1984. Alaska domestic groundfish fishery for the years 1970 through 1980 with a review of two historic fisheries - Pacific cod (*Gadus macrocephalus*) and sablefish (*Anoplopoma fimbria*). ADF&G Tech. Rept. No. 108. 446 pp.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1976. An assessment of the demersal fish and invertebrate resources of the northeastern Gulf of Alaska, Yakutat Bay to Cape Cleare May-August 1975. NEGOA ann. rept. NMFS, NWAFC. Processed rept. Seattle, WA. 184 pp.

Rosenthal, R.J., L.J. Field, and O.O. Myer. 1981. Survey of nearshore bottomfish in the outside waters of Southeastern Alaska. Prepared for ADF&G, Div. Commer. Fish. March 1981. 85 pp. + appendices.

Rosenthal, R.J., L. Haldorson, L.J. Field, V.M. O'Connel, M.G. LaRiviere, J. Underwood, and M.C. Murphy. 1982. Inshore and shallow offshore bottomfish resources in the Southeastern Gulf of Alaska. Prepared for ADF&G, Div. Commer. Fish. December 1982. 166 pp.

Shippen, H., and J.W. Stark. 1982. Pacific ocean perch. Pages 147-171 in J. Balsiger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept. 198 pp. NWAFC, NOAA. Seattle, WA.

Smith, G.B., and R.S. Hadley. 1979. A summary of productive foreign fishing locations in the Alaska region during 1977-78: trawl fisheries. Alaska Sea Grant Rept. 79-7. 287 pp. + maps.

Smith, G.B., R.S. Hadley, R. French, R. Nelson, Jr., and J. Wall. 1980. A summary of productive foreign fishing locations in the Alaska region during 1977-79: longline fisheries. Alaska Sea Grant Rept. 80-1.

USDC. 1982. Current fishery statistics No. 8200. Fisheries of the U.S., 1981. USDC: NOAA, NMFS, Seattle, WA. April 1982. 131 pp.

Westpestad, V.G. 1981. Movement of sablefish (*Anoplopoma fimbria*) in the northeastern Pacific Ocean as determined by tagging experiments (1971-1980). Unpubl. M.S. NMFS, NWAFC, Seattle, WA. 18 pp. Cited in Balsiger 1982.

Zenger, H.H., and N.J. Cummings. 1982. Pacific cod. Pages 88-110 *in* J. Balsinger, ed. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpubl. rept. USDC: NWAFC, NMFS, NOAA. 198 pp.

Commercial Harvest of Pacific Halibut

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The Pacific halibut fishery in the Gulf of Alaska is monitored by the International Pacific Halibut Commission (IPHC). The IPHC has divided the northeast Pacific Ocean and Bering Sea into several regulatory areas (map 1). The Southcentral Region covered in this guide is included in IPHC Regulatory Area 3A. The IPHC has also divided the Gulf of Alaska into a series of several statistical areas, each approximately 60 mi wide. In the Southcentral Region, many of these statistical areas are further subdivided into subareas (map 2). In this account, annual catch totals are reported by statistical area (table 1), but regulation and management is discussed for Area 3A as a whole.

B. Summary of Regional Fishery

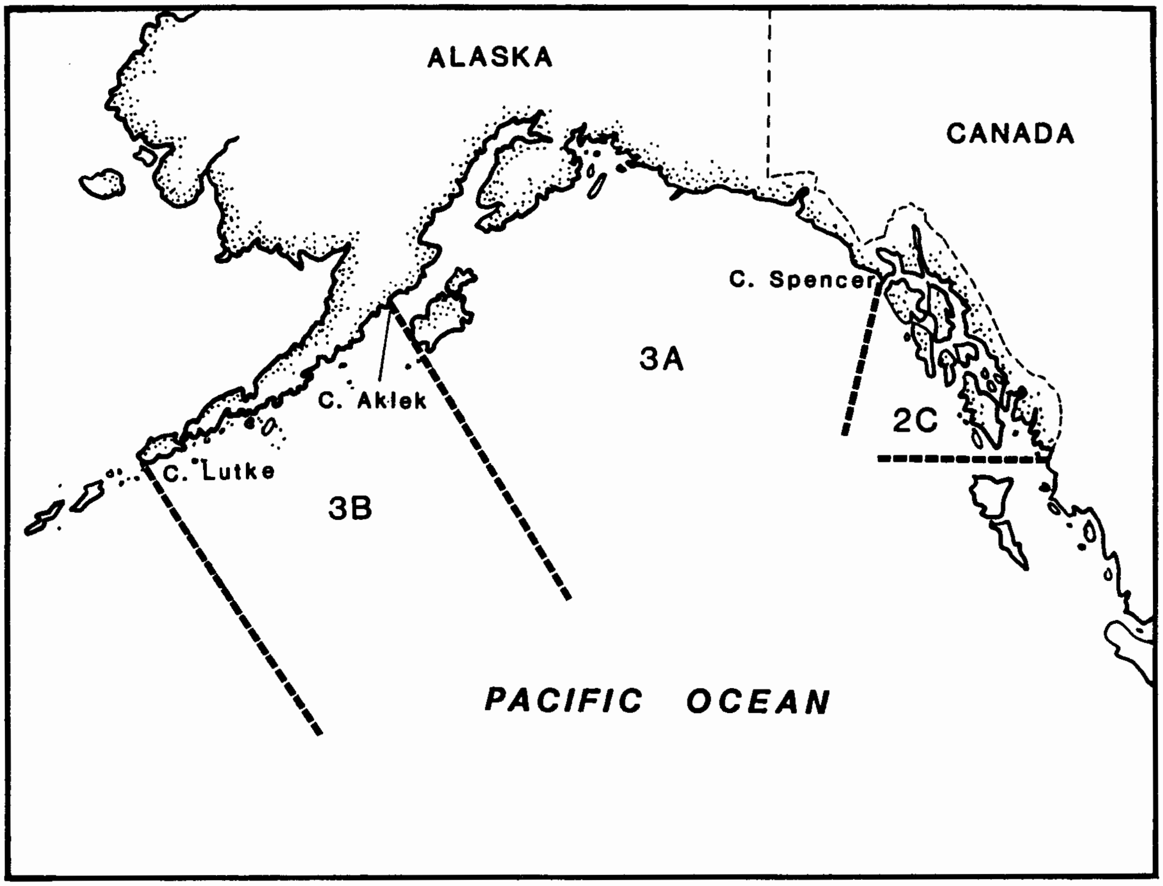
1. Harvest summary. The deep sea halibut fishery in the Gulf of Alaska began in 1923. The catch of halibut in the North Pacific declined from then until 1931, when the catch was only 20,000 metric tons (Natural Resources Consultants 1982). Conservation measures led to a rebuilding of stocks to a record catch of 34,000 metric tons in 1962 (ibid.). As the resource improved, small vessels, particularly salmon trollers and gillnetters, joined the halibut fleet, which had previously been made up mostly of 50 to 80 ft halibut schooners (IPHC 1978).

   Halibut stocks once again declined in the 1960's, probably as a result of large incidental catches in the foreign trawl fisheries. Regulations intended to reduce the incidental catch of halibut have apparently stopped the downward trend in halibut abundance, but catches in the North Pacific until recently have remained relatively small (10,400 to 11,800 metric tons during 1979-1981) (Natural Resources Consultants 1982). Incidental catch, though reduced, is still high.

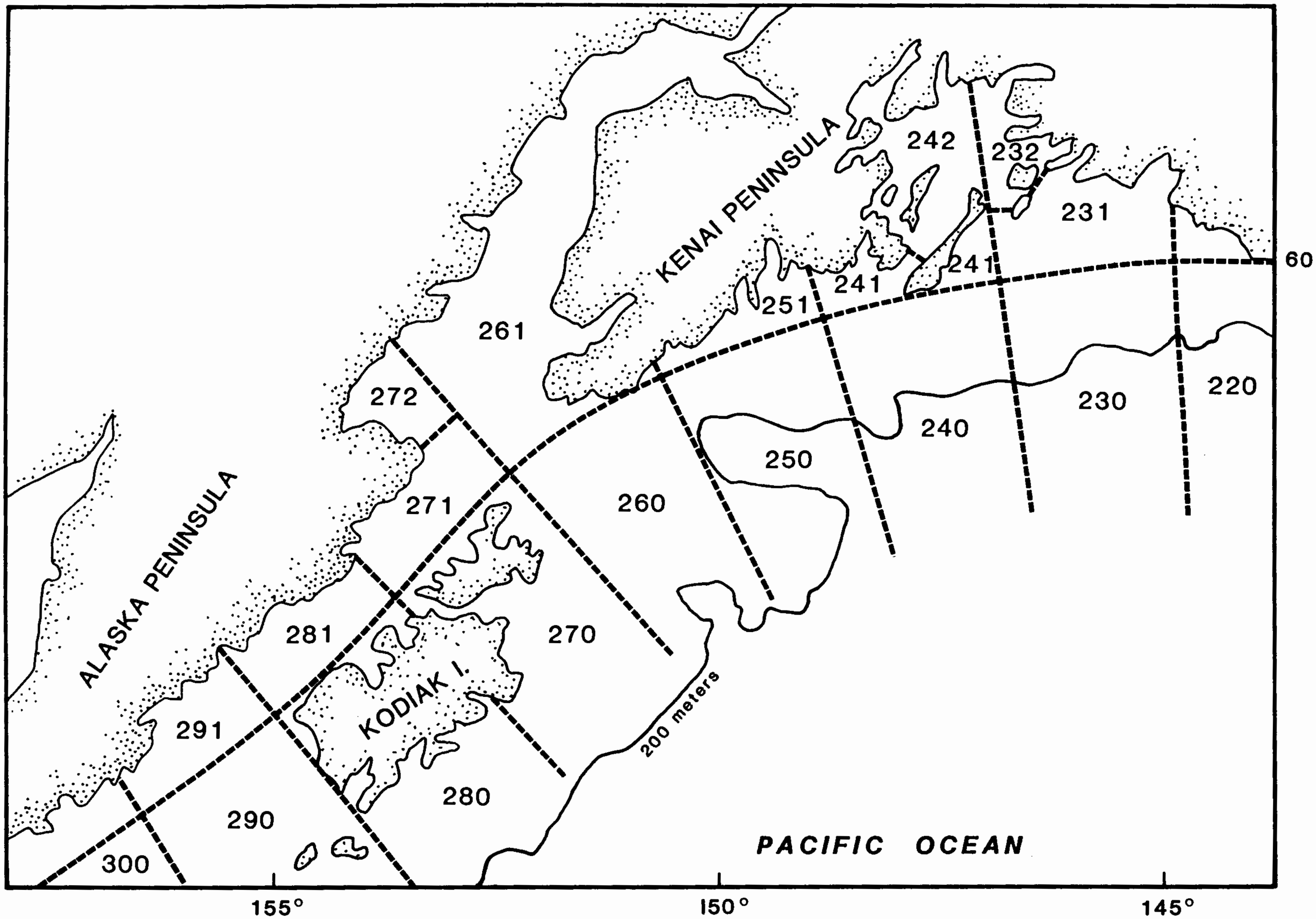
2. Harvest methods. Commercial fishing for halibut is restricted to hook and line gear. Most halibut are taken with longline gear.

3. Period of use. The halibut fishery in the Gulf of Alaska takes place in the summer months. In the 1960's, the commercial season was about six months long but has become shorter and shorter. The fishing season in 1984 in Area 3A (Cape Spencer to Cape Trinity) was open for only four days in May and one day in August.

4. Significance of particular use areas. In past years, when open seasons for halibut were longer, it was possible to delineate small areas of concentrated fishing effort in the northern Gulf of Alaska. At today's intensive level of



Map 1. Regulatory areas for the Pacific halibut fishery in the Northern Gulf of Alaska (redrawn from IPHC 1983).



Map 2. IPHC statistical areas (IPHC unpublished 1983).

Table 1. Pacific Halibut Commercial Catch from the Southcentral Area in Metric Tons Dressed Weight[a] (Statistical Areas Are Illustrated in Map 2)[b]

	Year									
Stat. Area	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
22	182	178	265	337	167	337	352	418	416	310
230	124	93	266	194	115	110	167	488	505	263
231	100	44	99	118	78	35	92	55	90	22
232	54	3	Tr	1	2	3	8	23	27	34
23 total	460	318	630	313	194	148	267	567	622	319
240	239	165	306	280	249	315	472	461	473	396
241	31	20	46	61	67	61	150	123	104	112
242	33	24	12	41	19	8	19	21	39	54
24 total	303	209	364	381	335	384	641	605	616	562
250	1,374	709	934	753	662	796	851	862	1,263	1,305
251	52	52	59	35	27	20	111	125	168	196
25 total	1,426	761	993	788	689	816	962	987	1,431	1,500
260	682	451	556	528	556	744	361	334	560	476
261	302	298	248	293	329	309	460	368	588	530
26 total	984	749	804	822	885	1,053	821	702	1,148	1,005
270	750	322	277	401	299	359	213	202	493	734
271	241	100	177	148	75	30	16	17	51	29
272	15	0	6	17	26	46	14	0	18	0
27 total[c]	1,006	422	460	566	402	436	244	218	562	764
Grand total	4,179	2,459	3,251	3,207	2,672	3,174	3,287	3,497	4,795	4,460

Sources: Myhre et al. 1977, IPHC annual reports 1978-82, and computer printouts from IPHC.

a Dressed weight can be converted to round weight by multiplying by 1.33 (Myhre et al. 1977).

b Values for total area (two-digit number) catches have been more extensively edited and revised by the IPHC than subarea (three-digit number) catches. Thus, in some cases, catch by subareas may not exactly correspond to, and are not as accurate as, the respective total area catch.

c Most of Area 27 is outside the Southcentral Region covered in this guide (map 2), but it is included in this table because Area 272 and a small part of 271 fall within the Southcentral Regional boundaries.

Tr: trace - less than 0.5 metric tons.

fishing effort, however, almost the entire Southcentral Region is being used (Best, pers. comm.).

Pacific halibut are fished commercially in all areas of Cook Inlet south of Kalgin Island. A major part of the halibut catch in Cook Inlet occurs in the area south of Ninilchik to Augustine Island in waters ranging from 18 to 64 m (Governor's Agency Advisory Committee on Leasing 1981). No large halibut vessels fish in Cook Inlet itself, and none of the large halibut boats that fish in the Gulf of Alaska are based in Cook Inlet ports. Ninilchik, Homer, and Soldotna are the main halibut landing ports for the small boats that fish in lower Cook Inlet (BLM 1976).

In Prince William Sound, a major halibut fishing ground is located off Hinchenbrook Island, and another south of Montague Island (OCS Socioeconomic Studies Program 1980).

The largest halibut catches in the Southcentral Region are reported from IPHC Statistical Area 250 (map 2), which includes Portlock Bank, and from other statistical areas that contain the 200 m shelf break (Areas 230, 240, 260, and 270). Major halibut commercial fishing areas are depicted on a 1:1,000,000-scale groundfish harvest area map and may be found in the reference map series that supplements this text.

C. Managerial Authority

The International Pacific Halibut Commission, originally called the International Fisheries Commission, was established in 1923 by a convention between Canada and the United States (IPHC 1978). In 1953, the United States and Canada signed the present Convention for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and the Bering Sea. In 1979, the convention was amended to make it consistent with the purposes, policy, and provisions of the 1977 Magnuson Fishery Conservation and Management Act. The Northern Pacific Halibut Act of 1982 was subsequently enacted to give effect to the 1979 protocol (Miller and Larson 1984). This act grants the Fishery Management Council authority to develop regulations applicable to that portion of the North Pacific halibut fishery conducted in United States waters. These regulations may include access limitation regulations but must not conflict with IPHC regulations (ibid.).

The IPHC has jurisdiction over the Canadian and United States halibut fisheries (both sport and commercial) but has no jurisdiction over foreign fisheries and cannot regulate domestic or foreign trawl fisheries to reduce incidental catch of halibut (Skud 1976, IPHC 1978). The halibut commission does have the authority to monitor catch and effort, establish open and closed seasons, limit the size and quantity of fish taken, regulate the retention of incidental catch of halibut in other fisheries, restrict gear type, and close halibut nursery areas to halibut fishing (IPHC 1978).

Prior to 1977, restrictions on foreign fishing for halibut were achieved through separate agreements between the United States and the foreign nations involved. Since the passage in 1977 of the Magnuson Fishery Conservation and Management Act, halibut has been an unallocated species that must be avoided by United States and foreign groundfish fleets within the 200-mi fishery conservation zone (NPFMC 1983a). The North Pacific Fishery Management Council (NPFMC) has included in their Gulf of Alaska Groundfish Management Plan time-area closures designed to minimize the incidental catch of halibut and to allow halibut grounds to remain undisturbed for a short time before the beginning of the halibut season (ibid.). Foreign groundfish trawling is also restricted to pelagic trawls during late winter and early spring by the NPFMC to minimize the incidental catch of halibut.

The minimum size of commercially caught halibut is 32 inches (with head on), and halibut can be taken only with hook and line gear.

1. Management objectives. The IPHC's management goal is to maintain the stocks of halibut at levels producing the maximum sustainable yield (IPHC 1978). Until recently, however, stock abundance has been low, and the commission's efforts have been directed toward rebuilding the resource (Skud 1976).

   The NPFMC's objectives for halibut management (NPFMC 1983b) are to

   - ensure survival of the north Pacific halibut resource;
   - distribute the halibut fishery in time and place to ensure the harvest of the available surplus of all components of the halibut population over all areas of the North Pacific Ocean, including the Bering Sea;
   - continue to limit the harvesting of halibut to hook and line as the best means of utilizing and maintaining the resource at its highest sustained level of abundance;
   - retain the IPHC as the primary managerial authority over the coastwide range of the halibut population;
   - provide high quality fresh, frozen, or preserved halibut to the consumer throughout the year;
   - and strive to reduce incidental halibut mortality caused by gear that is not legal for a directed halibut fishery.

2. Management considerations. A significant consideration in halibut management is the large incidental catch of halibut taken in fisheries directed for other species. The IPHC reported that incidental catches increased by nearly 50% between 1978 and 1980 (IPHC 1981). In 1980, the estimated total incidental catch in the North Pacific was 20.4 million pounds (9.3 thousand metric tons), compared to the commercial catch of 21.8 million pounds (9.9 thousand metric tons) (ibid.). Incidental catches in 1981 and 1982, however, dropped to 16.8 million pounds (7.6 thousand metric tons), and 13.7 million pounds (6.2 thousand metric tons) respectively (Peltonen 1984). Because regulations require that incidental catches be released, the actual loss to the

population is not as great as the catch indicates (ibid.); however, the IPHC estimates that 35% of prerecruit halibut are lost to incidental catch (McCaugharan 1981). The IPHC is particularly concerned with the growth of domestic and joint-venture fisheries for flounder, which are currently centered in the Kodiak area. Observers have reported that nearly 5% of the catch in this fishery was halibut (Peltonen 1984). Continued growth of the Gulf of Alaska flounder fishery could result in a major increase in the incidental halibut catch (ibid.)

Another important consideration for halibut management is the increasing number of boats participating in the fishery. Since the 1970's, more and more small boats have joined the halibut fleet. The size of the Alaska fleet increased 36% from 1977 to 1981 (Anonymous 1983a). A majority of the newly participating vessels has come from the salmon fleet, which is now under a limited entry program (Natural Resources Consultants 1982). As a result of the growth in the fleet, fishing pressure on halibut stocks has increased, and quotas of halibut are caught in increasingly short periods of time (Anonymous 1983a, McCaugharan 1983). In March 1983, the NPFMC approved a plan for a three-year moratorium on the halibut fishery that would have limited the United States halibut fleet to only those fishermen who made legal halibut landings during any season from 1978 to 1982 (Anonymous 1983b). The plan, however, was not approved by the federal Office of Management and Budget and so was dropped for the 1983 season (Anonymous 1983c). In December 1983, the NPFMC voted to discontinue efforts to impose a moratorium. The NPFMC will, however, pursue consideration of other management alternatives for the fishery (NPFMC 1983b).

II. ECONOMIC VALUE OF HALIBUT

Information concerning the value of halibut in the Southcentral Region is contained in the Economic Overviews of Fish and Wildlife volume of this series.

REFERENCES

Anonymous. 1983a. Halibut. Pacific Fishing, 1983 Yearbook:110-113.

________. 1983b. Council adopts "dual" halibut moratorium. Pacific Fishing 4(7):16.

________. 1983c. Bureaucrats bury halibut moratorium for 1983 season. Pacific Fishing 4(9):12.

Best, E.A. 1984. Personal communication. Senior Biologist, IPHC, Seattle, WA.

BLM. 1976. Final environmental statement. Proposed 1976 outer continental shelf oil and gas lease sale. Lower Cook Inlet. Oil and gas lease Sale No. C1. Vol. 1. Alaska OCS office. 562 pp.

Governor's Agency Advisory Committee on Leasing. 1981. A social economic and environmental analysis of a proposed oil and gas lease sale in Lower Cook Inlet. State of Alaska. 149 pp. + appendices.

IPHC. 1978. The Pacific halibut: biology, fishery, and management. IPHC Tech. Rept. No. 16 (revision of No. 6). 57 pp.

________. 1982. Annual report. 1981. Seattle, WA. 48 pp.

________. 1983. Pacific halibut fishery regulations. 8 pp.

________. 1984. Commercial halibut regulations for 1984. Informational Bull. No. 29. 2 pp.

McCaughran, D. 1981. The effect of trawling on halibut stocks in the Bering Sea and Gulf of Alaska. Pages 52-61 in M.A. Miller, ed. First Alaska groundfish trawler conference, October 22-23. NOAA Western Regional Center. Seattle, WA.

Miller, R.W., and D. Larson. 1984. Environmental assessment of possible regulation promoting a developmental halibut fishery in the Bering Sea. NPFMC. 12 pp.

Myhre, R.J., G.J. Peltonen, G. St.-Pierre, B.E. Skud, and R.E. Walden. 1977. The Pacific halibut fishery: catch, effort, and CPUE, 1929-1975. Supplement to IPHC Tech. Rept. No. 14.

Natural Resources Consultants. 1982. Fisheries of Alaska 1981. Prepared for Alaska Fisheries Development Foundation. Anchorage, AK. 46 pp.

NPFMC. 1983a. Summary of Gulf of Alaska Groundfish Fishery Management Plan (through Amendment 12). Revised 3 May 1983. 21 pp.

________. 1983b. Newsletter No. 7-83. 15 Dec. 1983. 12 pp.

OCS Socioeconomic Studies Program. 1980. Northern and western Gulf of Alaska petroleum development scenarios. Commercial fishing industry analysis. Tech. Rept. No. 30. Prepared for BLM, Alaska OCS office. 517 pp.

Peltonen, G.J. 1984. Review of the 1983 halibut fishery. Pages 3-10 in IPHC 1984 annual meeting documents. 42 pp.

Skud, B.E. 1976. Jurisdictional and administrative limitations affecting management of the halibut fishery. IPHC Sci. Rept. No. 59. 24 pp.

Commercial Harvest of Pacific Herring

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The Southcentral Region includes the Upper Cook Inlet (UCI), Lower Cook Inlet (LCI), and Prince William Sound (PWS) commercial fisheries management areas. Included in these areas are all waters west of the longitude of Cape Suckling to Cape Douglas and north of the latitude of Cape Douglas. The narratives that follow in II. through IV. are separated into discussions of the three fisheries management areas.

B. Summary of the Regional Fishery

1. Harvest summary. Exploitation of herring in the Southcentral Region began in the early 1900's. Initially, herring were salt-cured as a food product and were also sold for halibut bait. Emphasis, however, changed by the 1930's to reduction fisheries, with fertilizer and oil as final products. Reduction plants closed by the 1960's. Though food/bait fisheries continued at lower levels of effort, the Japanese interest in herring roe products resulted in development of fisheries for sac roe by the early 1970's. The Southcentral Region supports fisheries for food bait, sac roe, and one of three spawn-on-seaweed fisheries in Alaska.

   During the past 10 years, herring catches for the entire Southcentral Region have ranged from 1,840.5 metric tons taken in 1978 to 14,085.6 metric tons harvested during the 1981 season. PWS accounts for about 82% of the region's harvest. Management problems, stock status, and development of these herring fisheries are unique to each management area.

2. Managerial authority. Pacific herring in the Southcentral Region are managed by the Alaska Department of Fish and Game.

3. Gear types. Legal gear for harvesting herring is dependent on the season and management area. Generally speaking, purse seines, gill nets, and trawls may be used to harvest herring in the Southcentral Region. Herring eggs (i.e., spawn-on-seaweed) may be hand picked or harvested by a hand-held utensil.

4. Period of use. Seasons for herring in the Southcentral Area are dependent on the management area and the product desired. Herring in spawning condition, which move into bays and estuaries to spawn during spring months, are harvested in the sac roe fishery. Though unripe herring may be processed as food or bait during the sac roe season, the food/bait fishery generally targets on herring in nonspawning condition during the fall and winter months. Spawn-on-seaweed harvest occurs during the spring months, following the sac roe fishery.

II. UPPER COOK INLET (UCI) MANAGEMENT AREA

A. Boundaries

UCI consists of all waters of the Gulf of Alaska north of the latitude of Anchor Point (ADF&G 1984a). UCI is divided into the Central and Northern districts, which will serve as the basis for presenting data in this summary (map 1).

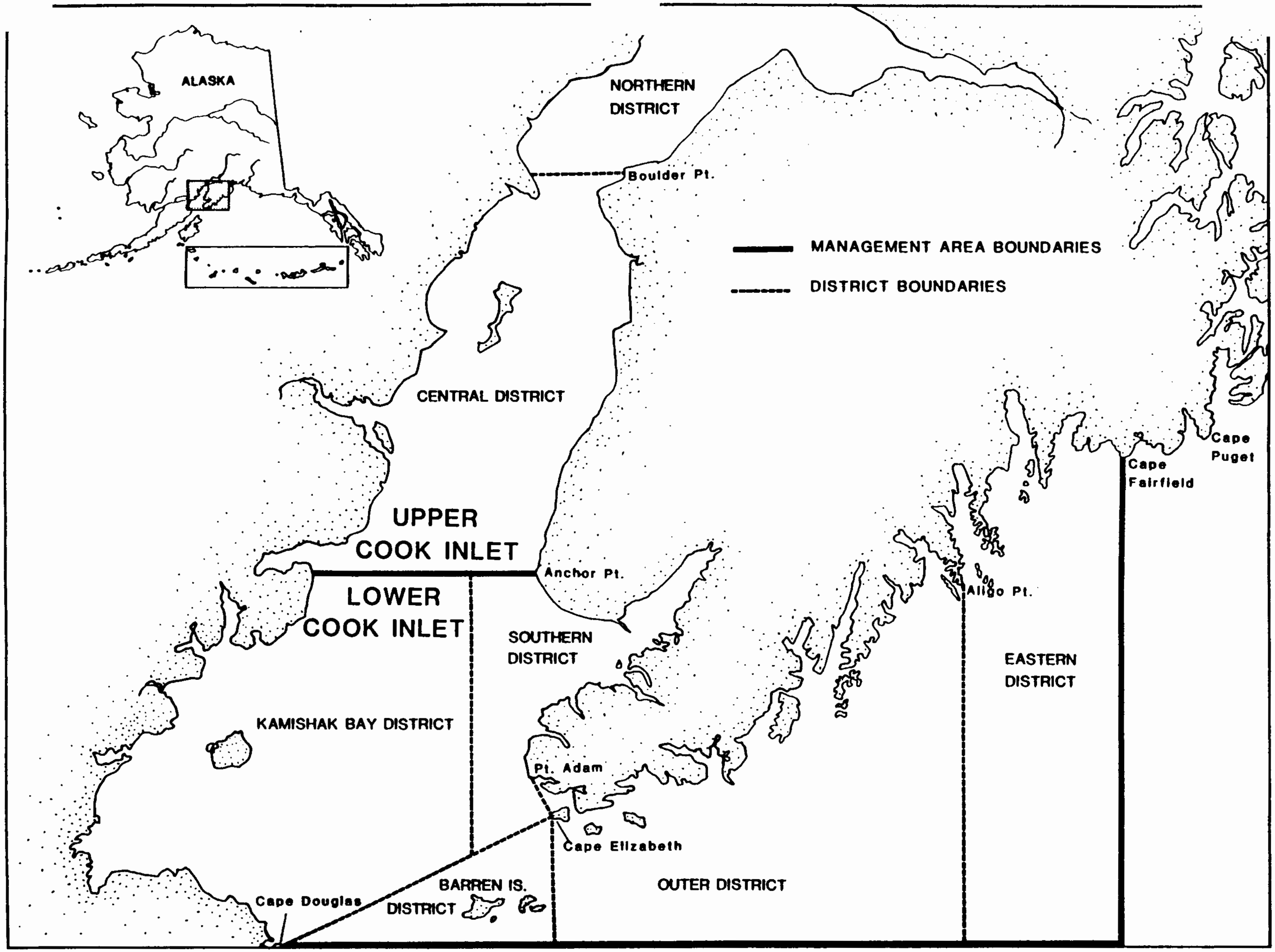
B. Fishery Description and Reported Harvest

1. Harvest summary. The commercial fishery in UCI is of recent development, beginning in 1973 as a set gill net fishery on the east-side beaches. Though a minor harvest occurs in the Northern District, the Central District has accounted for about 99% of the harvest since the inception of the fishery. Currently, three primary fisheries are managed within the UCI area and are located in Tuxedni Bay, Chinitna Bay, and on the east-side beaches (see map 1). Areawide, catches have ranged between the 5.2 metric tons of the 1976 season to the 396.9 metric tons of the 1983 season. The fishery has produced an average harvest of 109 metric tons annually (table 1). Three fisheries are summarized below:

   a. Chinitna Bay fishery. In 1978, the UCI herring harvest increased four times the previous year's catch, with development of the sac roe fishery in Chinitna Bay (ADF&G 1978). Most of the 1978 harvest in this area was taken by drift net and comprised 87% of the total UCI catch. With good harvest levels in 1978 and 1979, a downward shift in age composition of the commercial catch indicated potential overharvest. Therefore, a 35 ton (70,000 lb) guideline harvest level was established for Chinitna Bay (ADF&G 1982). In response to the quota, the catch in 1980 decreased from a high of 188,000 lb taken in 1979 by 103 permit holders to 40,012 lb by 12 permit holders. Subsequent harvest fluctuation has resulted from imposition of the quota. Since 1978, the fishery has averaged 98,800 lb (Middleton and Rowell 1984).

   b. Tuxedni Bay fishery. Exploitation of herring began in Tuxedni Bay in 1979. Beginning as a set net fishery for sac roe, drift gill nets dominated the fishery in 1980 and 1981. Most of the harvest was taken by set net in 1982. Catches at Tuxedni Bay have increased steadily over four years, showing a maximum harvest in 1982 of 184,000 lb and averaging 142,500 lb annually (ibid.).

   c. East-side fishery. Harvest on east-side beaches is primarily by set gill nets. The herring are usually of low roe content and marketed for bait (ADF&G 1982). The fishery has been irregular, averaging 68,000 lb annually. A record harvest of 172,408 lb was landed by 39 permit holders in 1981. Although fishing activity usually extends from Ninilchik in the Central District to beaches along the East Forelands in the Northern



Map 1. Herring commercial fishing districts of the Upper and Lower Cook Inlet Management areas (ADF&G 1984a).

Table 1. Commercial Harvest of Herring in Metric Tons in the UCI Management Area, 1974-83

	Fishing Season									
District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	0.5	0	0	0.2	0	0.3	0	0	0	0
Central	32.5	5.6	5.2	15.2	54.7	171.4	127.4	197.8	180.0	396.9
Management area total	33.0	5.6	5.2	15.4	54.7	171.7	127.4	197.8	180.0	396.9

Source: Middleton and Rowell 1984.

District, most effort and harvest on the east side occurs on Central District beaches (Middleton and Rowell 1984).

2. Harvest methods. Since 1979, only gill nets have been used in the UCI area. Only set gill nets are legal in Chinitna Bay (ADF&G 1984a).
3. Period of use. Unlike the LCI purse seine fishery, the gill net fishery in UCI is not limited to entry. The fishery opens by regulation in both the Northern and Central districts April 15 and closes June 30 (ADF&G 1984a).

C. Management Objectives and Considerations

Essentially, management occurs by evaluation of past years' harvest levels, available for five to seven years. Because herring are not fully recruited to the gear until age five, the relative strength of upcoming year classes cannot be evaluated for application to the appropriate management strategy. The quota imposed on Chinitna Bay occurred as the result of a perceived shift in age composition of harvested herring, utilizing only two years of data. Although overexploitation can certainly cause a shift to younger age classes, many other reasons, such as variable year-class strength, might account for these shifts (Ruesch 1982). The database for UCI herring is practically nonexistent. Harvest records are unreliable, as much of the herring caught is sold to crab and halibut fishermen and to tackle shops without the appropriate fish ticket. Catch sampling has often been insufficient to provide a statistically valid profile of the harvest. Glacial waters of Cook Inlet prevent any estimate of biomass or spawning success. There is no documentation of spawning areas anywhere in UCI, and the integrity of the stocks is only conjectural (ibid.).

D. Significance of Particular Use Areas

Most harvest of herring in UCI occurs in Tuxedni Bay, Chinitna Bay, and along beaches on the east side of the inlet.

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- ° Commercial herring harvest areas
- ° Potential herring harvest areas

E. Economic Value

Information concerning the value of herring within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. LOWER COOK INLET (LCI) MANAGEMENT AREA

A. Boundaries

The LCI Management Area is comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point. The area is divided in terms of fisheries management into the Southern, Kamishak, Barren Islands, Outer, and Eastern districts (map 1).

B. Fishing Description and Reported Harvest

1. Harvest summary. Herring were first exploited commercially in the LCI area in 1914. The fishery was centered in the Halibut Cove area of Kachemak Bay. Gill nets were the primary gear used until purse seines were introduced in 1923. Most of the catch was pickled and salted for human consumption. A small percentage of the harvest was marketed as bait.

   Between 1914 and 1928, the Kachemak Bay fishery averaged 5.8 million pounds. A record harvest occurred in 1925 at 19.3 million pounds, providing about 29% of the statewide harvest. Harvest levels decreased shortly thereafter because of apparent stock depletion (Rounsefell 1930).

   With continued interest in herring for the manufacture of oil and fertilizer, and with the depletion of herring populations in other Alaskan fisheries, exploitation of herring began a second phase in the LCI area. In 1937, a purse seine fishery developed in the Resurrection Bay-Day Harbor area. The fishery was sporadic and ended in 1959. Catches averaged 8.4 million pounds for the years when fishing occurred.

   Activity between 1960 and 1968 in LCI was discontinuous. Fishing occurred in the Southern and Eastern districts and averaged about 3,900 lb annually. In 1969, the fishery began to expand in response to the developing Japanese market for sac roe (ADF&G 1974). Effort first concentrated in the Eastern and Southern districts, peaking in 1970, with respective harvests of 5.4 million pounds and 4.2 million pounds. Apparent stock depletion in these two districts resulted in a shift of effort to the Kamishak District, where peak harvest occurred in 1976, with catches declining steadily since (table 2). The LCI herring fishery has been closed since 1980 because of low herring abundance (Middleton and Rowell 1984).

   The LCI purse seine fishery for sac roe is limited to entry. By 1982, 69 permits for herring, mostly held by local residents, had been issued (CFEC 1983).

2. Harvest methods. During the food/bait season (1 July-28 February), herring may be taken by seines, gill nets, and trawls. From April 15 to June 30 during the sac roe season, herring may be harvested only by purse seine (ADF&G 1984a).

3. Period of use. Herring may be taken in all districts of LCI from 1 July through February 28. Fishing during this time is to be for herring as bait. The sac roe fishery, which is the primary herring fishery, occurs from April 15 through June 30 (ADF&G 1984a).

C. Management Objectives and Considerations

Through the 1984 season, periodic aerial surveying of the fishing districts was the only method used to assess in-season stock abundance. The management strategy dictated fishery openings only when observed tonnages were similar to past historic catch levels

Table 2. Commercial Harvest of Herring in Metric Tons in the LCI Management Area, 1974-83

	Fishing Season									
District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Southern	98.7	2.0	0	261.9	14.9	11.8	0[a]	0[a]	0[a]	0[a]
Kamishak	1,902.3	3,706.7	4,358.0	2,616.8	361.7	373.6	0[a]	0[a]	0[a]	0[a]
Eastern	42.4	0	0	0	0	0	0[a]	0[a]	0[a]	0[a]
Outer	345.6	0	0	0	0	0	0[a]	0[a]	0[a]	0[a]
Barren Islands	0	0	0	0	0	0	0[a]	0[a]	0[a]	0[a]
Management area total	2,389.0	3,708.9	4,358.0	2,878.7	376.6	373.5	0[a]	0[a]	0[a]	0[a]

Source: ADF&G 1984b.

a Closed to fishing because of low herring abundance.

and when samples of these fish would indicate the presence of a healthy age composition.

Observations of biomass in any district would have to reach or exceed past historic harvest levels, and samples would have to indicate that the majority of the fish are mature and at least four or five years old. The tonnages by district are as follows:

Kamishak District = 8,000 tons
Southern District = 2,000 tons
Eastern District = 2,000 tons
Outer District = no estimate

After what has appeared to be extensive overfishing in the Kamishak District during the mid 1970's, a very minimal harvest would be allowed, probably only 400 to 500 tons; and if the majority of fish were ages three to four, the fishery would probably be delayed for one or two years to allow for maximum reproduction to occur (ADF&G 1984b).

D. Significance of Particular Use Areas

The sac roe fishery occurs mostly in small bays, where ripe herring move inshore to spawn. Such areas, where historically the fishery has occurred, have been Iniskin Bay in the Kamishak District; Humpy Creek, Mallard Bay, Bear Cove, Aurora Spit, and Tutka Lagoon in the Southern District; and McCarthy Lagoon and Resurrection Bay in the Outer and Eastern districts (ADF&G 1984b).

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

° Commercial herring harvest areas
° Potential herring harvest areas

E. Economic Value

Information concerning the value of herring within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

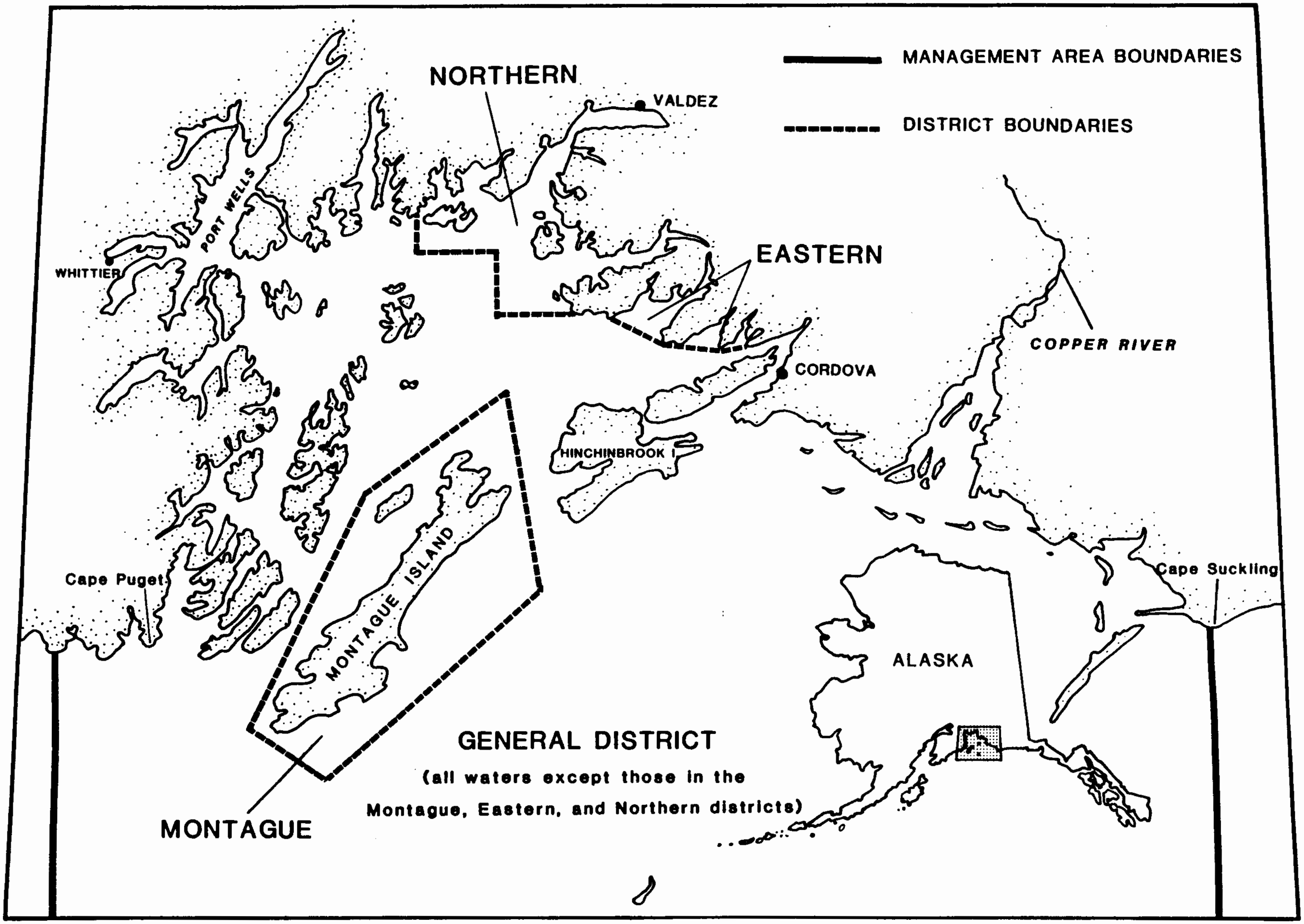
IV. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

A. Boundaries

The PWS Management Area, or Herring Statistical Area E, has as its western boundary a line extending south from Cape Fairfield, as its eastern boundary a line extending south from Cape Suckling, and as its southern boundary 59° north latitude. Statistical Area E is divided into the General, Montague, Northern, and Eastern districts for management of commercial herring fisheries. The Eastern District was created during the 1980 season (map 2) (ADF&G 1984a).

B. Fishery Description and Reported Harvest

1. Harvest summary. Herring in the PWS Management Area were first commercially harvested in 1913 for food and halibut bait. Expansion of the fishery occurred with an increased demand for food products during World War I. Reduction plants were built to use the waste material from the curing process. By the mid 1930's, the herring harvest was



Map 2. Herring commercial fishing districts of the PWS Management Area (ADF&G 1984a).

primarily directed toward the manufacture of such reduction products as fertilizer and oil (Dahlgren and Kollen 1943).

The PWS herring fishery was one of the major fisheries in Alaska. A peak catch of 47,313 metric tons was taken in 1939. The fishery declined through 1943, apparently because of reduced stock abundance. Catches again increased to about 10.8 metric tons in 1956. The reduction facilities closed in PWS after the 1959 season (Pirtle 1974, Dahlgren and Kollen 1943). Through the 1960's, therefore, herring were primarily harvested for a crab-bait market. By the early 1970's, however, increased Japanese interest in sac roe and spawn-on-seaweed products resulted in increased development of these fisheries.

Currently, the PWS area supports four herring fisheries. They include a sac roe fishery, a wild spawn-on-seaweed fishery, a pound herring fishery, and a food/bait fishery. Herring production in the sac roe and food/bait fisheries since 1973 has averaged about 5,998 metric tons annually. In addition, the combined natural and pound spawn-on-seaweed harvest has averaged about 1,558 metric tons annually during the past decade.

The sac roe fishery in PWS is limited to entry. Boats registered in the food/bait fishery cannot fish herring in other areas of the state and vice versa. Vessels fishing in other management areas are excluded from the PWS boat fishery.

Following is a brief summary of each of four types of herring fisheries conducted within PWS:

a. Sac roe fishery. First harvest of herring for sac roe occurred in 1962. About 62 tons were taken to determine the feasibility of a herring roe operation in PWS (Pirtle 1974). Further interest in a sac roe product was not expressed until the 1969 season, when about 350 short tons were taken (Pirtle 1969). A fishery for sac roe did not occur in PWS during 1970. Interest has been continuous since the 1971 season.

   Currently, the sac roe fishery may occur in any of the four herring districts (ADF&G 1983a). Herring in this fishery are intercepted as they migrate through the open fishing areas to the spawning grounds of these districts. Concentration of fishing effort for both the gill net and purse seine fisheries has shifted between areas each year, depending on the abundance and location of herring concentrations. Since 1974, the sac roe harvest has ranged from 1,262 metric tons in 1978 to a peak harvest of 12,703 metric tons in 1981. About 2,570 metric tons were taken in 1983 (table 3). The gill net harvest has been sporadic throughout the history of the fishery, accounting for less than 2% of the commercial sac roe harvest. Effort in the gill net fishery has

Table 3. Commercial Harvest of Herring in Metric Tons and Effort by Product Type and Gear Type for the PWS Management Area, 1974-83

Product Type	Gear Type	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[d]
		Fishing Season									
Sac roe	Purse seine harvest	5,776.1	5,516.1	2,344.2[f]	2,070.7[g]	1,206.0	3,753.8	5,481.4[h]	12,490.3	6,485.0[g]	2,474.8
	Purse seine effort (# vessels)	72	76	66	60	75	89	74	101	104	103
	Gill net harvest	3.48	a	a	b	57.4[b]	a	239.9	212.78	304.35	95.6
	Gill net effort (# vessels)	3	a	a	1	38	a	18	18	20	22
Product total harvest		5,779.6	5,516.1	2,344.2	2,072.1	1,262.0	3,753.8	5,721.3	12,703.0	6,789.4	2,570.4
Product total effort (# vessels)		75	76	66	60	114	89	90	119	124	125
Food/bait[e]	Purse seine harvest	a	a	a	a	147.2[e]	1,156.1[c]	691.0[c]	1,184.8[c]	1,145.2[c]	801.1
	Purse seine effort (# vessels)					5	6[c]	3[c]	6[c]	8[c]	5
	Trawl harvest	a	a	a	a	a	c	c	c	c	0
	Trawl effort (# vessels)	a	a	a	a	a	c	c	c	c	0
Sac roe and food/bait total harvest		5,779.6	5,516.1	2,344.2	2,072.1	1,409.2	4,909.9	6,412.3	13,887.8	7,934.6	3,371.5
Sac roe and foot/bait total effort (# vessels)		75	76	66	60	119	95	93	125	132	130
Herring spawn-on-seaweed											
Wild	Harvest	250.4	415.9	219.9	189.1	63.9	214.6	277.7	55.5	140.4	137.5
	Effort (# persons with permits)	166	437	357	164	66	198	469	214	151	186
Pound	Harvest	a	a	a	a	a	a	1.2	8.8	23.2	25.2
	Effort (# permits for pounds)							2	11.0[i]	18.0[j]	30.0[k]
Herring spawn-on-seaweed total harvest		250.8	415.9	219.9	189.1	63.9	214.6	287.9	64.3	163.6	162.7

Source: ADF&G 1983a.

a No harvest

b Harvest for 1977 and 1978 combined to protect confidentiality.

c Trawl harvest combined with seine harvest to protect confidentiality.

d Preliminary data for 1983.

e Food/bait fishery occurs across calendar years. Therefore, harvest for 1978 corresponds to the 1977-78 fishery, 1979 to the 1978-79 fishery, etc.

f No fishery for sac roe in the Northern District.

g No sac roe fishery in the Montague District.

h Includes 300-350 tons deadloss.

i Though 11 permittees reported production harvest was from only 7 of 18 pounds constructed.

j Though all pound operators reported production, harvest was from only 18 of 20 pounds constructed.

k Though 30 pound operators reported production, harvest came from only 26 of 30 pounds constructed.

ranged from one vessel in 1977 to 39 participants in 1978. Entry into the purse seine sac roe fishery was limited after 1977, whereas the gill net fishery was not limited until 1910 (Randall, pers. comm.). Purse seines dominate the sac roe harvest, accounting for about 98% of the catch since 1974. Effort has ranged from six vessels in the 1969 fishery to a peak of 104 vessels during the 1982 season. During the 1983 season, 103 purse seine vessels and 22 gill net vessels participated in the sac roe fishery (table 3).

b. Food/bait fishery. The herring fishery in PWS was developed to harvest herring in nonspawning condition for a salted food and a halibut bait product (Rounsefell 1930). By the mid 1930's, interest had shifted to the reduction products of fertilizer and oil. The Japanese interest in a sac roe product resulted again in a shift in emphasis for the fishery. Throughout the history of the PWS herring fishery, the interest in food/bait herring had been consistent until the 1973 season. Harvest on herring has fluctuated in response to market demand. Because of low interest in a food/bait product, the harvest of food/bait herring did not occur from the 1974 to the 1977-1978 season. Since the 1977-1978 fishery, catches have ranged from 691 metric tons taken during the 1979-80 season to 1184.8 metric tons taken during the 1980-1981 season. About 801.1 metric tons were taken during the 1982-1983 fishery (table 3). The fishery for food/bait is restricted to the General District (map 2).

Purse seines and trawls are operated during the food/bait fishery. Since the 1977-1978 season, purse seines accounted for about 98% of the harvest. Trawls did not participate during the 1982-1983 season. Effort in the recent years of bait fishery has been small, with a maximum of eight vessels participating during the 1982-1983 season (ADF&G 1983b).

c. Natural herring spawn-on-seaweed. PWS supports one of three spawn-on-seaweed fisheries in Alaska. Herring spawn-on-seaweed, or "kazunoko kombu," is a traditional Japanese food eaten in conjunction with the New Year (Rosenthal 1978). Interest in this fishery developed concurrently with interest in the herring sac roe fishery. The first harvest of 2.4 metric tons was taken in 1969 (Pirtle 1969). Interest in the fishery increased, resulting in a peak harvest of 415.9 metric tons taken during the 1975 season by 437 "kelpers." A decrease in harvest to 63.9 metric tons in 1978 was a result of low kelp biomass (table 3). The decrease caused an investigation into harvest methods and recolonization of the seaweed beds. As a result of this investigation, regulations were changed to outlaw grappling hooks in harvesting seaweed in subtidal areas. The new regulation requires that the plant blades be cut at least four inches above the stipe. Both catches and effort fluctuated after the 1978 season. Effort ranged from 66 participants in 1978 to 469 permit holders in 1980 (table 3). A second low harvest of 55.5 metric tons of spawn-on-seaweed was taken during the 1981 season. The reason for this low harvest was that marketable spawn was available to the fishery (Randall and Fridgen 1982).

d. Pound herring spawn-on-seaweed fishery. The herring pound fishery in the PWS area is the newest of the recognized four fisheries that target on herring or herring spawn-on-seaweed. The recent development of the pound culture of herring eggs on kelp has been an outgrowth of the wild spawn-on-kelp fishery that first occurred in 1969. The impetus behind the development of the pound type fishery has been the desire to eliminate some uncertainties surrounding the wild seaweed fishery. The pound technique first practiced in British Columbia involves confinement of mature herring in a small enclosure (pound) along with carefully selected seaweed hung from lines in the enclosure to hopefully force the herring to deposit the eggs on the seaweed (ADF&G 1983a).

   The first pounds were constructed in 1979. Laminaria and Macrocystis are the species of seaweed used as spawning substrate. Interest in this type of operation has gradually increased. The pound herring spawn-on-seaweed fishery has primarily occurred in Landlocked and Boulder bays in Port Fidalgo. The 1983 season has shown the most participation, with 47 permits issued, construction of 38 pounds, and production by 30 pounds. The guideline harvest level for the pound fishery was increased to 26 tons in 1983 as a result of a reallocation from the wild spawn-on-kelp fishery. The 1983 season also exhibited the best pound production to date, 25.2 metric tons, of which 64% was Laminaria spp., 36% Macrocystis (ADF&G 1983b).

2. Harvest methods. Herring may be harvested in the sac roe and food/bait fisheries by purse seine, trawl, and gill net. Herring spawn-on-seaweed (kelp) can be harvested by a hand-held, unpowered blade cutting device. Stipulations for aquatic vegetation harvested for use in herring pounds is provided in the permit issued by the commissioner for pound operations. Herring pounds may be used only north and east of a line from Porcupine Point to Point Freemantle as specified by the permit issued for operation (ADF&G 1984a).

3. Period of use. The sac roe and spawn-on-kelp fisheries occur during spring months when herring are in spawning condition. The wild spawn-on-seaweed, herring in pounds, and herring spawn-on-kelp in pounds fishery opens and closes during this time by emergency order. In the Montague, Northern, and Eastern districts, herring may be taken by purse seines only from April 1 until closed by emergency order. In the Northern District, herring may be taken by gill nets only during periods established by emergency order. In the General District, herring may be taken only from September 15 through January 31. Herring may not be harvested July 1 through October 1 in any waters closed throughout the year to the harvest of salmon (ADF&G 1984a).

C. Management Objectives and Considerations

The objective of herring management in PWS is to manage the resource within guideline harvest levels to optimize the resource yield (ADF&G 1983a). Guideline harvest levels have been established for each of the four fisheries. Preseason surveys to determine biomass and distribution of herring determine the location of the fishery. Guideline harvest levels are as follows:

1) During the period March 1 through June 30, which is essentially the sac roe fishery, the guideline harvest level is 5,000 tons.
2) The guideline harvest level for herring spawn-on-kelp is 187 tons.
3) The guideline harvest level for gill net harvest in the sac roe fishery is 10% of the guideline harvest level as determined by the ADF&G for the Northern District and shall not exceed 250 metric tons.
4) The guideline harvest level for taking herring spawn-on-kelp in herring pounds is 40 tons of herring spawn and kelp, under permit provisions stipulated by the commissioner.
5) The guideline harvest level for herring during the period September 15 through January 31 is 1,400 tons (ADF&G 1984a).

The major consideration in managing the commercial fishery for herring in PWS is to prevent multiple harvest of the same herring population in the four herring fisheries that occur in the management area. Currently, studies are in progress to determine whether or not spawning herring harvested in the sac roe fishery belong to the same population harvested during the fall and winter months in the food/bait fishery (ADF&G 1979).

Conflicts between user groups may also constitute a problem in herring management. To prevent conflict between harvesters of wild seaweed and pound operators, a permit system was developed that designates the location of pounds where natural spawning or historic kelping areas do not occur. The seining of herring for introduction into pounds will not be allowed in areas where spawning has already ocurred (ibid.).

Another consideration regarding user groups concerns gear types in the herring sac roe fishery. Efficiency of the seine fleet exceeds that of the gill net fleet in the harvest of herring. Allocation of portions of the present guideline harvest level is required. Therefore, 10% of the guideline harvest level in the Northern District is allocated to the sac roe gill net fishery; however, regulations state that the gill net harvest should not exceed 250 metric tons (ADF&G 1984a, ADF&G 1979).

D. Significance of Particular Use Areas

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- Commercial herring harvest areas
- Potential herring harvest areas
- Wild herring spawn-on-seaweed
- Herring pounds

E. Economic Value

Information concerning the value of herring within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

REFERENCES

ADF&G. 1974. Cook Inlet herring report to the Board of Fish and Game. Div. Commer. Fish., Soldotna. 14 pp.

________. 1978. Upper Cook Inlet annual management report. Div. Commer. Fish., Soldotna. 43 pp.

________. 1979. Prince William Sound Herring Management Plan. Div. Commer. Fish., Cordova. 13 pp.

________. 1982. Cook Inlet herring fishery, 1982. Div. Commer. Fish., Rept. to the Baord of Fisheries, Soldotna. 7 pp.

________. 1983a. Prince William Sound area annual finfish report. Div. Commer. Fish., Cordova. 135 pp.

________. 1983b. Summary and description of the program and component projects included in the Commercial Fisheries Division FY84 operational budget request. Div. Commer. Fish., Juneau. 637 pp.

________. 1984a. Commercial herring fishing regulations. Div. Commer. Fish., Juneau. 48 pp.

________. 1984b. Lower Cook Inlet herring fishery. Rept. to Alaska Board of Fisheries, 1984. Div. Commer. Fish., Homer. 11 pp.

Commercial Fisheries Entry Commission (CFEC). 1983. 1982 ann. rept. Juneau. 22 pp.

Dahlgren, E.H., and L.N. Kollen. 1943. Outlook for the Alaska herring fishery in 1943. USDI, FWS, Leaflet No. 16. 16 pp.

Middleton, K.R., and K.A. Rowell. 1984. Upper Cook Inlet stock status report: a summary of commercial salmon, herring, and razor clam fisheries through 1982. ADF&G, Div. Commer. Fish., Anchorage. Draft.

Pirtle, R.B. 1969. The status of the Prince William Sound herring stocks and fishery. ADF&G, Div. Commer. Fish. Rept. to Alaska Board of Fisheries, Anchorage. 3 pp.

________. 1974. Herring and herring spawn on kelp fishery Prince William Sound, 1974. ADF&G, Div. Commer. Fish., rept. to Alaska Board of Fish and Game, Cordova. 14 pp.

Randall, R. 1985. Personal communication. Area Fisheries Mgt. Biologist. ADF&G, Div. Commer. Fish., Homer.

Randall, R.R., and P. Fridgen. 1982. Preliminary review of the 1981 herring fishery. ADF&G, Div. Commer. Fish., rept. to Alaska Board of Fisheries, Cordova. 30 pp.

Rosenthal, R.J. 1978. An investigation of the herring egg on seaweed fishery in Prince William Sound, Alaska: estimates of standing crop, growth rates of kelps and patterns of recolonization in harvested areas. Alaska Coastal Research Job No. 1, Ocean 04-78. 44 pp.

Rounsefell, G.A. 1930. Contribution to the biology of the Pacific herring, Clupea Pallasii, and the condition of the fishery in Alaska. USDC, Bureau of Fisheries, Doc. No. 1080. 319 pp.

Ruesch, D. 1982. Upper Cook Inlet herring summary. ADF&G, Div. Commer. Fish., Soldotna. Memo. 3 pp.

Commercial Harvest of Salmon

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The Southcentral Region includes the Prince William Sound (PWS), the Upper Cook Inlet (UCI), and the Lower Cook Inlet (LCI) commercial fisheries management areas. Included in these areas are all waters west of the longitude of Cape Douglas. Subregions depicted in the following narrative are shown on maps 1 and 2.

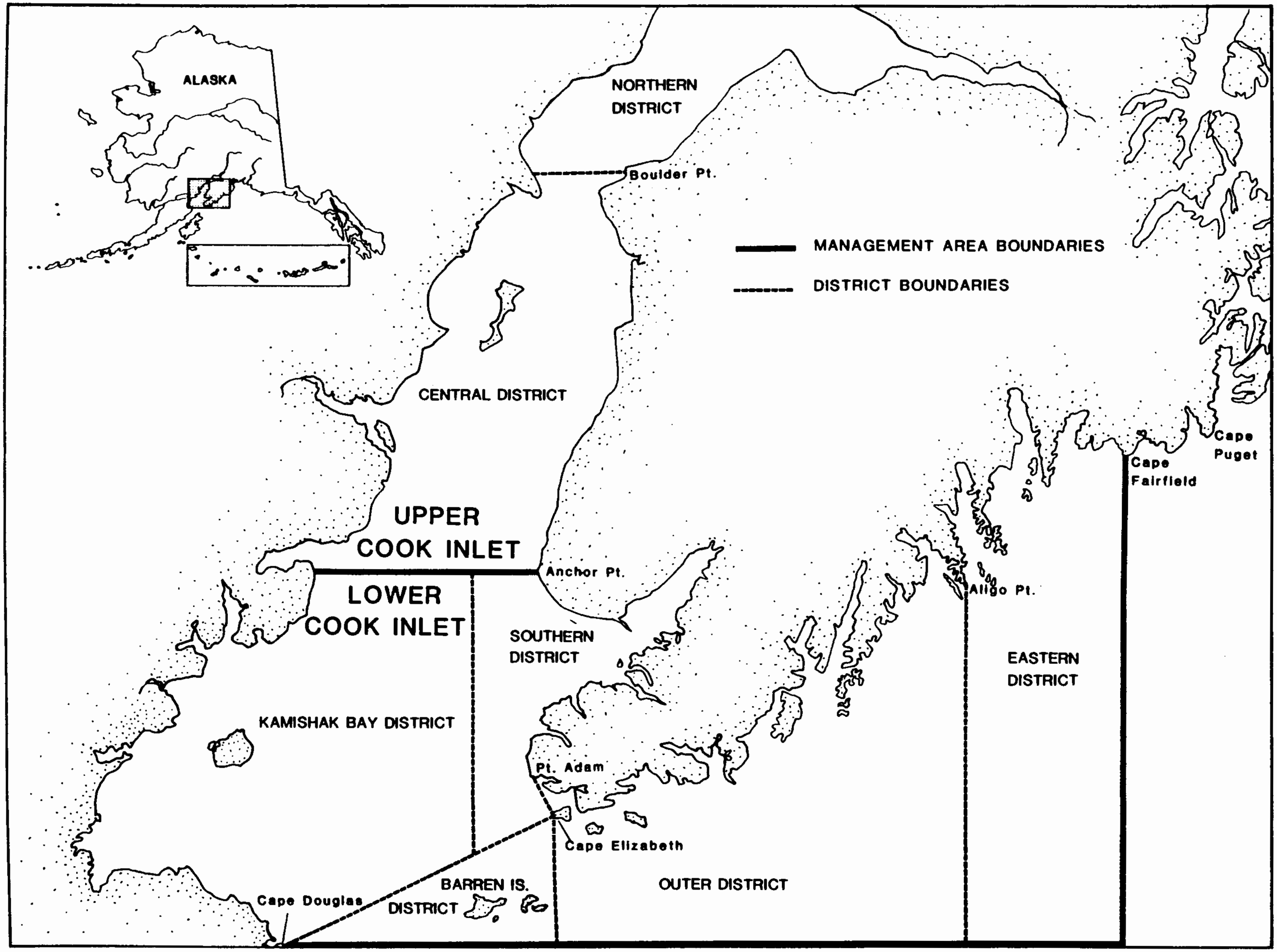
B. Summary of the Regional Fishery

1. Harvest summary. Chinook, sockeye, coho, pink, and chum salmon are harvested in the three management areas presented in this narrative. The dominant species are sockeye and pink salmon, which have composed about 17% and 69% of the total catch, respectively. Since 1973, the Southcentral Region harvest has ranged from 3.0 million fish in 1974 to a record harvest of 32.0 million fish in 1982 and has averaged about 16.1 million fish per year. By the 1983 season, a total of 2,248 permanent limited entry permits had been issued for salmon in the Southcentral Region. Of this total, about 78% are owned by Alaskan residents (CFEC 1984).

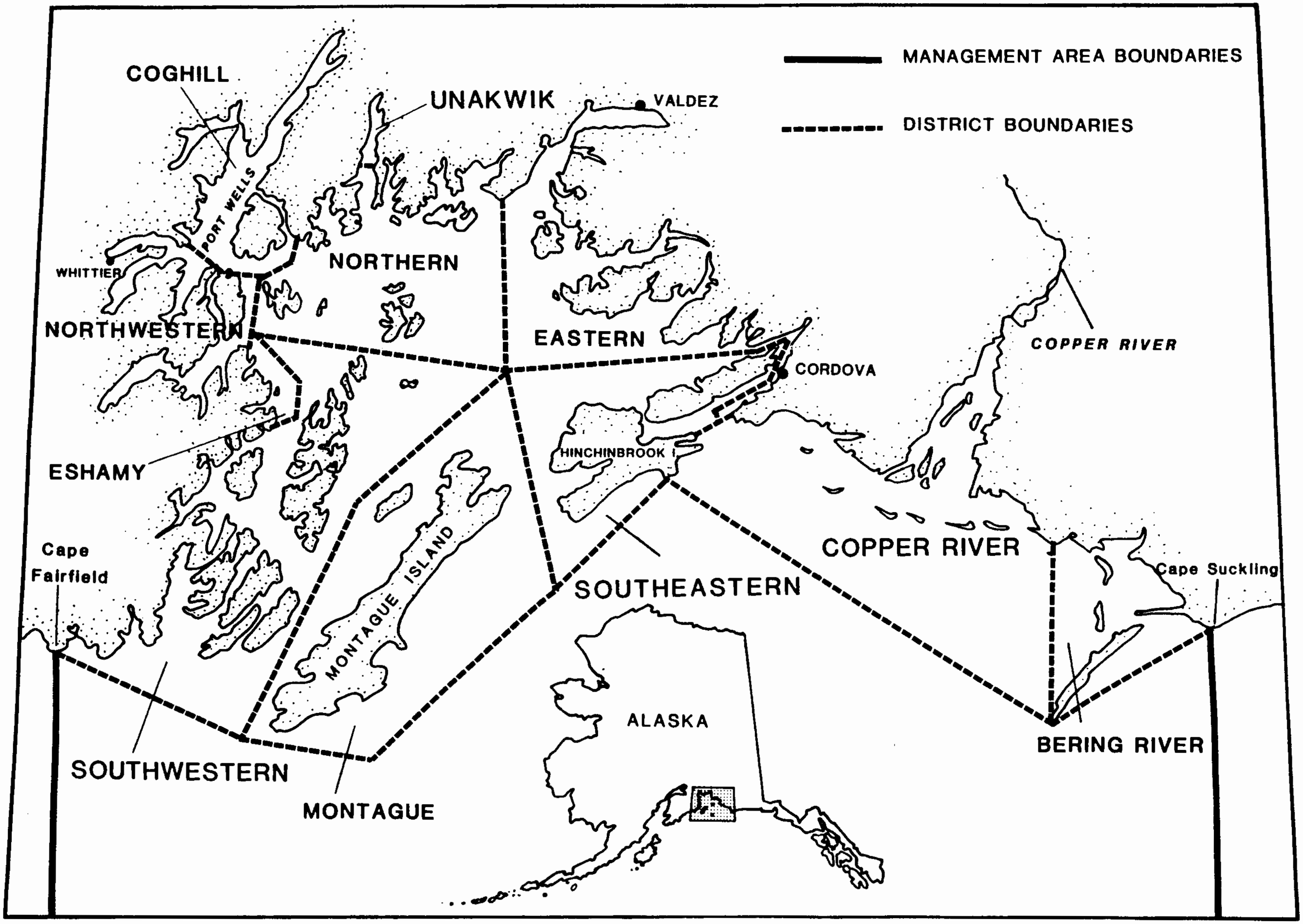
2. Managerial authority. The U.S. Fish and Wildlife Service (USFWS) regulated Alaska's fisheries from the late 1800's through 1959. After statehood was granted in 1959, the Alaska Department of Fish and Game (ADF&G) managed the salmon fishery. The Alaska salmon fishery became a limited entry fishery in 1974 after the Commercial Fisheries Entry Commission was established.

   Management of fisheries in waters within three nautical miles of shore is the responsibility of the State of Alaska. The Magnuson Fishery Conservation and Management Act, implemented in 1977 and amended in 1980, provided for conservation and exclusive United States management of all fisheries within 200 nautical miles of shore, creating the Fishery Conservation Zone from 3 to 200 nautical miles from shore. The North Pacific Fishery Management Council is responsible for managing fisheries in the Fisheries Conservation Zone and prepares management plans, which become federal law. The International North Pacific Fisheries Commission, comprised of Canada, Japan, and the United States, recommends management procedures and prepares conservation measures outside the United States and Canadian 200 nautical mile zones. The ADF&G manages the salmon fishery in the Southcentral Region in three management areas: UCI, LCI, and PWS.

3. Gear types. Prior to statehood, purse seines, gill nets (drift and set), beach seines, and fish traps were used



p 1. Salmon fishing districts of the UCI and LC nagement areas (ADF&G 1983c, Ruesch 1984).



Map 2. Salmon commercial fishing districts of the PWS Management Area (ADF&G 1983a, 1984d).

throughout the Southcentral Region to harvest salmon. Troll gear was also employed in some areas. However, fish traps were banned statewide. Since statehood, development of regulations for gear became specific to the districts within the management area. Currently, in the Southcentral Region, purse seines, drift gill nets, and set gill nets are used (ADF&G 1983a).

4. Period of use. The timing of the commercial fishery depends upon the timing of salmon runs into a specific management area. In some cases, the season opens by regulation on a specific date. In other instances, the fishery is open by emergency order, depending upon the strength and migration timing of the runs. Generally speaking, chinook salmon are the first species to enter the fishery, followed in order by sockeye salmon, pink, and chum salmon. Coho salmon are usually the latest species present in the fishery.
5. Economic value. Information concerning the value of salmon within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife Use volume.

II. UPPER COOK INLET (UCI) MANAGEMENT AREA

A. Boundaries

The Cook Inlet area includes all waters of Alaska enclosed by a line extending east from Cape Douglas (lat 58°52'N) and a line extending south from Cape Fairfield (long 148°40'W) (ADF&G 1983a). The UCI area consists of all waters of the Gulf of Alaska north of the latitude of Anchor Point (Ruesch 1984). UCI is divided into the Central and Northern districts, which will serve as the basis for presenting data in this summary (map 1). Districts and statistical areas used in the UCI to report commercial salmon harvest are listed in table 1.

Table 1. Districts and Statistical Areas Used for Reporting Commercial Salmon Harvest in the UCI Management Area, 1969-83

District	Statistical Areas
Central	244-00
	245-00
	246-00
Northern	247-00

Source: Div. Commer. Fish., IBM Fish Ticket Summaries (April 1985).

B. Fishery Description and Reported Use

1. Salmon - all-species information:

   a. Harvest summary. UCI is the primary salmon-producing portion of Cook Inlet, providing about 80% of the total Cook Inlet catch since 1960. Five species of North American Pacific salmon are harvested commercially. About 5% of Alaska's commercial salmon harvest is from UCI. Since statehood, catches have ranged from 1.1 million fish in 1969 to a record harvest of 6.7 million salmon taken in 1983. Though all five species of salmon are harvested in the commercial fishery, sockeye salmon are the most abundant and the highest in value per pound.

      There are eight fisheries in UCI that target on salmon migrating to their river of origin. Within th Northern District are two beach set net fisheries: the Northern District east-side and the Northern District west-side. In the Central District, there is a drift net fishery and five set net beach fisheries: Central District west-side, Kalgin Island, Salamatof Beach, Kalifonsky Beach, and Cohoe/Ninilchik Beach (Rowell and Middleton 1985).

   b. Effort. The Cook Inlet salmon fishery is limited to entry. Effort is gauged by the number of permits issued and, because fishermen harvest all species, is presented in terms of all salmon. There is also no breakdown in gear type for UCI and LCI. Due to the geography of Cook Inlet and salmon migrational patterns, however, drift net and set net gear have proven more suitable for the UCI area. Purse seines are primarily used in LCI by regulation, with the exception of Chinitna Bay in UCI. In 1983, a total of 1,376 permanent limited entry permits had been issued for Cook Inlet. Of these, 78 were for purse seine, 555 for drift gill net, and 743 for set gill net. About 84% of the permits were issued to Alaskan residents.

2. Sockeye salmon:

   a. Harvest summary. Management of the UCI commercial salmon fishery has focused on sockeye salmon because of its higher monetary value and the abundance of the species. Since statehood, the UCI catch has been composed of about 95% of the total Cook Inlet harvest and about 8% of statewide production. Catches have remained relatively stable throughout statehood. The lowest period of production since 1960 occurred from 1969 through 1975, when the average harvest dropped to about 730,000 fish annually. This period coincided with reduced sockeye production statewide. From 1976 through the 1983 season catches increased steadily, averaging about 2.0 million fish per year. A record harvest of about 5.0 million sockeye salmon was taken in 1983 (ADF&G 1984a).

The opening of the commercial fishery coincides with the timing of the sockeye salmon return to UCI. The midpoint of the harvest from 1979 through 1981 was similar to that of the total run, occurring between 7 July and 11 July (Rowell and Middleton 1985).

Most of the sockeye harvest occurs in the Central District, where the greatest exploitation is by the drift net fleet. Since 1974, the Northern District has accounted for about 6% of the UCI sockeye harvest (table 2).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See II.B.1.b. above for a summary of the total fishing effort.)

3. Chum salmon:

a. Harvest summary. Chum salmon are the third most abundant salmon species in UCI and have composed about 24% of the total UCI salmon harvest since statehood. Annual harvest levels remained below 500,000 fish until the 1950's. Production continued to build through 1960 (Rowell and Middleton 1985). Between 1974 and 1983, the catch averaged about 803,000 fish annually. A record harvest of 1.4 million fish was taken in 1982, and about 1.1 million chum salmon were harvested in 1983.

Most of the chum salmon harvest occurs in the Central District. About 85% of the catch has consistently been harvested by the drift net fleet in the Central District. In even years, chum salmon have entered the fishery the first week of July, peaking about 24 July. The run has usually been completed by the first week of August. In odd years, the run peaks the last week of July and ends in mid August (table 3) (ibid.).

A directed fishery targeting on chum salmon occurs in the Chinitna Bay area. Hand purse seines, which are illegal in other sections of UCI, have been permitted in Chinitna Bay; but they account for less than 3% of the harvest in that area. The Chinitna Bay fishery has usually peaked the first week of August, ending in late August (ibid.).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See II.B.1.b. above for a summary of the total fishing effort.)

Table 2. Commercial Harvest of Sockeye Salmon in Numbers of Fish in the UCI Management Area by Fishing District and Gear Type, 1974-83

Sockeye Salmon - Drift Gill Net*

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	0	0	0	0	0	0	0	0	0	0
Central	265,751	368,116	1,055,768	1,073,098	1,803,479	454,716	770,256	633,160	2,104,971	3,193,590
Total	265,751	368,116	1,055,768	1,073,098	1,803,479	454,716	770,256	633,160	2,104,971	3,193,590

Sockeye Salmon - Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	41,563	65,526	69,649	123,780	51,624	112,449	105,647	249,662	90,231	182,767
Central	189,846	245,094	538,714	855,631	766,564	357,250	697,734	556,413	1,042,119	1,626,713
Total	231,409	310,620	608,363	979,411	869,812	469,699	803,381	806,075	1,132,350	1,809,480

Total Harvest for All Gear Types for Sockeye Salmon

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	41,563	65,526	69,649	123,780	51,624	112,449	105,647	249,662	90,231	182,767
Central	455,597	613,210	1,594,482	1,928,729	2,570,043	811,966	1,467,990	1,189,573	3,147,090	4,820,303
All gear total for mgmt. area	497,160	678,736	1,664,131	2,052,509	2,621,667	924,415	1,573,637	1,439,235	3,237,321	5,003,070

Source: ADF&G, Div. Commer. Fish., IBM Fish Ticket Summaries (August 1983).

* Includes purse seine catches from Chinitna Bay.

Table 3. Commercial Harvest of Chum Salmon in Numbers of Fish in the UCI Management Area by Fishing District and Gear Type, 1974-83

Chum Salmon - Drift Gill Net*

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	0	0	0	0	0	0	0	0	0	0
Central	345,809	886,474	406,390	1,153,740	489,119	609,838	341,830	758,413	1,343,385	1,043,165
Total	345,809	886,474	406,390	1,153,740	489,119	609,838	341,830	758,413	1,343,385	1,043,165

Chum Salmon - Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	36,492	30,787	14,050	23,861	37,331	9,270	16,728	46,208	34,400	30,981
Central	15,852	33,720	49,366	56,130	45,509	31,249	32,252	28,928	35,100	50,635
Total	52,344	64,507	63,416	79,991	82,840	40,519	48,980	75,136	69,500	81,616

Total Harvest for All Gear Types for Chum Salmon

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	36,492	30,787	14,050	23,861	37,331	9,270	16,728	46,208	34,400	30,981
Central	361,661	920,194	455,756	1,209,840	534,628	641,087	374,082	787,341	1,378,485	1,093,800
All gear total for mgmt. area	398,153	950,981	469,806	1,233,731	571,959	650,357	390,810	833,549	1,412,885	1,124,781

Source: ADF&G, Div. Commer. Fish., IBM Fish Ticket Summaries (August 1983).

* Includes purse seine catches from Chinitna Bay.

4. Coho salmon:
    a. Harvest summary. Coho salmon is the fourth-ranking species in the commercial catch, comprising about 9% of the total Cook Inlet salmon harvest and about 12% of the statewide coho salmon harvest. In the past 10 years, catches have fluctuated from a low of 192,591 fish in 1977 to a record harvest of 775,581 coho salmon in 1982. About 520,800 coho salmon were taken during the 1983 season (table 4).

       Coho salmon are taken by drift and set gill net in the Central and Northern districts. The Central District drift net fleet has increasingly accounted for a larger percentage of the catch. Most of the coho salmon are taken in the Central District, where drift and set gill nets in 1983 accounted for 64% and 26% of the catch, respectively.

       Coho salmon enter the fishery in significant numbers about 10 July and peak about 21 July for the Central District, Kalgin Island, and west-side set net fisheries, 23 July for the Northern District set gill net fishery, and 6 August in the Central District east-side set gill net fishery (Rowell and Middleton 1985, ADF&G 1984e).
    b. Effort. Because effort is measured by the number of permit holders fishing and because fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See II.B.1.b. above for a summary of the total fishing effort.)
5. Pink salmon:
    a. Harvest summary. Pink salmon in UCI exhibit even-year run strengths. The even-year commercial harvest accounts for 4% of the statewide total and 53% of the combined Upper and Lower Cook Inlet catch. Records dating from 1954 indicate that a larger percentage of even-year pink salmon return to UCI, whereas LCI supports most of the odd-year returns. A record harvest in UCI of 2.3 million fish was taken in 1968. Harvest levels have decreased thereafter (Rowell and Middleton 1985). Between 1974 and 1983, an average of 716,820 pink salmon were taken in the commercial fishery, with the 1983 harvest totaling 73,555 fish (table 5).

       The Northern District set gill net fishery accounts for an average of 24% of the harvest, and about 76% of the catch is taken in the Central District. During most years, the majority of pink salmon are actually sought by the drift net fleet once sockeye and chum salmon become less available to the fishery. The drift fishery takes an average of about 36% of the UCI pink salmon harvest (ibid.).

Table 4. Commercial Harvest of Coho Salmon in Numbers of Fish in the UCI Management Area by Fishing District and Gear Type, 1974-83

Coho Salmon - Drift Gill Net*

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	0	0	0	0	0	0	0	0	0	0
Central	75,584	88,569	80,743	110,190	76,259	114,498	89,512	226,263	412,003	333,488
Total	75,584	88,569	80,743	110,190	76,259	114,498	89,512	226,263	412,003	333,488

Coho Salmon - Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	47,038	33,051	37,850	20,623	47,256	52,635	90,098	134,362	69,977	53,783
Central	77,261	99,927	89,972	61,778	95,845	98,033	91,768	124,523	293,601	133,563
Total	124,299	132,978	127,822	82,401	143,101	150,668	181,866	258,885	363,578	187,346

Total Harvest for All Gear Types for Coho Salmon

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	47,038	33,051	37,850	20,623	47,256	52,635	90,098	134,362	69,977	333,488
Central	152,845	188,496	170,715	171,968	172,104	212,531	181,280	350,786	705,604	187,346
All gear total for mgmt. area	199,883	221,547	268,565	192,591	219,360	265,166	271,378	485,148	775,581	520,834

Source: ADF&G, Div. Commer. Fish., IBM Fish Ticket Summaries (August 1983).

* Includes purse seine catches from Chinitna Bay.

Table 5. Commercial Harvest of Pink Salmon in Numbers of Fish in the UCI Management Area by Fishing District and Gear Type, 1974-83

Pink Salmon - Drift Gill Net*

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	0	0	0	0	0	0	0	0	0	0
Central	140,770	113,868	599,600	286,308	934,442	19,556	964,535	53,901	273,545	29,563
Total	140,770	113,868	599,600	286,308	934,442	19,556	964,535	53,901	273,545	29,563

Pink Salmon - Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	42,879	90,953	148,090	116,580	327,270	26,332	474,488	53,325	66,388	21,769
Central	300,328	130,808	509,053	151,029	427,386	27,094	347,407	19,935	448,765	22,223
Total	343,207	221,761	657,143	267,609	754,656	53,426	821,895	73,260	515,153	43,992

Total Harvest for All Gear Types for Pink Salmon

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Northern	42,879	90,953	148,090	116,580	327,270	26,332	474,488	53,325	66,388	21,769
Central	441,098	244,676	1,108,653	437,337	1,361,828	46,650	1,311,942	73,836	722,310	51,786
All gear total for mgmt. area	483,977	335,629	1,256,743	553,917	1,689,098	72,982	1,786,430	127,161	788,698	73,555

Source: ADF&G, Div. Commer. Fish., IBM Fish Ticket Summaries (August 1983).

* Includes purse seine catches from Chinitna Bay.

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may take all species, it is difficult to determine the number of fishermen targeting on one species. (See II.B.1.b. above for a summary of the total fishing effort.)

6. Chinook salmon:

a. Harvest summary. Chinook salmon is the least abundant salmon species in UCI but has provided an important component of the commercial fishery. Over 90% of the total Cook Inlet chinook harvest occurs in the UCI area. Through 1940, annual harvest remained fairly stable at about 60,000 fish. Catches increased steadily until 1951, when the fishery produced a peak harvest of 188,000 fish. Beginning in 1962, to protect depressed stocks of chinook salmon, the dates for the opening of the commercial fishery were delayed from mid May to the end of June to protect passage of the chinook salmon run migrating through the inlet to the Northern District river systems. Commercial harvest of chinook salmon is thereby minimized.

Since statehood, catches have averaged about 13,000 fish each year. The 1982 catch, in which about 20,600 fish were taken, was the largest since statehood (table 6) (ibid.).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See II.B.1.b. above for a summary of the total fishing effort.)

C. Harvest Methods

From the beginning of the fishery through 1896, gill nets and beach seines were used to catch salmon in inlet rivers of the UCI Management Area. Fish traps were introduced to the fishery in 1897 and were last fished in 1958. The efficiency of gill nets increased with development of durable synthetic materials and improved outboard motors. These advances contributed to creating a mobile drift gill net fishery by the late 1940's. Within three years, the drift fishery captured more than 50% of the total salmon harvest and has since been responsible for most of the salmon catch (ibid.).

Currently, gill nets are the only legal gear permitted in Upper Cook Inlet, except in Chinitna Bay, where hand purse seines and beach seines are also allowed. Both set and drift gill nets are permitted in the Central District, whereas only set gill nets are allowed in the Northern District (ibid.).

D. Period of Use

The commercial fishing season for the UCI Management Area opens on the Monday or Friday following June 25th. The commercial fishery

Table 6. Commercial Harvest of Chinook Salmon in Numbers of Fish in the UCI Management Area by Fishing District and Gear Type, 1974-83

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Chinook Salmon - Drift Gill Net*										
Northern	0	0	0	0	0	0	0	0	0	0
Central	422	250	692	3,411	2,072	1,089	889	2,319	1,332	1,551
Total	422	250	692	3,411	2,072	1,089	889	2,319	1,332	1,551
Chinook Salmon - Set Gill Net										
Northern	169	129	457	565	669	1,714	990	725	2,453	905
Central	5,995	4,394	9,718	10,816	14,561	10,935	11,916	9,196	16,851	17,940
Total	6,164	4,523	10,175	11,381	15,230	12,649	12,906	9,921	19,304	18,845
Total Harvest for All Gear Types for Chinook Salmon										
Northern	169	129	457	565	669	1,714	990	725	2,453	905
Central	6,417	4,644	10,410	14,227	16,633	12,024	12,805	11,515	18,183	19,991
All gear total for mgmt. area	6,586	4,773	10,867	14,792	17,302	13,738	13,795	12,240	20,636	20,396

Source: ADF&G, Div. Commer. Fish., IBM Fish Ticket Summaries (August 1983).

* Includes purse seine catches from Chinitna Bay.

remains open until closed by emergency order, with the exception of the Central District east-side beaches, which are closed to fishing after August 15 (ADF&G 1983a).

E. Management Objectives

The ultimate goal of UCI salmon management is to harvest the surplus of salmon from each stock, yet provide adequate escapement levels. The mixed-stock and mixed-species nature of the UCI fishery, as well as the interest of several user groups in these fish, has resulted in adoption of several management policies by the Alaska Board of Fisheries for salmon management in the UCI area. They are summarized below.

1. UCI Salmon Management Plan (5AAC 21.363). The most encompassing policy is the Comprehensive Management Policy for UCI salmon, which was developed for long-term management of the UCI fishery. Essentially, the policy states that salmon stocks moving into Cook Inlet prior to June 30 shall be managed as a noncommercial resource. Salmon stocks moving into Cook Inlet from June 30 through August 15 shall have nonrecreational priority, and salmon moving into the UCI area after August 15 shall be managed for noncommercial use.
2. Late Kenai River King Salmon Management Plan. This plan was originally adopted by the Board of Fisheries in December of 1976 and was later amended to its present form in January of 1981. It has not been formalized as a regulation (Ruesch and Logan 1983). Its goal is to ensure sustained yields by achieving adequate spawning escapement of late-run chinook salmon through the subsistence, commercial, and sport fisheries into spawning areas of the Kenai River drainage. The sport harvest of late-run chinook salmon should be on an equitable 1:1 basis with the commercial set net fishery in commercial fisheries statistical areas 244-20, 244-30, 244-40, as projected statistically after July 20. The plan also addresses additional constraints regarding chinook salmon harvest during extra commercial and subsistence fishing periods and when the sport fish harvest of chinook salmon exceeds commercial catch levels (ADF&G 1984e).
3. Early Kenai River King Salmon Management Plan (5AAC 21.362). This plan guides harvest levels of early run Kenai River chinook salmon by subsistence, recreational, and commercial fishermen to ensure adequate escapement levels (ibid.).
4. Russian River Red Salmon Management Policy (5AAC 21.361). This policy statement provides for joint management of Russian River sockeye salmon by the Divisions of Commercial Fisheries and Sport Fish. The Division of Commercial Fisheries is to regulate the east-side set net fishery to allow a minimum of 20,000 sockeye salmon past the sonar counter by June 20th. The Division of Sport Fish will manage the Russian River sockeye salmon run and harvest to attain an escapement of 8,500 fish (ibid.).

5. Kenai River Sockeye Salmon Management Plan (5AAC 21.360). The purpose of this management plan is to ensure an adequate escapement of sockeye salmon as determined by the ADF&G into the Kenai River system and to provide management guidelines to the department in an effort to preclude allocative conflicts between various users of this resource (ibid.)
6. Central and Northern District Personal Use Coho Management Plan. A discussion of this plan is presented in section II.C. of the Salmon Personal Use narrative found elsewhere in this volume.

F. Management Considerations

1. Salmon - all-species information. UCI fisheries harvest five species of Pacific salmon as they migrate to their stream of origin. Major salmon-producing systems are the Kenai and Kasilof rivers on the east side of the Central District, the Chakachatna/McArthur River system, and Big and Crescent rivers, which drain into the west side of the Central District and the Susitna River in the Northern District. Several large freshwater systems flow into the inlet from the west side, but their contribution has yet to be fully assessed. Mixed stocks and mixed species of salmon mingle in Cook Inlet at about the same time, hindering stock-specific management in the commercial fishery (Rowell and Middleton 1985).

   In addition to the stock management problems is one of allocation. Commercial fishermen, recreational fishermen, personal use, and subsistence fishermen all utilize the UCI resource. Meeting the needs of these user groups and maintaining adequate salmon population levels creates extremely complex management strategies. Presented here are considerations that involve the commercial fishery (ADF&G 1984e).

   The goal of the UCI Salmon Management Plan is to establish priorities among beneficial uses of the salmon resources. It is not the stated intent of the Board of Fisheries to establish exclusive use of the various salmon stocks but rather to define the primary beneficial use of a stock while allowing secondary uses to the extent they are consistent with the maximum benefit to the people of the state (ibid.).

   Implementation of the UCI Management Plan was easily accomplished for those stocks and species segregated by time and area. Late June opening dates for the commercial fishery effectively limits the harvest of Susitna chinook salmon, early Kenai chinook salmon, and early Russian River sockeye salmon, and allocates these runs totally to sport fishermen. The commercial harvest of late Kenai coho salmon is easily controlled by the August 15 closing date of the east-side set net fishery (ibid.).

   Other goals of the plan, however, have proved difficult, if not impossible, to achieve. Attempts to maximize the sustained yield of sockeye, chum, and pink salmon stocks while simultaneously minimizing the incidental take of Susitna coho, late Kenai chinook, and early Kenai coho salmon have been only partially successful. The recent large runs of sockeye, chum, and pink salmon have resulted in extra commercial fishing time and have led to increased harvest of nontargeted species. Dissatisfaction with this condition by the sportfishing public has been focused primarily around the increased catches of Kenai chinook salmon in the east-side set net fishery in recent years (ibid.).

In summary, the plan is a pattern for allocation. It serves as a guideline for regulatory decisions on the allocation of harvestable surpluses. However, although not stated in the plan, the board's and the department's highest priority is conservation of the various stocks. When low salmon returns occur, the department will use its emergency order authority to reduce the harvest by all users, consistent with the subsistence priority, to provide adequate spawning escapement of all stocks (ibid.).

2. Sockeye salmon:

   a. <u>UCI areawide information</u>. The major producers of sockeye salmon in UCI are the Kenai, Kasilof, and Susitna rivers, followed in magnitude by Crescent River and Fish Creek (outlet stream of Big Lake). Numerous other systems are known to produce smaller runs of sockeye salmon, including Lake Creek (outlet stream on Nancy Lake), Cottonwood Creek, Packers Creek, Wolverine Creek (Big River Lakes), and the Chakachatna River (Cross 1983).

      The timings of migration of the major sockeye salmon stocks through the fishery substantially overlap, causing difficulty in protecting or allowing selective harvest of individual stocks based on their run size and distribution. Consequently, the commercial harvest is comprised of differing proportions of fish from each river system. Fisheries management by stock requires a method to estimate the numbers of fish harvested from each river system.

      Currently, an in-season program exists for stock identification by use of scale patterns. Five principal systems are considered in apportionment of the catch (Susitna, Kenai, Kasilof, and Crescent rivers and Fish Creek). This technique, however, is limited by the fact that it cannot account for systems that are not included in the model. Therefore, salmon from other than the five systems are all classified to one of the modeled systems, either increasing or decreasing the apparent contribution of the river system included in the model. In addition, problems arise when characteristics of fish from different systems included in the model are not distinguishable. This results in misclassification and apparent over estimates or underestimates of the contribution of a given system to the commercial catch (Rowell and Middleton 1985).

Run timing of sockeye salmon to the Kenai/Kasilof and Susitna rivers overlaps, causing difficulty in scheduling fishing time to prevent overharvest of one stock yet provide optimal harvest of another. Therefore, the stock analysis is used as a tool to help differentiate between systems for better management of the fishery (ibid.).

b. <u>Kenai River (Russian River)</u>. Late-run Russian River sockeye salmon enter Cook Inlet with the other major sockeye salmon stocks. In UCI, these fish are subject to the mixed-stock Central District drift and set gill net fisheries. These fish are primarily allocated to commercial use because of their run timing and in accordance with the UCI Salmon Management Plan.

Russian River sockeye salmon intermingle with other fish headed for the Kenai River and begin to enter fresh water in early July. They start arriving at Russian River in mid July, with the migration to the spawning grounds at Upper Russian Lake continuing through August. The late Russian River run constitutes an average of 14% of the Kenai River production and has ranged from 7 to 39% (ADF&G 1984e).

Kenai River escapement goals, designed to provide optimum numbers of spawners in the systems as a whole, have provided a surplus in the Russian River. To prevent the growing sport fishery from overharvesting this stock, the Board of Fisheries in 1977 adopted the Russian River Sockeye Salmon Management Plan (5 AAC 21.361), which established escapement goals for both the early and late runs while recognizing the mixed-stock nature of the commercial fishery (ibid.).

When the number of sockeye salmon in surplus of the needed escapement is limited, early closures are imposed on the sport fishery. This has occurred five times during the period 1973 to 1982. When production rates from the remainder of the Kenai systems equal or exceed the production rate from the Russian River, as has been the case in recent years, the percentage of Russian River fish in the escapement falls, providing fewer fish for the sport harvest (ibid.).

Because Russian River sockeye salmon have similar run timing as other Kenai sockeye salmon and probably use similar migration routes, no method currently exists for providing different exploitation rates on these stocks in the commercial fishery. Therefore, ensuring that greater numbers of sockeye salmon are available to the sport fishery at Russian River would require allowing a much greater overall escapement into the Kenai River. If, typically, one out of every seven Kenai sockeye salmon is bound for the Russian River, it would require raising the Kenai River escapement by 210,000 and lowering the commercial harvest by the same number (ibid.).

3. Chum salmon:
   a. Chinitna Bay. The Chinitna Bay chum salmon fishery is primarily a terminal fishery, with few problems regarding mixed stocks and mixed species interception.
   b. Remainder of UCI. In contrast to Chinitna Bay, Susitna River run timing of chum salmon coincides with all other sockeye and pink salmon runs in the commercial fishery. One problem has been the inability to assess run strength during the fishing season for chum salmon in order to direct fishing pressure toward or away from chum salmon in a particular time or area.

      The timing of coho salmon returning to the Northern District systems is also similar to that of the Susitna River chum salmon. Both species move through the mid portion of the Central District, where the drift fleet targets on chum salmon. Therefore, it is difficult to optimize the harvest of chum salmon while minimizing interception of coho salmon (Rowell and Middleton 1985).
4. Coho salmon:
   a. Northern District coho. The UCI Salmon Management Plan specifies that management minimize the incidental take of Northern District coho salmon, while calling for optimum commercial use of sockeye, chum, and pink salmon. The overlapping migration routes and run timing of sockeye, northern coho, chum, and even-year Susitna River pink salmon make it exceedingly difficult to obtain a significant reduction in the commercial coho harvest (ADF&G 1984e).

      Because the majority of the northern coho salmon catch is taken by the drift fishery, it is apparent that whenever this segment of the commercial fishery is afforded "extra" time to harvest above-average sockeye salmon runs, the incidental catch of northern coho salmon increases. Increased interception of northern coho salmon by the drift fleet means fewer coho salmon are available to both the Northern District set net fishery and to the Susitna-Knik Arm sport fishery (ibid.).

The magnitude of the drift harvest, as well as the trend toward even greater interception by the drift fleet, is the basis for the conflict surrounding northern coho (ibid.).

Increased commercial fishing time to harvest large sockeye and chum salmon runs could pose a biological threat to northern coho salmon should future stock abundance return to lower levels. A weak northern coho salmon return mixed with large sockeye salmon, chum, and/or even-year pink salmon runs remains a serious concern of Cook Inlet managers. In this situation, restrictive conservation measures would be imposed chiefly on the recreational harvest. It currently is very difficult to accurately and rapidly estimate coho salmon run strength in the commercial fishery. A large percentage of the commercial harvest would be completed before the run strength of a weak coho salmon stock could be determined. By that time, the in-river sport fisheries would be only beginning. Because of the difference in timing of the two harvests, the major opportunity to reduce harvest and maximize the number of spawning coho salmon would be to restrict the sport fishery (ibid.).

There are few options available that allow managers to minimize the commercial harvest of northern coho salmon while still achieving optimum harvests of the more numerous sockeye, chum, and even-year pink salmon. A much greater understanding of run strength, run timing, and stock-specific harvest areas is necessary before northern coho salmon can be managed on a stock-specific basis. Even after such essential information is acquired, the question of an acceptable trade-off with other species will eventually need to be addressed (ibid.).

b. <u>Early Kenai River coho salmon</u>. The problems with the harvest of early run Kenai River coho salmon with Kenai River sockeye and pink salmon are

- the increased interception of coho salmon when extra fishing periods are given to the east-side set nets to harvest surplus sockeye and even-year pink salmon, and
- the harvest of the coho salmon by the set net fishery during the first two weeks of August during odd years, a time when coho salmon are usually the predominant species caught (ibid.).

All three runs occur during the July 1-August 15 period, when salmon stocks are to be managed primarily for commercial uses, and the UCI Salmon Management Plan directs the department to minimize the incidental catch of early Kenai River coho salmon.

The overriding priority on maintaining sustained yield harvests on sockeye and even-year pink salmon affords little opportunity to minimize commercial harvest of the intermingled coho salmon during even-numbered years. During odd-numbered years, after August 1, coho salmon commonly are the predominant species in the east-side harvest, and no additional fishing time has been given to the set net fishery regardless of coho salmon run strength. With increasing frequency, commercial fisheries managers have been asked by the sportfishing public to halt the set net fishery entirely during this time period (ADF&G 1984e). Because this issue concerns allocation, it remains for the Board of Fisheries to decide the preferred course of action (ibid.).

5. <u>Pink salmon</u>. The primary problem in UCI pink salmon management is the simultaneous timing of pink salmon runs with most UCI salmon species and stocks (late Kenai River chinook salmon returns; Susitna, Kenai, and Kasilof sockeye salmon, Susitna River chum salmon runs; and Kenai, Susitna, and Kasilof coho salmon runs). Problems arise in determing the run magnitude of these different species and stocks and selectively minimizing or maximizing the harvest of specific stocks.
6. <u>Chinook salmon</u>. Late-run Kenai River chinook salmon are harvested incidentally by the east-side set net commercial fishery that is targeted on sockeye salmon. Because of their large size, late-run Kenai River chinook salmon are highly prized by sport fishermen and annually attract more sportfishing effort than any other salmon stock in the state (56,000 man-days in 1983). The sockeye salmon stocks are the backbone of the east-side set net fishery, historically averaging over 58% of the total Cook Inlet annual catch and 86% of the annual ex-vessel value (ADF&G 1984e).

   The late-run Kenai River chinook salmon and the three principal sockeye salmon stocks all enter the UCI commercial fishing districts in significant numbers by early July. Typically, Kenai, Kasilof, and Susitna river sockeye salmon move primarily through the center of the inlet. At some point the three stocks segregate, with Susitna River fish entering the Northern District and Kenai and Kasilof river fish moving eastward to the beach prior to their entry into the rivers. The drift gill net fleet is the principle harvester of these three sockeye salmon stocks during their offshore migration, with set gill nets in the Northern District and the eastern shore of the Central District taking the bulk of their catch during the brief period of time the fish are concentrated along the beach. Kasilof-bound sockeye salmon enter the river approximately a week earlier than do the Kenai and Susitna rivers sockeye salmon and have an extended run timing. Therefore, Kasilof River sockeye salmon are harvested over a longer period of time by east-side set nets. Kenai-bound chinook salmon migrate principally along the east-side beaches, and, accordingly, the bulk of the incidental harvest of this stock comes from the east-side set nets (ibid.).

The sport fishery on the late-run Kenai chinook salmon stock has developed to the point where the sport harvest is approaching the harvest level in the commercial fishery. To halt the rising harvest of this stock, the Board of Fisheries adopted in 1976 and amended in 1981 the Late Kenai King Salmon Management Plan, limiting the in-river sport harvest to the level of the east-side set net catch during regular fishing periods. Any commercial catches from additional openings were to be subtracted from the allowable sport harvest. This plan was adopted to help prevent overharvesting the late Kenai River chinook salmon stock, inasmuch as an actual count of spawning escapement is not yet possible (ibid.).

The only area where commercial harvest of the chinook salmon would reach the magnitude of the sport fishery is the east-side set net fishery augmented by an area-restricted drift fishery. Thus, any attempt to limit the east-side fishery to reduce king salmon interception inevitably limits the commercial managers' ability to provide for precise management of sockeye stocks.

The current issue over late Kenai River king salmon is one of allocation. Present regulations providing for emergency order closures have been adequate to protect the biological integrity of this stock (ibid.).

G. Significance of Particular Use Areas

1. Maps. A series of 1:250,000-scale reference maps have been prepared that depict areas used for commercial salmon harvest. Categories of mapped information include the following:
   - Gear type
   - Target species
2. Other issues. There is increasing dissatisfaction among Northern District set net gill net fishermen about the number

of Northern District Cook Inlet salmon stocks being intercepted by the Central District commercial fishery, primarily the drift gill net fishery.

Although precise salmon migrational patterns are unknown, it appears that most salmon enter UCI in an area known as the "mid channel tide rip." In addition, east and west channel rips are present. Even though Cook Inlet is relatively large, salmon tend to concentrate in these tide rips, where they are vulnerable to harvest by the drift gill net fleet (ADF&G 1984e).

Inherent in any mixed stock fishery is the difficulty of defining manageable units. In Cook Inlet, four species of salmon migrating to a series of major drainages results in more than 20 spawning stocks of salmon. These spawning stocks are typically of different run strengths and display little difference in run timing. Therefore, managers must constantly evaluate the relative strengths and weaknesses of all the intermingled stocks when decisions are made to open or close the fisheries. Manipulation of the drift gill net fleet has become an integral part of the UCI management techniques. As directed by the Board of Fisheries in 1980, in years of large returns of sockeye salmon to the Kenai and Kasilof rivers (e.g., 1982 and 1983), the aggressive use of the drift fleet would be to reduce the number of sockeye salmon to relatively manageable levels by the time they enter the east-side set net fishery. Reducing the drift fleet harvest during years of large sockeye salmon runs to the Kenai and Kasilof rivers could require more fishing time by east-side set nets to adequately harvest surplus stocks, with a potential corresponding increased harvest of Kenai River coho and chinook salmon. Conversely, unlimited use of the drift gill net fleet to harvest excess Kenai sockeye salmon would potentially overharvest Northern District stocks. Therefore, various time and area restrictions to target the drift fleet on surplus salmon (i.e., moving the fleet out of concentrations of untargeted stocks) have been implemented. Even with these measures, an above-average harvest rate is probable for salmon bound for the Northern District. Coho salmon are especially vulnerable because of their abundance throughout the Central District at critical sockeye harvest periods. Consequently, there are fewer salmon in the Northern District available for harvest (ADF&G 1984e).

The refinement of management programs should in future years increase the manager's ability to meet escapement objectives. However, allocative balances must be made among the 20 spawning stocks passing through the Central District. This trade-off does not guarantee a harvestable surplus in the Northern District, however, nor does it ensure that all Northern District systems will achieve escapement objectives every year (ibid.).

H. Economic Value of Salmon in the UCI Management Area

Information concerning the value of salmon within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. LOWER COOK INLET (LCI) MANAGEMENT AREA

A. Boundaries

The LCI Management Area is comprised of all waters west of the longitude of Cape Fairfield north of the latitude of Cape Douglas and south of the latitude of Anchor Point (ADF&G 1983c). The area is divided into the Southern, Kamishak Bay, Barren Islands, Outer, and Eastern fishing districts (map 1) (ADF&G 1983a). Districts and statistical areas used in the LCI to report commercial salmon harvest are listed in table 7.

B. Fishery Description and Reported Use

1. Salmon - all-species information:

a. Harvest summary. Salmon in LCI are primarily harvested in the Southern, Kamishak, Outer, and Eastern districts. Pink salmon are the most abundant species, followed in order of magnitude by chum salmon, sockeye salmon, coho salmon, and chinook salmon. Between 1974 and 1983, pink salmon has accounted for over 80% of the total salmon production. Since 1951, the total LCI salmon catch has ranged from about 158,500 salmon in 1965 to 3.7 million fish in 1981. A total of over 1.3 million salmon were harvested in 1983.

LCI is characterized by numerous small bays and lagoons fed by short coastal streams. The area lends itself well to conducting stock-specific terminal area fisheries (Middleton 1981). LCI has also been a prime candidate for aquacultural projects because of the strong demand for additional salmon by recreational, subsistence, and commercial user groups, and because the coastal geography is ideal for managing hatchery produced runs separately from naturally produced runs (ADF&G 1983b).

b. Effort. The Cook Inlet salmon fishery is limited to entry. Effort is measured by the number of permits issued and, because fishermen harvest all species, is presented in term of all salmon. There is also no breakdown in gear type for UCI and LCI. Due to the geography of Cook Inlet and salmon migrational patterns, however, drift net and set net gear have proven more suitable for the UCI area. Purse seines are primarily used in LCI by regulation, with the exception of Chinitna Bay in UCI. In 1983, a total of 1,376 permanent limited entry permits had been issued for Cook Inlet. Of these, 78 were for purse seine, 555 for drift gill net, and 743 for set gill net. About 84% of the permits were issued to Alaskan residents.

Table 7. Districts and Statistical Areas Used for Reporting Commercial Salmon Harvest in the LCI Management Area, 1969-83

District	Years	Statistical Areas
Kamishak	1969-1975	243-10 to 70 248-10 to 60,70 249-10 to 20,51,95
	1976-1983	243-10,30 to 70 248-10,40,60,70 249-10 to 90,95
Southern	1969-1975	241-00,10 to 39,41 to 50,60,68
	1976-1983	241-00,10 to 60
Barren Islands	1969-1975	241-51 248-61 249-21
	1976-1983	248-20,30,61
Outer	1969-1975	232-01 to 39 241-40 242-10 to 45
	1976-1983	232-01 to 39 241-40,30,32,35,41,42
Eastern	1969-1975	231-00 to 190 232-40 to 80 233-00,10 to 45
	1976-1983	231-00 to 190 232-40 to 45,60,70,80 233-10,20,30,33

Source: Div. Commer. Fish., IBM Fish Ticket Summaries (April 1985).

2. Sockeye salmon:

   a. Harvest summary. Since 1974, sockeye salmon have comprised about 7% of the total Cook Inlet salmon harvest. Sockeye salmon are harvested in the Southern, Eastern, Kamishak, and Outer districts. Sockeye salmon are the first species to appear in any numbers in LCI. This fishery begins in early June and is usually over by mid July (Middleton 1981). In most years, the Southern District has accounted for about 50% of the LCI sockeye salmon harvest (table 8). It is believed that a good part of the Southern District catch prior to 1983 targeted on sockeye salmon migrating to UCI systems. A small fishery for sockeye salmon occurs in the Outer District from late June until mid July (ibid.). With the exception of the period 1968 through 1971, when the drift fleet operated, the Eastern District has consistently been the lowest-producing district for sockeye salmon in LCI (ADF&G 1983c).

      Catches for sockeye salmon in LCI have ranged from about 14,000 fish in 1965 to a record harvest of about 184,600 fish in 1983. The average annual harvest since 1974 has been 92,927 fish.

   b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See III.B.1.b. above for a summary of the total fishing effort.)

   3. Chum salmon:

      a. Harvest summary. Chum salmon are the second most abundant species in LCI, accounting for about 10% of the area's catch since 1974. The Outer District accounts for about 50% of the LCI chum salmon harvest, followed by Kamishak, at about 44%, with the Southern and Eastern districts accounting for the remaining 6% (table 9). Production of LCI chum salmon has been building since 1979. Catches have ranged from a low of 19,200 fish in 1974 to a record harvest of 339,000 fish in 1981. Since 1974, catches have averaged 132,590 fish per year. About 192,300 chum salmon were taken in the 1983 fishery (table 9).

         The timing of the chum salmon harvest in LCI differs with each district. The few chum salmon caught in the Southern District are taken from late June or early July through the first week of August. Chum salmon enter the southern portion of the Kamishak District in late June and are found in Bruin Bay from the last week of July until mid August, whereas the species is most numerous in

Table 8. Commercial Harvest of Sockeye Salmon in Numbers of Fish by Gear Type and District for the LCI Management Area, 1974-83

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	29	3,988	7,425	4,619	1,778	3,877	4,972	18,014	11,207
Southern	63	805	1,287	259	54,154	2,975	13,007	24,215	1,044	88,960
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	399	720	18,886	33,733	10,695	25,297	22,514	18,133	66,781	16,835
Eastern	0	0	5	5,776	2	0	122	9,270	3,092	25,932
Total	462	1,584	24,166	47,193	69,470	30,050	39,520	56,590	88,931	142,934

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	26,966	26,588	33,993	54,404	6,934	34,367	29,922	53,665	42,389	41,707
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	26,966	26,588	33,993	54,404	6,934	34,367	29,922	53,665	42,389	41,707

(continued)

Table 8 (continued).

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Harvest by Troll										
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Total Harvest of Sockeye Salmon for All Gear Types for LCI										
Kamishak	0	29	3,988	7,425	4,619	1,778	3,877	4,972	18,014	11,207
Southern	27,471	27,393	35,280	54,663	141,088	37,342	42,929	77,880	43,433	130,667
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	399	720	18,886	33,733	10,695	25,297	22,514	18,133	66,781	16,835
Eastern	0	0	5	5,776	2	0	122	9,270	3,092	25,932
All gear total for mgmt. area	27,428	28,142*	58,159	101,597	156,404	64,417	69,442	110,255	131,320	184,641

Source: ADF&G 1982b; Div. Commer. Fish., IBM Fish Ticket Summaries (April 1985).

* Includes four from unknown district in 1975.

Table 9. Commercial Harvest of Chum Salmon in Numbers of Fish by Gear Type and District for the LCI Management Area, 1974-83

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	4,554	4,868	48,848	65,659	48,669	29,711	35,921	73,501	108,946	142,901
Southern	12	1,408	164	3,958	1,408	7,493	2,029	15,356	11,353	9,904
Barren Island	0	2,763	0	0	0	0	0	0	0	0
Outer District	11,931	11,350	412	70,167	19,224	180,558	32,246	238,393	62,877	27,203
Eastern	0	0	45	3,229	100	0	720	3,279	7,698	7,934
Total	16,597	20,389	49,469	143,013	69,401	217,762	70,916	330,529	190,874	187,942

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	2,713	4,020	1,353	2,765	4,117	5,266	2,576	8,524	7,113	4,377
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	2,713	4,020	1,353	2,765	4,117	5,266	2,576	8,524	7,113	4,377

(continued)

Table 9 (continued).

Harvest by Troll

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Total Harvest of Chum Salmon for All Gear Types for LCI

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	4,554	4,868	48,848	65,659	48,669	29,711	35,921	73,501	108,946	142,901
Southern	2,725	5,428	1,517	6,723	5,525	12,759	4,605	23,880	18,466	14,281
Barren Island	0	2,763	0	0	0	0	0	0	0	0
Outer District	11,931	11,350	412	70,167	19,224	180,558	32,246	238,393	62,877	27,203
Eastern	0	0	45	3,229	100	0	720	3,279	7,698	7,934
All gear total for mgmt. area	19,210	24,409	50,822	145,778	73,518	223,028	73,492	339,053	197,987	192,319

Source: ADF&G 1982b; Div. Commer. Fish., IBM Fish Ticket Summaries (April 1984).

Rocky and Iniskin bays from early to late August. In Cottonwood and Ursus bays, there is a late run of chum salmon that occurs from mid August until early September (Middleton 1981; Schroeder, pers. comm.).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See III.B.1.b. above for a summary of the total fishing effort.)

4. Coho salmon:

a. Harvest summary. Since 1973 coho salmon account for less than 0.9% of the total LCI salmon catch. With the exception of the 1982 season, the Southern District has shown greater long-term production, accounting for about 44% of the coho salmon catch since 1974. The Kamishak District, however, with the exceptionally high run in 1982, has produced the largest number of coho salmon since 1974, at 49% of the total LCI catch (table 10). The total harvest of coho salmon in LCI has ranged from a low of about 600 fish in 1969 to a peak harvest of 46,900 fish in 1982. About 11,400 coho salmon were taken in 1983. Limited coho returns usually begin building the first week of August, ending by the end of August (ibid.).

Coho salmon in LCI are primarily harvested by purse seine (table 10). Troll catches recorded for the Eastern District are not directly a function of the commercial fishery but are catches sold from the Seward Silver Salmon Derby (Schroeder, pers. comm.).

Commercial seining in Resurrection Bay is conducted under a policy developed by the Board of Fisheries in December 1976. This policy is designed to minimize conflicts between recreational and commercial users (Logan 1982). It basically states that

- no commercial fishery will occur until after August 15;
- no commercial fishery will occur 48 hours prior to or after the Seward Salmon Derby;
- reasonable separation by area will be maintained by sport and commercial users;
- and the fishery will be closely monitored by the Divisions of Commercial Fish, Sport Fish, and Protection staffs.

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen

Table 10. Commercial Harvest of Coho Salmon in Numbers of Fish by Gear Type and District for the LCI Management Area, 1974-83

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	2,915	3,041	1,111	105	1,584	1,116	2,495	1,845	38,685	7,138
Southern	44	702	584	370	1,265	3,093	3,530	1,241	1,608	1,634
Barren Island	0	66	0	0	0	0	0	0	0	0
Outer District	28	7	0	1,528	45	150	16	485	92	54
Eastern	0	0	0	0	0	0	8	0	377	0
Total	2,987	3,816	1,695	2,003	2,894	4,359	6,049	3,571	40,762	8,827

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	3,010	2,337	1,321	869	3,053	7,595	8,038	6,735	5,557	1,955
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	3,010	2,337	1,321	869	3,053	7,595	8,038	6,735	5,557	1,955

(continued)

Table 10 (continued).

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
					Harvest by Troll					
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	517	124	200	360	582	296	418	472	573	593
Total	517	124	200	360	582	296	418	472	573	593

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
				Total Harvest of Coho Salmon for All Gear Types for LCI						
Kamishak	2,915	3,041	1,111	105	1,584	1,116	2,495	1,845	38,685	7,138
Southern	3,054	3,039	1,905	1,239	4,318	10,688	11,568	7,976	7,165	3,589
Barren Island	0	66	0	0	0	0	0	0	0	0
Outer District	28	7	0	1,528	45	150	16	485	92	54
Eastern	517	124	200	360	582	296	426	472	950	594
All gear total for mgmt. area	6,514	6,277	3,216	3,232	6,529	12,250	14,505	10,778	46,892	11,375

Source: ADF&G 1982b; Div. Commer. Fish., IBM Fish Ticket Summaries (April 1984).

issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See III.B.1.b. above for a summary of the total fishing effort.)

5. Pink salmon:
   a. Harvest summary. Pink salmon are the dominant species harvested in LCI, comprising about 83% of the total LCI salmon harvest. About 98% of the catch is taken by purse seine. About 39% of the purse seine and gill net harvest combined occurs within the Southern District (table 11).
      LCI pink salmon exhibit odd-year run strengths. Pink salmon enter the Southern District in late June or early July and usually peak by the last week of July or the first week of August. Pink salmon move into the southern portion of the Kamishak District in mid July (Middleton 1981). Old catch records indicate that the peak period of natural salmon production in LCI occurred from 1940 through 1947 (ibid.). Average catches from 1975 through 1982 have exceeded this period but have been profoundly affected by Hatchery production (Schroeder, pers. comm.). Catches have ranged from a low of 28,700 fish in 1972 to a peak of about 3.3 million fish in 1981. The 1983 harvest totaled 927,451. Catches since 1974 have averaged about 396,200 fish annually during even years and 1.9 million fish in odd years.
   b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See III.B.1.b. above for a summary of the total fishing effort.)

6. Chinook salmon:
   a. Harvest summary. The chinook salmon harvest in LCI is incidental to other species. Over 90% of the catch is taken in the Southern District. Because spawning of chinook salmon is minimal in LCI, it is believed that those caught are destined for UCI river systems. Set net catches since 1981 have intercepted large numbers of Halibut Cove chinook salmon (Schroeder, pers. comm.). Most of the chinook salmon are caught in the Southern District during July, leading biologists to believe these fish are from the late Kenai River stock (ibid.). Chinook salmon catches in LCI are small, ranging from 10 fish in 1965 to a peak harvest of 1,747 fish in 1978. Since 1974, catches have averaged about 740 fish annually (table 12).

Table 11. Commercial Harvest of Pink Salmon in Numbers of Fish by Gear Type and District for the LCI Management Area, 1974-83

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	48	9,432	1,112	6,308	982	58,484	101,864	66,097	43,871	1,405
Southern	37,778	844,125	86,405	118,632	240,205	913,161	451,406	1,382,228	280,718	669,721
Barren Island	0	2	0	0	0	0	0	0	0	0
Outer District	1,678	160,291	93	1,127,800	70,080	1,945,521	154,041	1,714,115	67,456	199,794
Eastern	0	0	35,423	1,349	29,738	0	155,779	44,987	143,639	36,154
Total	39,504	1,013,850	123,033	1,254,089	341,005	2,917,166	863,090	3,207,427	535,684	907,074

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	94	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	94	0	0	0	0	0	0	0	0

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	11,097	49,490	13,412	38,064	11,556	69,368	26,613	68,794	15,838	20,377
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	11,097	49,490	13,412	38,064	11,556	69,368	26,613	68,794	15,838	20,377

(continued)

Table 11 (continued).

Harvest by Troll

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	2	0	0
Total	0	0	0	0	0	0	0	2	0	0

Total Harvest of Pink Salmon for All Gear Types for LCI

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	48	9,432	1,112	6,308	982	58,484	101,864	66,097	43,871	1,405
Southern	48,875	893,709	99,817	156,696	251,761	982,529	478,019	1,451,022	296,556	690,098
Barren Island	0	2	0	0	0	0	0	0	0	0
Outer District	1,678	160,291	93	1,127,800	70,080	1,945,521	154,041	1,714,115	67,456	199,794
Eastern	0	0	35,423	1,349	29,738	0	155,779	44,989	143,639	36,154
All gear total for mgmt. area	50,601	1,153,721*	136,445	1,292,153	352,561	2,986,534	889,703	3,276,223	551,522	927,451

Source: ADF&G 1982b; Div. Commer. Fish., IBM Fish Ticket Summaries (April 1984).

* Includes 90,287 from unknown district in 1975.

Table 12. Commercial Harvest of Chinook Salmon in Numbers of Fish by Gear Type and District for the LCI Management Area, 1974-83

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Harvest by Purse Seine										
Kamishak	0	0	1	1	0	9	0	1	11	1
Southern	7	46	266	7	459	716	189	802	32	36
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	1	0	7	34	236	30	10	61	129	14
Eastern	0	1	0	0	0	0	0	0	0	0
Total	7	47	274	42	695	755	199	864	172	51
Harvest by Drift Gill Net										
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Harvest by Set Gill Net										
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	175	96	176	175	1,052	483	225	222	894	822
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	0	0	0	0
Total	175	96	176	175	1,052	483	225	222	894	822

(continued)

Table 12 (continued).

Harvest by Troll

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	0	0	0	0	0	0	0	0
Southern	0	0	0	0	0	0	0	0	0	0
Barren Island	0	0	0	0	0	0	0	0	0	0
Outer District	0	0	0	0	0	0	0	0	0	0
Eastern	0	1	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	0

Total Harvest of Chinook Salmon for All Gear Types for LCI

District	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Kamishak	0	0	1	1	0	9	0	1	11	1
Southern	182	142	442	182	1,511	1,199	414	1,024	926	858
Barren Island	0	1	0	0	0	0	0	0	0	0
Outer District	0	0	7	34	236	30	10	61	129	14
Eastern	0	1	0	0	0	0	0	0	0	0
All gear total for mgmt. area	182	144	450	217	1,747	1,238	424	1,086	1,066	873

Source: ADF&G 1982b; Div. Commer. Fish., IBM Fish Ticket Summaries (April 1984).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See III.B.1.b. above for a summary of the total fishing effort.)

C. Harvest Methods

Hand purse seines may be used in all fishing districts of the LCI Management Area. Power seining is prohibited. Harvest by set nets is permitted only along very restricted beach areas in the Southern District. Although beach seines are legal, this gear has not been used in recent years. Drift gill netting has not been permitted in LCI since 1976 (ADF&G 1983a).

D. Period of Use

Salmon fishing by set gill net opens by regulation the first Monday in June (Schroeder, pers. comm.). The salmon purse seine fishery in all areas in LCI opens and closes by emergency order. The timing of the openings is determined by adequate escapement levels being reached in contributing river systems, which varies between years and areas for the entire LCI area. Generally speaking, salmon fisheries may occur from the first of June through September 15 (ADF&G 1983b; Haanpaa, pers. comm.).

E. Management Objectives and Considerations

Salmon management in LCI is directed at three species (sockeye, pink, and chum), with additional emphasis on coho salmon in recent years because of subsistence importance. Salmon return to streams located within a number of bays in the LCI area. These areas are managed separately and as close to the stream of origin as possible to obtain stock-specific optimum management of the returns (ADF&G 1983b).

A discussion of the Southern District Personal Use Coho Salmon Fishery Management Plan and the Cook Inlet Personal Use Dip Net Fishery Management Plan as it applies to the LCI area is contained in sections III. A. and B. of the Salmon Personal Use narrative found elsewhere in this volume.

F. Significance of Particular Use Areas

A series of 1:250,000-scale reference maps have been prepared that depict areas used for commercial salmon harvest. Categories of mapped information include the following:

- Gear type
- Target species

G. Economic Analysis of Salmon in the LCI Management Area

Information concerning the value of salmon within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife Use volume.

IV. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

A. Boundaries

The PWS Management Area encompasses all coastal waters and inland drainages entering the northcentral Gulf of Alaska between Cape

Suckling and Cape Fairfield (map 2) (ADF&G 1983d). Districts and statistical areas used in the PWS to report commercial salmon harvest are listed in table 13.

B. Fishery Description and Reported Harvest

1. Salmon - all-species information:

a. Harvest summary. Five species of North American Pacific salmon are harvested in 11 management districts of the PWS Management Area. Pink salmon are the dominant species, comprising about 87% of the catch, followed by sockeye, chum, and coho salmon at respective contributions of 6%, 5%, and 2%. Chinook salmon occur primarily in the Copper River area and comprise less than 2% of the PWS catch (tables 14 through 18).

Harvest records in PWS are available since 1893. Catches for all species and districts averaged about 800,000 annually prior to 1915. Only one cannery, located at Eyak, operated during this period. Sockeye salmon was the preferred species. Chinook and coho salmon were second and third in importance. Most fishing occurred in the Copper River area, where these species were most abundant (PWSRPT 1984). Between 1915 and 1959, harvest levels increased, with construction of additional canneries and expansion of fishing effort into PWS. As pink salmon fisheries developed, interest in sockeye salmon remained relatively stable. The total salmon catch increased, reaching a record harvest prior to statehood of 14.8 million fish in 1945. Harvest levels then declined drastically, resulting in the closure of the PWS fishery in 1954 and 1955 (ibid.).

The closures resulted in rebuilding even-year pink salmon runs (ibid.). With the change to state jurisdiction, establishment of escapement goals, and adjustments in fishing time, chum and pink salmon harvests increased for a brief period of time. The 1964 earthquake damaged spawning habitat, causing supporting stocks to decline (ibid.).

The total salmon harvest since statehood fluctuated from 1.2 million fish in 1972 to a record harvest of 24.8 million fish in 1982. Since 1974, the PWS salmon harvest has averaged about 12 million fish annually. About 16.5 million fish were taken during the 1983 season (table 19).

b. Effort. A total of 822 permanent salmon permits have been issued for the PWS area, of which 612, or 74%, are held by Alaskan residents (CFEC 1984). Drift gill net fisheries are most numerous and are permitted to fish in the Bering River, Copper River, Coghill, Unakwik, and Eshamy districts. By 1983, a total of 533 permanent drift gill net permits were issued, of which 396 were held by Alaskan residents. Two hundred and fifty-nine

Table 13. Districts and Statistical Areas Used for Reporting Commercial Salmon Harvest in the PWS Management Area, 1969-83

District	Years	Statistical Areas
Bering River	1969-1974 1975-1983	200-10,20,30,40 100-10,20,30
Copper River	1969-1974 1975-83	212-00,10,12,20,24,30 212-10,20,30
Eastern	1969-1974 1975-1983	221-00,10,20,30,40,50,60 221-10,20,30,40,50,60,62
Northern	1969-1974 1975-1983	222-10,20,30,40 222-10,20,21,30,40
Coghill	1969-1974 1975-1983	223-10,20,30,40,50 223-10,20,30,40
Southeastern	1969-1974 1975-1983	228-00 to 70,90 228-10,20,30,40,50,60,70,90
Northwestern	1969-1974 1975-1983	224-00 to 40 224-10,20,30,40
Eashamy	1969-1983	225-10,20,21,30,32,40,50
Southwestern	1969-1983	226-00,10,20,30,40,50,60,61,62
Montague	1969-1983	227-00,10,20,30,40
Unakwik	1969-1983	222-50

Source: Div. of Commer. Fish., IBM Fish Ticket Summaries (April 1985).

Table 14. Commercial Harvest of Sockeye Salmon in Numbers of Fish by Gear Type and District for the PWS Management Area, 1974-83

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	12,640	0	0	16,918	0	0	684	0[b]	0[b]	724
Unakwik	10,449	11,922	8,421	7,912	9,116	9,250	1,547	2,445	48,947	13,275
Coghill	96,110	146,116	58,963	154,341	193,899	75,753	56,957	101,058	929,965	37,986
Copper River	607,766	335,687	865,195	619,140	249,872	80,528	18,908	477,622	1,177,632	633,010
Bering River	4,208	21,637	30,908	14,445	33,554	139,015	0	55,585	129,667	179,273
General purse seine[c]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[d]	0	0	0	0	0	0	0	0	0	0
Total	731,173	515,362	963,487	812,756	486,441	304,546	78,096	636,710	2,286.211	864,268

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	6,394	0	0	9,889	0	0	2,000	0	0	1,328
Unakwik	0	0	0	0	0	0	0	0	0	0
Coghill	0	0	0	0	0	0	0	0	0	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[c]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[d]	0	0	0	0	0	0	0	0	0	0
Total	6,394	0	0	9,889	0	0	2,000	0	0	1,328

(continued)

Table 14 (continued).

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	0	0	0	0	0	0	0	0	0	0
Unakwik	0	0	0	0	268	0	6	108	2	6
Coghill	4,273	6,367	6,942	16,436	9,623	3,047	2,159	1,997	17,446	169
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[c]	0	25,208	38,476	104,863	9,177	61,990	126,463	147,654	58,669	37,542
Hatchery sales[d]	0	0	0	0	0	0	0	0	0	0
Total	4,273	31,575	45,425	121,299	19,068	65,037	128,628	149,760	76,117	37,717

Total Harvest of Sockeye Salmon for All Gear Types for PWS

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	19,034	0	0	26,807	0	0	2,684	0	0	2,052
Unakwik	10,449	11,922	8,428	7,912	9,384	9,250	1,553	2,553	48,949	13,281
Coghill	100,383	152,483	65,905	170,777	203,522	78,800	59,116	103,055	947,411	38,155
Copper River	607,766	335,687	865,195	619,140	249,872	80,528	18,908	477,622	1,177,632	633,010
Bering River	4,208	21,637	30,908	14,445	33,554	139,015	0	55,585	129,667	179,273
General purse seine[c]	0	25,208	38,476	104,863	9,177	61,990	126,463	147,654	58,669	37,542
Hatchery sales[d]	0	0	0	0	0	0	0	1	0	0
All gear total for mgmt. area	741,840	546,937	1,008,912	943,944	505,509	369,583	208,724	786,470	2,362,328	903,313

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Closed to fishing.

c Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

d Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

Table 15. Commercial Harvest of Chum Salmon in Numbers of Fish by Gear Type and District for the PWS Management Area, 1974-83

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	23,488	0	0	8,344	0	0	130	0	0	2,754
Unakwik	500	70	331	141	597	289	727	1,330	597	1,423
Coghill	51,428	39,762	110,994	127,476	110,679	56,916	68,071	135,962	246,694	232,098
Copper River	664	807	178	335	2,233	107	198	1,799	1,177	2,217
Bering River	2	0	1	221	2,391	23,094	0	8,307	333	4,615
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	76,082	40,639	111,504	136,517	115,900	80,406	69,126	147,398	248,801	243,107

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	5,408	0	0	4,218	0	0	134	0	0	3,429
Unakwik	0	0	0	0	0	0	0	0	0	0
Coghill	0	0	0	0	0	0	0	0	0	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	5,408	0	0	4,218	0	0	134	0	0	3,429

(continued)

Table 15 (continued).

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	0	0	0	0	0	0	0	0	0	0
Unakwik	0	0	231	0	5,025	0	355	17,650	517	693
Coghill	7,720	4,905	55,809	37,102	14,007	5,709	4,702	23,378	135,553	8,598
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	0	55,742	203,113	395,329	354,839	263,500	407,891	1,700,278	952,006	792,265
Hatchery sales[c]	0	0	0	0	0	0	6	118	0	0
Total	7,720	60,647	259,153	432,431	373,871	269,209	412,954	1,741,424	1,088,076	801,556

Total Harvest of Chum Salmon for All Gear Types for PWS

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	28,896	0	0	12,562	0	0	264	0	0	6,183
Unakwik	500	70	562	141	5,622	289	1,082	18,980	1,114	2,116
Coghill	59,148	44,667	166.803	164,578	124,686	62,625	72,773	159,340	382,247	240,696
Copper River	664	807	178	335	2,233	107	198	1,799	1,177	2,217
Bering River	2	0	1	221	2,391	23,094	0	8,307	333	4,615
General purse seine[b]	0	55,742	203,113	395,329	354,839	263,500	407,891	1,700,278	952,006	792,265
Hatchery sales[c]	0	0	0	0	0	0	6	118	0	0
All gear total for mgmt. area	89,210	101,286	370,657	573,166	489,771	349,615	482,214	1,888,822	1,336,877	1,048,092

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

c Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

Table 16. Commercial Harvest of Coho Salmon in Numbers of Fish by Gear Type and District for the PWS Management Area, 1974-83

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	114	0	0	49	0	0	25	0	0	9
Unakwik	3	0	0	2	0	9	6	0	0	0
Coghill	103	472	206	49	64	1,837	1,053	1,008	213	752
Copper River	46,625	53,502	111,900	131,356	220,338	194,885	225,299	310,154	454,763	234,243
Bering River	28,615	24,162	42,423	47,218	91,097	114,046	108,872	82,626	144,752	117,669
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	75,460	78,136	154,529	178,674	311,499	310,777	335,255	393,788	599,728	352,673

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	11	0	0	2	0	0	38	0	0	13
Unakwik	0	0	0	0	0	0	0	0	0	0
Coghill	0	0	0	0	0	0	0	0	0	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	11	0	0	2	0	0	38	0	0	13

(continued)

Table 16 (continued).

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	0	0	0	0	0	0	0	0	0	0
Unakwik	0	0	0	0	5	0	0	0	4	0
Coghill	22	134	30	50	34	55	0	0	29	16
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	548	5,536	5,935	691	1,392	4,942	1,830	3,375	24,116	9,706
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	570	5,670	5,965	741	1,431	4,997	1,830	3,375	24,149	9,722

Total Harvest of Coho Salmon for All Gear Types for PWS

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	125	0	0	51	0	0	63	0	0	22
Unakwik	3	0	0	2	5	9	6	0	4	0
Coghill	125	606	236	99	98	1,892	1,053	1,008	242	768
Copper River	46,625	53,502	111,900	131,356	220,338	194,885	225,299	310,154	454,763	234,243
Bering River	28,615	24,162	42,423	47,218	91,097	114,046	108,872	82,626	144,752	117,669
General purse seine[b]	548	5,536	5,935	691	1,392	4,942	1,830	3,375	24,116	9,706
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
All gear total for mgmt. area	76,041	83,806	160,494	179,417	312,930	315,774	337,123	397,163	623,877	362,408

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

c Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

Table 17. Commercial Harvest of Pink Salmon in Numbers of Fish by Gear Type and District for the PWS Management Area, 1974-83

Harvest by Drift Gill Net										
District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	217,141	0	0	63,036	0	0	3,235	0	0	164,856
Unakwik	10,911	84	2,744	257	2,082	2,359	4,815	4,152	335	1,517
Coghill	98,149	185,558	154,327	332,859	49,527	259,372	355,684	526,739	181,529	243,359
Copper River	9,839	236	3,392	23,185	3,512	1,295	3,966	23,952	7,154	7,345
Bering River	7	0	43	192	266	6,895	0	9,882	47	851
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	336,047	185,878	160,506	419,529	55,387	269,921	367,700	564,725	189,065	417,928

Harvest by Set Gill Net										
District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	68,300	0	0	24,743	0	0	2,371	0	0	190,153
Unakwik	0	0	0	0	0	0	0	0	0	0
Coghill	0	0	0	0	0	0	0	0	0	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	68,300	0	0	24,743	0	0	2,371	0	0	190,153

(continued)

Table 17 (continued).

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	0	0	0	0	0	0	0	0	0	0
Unakwik	0	0	9,403	0	55,115	0	9,113	71,624	89,837	2,460
Coghill	54,268	303,597	217,696	230,215	13,059	38,560	134,876	34,083	1,006,579	40,326
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	4	3,963,566	2,634,821	3,861,972	2,660,290	15,083,568	13,290,135	19,180,835	17,762,418	12,711,549
Hatchery sales[c]	0	0	0	0	133,648	223,761	356,828	707,037	1,355,524	765,924
Total	54,272	4,267,163	2,861,920	4,092,187	2,862,112	15,345,889	13,790,952	19,993,579	20,214,358	13,520,259

Total Harvest of Pink Salmon for All Gear Types for PWS

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	285,441	0	0	87,779	0	0	5,606	0	0	355,009
Unakwik	10,911	84	12,147	257	57,197	2,359	13,928	75,776	90,172	3,977
Coghill	152,417	489,155	372,023	563,074	62,586	297,932	490,560	560,822	1,188,108	283,685
Copper River	9,839	236	3,392	23,185	3,512	1,295	3,966	23,952	7,154	7,345
Bering River	7	0	43	192	266	6,895	0	9,882	47	851
General purse seine[b]	4	3,963,566	2,634,821	3,861,972	2,660,290	15,083,568	13,290,135	19,180,835	17,762,418	12,711,549
Hatchery sales[c]	0	0	0	0	133,648	223,761	356,828	707,037	1,355,524	765,924
All gear total for mgmt. area	458,619	4,453,041	3,022,426	4,536,459	2,917,499	15,615,810	14,161,023	20,558,304	20,403,423	14,128,340

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

c Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

Table 18. Commercial Harvest of Chinook Salmon in Numbers of Fish by Gear Type and District for the PWS Management Area, 1974-83

Harvest by Drift Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	18	0	0	22	0	0	0	0	0	1
Unakwik	5	4	4	3	24	11	0	0	1	8
Coghill	156	674	138	124	469	543	107	152	127	596
Copper River	18,980	19,644	31,479	22,089	29,062	17,678	8,454	20,178	47,362	50,022
Bering River	32	162	228	127	331	385	0	200	254	610
General purse seine[b]	0	0	0	0	0	0	0	0	0	1
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	19,191	20,484	31,849	22,365	29,886	18,617	8,561	20,530	47,744	51,238

Harvest by Set Gill Net

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	4	0	0	9	0	0	0	0	0	1
Unakwik	0	0	0	0	0	0	0	0	0	0
Coghill	0	0	0	0	0	0	0	0	0	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	0	0	0	0	0	0	0	0	0	0
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	4	0	0	9	0	0	0	0	0	1

(continued)

Table 18 (continued).

Harvest by Purse Seine

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	0	0	0	0	0	0	0	0	0	0
Unakwik	0	0	0	0	3	0	0	0	0	0
Coghill	181	316	88	40	206	692	0	1	23	0
Copper River	0	0	0	0	0	0	0	0	0	0
Bering River	0	0	0	0	0	0	0	0	0	0
General purse seine[b]	1,215	1,525	779	450	340	769	82	252	104	438
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
Total	1,396	1,841	867	490	549	1,461	82	253	127	438

Total Harvest of Chinook Salmon for All Gear Types for PWS

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	22	0	0	31	0	0	0	0	0	2
Unakwik	5	4	4	3	27	11	0	0	1	8
Coghill	337	990	226	164	675	1,235	107	153	150	596
Copper River	18,980	19,644	31,479	22,089	29,062	17,678	8,454	20,178	47,362	50,022
Bering River	32	162	228	127	331	385	0	200	254	610
General purse seine[b]	1,215	1,525	779	450	340	769	82	252	104	439
Hatchery sales[c]	0	0	0	0	0	0	0	0	0	0
All gear total for mgt. area	20,591	22,325	32,716	22,864	30,435	20,078	8,643	20,783	47,871	51,677

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

c Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

Table 19. Commercial Harvest of Salmon in Numbers of Fish by District and Year for the PWS Management Area, 1974-83

District	1974	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983[a]
Eshamy	333,518	0	0	127,230	0	0	8,617	0	0	363,268
Unakwik	21,868	12,080	21,141	8,315	72,235	11,918	16,569	97,309	140,240	19,382
Coghill	312,410	687,901	605,193	898,692	391,567	442,484	623,609	824,378	2,518,158	563,900
Copper River	683,874	409,876	1,012,144	796,105	505,017	294,493	256,825	833,705	1,688,088	926,837
Bering River	32,864	45,961	73,603	62,203	127,639	283,435	108,872	156,600	275,053	303,018
General purse seine[b]	1,767	4,050,052	2,883,124	4,363,305	3,026,038	15,414,769	13,826,319	21,032,394	18,797,313	13,551,501
Hatchery sales[c]	0	0	0	0	133,648	223,761	356,916	707,156	1,355,524	765,924
Total	1,386,301	5,207,395	4,595,205	6,255,850	4,256,144	16,670,860	15,197,727	23,651,542	24,774,376	16,493,830

Source: ADF&G 1983d; Randall, pers. comm.; ADF&G, IBM fish ticket summaries (April 1984).

a Preliminary data.

b Includes the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts.

c Includes sales harvests of returns to PWS Aquaculture Corporation hatchery at Port San Juan, Evans Island; NERKA, Inc., hatchery at Perry Island; and Valdez Fisheries Development Association hatchery at Solomon Gulch. Doesn't include estimates of common property interceptions.

purse seine permits, which are restricted to PWS proper, have been issued in the 1983 season, of which 188 were held by Alaskan residents. Set net gear is legal only in the Eshamy District, where only 30 permits have been issued, of which 28 permit holders are Alaskan residents (CFEC 1984, ADF&G 1984c).

2. Sockeye salmon:
   a. Harvest summary. During the early years of the fishery, sockeye salmon were the most important species harvested in the PWS area. From 1889 through 1915, the fishery occurred near the Copper River delta, where sockeye salmon are the most abundant species. Emphasis, however, changed to pink and chum salmon fisheries in the general PWS area, and interest in sockeye salmon declined (PWSRPT 1984). Though sockeye salmon are currently harvested incidentally in the purse seine fishery, most of the harvest is by drift gill net in the Eshamy, Copper River, Bering River, Unakwik, And Coghill districts (table 14).

      The Eshamy District was closed during the 1981 and 1982 seasons because of low returns to the Eshamy River system. Based on available information regarding sockeye salmon from the Eshamy System, it appears that sockeye salmon returns to the General District build slowly through July and August and are generally most abundant the first part of August (ADF&G 1978).

      The Bering District sockeye salmon run normally begins in mid June and extends to early July. Peak catches normally occur the last week of June (ibid.).

      Since 1974, PWS sockeye salmon catches have ranged from a low of 208,724 fish in 1980 to a peak of 2,262,328 fish in 1982, averaging 627,756 fish annually. About 903,313 fish were harvested during the 1983 season (table 14).

      The only enhancement program for sockeye salmon in PWS is the Gulkana River Sockeye Enhancement Project located in the Gulkana River. The project is a streamside incubation facility first built in 1973. The project has expanded since, with a capacity for 26.7 million eggs, significantly contributing to sockeye salmon production in the Copper River drainage (Roberson, pers. comm.).
   b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See VI.B.1.b. above for a summary of the total fishing effort.)

3. Chum salmon:

a. Harvest summary. Development of the fishery for chum salmon in PWS has been concurrent with developing exploitation of pink salmon (PWSRPT 1984). The first commercial catch of chum salmon was recorded in 1912; catches became significant by 1916. Harvest levels have fluctuated throughout the history of the fishery, ranging from 100 fish taken in 1913 to a peak catch of about 1.9 million fish harvested during the 1981 season (ADF&G 1984a). Since 1973, catches have averaged about 672,237 fish annually (table 15). About 1,048,092 fish were taken in 1983 (table 15).

PWS chum salmon populations do not return to spawn all at one time but consist of an early, middle, and late run. Early run stocks enter the sound from the northern Gulf of Alaska between late April and early July. The timing of middle-run chum salmon coincides with the main pink salmon run into PWS, which peaks from the first to the third week of August. The late-run chum salmon move into PWS through mid and late July and concentrate in the fjords after August 10 (ADF&G 1978).

There are several enhancement programs in PWS, whose purpose is to increase chum salmon production, primarily for the gill net fishery, with minor contributions to the purse seine fishery. These include the Main Bay hatchery, Esther Lake hatchery (proposed), Port San Juan, and Solomon Gulch.

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See IV.B.1.b. above for a summary of the total fishing effort.)

4. Coho salmon:

a. Harvest summary. Throughout the history of the fishery, catches of coho salmon have fluctuated between 400 fish taken in 1913 to 773,600 fish taken in 1942 (ADF&G 1984a). Coho salmon populations are relatively small throughout the PWS area. Most coho production occurs in the Bering and Copper river areas. In the Bering River fishery, the coho salmon run begins in mid August, extending into late September. Peak catches generally occur in early September. Coho salmon are generally available to the Copper River fishery in early August, with peak catches occurring about the second week of September (ADF&G 1978; Schroeder, pers. comm.).

The Copper River drift gill net fishery has produced the largest and most consistent harvest of coho salmon in the PWS area (ibid.), accounting for about 70% of the harvest since 1974 (table 16).

The harvest of coho salmon has ranged from the 76,041 fish taken in 1974 to the 623,877 fish taken in 1982, with an average annual harvest of 284,904 fish. About 362,408 coho salmon were taken during the 1983 season (table 16).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See IV.B.1.b. above for a summary of the total fishing effort.)

5. Pink salmon:

a. Harvest summary. Pink salmon are the most important salmon species in PWS. Though the first harvest of pink salmon was recorded in 1896, their harvest did not dominate the fishery until 1916 (ADF&G 1984a). Long-term averages show somewhat higher abundance in the even-year stocks, but odd-year stocks have periodically exhibited several years of high abundance (ADF&G 1978). Three runs of pink salmon occur in PWS. The early run peaks generally between late July through the first part of August. The middle runs peak from the first through the third week of August, and the late run usually peaks from the third week of August through the first week of September (ibid.).

Most of the pink salmon harvested in PWS are taken by purse seine. Purse seine fisheries usually begin in early to mid July, depending on the strength of early pink salmon runs, and extend into the first or second week of August (ibid.). Pink salmon are also harvested in smaller numbers in the gill net districts (Eshamy, Bering River, Copper River, Coghill, and Unakwik). Historical catches range from 1,200 pink salmon taken in 1959 to the record harvest of about 20.6 million fish harvested in 1981. Since 1974, harvest has averaged 8.2 million fish in even years and 11.9 million fish in odd years (table 17), providing 19% of the statewide harvest in even years and 28% in odd years.

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See VI.B.1.b. above for a summary of the total fishing effort.)

6. Chinook salmon:

a. Harvest summary. Commercial harvest of chinook salmon in the PWS purse seine fishery is minor. Most of the harvest is by drift gill net and has occurred in the Copper River District (table 18). The Copper River chinook salmon run generally begins in mid May and continues into July. Peak catches primarily occur during the last week of May (Randall, pers. comm.). Historically, catches of PWS chinook salmon have ranged from 5,500 fish recorded in 1980 to a record harvest of 51,677 salmon taken during the 1983 fishery. During the past 10 years, the lowest harvest occurred during the 1980 season, when 8,643 fish were harvested. Catches since 1973 have averaged 27,681 chinook salmon annually (table 18).

b. Effort. Because effort is measured by the number of permit holders fishing and because all fishermen issued salmon permits may fish all species, it is difficult to determine the number of fishermen targeting on one species. (See IV.B.1.b. above for a summary of the total fishing effort.)

C. Harvest Methods

Salmon in the commercial fishery have been harvested by troll gear, fish traps, purse seine, and both drift and set gill net. Traps were banned statewide in 1958. Troll gear in PWS was eliminated by the 1974 salmon season (ADF&G 1973, 1974). Currently, legal gear differs with each district. Purse seine only may be fished in the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts. Drift nets are legal in the Copper and Bering river districts. Drift gill nets and purse seines may be employed in the Unakwik and Coghill districts, and both drift and set gill nets are legal in the Eshamy District (ADF&G 1983a).

D. Period of Use

The salmon season generally commences in mid May for chinook and sockeye salmon in the Copper River District. The Coghill-Unakwik district's drift gill net fishery for sockeye salmon begins in mid June and ends in mid July. The purse seine fisheries targeting on chum and pink salmon usually begin in early to mid July, depending on the strength of the early pink salmon runs. It extends into the second week of August. The Eshamy District fishery for late-run sockeye salmon utilizes both drift and set gill nets and commences in mid July and extends to early September. A late-season coho salmon fishery in the Copper and Bering river districts generally begins in early August and extends through late September (ADF&G 1978; Randall, pers. comm.). The salmon season's opening and closure is entirely dependent upon the timing and strength of the salmon run into each district and is therefore controlled by emergency order (ADF&G 1984c).

E. Management Objectives and Considerations

The goal of the PWS salmon fishery unit program is to manage the commercial salmon fisheries of PWS on a district-by-district basis to 1) achieve desired escapement objectives and optimum distribution of individual spawning stocks within individual fishing districts; 2) allow an orderly common-property fishery targeting on the annual harvestable surplus of natural stocks of salmon returning to individual fishing districts; 3) continue to rebuild those natural stocks impacted by the 1964 earthquake so that they can sustain a larger yield in the future; and 4) provide an orderly common property fishery targeting on hatchery salmon stocks returning to various facilities located in PWS when these stocks are surplus to operating costs and hatchery egg-take needs (ADF&G 1983b).

Salmon management in PWS is directed at four species (sockeye, pink, chum, and coho salmon). Fisheries are managed on an emergency order basis to meet the area's objectives and management plans established by the Alaska Board of Fisheries and the Alaska Department of Fish and Game (ADF&G 1984c).

1. Harvest of natural and hatchery pink and chum salmon stocks. The recent development in the 1970's of pink and chum salmon hatcheries in the greater PWS area has required a management policy for both hatchery and natural stocks. Management should provide for the harvest of the hatchery returns to ensure a quality catch yet provide a sufficient and timely escapement. Because hatchery and natural stocks can withstand varying exploitation rates, it is difficult to schedule fishing time when these stocks are mixed in the fishery. Information provided by tagging studies has helped to identify timing and migration routes to hatchery stocks in PWS.
2. Interception fisheries. Another complication is that of cape fisheries where the commercial fleet fishing in some areas intercepts pink and chum salmon destined for other districts in PWS. This could result in multiple harvest of some stocks and is an important consideration in management of both natural and hatchery stocks. Studies have been undertaken to model the fishery to optimize the harvest and better ensure optimum escapements for each management district (ADF&G 1984c, 1969).
3. Copper River. The Copper River system supports a commercial fishery at the mouth of the river. Salmon migrating up the river are also harvested by traditional subsistence and personal use fisheries. In addition, sportfishing for salmon occurs within the Copper River. To provide for the interest of all user groups, the Board of Fisheries adopted the Copper River District Salmon Management Plan in 1980, with revision in 1984 (ADF&G 1984). The plan provides for harvest levels of chinook and sockeye salmon - the subsistence, personal use, and commercial fisheries - based on forecast and in-season run strength (Roberson 1984). The plan specifies gear restrictions, weekly quotas, length of fishing period, and allowable catch of sockeye salmon as incidental harvest (ibid.).

   Currently, a stock-identification program has been implemented to determine the stock contribution of fish from the upper Copper River drainage, small watersheds of the

Copper River delta, and from the Bering River throughout the duration of the commercial fishery (Sharr et al. 1982). This information will help to define the timing of the migration of various stocks through these subdistricts, helping managers to selectively harvest or protect the various stocks in order to provide optimum yield (ADF&G 1983b).

4. Kayak Island. At the extreme southeastern end of the PWS Management Area in the Bering River District is Kayak Island. The southern tip of Kayak Island extends into the open waters of the Gulf of Alaska and is directly in the Gulf Current and main path of salmon migrating through the area. Beginning with the 1978 season, a shift in fishing effort has occurred in the waters outside of PWS southeast of Kayak Island. The overall trend has resulted in an increase in both peak effort and average seasonal harvest of sockeye salmon from the area (ADF&G 1984b).

   Concern has been expressed, particularly by Yakutat area fishermen, that Kayak Island catches are composed of a significant portion of fish from river systems other than the Bering River. Analysis of available data indicates that Copper River and Copper River delta stocks, as well as nonlocal stocks, contribute to Kayak Island catches (ADF&G 1984d).

F. Significance of Particular Use Areas

A series of 1:250,000-scale reference maps has been prepared that depicts areas used for commercial salmon harvest. Categories of mapped information include the following:

- Gear type
- Target species

G. Economic Value of Salmon in the PWS Management Area

Information concerning the value of salmon within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife Use volume.

REFERENCES

ADF&G. 1969. Cape fisheries in Alaska. Rept. to the Board of Fisheries. Div. Commer. Fish., Cordova. 18 pp.

________. 1973. Alaska commercial fishing regulations. Div. Commer. Fish., Juneau.

________. 1974. Alaska commercial fishing regulations. Div. Commer. Fish., Juneau.

________. 1978. Alaska's fisheries atlas. Vol. 1 [R.F. McLean and K.J. Delaney, comps.]. 40 pp. + maps.

________. 1982a. Copper River-Prince William Sound area, Copper River subsistence salmon fishery management and research report to the Alaska Board of Fisheries. Div. Commer. Fish., Glennallen. 15 pp.

________. 1982b. Lower Cook Inlet annual finfish management report - 1982. Div. Commer. Fish., Homer. 91 pp.

________. 1983a. Regulations of the Alaska Board of Fisheries for commercial fishing (finfish) in Alaska. Div. Commer. Fish., Juneau. 182 pp.

________. 1983b. Summary and description of the program and component projects included in the Commercial Fisheries Division operational budget request. Div. Commer. Fish., Juneau. 637 pp.

________. 1983c. Annual finfish management report, 1982, Lower Cook Inlet. Div. Commer. Fish., Homer. 91 pp.

________. 1983d. Prince William Sound Area annual finfish management report. Div. Commer. Fish., Cordova. 135 pp.

________. 1984a. Alaska commercial salmon catches 1878-1983. Div. Commer. Fish., Juneau. 54 pp.

________. 1984b. Prince William Sound Area - catch composition analysis of the Kayak Island salmon fishery. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Anchorage. 20 pp.

________. 1984c. Prince William Sound Area - preliminary review of the 1983 salmon fishery. Management rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 35 pp.

________. 1984d. Prince William Sound Area - status of the Kayak Island salmon drift gill net fishery. Bering River District, 1974-83. Management rept. to the Alaska Board of Fisheries. Div. Commer. Fish. 12 pp.

________. 1984e. Upper Cook Inlet salmon allocation issues. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Anchorage. 64 pp.

________. 1984f. Lower Cook Inlet salmon fishery, 1983. Rept. to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 16 pp.

Commercial Fisheries Entry Commission (CFEC). 1984. The annual report of the Commercial Fisheries Entry Commission, State of Alaska. Juneau. 34 pp.

Cross, B.A. 1983. Origins of sockeye salmon in the Upper Cook Inlet fishery of 1981 based on peak pattern analysis. ADF&G, Tech. Data Rept. 83. Div. Commer. Fish., Anchorage. 98 pp.

Haanpaa, D. 1984. Personal communication. Mgt. Coordinator, Central Region, ADF&G, Div. Commer. Fish., Anchorage.

Logan, S.M. 1982. Major recreational and personal use dip net fisheries of the Kenai Peninsula. Rept. to the Alaska Board of Fisheries. ADF&G, Div. Sport Fish.

Middleton, K.R. 1981. Cook Inlet stock status report. Draft. ADF&G, Div. Commer. Fish., Anchorage. 110 pp.

PWSRPT (Prince William Sound Regional Fisheries Planning Team). 1984. Prince William Sound-Copper River Comprehensive Salmon Plan. Cordova. 176 pp.

Randall, R. 1985. Personal communication. Prince William Sound Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Glennallen.

Roberson, K. 1984. Copper River subsistence and personal use salmon fishery management and research report to the Alaska Board of Fisheries. Prince William Sound Data Rept. 84-12. ADF&G, Div. Commer. Fish., Glennallen. 21 pp.

________. 1985. Personal communication. Copper River Research Project Leader, ADF&G, Div. Commer. Fish., Glennallen.

Rowell, K.A., and K.R. Middleton. 1985. Upper Cook Inlet stock status report: a summary of commercial salmon, herring, and razor clam fisheries through 1982. ADF&G, Div. Commer. Fish., Anchorage. Draft rept.

Ruesch, P.H. 1984. Annual management report 1982 Upper Cook Inlet, Region II. Div. Commer. Fish., Soldotna. 83 pp.

Ruesch, P.H., and J.B. Browning. 1984. Upper Cook Inlet management report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., Soldotna. 29 pp.

Ruesch, P.H., and S.M. Logan. 1983. Management options related to late run Kenai River king salmon. Rept. to the Alaska Board of Fisheries. ADF&G, Soldotna. 35 pp.

Schroeder, T. 1985. Personal communication. Lower Cook Inlet Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Schroeder, T.R. 1984. Personal communication. Lower Cook Inlet Area Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer.

Sharr, S., D.R. Bernard, and W.E. Goshert. 1984. Origins of sockeye salmon (*Oncorhynchus nerka*) in the Copper River fishery of 1982 based on scale pattern analysis. ADF&G Informational Leaflet No. 109. Div. Commer. Fish., Juneau. 31 pp.

Commercial Harvest of Dungeness Crab

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Within the Southcentral Region are found the Cook Inlet, and Prince William Sound (PWS) management areas (Dungeness Crab Statistical Areas H and E, respectively). Dungeness crab are harvested commercially in the Lower Cook Inlet (LCI) (the southern portion of Statistical Area H) and PWS management areas. The following summaries will be presented by these two areas (maps 1 and 2).

B. Summary of Regional Fishery

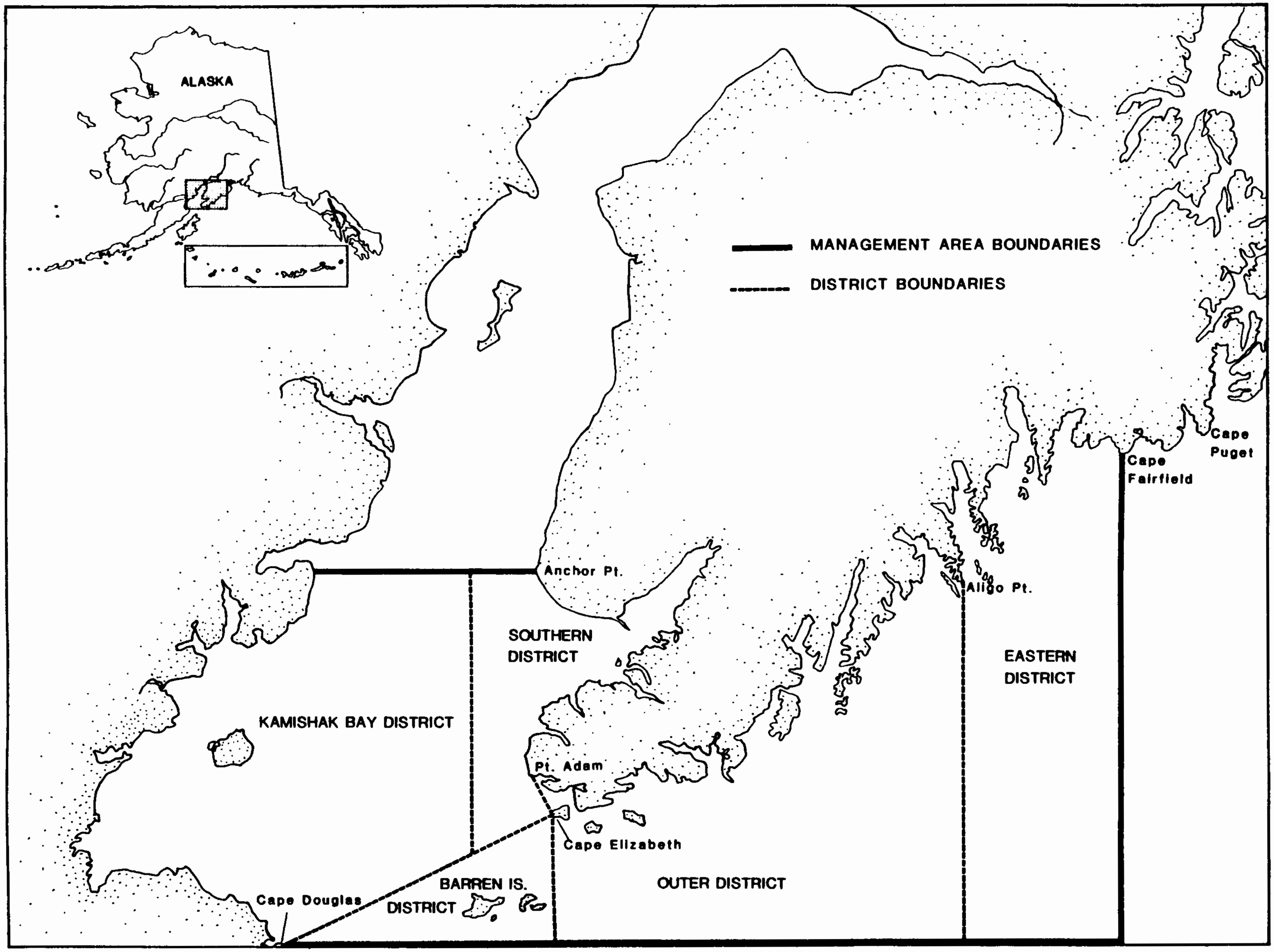
1. Harvest summary. The harvest of Dungeness crab was first documented in the Southcentral Region in the early 1900's. The fishery has been strongly influenced by West Coast market conditions. Therefore, good fishing seasons in Washington, Oregon, and California in past years have made it economically impractical for Alaskan Dungeness crab fishermen to compete in major markets. Therefore, historical catch data are not always a reliable indicator of stock abundance.

   The development and importance of the Dungeness fishery is different for each management area. Since 1974, however, the regionwide harvest has ranged from 409,600 lb, taken during the 1976 fishery, to a combined harvest of about 3.4 million pounds during the 1981 season (table 1). Since 1973, the Dungeness crab fishery in the Southcentral Region has averaged about 1.8 million pounds annually.
2. Managerial authority. The Dungeness crab fishery is regulated by the Alaska Department of Fish and Game based on policy established by the Alaska Board of Fisheries.
3. Gear type. Legal gear for Dungeness crab in the Southcentral Region are pots and ring nets.
4. Period of use. The fishing season for Dungeness crab is year-round, with closures by emergency order to avoid harvest of soft-shelled crabs. Seasons are different for each management area and for districts within each management area.

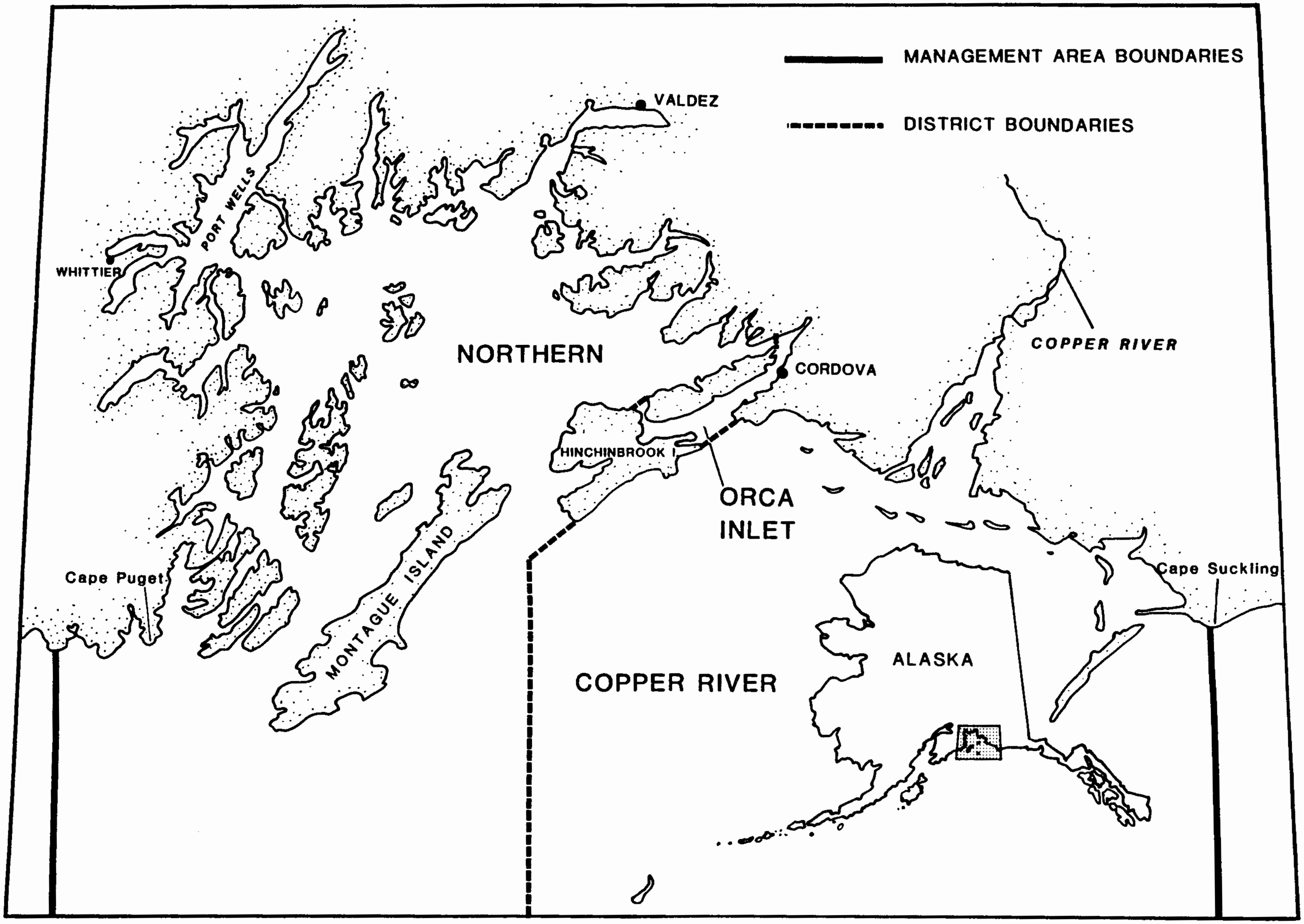
II. LOWER COOK INLET (LCI) MANAGEMENT AREA

A. Boundaries

The LCI Shellfish Management Area is comprised of all waters west of the longitude of Cape Fairfield (148°50'W), north of the latitude of Cape Douglas, and south of the latitude of Anchor Point. There are five shellfish districts grouped into three management units: 1) the Southern District, 2) the Kamishak Bay and Barren Islands districts, and 3) the Outer and Eastern districts (see map 1) (ADF&G 1983a).



Map 1. Dungeness crab commercial fishing districts of the LCI Management Area (ADF&G 1983a).



Map 2. Dungeness crab commercial fishing districts of the PWS Management Area (ADF&G 1983a).

Table 1. Commercial Harvest in Thousands of Pounds and Effort in Number of Vessels of Dungeness Crab for the Southcentral Region by Year, Management Area, and District

			Fishing Season									
Mgt. Area	District	Harvest/Effort	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LCI												
	Southern	Harvest	718.7	361.9	118.9	74.2	1,212.6	2,131.0	1,875.3	1,851.0	818.4	746.6
	All other[a]	Harvest	2.5	0.9	0.4	0.5	3.2	0	0	0	0.5	0.8
Mgt. area total		Harvest	721.2	362.8	119.3	74.7	1,215.8	2,131.0	1,875.3	1,851.0	818.9	747.4
Mgt. area total		Effort	38	34	19	18	49	72	54	88	128	71
PWS												
	Copper River	Harvest	290.1	654.4	254.9	506.8	1,319.5	504.8	659.7	1,503.6	757.9	379.1
		Effort	---	---	4	4	12	19	10	18	16	9
	Orca Inlet	Harvest	261.1[g]	163.6[c]	35.4[c]	228.9[c]	684.4	123.2	b	b	b	b
		Effort	---	---	3[c]	23[c]	34	32	b	b	b	b
	Northern[c]	Harvest	0[c]	0[c]	0[c]	0[c]	49.6	20.9	31.2	5.7	4.2	0.5
		Effort	---	---	---	---	17	16	5	5	2	2
Mgt. area total		Harvest	559.2	818.0	290.3	735.7	2,053.5	648.9	690.9	1,509.3	762.1	379.6
Mgt. area total		Effort[d]	e	e	e	e	e	e	e	e	e	e
Southcentral Region total		Harvest	1,280.4	1,180.8	409.6	810.4	3,269.3	2,779.9	2,566.2	3,360.3	1,581.0	1,127.0

Source: Kimker 1984, Kyle 1984.

--- means no data were available.

a Includes Outer, Kamishak, Barren Islands, and Eastern districts.

b No fishery.

c Northern District was included in Orca Inlet District prior to 1978.

d Effort for management area total is not necessarily the sum of district figures, because fishermen may fish in more than one district; therefore total effort is not available at this time.

B. Fishery Description and Reported Harvest

1. Harvest summary. Dungeness crabs in the Cook Inlet Management Area have been harvested intermittently since the early 1900's. Catches were primarily reported from the Kachemak Bay area of the Southern District. Harvest of Dungeness crab has been related more to market demand on the West Coast than to stock size. In recent years, poor king and Tanner crab fisheries have contributed to the overall increase in the Dungeness harvest (ADF&G 1983c). The crabs captured in LCI are relatively larger than crabs from other West Coast stocks. Therefore, the LCI crabs sell well as the whole crab, primarily in the Pacific Northwest market (Davis 1981). Though Dungeness crab catches were first reported in the 1920's, the fishery did not become a stable annual fishery until 1961. Since statehood, catches have ranged from 7,170 lb in 1967 to 2.1 million pounds taken in 1979. Peak effort of 128 vessels occurred during the 1982 season. The average Dungeness crab catch from the 1974 through the 1983 season has been about 1.0 million pounds. Approximately 99% of the LCI harvest has been taken from the Southern District. Some catches have been reported from the Kamishak and Outer districts. The 1983 harvest in Dungeness crab totaled 747,400 lb (table 1).
2. Harvest methods. Dungeness crab may be taken by pots in LCI. In 1979, the Alaska Board of Fisheries removed all shellfish pot limits in the Cook Inlet Management Area (ibid.).
3. Period of use. Based on tagging data, it appears that Dungeness crabs move in a northerly direction in June and July and then begin to migrate south through the fishing grounds along the Bluff Point area of Kachemak Bay in August and September. In 1983, most of the catch was taken from May through October, although the season runs through December 31 in the Bluff Point area (ADF&G 1981). In the remaining Cook Inlet area, the season extended from January 1 through December 31 (ADF&G 1983a).

C. Management Objectives and Considerations

It is the objective of management to allow maximum utilization of available shellfish surpluses without triggering declines in the stock. In order to maintain a conservative management policy, quotas, size limits, seasons, and other restrictions have been initiated in most areas. The managerial policy must remain conservative because it is difficult to estimate the long-term sustainable yield of Dungeness crab because of the fast development of the industry (ADF&G 1983c).

Stock assessment research has been limited for Dungeness crab in LCI. Tagging studies have delineated migrational patterns and indicated fishing mortality. Life history population abundance, and distribution data, however, are essential for adequate management of this species (ibid.).

D. Significance of Particular Use Areas

Most of the Dungeness crab harvest occurs in the Southern District of LCI. Kachemak Bay is the most productive section. The two primary harvest areas are Bluff Point west of Coal Point and the upper part of Kachemak Bay northeast of Coal Point (ADF&G 1980). A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- ° Commercial Dungeness crab harvest areas
- ° Commercial historic Dungeness crab harvest areas

E. Economic Value

Information concerning the value of Dungeness crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

A. Boundaries

The PWS Management Area (Dungeness Crab Statistical Area E) has as its western boundary the longitude of Cape Fairfield (148°50'W), its eastern boundary the longitude of Cape Suckling (143°53'W), and its seaward boundary the 200 fathom (366 m) depth contour (ADF&G 1983a). PWS is divided into three districts for management of Dungeness crab. These districts are Orca Inlet District, Northern District, and Copper River District (see map 2).

B. Fishery Description and Reported Harvest

1. Harvest summary. Until the expansion of the Tanner crab fishery in the mid 1970's, the Dungeness crab fishery was the major crab fishery in PWS (ADF&G 1978). Catches of Dungeness crab in PWS have been documented since 1950. Market conditions have determined the harvest of Dungeness crab throughout the history of the fishery. Catches during the first 10 years of the fishery averaged 1.6 million pounds per year, dropping to 1.2 million pounds per year the following decade. During this era, the Orca District was the primary producing area through the mid 1960's. Harvest levels for PWS decreased within five years after the 1964 earthquake. The decreased harvest was caused by loss of habitat or a prolonged downward trend in the life cycle of the Dungeness crab (ADF&G 1979). The total catch dropped from a peak harvest of about 3.4 million pounds taken during the 1964 season to 541,000 lb in 1961.

   The PWS harvest of Dungeness crab again increased in the late 1970's, with most of the harvest taken from the Copper River District. The Orca District has been closed since 1980 because of low stock abundance, which may be attributed to sea otter predation. The Northern District, though a minor contributor to the area's Dungeness crab harvest, has also shown a drop in recent harvest levels. From 1973-1983, the Dungeness crab harvest for PWS ranged from 290,300 lb in 1976 to 2.1 million pounds taken in 1978. The fishery averaged about 897,000 lb per year (table 1).

2. Harvest methods. Legal gear for Dungeness crab are pots (ADF&G 1983a). The near proximity of Orca Inlet in the Orca District to Cordova has resulted in development of a fishery that allows small vessel participation. The largest vessels are in the 40-ft seiner class, but most seiners are smaller than 40 ft (ADF&G 1982). The Copper River District is subject to heavier sea conditions and longer running distances to market, thus requiring larger vessels (ADF&G 1983b). The result is differing pot limits for each district. The Orca District is limited to 100 crab pots per vessel, whereas up to 250 crab pots per vessel are allowed throughout the remainder of PWS (ADF&G 1983a).
3. Period of use. Fishing seasons are specific to each district. Openings are scheduled to prevent the harvest of newly molted or soft-shelled crabs. The Copper River District usually supports a summer-fall fishery. The season extends from April 1 through December 31, except for the Controller Bay area, which closes on October 15, given adequate crab abundance. Orca Inlet opens September 1 by emergency order, closing May 31. The Northern District is open year-round (ibid.).

C. Management Objectives and Considerations

The goal of the PWS crab fishery unit program is to manage the commercial fisheries of PWS to retain optimal reproductive capacity of the resource (ADF&G 1983b).

There is little available data upon which to base optimal regulatory regimes for any of these fisheries. The current data base for management is built from analysis of fish tickets, dockside sampling of the harvest, and interviews of fishermen and processors. Sampling crabs in preseason index surveys provides information regarding the molt period of Dungeness crabs. This information can be used to prevent harvest upon crabs in soft-shell condition and to determine the possible prerecruit strength (ADF&G 1979).

D. Significance of Particular Use Area

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- Commercial Dungeness crab harvest areas
- Commercial historic Dungeness crab harvest areas

E. Economic Value

Information concerning the value of Dungeness crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

REFERENCES

ADF&G. 1978. Alaska's fishery atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + maps.

________. 1979. Prince William Sound management area shellfish report to the Board of Fisheries. Div. Commer. Fish., Cordova. 6 pp.

________. 1980. Lower Cook Inlet annual shellfish management report to the Board of Fisheries. Div. Commer. Fish., Homer. 26 pp.

________. 1981. Lower Cook Inlet annual shellfish report to the Board of Fisheries. Div. Commer. Fish., Homer. 53 pp.

________. 1982. Prince William Sound management area shellfish report to the Board of Fisheries. Div. Commer. Fish., Cordova. 44 pp.

________. 1983a. Commercial shellfish regulations. Div. Commer. Fish., Juneau.

________. 1983b. Prince William Sound shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 38 pp.

________. 1983c. Summary and description of the program and component projects included in the Commercial Fisheries Division FY 84 operational budget request. Div. Commer. Fish., Juneau. 637 pp.

________. 1984. Alaska 1981 catch and production commercial fisheries statistics. Div. Commer. Fish. Statistical Leaflet No. 34. Juneau.

Davis, A.S. 1981. Dungeness crab of the Lower Cook Inlet area, 1979-1981 seasons. ADF&G Informational Leaflet No. 192. Div. Commer. Fish., Homer. 25 pp.

Kimker, A. 1984. Prince William Sound area shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish. Prince William Sound Data Rept. 84-5. Cordova. 54 pp.

Kyle, S.C. 1984. Lower Cook Inlet shellfish report to the Board of Fisheries. ADF&G, Div. Commer. Fish. Lower Cook Inlet Data Rept. 84-2. Homer. 41 pp.

Commercial Harvest of King Crab

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The Southcentral Region includes the Prince William Sound (PWS), Upper Cook Inlet (UCI), and Lower Cook Inlet (LCI) fisheries management areas. Commercial harvest of king crab occurs in the LCI and PWS management areas. The following narratives are organized by management area.

B. Summary of the Regional Fishery

1. Harvest summary. The king crab harvest in the Southcentral Region has been very small relative to historical catches from other areas of the state. King crabs were first taken in the Cook Inlet area in the 1930's. Fisheries in both the Cook Inlet and PWS areas did not achieve steady production until the 1950's. A record harvest in the Southcentral Region of 8.6 million pounds was taken during the 1962-1963 season. Since 1973, the harvest has ranged from 4.8 million pounds during the 1974-1975 fishery to 997,948 lb taken during the 1982-1983 season. Since the 1973-1974 season, catches have averaged about 2.5 million pounds annually (table 1). The Cook Inlet fishery has dominated the Southcentral Region harvest, contributing about 98% of the catch since 1973. Cook Inlet has been closed to the taking of king crab (commercial and subsistence) since the 1983 season (Merritt, pers.comm.).

2. Managerial authority. The king crab fishery is managed by the Alaska Department of Fish and Game under a framework developed by the North Pacific Fisheries Management Council and the Alaska Board of Fisheries. The resource is managed to achieve optimum yield of king crab stocks and to promote full utilization of the resource by the domestic fishery (NPFMC 1980).

The management regime has evolved through a complex system of regulatory measures involving size, sex, season, area, gear restriction, area registration, and a flexible quota system. These regulatory measures relate to 1) maximization of the reproductive potential of the resource, 2) the competitive advantage between vessels of different sizes, 3) prevention of conflicts with other fisheries, 4) promotion of an even distribution of the fishing fleet, and 5) monitoring catch and catch rate in particular areas (ibid.). Management objectives are similar in both Southcentral areas, and guideline harvest levels are set at specified percentages dependent upon the estimated abundance of recruit crabs (ADF&G 1983a). Regulations used to address these objectives differ by area (NPFMC 1980).

Table 1. Commercial Harvest of King Crab in Number of Pounds by Management Area and Dist ict for the Southcentral Region[a], 1973-83

	Fishing Season									
Management Area/District	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
LCI										
Southern District	1,971,841	1,816,512	1,674,602	1,035,316	584,090	664,388	853,584	508,670	183,899	0[b]
Kamishak/Barren Is. districts	2,236,131	2,965,310	1,832,484	3,103,895	1,099,279	480,261	489,365	1,635,922	1,371,821	807,079
Eastern and Outer districts	5,613	2,035	45,243	16,384	1,350	1,753	4,871	8,022	4,143	14,280
LCI total	4,213,585	4,783,857	3,552,379	4,155,595	1,684,719	1,146,402	1,347,820	2,152,584	1,559,863	821,359
PWS										
All districts	29,747	15,443	1,516	2,160	29,865	12,904	5,831	28,709	15,275	176,589
Southcentral Region total	4,243,332	4,799,300	3,553,895	4,157,755	1,714,584	1,159,306	1,353,651	2,181,293	1,575,138	997,948

Source: Kyle 1984, Kimker 1983.

a Includes all species of king crab.

b District closed to fishing.

To regulate the number of vessels fishing in an area, both PWS and Cook Inlet are designated superexclusive registration areas. A vessel or gear registered for an exclusive registration area may not be used to take king crab in any superexclusive registration area or in any other exclusive registration area during that registration year (ADF&G 1984).

3. Gear types. To maximize the reproductive potential of the crab resource, harvest is restricted to male crabs. Size limits are established to ensure that sufficient numbers of male crabs are available to meet reproductive needs and to maximize the total yield from each year class. Gear is restricted to pots and ring nets to prevent high mortality rates of nonlegal crabs, which can occur with other gear types (tangle nets, trawls) (NPFMC 1980).
4. Period of use. Harvest seasons for king crab have historically been used in the king crab fishery to protect crabs during the mating, molting, and growing period of their life cycle, which usually occurs from mid January through mid July in most areas of Alaska. The fishing season may therefore occur from August through mid January. Seasons differ by management area because other than biological concerns may be considered (recovery rate, migrational patterns, weather conditions, etc.) (ibid.).

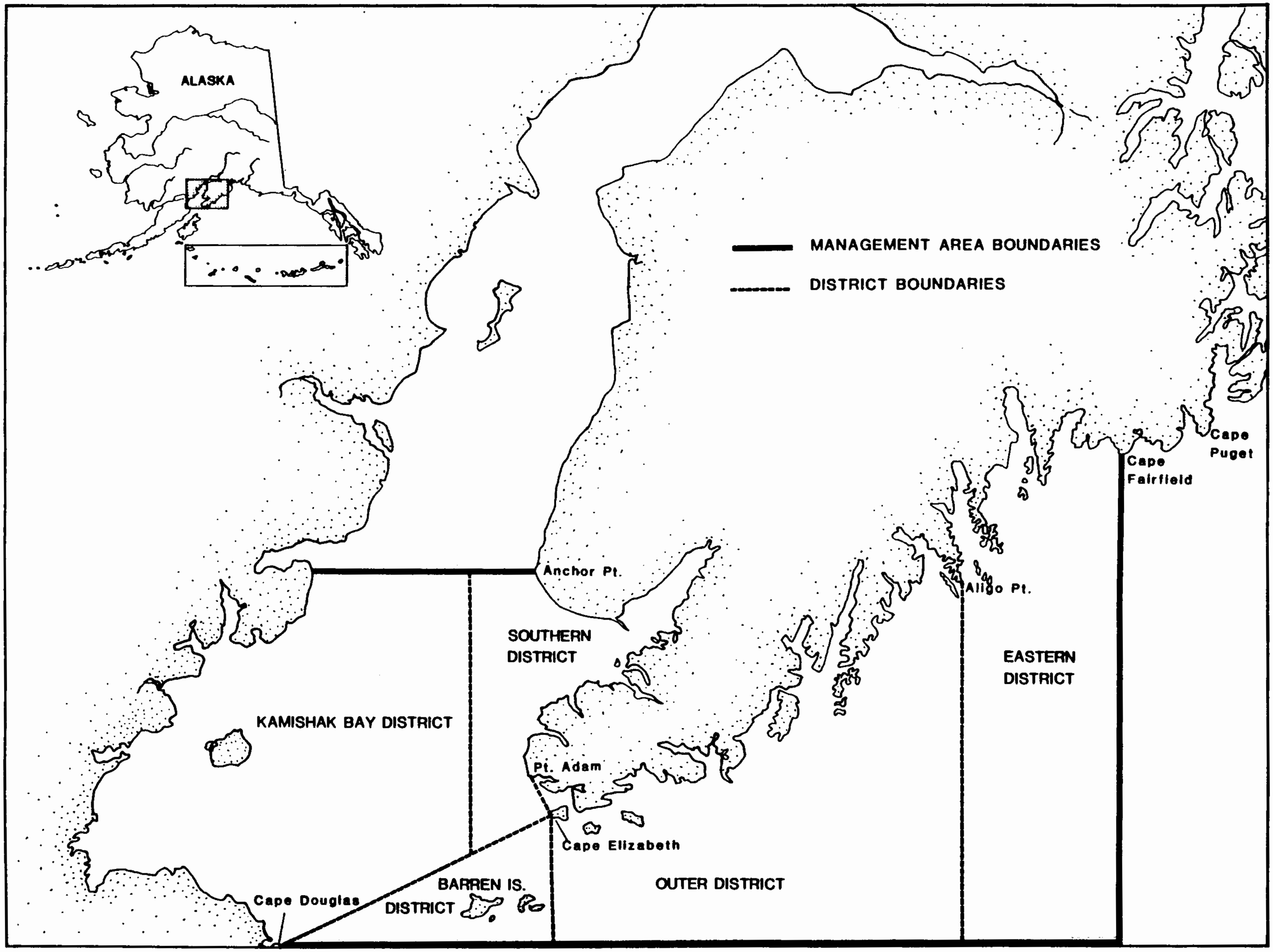
II. LOWER COOK INLET MANAGEMENT AREA

A. Boundaries

Cook Inlet, or King Crab Statistical Area H, has as its eastern boundary the longitude of Cape Fairfield (148°50'W.) and as its southern boundary the latitude of Cape Douglas (58°25' N.). LCI is the portion of Statistical Area H below the latitude of Anchor Point. LCI is divided into five districts for king crab management. These are the Southern, Kamishak, Barren Islands, Outer, and Eastern districts (map 1) (ADF&G 1984).

B. Fishery Description and Reported Harvest

1. Harvest summary. The earliest recorded effort directed toward king crab in LCI occurred in 1937 when crabs were canned in a Halibut Cove packing facility. Commercial fishing for this species remained at a relatively low level through the mid 1940's. By the mid 1950's, harvest levels reached 2.0 million pounds per year, with most of the harvest occurring in the Southern District. During the 1960's, the fishery expanded to the Kamishak Bay area, and boats were harvesting up to 8.6 million pounds of crabs annually. During the 1964-1965 period, a significant decrease in the harvest occurred in the Kamishak Bay District primarily because of the decreased processing capacity in Seldovia caused by damage from the 1964-1965 earthquake. Catches have never again achieved the level attained during the 1962-1963 season. During the 1971-1972 through 1976-1977 seasons, catches were stable and averaged 4.3 million pounds per year.



Map 1. King crab commercial fishing districts of the Cook Inlet Management Area (ADF&G 1984).

Average catches have decreased to 1.5 million pounds annually since the 1977-1978 season (table 1).

The Southern District was closed during the 1982-1983 season, and the other Cook Inlet districts experienced drastically reduced king crab abundance. The Kamishak District was closed during the 1983-1984 season, and all of Cook Inlet has remained closed through the 1984 season (Merritt, pers. comm.) The 1982-1983 harvest of 822,539 lb was the smallest since statehood. Effort in the fishery has been documented since 1977 and has ranged from 89 vessels participating during the 1978-1979 fishery to 17 vessels fishing during the depressed 1982-1983 season. The target species in LCI is the red king crab, although brown king crabs may occasionally be harvested (Kyle 1984).

LCI districts have been grouped to reflect three areas for management purposes: 1) The Southern District, 2) the Kamishak and Barren Island districts, and 3) the Eastern and Outer districts. The Kamishak/Barren Islands area has been the most productive, particularly in recent years, contributing about 67% of the catch since 1960 (ibid.).

2. Harvest methods. King crab may be harvested only by pots or ring nets (ADF&G 1984).
3. Period of use. During the 1984 season, male king crabs seven inches or greater in shell width may be harvested from July 15 through March 15. The season for male king crabs eight inches or greater in shell width will be opened and closed by emergency order (ibid.).

C. Management Objectives and Considerations

Overall, the objectives of king crab management coincide with those presented in I.B.2. above. LCI management strategy basically follows the Board of Fisheries policy for a multiple age-class king crab fishery. Since 1974, the fishery has been managed on data reflecting stock abundance and condition. Guideline harvest levels had been established in past years to meet management objectives. Because harvest levels were so far below the guideline harvest levels, however, they were repealed for the 1982-1983 season (ADF&G 1983b). Currently, catch levels are projected from indices of pot surveys during the preseason surveys and in-season fishing performance (Haanpaa, pers. comm.). Throughout the district, the abundance of king crab is very low. The reduced ovigerity, or egg-carrying capacity of females, and the increased presence of disease agents are not encouraging. Moreover, the cause of the population decline and the measures required to revive population levels have yet to be determined.

D. Significance of Particular Use Areas

A series of reference maps, available in ADF&G area offices, have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

° Commercial king crab harvest areas

E. Economic Value

Information concerning the value of king crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. PRINCE WILLAIM SOUND (PWS) MANAGEMENT AREA

A. Boundaries

PWS, or King Crab Statistical Area E, has as its eastern boundary the longitude of Cape Fairfield (148°50'W.), as its eastern boundary the longitude of Cape Suckling (143°53'W.), and as its seaward boundary the 400 fathom depth contour (map 2) (ADF&G 1984).

B. Fishery Description and Reported Harvest

1. Harvest summary. A family operation processed the first commercial harvest of king crab in 1959. The catch was small, consisting of about 30,929 lb. In 1960, five vessels moved into the area from Seldovia to explore the prospect of a king crab fishery, convincing several local vessels to participate. The increased activity resulted in a harvest of 246,965 lb.

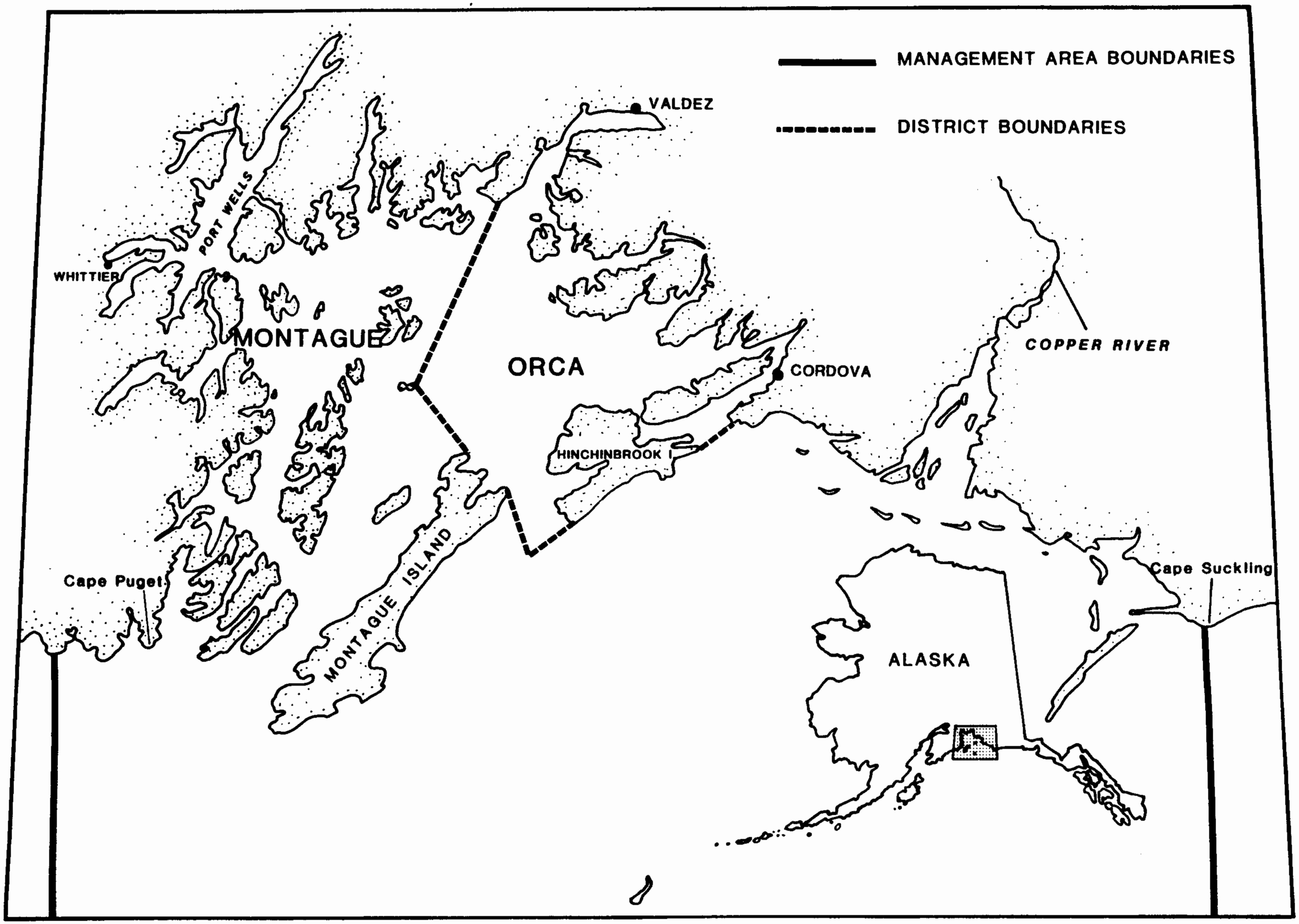
The king crab fishery has remained small. During the early years of the fishery, one to five vessels fished king crab periodically to satisfy the local market demand for a fresh product. In 1968, the value of king crab skyrocketed, creating increased harvest and participation in the fishery (Pirtle 1970).

The PWS fishery, however, has remained relatively small in relation to other king crab fisheries in the state (Kimker 1982). Catches through 1976 have been either incidental to the Tanner crab fishery or influenced by increased price and market fluctuations (Kimker 1983). A record harvest of about 296,000 lb was taken during the 1972 season.

Although red king crab is the primary species harvested in PWS, brown and blue king crab are also taken in the Montague District. Both blue and brown king crab are fished in the Port Wells area, whereas only red king crab is harvested in the southwestern portion of the district. Red king crabs are also taken in the Orca District, where they are harvested incidentally to Tanner crab (Kimker 1982).

The first significant harvest of brown king crab, totaling about 137,831 lb, was taken during the 1983 season. The future for brown king crab is dependent upon market demand for this species (Kimker 1983).

In the past decade, king crab catches have fluctuated, ranging from 17,087 lb during the 1976-1977 season to 176,589 lb harvested in the 1982-1983 season. The increased harvest during the 1982-1983 season was not related to any increase in stock abundance but rather was a result of an increase in price per pound. Overall production has appeared to decrease



Map 2. King crab fishing districts (1978 to 1982) of the PWS Management Area (ADF&G 1982).*
*Beginning with the 1983 fishing season, the fishing districts were eliminated, and the king crab fishery is now managed on an areawide basis (Haanpaa, pers. comm.).

during this period, with catches averaging 66,949 lb annually (table 1).

2. Harvest methods. Male king crabs 7.0 inches or larger in carapace width and male blue king crabs 5.9 inches or larger in carapace width may be harvested only by ring nets and pots (ADF&G 1984).

3. Periods of use. By regulation, the season for king crab extends from October 1 through December 20 and from January 5 through March 15 (ibid.). In past years, the season opened October 1 in the Montague District (map 2) and November 15 in the Orca District. The boundaries for the Orca District and the November 15 opening date for that district were established in 1978. The season change and district delineation were to prevent some Tanner crab fishermen from setting their gear early in this productive Tanner crab area under the guise of king crab fishing. The Montague District was also established in 1978 (map 2). This area incurred the same problems as the Orca District, with Tanner crab fishermen setting their gear early. Therefore the split season was adopted for the management area to address this problem. The second opening date of the king crab season (Jan. 15) coincides with the opening date for the Tanner crab season (Kimker 1983, ADF&G 1984). Beginning with the 1983 fishing season, the two districts were eliminated, and the PWS king crab fishery is now managed as a single unit on an areawide basis (Haanpaa 1984).

C. Management Objectives and Considerations

Management objectives for PWS king crab are commensurate with those under I.B.2 above. Harvest levels are determined by fishery performance and by indices showing the relative abundance of recruit and prerecruit crabs similar to those of Cook Inlet.

D. Significance of Particular Use Areas

See II.D. above.

E. Economic Value

Information concerning the value of king crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

REFERENCES

ADF&G. 1982. Commercial shellfish regulations. Div. Commer. Fish., Juneau. 110 pp.

________. 1983a. Summary and description of projects included in the Commercial Fisheries FY84 operational budget request. Div. Commer. Fish., Juneau.

________. 1983b. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. (Map reference.) Div. Commer. Fish., Cordova, Ak. 39 pp.

________. 1984. Commercial shellfish regulations. Div. Commer. Fish., Juneau. 115 pp.

Haanpaa, D. 1984. Personal communication. Mgt. Coordinator, Central Region, ADF&G, Div. Commer. Fish., Anchorage.

Kimker, A. 1982. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., Cordova. 10 pp.

________. 1983. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., Cordova. 21 pp.

Kyle, S.L. 1984. Lower Cook Inlet shellfish report to the Alaska Board of Fisheries. LCI Data Rept. 84-2. ADF&G, Div. Commer. Fish., Homer. 18 pp.

Merritt, M.F. 1985. Personal communication. Shellfish Research Biologist, ADF&G, Div. Comm. Fish., Homer.

NPFMC. 1980. Western Alaska king crab draft fishery management plan. Anchorage, Ak. 115 pp.

Pirtle, R.B. 1970. Status of the Prince William Sound king and Tanner crab fishery. ADF&G, Div. Commer. Fish. rept. to the Alaska Board of Fisheries. Cordova. 37 pp.

Commercial Harvest of Tanner Crab

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Discussion of Tanner crab in the Southcentral Region will be organized according to commercial fisheries management areas. Tanner crabs in Southcentral Alaska are harvested in the lower portion of the Cook Inlet and Prince William Sound (PWS) management areas.

B. Summary of Regional Fishery

1. Harvest summary. A steady fishery for Tanner crab (*C. bairdi*) was established in the Southcentral Region in 1968. First catches were incidental to the king crab fishery. Harvest levels fluctuated for the region through the early years of the fishery. The best harvest for the region of 21.5 million pounds was taken during the 1972-1973 season and was primarily a result of the record harvest in the PWS fishery. Though PWS has historically supported a larger harvest than Cook Inlet, both areas have experienced a decrease in population levels since the 1978-1979 fishing season. This population decline has also caused a drastic decrease in harvest levels. The lowest combined Tanner crab catches since the early 1970's catches of about 4.4 million pounds were harvested in the 1982-1983 fisheries. This decreased abundance has yet to be explained.

   Participation in the Tanner crab fishery has also been variable. Though historically PWS has produced greater catches than Cook Inlet, Cook Inlet has had a larger number of vessels participating in the fishery. Data available since 1976 indicate that the effort has ranged from a low of 80 vessels during the 1980-1981 fishery to a high of 130 vessels during the 1977-1978 season. About 105 boats fished the 1982-1983 season.

   Regulations, though nonexistent during the first three years of the Tanner crab fishery, have since evolved to address the following objectives:

   ° To maximize the yield from harvestable surpluses by season and gear restrictions designed to increase the meat yield per individual crab and by gear restrictions to reduce mortality on sublegal crabs

   ° To maximize the reproductive potential of the Tanner crab stocks by imposing season and gear restrictions, size and sex limits, and harvest levels to protect crabs during reproduction, minimize mortality on female crabs due to handling or harvest, and assure full female fertilization by providing adequate numbers of males of all sizes for breeding

- To seek economic stability in the Tanner crab industry and avoid overcapitalization based on levels of population abundance that may not be sustained over time by 1) regulating the annual harvest to discourage too rapid expansion of harvesting and processing capabilities until the resource potential can be better evaluated and 2) by stabilizing harvest levels within the range of natural recruitment fluctuations, if not precluded by excessive natural mortality beyond the first year of maturity (NPFMC 1981)

Currently, forecasting long-term abundance and harvest levels for different fisheries is difficult. Better knowledge of the biology and refinement of population assessment and age classification are needed to forecast abundance and harvest levels for the fishery and to ensure compatible management policies.

2. Managerial authority. The fishery within the 3-mi limit is managed by the State of Alaska and from 3 to 200 mi by the National Marine Fisheries Service. Management is directed by joint policy developed by the Alaska Board of Fisheries and the North Pacific Fisheries Management Council. Tanner crab populations do not abide by these boundaries, which causes problems when state and federal policies are not compatible (ibid.).

3. Gear types and period of use. Harvest seasons for Tanner crab have been designed to prevent fishing during the soft-shelled and reproductive stages of the species' life cycle.

   In the Southcentral Region, the fishing season varies by management area but usually occurs sometime from late fall through late spring. Only male crabs may be kept. Minimum size limits have been established for both management areas to allow at least one breeding season prior to removal of the crabs from the population. Pots are the only legal gear that may be used in the fishery.

   Superexclusive registration areas have been established. Both PWS and Lower Cook Inlet are superexclusive Tanner crab registration areas. A vessel or gear registered for a super exclusive registration area may not be used to take Tanner crab in any other registration area during that registration year. A vessel or gear registered for a nonexclusive registration area may not take Tanner crab in a superexclusive registration area during that registration year (ADF&G 1984).

   The exclusive registration areas were established primarily for economic reasons. The fleet was mainly composed of small vessels that would not be able to compete successfully with a large mobile crab fleet such as the type based in Kodiak. The Kodiak fleet would be capable of attaining the harvest levels of the Southcentral Region rapidly if allowed unrestricted fishing, leaving a relatively small catch and short seasons to the local fishermen (NPFMC 1981).

II. COOK INLET MANAGEMENT AREA

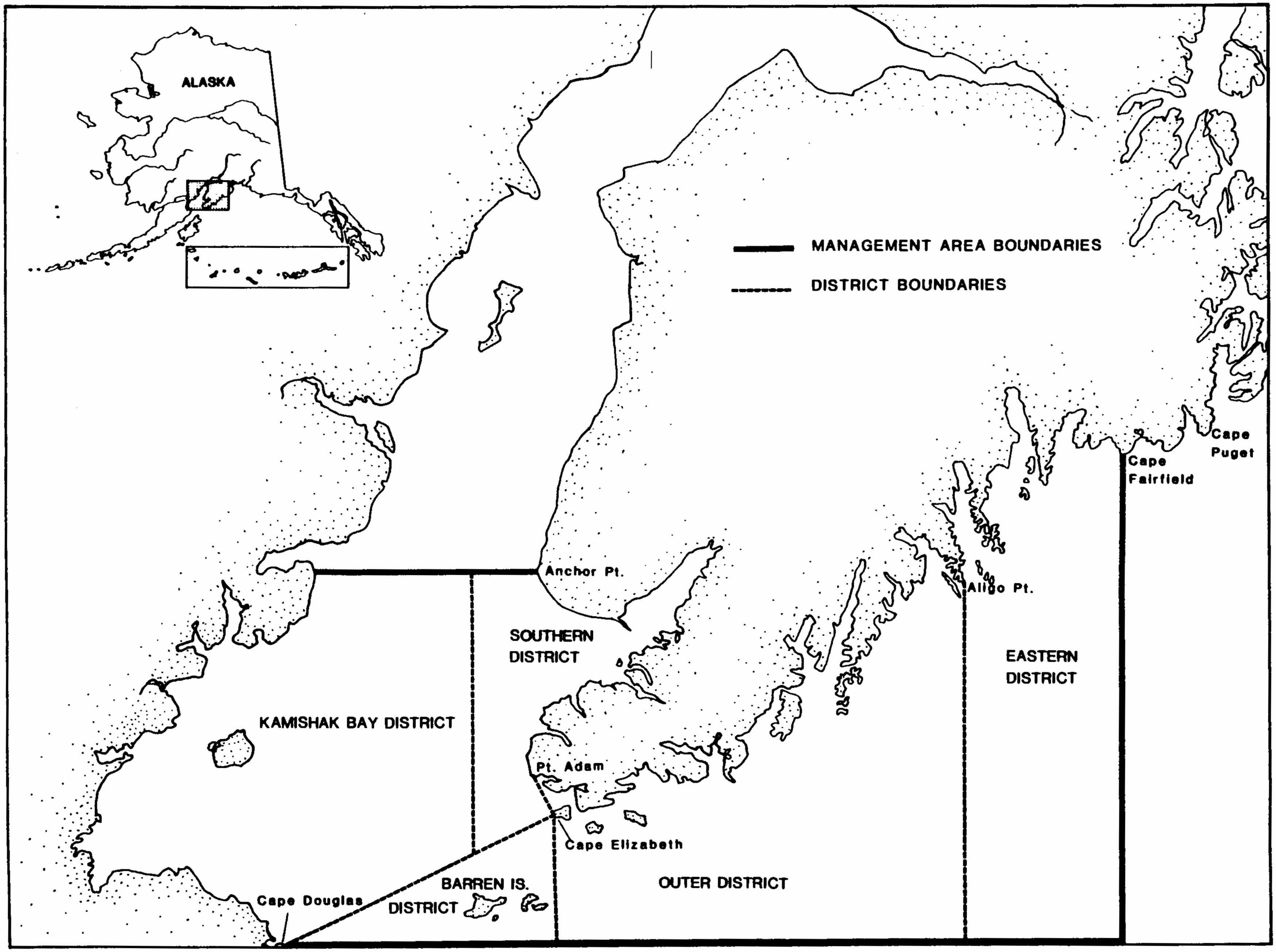
A. Boundaries

The Cook Inlet Management Area, or Tanner Crab Statistical Area H, has as its eastern boundary the longitude of Cape Fairfield (148°50' W.) and as its southern boundary the latitude of Cape Douglas (58°52' N.) (ADF&G 1983b). Commercial harvest of Tanner crab occurs only in Lower Cook Inlet (LCI), or the portion of the statistical area south of the latitude of Anchor Point. LCI is divided into the Eastern, Outer, Kamishak, Barren Islands, and Southern districts (map 1) (ADF&G 1984).

Though there are five districts within the LCI area, these in combination create three geographically distinct Tanner crab fisheries. These fisheries are 1) the Southern District fishery (Kachemak Bay), 2) the Kamishak Bay-Barren Islands fishery, and 3) the Outer and Eastern districts fishery (Davis 1983).

B. Fishery Description and Reported Harvest

1. Harvest summary. The target species of Tanner crab in LCI is *C. bairdi*. Initial catches of Tanner crab were incidental to those of king crab during the open king crab season. The first reported harvest of Tanner crab in lower Cook Inlet was documented in 1962 (ADF&G 1978). Harvest of Tanner crab did not occur again until 1968. The fishery gradually developed in response to an increase in both price and demand for Tanner crab during the early 1970's. The first significant harvest of 1.4 million pounds was taken primarily from the Southern District. Effort spread to other districts thereafter as interest in the fishery increased (Kyle 1984). Peak harvest occurred during the 1973-1974 season, when about 7.7 million pounds were taken. Catches since then have significantly declined because of decreased stock abundance. The smallest harvest in the past decade, about 2.4 million pounds, was in the 1981-1982 season (table 1). Since the 1973-1974 season, the fishery has produced an average catch of 4.7 million pounds annually. The Southern District, Kamishak/Barren Islands area, and the Outer and Eastern districts during the same 10-year period contributed respectively 29%, 54%, and 16% of the total production. The close proximity of the Southern District to communities and harbors in lower Cook Inlet results in more intensive fishing in this area (Middleton 1981). The effort recorded since 1975 indicates that the greatest participation in the fishery occurred during the 1977 season, when 92 vessels fished. Effort steadily decreased thereafter, reaching a low of 51 vessels fishing during the 1981-1982 season. Effort again increased during the 1982-1983 season, when 65 vessels took about 3.0 million pounds (table 1).



Map 1. Tanner crab commercial fishing districts of the Cook Inlet Management Area (ADF&G 1984).

Table 1. Commercial Harvest of Tanner Crab in Thousands of Pounds and Effort as Number of Vessels by District and Fishing Season for LCI Management Area, 1973-83

	Fishing Season									
Management Area/District	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Southern District	1,387.5	967.8	1,339.2	2,009.6	2,806.6	2,323.4	1,134.9	1,047.7	548.5	584.9
Kamishak and Barren Is. districts	4,689.3	3,150.5	3,281.1	1,765.9	2,077.1	2,713.3	3,338.6	1,757.3	1,286.3	1,693.8
Eastern and Outer districts	1,891.0	656.7	851.0	824.5	502.0	694.7	595.6	463.2	524.9	682.9
LCI Mgt. Area total	7,967.8	4,775.0	5,471.3	4,600.0	5,385.7	5,731.4	5,069.1	3,268.2	2,359.7	2,961.6
No. of vessels	---	---	57	67	92	77	68	52	51	65

Source: Kyle 1984.

--- means no data were available.

D. Significance of Particular Use Areas

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- Commercial Tanner crab harvest areas
- Commercial historic Tanner crab harvest areas

E. Economic Value

Information concerning the value of Tanner crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

A. Boundaries

The PWS Management Area, or Tanner Crab Statistical Area E, has as its western boundary the longitude of Cape Fairfield (148°50'W.), as its eastern boundary the longitude of Cape Suckling (143°53'W.) and as its seaward boundary the 400 fathom (732 m) depth contour (ADF&G 1984). The districts into which PWS has been divided for the purposes of Tanner crab management are the Northern, Western, Eastern, and Hinchinbrook districts (map 2).

Prior to the 1976-1977 season, the PWS Management Area was divided into "Inside" and "Outside" fishing portions. The "Inside" area referred to PWS, whereas the "Outside" was the fishing area that extended into the Gulf of Alaska. For the 1976-1977 fishing season, new district boundaries were defined for the PWS area. The districts for Tanner crab management in PWS are the Eastern, Western, Northern, and Hinchinbrook districts (map 2). Most of the area contained in the Eastern and Western districts corresponds to the former "Outside" fishing area and the remaining districts to the "Inside" fishing area.

B. Fishery Description and Reported Harvest

1. Harvest summary. The commercial fishery for Tanner crab in PWS began in 1968, with a harvest of 1.2 million pounds. The fishery peaked by the 1972-1973 season with a harvest of 13.9 million pounds (table 2). Catches fluctuated thereafter, dropping precipitously during the 1976-1977 season, primarily as a result of the imposition of a minimum size limit (Kimker 1978). Since the 1978-1979 fishery, the commercial harvest has declined steadily, reaching 1.5 million pounds during the 1982-1983 season. The figure represents the lowest harvest level since the fishery was fully developed in the early 1970's.

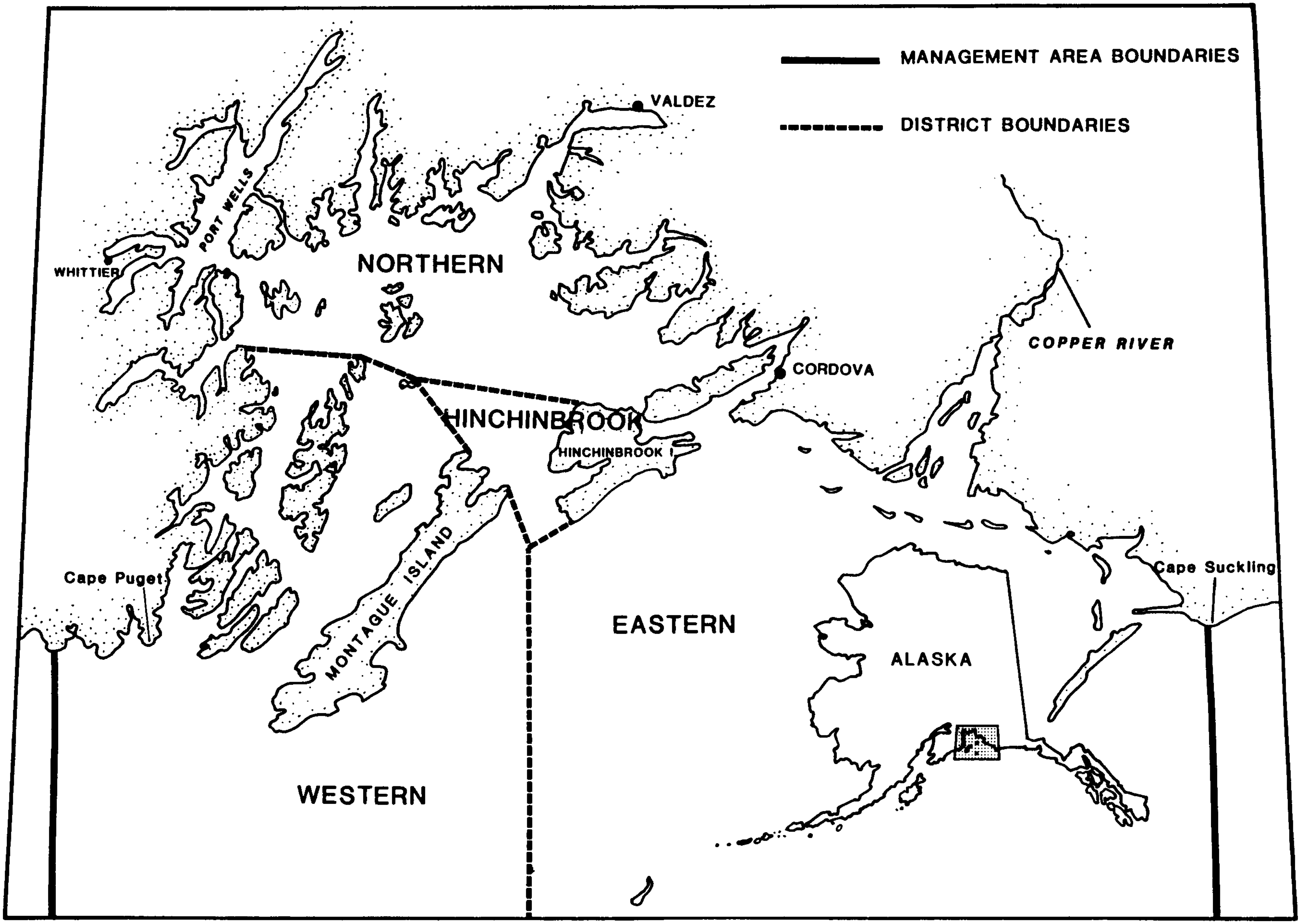
   The decreased catches have been attributed to the harvest of small crab (crab smaller than the current minimum size limit) prior to 1976. Growth data published by the ADF&G indicate that a period of about eight years is required for crabs to develop from the egg stage to harvestable size. Therefore, small crabs taken prior to 1976 would possibly now be reaching harvestable size.

2. Harvest methods. Legal gear for harvest of Tanner crab in the Cook Inlet Management Area are pots or ring nets (ADF&G 1984). Prior to the 1976-1977 fishing season, there were no size restrictions for the harvest of Tanner crab. However, the regulation first imposed for the 1976-1977 season stipulates that male crabs with a carapace width less than 5.5 inches (140 mm) may not be taken commercially. This regulation is based on findings regarding size at maturity of Tanner crabs in the Kodiak area. Studies indicate that the size limit assures at least one year of reproductive activity before the crabs become available to the fishery and are then removed (NPFMC 1981).
3. Period of use. The first fishing seasons for Tanner crab were in effect during 1970-1971, when the season extended from August 15 through July 15. The following year the season was further restricted, lasting from October 1 through June 30 (ibid.). An opening date of December 1 was established from 1974 through 1982 to maximize meat recovery and was again changed in 1983 to November 1 (Kyle 1984). Season closing dates have varied through the history of the fishery, with some districts remaining open through May. Closing dates, though established by regulation, have been dependent upon the presence of newly molted crabs (NPFMC 1981). For 1983, the fishing season by regulation extended from November 1 through April 30 for the Southern District and from November 1 through May 31 for the Kamishak, Barren Islands, Outer, and Eastern districts (ADF&G 1984).

C. Management Objectives and Considerations

The objectives of Tanner crab management coincide with those listed in I.B.I above. The only restrictions on the Tanner crab fishery in Cook Inlet during the first three years of the fishery were for the harvest of males only and a measure describing legal gear for harvest (NPFMC 1981). As the fishery developed, however, seasons, size limits, and guideline harvest levels, were established. Guideline harvest levels in effect, beginning with the 1974-1975 season, were repealed for the 1983 season because catch levels have been so low that the guideline harvest levels exceeded the annual harvest since the 1973-1974 season. Currently, harvest levels are developed by index surveys and catch-monitoring projects that provide estimates of population abundance by year class, legal size crabs, population strength, and crab condition and fecundity.

The overall data base for Tanner crab is relatively weak. Aging of Tanner crabs once they reach legal size is so imprecise that it is difficult to apply a differential harvest rate to the species. Estimates of the maximum sustainable harvest rate and the optimal size of male Tanner crabs for harvesting while maintaining the population's reproductive potential are still being developed (ADF&G 1983a).



Map 2. Tanner crab commercial fishing districts of the PWS Management Area (ADF&G 1983b).

Table 2. Commercial Harvest of Tanner Crab of Thousands of Pounds and Effort as Number of Vessels by District and Fishing Season for PWS Management Area, 1973-83

	Fishing Season									
Management Area/District	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Inside District	1,658.0	1,187.0	3,322.5	[a]	[a]	[a]	[a]	[a]	[a]	
Northern District	[a]	[a]	[a]	782.0	994.7	650.0	140.2	152.2	351.1	471.4
Hinchinbrook District	[a]	[a]	[a]	776.7	1,161.8	708.6	332.6	812.4	722.8	31.5
Outside District	8,500.0	2,667.0	3,810.3	[b]	[b]	[b]	[b]	[b]	[b]	
Western District	[b]	[b]	[b]	701.7	2,079.5	2,248.5	1,462.1	1,561.2	1,503.3	921.7
Eastern District	[b]	[b]	[b]	70.9	570.8	3,443.5	4,057.8	250.1	288.4	45.3
PWS Mgt. Area Total	10,158.0	3,854.0	7,132.8	2,321.3	4,806.8	7,050.6	5,992.7	2,775.9	2,865.6	1,469.9
No. of vessels	---	---	---	23	38	51	49	30	29	40

Source: Kimker 1983.

--- means no data were available.

a The Inside District closely corresponds to the area currently managed as the Northern and Hinchinbrook districts.

b The Outside District.

Since the 1976-1977 fishing season, the Western District has produced about 40% of the PWS Tanner crab harvest. Extremely large catches of Tanner crabs were taken from the Eastern District during the 1979 and 1980 seasons, boosting the contribution of the Eastern District to the PWS catch since 1976 to about 33%. The northern and Hinchinbrook districts, though the smallest contributors to the total catch at 13% and 14%, respectively, have been most consistent in producing all sizes and both sexes of crab during the past five years. Results of tagging studies indicate that the Orca Bay portion of the Northern District has provided significant numbers of recruit crabs not only for the Northern District, but also for the Hinchinbrook and the northern portion of the Western districts (Kimker 1983b).

2. Harvest methods. Male Tanner crabs 5.3 inches or greater in carapace width may be harvested with either pots or ring nets (ADF&G 1984).
3. Period of use. The first regulated fishing season for PWS was imposed in 1971. This first season closed an area inside PWS between June 1 and August 31. The season changed for the 1973-1974 season, with the opening date set at October 15 and the closure established by emergency order. The opening date was based on meat recovery, whereas the closure was set when soft-shelled crabs appeared in the deliveries. The season established for the 1974-1975 fishery moved the opening date to November 15, and in 1977 a specified closure date of May 31 or by emergency order was established based on the historical appearance of soft-shelled crabs in the harvest (NPFMC 1981). To maintain the objective of protecting soft-shelled crabs, the 1984 Tanner crab season was from January 5 through May 31 (ADF&G 1984).

C. Management Objectives and Considerations

Management objectives for Tanner crab in PWS are identified in section I.B.I. above. To accomplish these objectives, fishing seasons have been developed since 1971 to protect soft-shelled crabs, a minimum size limit of 5.3 inches was established to ensure reproductive capability, and the harvest of males only was mandated. Guideline harvest levels were first set during the 1972-1973 fishing season, based on an estimate of what level of harvest the resource might be able to sustain (NPFMC 1981). The guideline harvest level was decreased from 15.5 million pounds to a range of from 3.0 to 7.0 million pounds. This range was again revised to from 1.0 to 5.0 million pounds and was in effect through the 1982-1983 season, with the point estimate based on preseason surveys. Because stock condition is so low, the guideline harvest constraints were repeated after the 1982-1983 season.

Regulations for the commercial harvest of Tanner crab were nonexistent until 1971, when the first fishing season was established. Guideline harvest levels were first implemented for the 1972-1973 fishery, and the area became an exclusive registration area by the 1973-1974 season. By the 1976-1977 season, a size limit, a stipulation to harvest males only, establishment of district boundaries, and the designation of legal gear had been instituted (ibid. 1981). Currently, harvest levels are determined by indices obtained in preseason index surveys. In-season management is based on fishery performance tag recovery ratios, prior year harvest levels, breeding seasons of females, and catch per effort. As with Cook Inlet (NPFMC 1981, ADF&G 1982), the overall data base for Tanner crab is limited. Projecting harvest levels of progeny from parent year success is difficult because of the estimated eight-year period from the time Tanner crabs develop from the egg stage and until they reach fishable size (Donaldson and Colgate, pers. comms.). As was mentioned earlier, the apparent population decline of Tanner crab in PWS has yet to be explained. Some possible reasons for the poor stock condition are larval drift, increased predation, overfishing during the period when a minimum size limit had not been established, and a change in food supply or in physical oceanographic parameters.

D. Significance of Particular Use Areas

Major Tanner crab fishing areas within the PWS Management Area are the eastern portion of PWS, Hinchinbrook entrance, the area immediately east of Montague Island, the area between Cape Cleare and Cape Fairfield, the area immediately south of Hinchinbrook Island and the area west of Kayak Island (NPFMC 1981). Traditionally, smaller vessels fished the Northern and Hinchinbrook districts, and vessels greater than 50 ft in length concentrated in the less protected Western and Eastern districts. During the 1982-83 fishing season, however, low crab abundance and economic considerations forced all fishermen to concentrate where most of the crabs could be caught. As a result. vessels ranging from 50 to 90 ft in length fished the Northern District. In the past, this area had normally been fished only by small seine-type vessels.

During the early years of the fishery, effort was distributed throughout PWS into the Gulf of Alaska, south of Montague Island and eastward along the gulf to Cape St. Elias (Pirtle 1975). More recently, fishing activity during the first few months of the fishing season occurred in the Northern and Hinchinbrook districts by seine-type vessels. As catch per pot declines in the Northern District and weather conditions improve in the less protected areas, fishing effort shifts to the Eastern and Western districts. Corresponding to this shift in effort, vessels larger than 50 ft in length enter the fishery, and the smaller vessels drop out of the Tanner crab fishery to prepare for the herring sac roe fishery (Kimker 1978).

Effort recorded since the 1976-1977 season has ranged from 23 vessels participating in the 1976-1977 fishery to a record of

53 vessels during the 1978-1979 season. Effort again increased to 40 vessels during the 1982-1983 season (table 2).

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

° Commercial Tanner crab harvest areas
° Commercial historic Tanner crab harvest areas

E. Economic Value

Information concerning the value of Tanner crab within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

REFERENCES

ADF&G. 1978. Alaska's fisheries atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + maps.

________. 1983a. Summary and description of the program and component projects included in the Commercial Fisheries Division FY 84 divisional budget request. Div. Commer. Fish., Juneau. 637 pp.

________. 1983b. PWS Management Area shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 39 pp.

________. 1984. Commercial shellfish regulations. Div. Commer. Fish., Juneau. 115 pp.

Colgate, W. 1984. Personal communication. Shellfish Biologist, ADF&G, Div. Commer. Fish., Kodiak.

Davis, A.S. 1983. Studies of king and Tanner crab in LCI during 1982. ADF&G, Div. Commer. Fish. LCI Data Rept. 83-5. Homer. 39 pp.

Donaldson, W. 1984. Personal communication. Habitat Biologist, ADF&G, Div. Habitat, Anchorage.

Kimker, A. 1978. PWS Management Area shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., Cordova. 21 pp.

________. 1983a. 1982-83 PWS (Area E) Tanner crab fishery summary. ADF&G, Div. Commer. Fish. memo. 6 pp.

________. 1983b. PWS Management Area shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., Cordova. 38 pp.

Kyle, S.C. 1984. Shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish. LCI Data Rept. 84-2.

Middleton, K.R. 1981. Cook Inlet stock status report. ADF&G, Div. Commer. Fish. Draft rept. 110 pp.

NPFMC. 1981. Fishery management plan for the commercial Tanner crab fishery off the coast of Alaska. Anchorage. Amended July 1981.

Pirtle, R.B. 1975. Status of the PWS shellfish fisheries - 1975. ADF&G, Div. Commer. Fish., Cordova. 9 pp.

Commercial Harvest of Razor Clam

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Commercial harvest of razor clams in the Southcentral Region is managed by the ADF&G, Division of Commercial Fisheries. Commercial harvest of razor clams in Cook Inlet is reported by statistical areas that are the same for all finfish and shellfish. Statistical areas are also used in Prince William Sound (PWS) to report harvest; however, these vary among species groups. Razor clam harvest is reported by shellfish statistical areas. In this report, regionwide harvest summary, managerial authority, gear type, and period of use information is followed by commercial harvest information specific to major harvest areas of Cook Inlet and PWS.

B. Summary of Regional Fishery

1. Harvest summary. A commercial razor clam fishery in Alaska began in 1916 on razor clam beds near Cordova. These clam beds were soon overharvested, and the harvest declined by 1920. Additional beds were discovered at Snug Harbor (Cook Inlet), Kukak Bay (Alaska Peninsula), and Alitak (Kodiak areas), causing the Alaska clam pack to increase again in the mid 1920's (Orth et al. 1975).

Production continued to increase, and by 1932 Alaska produced more than half of the entire Pacific Coast pack of clams (ibid.). In 1933, the U.S. Government, which was then responsible for commercial fisheries in Alaska, established regulatory controls that served to stabilize the clam harvest at around one million pounds (shell weight) annually (Smelcer 1974). The high cost of catch and production of clams in Alaska, combined with competition from dredge-harvested clams on the east coast, caused a decline in the significance of the clam harvest in the 1950's (Orth et al. 1975). The U.S. Food and Drug Administration (FDA) withdrew its endorsement of Alaska's membership in the National Shellfish Sanitation Program (NSSP) in 1954 as a result of paralytic shellfish poisoning (PSP) problems with hardshell clam stocks (Schink et al. 1983). This, combined with poor market conditions and the destruction of commercially important beaches by the 1964 earthquake, completed the decline of razor clam harvest in Alaska.

In 1975, Alaska regained its membership in NSSP, and the commercial harvest of razor clams for human consumption resumed (ibid.). Three beaches in Alaska are certified as free of PSP and approved for this harvest. Two of these beaches are in the Southcentral Region: Polly Creek-Crescent River beach on the west side of Cook Inlet and a beach to the east of Cordova. Clams are also harvested at several unapproved beaches to be used as bait in the Dungeness crab fishery. Crab fishermen prefer razor clams as bait and have in recent years been willing to pay high prices for this use (Orth et al. 1975). Clams are also harvested by sport fishermen, especially on east-side beaches in Cook Inlet. Since 1959, all east-side beaches south of Kenai have been closed to commercial digging, being reserved for noncommercial harvest only (ADF&G 1979a). The most intensively used beach in this area is Clam Gulch.

2. Managerial authority. Razor clam harvest in Alaska is managed by the Alaska Department of Fish and Game. Sanitary control of the commercial shellfish industry is regulated jointly by the State of Alaska Department of Environmental Conservation, the Department of Public Safety, and the Department of Fish and Game (Orth et al. 1975).
3. Gear types. At this time, almost all razor clams are harvested by hand digging with shovels. Efforts are underway, however, to perfect a hydraulic dredge harvester that would be a more effective and less labor-intensive method of harvest (ADF&G 1982a, Middleton and Rowell in press). Design and use of a dredge must be approved by the ADF&G. Permits must specify the location and proposed duration of intended operation and include a detailed gear specification. Less than 10% of the dredge harvest may be lost from breakage (Rowell and Middleton 1985).
4. Period of use. Although harvest of razor clams is permitted throughout the year, weather conditions generally confine digging activity to the months of March through August (Nelson 1982, Orth et al. 1975).

II. COOK INLET

A. Major Harvest Areas

In Cook Inlet, with the exception of a small harvest in the Augustine Island area in 1982 and from an east-side beach north of the Kenai River in 1981, razor clam commercial harvests have taken place entirely on west-side beaches in the ADF&G Central District. Polly Creek Beach and Crescent River Bar, a 5 mi stretch of land between Redoubt Point and Crescent River on the west side of Cook Inlet, is certified for commercial harvest of razor clams for human consumption. Clams to be sold as bait are also taken from Polly Creek and adjacent beaches. Highest commercial razor clam catches since 1980 have come from the 245-30 subdistrict, which includes the Polly Creek Beach (ADF&G 1983).

B. Fishery Description and Reported Harvest

1. Harvest summary. The majority of commercial razor clam harvest in Alaska now takes place on Cook Inlet west-side beaches. Razor clam harvest from Cook Inlet has increased in the last two years. This increase is due to the approval by the of Crescent River Bar, south of Polly Creek, for the commercial harvest of razor clams for human consumption

(ADF&G 1982a). The expansion of the area available for commercial harvest allows two processors to operate simultaneously without interfering with each other. In 1981, one processor operated at Polly Creek with 15-20 diggers, while another processor operated at the Crescent River Bar area with about 30 diggers (ibid.). In 1981, approximately 70% of the Cook Inlet harvest (315,000 lb) came from Crescent River Bar (ibid.). Harvest information for the period 1973 to 1982 is presented in table 1.

2. Harvest methods. Harvest methods for razor clams are the same throughout Alaska and are discussed in the summary of regional fishery (section I.B.3.).
3. Period of use. The period of use for razor clams is approximately the same throughout Alaska and is discussed in the summary of regional fishery (section I.B.4.).

C. Management Objectives

Though no specific management objectives for razor clams in Alaska have been published by the ADF&G, research and management activities have been directed towards maintaining populations at a level that allows good recreational and commercial harvests.

D. Management Considerations

Harvest on the west side of Cook Inlet has greatly increased in recent years; however, budgetary constraints have prevented the ADF&G from establishing a scientific population monitoring program (ADF&G 1982a). Currently, the Division of Commercial Fisheries carries out biweekly paralytic shellfish poisoning sampling trips. These sampling trips are the extent of the department's data-collection activities for west-side razor clams (ibid.).

E. Significance of Particular Use Areas

Polly Creek Beach and the Crescent River Bar are the major areas of commercial razor clam harvest in Cook Inlet. Razor clam harvest areas are mapped on a 1:250,000-scale reference map, which supplements this report.

III. PRINCE WILLIAM SOUND

A. Major Harvest Areas

Prince William Sound razor clam harvest takes place in Orca Inlet, Copper River Flats-Controller Bay areas.

B. Fishery Description and Reported Harvest

1. Harvest summary. During the early 1960's, major processing in the Cordova area ceased, and subsequent years' harvests have been used primarily for bait (ADF&G 1978). Razor clam beds in Orca Inlet, which have easy access from Cordova, received heavy use, especially in 1978, when the demand for razor clams as Dungeness crab bait resulted in a high price being paid for the clams (ADF&G 1979b). Because of a decline in abundance, the Orca Inlet area was closed to commercial harvest in September 1981 (ADF&G 1982b). Since then, the entire commercial harvest has been taken from the Copper River-Controller Bay area (ADF&G 1982b, 1983a).

Table 1. Razor Clam Harvest in the Southcentral Area in Pounds (Round Weight)

		Prince William Sound		
Year	Central Cook Inlet [a]	Orca Inlet Area [b]	Copper River-Controller Bay Bay Area	Southcentral Total
1973	34,415	0	30,818	65,233
1974	0	0	29,747	29,747
1975	10,020	0	15,443	25,463
1976	0	0	[f]	[f]
1977	[d]	2,023	1,653[f]	3,676[df]
1978	47,693[d]	23,982	5,883	77,558[d]
1979	144,358	3,100	9,804	157,262
1980	140,420	1,023[e]	4,879	146,322[e]
1981	441,776	[e]	27,770	469,719[e]
1982	460,639	0	15,275	476,297

Source: ADF&G 1983.

a Includes harvest from the following ADF&G statistical areas: 245-10, 245-20, 245-30, 245-40, and 245-50.

b Includes harvest from the following ADF&G shellfish statistical areas: 202-01, 202-02, 202-03, 202-04, 202-05, and 202-09.

c Includes harvest from the following ADF&G shellfish statistical areas: 203-09, 203-10, and 203-12.

d Central Cook Inlet harvest for 1977 and 1978 are combined to maintain confidentiality.

e Orca Inlet area Prince William Sound catches for 1980 and 1981 are combined to maintain confidentiality.

f Controller Bay area Prince William Sound catches for 1976 and 1977 are combined to maintain confidentiality.

2. Harvest methods. Harvest methods for razor clams are the same throughout Alaska; they are discussed in the summary of regional fishery (section I.B.3.).
3. Period of use. The period of use for razor clams is approximately the same throughout Alaska; it is discussed in the summary of regional fishery (section I.B.4.).

C. Management Objectives

Though no specific management objectives for razor clams in Alaska have been published by the ADF&G, research and management activities have been directed towards maintaining populations at a level that allows good recreational and commercial harvests.

D. Management Considerations

The Orca Inlet area was closed to commercial razor clam harvest in 1981 because of a decline in clam abundance in that area. This decline was probably caused by several factors, including the 1964 earthquake and siltation by the Copper River. When razor clam populations were already at a low level, the sea otter populations in Orca Inlet increased, and predation by sea otters on the clams may now be preventing any increase in abundance (ADF&G 1983a, Johnson 1982). Razor clams are still abundant in the Copper River-Controller Bay area; however, logistics problems make harvest difficult in this area (ibid.). The Orca Inlet area will remain closed until sampling, which is conducted regularly to check for paralytic shellfish poisoning, shows an increase in abundance (ADF&G 1982b, 1983a).

E. Significance of Particular Use Areas

Areas of historical harvest in the Cordova area are Orca Inlet, Copper River Flats, and Controller Bay (ADF&G 1978). Razor clam harvest areas are mapped on a 1:250,000-scale reference map, which supplements this report.

REFERENCES

ADF&G. 1978. Annual management report. Prince William Sound area, Region II.

________. 1979a. Razor clam summary 1979. Unpubl. rept. 4 pp.

________. 1979b. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries.

________. 1982a. Upper Cook Inlet razor clam report to the Alaska Board of Fisheries.

________. 1982b. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries.

________. 1983a. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries.

________. 1983b. Computer printouts.

Johnson, A.M. 1982. Status of Alaska sea otter populations and developing conflicts with fisheries. Pages 293-299 in Transactions of the 47th North American wildlife and natural resources conference. Wildlife Management Institute. Washington, DC.

Nelson, D.C. 1982. A review of Alaska's Kenai Peninsula eastside beach recreational razor clam (Siliqua patula, Dixon) fishery, 1965-1980. Unpubl. MS. ADF&G, Div. Sport Fish. 266 pp.

Orth, R.L., C. Smelcer, H.M. Feder, and J. Williams. 1975. The Alaska clam fishery: a survey and analysis of economic potential. Univ. Alaska, Inst. Mar. Sci. Rept. No. R75-3 (Sea Grant Rept. 75-5). 148 pp.

Rowell, K.A., and K.R. Middleton. 1985. Upper Cook Inlet stock status report: a summary of commercial salmon, herring, and razor clam fisheries through 1982. ADF&G, Div. Commer. Fish., Anchorage. Draft rept.

Sabella, J. 1984. Razor clams. Pacific Fishing 5(1):30-33.

Schink, T.D., K.A. McGraw, and K.K. Chew. 1983. Pacific coast clam fisheries. Tech. rept. Washington Sea Grant WSG-1. 72 pp.

Smelcer, C. 1974. The economic potential of the clam industry in Alaska. Thesis, Univ. Alaska, Fairbanks. 207 pp.

Smelcer, C., and F.L. Orth. 1974. The Alaska clam industry. Alaska Seas and Coasts 2:3.

Commercial Harvest of Shrimp

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Pandalid shrimp management in the Southcentral Region is defined by two management areas: Lower Cook Inlet (LCI) and Prince William Sound (PWS). There is no commercial shrimp harvest in Upper Cook Inlet, the third management area found in the Southcentral Region. The management history and present status of the commercial shrimp fishery will be described by management area and the districts that further subdivide the management areas.

B. Summary of the Regional Fishery

1. Harvest summary. Two methods are used for commercially harvesting pandalid shrimp: trawling and pot fishing. The trawl shrimp fishery primarily exploits the pink shrimp (*Pandalus borealis*), humpy shrimp (*P. goniurus*), and sidestripe shrimp (*Pandalopsis dispar*), but incidental harvests of other shrimp species also occurs (Middleton 1981). The pot shrimp fishery concentrates on the larger coonstripe shrimp (*Pandalus hypsinotus*) and spot shrimp (*P. platyceros*) (Middleton 1981).

   Shrimp harvests in the Southcentral Region have changed considerably with the development of the fishery in the past 10 years. LCI harvests have dominated the fishery in this region, with a total of 51.2 million pounds harvested between 1974 and 1983 (table 1). Total harvest in PWS was 3.5 million pounds for the same time period (table 2).

2. Managerial authority. Management of the commercial shrimp fishery is specified by the Alaska Board of Fisheries and implemented by the Alaska Department of Fish and Game (ADF&G), Commercial Fisheries Division. Shrimp management in the Southcentral Region is comprised of three shrimp statistical areas: 1) Area E, PWS; 2) Area H, Cook Inlet; and 3) Area G, Outer Cook Inlet. Each statistical area consists of 1) a registration area, comprised of all the waters within the statistical area that are territorial waters of Alaska, and 2) an adjacent seaward biological influence zone (ADF&G 1983a).

3. Gear types. Shrimp may be harvested commercially by pots or trawls. (More detailed descriptions of the gear are given in section II.B.3. below.)

4. Period of use. Fishing seasons differ by management area for the harvest of shrimp in the Southcentral Region. In Area E, PWS, shrimp may be taken by trawls between May and February. Shrimp are usually taken by pots from about April through November (ibid.).

Table 1. Commercial Harvest in Thousands of Pounds of Shrimp by District and by Year for the LCI Management Area, 1974-83

	Fishing Season									
District	1974	1975	1976	1977	1978	1979	1980	1981	1982a	1983a
Kamishak	b	0	0	0	0	0	0	0	0	0
Southern	b	4,750.5	6,207.1	5,115.6	7,549.9	4,268.0	6,404.6	5,183.5	3,872.1	1,086.2
Barren Island	b	0	0	0	0	0	0	0	0	0
Outer	b	1.7	0.6	26.5	10.2	0.7	2.7	2.4	75.1	427.1
Eastern	b	0	0	1.8	1.9	3.8	0.6	18.1	175.3	229.2
Total	5,749.2	4,752.2	6,207.7	5,144.0	7,562.0	4,272.5	6,407.9	5,204.0	4,122.5	1,752.5

Source: ADF&G 1983e.

a Preliminary data.

b Breakdown by district not available.

Table 2. Commercial Harvest of Shrimp in Thousands of Pounds for the PWS Management Area by Year and by Area, 1974-83

	Fishing Season									
Gear Type	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Trawl	1.3	27.0	134.1	170.8	440.7	634.5	557.3	70.6	346.5	473.7
Pot	20.9	3.5	2.0	6.3	12.9	43.6	75.2	144.9	178.5	178.2
Management area total	22.2	30.5	136.1	177.1	453.6	678.1	632.5	215.5	525.0	601.9

Source: Kimker 1984.

In Area H, LCI, the commercial shrimp pot and trawl seasons are primarily June 1 through March 30, with special regulations outlined for Kachemak Bay (see section II.B.4. below) (ibid.).

In Area G, Outer Cook Inlet, there is no closed season for taking shrimp with pots or trawls (ibid.). Individual districts may be opened or closed by emergency order during the season.

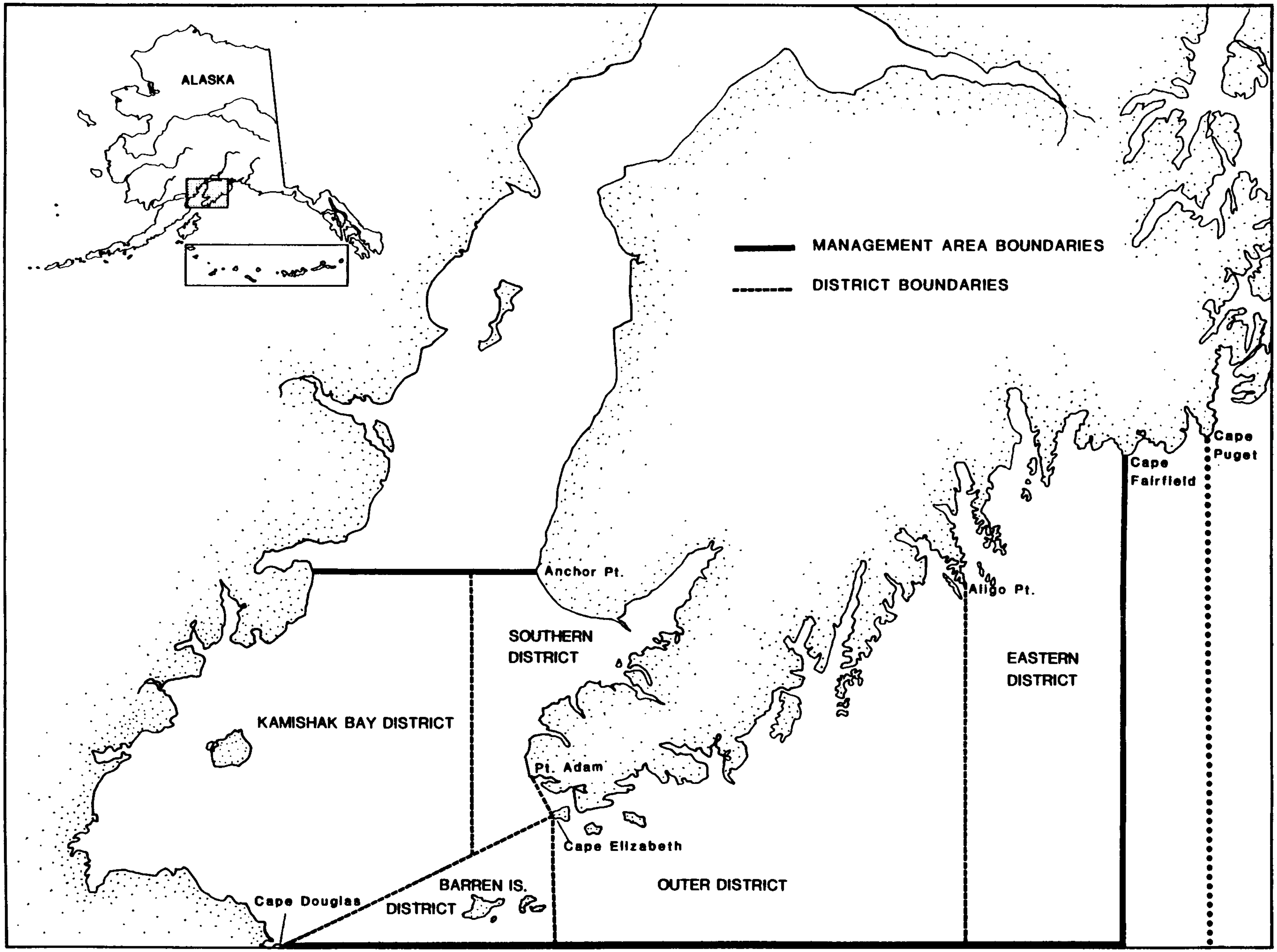
II. LCI MANAGEMENT AREA

A. Boundaries

The LCI Management Area is comprised of all the waters west of the longitude of Cape Fairfield (148°50'W), north of the latitude of Cape Douglas (58°52'N), and south of the latitude of Anchor Point. The Lower Cook Inlet Management Area is divided into five shellfish districts, which are grouped into three "Guideline Harvest Level" areas: 1) Southern District, 2) Kamishak Bay and Barren Islands districts, and 3) Outer and Eastern districts (Kyle et al. 1983).

The districts are further grouped into the two statistical areas for purposes of registering to fish for shrimp. Statistical Area H, or Cook Inlet, is comprised of the Southern, Kamishak Bay, and Barren Islands districts, and Statistical Area G, or Outer Cook Inlet, is comprised of the Outer and Eastern districts (map 1). During the period July 1, 1984, to December 31, 1984, the boundary line between Area G (Outer Cook Inlet) and Area E (PWS) was changed by emergency order for shrimp management. The change moved the eastern boundary of Area G from the longitude of Cape Fairfield to the longitude of Cape Puget. The change was implemented only for the 1984 season by emergency order because past fisheries in Area G have indicated that concentrations of shrimp east and west of Cape Fairfield may be of the same stock and should be harvested under one statistical area. Area E shrimp fishermen have no record of participation in the area between Cape Fairfield and Cape Puget. However, Area G trawl shrimp fishermen have fished up to Cape Fairfield, and it appears that these stocks extend east toward Cape Puget. To avoid the necessity of off-loading shrimp caught in Area G and being reinspected and registered for Area E to fish this area between the two capes, movement of the line is justified to explore and harvest shrimp of the same stock. Area G fishermen volunteered to provide the department with log book information and collect samples from Area G and especially this new area between the two capes in an effort to assist the department in gathering more information on these stocks (ADF&G 1984).

Area H is an exclusive registration trawl-fishing area, and Area G is a nonexclusive registration area. The shrimp management regulations (ADF&G 1983a) include a provision that shrimp trawl vessels registered to fish in Area H may also register to fish in



Map 1. Shrimp commercial fishing districts of the Cook Inlet Management Area.

Area G. Both Areas H and G are nonexclusive registration areas for shrimp pot fishing.

Within the Southern District, the upper portion of Kachemak Bay northeast of a line from the end of Homer Spit to Glacier Spit has been closed to trawl fishing since the start of the fishery (map 2). This area is a nursery and rearing area for juvenile shrimp (Davis 1982).

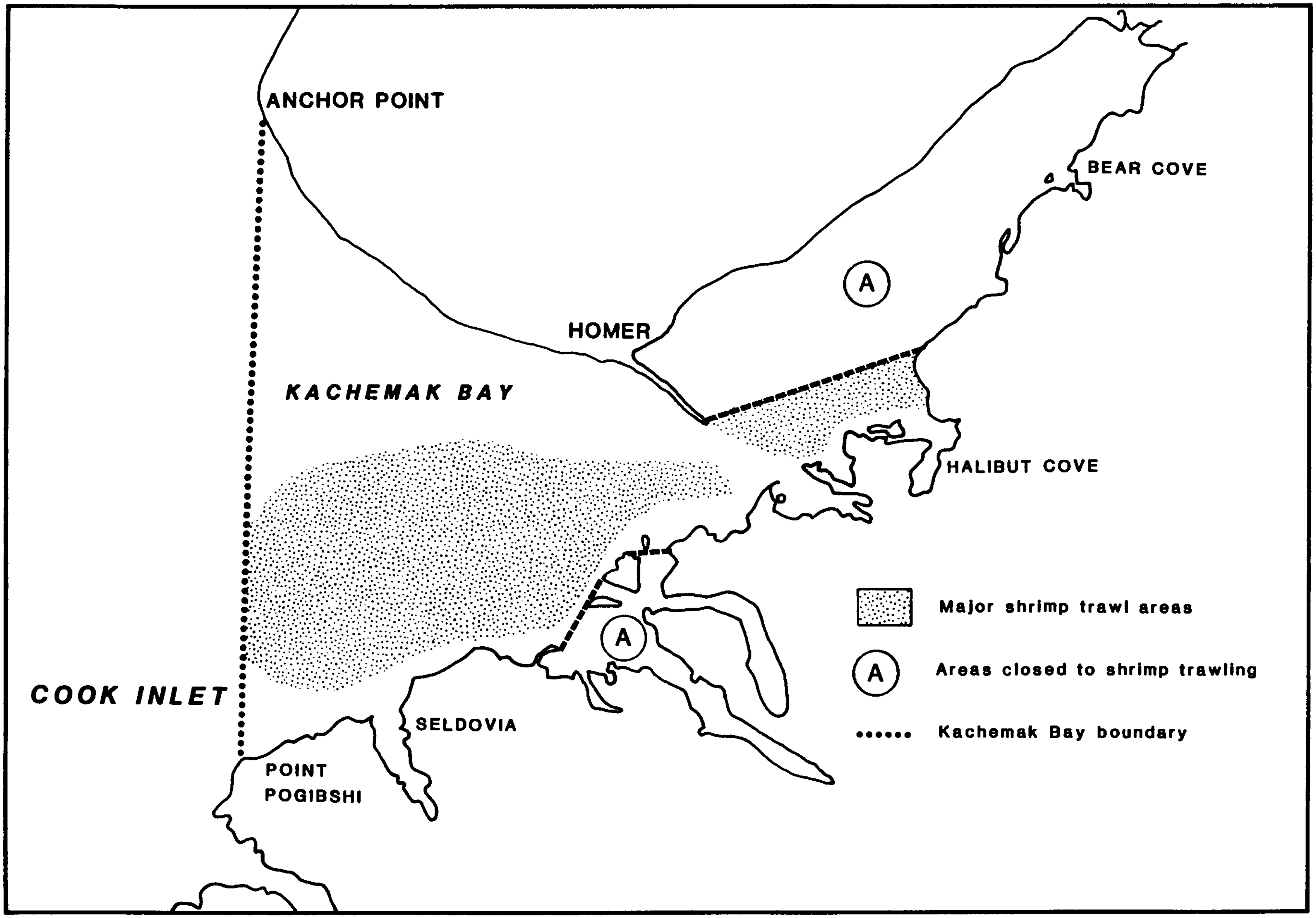
B. Fishery Description and Reported Harvest

1. Historical harvest summary. The shrimp trawl and pot fisheries were both conducted on a small scale by local area fishermen during the late 1950's and early 1960's in LCI. Until the 1970's, the shrimp industry was operated at low levels because of few operating large-scale processing facilities and low market demand (ibid.).

   By 1970, mechanical peelers were installed in processing facilities in Homer, which increased the production capacity for trawl-caught shrimp. Historical shrimp trawl catches range from a low of 25,000 lb in 1968 to a high of 7,186,000 lb in 1978 (ibid.). The annual number of shrimp trawl vessels fished has ranged from 1 to 22 between the early 1960's and the present. Catch data over the past 10 years (1974-1983) reflect changes in the fishery and increased harvest levels brought about by higher market demand and the increased production capabilities of processing facilities (table 3). The 10-year average shrimp trawl catch for this period was 4,808,000 lb.

   The historical pot shrimp harvest in LCI has followed similar trends, with an increased market demand for the large pot shrimp occurring in the early 1970's (Davis 1983). A record high catch of 685,200 lb was taken in 1974 by 44 vessels. This can be compared to record low catches of 131 lb in 1963. The average shrimp pot catch in LCI during the period 1962-1970 was 5,100 lb (ibid.). During the past 10 years (1974-1983), the average shrimp pot catch has been 310,000 lb. Shrimp pot catches have been regulated by seasons and guideline harvest levels since 1977, so lower catches in recent years reflect this regulation (table 4).

2. Recent harvest summary. Total harvest of pot and trawl shrimp in LCI between 1974 and 1983 was 51.2 million pounds. Annual shrimp trawl harvests remained at a high level of about 5.0 million pounds through 1981. Guideline harvest levels for the trawl fishery were established in 1971 and were set at 5.0 million pounds. In 1982, trawl harvests dropped to 3.95 million pounds, reflecting the reduced guideline harvest levels of 1.0 million pounds in each of three seasons. Vessel effort during the 1982-1983 season ranged from 3 to 13 in any given week, and a total of 14 different vessels fished during the year. This compares to the 1981-1982 season when 2 to 19 vessels fished, with a



Map 2. Location of major commercial shrimp trawl areas and closed portions of the Kachemak Bay (Kyle 1984).

Table 3. Commercial Harvest in Thousands of Pounds of Trawl-Caught Shrimp by District and by Year for the LCI Management Area, 1974-83

	Fishing Season									
District	1974	1975	1976	1977	1978	1979	1980	1981	1982a	1983a
Kamishak	b	0	0	0	0	0	0	0	0	0
Southern	b	4,526.0	5,769.2	4,652.1	7,183.9	4,041.2	6,196.7	4,986.7	3,705.5	1,009.9
Barren Island	b	0	0	0	0	0	0	0	0	0
Outer	b	0	0	25.4	0	0	0	0	73.7	425.6
Eastern	b	0	0	1.0	1.9	0	0.4	17.5	174.8	222.5
Total	5,064.0	4,526.0	5,769.2	4,678.5	7,185.8	4,041.2	6,197.1	5,004.2	3,954.0	1,658.0

Source: ADF&G 1983e.

a Preliminary data.

b Breakdown by district not available.

Table 4. Commercial Harvest in Thousands of Pounds of Pot-Caught Shrimp by District and by Year for the LCI Management Area, 1974-83

	Fishing Season									
District	1974	1975	1976	1977	1978	1979	1980	1981	1982a	1983a
Kamishak	b	0	0	0	0	0	0	0	0	0
Southern	b	224.5	437.9	463.5	366.0	226.8	207.9	196.8	166.6	76.3
Barren Island	b	0	0	0	0	0	0	0	0	0
Outer	b	1.7	0.6	1.1	10.2	0.7	2.7	2.4	1.4	11.5
Eastern	b	0	0	0.8	0	3.8	0.2	0.6	0.5	6.7
Total	685.2	226.2	438.5	465.4	376.2	231.3	210.8	199.8	168.5	94.5

Source: ADF&G 1983e.

a Preliminary data.

b Breakdown by district not available.

total of 23 vessels participating throughout the season (Kyle et al. 1983).

Guideline harvest levels were lowered (to 1.0 million pounds) during the 1982-1983 season because ADF&G shrimp trawl index surveys indicated record low population abundances. During the month of May 1982, the shrimp survey showed a population abundance of 4.369 million pounds of shrimp available. This was 40% below historic low levels of index values that have sustained a 5.0 million pound harvest (ibid.). Low abundance of humpy shrimp has caused the main reduction in shrimp biomass, but there is evidence of declining trends in all other shrimp species as well (Kyle et al. 1983, Davis 1982).

The 1983 and 1984 Cook Inlet commercial shrimp trawl fishery suffered again from low abundance of shrimp stocks. The fishery was closed in July 1983 because of continued low catches during the annual index surveys conducted by the ADF&G (Hammarstrom 1984). One season, January-February 1984, was opened only after intensive computer-assisted analysis of survey data from prior years (ibid.). During this season, 524,147 lb of shrimp were harvested under the guideline harvest level of 500,000 lb. Species composition data showed a continued lack of humpy shrimp in all areas as compared to other years (ibid.).

Present guideline harvest levels for the 1984-1985 season are set based on the index survey and may be adjusted as needed. Seasons usually consist of 10 weekly openings. The May 1984 shrimp trawl survey indicated an abundance of 4.1 million pounds. This is an increase from the record low May 1983 index of 2.9 million pounds.

The recent shrimp pot harvests have also been severely affected by low shrimp population abundances in LCI. The 1982 total harvest was 168,500 lb, continuing a downward harvest trend since the 1977 harvest of 465,400 lb (table 4). Guideline harvest levels were held at the lower end of the established range (50,000-100,000 lb per season) during the 1982-1983 season because of low population abundance indicated by the shrimp pot surveys (Kyle et al. 1983).

3. <u>Harvest methods</u>. Shrimp are harvested commercially with both otter trawls and pots. Shrimp pot gear consists of many shapes and sizes, and vessels used to transport and haul pots are typically 32-38 ft in length (Davis 1983). Shrimp trawl vessels are typically 50-80 ft in length, and each vessel fishes a single otter trawl. The otter trawls are 60 to 100 ft wide at the foot rope (Davis 1982). Trawl gear has dominated the harvest historically, but increased market demand for the larger pot shrimp species has caused increased effort by pot fishermen (number of vessels fished) during recent years.

4. <u>Period of use</u>. The shrimp trawl fishery runs from July 1 through March 31 in Cook Inlet. The Southern District is

managed under regulations adopted by the Board of Fisheries in 1977 in the "Kachemak Bay Shrimp Management Plan." Under this plan, three three-month trawl fishery seasons were established, running consecutively from July 1 through March 31. Each season is further divided into weekly periods, and a minimum of nine weeks are fished in each season. Weekly periods are announced in-season by emergency order as survey and catch data are analyzed. Increased competition and subsequently increased efficiency of trawl shrimp harvests have caused changes in catch per unit effort in recent years. Thus, quotas are often reached within hours of an opening, and fishing periods have tended to become shorter (Davis 1982).

All other districts in LCI are open to shrimp trawl fishing from June 1 through March 31 (ADF&G 1983a).

The shrimp pot fishery also operates annually on a three season plan in the Southern District. Shrimp pot fishery seasons are as follows: 1) June 1 through September 15; 2) November 1 through December 31; and 3) February 1 through March 31. Seasonal fishing time and harvest level adjustments are made by emergency order in-season as index survey and catch data are analyzed (Middleton 1981).

All other areas of the LCI Management Area are open to shrimp pot fishing June 1 through March 31. Management regulations in Lower Cook Inlet do not allow shrimp fishing (pot or trawl) from April 1 through May 31 in order to protect the egg-bearing females during the spring egg hatch period (Davis 1982).

C. Management Objectives and Considerations

The Southern District of the LCI Shrimp Management Area has been managed under the Kachemak Bay Trawl Shrimp Management Plan since 1979. Because the primary shrimp harvest area for both trawl and pot fishing is in Kachemak Bay, both management and research have been focused on this area (Davis 1980). The plan is organized to maintain the present harvest characteristics in a way similar to historic fishing. By setting guideline harvest levels and seasons for fishing, the plan seeks to ensure that all species and segments of the stocks are harvested (Davis 1982). It states that guideline harvest levels should remain conservative until an adequate data base can be established to justify any substantial increase in the harvest. Management regulations and periods of fishing are based on preseason abundance index surveys conducted by the ADF&G. Two or more trawl index surveys (May and October) and three pot index surveys (May, October, March) are conducted each year. In addition to the estimates of shrimp abundance made from the index surveys, in-season catch sampling is conducted to determine species composition, weight, and length frequencies. Also, catch per unit of effort (by commercial trawl vessels) information is collected to indicate seasonal abundance and trawler efficiency (ibid.). These data allow for adjusting in-season fishing schedules and providing an optimal sustained yield for the shrimp resources.

The objectives of shrimp monitoring are to regulate the commercial fisheries to meet the guideline harvest levels specified by the Kachemak Bay Trawl Shrimp Management Plan, to enumerate the commercial harvests, and to evaluate management strategies and their effect on the shrimp resources of LCI (ADF&G 1983a).

Population abundance of coonstripe shrimp, the major pot shrimp species, is determined by 1) the shrimp pot index surveys, 2) research index trawl surveys, and 3) in-season catch sampling of commercial shrimp trawlers (Davis 1983a).

Research trawl indexes of abundance have been used as indicators of population trends when compared to other surveys conducted during similar time periods (ibid.). Catch sampling of shrimp trawlers has also provided information on the relative abundance of coonstripe shrimp through determining the species composition of the catch. This information has suggested a gradual decline of coonstripe shrimp populations through the 1970's (ibid.). The pot index surveys have been conducted three times yearly since May 1978, and they have indicated a general declining trend in coonstripe shrimp abundance (ibid.).

The index trawl and pot surveys have also provided information on the abundance of other fish species. The coonstripe shrimp population decline has paralleled similar reductions of other pandalid shrimp species in the Southcentral Region. At the same time, the abundance of groundfish species such as halibut (Hippoglossus stenolepis), gray cod (Gadus macrocephalus), and pollock (Theragra chalcogramma) has increased dramatically during the years in which the shrimp populations declined (ibid.). It is speculated that these groundfish species prey heavily on shrimp juveniles and adults, thereby contributing to part of the overall shrimp population decline. Changes in oceanographic conditions as influenced by "El Nino" are speculated to have occurred and may have adversely affected shrimp populations (Merrett 1985).

D. Significance of Particular Use Areas

A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:

- Commercial shrimp harvest areas

E. Economic Value

Information concerning the value of shrimp within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

III. PWS MANAGEMENT AREA

A. Boundaries

The PWS Management Area (Statistical Area E) is bounded on the west by the longitude of Cape Fairfield (148°50'W), on the east by the longitude of Cape Suckling (143°53'W), and seaward by the 400 fathom (732 m) depth contour. A single district, Icy Bay, is defined for shrimp management purposes in PWS. The Icy Bay District consists of all waters west of a line from the northernmost tip of Point Countess to the southernmost tip of Chenega Point and west of a line from the northernmost tip of Chenega Island to the southernmost tip of Point Nowell (see map 3) (ADF&G 1983a).

B. Fishery Description and Reported Harvest

1. Harvest summary. The shrimp fishery in PWS is a relatively recent fishery and has increased in importance since the late 1970's as a consequence of higher market demands. Until 1981, the shrimp fishery occurred continuously throughout the year. Historical catches of pot shrimp have been recorded since 1960, with none reported in 1961 and 1966. Total harvest of pot and trawl shrimp between 1974 and 1983 was 3.5 million pounds. The record high shrimp pot catch of 178,507 lb was taken in 1982. Record high harvests for the shrimp trawl fishery occurred in 1979, when 634,518 lb were taken by four vessels. The record low trawl catch was made in 1974, when 1,345 lb were caught. No trawl catches were reported prior to 1972. Effort during the 1970's was quite variable because of low market demands. The average catch of pot shrimp over 10 years, 1974-1983, was 66,591 lb; the average catch of trawl shrimp over the period 1974-1983 was 280,646 lb (table 2).

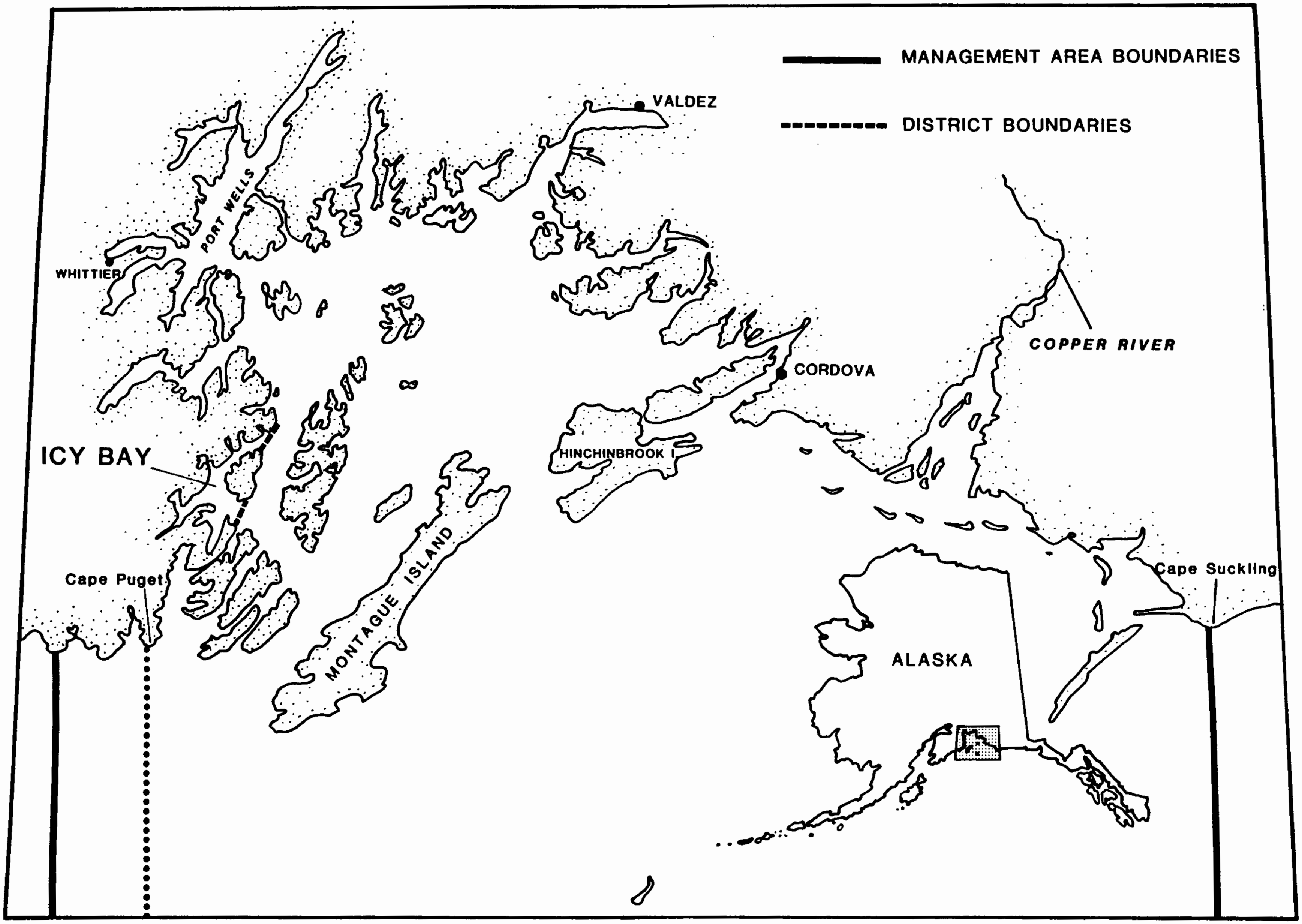
   The primary pot fishery occurs in central and western PWS, whereas nearly all of the trawl fishery takes place in Icy Bay. Trawl harvests, comprising 10% of the total trawl catch, also occurred in Simpson Bay in eastern PWS in 1983 (see map 4) (Kimker 1984).

   The shrimp pot fishery concentrates on the spot shrimp and coonstripe shrimp. The spot shrimp is the largest of the two species and is targeted on because it demands a higher market value. In 1982 and 1983, spot shrimp comprised 96% and 93% of the total pot harvest, respectively. The remainder of the harvests were coonstripe shrimp, with incidental catches of pink shrimp.

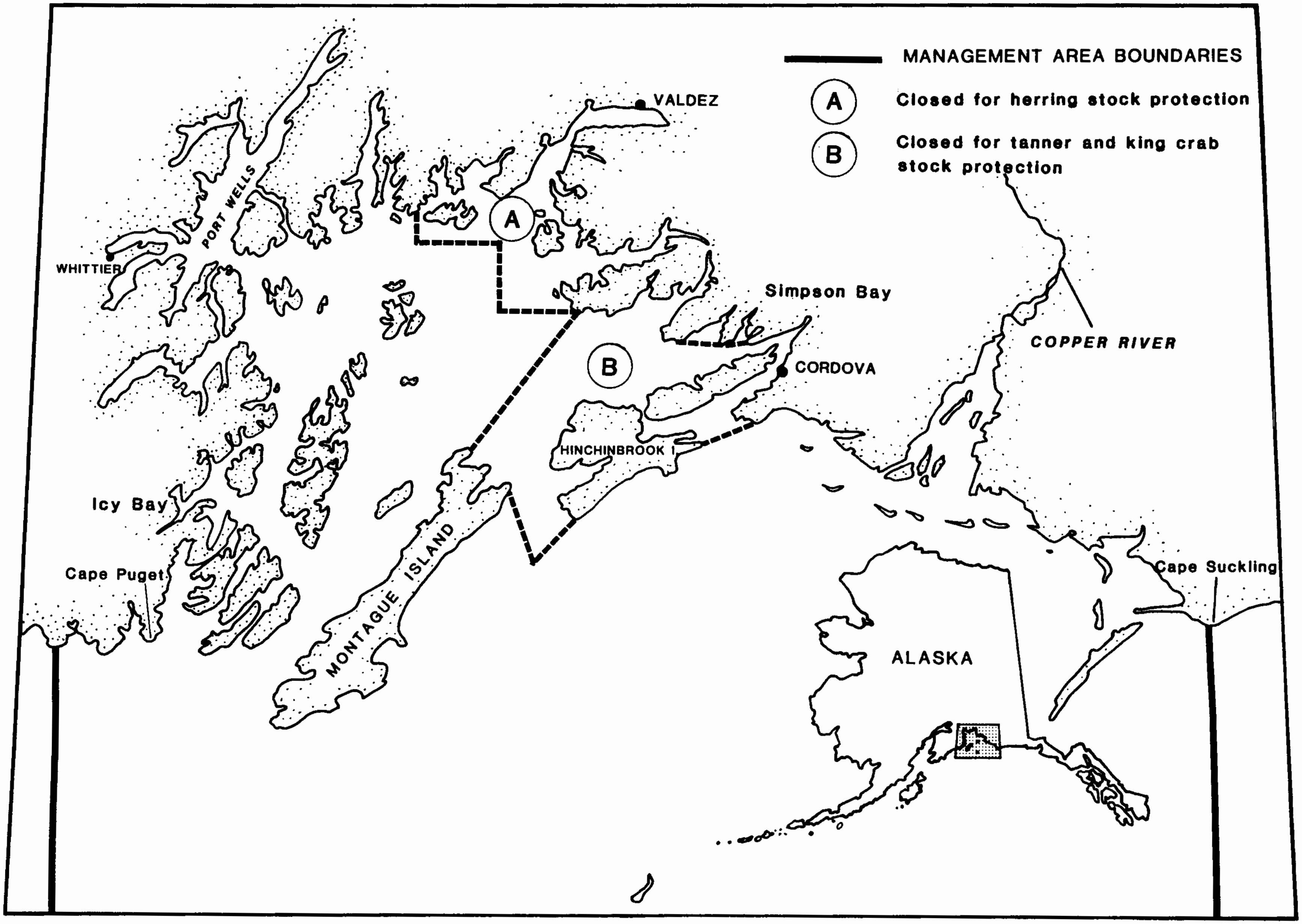
   The shrimp trawl fishery primarily exploits pink shrimp. In 1983, pink shrimp comprised 99% of the total trawl harvest, while spot, sidestripe, and coonstripe shrimp comprised 1% of the harvest (ibid.).

   Catch and effort in the shrimp pot fishery in PWS have increased dramatically since 1977. Prior to 1977, no data are available on harvest effort. Nine vessels operated in 1977, and by 1983 71 vessels fished with pots. Trawl vessel effort has remained at fairly low numbers, ranging from 4 to 13 vessels between 1978 and 1983. Most of the catch is delivered to Seward, Whittier, or Valdez, and small amounts are taken to Cordova or outside Alaska.

2. Harvest methods. Commercial shrimp harvest methods in PWS are the same as those described for LCI in section II.B.3.



Map 3. Shrimp commercial fishing districts of the PWS Management Area. The dotted line represents an extension of the Eastern District of the Lower Cook Inlet Management Area made for the period July 1, 1984 to December 31, 1984 (ADF&G 1983d, 1984).



Map 4. PWS Management Area, showing shrimp trawl closure locations (Kimker 1984).

above. In addition to otter trawls, beam trawls are utilized in the trawl fishery. Effort by shrimp pot fishermen in PWS is much greater than by trawl fishermen, but the commercial harvest is dominated in bulk by the trawlers.

3. Period of use. The shrimp pot harvest season in PWS operated year-round until 1982, when the Alaska Board of Fisheries established a regulatory season from April 1 through November 30. The closed period, December 1 through March 31, was designed to protect the peak egg hatch period. A guideline harvest range of 75,000 to 145,000 lb was also established (ibid.). Harvests in 1983 exceeded the upper limit of this range, and the fishery was closed by emergency order on August 30. It is anticipated that future effort and fishing efficiency will increase, so the season may be limited again by the upper level of the guideline harvest range.

   The trawl harvest season in PWS has also been regulated since 1982 and is open from May 1 to February 28. A guideline harvest range for the Icy Bay District is set at 200,000 to 650,000 lb.

C. Management Objectives and Considerations

The management objectives of the PWS shrimp fishery are to retain the optimal reproductive capacity of shrimp stocks yet provide for commercial harvest (ADF&G 1983b).

Management of the shrimp fishery is relatively new in PWS because the fishery has only recently increased to higher levels of harvest. The department is faced with such problems as there being no practical method of implementing a minimum legal size, the difficulty in assessing biomass, closed-fishing violations, and nonbiological interference (Kimker 1984).

Because of the increased harvest levels of shrimp in PWS during recent years, biologists are concerned with the potential of approaching or exceeding the maximum sustained yield of the shrimp resources. The guideline harvest levels and fishing seasons were set by the Alaska Board of Fisheries in 1982 until further research could be conducted on the life histories and resource status of the shrimp species in PWS (ibid.).

The department began shrimp research work by collecting data on length frequencies and on the incidence of egg-bearing females. An effort has been made to increase the accuracy of commercial harvest information, because management is based on reported catch (fish tickets), dockside sampling, and fishermen/processor interviews (ADF&G 1983b). In 1982, a tagging study of spot shrimp was initiated to determine the primary locations of large shrimp and to define shrimp stocks, migration, and growth. Tag recoveries have allowed identification of growth and change in the egg-bearing status of PWS shrimp. No significant movement of shrimp has yet been observed. The project is expected to continue through 1984 (Kimker 1984).

D. Significance of Particular Use Areas
A series of reference maps have been prepared for use with this report. The categories of mapped information are species-specific and include the following:
° Commercial shrimp harvest areas

E. Economic Value
Information concerning the value of shrimp within the Southcentral Region is presented in the Economic Overviews of Fish and Wildlife volume.

REFERENCES

ADF&G. 1983a. Commercial shellfish regulations.

________. 1983b. Summary and description of the program and component projects included in the Commercial Fisheries Division, FY84 operational budget request.

________. 1983c. Lower Cook Inlet shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Homer. 22 pp.

________. 1983d. Prince William Sound Management Area shellfish report to the Alaska Board of Fisheries. Div. Commer. Fish., Cordova. 39 pp.

________. 1983e. Computer printouts. Commercial Fisheries Catch Reporting System.

________. 1984. Emergency order No. 2-S-G-15-84. Div. Commer. Fish., Homer. 2 pp.

Davis, A.S. 1979. Shrimp trawl fishing in the Cook Inlet area, 1978-79 fishing season. ADF&G, LCI Data Rept. 79-4.

________. 1980. Shrimp pot fishing in the Cook Inlet area, 1979-80 fishing season. ADF&G, LCI Data Rept. 80-3.

________. 1982. The commercial otter trawl shrimp fishery of Cook Inlet. ADF&G, Informational Leaflet 205.

________. 1983. The pandalid shrimp pot fishery of Cook Inlet, Alaska. From the initiation of the fishery through the spring of 1983. ADF&G, Informational Leaflet 220.

Hammarstrom, L. 1984. Lower Cook Inlet trawl shrimp, July 1983-March 1984. LCI Data Rept. 84-1.

Kimker, A. 1984. Prince William Sound shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., PWS Data Rept. 84-5.

Kyle, S.C. 1984. Shellfish report to the Alaska Board of Fisheries. ADF&G, Div. Commer. Fish., LCI Data Rept. 84-2. Homer. 41 pp.

Kyle, S.C., A.S. Davis, and H. Vanderbrink. 1983. Lower Cook Inlet shellfish report to the Alaska Board of Fisheries, 1982. ADF&G, Div. Commer. Fish., Anchorage.

Merrit, M.F. 1985. Personal communication. Shellfish Research Biologist, ADF&G, Commer. Fish., Homer.

Middleton, K. 1981. Lower Cook Inlet stock status report. Draft manuscript. ADF&G, Div. Commer. Fish., Anchorage.

Sportfishing

Sport Use and Economic Value of Selected Freshwater Resident and Anadromous Fish Species

I. POPULATION MANAGEMENT HISTORY

A. Selected Species

This narrative and the accompanying maps present available information on the recreational (sport) fisheries use of a group of anadromous and freshwater resident fish species found in the Southcentral Region. This group of fish includes all five species of North American Pacific salmon (chinook, coho, sockeye, pink, and chum), char (Dolly Varden/arctic char), steelhead trout, rainbow trout, and arctic grayling. These species were selected for inclusion in the Southcentral Guide because of their representative life histories and habitat requirements and their relative importance within the Southcentral Region's recreational fisheries. In addition, where important harvests of other species (i.e., whitefish, burbot, and lake trout) take place, a general summary is provided in the appropriate harvest survey area summary (I.E.1 to 7 below).

B. Management History

1. Management agency jurisdiction. The territory of Alaska established a sport fish management program in 1951. Program activities were concentrated on inventory studies, lake rehabilitation, and trout stocking on lakes and streams near population centers and bordering the highway system (ADF&G 1957). With the granting of statehood in 1959, the ADF&G, Sport Fish Division, assumed full control of the sport fish resources. Primary regulatory authority is vested in the Alaska Board of Fisheries. Following statehood, the Division of Sport Fish began receiving federal funds from the Dingell-Johnson (D-J) Bill and was able to initiate several research projects in addition to extending its management program (ADF&G 1959).
2. Management objectives. During the early years of resource management, sportfishing was viewed as a minor factor in context of the management of commercially harvested species. The sport fisheries of the state were not intense enough to damage stocks. The management objective was simply to accumulate basic survey information on the fishery resources. With rapid population expansion and industrial development came many more user groups, including an ever-increasing recreationally oriented population. Gradually, management objectives began to focus on stocks and areas having potential for overharvest. As natural fish stocks around cities and towns began to decrease and easily accessible sport fisheries began to get crowded, new fisheries were developed. In response to public demand for quality recreational fishing opportunities, standard fishery

management practices that had been aimed primarily at maximizing numbers of fish available for harvest (yield) were refined to meet the aesthetic, social, and psychological needs of people. A multi-user group philosophy and a quality fishing concept were incorporated into Alaska sport fish management in the 1960's. Since 1966, the ADF&G has been managing selected streams and drainages in Bristol Bay and upper Cook Inlet for "trophy" rainbow trout. This program emphasizes quality fishing for a unique strain of native rainbow trout.

Recreational fisheries have grown tremendously since statehood and now play a significant role in total fisheries management (Mills 1983). Alaska statewide sportfishing regulations now address access to and development near recreational fisheries. Bag limits and/or gear have become restrictive to prevent overharvest and distribute the available larger fish among more anglers, thus affording the optimum possible opportunity per angler for taking large, or trophy-size, fish (Andrews n.d.).

Artificial (stocked) urban fisheries also continue to be created adjacent to population centers and are enthusiastically used.

C. Alaska Statewide Sport Fish Harvest Program

1. Program history. In the early years of statehood, when quality, uncrowded sportfishing was readily available, large sport fisheries were few and easily monitored. On-site creel census surveys of the more intensively fished waters, rather than the compulsory statewide reporting as required of the commercial fishing industry, provided the information needed for proper management of the sport fish populations.

Detailed statistics were not kept on the sport harvest of fish in Alaska prior to 1977, except where a knowledge of the effort and catch was required for protective in-season management or to ensure compliance with regulatory and management policies, quotas, and guidelines (Mills 1983). Annual sport harvest estimates for ADF&G management areas were based on area sport fish biologists' own knowledge and observations, in addition to creel census data. These "historical" annual management area harvest estimates are therefore subjective, limited in total scope, and should be considered minimum harvest estimates. The annual sport harvest estimates of salmon caught in Alaska as reported to the Technical Committee of the INPFC and published in their annual Statistical Yearbook are examples of such historical data (Mills, pers. comm.).

Essential for regulation and management of Alaska's sport fisheries and for total regulation, management, and allocation of multiple-use fisheries is a statewide data base of information on where sportfishing occurs, the extent of participation, the preferences of participants, and the species and numbers of major sport fishes being harvested. Statewide on-site creel censuses were considered prohibitively costly. To meet this data need in 1977, the ADF&G, Division of Sport Fish, combined a postal survey with creel censuses to obtain annual estimates of effort and harvest for major Alaskan sport-caught species by area and fishery (Mills 1983). Southcentral Regional harvest survey areas and boundaries are delineated on map 1. This program is in its eighth year of operation.

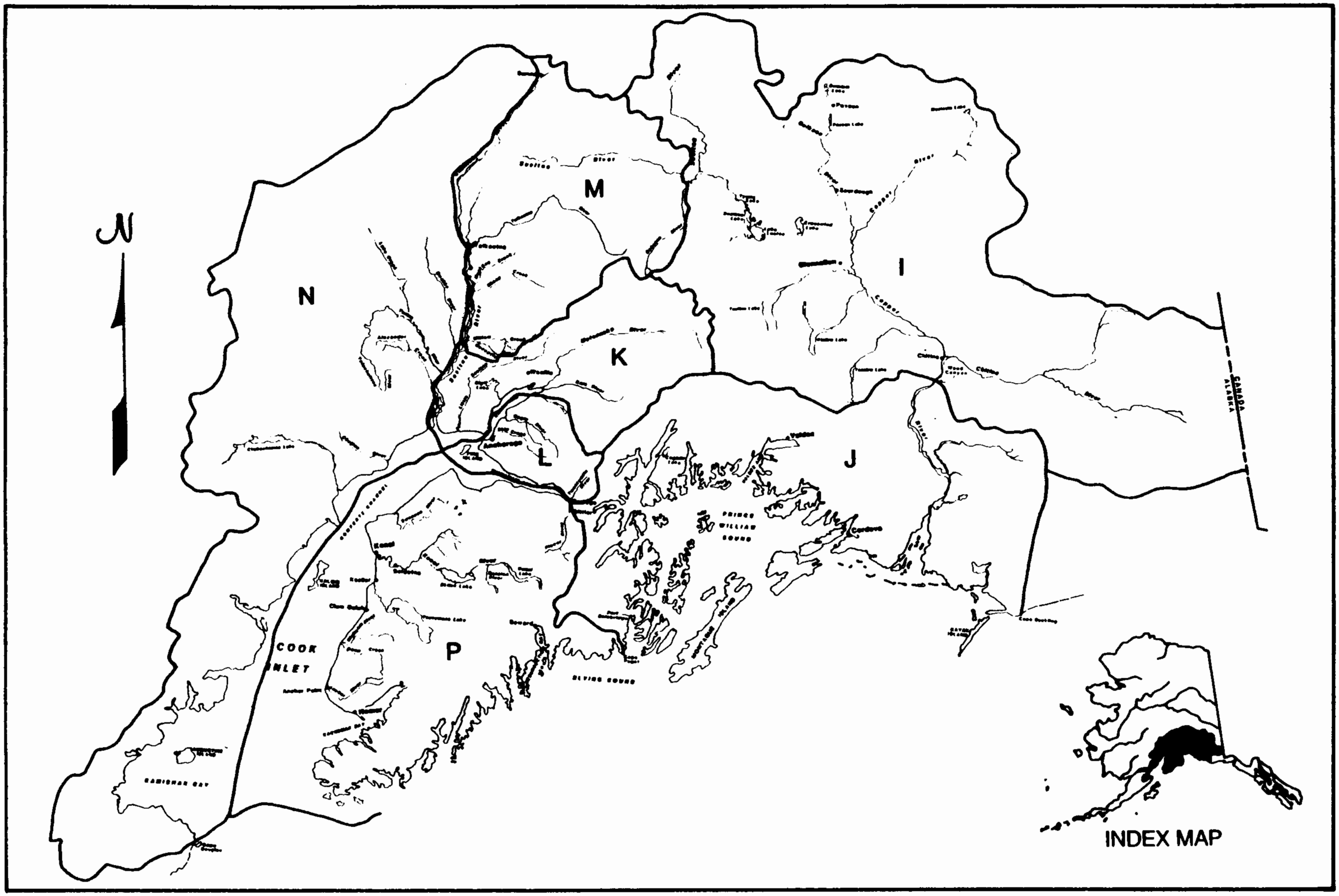
2. Application of data. Detailed tabulations of annual effort and harvest by region, area, fishery, and species for 1977 through 1982 may be found in Mills (1979-1983). Summary tables of annual (1977-1982) Southcentral Region sportfishing effort and harvest data have been prepared and are included in this narrative for easy reference. When using these tables, it is important to remember that effort is reported by lake or river system, not by species. Thus data in tables 1 through 8 include effort directed toward species, such as whitefish, not addressed in these narratives. It is also important to remember that harvest data include only those fish caught and kept, not those caught and released. In this way, harvest totals that are of most direct importance for management are readily available. However, the importance of recreational fisheries where catch and release is a common practice (such as the Talachuitna River rainbow trout and Gulkana River grayling fisheries) may be underestimated if evaluated on the basis of these tables alone.

D. Regional Harvest Summary

1. Harvest methods. Sportfishing for salmon, char, steelhead trout, rainbow trout, arctic grayling, lake trout, burbot, and other species in the Southcentral Region is permitted by the use of hook and line only. Spear fishing is allowed for northern pike regionwide and in the Upper Copper-Upper Susitna River Area from October 1 through March 31 for whitefish (ADF&G 1984a).

2. Angler effort. Sportfishing effort in the Southcentral Region has increased by nearly 25% since 1977 (table 1). In 1982, sport anglers spent over 980,000 man-days fishing in the Southcentral Region. Since 1977, an average of 64% of the total number of angler-days fished in Alaska were in the Southcentral Region (Mills 1983). Within the Southcentral Region, over half of the annual effort takes place on the Kenai Peninsula. Freshwater areas account for the majority of the effort; however, about 20% of the effort in the Southcentral Region is expended in saltwater areas of the Kenai Peninsula.

3. Harvest data. Rainbow trout, sockeye salmon, pink salmon, coho salmon, and char are generally the most heavily exploited sport fish in the Southcentral Region. The smelt harvest is usually the largest in the Southcentral Region in



Map 1. Southcentral Region sport fish survey areas (ADF&G 1984b).

Detailed maps of these survey areas boundaries are available at the Division of Sport Fish, Biometrics Section.

Table 1. Southcentral Region Sportfishing Effort Expressed In Angler-Days[a] and as a Percentage of Total Southcentral Region Sportfishing Effort, 1977-82

Postal Survey Area	Angler-Days											
	1977		1978		1979		1980		1981		1982	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Glennallen (I)	51,485	6.9	44,566	5.4	57,266	6.3	50,518	5.3	53,499	6.0	54,953	5.6
PWS (J)												
Salt water	---	---	---	---	33,939	3.7	31,317	3.3	33,669	3.8	30,826	3.1
Fresh water	---	---	---	---	12,655	1.4	15,151	1.6	9,065	1.0	9,742	1.0
Subtotal	48,369	6.5	35,046	4.2	46,594	5.1	46,468	4.9	42,734	4.8	40,568	4.1
Knik Arm (K)	81,949	10.9	75,540	9.1	78,411	8.6	102,530	10.8	105,052	11.8	91,713	9.3
Anchorage (L)	55,060	7.3	31,147	3.7	65,425	7.2	79,665	8.4	67,618	7.6	82,007	8.3
E. Susitna (M)	56,651	7.6	86,010	10.3	78,222	8.6	91,304	9.6	59,854	6.7	80,745	8.2
W. Cook Inlet (N)												
Salt water	---	---	---	---	2,373	0.3	1,799	0.2	3,323	0.4	4,589	0.5
Fresh water	---	---	---	---	50,374	5.5	48,125	5.1	37,335	4.2	52,222	5.3
Subtotal	32,842	4.4	38,771	4.7	52,747	5.8	49,924	5.3	40,658	4.6	56,811	5.8
Kenai Penin. (P)												
Salt water	146,235	19.5	176,912	21.2	173,909	19.0	170,182	17.9	181,140[b]	20.4	172,154[b]	17.5
Fresh water	276,719	36.9	344,586	41.4	361,418	39.5	360,311	37.9	338,522	38.1	404,431	41.1
Subtotal	422,954	56.4	521,498	62.6	535,327	58.6	530,493	55.8	519,662	58.4	576,585	58.6
Saltwater total	---	---	---	---	210,221	23.0	203,298	21.4	218,132	24.5	207,569	21.1
Freshwater total	---	---	---	---	703,771	77.0	747,604	78.6	670,945	75.5	775,813	78.9
Grand total	749,310	100.0	832,578	100.0	913,992	100.0	950,902	100.0	889,077	100.0	983,382	100.0

Source: Mills 1979-83.
--- means no data were available.
a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.
b Saltwater effort does not include angler-days reported in the newly created or recognized personal use fisheries for king crab, Dungeness crab, Tanner crab, shrimp, and hardshell clams.

Table 2. Glennallen Area Sportfishing Effort Expressed as Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the Glennallen Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Gulkana Float (Paxson to Sourdough)	---	---	---	---	---	---	---	---	---	---	4,811	6.9
Gulkana other	---	---	---	---	---	---	---	---	---	---	10,168	14.5
Gulkana total	4,165	8.1	6,570	14.7	17,323	30.3	13,752	27.2	14,430	27.0	14,979	21.4
Lake Louise, Susitna, & Tyone	14,899	28.9	13,161	29.5	12,199	21.3	10,539	20.9	14,397	26.9	14,024	20.1
Van (Silver) Lake	1,160	2.3	1,335	3.0	518	0.9	1,143	2.3	802	1.5	1,399	2.0
Paxson & Summit lks.	6,429	12.5	6,117	13.7	6,948	12.1	5,840	11.6	7,133	13.3	6,432	9.2
Strelna Lake	548	1.1	495	1.1	204	0.4	123	0.2	278	0.5	222	0.3
Sculpin Lake	68	0.1	754	1.7	314	0.5	471	0.9	393	0.7	---	---
Crosswind Lake	1,852	3.6	2,800	6.3	802	1.4	1,885	3.7	769	1.4	2,423	3.5
Hudson Lake	234	0.5	---	---	63	0.1	129	0.3	---	---	---	---
Other waters	22,130	43.0	13,334	29.9	18,895	33.0	16,636	32.9	15,297	28.6	15,474	22.1
Glennallen total	51,485	100.0	44,566	100.0	57,266	100.0	50,518	100.0	53,499	100.0	69,932	100.0

Source: Mills 1979-83.

--- means no data were available.

a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.

Table 3. Prince William Sound Area Sportfishing Effort Expressed in Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the Prince William Sound Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Valdez Bay	19,423	40.2	12,687	36.2	19,068	40.9	18,707	40.3	18,716	43.8	13,904	34.3
Passage Canal	---	---	---	---	4,134	8.9	3,756	8.1	4,875	11.4	4,520	11.1
Other salt water	---	---	---	---	10,737	23.0	8,854	19.1	10,078	23.6	12,402	30.6
Saltwater total	---	---	---	---	33,939	72.8	31,317	67.4	33,669	78.8	30,826	76.0
Eyak River	3,544	7.3	2,003	5.7	4,653	10.0	6,954	15.0	3,910	9.1	4,043	10.0
Eshamy Cr. & Lagoon	---[b]	---	---[f]	---	802	1.7	457	1.0	753	1.8	802	2.0
Coghill River	---[b]	---	1,745[g]	5.0	1,273	2.7	1,371	3.0	1,734	4.1	1,621	4.0
Shrode Creek	---	---	---	---	220	0.5	414	0.9	164	0.4	307	0.8
Pigot R. drainage	1,325[c]	2.7	926[c]	2.6	236	0.5	---	---	---	---	---	---
Other streams	---	---	---	---	3,333	7.2	4,355	9.4	1,358	3.2	2,047	5.0
Eshamy Lake	5,842[b]	12.1	2,305[f]	6.6	236	0.5	257	0.6	115	0.3	205	0.5
Shrode Lake	1,209[d]	2.5	1,314[d]	3.7	204	0.4	243	0.5	262	0.6	---	---
Other lakes	---	---	---	---	1,698	3.6	1,100	2.4	769	1.8	717	1.8
Freshwater total	11,920	24.6	8,293	23.7	12,655	27.2	15,151	32.6	9,065	21.2	9,742	24.0
Others[e]	17,026	35.2	14,066	40.1	---	---	---	---	---	---	---	---
Grand total	48,369	100.0	35,046	100.0	46,594	100.0	46,468	100.0	42,734	100.0	40,568	100.0

Source: Mills 1979-83.
--- means no data were available.
a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.
b Data for 1977 are under the category Eshamy Lake and Lagoon, Coghill River and Lake (Mills 1979a).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979a, 1979b).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979a, 1979b).
e In 1977 and 1978 the "others" category was not divided between fresh and salt water or lakes and streams (Mills 1979a, 1979b).
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1979b).
g Data for 1978 are listed as Coghill River and Lake (Mills 1979b).

Table 4. Knik Arm Drainage Area Sportfishing Effort Expressed in Angler-Days[a] and as a Percentage of Total Sportfishing Effort in the Knik Arm Drainage Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Little Susitna R.	11,063	13.5	12,127	16.1	21,301	27.2	22,420	21.9	26,162	24.9	24,020	26.2
Knik River & Tributaries, including Jim Creek	---	---	---	---	---	---	---	---	4,904	4.7	6,653	7.3
Wasilla Creek (Rabbit Slough)	2,805	3.4	3,446	4.6	4,024	5.1	5,726	5.6	4,019	3.8	6,261	6.8
Cottonwood Creek	---	---	---	---	5,345	6.8	9,268	9.0	8,663	8.2	5,186	5.7
Wasilla Lake	---	---	---	---	3,521	4.5	1,642	1.6	2,829	2.7	2,457	2.7
Finger Lake	14,864	18.1	11,502	15.2	4,433	5.7	6,483	6.3	5,267	5.0	3,514	3.8
Kepler Lake complex	7,962	9.7	5,730	7.6	5,439	6.9	8,597	8.4	8,227	7.8	6,943	7.6
Lucille Lake	7,440	9.1	4,803	6.4	2,987	3.8	3,798	3.7	2,844	2.7	2,218	2.4
Big Lake	11,869	14.5	9,856	13.0	8,300	10.6	12,195	11.9	14,568	13.9	15,371	16.8
Nancy Lake Rec. Area, including Nancy Lk.	7,259	8.9	7,647	10.1	7,011	8.9	9,153	8.9	8,488	8.1	8,615	9.4
Others	18,687	22.8	20,420	27.0	16,050	20.5	23,248	22.7	19,081	18.2	10,475	11.4
Freshwater total	81,949	100.0	75,531	100.0	78,411	100.0	102,530	100.0	105,052	100.0	91,713	100.0
Grand total	81,949	100.0	75,531	100.0	78,411	100.0	102,530	100.0	105,052	100.0	91,713	100.0

Source: Mills 1979-83.

--- means no data were available.

a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.

Table 5. Anchorage Area Sportfishing Effort Expressed as Angler-Days[a] and as a Percentage of Total Sportfishing Effort in the Anchorage Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Jewel Lake	5,908	10.7	4,157	13.3	7,923	12.1	8,182	10.3	5,819	8.6	9,076	11.1
Campbell Point Lake	3,099	5.6	1,077	3.5	2,814	4.3	2,142	2.7	2,902	4.3	921	1.1
Sand Lake	2,099	3.8	1,702	5.5	2,295	3.5	2,113	2.7	2,278	3.4	4,043	4.9
Lower Fire Lake	3,132	5.7	1,508	4.8	5,109	7.8	4,955	6.2	2,118	3.1	2,218	2.7
Mirror Lake	1,808	3.3	495	1.6	1,053	1.6	1,414	1.8	2,206	3.3	2,167	2.6
Otter Lake	5,197	9.4	2,046	6.6	7,687	11.7	7,040	8.8	5,543	8.2	7,421	9.0
Clunie Lake	2,977	5.4	1,809	5.8	3,490	5.3	4,498	5.6	4,034	6.0	5,254	6.4
Gwen Lake	837	1.5	302	1.0	1,588	2.4	914	1.1	2,336	3.5	3,924	4.8
Sixmile Lake	1,473	2.7	969	3.1	2,688	4.1	4,241	5.3	3,468	5.1	5,016	6.1
Green Lake	3,278	6.0	1,766	5.7	7,136	10.9	7,868	9.9	4,890	7.2	8,223	10.0
Hillberg Lake	2,487	4.5	1,680	5.4	2,814	4.3	4,369	5.5	4,498	6.7	4,828	5.9
Triangle Lake	---	---	---	---	---	---	2,199	2.8	1,785	2.6	1,535	1.9
C Street Lake	---	---	---	---	---	---	1,899	2.4	1,059	1.6	2,167	2.6
Beach Lake	---	---	---	---	---	---	1,028	1.3	1,001	1.5	768	0.9
Fish Lake	---	---	---	---	---	---	1,842[b]	2.3	2,177	3.2	1,365	1.7
Cheny Lake	---	---	---	---	---	---	b		1,480	2.2	1,706	2.1
Eagle River	1,328	2.4	646	2.1	2,703	4.1	2,085	2.6	2,060	3.0	3,037	3.7
Ship Creek	1,156	2.1	1,551	5.0	4,150	6.3	4,441	5.6	2,293	3.4	2,695	3.3
Bird Creek	7,389	13.4	1,896	6.1	2,971	4.5	3,927	4.9	2,946	4.4	2,081	2.5
Twentymile River	6,403	11.6	2,736	8.8	3,899	6.0	8,582	10.8	7,429	11.0	7,489	9.1
Others	6,489	11.8	6,807	21.9	7,105	10.9	5,926	7.4	5,296	7.8	6,073	7.4
Total	55,060	100.0	31,147	100.0	65,425	100.0	79,665	100.0	67,618	100.0	82,007	100.0

Source: Mills 1979-83.
--- means no data were available.
a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.
b Fish Lake and Cheny Lake effort was reported together in 1980.

Table 6. East Side Susitna River Drainage Sportfishing Effort Expressed in Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in The East Side Susitna Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Willow Creek	14,024	24.8	22,682	26.4	18,911	24.2	29,011	31.8	14,060	23.5	19,704	24.4
Caswell Creek	---	---	---	---	3,710	4.7	4,963	5.4	3,860	6.4	5,101	6.3
Montana Creek	14,268	25.2	25,762	30.0	22,621	28.9	19,287	21.1	16,657	27.8	23,645	29.3
Sunshine Creek	---	---	---	---	3,317	4.2	5,208	5.7	3,062	5.1	3,787	4.7
Clear (Chunilna) Cr.	3,163	5.6	5,040	5.9	5,125	6.6	4,388	4.8	3,584	6.0	3,856	4.8
Sheep Creek	8,112	14.3	11,869	13.8	6,728	8.6	8,041	8.8	6,936	11.6	9,093	11.3
Little Willow Creek	4,583	8.1	5,687	6.6	5,171	6.6	8,190	9.0	3,845	6.4	5,579	6.9
Others	12,501	22.1	14,970	17.4	12,639	16.2	12,216	13.4	7,850	13.1	9,980	12.4
Total	56,651	100.0	86,010	100.0	78,222	100.0	91,304	100.0	59,854	100.0	80,745	100.0

Source: Mills 1979-83.

--- means no data were available.

a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.

Table 7. West Side Cook Inlet - West Side Susitna Drainage Area Sportfishing Effort Expressed in Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the West Side Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Salt water												
Boat	---	---	---	---	880	1.7	928	1.9	972	2.4	1,501	2.6
Shoreline	---	---	---	---	1,493	2.8	871	1.7	2,351	5.8	3,088	5.4
Total	---	---	---	---	2,373	4.5	1,799	3.6	3,323	8.2	4,589	8.1
Deshka River	3,852	11.7	9,111	23.5	13,236	25.1	19,364	38.8	13,248	32.6	18,391	32.4
Lake Creek	6,946	21.1	8,767	22.6	13,881	26.3	8,325	16.7	6,471	15.9	8,649	15.2
Alexander Creek	5,991	18.2	6,914	17.8	8,284	15.7	6,812	13.6	6,892	17.0	10,748	18.9
Polly Creek	---	---	---	---	---	---	---	---	377	0.9	512	0.9
Talachulitna River	1,342	4.1	732	1.9	2,185	4.1	2,542	5.1	1,378	3.4	1,911	3.4
Chuit River	1,355	4.1	1,185	3.1	1,069	2.0	614	1.2	1,364	3.4	751	1.3
Theodore River	1,037	3.2	905	2.3	912	1.7	700	1.4	899	2.2	375	0.7
Lewis River	343	1.0	172	0.4	31	0.1	43	0.1	---	---	---	---
Other rivers	7,269	22.1	6,011	15.5	7,577	14.4	4,998	10.0	4,586	11.3	6,500	11.4
Shell Lake	566	1.7	302	0.8	263	0.5	414	0.8	d		444	0.8
Whiskey Lake	287	0.9	129	0.3	189	0.4	29	0.1	d		171	0.3
Hewitt Lake	436	1.3	172	0.4	613	1.2	471	0.9	d		358	0.6
Judd Lake	317	1.0	151	0.4	519	1.0	814	1.6	d		---	---
Other lakes	2,205	6.7	3,420	8.8	1,615	3.1	2,999	6.0	2,120[d]	5.2	3,412	6.0
Freshwater total	---	---	---	---	50,374	95.5	48,125	96.4	37,335	91.8	52,222	91.9
Grand total	32,842[b]	100.0	38,771[c]	100.0	52,747	100.0	49,924	100.0	40,658	100.0	56,811	100.0

Source: Mills 1979-83.
--- means no data were available.
a Effort is the number of days spent fishing, where any portion of a day spent fishing is counted as one whole angler-day.
b Total for 1977 includes 896 angler-days spent harvesting razor clams that were not cited at any specific location, and accounted for 2.7 % of the total sportfishing effort.
c Total for 1978 includes 800 angler-days spent harvesting razor clams (2.1 % of total sportfishing effort).
d All lakes were reported together in 1981 in the category "other lakes."

Table 8. Kenai Peninsula Sportfishing Effort Expressed in Angler-Days[a] and as a Percentage of Total Sportfishing Effort in the Kenai Peninsula Area Each Year, 1977-82

	Angler-Days											
	1977		1978		1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Salt water:												
Deep Cr. finfish	32,218	7.6	34,679	6.6	35,354	6.6	31,987	6.0	25,538	4.7	29,718	5.0
Resurrection Bay												
Finfish	---	---	---	---	---	---	---	---	56,410	10.3	49,167	8.3
Shellfish[b]	---	---	---	---	---	---	---	---	1,145	0.2	682	0.1
Total	41,797	9.9	53,355	10.2	43,576	8.1	49,623	9.4	57,555	10.5	49,849	8.4
Kachemak Bay												
Finfish	---	---	---	---	---	---	---	---	60,336	11.0	52,631	8.9
Shellfish	---	---	---	---	---	---	---	---	25,391	4.6	15,712	2.6
Total	38,498	9.1	47,259	9.1	52,442	9.8	51,080	9.6	85,727	15.7	68,343	11.5
Other salt water												
Finfish	---	---	---	---	---	---	---	---	7,558	1.4	8,684	1.5
Shellfish	---	---	---	---	---	---	---	---	1,178	0.2	1,160	0.2
Total	8,329	2.0	11,869	2.3	12,214	2.3	5,998	1.1	8,736	1.6	9,844	1.7
Razor clams	25,393	6.0	29,750	5.7	30,323	5.7	31,494	5.9	31,298	5.7	31,954	5.4
Saltwater total	146,235	13.6	176,912	12.4	173,909	12.3	170,182	12.0	208,854	38.2	189,708	31.9
Fresh water:												
Kenai River (Cook Inlet - Soldotna Br.)	---	---	---	---	---	---	---	---	91,763	16.8	119,164	20.1
Kenai River (Soldotna Br. - Moose R.)	---	---	---	---	---	---	---	---	35,877	6.6	49,372	8.3
Kenai River (Moose R. - Skilak outlet)	---	---	---	---	---	---	---	---	33,701	6.2	39,170	6.6
Kenai River (Skilak Inlet - Kenai L.)	---	---	---	---	---	---	---	---	17,375	3.2	24,242	4.1
Kenai R. total	122,138	28.9	164,264	31.5	178,485	33.3	171,803	32.4	178,716	32.6	231,948	39.0

(continued)

Table 8 (continued).

Location	Angler-Days											
	1977		1978		1979		1980		1981		1982	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Anchor River	31,515	7.5	42,671	8.2	44,220	8.3	33,272	6.3	34,257	6.3	24,709	4.2
Ninilchik River	11,350	2.7	14,173	2.7	18,282	3.4	19,706	3.7	14,184	2.6	11,806	2.0
Deep Creek	11,399	2.7	13,872	2.7	12,560	2.3	8,796	1.7	10,127	1.9	12,149	2.0
Stariski Creek	1,442	0.3	3,662	0.7	1,965	0.4	1,499	0.3	1,080	0.2	1,023	0.2
Russian River	54,220	12.8	67,237	12.9	58,133	10.9	78,983	14.9	54,642	10.0	70,372	11.8
Kasilof River[c]	---	---	---	---	---	---	---	---	8,311	1.5	13,238	2.2
Other rivers	11,822	2.8	13,850	2.7	18,141	3.4	16,550	3.1	11,329	2.1	10,338	1.7
Hidden Lake	7,462	1.8	4,028	0.8	5,974	1.1	5,783	1.1	4,761	0.9	6,278	1.1
Canoe Lake system	8,183	1.9	6,376	1.2	5,769	1.1	6,697	1.3	5,235	1.0	6,329	1.1
Other lakes	17,188	4.1	14,453	2.8	17,889	3.3	17,222	3.2	15,880	2.9	16,241	2.7
Freshwater tot.	276,719	65.4	344,586	66.1	361,418	67.5	360,311	67.9	338,522	61.8	404,431	68.1
Grand total	422,954	100.0	521,498	100.0	535,327	100.0	530,493	100.0	547,376	100.0	594,139	100.0

Source: Mills 1979-83.

--- means no data were available.

a Effort is the number of days spent fishing, where any portion of day spent fishing is counted as one whole angler-day.

b Shellfish values represent effort expended in the newly created or recognized personal use fisheries.

c Effort at the Kasilof River does not include the personal use dip net fishery.

terms of numbers. Smelt, however, are small fish that are taken by dipnetting. The smelt harvest, therefore, though large in terms of numbers of fish, is not comparable to the hook-and-line harvest of other species.

In the following sections, general harvest information will be presented for each sport fish postal survey area. This discussion will be followed by more detailed narratives discussing the sport harvest of each selected species in each survey area.

E. Harvest Survey Areas

1. Glennallen Area:

a. Boundaries. The Glennallen Area (Sport Fish Postal Survey Area I, illustrated on map 1) includes all waters and tributaries of the Copper River upstream from a line between the south bank of Haley Creek and the south bank of Canyon Creek in Wood Canyon; this area also includes the upper Susitna drainage from its confluence with the Oshetna River. It does not include the Oshetna River. Crosswind, Tyone, Van, Paxson, Summit, Strelna, Sculpin, Hudson, and Susitna lakes, Lake Louise, and the Gulkana River are within this area (ADF&G 1984b).

b. Major watersheds and significant fisheries. Most of the angling pressure in the Glennallen Area is on waters adjacent to the highway system (Williams and Potterville 1983); however, many lake trout and rainbow trout fishermen fly into more remote areas (ADF&G 1977a), and the Hanagitna River supports a fly-in fall steelhead fishery (ibid.). The principal lake-dwelling species caught by recreational anglers are the indigenous stocks of burbot, lake trout, and arctic grayling, and stocked populations of rainbow trout and coho salmon (Williams and Potterville 1983).

In 1982, 60% of the lake trout harvest and 83% of the burbot harvest in the Southcentral Region was taken from the Glennallen Area. The Glennallen Area grayling harvest is also significant regionwide, contributing 61% of the total Southcentral Region grayling harvest in 1982. Twenty percent of the Southcentral Region harvest of land-locked coho and 2% of the rainbow trout harvest also came from the Glennallen Area.

The greatest amount of angler effort on lakes of the Glennallen Area is expended on Lakes Louise, Susitna, and Tyone (table 2), where burbot, lake trout, and grayling are harvested. Paxson, Summit, and Crosswind lakes also support significant harvests of these three species. Crosswind Lake is a fly-in fishery. Many smaller roadside lakes, such as Two Mile and Three Mile lakes on the Edgerton Highway and Sculpin, Strelna, and Van (Silver) lakes on the McCarthy Road, support fisheries for rainbow trout or land-locked coho salmon.

The Glennallen Area supports the largest burbot and lake trout harvest of any Southcentral Area (tables 9 and 10). The burbot sport harvest takes place in the winter. Burbot are taken with baited set lines. Alaska sportfishing regulations require that these lines be checked at least once in every 24-hour period (ADF&G 1984a). Commonly, the lines are checked late in the evening and then left until the following morning (Williams 1969). Lakes Louise, Susitna, and Tyone contribute the largest number of burbot to the sport harvest each year (table 9); however, many other lakes are also used. The most important factor influencing the spread of this sport fishery has been the snow-machine (ADF&G 1977a, Williams 1970). The use of snowmachines allows the fishermen to travel to remote lakes or the far shores of large lakes containing unexploited populations (ibid.). Other important burbot lakes in the Glennallen Area include Tolsona and Moose lakes (Williams 1975, ADF&G 1978b) and Crosswind Lake (ADF&G 1978b).

The largest harvests of lake trout are taken from lakes Louise, Susitna, and Tyone, followed by Paxson and Summit lakes. Lake trout fishing is generally most popular in spring and fall when the trout enter shallow, near shore waters to feed.

The stream-dwelling species most often taken in the Glennallen Area by sport anglers are grayling, char, rainbow trout, and chinook and sockeye salmon (Williams and Potterville 1983). In 1982, 6% of the Southcentral Region chinook salmon harvest and 3% of the Southcentral sockeye salmon harvest were taken from the Glennallen Area.

Whitefish are also harvested in the Glennallen Area. A whitefish sport fishery takes place in October on the Slana River near Tok. These fish are taken at night with spears, using lanterns for illumination (Williams and Potterville 1981). Both humpback and round white-fish are taken.

The Gulkana River supports the most important sport fishery in the Upper Copper River drainage (Williams 1979). It is paralleled by the Richardson Highway and has several easy access points for anglers (ibid.). This stream supports the second most productive grayling fishery in Alaska (Mills 1982), along with a substantial harvest of rainbow trout and chinook and sockeye salmon. The Gulkana draws anglers from both Anchorage and Fairbanks, in addition to local area residents (Williams and Potterville 1980). Anglers floating the Gulkana River from Paxson Lake to Sourdough catch the most grayling and release the majority of those they catch

Table 9. Glennallen Area (Sport Fish Postal Survey Area I) Burbot Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	31	0
Gulkana other	---	---	---	---	---	52	84
Gulkana total	4	9	45	164	22	83	84
Klutina River	---	---	---	---	---	---	0
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Lakes Louise, Susitna, and Tyone	3,157	2,947	2,363	6,612	5,292	5,565	4,070
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	212	307	373	740	756	199	210
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	291	868	100	646	367	262	178
Hudson Lake	467	---	118	34	---	---	---
Other lakes	---	---	---	---	---	---	2,013
Other waters[a]	1,497	3,092	809	1,963	2,570	1,897	---
Glennallen total	5,628	7,223	3,808	10,159	9,007	8,006	6,555

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 10. Glennallen Area (Sport Fish Postal Survey Area I) Lake Trout Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	147	21
Gulkana other	---	---	---	---	---	0	21
Gulkana total	15	18	36	34	54	147	42
Klutina River	---	---	---	---	---	---	136
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	157
Lakes Louise, Susitna, and Tyone	2,838	2,522	2,618	2,609	4,093	4,056	3,210
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	1,420	1,085	2,245	2,290	1,987	2,630	2,623
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	252	714	609	895	540	734	388
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	659
Other waters[a]	3,174	1,094	1,763	2,239	1,663	1,132	---
Glennallen total	7,699	5,433	7,271	8,067	8,337	8,699	7,215

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

(Williams and Potterville 1983, Williams and Potterville 1980). The majority of the salmon harvested in the Gulkana are caught by powerboat anglers between Sourdough and the confluence of the West Fork and the main stem of the Gulkana River (Williams and Potterville 1981). A fishery for chinook salmon also takes place at the mouth of Mendeltna Creek, which drains into Tolsona Lake, and at Kaina Creek, which drains into Tazlina Lake (Williams and Potterville 1983).

2. Prince William Sound (PWS) Area:
   a. Boundaries. The PWS Area (Sport Fish Postal Survey Area J, illustrated on map 1) includes all saltwater and freshwater drainages from Cape Suckling on the east through PWS to Cape Puget (including Cape Suckling, as well as waters emptying into Port Bainbridge). Also included is that portion of the Copper River drainage downstream of a line between the south bank of Haley Creek and the south bank of Canyon Creek in Wood Canyon. Valdez Bay; Passage Canal (Whittier); Eshamy and Shrode creeks; Eyak, Coghill, and Pigot rivers; and Eshamy and Shrode lakes are within this area (ADF&G 1984b).
   b. Major watersheds and significant fisheries:
      (1) Salt water. In 1977 through 1982, an average of 5% of the total Southcentral Region sportfishing effort was expended in the PWS Area (table 1). Most of this effort was directed toward salt water fisheries.

      Fishing within the Cordova (PWS) area is primarily commercially oriented (Williams and Potterville 1983). Sportfishing effort is light and primarily directed toward coho salmon, chinook salmon, and halibut (ibid.). In the Valdez area, most of the recreational angling opportunities are provided by saltwater fisheries directed toward pink, chum, and coho salmon, and bottomfish (ibid.). The community of Valdez conducts a salmon derby in Valdez Bay in August (ADF&G 1978a).

      Saltwater fishing is also becoming popular in the western PWS (Whittier) Area. There is some concern, however, that the many small streams in the area may not have the production capacity to accommodate further increases in fishing effort (Delaney and Hepler 1983). Anglers with boats or float planes in the western PWS Area have access to sockeye salmon at Eshamy Creek and Lagoon (Kubik and Wadman 1979), Shrode Creek and Lake southeast of Whittier, and the Coghill River northeast of Whittier (Mills 1979-83). Pink salmon are harvested in Passage Canal and, in lesser numbers, in Eshamy Creek and Lagoon and the Coghill River (ibid.). Coho salmon smolts are planted by the Division of FRED in Passage Canal and are harvested when they return as adults (Delaney and Hepler 1983) A small number of chum salmon are also taken by boat anglers in areas such as Culross Passage outside of Whittier.

In 1982, 17% of the Southcentral Region pink salmon harvest came from fresh and salt waters of the PWS Area; however, the percentage harvested from PWS is higher in odd-numbered years. In 1981, 34% of the Southcentral Region pink salmon sport harvest was taken in PWS. In 1982, 12% of the Southcentral Region chum salmon sport harvest, 9% of the coho salmon sport harvest, 1% of the chinook salmon sport harvest, and 4% of the sockeye sport harvest also came from fresh and salt waters of the PWS Area.

(2) Fresh water. In the Cordova area, freshwater angling is directed toward coho salmon, cutthroat trout, and char (Williams and Potterville 1983). Large numbers of coho salmon and char are harvested from the Eyak River each year (Mills 1979-1983). In the Valdez area, all freshwater drainages into Valdez Arm, with the exception of the Robe River from May 15 to June 14, are closed to salmon fishing, but char are taken in fair numbers (Williams and Potterville 1983).

In the Whittier area, sockeye, pink, and a few chum salmon, along with char, are taken from Schrode Creek (Mills 1979-83). A large harvest of sockeye salmon, along with pinks and chum and a few char, are taken from the Coghill River. Sockeyes and pinks are also taken from Eshamy Lake. In 1982, 8% of the total Southcentral Region char harvest came from PWS. Only a fraction of the Southcentral Region rainbow trout harvest came from PWS.

3. Knik Arm Drainage Area:

a. Boundaries. The Knik Arm Drainage Area (Sport Fish Postal Survey Area K, illustrated on map 1) includes all watersheds of the Matanuska River, Knik River, and Little Susitna River, as well as east-side drainages of the Susitna River from Cook Inlet north to, but not including, the Willow Creek drainage. It also includes Knik Arm west of the Anchorage municipal boundary and its drainages, including the Nancy Lake Recreation Area and fish caught from the east bank of this portion of the Susitna River. The Fish Creek area; Wasilla, Cottonwood, and Jim creeks; Wasilla, Finger, Lucille, Nancy, and Big lakes; and the Kepler Lake complex are within this area (ADF&G 1984b).

b. Major watersheds and significant fisheries. From 1977 through 1982, an average of 10% of the total Southcentral Region sportfishing effort was expended in the Knik Arm Drainage Area (table 1). In 1982, 12% of the total Southcentral Region sport harvest of chum salmon and 12% of the harvest of anadromous coho salmon were taken from the Knik Arm Drainage Area. The Knik Arm Drainage Area also contributed 4% of the 1982 Southcentral Region sockeye salmon sport harvest, 2% of the pink salmon sport harvest, and 1% of the sport harvest of large (greater than 20 inches) chinook salmon. Small (less than 20 inches) chinook salmon and land-locked coho salmon are also taken in the Knik Arm Drainage Area; 12% of the Southcentral Region small chinook harvest and 46% of the landlocked coho harvest were taken in the Knik Arm Drainage Area in 1982. Rainbow trout, char, and arctic grayling are also harvested by sport fishermen in this area, along with lake trout and burbot (tables 11 and 12). The rainbow trout and char sport harvests are the largest for freshwater species in this area, and contribute 23% and 18%, respectively, of the total Southcentral Region harvest of each species.

The largest amount of sportfishing effort in the Knik Arm Drainage Area is spent on the Little Susitna River (table 4). Data from the statewide harvest survey (Mills 1979-1983) indicate that the Little Susitna is the second largest producer of freshwater-caught anadromous coho salmon in the state (Bentz 1983). The Little Susitna is also an important producer of sockeye, chinook, pink, and chum salmon. Char, grayling, rainbow trout, and a few burbot are also taken from the Little Susitna River (Mills 1979-1983). The river is open to salmon fishing downstream from the Parks Highway bridge to its mouth, a distance of 70 river miles (Bentz 1983). Most fishing, however, is concentrated in an 8-mi stretch of the upper river, just downstream of the Parks Highway bridge, and at river miles 16 to 33 in the lower section of the river around an undeveloped access site at the end of the Burma Road (ibid.). Some boat anglers also launch from Anchorage and cross Knik Arm at high tide, fish the lower river, and return to Anchorage at a later high tide (ibid.). Shore fishermen are generally restricted to a 1.5 mi stretch of river immediately downstream of the Parks Highway bridge and to the area around the end of the Burma Road access point. During high-flow periods, shore fishing at the Burma Road access is curtailed or eliminated completely because fishing sites and bankside trails become inundated (ibid.).

Table 11. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Lake Trout Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	0
Little Susitna River	0	0	0	0	0	0	31
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	0	0	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	0
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	665	0	455	594	623	440	441
Nancy Lake Rec. Area, including Nancy Lake	336	127	145	749	354	356	304
Other lakes	---	---	---	---	---	---	503
Others[a]	1,259	380	654	775	814	262	
Freshwater total	2,260	507	1,254	2,118	1,791	1,058	1,279
Grand total							1,279

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 12. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Burbot Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	0
Little Susitna River	6	9	55	9	29	10	52
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	0	0	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	31
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	73	18	0	43	0	461	94
Nancy Lake Rec. Area, including Nancy Lake	148	145	9	34	29	210	357
Other lakes	---	---	---	---	---	---	63
Others[a]	63	280	227	224	29	0	597
Freshwater total	290	452	291	310	87	681	597
Grand total							597

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Other important sportfishing streams in the Knik Arm Drainage Area are Cottonwood Creek, Wasilla Creek, Rabbit Slough, and the Knik River and its tributaries (especially Jim Creek).

Cottonwood Creek produces a sport harvest of both coho and sockeye salmon, along with rainbow trout and a few char (Mills 1979-83). During extreme high tides, sportfishing effort in Cottonwood Creek is decreased because the entire intertidal flood plain through which the stream runs becomes flooded, and anglers cannot reach the stream bank (Bentz 1983). Sockeye salmon are also harvested around the mouth of Fish Creek, which drains Big Lake.

Coho salmon, pink salmon, char, rainbow trout, and a few chum salmon are also harvested from Wasilla Creek, which drain into Knik Arm (Mills 1979-1983). The Knik River and its tributaries, especially Jim Creek, also provide a sport harvest of coho salmon, along with sockeye salmon, chum salmon, and a few pink salmon and char.

Lakes in the Knik Arm Drainage Area also provide important sportfishing opportunities. Fishing is directed toward both stocked and natural populations. In 1983, 11 Matanuska-Susitna Valley lakes were stocked with coho salmon, 20 with rainbow trout, and 3 with arctic grayling (ADF&G 1984h). Tables listing lakes stocked with each species are included in the Distribution and Abundance narratives. Sportfishing effort takes place on these lakes in summer and in winter, when anglers fish for land-locked coho, rainbow trout, char, lake trout, and burbot through the ice. Important lakes and lake systems in the area include Big Lake, Kepler-Bradley Lake complex, Wasilla Lake, Finger Lake, and Lucille Lake and Nancy Lake and other lakes in the Nancy Lake State Recreational Area.

4. Anchorage Area:

   a. Boundaries. The Anchorage Area (Sport Fish Postal Survey Area L, illustrated on map 1) includes all marine and fresh waters bounded by the Eklutna River drainage on the north, Knik Arm on the west, Turnagain Arm to and including the Portage Creek drainage on the south, and the Chugach Mountains on the east. Included in this area are boundary streams, that part of Knik Arm east of the Anchorage municipal boundary, and that part of Turnagain Arm north of the Anchorage municipal boundary. Ship, Bird, and Campbell creeks; Twentymile and Eagle rivers; Jewel, Campbell Point, Sand, Lower Fire, Mirror, Otter, Clunie, Gwen, Sixmile, Green, Hillberg, Triangle, C Street, Beach, Fish, and Cheny lakes are within this area (ADF&G 1984b).

b. Major watersheds and significant fisheries. From 1977 through 1982, an average of 7% of the total Southcentral Region sportfishing effort was expended in the Anchorage Area (table 1). In 1982, 37% of the total Southcentral Region sport harvest of rainbow trout was taken from the Anchorage Area. The Anchorage Area also contributed 11% of the Southcentral Region land-locked coho salmon sport harvest and 4% of the char sport harvest in 1982. Significant harvests of pink salmon and anadromous coho salmon are also taken from the Anchorage Area.

Most of the fishing effort in the Anchorage Area is expended on stocked lakes (table 5). These lakes are scattered throughout Anchorage and the adjoining military bases. The major species and number of fish caught in these lakes have varied from year to year, depending upon variations in the stocking program. In 1983, rainbow trout were stocked in 23 Anchorage Area lakes (ADF&G 1984h). A table listing these lakes is included in the rainbow trout Distribution and Abundance narrative. Westchester Lagoon was planted with coho fry in 1982, and in 1983 and 1984 Campbell Creek was also stocked with catchable rainbow trout.

A sport harvest of pink salmon, sockeye salmon, coho salmon, char, and rainbow trout is taken from Anchorage Area streams (Mills 1979-1983). Generally, the most productive stream fisheries are those for char in the Twentymile and Eagle rivers and for pink salmon in Bird Creek (ibid.). An early spring fishery for eulacon (smelt) also takes place in and around the mouth of the Twentymile River (Browning 1976). The eulacon are harvested with dip nets as they enter the river to spawn. The eulacon harvest is now classified as a personal use fishery.

5. East Side Susitna Drainage Area:

a. Boundaries. The East Side Susitna Drainage Area (Sport Fish Postal Survey Area M, illustrated on map 1) includes all drainages of the Susitna River from its confluence with the Oshetna River downstream to its confluence with the Chulitna River near Talkeetna and including the Oshetna River drainage; all east-side drainages of the Susitna River from Talkeetna to, and including, Willow and Deception creeks on the south; and all east-side drainages of the Middle Fork of the Chulitna River, from near Summit to near Talkeetna. This includes all fish caught while fishing from the east bank of the Susitna and Chulitna rivers from Willow Creek north to near Summit. Summit Lake, Broad Pass Lakes, and other small lakes in the Summit area; and Willow, Deception, Caswell, Montana, Sunshine, Chunilna

(Clear), Sheep, and Little Willow creeks are within this area (ADF&G 1984b).

b. Major watersheds and significant fisheries. From 1977 through 1982, an average of 8.5% of the total Southcentral Region sportfishing effort was expended in the East Side Susitna Drainage Area (table 1). In 1982, 66% of the total Southcentral Region chum salmon harvest was taken from this area. The East Side Susitna Drainage Area also contributed 21% of the 1982 Southcentral Region pink salmon sport harvest, 15% of the small (less than 20 inches) chinook salmon sport harvest, 4% of the harvest of large chinook, 9% of the sea-run coho salmon harvest, and 1% of the sockeye salmon harvest. Arctic grayling, rainbow trout, char, and landlocked coho salmon, are also taken from the East Side Susitna Drainage Area, along with burbot and lake trout (tables 13 and 14). In 1982, 18% of the total Southcentral Region arctic grayling sport harvest, 6% of the rainbow trout harvest, and 5% of the char harvest was taken in the east Susitna area.

   The two streams receiving the greatest sportfishing effort in the east Susitna area are Montana and Willow creeks (table 6). Both streams are open to salmon harvest. When the chinook salmon fishery is active, these streams are open to fishing below the Parks Highway on weekends only. Chinook, coho, and pink salmon are all taken from these creeks, and sockeye are taken around the mouths of the creeks as they travel up the Susitna. Rainbow trout, char, and arctic grayling are also taken from Willow and Montana creeks.

   Boat access to Willow Creek is available at the Willow Creek bridge on the Parks Highway and via Susitna Landing on the Susitna River and Little Willow Creek (Bentz 1982). Access to Montana Creek is available below the Parks Highway bridge (ADF&G 1984c). Until recently, all public use of Montana Creek occurred completely on private land, and access to fishing areas has been blocked. The Alaska Division of Parks has, however, recently acquired and developed property along Montana Creek for public sportfishing access (ADF&G 1984c; Engel, pers. comm.). The ADF&G, in its Fish and Wildlife Resource Element for the Susitna Area Planning Study, has proposed that Montana Creek be designated a State Recreational River Corridor because of its large numbers and diversity of fish and wildlife and the extensive public use of the area (ibid.). In 1980, more than 68% of the Montana Creek sportfishing effort came from Anchorage anglers (ibid.).

   Other important sportfishing streams in the East Side Susitna Drainage Area include Sheep, Little Willow,

Table 13. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Burbot Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	26	9	18	0	48	63	21
Caswell Creek	---	---	0	26	0	0	31
Montana Creek	110	9	9	13	0	0	0
Sunshine Creek	---	---	45	39	115	73	367
Clear (Chunilna) Creek	0	27	9	32	0	0	84
Sheep Creek	45	18	64	45	0	0	10
Little Willow Creek	0	0	0	0	0	0	0
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	126
Lakes	---	---	---	---	---	---	262
Others[a]	438	208	282	212	57	63	
Total	619	271	427	367	220	199	901

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 14. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Lake Trout Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	0	0	0	0	0	0	0
Caswell Creek	---	---	0	0	0	0	0
Montana Creek	0	0	0	0	0	0	0
Sunshine Creek	---	---	0	0	0	0	0
Clear (Chunilna) Creek	0	0	0	0	0	0	0
Sheep Creek	0	0	0	0	0	0	0
Little Willow Creek	0	0	0	0	0	0	0
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	63
Lakes	---	---	---	---	---	---	1,341
Others[a]	693	877	472	267	287	335	
Total	693	877	472	267	287	335	1,404

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Caswell, Chunilna (Clear), and Sunshine creeks. Pink salmon and coho salmon are taken from all these creeks. Sockeye salmon are taken from the mouths of these creeks, and chum salmon are also taken in Sheep Creek, Little Willow Creek, Sunshine Creek, and Clear Creek (Mills 1979-1983). Chinook salmon harvest occurs in Caswell and Clear creeks (ibid.). Freshwater species harvested in these creeks are rainbow trout, grayling, char, and, in Sunshine Creek, a few burbot. In the Susitna River drainage between Chunilna River confluence and Devil Canyon, sportfishing occurs at Whiskers Creek, Lane Creek, Fourth of July Creek, Indian River, and Portage Creek (Sundet and Wenger 1984).

The designation of Chunilna (Clear) Creek as a State Recreational River Corridor has been proposed by the ADF&G (ADF&G 1984c). Clear Creek is highly rated as a sportfishing stream by fishermen using powerboats and by residents of the Chase I and Chase II communities (ibid.). Access to Clear Creek is primarily by the Alaska Railroad, local roads, and by powerboat up the creek from Talkeetna (ADF&G 1984c, Hepler and Bentz 1984). The creek has more than 20 mi of fishable area and, with the advent of recently proposed road construction for the Chase I, II, and III state subdivisions, may be subject to a large increase in angling pressure (ibid.). A large percentage of this effort is directed toward chinook salmon (Hepler and Bentz 1984); however, there has traditionally also been a fishery for resident fish species in Chunilna (Clear) Creek (Watsjold 1980).

Sheep Creek and the adjoining Goose Creek have also been proposed as a State Recreational River Corridor (ADF&G 1984c). In terms of sportfishing effort in 1981 and 1982, Sheep Creek was the third most important east side Susitna River stream (table 6). Sheep Creek is known for its rainbow trout, arctic grayling, and pink, coho, and chum salmon; sockeye salmon are taken at the mouth (ADF&G 1984c). More than 26% of the total 1982 chum salmon harvest in east side Susitna drainages was taken from Sheep Creek (Mills 1983). In 1980, more than 77% of this creek's sportfishing effort came from Anchorage anglers (ADF&G 1984c). Most of the sportfishing for salmon on Sheep Creek occurs below the Parks Highway (ibid.). Very little public access or land is available to accommodate this use. Until the recent purchase of five acres at the mouth of Sheep Creek, most of the fishing on this creek was in trespass on private land (ibid.). Sheep and Goose creeks could provide substantially greater sportfishing opportunities if more land and access were purchased below the highway (ibid.).

6. West Side Cook Inlet-West Side Susitna Drainage Area:

   a. Boundaries. The West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N, illustrated on map 1) includes all west-side drainages of the Susitna River, from its confluence with the Chulitna River near Talkeetna to Cook Inlet; all west-side drainages of the Chulitna River from Summit to its confluence with the Susitna, near Talkeetna; and all drainages emptying into Cook Inlet from the Susitna River to Cape Douglas and including Kamishak Bay and other associated salt water. Deshka, Talachulitna, Chuitna, Theodore, and Lewis rivers; Alexander, Polly, and Lake creeks; and Shell and Judd lakes are within this area (ADF&G 1984b).

   b. Major watersheds and significant fisheries. From 1977 through 1982, an average of 5% of the total Southcentral Region sportfishing effort was expended in the West Side Cook Inlet-West Side Susitna Drainage Area (table 1). In 1982, 43.5% of the total Southcentral Region harvest of small (less than 20 inches) chinook salmon was taken from the West Side Cook Inlet-West Side Susitna Drainage Area, along with 20% of the Southcentral Region harvest of large chinook salmon. Sea-run coho salmon, chum salmon, pink salmon, and sockeye salmon are also taken from West Side Cook Inlet-West Susitna Area streams. Resident fish harvest includes arctic grayling, rainbow trout, char, and a small number of burbot and lake trout (tables 15 and 16). In 1982, 12% of the Southcentral Region arctic grayling harvest, 9% of the rainbow trout harvest, and 8% of the burbot harvest was taken from the West Cook Side Inlet-West Susitna Area.

      The three most heavily fished streams in this area are the Deshka River (Kroto Creek), Lake Creek, and Alexander Creek. From 1977 through 1982, an average of 27% of the area's annual sport harvest effort has been on the Deshka River, 20% on Lake Creek, and 17% on Alexander Creek (table 7). These west-side streams are located in remote areas, generally accessible only by aircraft or boat.

      The Deshka River has historically been the most important producer of chinook salmon in upper Cook Inlet (Delaney and Hepler 1983). A large sport harvest of coho salmon, and a few pink salmon are also taken from the Deshka each year, as well as rainbow trout, grayling, and a small number of burbot. Access to the Deshka is provided either by powerboat, aircraft, or by floating down Moose Creek from access points on Petersville and Oilwell roads (ADF&G 1984c, Delaney and Hepler 1983). The Moose Creek float is becoming increasingly popular and is causing the distribution of

Table 15. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Burbot Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	0	0	0
Shoreline	---	---	0	0	0	0	0
Total	---	---	0	0	0	0	0
Deshka River	3	0	309	224	96	252	126
Lake Creek	42	45	64	0	29	0	283
Alexander Creek	0	0	36	0	29	84	0
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	0	0	0	0	0	0	0
Chuit River	0	0	0	0	0	0	0
Theodore River	0	0	0	0	0	0	0
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	51	72	45	448	57	10	125
Shell Lake	0	0	0	0	0	0	63
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	19	36	0	34	0	430	210
Freshwater total	---	---	454	706	211	776	807
Grand total	115	153	454	706	211	776	807

Source: Mills 1979-84.

--- means no data were available.

Table 16. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Lake Trout Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	0	0	0
Shoreline	---	---	0	0	0	0	0
Total	---	---	0	0	0	0	0
Deshka River	0	0	0	0	0	0	0
Lake Creek	116	36	9	0	19	0	52
Alexander Creek	0	0	0	0	0	0	0
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	0	0	0	0	0	0	0
Chuit River	0	0	0	0	0	0	0
Theodore River	0	0	0	0	0	0	0
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	23	0	36	181	0	0	10
Shell Lake	23	45	18	69	a	52	409
Whiskey Lake	0	0	0	0	a	0	---
Hewitt Lake	0	0	0	0	a	0	---
Judd Lake	8	0	0	0	a	---	0
Other lakes	108	515	0	198	278[a]	115	430
Freshwater total	---	---	63	448	297	167	849
Grand total	278	596	63	448	297	167	849

Source: Mills 1979-84.

--- means no data were available.

a All lakes were reported together in 1981.

fishing effort on the river to shift towards its upper reaches (Delaney and Hepler 1983). In 1980, more than 72% of the Deshka River fishing effort came from Anchorage anglers (ADF&G 1984c). The ADF&G, in its Fish and Wildlife Element for the Susitna Area Planning Study, has proposed that the Deshka River be designated a State Recreational River Corridor (ibid.).

Lake Creek has also been proposed as a State Recreational River Corridor (ibid.). Sportfishing on Lake Creek accounted for 8,649 angler-days of effort in 1982 (Mills 1983). Lake Creek is famous for its large rainbow trout and arctic grayling. Chinook salmon fishing is important on Lake Creek, and large numbers of coho salmon are also taken, along with smaller harvests of pink salmon, sockeye salmon, and chum salmon.

Lake Creek is highly rated for its float trip opportunities (ADF&G 1984c). Access to the upper reaches of Lake Creek is exclusively by aircraft at Chelatna Lake, then by raft down the creek. Most floaters take out at Shovel Lake (ibid.). The lower 2 mi of the creek, where most of the chinook fishing occurs, can be reached by power riverboat from the Yentna River and by trails from Bulchitna Lake (Delaney, pers. comm. in ADF&G 1984c). In 1980, more than 75% of the Lake Creek sportfishing effort came from Anchorage anglers (ADF&G 1984c).

Alexander Creek also supports a large annual sport harvest of chinook salmon and has been proposed as a State Recreational Corridor (ibid.). In 1982, 10,748 angler-days of effort were spent by sport fishermen on Alexander Creek. Alexander Creek is also known for its abundant rainbow trout and arctic grayling (ADF&G 1984c), and sport harvests of coho, pink, and sockeye salmon are also taken from Alexander Creek each year. Alexander Creek has good float trip opportunities. The entire system is floatable from Alexander Lake to its confluence with the Susitna River. The lower 25 mi from the mouth as far upstream as the Sucker Creek confluence are accessible to powerboats (ADF&G 1984c, Hepler and Kubik 1982).

Three other important sportfishing streams in the West Side Cook Inlet-West Side Susitna Drainage Area have been proposed by the ADF&G as State Recreational River Corridors (ibid.). They are the Talachulitna River, Chuitna River, and Peters Creek. The ADF&G manages the Talachulitna River as a catch-and-release trophy rainbow fishery. The Talachulitna also supports an excellent grayling fishery (Kubik and Chlupach 1975, Mills 1979-1983). In 1983, it was opened for the first time since 1972 to the taking of chinook salmon. Access to the upper reaches of the Talachulitna is exclusively by float plane at Judd Lake and then by raft down the river. Float planes can also land on a long straight stretch of the Talachulitna near Highline Lake (Kubik and Chlupach 1975). Several lodges are located in this area and use riverboats to take clients to nearby fishing spots. Riverboat access below the Highline Lake area is blocked by rapids, and the river from there to near the mouth is accessible only to rafts. At least three lodges are located at the mouth of the river (ADF&G 1984c). In 1980, more than 63% of the Talachulitna sportfishing effort came from Anchorage anglers; 21% of the effort was from nonresidents (ibid.).

The Chuitna (Chuit) River is located on the west side of Cook Inlet near Tyonek. The Chuitna River is known for its populations of rainbow trout and char (ADF&G 1984c) and was opened to chinook salmon fishing in 1983 (Hepler and Bentz 1984). Most of the sportfishing on the Chuitna occurs on its lower 2 mi, although the entire river provides excellent sportfishing (ADF&G 1984c). In 1983, anglers used three main access points on the Chuitna during the chinook sport fishery. The first access point was the Chuitna River mouth area, the second was the road crossing, approximately 4 mi upstream from the mouth, and the third was the cable crossing, located approximately 8 mi upstream from the mouth (Hepler and Bentz 1984). Wheel planes can land on the northern bank near the mouth at low tide and on airstrips near the other two access points (ibid.).

Peters Creek, a clearwater tributary to the Kahiltna River, can be reached via the Petersville Road and is one of the few west side Susitna streams with road access. In addition to the road access, anglers can gain float plane access through Shulin Lake, located 1.5 mi from the mouth of Peters Creek (ibid.). In 1983, Peters Creek was opened to chinook harvest, and though the 1983 harvest was not very large, it is anticipated that as angler awareness increases the harvest will greatly increase (Hepler and Bentz 1984, ADF&G 1984c). Rainbow trout, arctic grayling, and coho salmon are also harvested on Peters Creek (Kubik, pers. comm. in ADF&G 1984c).

7. Kenai Peninsula Area:

   a. Boundaries. The Kenai Peninsula Area (Sport Fish Postal Survey Area P, illustrated on map 1) includes all fresh water and associated salt water of the Kenai Peninsula bounded on the north by Turnagain Arm and including the Placer River drainage; on the west by Cook Inlet and including Kalgin Island; and on the east by the Placer River drainage, Kenai Lake watershed, and waters flowing into the Gulf of Alaska west of Port Bainbridge (includes Resurrection Bay). Kenai, Anchor, Ninilchik, Russian, and Kasilof rivers; Deep and Stariski creeks; Hidden Lake; Swanson River and Swan Lake Canoe system are within this area (ADF&G 1984b).

b. Major watersheds and significant fisheries. From 1977 through 1982, an average of 58% of the total Southcentral Region sportfishing effort and 37% of the statewide effort was expended in the Kenai Peninsula Area (table 1) (Mills 1983). In 1982, 93% of the steelhead Southcentral Region sport harvest, 85.5% of the sockeye salmon sport harvest, 66% of the chinook salmon sport harvest, 59% of the char sport harvest, 58% of the coho salmon sport harvest, 55% of the pink salmon sport harvest, 30% of the lake trout harvest (table 17), and 23% of the rainbow trout harvest came from the Kenai Peninsula Area. Chum salmon, arctic grayling, land-locked coho salmon, and kokanee are also taken in this area.

   Sportfishing effort on the Kenai Peninsula is far greater than in any other area of Alaska. There are two principal reasons for the large amount of sportfishing effort expended on the Kenai Peninsula (ADF&G 1984d): 1) the availability of large chinook, coho, and sockeye salmon stocks in a healthy condition, providing during most years acceptable catch rates, and 2) the good access available to those waters having salmon stocks. Overall, recreational demand centers on chinook and coho salmon (ibid.).

   The concentration of sportfishing effort in this area, coupled with the importance of these stocks to commercial and personnel use fishermen, has resulted in conflicting demands on the resource. Stocks bound for areas important to sportfishing first pass through Cook Inlet, intermingled with stocks that are intended to be harvested primarily by commercial or personal use fisheries. In some cases it is possible to separate different fisheries in time and space to reduce the user conflicts. In other instances, however, this has been more difficult. Conflicts also arise between different groups of sport fishermen in heavily used fisheries. These demands on the resource are discussed in more detail in section II.H.2. of this narrative.

   1. Freshwater fisheries. Streams with strong runs of salmon, especially chinook salmon, receive the greatest amount of angler effort on the Kenai Peninsula, and among these streams the Kenai River is used most heavily. Because of the emphasis on salmon, a large amount of the information on Kenai Peninsula fishing locations is contained in

Table 17. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Lake Trout Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other salt water[a]	0	0	0	0	0	0	0
Other boat	---	---	---	---	---	---	0
Other shoreline	---	---	---	---	---	---	0
Saltwater total	0	0	0	0	0	0	0
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	86	0	241
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	42	10
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	151	10	126
Kenai River (Skilak inlet to Kenai Lake	---	---	---	---	486	576	273
Kenai River total	252	524	409	112	723	628	650
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	151	42	0
Swanson River	---	---	---	---	---	---	0
Other rivers	537	63	545	164	162	10	0
Hidden Lake	1,542	850	1,109	1,860	1,069	2,117	1,437
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	1,347	1,681	1,554	1,433	1,264	1,540	1,332
Freshwater total	3,678	3,118	3,617	3,569	3,369	4,337	3,419
Grand total	3,678	3,118	3,617	3,569	3,369	4,337	3,419

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

section II. of this narrative, which addresses sport harvest of salmon.

Because of its accessibility, its proximity to Anchorage, and its exceptional productivity, the Kenai River is the most popular sportfishing river in the state (Kenai River Task Force 1983). Prior to 1973, effort on the Kenai had been directed toward other salmon species, trout, and char, but after 1973 chinook salmon began contributing heavily to the Kenai River sport harvest and angler effort began its increase to the present level (Hammarstrom 1979). Part of the increase in effort on the Kenai River has been attributed to more sophisticated fishing techniques and greater access to the river through increased private ownership of boats (U.S. Army Corps of Engineers 1978, Hammarstrom 1977).Angling effort for chinook salmon on the Kenai River has made this fishery the largest in Alaska (Hammarstrom and Larson 1983). Since 1975, there has also been a dramatic increase in the number of fishing guides operating on the Kenai River. The rapid increase in the number of guides, coupled with the high level of success of their clients compared to unguided fishermen, has resulted in their being viewed unfavorably by many fishermen (Kenai River Task Force 1983).

Angler effort on the Kenai River is directed primarily toward chinook and coho salmon, although sockeye and pink salmon are also harvested.

Large numbers of char and rainbow trout are also taken from the Kenai. Generally, these fish are taken incidentally in fisheries for salmon. An early spring fishery for large rainbow trout at the inlet and outlet of Skilak Lake, however, has become increasingly popular in recent years (Wallis and Hammarstrom 1982).

The Russian River, which enters the Kenai between Skilak Lake and Kenai Lake, supports a large sport fishery for sockeye salmon. The Russian River also supports harvests of char, rainbow trout, coho salmon, and pink salmon, along with a small number of grayling (Nelson 1983).

Four streams south of the Kenai River also receive fishing effort directed toward chinook salmon. These are the Kasilof River, the Ninilchik River, Deep Creek, and the Anchor River.

Chinook salmon production in the Kasilof River has been enhanced by the Division of FRED Crooked Creek Hatchery since 1976 (Waite 1983). The Crooked Creek/Kasilof River chinook salmon fishery has greatly increased the opportunity for Kenai Peninsula anglers to fish from the shore with a good likelihood of catching fish (ibid.). Coho salmon, sockeye salmon, char, and a few pink salmon, rainbow trout, steelhead, and lake trout are also taken from the Kasilof (Mills 1982-83).

The Ninilchik River, Deep Creek, and the Anchor River support fisheries for chinook salmon. Each stream is open for a series of weekends in May and June. These are smaller streams that cannot accommodate boat traffic, and the success of bank fishermen is largely affected by weather conditions. Heavy rains cause the streams to run high and turbid and result in poor harvests (Hammarstrom and Larson 1983).

Substantial harvests of coho salmon, char, and steelhead are also taken from these streams, with the largest harvest of these species coming from the Anchor River (Mills 1979-83). Coho salmon, char, and steelhead are also harvested in Stariski Creek, which is closed to the taking of chinook salmon. The Anchor River is the site of the most intense Southcentral Region steelhead fishery (Wallis and Balland 1983).

Several lakes in the Kenai Peninsula also attract sportfishing effort. The Division of Sport Fish has undertaken a major program of chemically treating and stocking lakes to increase the recreational harvest of lake-reared resident game fish, primarily rainbow trout and land-locked coho salmon. This stocking program has been very successful, chiefly in producing spring and fall fisheries (ADF&G 1984d). The lake fisheries have a reduced catch rate during midsummer, however, and most anglers prefer salmon rather than resident fish species when both types of fisheries are available (ibid.). Popular sportfishing lakes on the Kenai Peninsula include the several stocked lakes (table 4 in the rainbow trout Distribution and Abundance narrative), lakes on the Swanson River and Swan Lake Canoe Routes, Crescent Lake, and Hidden Lake.

The Swan Lake and Swanson River Canoe Routes were established on the Kenai National Moose Range - now the Kenai National Wildlife Refuge - in 1965. Management policies on the canoe routes are designed to maintain their wilderness characteristics. No development beyond portage construction has occurred, and no motorized boats or fly-in fishing camps are allowed, except on

Wilderness and King lakes in the extreme northern portion of the Swanson River Route (Shon 1981). Possibly due to the wilderness character of these routes, persons using the area expressed several reasons, such as temporary escape and contact with nature, in addition to fishing for their visit in a 1975 survey (ibid.). Rainbow trout, char, and a few land-locked coho are taken from lakes on these canoe routes (Mills 1979-83).

Hidden Lake, which is popular with powerboat anglers, supports a large harvest of lake trout. In 1982, 49% of the Kenai Peninsula Area lake trout harvest was taken from Hidden Lake, along with a substantial harvest of kokanee and a few rainbow trout and char (ibid.). Crescent Lake, which drains into Quartz Creek, supports a popular grayling fishery.

2. <u>Saltwater fisheries</u>. From 1977 through 1982, an average of 34% of the effort expended on the Kenai Peninsula was in salt water, including effort expended in the harvest of razor clams (table 8). There are three marine fisheries immediately available to Kenai Peninsula anglers: Resurrection Bay, Kachemak Bay, and Deep Creek (ADF&G 1984d). Launching and berthing facilities at the two most popular marine bays (Kachemak and Resurrection) are already overloaded. Thus, the marine fisheries at these two sites have grown slowly (ibid.). In contrast, the Deep Creek marine fishery has grown very rapidly, with use rising from 5,000 angler-days in 1974 to 32,000 angler-days in 1983 (ibid.). This fishery initially became popular in 1972 when anglers discovered that chinook salmon were susceptible to harvest in Cook Inlet in the vicinity of Deep Creek (Hammarstrom 1979). This fishery is conducted mostly from small "car-top" boats and rubber rafts, which can be launched from shore. Halibut are also targeted in this fishery, with anglers frequently fishing for halibut while waiting for the salmon to appear. Coho salmon, sockeye salmon, char, and a few pink salmon are also taken in marine waters off Deep Creek.

   Kachemak Bay supports a varied sportfishing effort. Anglers with boats fish for chinook salmon in Halibut Cove Lagoon. These fish are planted as smolt in Halibut Cove Lagoon by the Division of FRED, and when they return they mill around in the lagoon as there is no suitable spawning stream. Pink salmon are taken by some boat anglers in Tutka Bay Lagoon. These fish are returning to the Tutka

Bay State Salmon Hatchery and so concentrate in the lagoon. Mud Bay, on the north side of the Homer Spit, is a popular area for anglers with small skiffs to take coho salmon. Kachemak Bay anglers who do not have boats may fish off the end of the Homer Spit for anadromous char. Shore anglers also take pink salmon, coho salmon, flatfish (especially starry flounder and yellowfin sole), and various species of cottids (sculpins) (Wallis and Hammarstrom 1979). Shore anglers on the Homer Spit have been described as "casual fishermen" (Engel 1967). When conditions are not favorable effort drops off noticeably (ibid.).

One of the fastest-growing fisheries in the Southcentral Region is the sport harvest of halibut in Kachemak Bay. The sport harvest of halibut from the Kenai Peninsula Area has risen from 15,171 fish in 1977 to 42,486 in 1982 (Mills 1983). Halibut is the preferred species of the majority of Kachemak Bay sport-boat anglers. In a 1978 creel census, 63.5% of the finfish anglers interviewed fished only for halibut, while 12.7% fished for salmon (Wallis and Hammarstrom 1979). In 1978, there were 12 charter boats in Homer known to specialize in halibut fishing (ibid.). In 1983, 19 charter companies operating a total of 37 boats were listed in the Homer tourist and recreation guide (Homer News, Inc. 1983). Halibut are taken by jigging with bait such as herring or octopus just off the bottom in 50 to 200 ft of water over bottom formations such as cliffs or gullies. The IPHC develops regulations for the halibut sport fishery that are then adopted by the state. Until 1973, sportfishing for halibut was legal only during the commercial halibut season. The sport fishery, however, began expanding in the 1960's and early 1970's at the same time that commercial halibut seasons became shorter. To provide more sportfishing opportunities, the IPHC in 1973 established a separate season for sportfishing, along with a limit on the number of fish per day each fisherman could retain (Skud 1975). The sportfishing season for halibut extends from March 1 to October 31. No more than two halibut of any size per person per day may be caught (IPHC 1983).

The Seward-Resurrection Bay Area is another popular saltwater area for Kenai Peninsula anglers. The largest sport harvests from Resurrection Bay are those for coho salmon and for rockfish; however, halibut, pink salmon, chinook salmon, chum salmon, and char are also harvested. Since 1961, the Resurrection Bay coho salmon recreational fishery has become the largest marine sport fishery for this species in Alaska (McHenry 1982).

From mid May through early July, most Resurrection Bay sportfishing effort is directed toward rockfish (McHenry 1983). From 1977 through 1982, an average of 86% of the Southcentral Region sport rockfish harvest and 32% of the total Alaska sport rockfish harvest was taken from waters in and around Resurrection Bay (Mills 1979-1983). This fishery developed in the early 1960's as a result of the military recreation camps in Seward and heavy recreational pressure from Anchorage (Blackburn et al. 1983). Rockfish are taken by jigging near exposed rocky cliffs, such as the area around Rugged Island, Fox Island, and Cape Resurrection. The species composition of rockfish in the sport harvest has not been reported; however, it is probably similar to the species composition found in a 1982 ADF&G rockfish survey conducted along the southeast side of the Kenai Peninsula using heavy-duty ocean rods and reels (Morrison 1982). In this survey, the most frequently caught species was black rockfish (*Sebastes melanops*), followed by dark dusky rockfish (*Sebastes ciliatus*), and yelloweye rockfish (*Sebastes ruberrimus*). This harvest is usually reported in numbers of fish; however, Morrison has converted 1977-1980 catches to an estimate of pounds caught, using mean weights of dominant rockfish caught in ADF&G surveys (Blackburn et al. 1983). Conversion to pounds allows a comparison of sport and commercial rockfish harvest and shows that for 1977-1980 the sport rockfish harvest exceeded the commercial harvest in the Southcentral Region. Rockfish are slow-growing fish, which can easily be overexploited, and local depletions have already occurred in Resurrection Bay in areas where sportfishing has been concentrated (McHenry, pers. comm. in Blackburn et al. 1983).

A large recreational harvest of razor clams takes place on several beaches in the Kenai Peninsula Area. This harvest, however, is now classified as personal use and is described in the shellfish Subsistence/Personal Use Harvest narrative found elsewhere in this volume.

II. SALMON

A. Regional Summary

All five species of North American Pacific salmon are harvested by recreational fishermen in the Southcentral Region. In 1982, 357,090 anadromous salmon were taken in the Southcentral Region. Generally, coho salmon and, in even-numbered years, pink salmon contribute the most to the catch, followed by sockeye salmon, chinook salmon, and chum salmon. Land-locked coho salmon, land-locked chinook salmon, and kokanee (land-locked sockeye) are also taken from stocked lakes in the Southcentral Region. Regionwide, 81% of the anadromous salmon harvested in 1982 sport fisheries were taken in fresh water.

In the Southcentral Region, 85.5% of the sockeye salmon harvest, 66% of the large (over 20 inches) chinook salmon harvest, 58% of the coho salmon harvest, and 55% of the pink salmon harvest was taken from the Kenai Peninsula Area in 1982. The chum salmon harvest is greatest in the East Side Susitna Drainage Area, with that area contributing 66% of the Southcentral Region harvest in 1982.

B. Glennallen Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Glennallen Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. Research activities in the Glennallen Area are directed toward the management needs of sport fish species in the area as well as toward the attainment of desirable levels of angler utilization (Williams and Potterville 1983).
2. Management considerations. The Gulkana River is the most important sport fishery in the upper Copper River drainage; however, salmon from this system are also very important to the subsistence and commercial user groups (Williams 1979). The Copper River Personal Use Salmon Fishery Management Plan contains a statement directing the ADF&G to manage the Copper River District commercial salmon fishery to allow an escapement to the sport fishery of 3,500 sockeye and 2,500 chinook salmon (5 AAC 77.590).

   The Gulkana River chinook sport fishery is basically managed on escapement rather than on the sport fish catch. The desired minimum escapement is 1,000 actually counted chinook salmon, and if aerial salmon surveys indicate escapement below this figure the fishery can be closed (Williams and Potterville 1981). The returns of chinook salmon to the upper Copper River area have remained high despite increases in fishing pressure (Williams and Potterville 1983, Williams 1979).

   Area biologists are concerned about the increase in sportfishing pressure on small runs of chinook salmon in Mendelta and Kaina creeks (Williams and Potterville 1983).

These creeks are used by the ADF&G as index streams to monitor Copper River chinook salmon escapement (ibid.).

In a 1982 survey conducted by the PWS Regional Planning Team, sport fishermen who preferred the Gulkana River ranked the most important problems affecting sportfishing in the Copper River-PWS area as overcrowded fishing areas, lack of access, and restrictive regulations. The Gulkana flows across large holdings of land owned by the AHTNA Native Corporation, and a fee is required of fishermen to gain access to AHTNA land (PWS Regional Fisheries Planning Team 1983).

The land disposal program conducted by DNR has made large tracts of land in the Glennallen Area available for private ownership. Much of this land borders lakes and streams that support, or have the potential to support fish. Retention of lands for public recreation and access has become a very important facet of fisheries investigation in the area (Williams and Potterville 1983).

3. Period of use. The Gulkana downstream of the confluence of the Middle Fork is open to sport salmon harvest year-round (ADF&G 1984a); however, chinook salmon generally are available only from mid June until mid July. Sockeye salmon enter the Gulkana after the chinook salmon and are available until early August.

4. Harvest methods. In 1975, the lower section of the Gulkana River from the Richardson Highway Bridge downstream to the marker 500 yd downstream of its confluence with the Copper River was made a fly-fishing only water from June 1 through July 31 (ADF&G 1984a, Williams 1979). The purpose of this regulation was to reduce the catch in this schooling area and encourage salmon to move upstream (Williams 1979). It was felt that this reduction in the early catch would help eliminate the need for emergency closures and short seasons and promote an uncrowded fishery in upstream areas (ibid.). Until 1975, sockeye salmon could be taken by snagging in the upper Copper River area; however, snagging is no longer allowed, and catches have been reduced to a lower level (PWS Regional Fisheries Planning Team 1983).

   Angler effort is usually relatively low in the fly-fishing-only section of the Gulkana, and harvest here is curtailed during times when the river runs high and muddy (Williams and Potterville 1981). In the upper area, powerboat anglers take the majority of the salmon. These anglers put their boats in the water at Sourdough and travel upstream to the confluence of the West Fork and the main stem of the Gulkana (ibid.).

5. Fishery summary and significant use areas:
   a. Effort and harvest. Sockeye salmon, chinook salmon, land-locked coho salmon, and a small harvest of anadromous coho salmon are taken in the Glennallen Area (tables 18 through 21). From 1977 through 1982, an average of 22% of the sportfishing effort for all fish

Table 18. Glennallen Area (Sport Fish Postal Survey Area I) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	283	273
Gulkana other	---	---	---	---	---	1,320	1,951
Gulkana total	421	606	2,440	1,688	1,469	1,603	2,224
Klutina River	---	---	---	---	---	---	147
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	177
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	31
Other waters[a]	111	35	508	413	248	199	
Glennallen total	532	641	2,948	2,101	1,717	1,802	2,579

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

Table 19. Glennallen Area (Sport Fish Postal Survey Area I) Sea-Run Coho Salmon Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	0	0
Gulkana other	---	---	---	---	---	0	0
Gulkana total	0	0	0	0	0	0	0
Klutina River	---	---	---	---	---	---	0
Little Tonsina River	---	---	---	---	---	---	84
Other streams	---	---	---	---	---	---	0
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	0
Other waters[a]	269	126	412	164	0	398	
Glennallen total	269	126	412	164	0	398	84

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

Table 20. Glennallen Area (Sport Fish Postal Survey Area I) Land-Locked Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	0	0
Gulkana other	---	---	---	---	---	0	0
Gulkana total	0	0	0	0	0	0	0
Klutina River	---	---	---	---	---	---	0
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	716	1,074	809	1,050	1,923	3,112	1,993
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	353	1,058	827	654	1,166	859	1,983
Sculpin Lake	0	0	0	0	0	---	199
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	0
Other waters[a]	681	687	282	215	162	755	
Glennallen total	1,750	2,819	1,918	1,919	3,251	4,726	4,175

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

Table 21. Glennallen Area (Sport Fish Postal Survey Area I) Sockeye Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	660	260
Gulkana other	---	---	---	---	---	1,226	1,661
Gulkana total	1,180	662	545	1,248	1,447	1,886	1,921
Lakes Louise, Susitna and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	0
Other waters[a]	2,482	944	1,054	861	76	1,457	
Glennallen total	3,662	1,606	1,599	2,109	1,523	3,343	2,619

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

species in the Glennallen Area was expended on the Gulkana River (table 2). This percentage increased from 8% in 1977 to a peak of 30% in 1979. In 1982, 89% of the Glennallen Area catch of chinook salmon and 56% of the sockeye salmon harvest was taken from the Gulkana River. Land-locked coho are harvested mainly from Van (Silver) Lake (table 20), which is regularly stocked with coho salmon and rainbow trout. Large numbers of land-locked coho are also taken from Strelna Lake (table 20).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. The Prince William Sound-Copper River Comprehensive Salmon Plan (PWS Regional Fisheries Planning Team 1983) predicts that minimum seasonal demand for chinook salmon available to sport fishermen in the Copper River-PWS area will increase to 8,600 by the year 2002. It is also predicted that a minimum of 25,700 sockeye salmon will be necessary to satisfy sport fish anglers in that area by the year 2002. This prediction is based on the assumption of a 43% population increase.
Changes in population distribution or in the transportation system in the Glennallen Area may cause shifts in effort to previously little-used areas.

C. Prince William Sound (PWS) Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish in the PWS Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. Research activities in the PWS Area are directed toward the management needs of sport fish species in the area as well as toward the attainment of desirable levels of angler utilization (Williams and Potterville 1983).

2. Management considerations. Most sportfishing effort in the PWS Area occurs on salt water. Sportfishing effort in the Cordova area is generally light, and local residents make up the majority of the participants (ADF&G 1978a). In the Valdez area, all freshwater drainages into Valdez Arm, with the exception of the Robe River from May 15 to June 14, are closed to salmon fishing, so effort is necessarily confined to salt water. It is expected that Valdez will continue to grow and become more industrialized in the future. This trend in growth may have a detrimental effect on the area fisheries. Suitable land for homes and businesses is limited in the Valdez area, and already there are trailer courts and housing projects adjacent to or bisected by salmon spawning and rearing streams (Williams and Potterville 1983). Spawning and rearing areas for fish may be reduced in area,

polluted, and, possibly, the groundwater supplies adversely affected. Increases in human population often result in additional harassment of spawning salmon, and increased monitoring of the fish stocks may be necessary (ibid.).

Salmon supporting systems within easy boating distance of Whittier have become increasingly popular in recent years. There is some concern, however, that the many small streams in the area may not have the production capacity to accommodate further increases in fishing effort (Delaney and Hepler 1983). The Whittier fishery is limited by access and the availability of boat slips (PWS Regional Fisheries Planning Team 1983); however, development of a small boat marina and recreational housing has recently resulted in an expansion of sportfishing effort originating from Whittier (ADF&G 1980).

3. Period of use. In the Cordova area, sport trolling for coho salmon takes place in August and early September (ADF&G 1978). A late winter "feeder" chinook salmon troll fishery also occurs in February and March (ibid.). In the Valdez area, the Valdez salmon derby begins around the beginning of August and lasts for one month (ibid.). Pink salmon fishing in Valdez Bay begins during the end of June and continues through August. In the Whittier area, fishing for pink and chum salmon begins in mid July and continues through late August. Coho salmon enter the Whittier fishery in mid August and continue to be taken through mid September (Kubik and Delaney 1980). Salmon fishing in Eshamy Creek and Lagoon takes place from the end of June until late September (Kubik and Wadman 1979); however, August is the most popular month (ADF&G 1978a). Inclement weather conditions may reduce boat and plane access to the Eshamy area and cause a reduction in catch and effort in some years (Kubik and Wadman 1978).

4. Harvest methods. Most sport salmon fishing in the PWS Area is done from boats. Anglers generally troll for coho with fresh herring as bait. Anglers also troll for pink salmon or may cast into large schools of pinks near the mouths of streams. Some success, however, is had by casting large spinners or spoons from shore. In the 1982 Whittier coho salmon fishery, 51% of the coho were taken by shore fishermen (Delaney and Hepler 1983). Boat anglers, however, had a higher catch per unit effort, probably because 1) the mobility of the boats allowed anglers to follow the tide fluctuations and therefore increase fishing time, and 2) the boat anglers had a better chance at getting close to the schooling cohos than did the shore anglers (ibid.).

   The Robe River near Valdez is a fly-fishing-only area, with a bag limit of one sockeye salmon per day (ADF&G 1984a). In the Eyak River fishery near Cordova, a boat is generally required to reach the best fishing areas, and boat traffic on this relatively small river is heavy during the salmon run (PWS Regional Fisheries Planning Team 1983).

5. Fishery summary and significant use areas:

a. Effort and harvest. All five species of North American Pacific salmon are harvested by sport fishermen in the PWS Area (tables 22 through 26). In 1982, 76% of the sportfishing effort for all fish species was expended in saltwater areas (table 3). Pink salmon are the most frequently caught salmon, with the catch being highest in odd-numbered years (table 25). Coho salmon are the second most frequently harvested salmon in the PWS Area, followed by sockeye salmon and chum salmon (tables 23, 24, and 26). A small number of chinook salmon are also harvested each year (table 22).

In the Cordova area, a large harvest of coho salmon is taken from the Eyak River each year. Fishing effort in this stream peaked in 1980 with 6,954 angler-days effort (table 3) and a harvest of 4,822 coho salmon (table 23). Effort has remained high (4,043 man-days in 1982); however, catches have fallen since 1980 (2,096 coho in 1982). The commercial salmon fishery in this area also harvests coho salmon bound for the Eyak River and may have an effect on the success of Eyak River sport fishermen (PWS Regional Fisheries Planning Team 1983). The Eyak River, however, is now collecting silty, glacial water from a meander of the Scott River, and sportfishing in this once clear water stream is declining. Sport salmon fishing in the Cordova area also occurs in salt water and is concentrated from Orca Inlet to Simpson Bay (ADF&G 1978a). Sport trolling for coho salmon occurs from Shepard Pt. to Simpson Bay, and a late winter "feeder" chinook trolling fishery occurs around the northern tip of Hawkins Island (ibid.).

In the Valdez area, all freshwater streams, with the exception of the Robe River from May 15 to June 14, are closed to salmon fishing (ADF&G 1984a). From 1977 through 1982, however, Valdez Bay has received an average of 39% of the total PWS Area sportfishing effort (table 3). The Valdez community sponsors a salmon derby during the month of August. Pink salmon usually contribute most to the Valdez Bay catch, with an average catch of 10,512 pink salmon in 1977 through 1982 (table 25). Large numbers of coho salmon are also taken, followed by chum salmon, sockeye salmon, and chinook salmon (tables 23, 26, 24, and 22). The sockeye salmon catch may be relatively small because the majority of them enter the Robe Lake system in late May and early June, when sportfishing effort is very low (Williams and Potterville 1980).

Salmon-supporting systems within easy boating distance of Whittier have become increasingly popular in recent years. Among the most popular are the Eshamy, Shrode,

Table 22. Prince William Sound Area (Sport Fish Postal Survey Area J) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Valdez Bay	247	58	88	121	76	210	241
Passage Canal	---	---	29	26	0	42	0
Other boat	---	---	---	---	---	---	293
Other shoreline	---	---	---	---	---	---	21
Other salt water[a]	---	---	215	121	248	147	
Saltwater total	---	---	332	268	324	399	555
Eyak River	0	0	0	0	0	0	0
Eshamy Cr. & Lagoon	b	f	0	0	0	0	0
Coghill River	b	0[g]	0	0	0	0	0
Shrode Creek	---	---	0	0	0	0	0
Pigot R. drainage	0[c]	0[c]	0	---	---	---	---
Copper River	---	---	---	---	---	---	21
Other streams	---	---	10	34	0	0	0
Eshamy Lake	0[b]	0[f]	0	0	0	0	0
Shrode Lake	0[d]	0[d]	0	0	0	---	---
Other lakes	---	---	0	0	0	0	0
Freshwater total	---	---	10	34	0	0	21
Others[e]	181	35					
Grand total	428	93	342	302	324	399	576

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, and Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

Table 23. Prince William Sound Area (Sport Fish Postal Survey Area J) Sea-Run Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Valdez Bay	5,277	3,582	6,402	5,545	4,018	4,014	4,710
Passage Canal	---	---	761	1,541	32	1,635	294
Other boat	---	---	---	---	---	---	1,636
Other shoreline	---	---	---	---	---	---	1,280
Other Salt water[a]	---	---	2,833	2,282	1,134	2,484	
Saltwater total	---	---	9,996	9,368	5,184	8,133	7,920
Eyak River	1,229	704	2,633	4,822	2,948	2,096	1,017
Eshamy Cr. & Lagoon	b	f	0	0	0	0	0
Coghill River	b	0[g]	0	0	0	0	0
Shrode Creek	---	---	0	0	0	0	0
Pigot R. drainage	61[c]	0[c]	25	---	---	---	---
Copper River	---	---	---	---	---	---	0
Other streams	---	---	1,310	1,119	367	713	849
Eshamy Lake	0[b]	0[f]	0	0	0	0	0
Shrode Lake	0[d]	0[d]	0	0	0	---	---
Other lakes	---	---	0	0	0	52	619
Freshwater total	---	---	3,968	5,941	3,315	2,861	2,485
Others[e]	2,262	4,839					
Grand total	8,829	9,125	13,964	15,309	8,499	10,994	10,405

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, and Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

Table 24. Prince William Sound Area (Sport Fish Postal Survey Area J) Sockeye Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Valdez Bay	557	78	141	568	367	241	343
Passage Canal	---	---	0	0	0	0	41
Other boat	---	---	---	---	---	---	1,000
Other shoreline	---	---	---	---	---	---	397
Other salt water[a]	---	---	1,210	861	562	1,603	
Saltwater total	---	---	1,351	1,429	929	1,844	1,781
Eyak River	209	127	362	69	43	0	192
Eshamy Cr. & Lagoon	b	f	990	138	443	336	1,205
Coghill River	b	690[g]	629	1,524	572	1,520	781
Shrode Creek	---	---	94	95	22	105	41
Pigot R. drainage	0[c]	0[c]	0	---	---	---	---
Copper River	---	---	---	---	---	---	452
Other streams	---	---	346	594	140	52	109
Eshamy Lake	2,898[b]	2,099[f]	0	0	22	335	110
Shrode Lake	319[d]	1,229[d]	0	0	11	---	---
Other lakes	---	---	0	0	0	94	453
Freshwater total	---	---	2,421	2,420	1,253	2,442	3,343
Others[e]	2,529	352					
Grand total	6,512	4,575	3,772	3,849	2,182	4,286	5,124

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

Table 25. Prince William Sound Area (Sport Fish Postal Survey Area J) Pink Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Valdez Bay	12,020	7,910	13,217	11,606	11,686	6,634	8,696
Passage Canal	---	---	573	1,343	691	2,065	2,014
Other boat	---	---	---	---	---	---	1,951
Other shoreline	---	---	---	---	---	---	1,353
Other salt water[a]	---	---	2,836	2,919	1,534	2,903	
Saltwater total	---	---	16,626	15,868	13,911	11,602	14,014
Eyak River	0	0	0	0	0	0	0
Eshamy Cr. & Lagoon	b	f	182	112	65	210	157
Coghill River	b	1,223[g]	654	276	637	723	168
Shrode Creek	---	---	73	17	32	105	168
Pigot R. drainage	1,565[c]	913[c]	82	---	---	---	---
Copper River	---	---	---	---	---	---	0
Other streams	---	---	200	525	97	283	147
Eshamy Lake	4,213[b]	511[f]	55	9	0	0	0
Shrode Lake	658[d]	310[d]	100	0	32	---	---
Other lakes	---	---	0	0	0	0	42
Freshwater total	---	---	1,346	939	863	1,321	682
Others[e]	6,969	5,433					
Grand total	25,425	16,300	17,972	16,807	14,774	12,923	14,696

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, and Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

Table 26. Prince William Sound Area (Sport Fish Postal Survey Area J) Chum Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Valdez Bay	219	1,444	845	913	572	639	976
Passage Canal	---	---	0	0	0	0	0
Other boat	---	---	---	---	---	---	147
Other shoreline	---	---	---	---	---	---	115
Other salt water[a]	---	---	573	34	324	440	1,238
Saltwater total	---	---	1,418	947	896	1,079	
Eyak River	0	0	0	0	0	0	0
Eshamy Cr. & Lagoon	b	f	0	0	0	0	0
Coghill River	b	1,034[g]	64	52	11	63	21
Shrode Creek	---	---	0	0	22	52	0
Pigot R. drainage	114[c]	234[c]	27	---	---	---	---
Copper River	---	---	---	---	---	---	84
Other streams	---	---	18	26	43	10	10
Eshamy Lake	158[b]	0[f]	0	0	0	0	0
Shrode Lake	25[d]	0[d]	0	0	0	---	---
Other lakes	---	---	0	0	0	0	0
Freshwater total	---	---	109	78	76	125	115
Others[e]	224	273					
Grand total	740	2,985	1,527	1,025	972	1,204	1,353

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

and Coghill rivers (ADF&G 1978a). Fly-in fishing is also popular in this area because of it proximity to Anchorage and more numerous landing sites for amphibious aircraft (ibid.). The Eshamy system supports a harvest of sockeye and pink salmon. Sockeye and pink salmon, along with a few chum salmon, are also harvested from Schrode Creek and Lake southeast of Whittier and the Coghill River northeast of Whittier. Since 1979, the Division of FRED has planted coho salmon smolts into Passage Canal. The immediate Whittier area lacks a freshwater system of sufficient size and water quality to accommodate the spawning requirements of the adult coho salmon (Kubik and Delaney 1980). The returning adults gather at the release site and mill around for some time, making them available to the sport angler.

In 1979, the first year of the fishery, 95% of the coho salmon taken were harvested by shore anglers fishing in the Whittier boat harbor. The remaining 5% were taken by boat anglers in the immediate vicinity of the boat harbor (Kubik and Wadman 1979, Kubik and Delaney 1980). In 1980, approximately 85% of the total coho salmon harvest was taken in the vicinity of Cove Creek Lagoon, 10% from the Divide Creek area, and the remaining 5% scattered throughout Passage Canal (Kubik and Delaney 1980).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish and are available at ADF&G offices.

6. Projected increase in demand. The Prince William Sound-Copper River Comprehensive Salmon Plan (PWS Regional Fisheries Planning Team 1983) predicts that a minimum of 8,600 chinook salmon will be necessary to satisfy sport fishermen in the PWS-Copper River area (including the Gulkana River) by the year 2002. Minimum demand for sockeye, pink, coho, and chum salmon is predicted to be 25,700, 17,200, 28,600, and 8,600, respectively. This is based on the assumption of a 43% population increase.

With the exception of the Eyak River, where fishing pressure has greatly increased in recent years, a significant increase in sportfishing effort in the Cordova area is not anticipated until access to and within the area improves (Williams and Potterville 1983). If the proposed Copper River Highway linking Cordova to the Alaska road system, which has been under study since at least 1949, is ever constructed, some restraints on limits, seasons, and bag limits may be necessary to protect the limited fishery resources along the route (Williams and Potterville 1983). The boat fishery, which originated from Whittier, is currently limited by access and the availability of boats slips in Whittier (PWS Regional Fisheries Planning Team 1983); however, it is anticipated that the Whittier area and western PWS will become a major sportfishing area for Anchorage residents (ADF&G 1980).

D. Knik Arm Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Knik Arm Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. An important objective in the Knik Arm Drainage Area is to increase angling opportunities through a lake-stocking program. Research activities in this area are directed toward determining levels of abundance of anadromous and resident fish stocks and evaluating densities to determine optimum levels necessary for maintenance of these stocks, determining anadromous fish harvest and fishing effort on selected streams, determining environmental characteristics of existing and potential fishery waters, and making recommendations for the proper management of sport fish waters (Bentz 1983).

2. Management considerations. Upper Cook Inlet chinook salmon, the largest component of the total Cook Inlet chinook salmon run, were reduced to remnant conditions in the 1960's due to probable overharvest during the 1940's and 1950's (Bentz 1983). Coho salmon stocks of upper Cook Inlet also experienced declines to very low levels in the early 1970's. An intense commercial fishery harvest in Cook Inlet and possible habitat degradation or loss are probable factors associated with the coho decline (ibid.).

   Intensive management of the chinook salmon stocks was initiated in the early 1960's through the extensive closures of commercial and sport fisheries. Further protection of these stocks was attained in 1973 when the Alaska Board of Fish and Game closed the sport and commercial chinook fisheries in upper Cook Inlet (ibid.).

   Since coho salmon run-timing through the commercial fishery in Cook Inlet coincides with that of all other species, except chinook salmon, it is difficult to specifically manage coho salmon by manipulation of the mixed stock commercial fishery (Bentz 1983, ADF&G 1984d). Northern Cook Inlet coho salmon are harvested incidentally by the commercial drift fishery for sockeye, pink, and chum salmon (ADF&G 1984d). Whenever this segment of the commercial fishery is given extra fishing time to harvest above-average sockeye salmon runs, the incidental catch of northern coho salmon increases. Increased interception of northern coho salmon by the drift fleet means fewer are available to the northern Cook Inlet sport fisheries (ibid.). Increased commercial fishing time to harvest large sockeye and chum salmon runs could pose a biological threat to northern coho salmon should future stock abundance return to lower levels (ibid.).

It is currently very difficult to accurately and rapidly estimate coho salmon run strength in the commercial fishery. A large percentage of the commercial harvest would be completed before the run strength of a weak coho salmon stock could be determined. By that time, the sport fisheries would be just beginning. Because of the difference in timing of the two harvests, the major opportunity to reduce harvest and maximize the number of spawning coho salmon is to restrict the sport fishery (ibid.). Therefore, management techniques for the coho salmon stocks have been conducted primarily through regulation of the sport fisheries. These techniques include protection of known spawning areas, restriction to weekend-only fishing, regulation of methods and means, and emergency closures when runs appear below average (Bentz 1983). As a result of these stringent regulations and more favorable environmental conditions, the upper Cook Inlet coho salmon populations began to increase substantially in 1975 (ibid.). Coho salmon escapement counts in 1980 were the highest since these counts were initiated in the early 1960's (ibid.).

Chinook salmon stocks have also substantially recovered. Results of the management efforts first appeared in 1976 when large increases in chinook salmon numbers were recorded in Susitna River spawning streams. High escapements were again observed in 1977 and 1978, and the Board of Fisheries allowed a limited sport fishery in 1979 on five east-side Susitna streams, including the Little Susitna River, and on three west-side Susitna streams. In 1979, the daily bag and possession limit was one chinook salmon and five per person over 20 inches in length, respectively. The seasonal limit applied to all waters of the Cook Inlet area. In 1980, the daily bag and possession limit was changed to two chinook over 20 inches in length, only one of which could exceed 28 inches. In 1981, the bag limit was one chinook 20 inches or more in length and two in possession (ibid.). This regulation has remained in effect through 1984 (ADF&G 1984a).

Fishing effort for all fish species on the Little Susitna has increased from 11,063 angler-days in 1977 to a peak of 26,162 in 1981, an increase of 136%. With this rapid increase in effort, the few access sites to the Little Susitna have become overcrowded. This has been especially apparent at the undeveloped Burma Road access on the lower river, where increased use coupled with a poor road and lack of facilities has resulted in degradation of the area and occasional angry confrontations between users.

Chinook harvest on upper Cook Inlet salmon streams is monitored by on-site creel censuses. The fisheries are monitored on a day-to-day basis for enforcement purposes and to ensure that adequate escapement is attained (ibid.). On-site creel censuses are also regularly conducted during coho salmon harvests on Cottonwood Creek and the Little Susitna River. Harvest and effort estimates for Knik Arm Drainage Area streams are also available from the sport fish postal survey program.

3. Period of use. Chinook salmon harvest takes place on the Little Susitna River from the last week of May until the season ends in the first week of July. Peak catches usually occur near the end of this time period in the upper river. Coho salmon are harvested from mid July until early September, with the peak effort usually occurring around the end of July (Bentz 1982, 1983; Watsjold 1980, 1981). In 1982, the peak harvest of sockeye and chum salmon at the Little Susitna Parks Highway bridge occurred in the first week of August, and harvest of both species dropped sharply in the next two weeks (Bentz 1983). During high-flow periods, shore fishing at the Burma Road access point on the Little Susitna is curtailed or eliminated completely because fishing sites and bankside trails become inundated (ibid.).

   The Cottonwood Creek coho salmon harvest takes place from the end of July until the end of August and peaks around mid August (Bentz 1982, 1983). Sockeye salmon harvest takes place at about the same time but peaks earlier, around the end of July (ibid.). Cottonwood Creek is a weekend-only fishery. Extreme high tides cause temporary decreases in fishing effort and harvest. High tides cause the entire intertidal floodplain, through which the stream runs, to become flooded, and anglers cannot reach the stream bank (ibid.).

   Ice fishing for land-locked coho salmon in area lakes usually occurs between freeze up and Christmas and then again just shortly before spring (ADF&G 1977b).

4. Harvest methods. Salmon are harvested on the Little Susitna River by shore anglers, powerboat anglers, and by anglers who float from the Parks Highway to the Burma Road access point (Bentz 1983). In 1982, creel census data indicated that boat anglers harvested 84% of the coho salmon taken at the Burma Road access point and 85% of those harvested at the Parks Highway. An additional harvest of coho salmon from the Little Susitna is taken by anglers from Anchorage who boat across Knik Arm during high tide to fish in the lower portion of the river. Overall, 88% of the coho salmon harvest in the Little Susitna in 1982 was taken by boat anglers (ibid.). In 1981, creel census data indicated that 95% of the Little Susitna coho salmon harvest was taken by boat anglers (Bentz 1982).

   Cottonwood Creek is a single-hook-only stream. This regulation was instituted in 1971 to protect the coho salmon stocks in that stream from overharvest. Fish Creek and

Wasilla Creek are also single-hook waters (ADF&G 1984a). In 1983, there was an active snagging fishery for sockeye salmon in the intertidal area at the mouth of Fish Creek; howver, snagging in any area of Cook Inlet north of Anchor Point was made illegal in 1984 (ADF&G 1984e).

5. Fishery summary and significant use areas:

   a. Effort and harvest. All five species of North American Pacific salmon are harvested in the Knik Arm Drainage Area, including land-locked coho salmon, which are stocked in several area lakes (tables 27 through 33).

      In 1982, 26% of the angler effort in the Knik Arm Drainage Area was expended on the Little Susitna River. Fishing effort for all species on the Little Susitna increased 136% from 11,063 angler-days in 1977 to 26,162 angler-days in 1981 (Bentz 1983). Effort fell slightly in 1982 (table 4). The coho salmon sport harvest from the Little Susitna is the second largest in the state, exceeded only by the Kenai River harvest (ibid.). The Little Susitna is open to salmon fishing downstream from the Parks Highway Bridge to its mouth, a distance of 70 river miles (ibid.). Fishing areas are described in section I.3.b. of this narrative. Creel census data show that during the coho salmon fishery, the harvest and the effort estimates at the Burma Road access site increased 87% and 128%, respectively, from 1981 to 1982. This increase is attributed to the improved access road to the river (ibid.). In 1982, 933 chinook salmon were taken from the Little Susitna (table 27). The Little Susitna also contributed 52% of the Knik Arm Drainage Area coho salmon harvest in 1982, 82% of the pink salmon harvest, 40% of the sockeye salmon harvest, and 80% of the chum salmon harvest (tables 29, 32, 31, and 33). Estimates from creel census information and aerial stream surveys indicate that the 1982 Little Susitna sport fishery harvested 52% of the total coho salmon return (ibid.). In 1981, the Division of FRED began a coho enhancement program on the Little Susitna. Eggs are taken from returning Little Susitna coho salmon reared in the Big Lake Hatchery complex, and released into the river as fry the following summer or as smolts (Bentz 1983; Engel, pers.comm.).

      Sport anglers harvest both coho and sockeye salmon from Cottonwood Creek. Cottonwood Creek is open to salmon fishing from its mouth upstream to a marker 1 mi upstream from the Palmer Hay Flats State Game Refuge access road (ADF&G 1984a). Since 1977, Division of FRED has supplemented Cottonwood Creek coho salmon stocks by annually releasing coho fry in favorable rearing areas throughout the Cottonwood system (Bentz 1983). In 1982, the contribution of hatchery fish to the total coho

Table 27. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	16
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	10
Total	---	---	---	---	---	---	26
Little Susitna River	0	0	800	646	920	933	847
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	0	0	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	0
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0
Nancy Lake Rec. Area, including Nancy Lake	0	0	0	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Others[a]	0	0	0	0	38	42	
Freshwater total	0	0	800	646	958	975	847
Grand total							873

Sources: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 28. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Small (Less Than 20 in.) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	37
Total	---	---	---	---	---	---	37
Little Susitna River	191	93	0	0	498	534	340
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	5
Wasilla Creek (Rabbit Slough)	0	47	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	0
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0
Nancy Lake Rec. Area, including Nancy Lake	0	0	0	0	10	157	0
Other lakes	---	---	---	---	---	---	0
Others[a]	16	0	0	0	0	0	0
Freshwater total	207	140	0	0	508	691	345
Grand total							382

Sources: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 29. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Sea-Run Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	983
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	513
Total	---	---	---	---	---	---	1,496
Little Susitna River	3,415	4,865	3,382	6,302	5,940	7,116	2,835
Knik River & tributaries, including Jim Creek	---	---	---	---	1,801	2,306	774
Wasilla Creek (Rabbit Slough)	472	2,112	1,211	3,555	814	1,624	345
Cottonwood Creek	---	---	1,198	3,375	1,373	1,886	518
Other streams	---	---	---	---	---	---	171
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0
Nancy Lake Rec. Area, including Nancy Lake	56	0	0	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Others[a]	423	918	1,348	2,798	556	744	
Freshwater total	4,366	7,895	7,139	16,030	10,484	13,676	4,643
Grand total							6,139

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 30. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Land-Locked Coho Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	0
Little Susitna River	0	0	0	0	0	0	0
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	0	0	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	0
Wasilla Lake	---	---	1,054	43	182	42	31
Finger Lake	14,739	8,588	5,209	10,685	9,321	4,506	12,714
Kepler Lake complex	528	298	64	2,807	2,577	681	2,224
Lucille Lake	8,952	4,963	4,272	3,633	7,549	3,312	2,245
Big Lake	721	226	145	189	651	324	462
Nancy Lake Rec. Area, including Nancy Lake	76	262	227	146	354	126	231
Other lakes	---	---	---	---	---	---	4,898
Others[a]	1,901	4,547	882	1,997	3,621	1,854	
Freshwater total	26,917	18,884	11,853	19,500	24,255	10,845	22,805
Grand total							22,805

Source: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 31. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Sockeye Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	6,013
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	1,748
Total	---	---	---	---	---	---	7,761
Little Susitna River	888	859	1,478	2,127	1,619	1,865	2,787
Knik River & tributaries, including Jim Creek	---	---	---	---	450	880	1,277
Wasilla Creek (Rabbit Slough)	274	0	0	0	0	0	0
Cottonwood Creek	---	---	1,525	2,660	3,245	608	1,632
Other streams	---	---	---	---	---	---	164
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	37	0	157	43	134	126	89
Nancy Lake Rec. Area, including Nancy Lake	56	14	0	69	316	618	587
Other lakes	---	---	---	---	---	---	0
Others[a]	321	366	456	775	316	524	
Freshwater total	1,576	1,239	3,616	5,674	6,080	4,621	6,536
Grand total							14,297

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

Table 32. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Pink Salmon Sport Catch, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	361
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	209
Total	---	---	---	---	---	---	570
Little Susitna River	1,208	1,517	618	3,918	709	1,163	251
Knik River & tributaries, including Jim Creek	---	---	---	---	0	31	47
Wasilla Creek (Rabbit Slough)	217	279	136	310	96	147	10
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	42
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	89
Nancy Lake Rec. Area, including Nancy Lake	0	0	0	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Others[a]	236	46	64	473	29	84	
Freshwater total	1,661	1,842	818	4,701	834	1,425	439
Grand total							1,009

Source: Mills 1979-1984.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

Table 33. Knik Arm Drainage (Sport Fish Postal Survey Area K) Chum Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	84
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	26
Total	---	---	---	---	---	---	110
Little Susitna River	131	956	364	465	278	943	450
Knik River & tributaries, including Jim Creek	---	---	---	---	0	168	10
Wasilla Creek (Rabbit Slough)	17	59	45	9	57	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	73
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0
Nancy Lake Rec. Area, including Nancy Lake	0	0	0	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Others[a]	102	117	245	60	96	63	
Freshwater total	250	1,132	654	534	431	1,174	533
Grand total							643

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

salmon run was estimated at 20% (ibid.). In 1982, 14% of the Knik Arm Drainage Area coho salmon harvest and 13% of the sockeye salmon harvest was taken from Cottonwood Creek (tables 29 and 31). The sockeye salmon harvest of 608 fish in 1982 was lower than in previous years. The 1981 sockeye harvest from Cottonwood Creek was 3,245. Creel census data, together with escapement information from the Division of FRED weir located upstream from the sportfishing area, indicated that in 1982 the sport fishery harvested 48% of the total coho salmon run returning to Cottonwood Creek. This was an increase from the 1981 harvest of 31% of the run (ibid.).

Coho salmon, pink salmon, and a few chum salmon are also harvested from Wasilla Creek, which drains into the Knik Arm (Mills 1979-1983). The Knik River and its tributaries, especially Jim Creek, also provide a sport harvest of coho, sockeye, chum, and a few pink salmon (ibid.). Jim Creek is accessible for four-wheel-drive vehicles by a network of unmaintained logging roads.

Land-locked coho salmon are harvested from several stocked lakes in the Knik Arm Drainage Area. Since 1977, the largest annual harvest of land-locked coho salmon in this area has regularly come from Finger Lake, with Lucille Lake contributing the second largest catch (table 30). Fluctuations in the catch of land-locked coho salmon are frequently caused by changes in the stocking program. Lakes stocked with coho salmon are listed in the coho salmon Distribution and Abundance narrative. In 1981 and 1984, some lakes in the Knik Arm Drainage Area were also stocked with chinook salmon. These lakes are listed in the chinook salmon Distribution and Abundance narrative. In a 1977 questionnaire regarding Cook Inlet basin stocked lakes (Watsjold 1978), 19% of the anglers interviewed said they preferred to fish for land-locked coho salmon (rather than for rainbow trout or grayling). Land-locked coho salmon also support an active winter fishery. Lakes in the Matanuska-Susitna Valley are popular ice-fishing sites for Anchorage residents, because one-day trips are possible (ADF&G 1977b).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. It is likely that, if the population of Southcentral Alaska (especially Anchorage) continues to grow and access to the Little Susitna improves, it will be subject to continued increases in fishing pressure (Bentz 1983).

E. Anchorage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Anchorage Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. An important objective in the Anchorage Area is to increase fishing opportunities through an active lake-stocking program. Research activities in the Lower Susitna River and Central Cook Inlet drainages (including Anchorage) are directed toward determining the environmental characteristics of existing and potential recreational fishing waters; evaluating the impact of water use and urban development on fisheries, aquatic life, and water quality of lakes and streams in the area; determining the stocking measures and formulating future management and research practices; and investigating and developing plans for the enhancement of salmon stocks (Delaney and Hepler 1983).
2. Management considerations. Most fishing opportunities in the Anchorage Area are provided by stocked lakes in the city and nearby military bases. Until 1982, many of these lakes were stocked with coho salmon (table 36 in coho salmon Distribution and Abundance); however, since 1982, rainbow trout have been almost exclusively the only species used for stocking in this area. In addition to the stocked-lake harvests, a few coho, pink, and sockeye salmon are taken from Anchorage Area streams each year. Anchorage Area salmon harvest and effort estimations are achieved through the postal survey program.
3. Period of use. Nearly all fishing in Anchorage Area stocked lakes takes place in the summer, especially in the early summer, when the fish have been recently stocked and are still actively feeding near the surface of the lakes. Fishing for pink salmon and coho salmon in Anchorage Area streams takes place in August and early September.
4. Harvest methods. Nearly all sportfishing in the Anchorage Area is done from shore or from small boats or canoes. Ship Creek in Anchorage is a single-hook water (ADF&G 1984a).
5. Fishery summary and significant use areas:
   a. Effort and harvest. Coho salmon, pink salmon, and a few sockeye salmon are taken from the Anchorage Area each year, along with a harvest of land-locked coho from stocked lakes (tables 34 through 37). Among the streams in the Anchorage Area, the Twentymile River generally receives the greatest amount of effort (table 5); however, a large amount of this effort is probably expended in the harvest of eulacon (smelt) rather than salmon. Coho salmon are harvested from Ship Creek and the Twentymile River along with a small harvest from Bird Creek. In 1982, 618 coho or 39% of the Anchorage Area coho harvest was taken from the Twentymile River, 168 or 11% from Ship Creek. Pink salmon are regularly

Table 34. Anchorage Area (Sport Fish Postal Survey Area L) Sea-Run Coho Salmon Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	314
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	0	0	0	0	0	0	0
Otter Lake	0	0	0	0	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	0	0	0	0
Sixmile Lake	0	0	0	0	0	0	0
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	0	0	0	0
Triangle Lake	---	---	---	0	0	0	0
C Street Lake	---	---	---	0	0	0	0
Beach Lake	---	---	---	0	0	0	0
Fish Lake	---	---	---	0	96	0	0
Cheny Lake	---	---	---	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Eagle River	6	0	0	0	0	10	74
Ship Creek	125	151	512	301	220	168	94
Bird Creek	0	151	0	26	38	31	94
Twentymile River	996	289	362	439	737	618	712
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	250
Others[a]	0	201	100	456	383	744	
Freshwater total	1,127	792	974	1,222	1,474	1,571	1,224
Grand total	---	---	---	---	---	---	1,538

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 35. Anchorage Area (Sport Fish Postal Survey Area L) Land-Locked Coho Salmon Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	0
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	0	0	0	1,266	1,092	1,593	304
Otter Lake	0	0	0	0	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	1,248	0	0	0
Sixmile Lake	19	18	209	2,127	1,390	136	21
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	5,028	0	0	0
Triangle Lake	---	---	---	1,231	1,542	0	0
C Street Lake	---	---	---	1,765	383	409	63
Beach Lake	---	---	---	370	115	31	0
Fish Lake	---	---	---	1,825[a]	1,399	21	0
Cheny Lake	---	---	---	a	604	220	136
Other lakes	---	---	---	---	---	---	0
Eagle River	0	0	0	0	0	0	0
Ship Creek	0	0	0	0	0	0	0
Bird Creek	0	0	0	0	0	0	0
Twentymile River	0	0	0	0	0	0	0
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Others[b]	110	0	0	714	642	147	
Freshwater total	129	18	209	15,574	7,167	2,557	524
Grand total	---	---	---	---	---	---	524

Source: Mills 1979-84.
--- means no data were available.
a Fish and Cheny lakes reported together in 1980.
b In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 36. Anchorage Area (Sport Fish Postal Survey Area L) Sockeye Salmon Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	178
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	0	0	0	0	0	0	0
Otter Lake	0	0	0	0	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	0	0	0	0
Sixmile Lake	0	0	0	0	0	0	0
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	0	0	0	0
Triangle Lake	---	---	---	0	0	0	0
C Street Lake	---	---	---	0	0	0	0
Beach Lake	---	---	---	0	0	0	0
Fish Lake	---	---	---	0	0	0	0
Cheny Lake	---	---	---	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Eagle River	0	0	0	0	0	0	0
Ship Creek	0	0	0	0	0	0	0
Bird Creek	0	0	0	0	0	0	0
Twentymile River	0	14	204	146	335	178	123
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	288
Others[a]	25	0	0	0	48	94	
Freshwater total	25	14	204	146	383	272	411
Grand total	---	---	---	---	---	---	589

Source: Mills 1979-83.
--- means no data were available.
a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 37. Anchorage Area (Sport Fish Postal Survey Area L) Pink Salmon Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	42
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	0	0	0	0	0	0	0
Otter Lake	0	0	0	0	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	0	0	0	0
Sixmile Lake	0	0	0	0	0	0	0
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	0	0	0	0
Triangle Lake	---	---	---	0	0	0	0
C Street Lake	---	---	---	0	0	0	0
Beach Lake	---	---	---	0	0	0	0
Fish Lake	---	---	---	0	0	0	0
Cheny Lake	---	---	---	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Eagle River	0	0	0	0	0	0	0
Ship Creek	93	93	91	405	230	0	42
Bird Creek	2,797	913	654	2,127	795	1,006	692
Twentymile River	0	31	36	43	48	73	31
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Others[a]	63	139	0	26	220	99	
Freshwater total	2,953	1,176	781	2,601	1,293	1,178	1,090
Grand total	---	---	---	---	---	---	1.132

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, the "others" category w ot divided between lakes and streams.

taken from Bird Creek and a few from Ship Creek. The 1982 harvest from Bird Creek was 1,006 pink salmon, or 85% of the Anchorage Area harvest. The highest harvest from Bird Creek since the postal survey was instituted in 1977 was 2,797 pink salmon in 1977 (table 37). A small number of sockeye salmon are also taken from the Twentymile River each year. The 1982 harvest was 178 sockeye salmon. The highest recorded harvest was in 1981, at 335 fish (table 36).

Though salmon harvests in the Anchorage Area are relatively small, these streams probably do provide important fishing opportunities for people without the time or means to travel a great distance for recreation.

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. No information on projected increase in demand in the Anchorage Area was found in the available literature.

F. East Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the East Side Susitna Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. Research activities in this area are directed toward determining levels of abundance of anadromous and resident fish stocks and evaluating densities to determine optimum levels necessary for maintenance of these stocks, determining anadromous fish harvest and fishing effort on selected streams, determining environmental characteristics of existing and potential fishery waters, and making recommendations for the proper management of sport fish waters (Bentz 1983).

2. Management considerations. Management considerations for upper Cook Inlet coho and chinook salmon stocks, including those entering East Side Susitna Drainage Area streams, are discussed in section II.D.2. (the Knik Arm Drainage Area). Four East Side Susitna streams were opened to a limited chinook salmon harvest in 1979 for the first time since 1973. In 1983, the Board of Fisheries expanded the areas open to fishing to include the entire Talkeetna River drainage (Hepler and Bentz 1984). Daily bag and possession limits since 1981 have been one chinook 20 inches or more in length and two in possession (ibid.).

A significant management consideration for many east-side Susitna streams is the lack of sufficient public access to fishing areas (ADF&G 1984c). Access problems are discussed in more detail in section I.5.b. of this narrative.

Chinook salmon harvest from upper Cook Inlet salmon streams is monitored by on-site creel censuses. The fisheries are monitored on a day-to-day basis for enforcement purposes and to ensure that adequate escapement is attained (Bentz 1983). Harvest and effort estimates for other salmon species are calculated from the postal survey program.

3. Period of use. Chinook salmon harvest takes place from the first week of June until the fishery is closed on the sixth of July. Chinook salmon fishing on Caswell, Montana, and Willow creeks is restricted to Saturdays and Sundays only for four consecutive weekends, commencing on the second Saturday in June. Emergency closures, however, may cut the season short on some streams if it appears that escapement goals will not be met. In years when all streams remain open, the harvest normally peaks at the end of the season (ibid.). In many years, chinook salmon do not arrive at Chunilna (Clear) Creek until near the end of the open season, so harvest from that creek is frequently confined to the final week of the season (Hepler and Bentz 1984).

   Fishing for coho, pink, and chum salmon takes place from near the end of July until the first week of September.

4. Harvest methods. Generally, East Side Susitna Drainage Area streams support both boat and shore fisheries, with shore fishermen concentrated around bridges on the Parks Highway and at confluence areas.

   In Chunilna (Clear) Creek during the 1983 chinook fishery, anglers who chartered boats from Talkeetna comprised 51% of the total fishing effort and harvested 42% of all chinook salmon taken (ibid.). Most of these anglers were transported upstream to Chunilna Creek, dropped off, and picked up again later in the day (ibid.). Anglers fishing from private boats experienced a chinook salmon harvest rate of 0.44 fish per angler-day, whereas the chartered anglers' harvest rate was 0.30 fish per angler-day (ibid.).

   In Willow Creek in 1983, anglers who chartered to the mouth of Willow Creek comprised 63% of the fishing effort and harvested 61% of the chinook salmon taken at the mouth (ibid.). Nearly all these anglers were transported down Willow Creek from the highway bridge, dropped off, and picked up again later in the day or at the end of the weekend (ibid.). Seventy-nine percent of all anglers who fished at the mouth of Willow Creek used the Willow Creek highway bridge launch site. The remaining 21% of the anglers used the Susitna Landing and Little Willow Creek bridge access points (ibid.). The Willow Creek highway bridge launch site is used less frequently in years when low water in Willow Creek restricts boat traffic up and down the creek (Bentz 1982). Anglers also use alternate access points for safety reasons as Willow Creek becomes more congested with boat traffic (ibid.).

5. Fishery summary and significant use areas:

a. Effort and harvest. All five species of North American Pacific salmon are harvested in the East Side Susitna Drainage Area, including land-locked coho salmon (tables 38 through 44). In 1982, 29% of the angler effort for all species in the East Side Susitna Drainage Area was spent on Montana Creek. Twenty-four percent of the East Side Susitna Drainage Area effort in 1982 was spent on Willow Creek. Willow and Montana creeks are consistently the most heavily used East Side Susitna Drainage Area streams, averaging 26 and 27% of the areawide effort, respectively, from 1977 through 1982 (table 6).

Willow, Montana, Chunilna (Clear), and Caswell creeks provide harvests of chinook salmon (table 38). The amount of effort expended on each of these creeks during the chinook salmon season varies greatly from year to year, depending upon water conditions, run timing, and emergency closures in each creek. The average effort expended during the chinook salmon season from 1979 through 1983, however, has been greatest on Montana Creek, with an average of 2,309 angler-days (Hepler and Bentz 1984). Harvest and effort for chinook salmon on Montana Creek was low in 1982 because the chinook did not enter the creek until the season had nearly ended (Bentz 1983; Engel, pers. comm.). Caswell, Montana, Little Willow, and Willow creeks are open to chinook salmon fishing from their mouths upstream to where they are crossed by the Parks Highway. The entire Talkeetna River drainage is open to chinook salmon harvest, except that portion of Chunilna (Clear) Creek upstream of an ADF&G marker placed 2 mi upstream from its mouth (ADF&G 1984a).

Although the entire Talkeetna River drainage was open to chinook fishing in 1983, nearly all the harvest and effort in the drainage occurred at Chunilna (Clear) Creek. Creel census data indicate that 98 and 94% of the respective total harvest and effort took place at Chunilna (Clear) Creek (Hepler and Bentz 1984). In Willow Creek prior to 1983, nearly all fishing effort for chinook salmon occurred at the mouth of Willow Creek; however, in 1983, an intense fishery occurred at the Parks Highway area during the last weekend of the chinook salmon season (ibid.). Since chinook salmon do not enter Caswell Creek, the fishery in that creek is at its confluence with the Susitna River, which is a resting area for chinook salmon bound for tributaries further up the Susitna River drainage (Watsjold 1980).

Pink, coho, and chum salmon are taken from Willow, Caswell, Montana, Sunshine, Chunilna (Clear), Sheep, and Little Willow creeks each year, along with smaller

Table 38. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Willow Creek	0	0	459	289	441	409	398
Caswell Creek	---	---	156	215	172	293	262
Montana Creek	0	0	312	559	422	115	305
Sunshine Creek	---	---	0	0	0	0	0
Clear (Chunilna) Creek	0	0	312	172	287	398	682
Sheep Creek	0	0	0	0	0	0	0
Little Willow Creek	0	0	0	0	0	0	0
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	42
Lakes	---	---	---	---	---	---	0
Others[a]	0	0	0	0	0	0	
Total	0	0	1,239	1,235	1,322	1,215	1,689

Sources: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 39. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Small (Less Than 20 in) Chinook Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	137	47	0	0	144	220	136
Caswell Creek	---	---	0	0	77	178	10
Montana Creek	415	408	0	0	239	126	199
Sunshine Creek	---	---	10	13	57	52	105
Clear (Chunilna) Creek	25	12	0	0	86	52	252
Sheep Creek	259	256	10	45	0	0	0
Little Willow Creek	16	0	0	32	0	0	0
Kashwitna River	---	---	---	---	---	---	231
Other streams	---	---	---	---	---	---	230
Lakes	---	---	---	---	---	---	0
Others[a]	204	163	39	45	277	220	
Total	1,056	886	59	135	880	848	1,163

Sources: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 40. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Sea-Run Coho Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	679	905	462	1,207	747	1,069	576
Caswell Creek	---	---	624	1,124	901	776	408
Montana Creek	1,415	2,451	1,735	2,684	2,261	3,060	1,402
Sunshine Creek	---	---	774	1,534	968	1,719	722
Clear (Chunilna) Creek	1,070	2,200	1,248	661	422	996	836
Sheep Creek	438	478	462	430	326	367	596
Little Willow Creek	225	151	262	494	29	398	52
Kashwitna River	---	---	---	---	---	---	52
Other streams	---	---	---	---	---	---	480
Lakes	---	---	---	---	---	---	52
Others[a]	1,882	2,388	1,997	2,234	939	1,782	
Total	5,709	8,573	7,564	10,368	6,593	10,167	5,176

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 41. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Land-Locked Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Willow Creek	0	0	0	0	0	0	0
Caswell Creek	---	---	0	0	0	0	0
Montana Creek	0	0	0	0	0	0	0
Sunshine Creek	---	---	0	0	0	0	0
Clear (Chunilna) Creek	0	0	0	0	0	0	0
Sheep Creek	0	0	0	0	0	0	0
Little Willow Creek	0	0	0	0	0	0	0
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Lakes	---	---	---	---	---	---	1,049
Others[a]	512	2,368	291	1,663	278	996	
Total	512	2,368	291	1,663	278	996	1,049

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 42. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Sockeye Salmon Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Willow Creek	831	56	94	83	77	94	425
Caswell Creek	---	---	0	77	38	52	151
Montana Creek	978	85	346	257	182	514	534
Sunshine Creek	---	---	157	116	220	189	685
Clear (Chunilna) Creek	334	28	31	6	29	115	534
Sheep Creek	450	14	31	0	105	88	370
Little Willow Creek	305	28	141	77	67	105	110
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	343
Lakes	---	---	---	---	---	---	69
Others[a]	696	56	220	257	115	398	
Total	3,594	267	1,020	873	833	1,555	3,221

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 43. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Pink Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Willow Creek	7,140	18,901	3,445	23,638	2,797	4,789	1,647
Caswell Creek	---	---	100	1,663	335	1,092	126
Montana Creek	3,568	15,619	2,472	8,230	1,782	3,595	902
Sunshine Creek	---	---	700	2,408	958	1,132	241
Clear (Chunilna) Creek	1,314	2,074	645	622	19	220	73
Sheep Creek	4,291	6,981	2,418	6,362	1,236	2,599	682
Little Willow Creek	1,261	3,142	745	6,420	604	1,520	157
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	126
Lakes	---	---	---	---	---	---	0
Others[a]	2,089	3,994	664	3,403	412	398	
Total	19,663	50,711	11,189	52,746	8,143	15,345	3,954

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 44. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Chum Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Willow Creek	343	2,458	582	989	1,533	2,086	1,490
Caswell Creek	---	---	9	19	0	0	0
Montana Creek	326	4,429	745	571	805	1,708	1,311
Sunshine Creek	---	---	55	225	125	231	42
Clear (Chunilna) Creek	146	1,912	355	385	57	31	650
Sheep Creek	202	1,697	682	648	987	1,750	902
Little Willow Creek	175	1,015	118	270	192	199	147
Kashwitna River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	440
Lakes	---	---	---	---	---	---	0
Others[a]	190	2,692	1,245	1,445	450	639	
Total	1,382	14,203	3,791	4,552	4,149	6,644	4,982

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

harvests from other east side streams. Sockeye salmon are also taken at the mouths of these streams (tables 43, 40, 44, and 42). Willow Creek is closed to harvest of pink, coho, chum, and sockeye salmon upstream from it confluence with Deception Creek. Montana Creek is closed to salmon fishing upstream from an ADF&G marker 1 mi upstream from the Alaska Railroad bridge (ADF&G 1984a). The coho salmon harvest is largest in Montana Creek, with an average of 28% of the East Side Susitna Drainage Area coho harvest taken from Montana Creek annually from 1977 through 1982. The average annual coho harvest from 1977 through 1982 from Montana Creek was 2,268 fish (table 40). Large harvests of pink salmon are taken from Willow, Montana, Sunshine, Sheep, Little Willow, and Caswell creeks. Pink salmon runs to East Side Susitna Drainage Area streams are stronger in even-numbered years. Pink salmon harvest peaked in 1980, with 23,638 taken from Willow Creek alone (table 43). Large numbers of chum salmon are taken from Willow, Montana, and Sheep creeks, with smaller annual harvests also taken from Sunshine, Chunilna (Clear), and Little Willow creeks (table 44). In 1982, the largest chum salmon harvests came from Willow Creek, with 2,086 taken.

b. Significant use areas. A series of maps at 1:250,000 scale harvest been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; however, it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on east-side Susitna streams will increase. This will be especially true if efforts by the state to improve public access to these streams are successful (ADF&G 1984c).

G. West Side Cook Inlet-West Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the West Side Cook Inlet-West Side Susitna Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. Research activities in this area are directed toward determining the environmental characteristics of existing and potential recreational fishing waters, obtaining estimates of the sport fish harvest and angler participation rates; evaluating the impact of water use and urban development projects on fisheries, aquatic life, and water quality; formulating management practices and directing the course of future studies; and evaluating and developing plans for the enhancement of salmon stocks (Delaney and Hepler 1983).

2. Management considerations. Management considerations for upper Cook Inlet coho and chinook salmon stocks, including those entering western Cook Inlet and west-side Susitna drainages, are discussed in section II.D.2. (the Knik Arm Drainage Area). Three west-side Susitna River streams were opened to a limited chinook salmon sport harvest in 1979 for the first time since 1973. These streams were Alexander Creek, Lake Creek, and the Deshka River. In 1983, the Board of Fisheries expanded the areas open to chinook salmon fishing to include the Chuitna River near Tyonek and the entire Yentna drainage (Hepler and Bentz 1984). In 1984, all waters draining into Cook Inlet between the West Foreland and the Susitna River, excluding the Chuitna River upstream from an ADF&G marker placed one-fourth mile downstream from the confluence of Lone Creek and also excluding the Susitna River, were opened to chinook salmon sport harvest (ADF&G 1984e). All waters draining into the west side of the Susitna River downstream of the Deshka River were also opened to chinook harvest in 1984 (ibid.). Daily bag and possession limits since 1981 have been one chinook salmon 20 inches or more in length and two in possession (ibid.).

   Chinook salmon harvest from upper Cook Inlet salmon streams is monitored by on-site creel censuses. The fisheries are monitored closely for enforcement purposes and for the collection of angling effort and harvest information and biological data, including sex ratios and age compositions (Delaney and Hepler 1983). Coho salmon harvest on the Deshka River was also monitored by an on-site creel census in 1977-1979. Harvest and effort estimates for other salmon species are calculated from the postal survey program.

3. Period of use. Chinook salmon harvest takes place from the last days of May until July 6, when the season ends. The time of peak harvest on each stream varies each year, depending upon weather conditions and the run timing of the fish.

   Harvest of coho, pink, and chum salmon takes place from mid July until the first week of September.

4. Harvest methods. With the exception of Peters Creek, located on the west end of the Petersville Road, all West Side Cook Inlet-West Side Susitna Drainage Area chinook salmon streams are not connected to the road system and are accessible only by boat or small plane. More information on access to these streams is given in section I.6.b. of this narrative.

   The Talachulitna River is the only west-side Susitna River stream with restrictive terminal gear regulations; only single-hook artificial lures are allowed. This regulation reduces the anglers' efficiency and, consequently, the overall harvest from the Talachulitna (Hepler and Bentz 1984). In 1983, the majority of effort expended on the

Talachulitna was attributable to guided anglers originating from local lodges (ibid.).

5. Fishery summary and significant use areas:
   a. <u>Effort and harvest</u>. All five species of North American Pacific salmon are harvested in the West Side Cook Inlet-West Side Susitna Drainage Area (tables 45 through 50).

      From 1977 through 1982, the Deshka River has received an average of 27% of the sportfishing effort for all fish species in this area. The Deshka received an average of 54% of the effort in the chinook salmon fishery in this area during the period 1977 through 1982. This percentage dropped to 29 in 1983, probably because the opening of more areas to chinook harvest and low water conditions in 1983, which restricted access to the upper reaches of the Deshka (ibid.). Harvest of chinook from the Deshka was below average in 1983 and also in 1981 (table 45) (Hepler and Bentz 1984). The 1981 harvest was low because of high, turbid water conditions and a paucity of chinook (Hepler and Kubik 1982). From 1979, when it was reopened to chinook salmon fishing, through 1982 an average of 43% of the annual sportfishing effort expended on the Deshka has been directed toward chinook salmon (Hepler and Bentz 1984, Mills 1980-1983).

      Lake Creek, which is a tributary to the Yentna River, received an average of 20% of the total annual sportfishing effort for all fish species from this area in 1977 through 1982 (table 7). From 1979 through 1983, Lake Creek received an average of 21% of the West Side Susitna Drainage Area chinook salmon fishing effort each year (Hepler and Bentz 1984). Chinook salmon fishing has accounted for an average of 29% of the total fishing effort expended on Lake Creek between 1979 and 1982 (Mills 1980-1983, Hepler and Bentz 1984). Although the entire Yentna River drainage was open to sportfishing for chinook salmon in 1983, nearly 90% of the harvest and effort in the drainage occurred at Lake Creek, the Talachulitna River, and Peters Creek; and Lake Creek accounted for 74% of the effort for these three streams (ibid.). The remaining Yentna drainage harvest and effort occurred on small, clearwater tributaries to the Yentna, especially Fish Lake Creek, located 1 mi north of Lake Creek (ibid.).

      Alexander Creek is the only other west-side Susitna stream that has been open since 1979. From 1977 through 1982, Alexander Creek received an average of 17% of the annual West Side Cook Inlet-West Side Susitna Drainage Area sportfishing effort for all fish species (table 7). An average of 26% of the annual chinook salmon fishing effort in this area from 1979 through 1983 was spent on

Table 45. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	10	0	57	189	0
Shoreline	---	---	0	0	19	0	31
Total	---	---	10	0	76	189	41
Deshka River	0	0	2,811	3,685	2,031	3,165	3,955
Lake Creek	0	0	1,796	775	632	1,289	1,888
Alexander Creek	0	0	712	1,438	843	1,825	1,039
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	0	0	0	0	0	0	273
Chuit River	0	0	0	0	0	0	797
Theodore River	0	0	0	0	0	0	0
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	0	0	0	0	0	0	136
Shell Lake	0	0	0	0	0	0	0
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	---	---	5,319	5,898	3,506	6,279	8,088
Grand total	0	0	5,329	5,898	3,582	6,468	8,129

Source: Mills 1979-84.

--- means no data were available.

Table 46. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Small (Less Than 20 in) Chinook Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	38	0	31
Shoreline	---	---	0	0	0	0	63
Total	---	---	0	0	38	0	94
Deshka River	1,017	850	0	0	738	1,142	934
Lake Creek	464	326	0	0	163	356	535
Alexander Creek	820	769	0	0	278	681	672
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	224	12	293	121	57	0	63
Chuit River	227	408	78	17	115	105	388
Theodore River	237	58	20	17	77	42	0
Lewis River	9	12	0	0	---	---	
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	413	82	156	129	0	115	73
Shell Lake	0	0	0	0	0	0	0
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	---	---	547	284	1,428	0	2,665
Grand total	3,411	2,517	547	284	1,466	0	2,759

Source: Mills 1979-84.

--- means no data were available.

Table 47. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Sea-Run Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	50	69	48	755	62
Shoreline	---	---	0	146	192	1,048	126
Total	---	---	50	215	240	1,803	188
Deshka River	559	1,798	973	2,290	632	2,463	1,036
Lake Creek	1,203	2,212	2,671	2,351	1,035	1,603	1,392
Alexander Creek	1,562	2,401	1,560	999	891	1,907	408
Polly Creek	---	---	---	---	249	410	188
Talachulitna River	346	88	125	491	240	524	84
Chuit River	316	277	287	258	594	220	554
Theodore River	113	101	50	370	10	115	10
Lewis River	103	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	1,800
Silver Salmon Creek	---	---	---	---	---	---	1,872
Other rivers	2,929	3,683	3,707	6,010	3,142	4,161	610
Shell Lake	0	0	0	0	0	0	0
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	0	0	0	0	0	0	40
Freshwater total	---	---	9,373	12,769	6,793	11,403	7,994
Grand total	7,131	10,560	9,423	12,984	7,033	13,206	8,182

Source: Mills 1979-84.

--- means no data were available.

Table 48. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Sockeye Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	79	17	10	0	69
Shoreline	---	---	47	9	10	21	274
Total	---	---	126	26	20	21	343
Deshka River	0	0	0	0	0	0	0
Lake Creek	658	254	440	267	211	252	726
Alexander Creek	349	183	79	52	67	335	69
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	457	141	47	112	172	63	41
Chuit River	6	0	0	0	48	10	356
Theodore River	0	0	0	0	0	0	0
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	110
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	842	662	362	34	594	1,320	1,370
Shell Lake	52	28	94	198	a	157	315
Whiskey Lake	99	28	252	0	a	283	---
Hewitt Lake	43	0	0	0	a	0	---
Judd Lake	24	70	220	267	a	---	0
Other lakes	262	268	63	181	364[a]	471	1,028
Freshwater total	---	---	1,557	1,111	1,456	2,891	4,015
Grand total	2,792	1,634	1,683	1,137	1,476	2,912	4,358

Source: Mills 1979-84.

--- means no data were available.

a All lakes were reported together in 1981.

Table 49. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Pink Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	91	17	0	0	0
Shoreline	---	---	18	69	10	0	63
Total	---	---	109	86	10	0	63
Deshka River	391	697	109	689	19	377	21
Lake Creek	4,927	2,833	882	2,101	412	398	430
Alexander Creek	1,263	1,146	236	809	57	482	126
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	539	31	100	276	29	220	0
Chuit River	245	155	55	69	38	147	21
Theodore River	363	449	9	232	57	63	0
Lewis River	62	46	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	10
Other rivers	1,022	898	527	362	38	597	125
Shell Lake	0	0	0	0	0	0	0
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	---	---	1,918	4,538	650	2,284	733
Grand total	8,812	6,255	2,027	4,624	660	2,284	796

Source: Mills 1979-84.

--- means no data were available.

Table 50. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Chum Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	0	0	0
Shoreline	---	---	0	0	0	0	0
Total	---	---	0	0	0	0	0
Deshka River	0	0	0	0	0	0	0
Lake Creek	162	1,015	136	69	48	199	52
Alexander Creek	30	215	45	121	10	0	0
Polly Creek	---	---	---	---	77	156	0
Talachulitna River	37	234	55	17	0	0	0
Chuit River	7	0	0	0	0	0	10
Theodore River	0	0	0	0	0	0	0
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	194	1,171	918	284	182	94	346
Shell Lake	0	0	0	0	0	0	0
Whiskey Lake	0	0	0	0	0	0	---
Hewitt Lake	0	0	0	0	0	0	---
Judd Lake	0	0	0	0	0	---	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	---	---	1,154	491	317	449	408
Grand total	430	2,635	1,154	491	317	449	408

Source: Mills 1979-84.

--- means no data were available.

Alexander Creek (ibid.). From 1979 through 1982, an average of 42% of the sportfishing effort on Alexander Creek was directed toward chinook salmon (ibid.). Most of the effort expended on Alexander Creek during the first weeks of the chinook season occurs on the lower 5 mi of Alexander Creek, principally at the mouth (Delaney and Hepler 1983, Hepler and Bentz 1984). The mouth of Alexander Creek, as well as the mouths of other clearwater Susitna and Yentna river tributaries is used by many stocks of chinook salmon as a holding area. Thus these mouth areas support what is essentially an interception fishery and allow stocks bound for other streams to contribute substantially to the harvest attributed to these tributaries (Hepler and Bentz 1984). The mouth of Alexander Creek is used by both Yentna and Susitna river chinook salmon stocks (ibid.). As the harvest rate declines at the mouth of Alexander Creek, effort shifts to upstream reaches; however, in years when low water conditions prevail (as in 1983), riverboat access to the upper reaches is curtailed (ibid.). Chinook salmon catch quotas for the Deshka River, Lake Creek, and Alexander Creek are 7,000, 2,000, and 2,000 fish, respectively (Delaney and Hepler 1983).

Coho, sockeye, pink, and a few chum salmon are also taken from West Side Cook Inlet-West Side Susitna Drainage Area streams. The coho salmon harvest fluctuates a great deal from year to year (table 47); however, the largest harvests are generally taken from the Deshka River, Lake Creek, and Alexander Creek. Coho salmon runs in the Deshka are stronger on even-numbered years (Kubik and Delaney 1980), and this is reflected in the harvest figures (table 47). Harvest of coho salmon from the Deshka in even-numbered years from 1978 through 1982 averaged 2,184 fish, whereas the harvest in odd-numbered years from 1977 through 1981 averaged only 721.

Pink salmon harvest takes place in Alexander Creek, Lake Creek, the Deshka River, and the Talachulitna, along with smaller harvests from the Chuitna and Theodore rivers and other west-side streams (table 49). Harvests have generally declined since 1977, hitting a low of 660 fish in the west-side area in 1981, down from 8,812 in 1977.

The sockeye salmon harvest from the west-side area has averaged 1,939 fish annually from 1977 through 1982 (table 48). Harvest dropped from 2,792 fish in 1977 to 1,137 in 1980 but rose in 1981 and peaked in 1982 at 2,912 sockeye.

A small harvest of chum salmon is also taken from the west-side area. This harvest is taken mainly from Lake Creek and Polly Creek. Harvest of chum peaked in 1978 at 2,635 fish but in most years since 1977 has been less than 500 (table 50).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps which depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; however, it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on west-side streams will increase. In particular, angler effort on Peters Creek, which was opened to chinook harvest in 1983 and is accessible from the Petersville Road, is expected to increase as anglers become more aware of fishing opportunities there (Hepler and Bentz 1984). Fishing pressure on the Chuitna, which was also opened to chinook harvest in 1983, is also expected to increase as more anglers realize its potential. In addition, it is anticipated that if a road is built from Anchorage to the Tyonek area the fishing pressure on the Chuitna River will increase (ADF&G 1984c).

H. Kenai Peninsula Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Kenai Peninsula Area and throughout the state is to optimize the survival and growth of resident fish and to maintain strong runs of anadromous species. Providing maximum opportunities for recreational anglers is another goal of the department, which is closely related to the first (ADF&G 1980). Research activities in the area are directed toward determining the environmental characteristics of existing recreational fishery waters, obtaining estimates of existing or potential angler use and sport fish harvest, evaluating the application of sport fish restoration measures and the availability of sport fish egg sources, assisting the investigation of the status of public access to the area's fishing waters, evaluating and developing plans for the enhancement of fish stocks, providing recommendations for the management of sport fish resources, and directing the course of future studies (Wallis and Hammarstrom 1983). Separate research projects dealing with chinook salmon, Russian River sockeye salmon, and the Anchor River stock of steelhead trout are also carried out by Kenai Peninsula Division of Sport Fish staff. One of the most critical management needs regarding the chinook salmon population of the Kenai River has been to accurately estimate the spawning escapement, and this has been a major goal of the chinook salmon research project.

The mixed stock nature of the upper Cook Inlet fishery, as well as the interest of several user groups in these fish, has resulted in adoption of several management plans by the

Alaska Board of Fisheries for salmon management in the upper Cook Inlet. The objectives of these plans are summarized in section II.E. of the Commercial Harvest of Salmon narrative in this document. The primary goal of all the management plans is to protect the sustained yield of the state's fishery resources, while providing an equitable distribution of the available harvest among available users (5 AAC 39.200). Basically, the Upper Cook Inlet Salmon Management Plan (the Comprehensive Management Policy, 5 AAC 21.363) states that Susitna chinook salmon, early Kenai chinook salmon, and early Russian River sockeye salmon stocks, which normally move in to upper Cook Inlet to spawning areas before June 30 will be managed primarily for recreational uses. From July 1 through August 15, salmon stocks that normally move in to upper Cook Inlet will be managed primarily for commercial uses, and after August 15 salmon stocks moving to spawning areas in Kenai Peninsula drainages will be managed primarily for recreational uses, while other stocks will continue to be managed primarily for commercial uses (ADF&G 1983). The other management plans generally offer more stock-specific guidance and specific goals to the ADF&G to help achieve the general goals laid out in the Upper Cook Inlet Salmon Management Plan.

2. Management considerations. The presence of large stocks of salmon readily accessible to Southcentral area fishermen has resulted in a sportfishing effort on the Kenai Peninsula that is far greater than in any other area of Alaska (ADF&G 1984d). Salmon stocks on the Kenai Peninsula are also an important resource for commercial and personal use fisheries. The concentration of fishing effort by three user groups in this area has resulted in conflicting demands on the resource. Salmon stocks, which are of primary importance to sport fishermen, must first pass through Cook Inlet, intermingled with stocks that are intended to be harvested primarily by commercial or personal use fisheries. In some cases, it is possible to separate different fisheries in time and space to reduce the user conflicts. In other instances, however, this has been more difficult. Late June opening dates for the commercial fishery effectively limit the harvest of Susitna chinook salmon, early Kenai chinook salmon, and early Russian River sockeye, and allocate these runs totally to sport fishermen (ibid.). The commercial harvest of late Kenai coho salmon is also easily controlled by the August 15 closing date of the east-side set net fishery (ibid.). Late-run Kenai River chinook salmon and early-run coho salmon, however, which are highly prized by sport fishermen, are harvested incidentally in east-side commercial set nets primarily targeting on sockeye salmon and pink salmon (ADF&G 1984d, Hammarstrom and Larson 1983). Late-run sockeye salmon bound for the Russian River, where an

important sport harvest occurs, are taken in the mixed stock Central District drift and set gill net fisheries. Conflicts between sport and commercial salmon fisheries are discussed in more detail in the Commercial Harvest of salmon section of this document.

Personal use and sport fishermen also compete for the same resources. The personal use fishery for late-run Kenai River coho salmon established by the Board of Fisheries in 1982 (5 AAC 77.548) can be large enough to reduce the catch rates for coho in the Kenai River sport fishery (ibid.).

Conflicts also arise between different sportfishing groups in heavily used areas of the Kenai Peninsula. This is especially evident on the Kenai River during the chinook salmon sport fishery, where volatile conflicts arise between professional sportfishing guides and individual recreational users, and among shore fishermen and various groups of boat fishermen (Kenai River Task Force 1983). Heavy use of the Kenai River is also resulting in stream-bank erosion and degradation of fish habitat in some areas. This erosion is caused primarily by stream-bank development, such as the placement of numerous groins and man-made canal systems, and by the run-up of the wakes of boats onto naturally unstable banks (ibid.).

Public access to recreational sites in the Kenai Peninsula Area is also becoming an important concern for resource managers. Because of ever-increasing demand for recreational angling, increasing population, recent legislation, and court decisions regarding land disposition, these problems of public access have become more acute. As a result, new fisheries must be developed in this area (ADF&G 1980).

Harvest and effort for several Kenai Peninsula salmon fisheries are monitored by on-site creel censuses. Harvest and effort totals for each location are also available from postal survey data.

3. <u>Period of use</u>. Chinook salmon harvest on the Kenai Peninsula generally begins in mid May and continues through July 31. The fishery for chinook salmon in the Kasilof River begins in the middle of May and is closed on June 30 (ADF&G 1984a). The Deep Creek marine fishery begins in early May and continues through July. The early run of chinook salmon, which is in the Deep Creek fishery from mid May through late June, attracts the majority of anglers and produces the most of the harvest (Hammarstrom and Larson 1982). The run of chinook salmon into the Kenai River and in the Deep Creek marine fishery is comprised of two segments, early and late. Because of the distance traveled and the characteristic behavior of the migration, timing in each segment of the Kenai River differs (ibid.). The early run is generally available in the downstream section (Beaver Creek to Soldotna Bridge) from the first of June until early July and in the

upstream section (Naptowne Rapids to Skilak Lake) from early June until mid July. The late run is available in the downstream section generally from early July until the season closes on July 31 and in the upstream section from late July until the season closes (Hammarstrom 1979-1981b; Hammarstrom and Larson 1982, 1983). Lower Kenai Peninsula chinook salmon streams are open on the last weekend of May and the first three weekends of June and the Monday following those weekends, with the exception of the Ninilchik River, which is not open the third weekend or Monday of June (ADF&G 1984a). Typically, the second weekend these streams are open is the most productive (Hammarstrom and Larson 1982).

The fishery for coho salmon in the Kenai River extends from late July to well into the winter, with the extent of winter effort largely affected by the weather. The coho salmon run into the Kenai River is comprised of two segments, early and late. The early run enters the stream in late July, peaks in early August, and is present until late August. The late run usually enters in late August and is present until freeze-up, with peak fishing occurring in mid September (Wallis and Hammarstrom 1983). In 1983, reports were received of anglers taking coho salmon at the outlet of Kenai Lake in February and March (Wallis and Hammarstrom 1983; Logan, pers. comm.). Generally, however, the harvest after September 30 is considered insignificant (Wallis and Hammarstrom 1982). The peak of the coho salmon run in the Russian River is from approximately August 20 through September 1 (Logan, pers.comm.). Harvest of coho salmon in lower Kenai Peninsula streams also begins around the end of July and continues until early October, with peak harvest in the Anchor River around the end of August (Wallis and Hammarstrom 1979, 1980, 1982; Hammarstrom 1981a). The Resurrection Bay coho salmon harvest begins in early July and continues through early September. Peak harvest usually occurs in mid August during the Seward Salmon Derby (McHenry 1980-1983).

The Russian River sockeye salmon harvest takes place from early June until August 20. The Russian River sockeye salmon run is divided into two segments, early and late. The early run generally enters the sport fishery from June 10-15, and by July 5 approximately 50% of the run is past the area open to sportfishing (Nelson 1977). The late run enters the fishery in mid July. Approximately 50% of the late run has usually passed through the fishery by August 5 (ibid.). The Russian River sockeye migration is generally complete by September 1 (ibid.).

Pink salmon enter Kenai Peninsula streams in late July and are available through August. Pink salmon generally enter the Russian River fishery in late August (Nelson 1979).

Harvest of land-locked coho and kokanee in lakes occurs chiefly in spring and fall (ADF&G 1984d).

4. Harvest methods. Chinook salmon are taken by both boat and shore fishermen on the Kenai River, but boat fishermen are much more successful. In 1973, relatively large numbers of anglers discovered that chinook salmon could be taken in the Kenai River by bouncing terminal gear along the bottom from a drifting boat (Hammarstrom 1979). In 1980, when turbid water conditions apparently reduced the willingness of chinook salmon to strike, anglers also discovered that fish could be taken by trolling bright diving plugs behind a boat as the boat operator slowly backed down, while under power, through the hole (Hammarstrom 1981b, ADF&G 1984d). By 1981, half the anglers were using this technique, referred to as "tadpollying" (Hammarstrom and Larson 1982). In summary, in addition to bank fishing, there are now three major types of boat-based fishing in use on the river. Some fishermen prefer to anchor over favorite holes; others prefer to drift through the holes; and still others prefer to troll deep-diving lures in the holes (Kenai River Task Force 1983). These three fishing methods are not compatible within the same hole on a congested waterway, and since the target fishes tend to stay in relatively confined areas, the increasing concentration of fishermen using variant harvest methods has produced many conflicts (ibid.).

A second area of conflict in the Kenai River chinook salmon fishery involves boat and motor size. There are a growing number of boats in the 18 to 22 ft class, with outboard as well as inboard jet motors in excess of 100 HP. These larger boats and motors operating at high speeds have, in combination with an ever greater number of boats on the river, resulted in collisions and public concern about danger to boaters (ADF&G 1984d).

Since 1975, there has also been a dramatic increase in the number of fishing guides operating on the Kenai River. Although no documentation exists, it is estimated that in 1974 and 1975 the number of Kenai River guides probably numbered less than 10 (Hammarstrom and Larson 1982). In 1982, the first year in which guides were required to register with the ADF&G, 207 individuals registered as sportfishing guides (Hammarstrom and Larson 1983). Many people registered as guides, however, only to protect their opportunity of guiding in the future, fearing that some type of limited entry may be imposed on Kenai River guiding that would restrict new entrants to the fishery (Logan et al. 1982). Only 163 guides reported at least one client, and of those only 57 reported at least 50 client-days (Hammarstrom and Larson 1983). Active guides, however, are quite successful. In the 1981 chinook sport fishery, guided anglers were estimated to be nearly three times as efficient as unguided anglers (Hammarstrom and Larson 1982). The rapid increase in the number of guides, coupled with their clients' high level of success compared to unguided fishermen, has resulted in their being viewed unfavorably by many fishermen (Kenai River Task Force 1983). The controversy between guided and unguided anglers is probably the most intense conflict occurring on the Kenai River (ADF&G 1984d).

When the chinook salmon season in the Kenai River ends, fishing effort is directed toward coho and pink salmon, and techniques change primarily to those of a stationary bait or a casting fishery. Although most anglers still use boats, they usually run to a favorite spot, anchor, and fish with either roe or lures (Wallis and Hammarstrom 1982). Most sockeye salmon are taken by shore anglers using streamer flies (Wallis and Hammarstrom 1980; Logan, pers. comm.).

Lower Kenai Peninsula streams are too small to support boat fisheries, so salmon fishing is by shore fishermen.

There are many gear restrictions in freshwater areas on the Kenai Peninsula. Several areas of the Kenai River are closed to boat fishing (ADF&G 1984a, 1984e). The Moose River is a fly-fishing-only area from May 15 to August 15, and the Russian River is a fly-fishing-only area from June 1 to August 20 (ADF&G 1984a). In the Kenai River upstream from Skilak Lake, only artificial lures are allowed (ibid.). Regulations change from year to year and the reader should refer to the current summary of sportfishing regulations for exact restrictions.

The marine fishery for chinook salmon near Deep Creek is conducted mostly from small "car-top" boats and rubber rafts, which can be launched from shore. Fishermen seeking coho salmon in Mud Bay on the Homer Spit either use small boats or cast from shore. The chinook salmon in Halibut Cove are taken primarily by snagging, which is legal in the whole lagoon (Wallis and Hammarstrom 1980).

Most of the coho salmon harvested in Resurrection Bay are taken by anglers trolling from small boats. Several charters operate out of Seward, and the U.S. Army and Air Force have recreation camps in Seward, which provide military personnel and their dependents with boats.

5. Fishery summary and significant use areas:
   a. Effort and harvest. All five species of North American Pacific salmon are harvested by sport fishermen in the Kenai Peninsula, although anglers show little interest in chum salmon (tables 51 through 58) (ADF&G 1984d). Pink salmon are often taken incidentally to other species if available. Sockeye salmon are harvested only in certain locations, with the largest fishery occurring in the Kenai-Russian River area (ibid.). Anglers prefer chinook salmon to any other species; however, the wider distribution and greater numbers of coho salmon available over a longer time period results in fishing effort for this species similar to that for chinook

Table 51. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Chinook Salmon Sport Harvest,[a] 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	4,470	4,800	4,070	1,636	2,711	3,836	2,832
Resurrection Bay	515	501	156	198	137	293	189
Kachemak Bay	614	315	400	224	583	1,540	1,521
Swanson River	---	---	---	---	---	---	0
Other salt water[b]	356	501	634	207	378	262	
Saltwater total	5,955	6,117	5,260	2,265	3,809	5,931	5,444
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	7,431	8,239	13,553
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	1,598	1,173	1,280
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	605	1,006	483
Kenai River (Skilak inlet to Kenai Lake	---	---	---	---	0	0	0
Kenai River total	7,585	7,130	8,843	4,942	9,634	10,418	15,316
Anchor River	1,077	2,109	1,913	605	1,015	650	1,206
Ninilchik River	1,168	1,445	1,493	723	1,372	1,079	808
Deep Creek	425	804	703	182	518	723	986
Stariski Creek	0	0	0	0	0	0	0
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	1,242	2,316	2,853
Other boat	---	---	---	---	---	---	734
Other shoreline	---	---	---	---	---	---	168
Other rivers	0	251	283	310	0	0	0
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	10,255	11,739	13,235	6,762	13,781	15,186	21,169
Grand total	16,210	17,856	18,495	9,027	17,590	21,117	26,613

Source: Mills 1979-83.
--- means no data were available.
a Data for 1977 through 1980 include harvest of small chinook (less than 20 in).
b In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

Table 52. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Small (LessThan 20 in.) Chinook Salmon Harvest,[a] 1981-83

Location	Harvest 1981	1982	1983
Salt water:			
Deep Creek finfish	0	0	0
Resurrection Bay	25	42	10
Kachemak Bay	108	153	178
Other boat	---	---	63
Other shoreline	---	---	0
Other salt water	76	8	
Saltwater total	209	203	251
Fresh water:			
Kenai River (Cook Inlet to Soldotna Bridge)	1,306	560	1,951
Kenai River (Soldotna Bridge to Moose R.)	216	382	168
Kenai River (Moose R. to Skilak outlet)	140	102	63
Kenai River (Skilak inlet to Kenai Lake	22	34	21
Kenai River total	1,684	1,078	
Anchor River	54	68	63
Ninilchik River	151	161	63
Deep Creek	86	68	168
Stariski Creek	0	0	0
Russian River	0	0	0
Kasilof River	65	51	336
Swanson River	---	---	---
Other rivers	0	0	189
Hidden Lake	0	0	0
Canoe Lake System	0	0	0
Other lakes	0	0	0
Freshwater total	2,040	1,426	3,022
Grand total	2,249	1,629	3,273

Source: Mills 1979-83.

a Small chinook salmon harvests were not reported separately from adult chinook salmon harvests in 1977 through 1980.

b In 1981 and 1982, "other salt water" was not divided between boat and shoreline.

Table 53. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Sea-Run Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	557	503	387	405	918	639	860
Resurrection Bay	14,528	16,731	14,315	19,665	14,721	18,518	11,277
Kachemak Bay	3,623	1,798	1,797	1,533	1,955	1,834	1,517
Other boat	---	---	---	---	---	---	367
Other shoreline	---	---	---	---	---	---	524
Other salt water	1,126	339	836	215	194	314	
Saltwater total	19,834	19,371	17,335	21,818	17,788	21,305	14,545
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	12,280	26,582	12,231
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	3,326	3,904	4,007
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	6,178	7,200	4,867
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	540	1,729	1,573
Kenai River total	9,537	10,823	15,276	26,838	22,324	39,415	22,678
Anchor River	1,339	1,559	4,006	2,649	2,949	2,379	1,395
Ninilchik River	122	88	200	321	432	241	210
Deep Creek	306	1,383	362	478	464	366	545
Stariski Creek	133	201	275	155	410	119	251
Russian River	1,472	1,446	1,098	1,025	346	1,275	1,490
Kasilof River	---	---	---	---	335	325	409
Swanson	---	---	---	---	---	---	525
Other rivers	732	2,514	1,523	2,101	2,084	2,138	712
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	10	0	0	0	0	0	0
Other lakes	89	25	0	43	119	398	199
Freshwater total	13,740	18,039	22,740	33,610	29,463	46,656	28,414
Grand total	33,574	37,410	40,075	55,428	47,251	67,961	42,959

Source: Mills 1979-84.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

Table 54. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Land-Locked Coho Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other Salt water	0	0	0	0	0	0	0
Saltwater total	0	0	0	0	0	0	0
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	0	0	0
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	0	0
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	0	0	0
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	0	0	0
Kenai River total	0	0	0	0	0	0	0
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	0	0	0
Swanson River	---	---	---	---	---	---	0
Other rivers	0	0	0	0	0	0	126
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	226	289	27	95	54	514	325
Other lakes	1,389	2,115	3,236	3,763	4,546	3,752	3,524
Freshwater total	1,615	2,404	3,263	3,858	4,600	4,266	3,975
Grand total	1,615	2,404	3,263	3,858	4,600	4,266	3,975

Source: Mills 1979-1984.
--- means no data were available.

Table 55. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Sockeye Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	1,133	1,437	1,006	878	292	500	562
Resurrection Bay	6	0	0	0	0	0	0
Kachemak Bay	122	70	252	52	151	373	472
Other boat	---	---	---	---	---	---	1,466
Other shoreline	---	---	---	---	---	---	2,740
Other salt water[a]	294	2,861	1,163	1,223	950	1,704	
Saltwater total	1,555	4,368	2,421	2,153	1,393	2,577	5,240
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	5,270	11,706	22,961
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	5,336	14,829	22,454
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	4,266	12,136	15,180
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	4,849	11,432	10,672
Kenai R. total	23,196	33,619	16,887	25,468	19,721	50,103	71,267
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	48,263	62,447	35,999	55,104	33,264	45,572	24,476
Kasilof River[b]	---	---	---	---	443	653	1,863
Swanson River							
Other rivers	1,272	1,465	1,367	1,998	788	1,026	739
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	37	0	0	0	0	0	0
Other lakes	53	409	534	120	194	136	315
Freshwater total	72,821	97,940	54,787	82,690	54,410	97,490	98,753
Grand total	74,376	102,308	57,208	84,843	55,803	100,067	103,993

(continued)

Table 55 (continued).

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

b Data from the Kasilof River do not include the personal use dip net fishery.

Table 56. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Kokanee Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other salt water[a]	0	0	0	0	0	0	0
Saltwater total	0	0	0	0	0	0	0
Freshwater:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	0	0	0
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	0	0
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	0	0	0
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	0	0	0
Kenai River total	0	0	0	0	0	0	0
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	0	0	0
Swanson River	---	---	---	---	---	---	0
Other rivers	0	0	0	0	0	0	0
Hidden Lake	1,256	1,206	1,382	1,154	1,382	1,541	1,899
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	812	496	1,836	1,197	4,158	1,878	0
Freshwater total	2,068	1,702	3,218	2,351	5,540	3,419	1,899
Grand total	2,068	1,702	3,218	2,351	5,540	3,419	1,899

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

Table 57. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Pink Salmon Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	305	588	82	474	54	161	31
Resurrection Bay	1,595	6,610	2,100	12,614	7,776	9,328	4,909
Kachemak Bay	6,921	6,238	6,218	6,604	6,772	2,368	2,927
Other salt water[a]	1,395	1,362	1,191	155	1,123	765	
Other boat	---	---	---	---	---	---	871
Other shoreline	---	---	---	---	---	---	472
Saltwater total	10,216	14,798	9,591	19,847	15,725	12,622	9,210
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	43	16,716	703
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	32	5,869	472
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	11	2,505	430
Kenai River (Skilak inlet to Kenai Lake	---	---	---	---	0	482	220
Kenai River total	163	26,579	127	18,580	86	25,572	1,825
Anchor River	27	139	18	339	11	161	252
Ninilchik River	0	46	0	260	0	10	42
Deep Creek	109	294	9	321	11	293	0
Stariski Creek	26	15	0	0	0	0	52
Russian River	37	1,300	0	930	0	1,142	31
Kasilof River	---	---	---	---	0	187	1,343
Swanson River	---	---	---	---	---	---	0
Other rivers	1,817	2,291	1,136	646	1,976	1,215	0
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	2,179	30,664	1,290	21,076	2,084	28,580	3,587
Grand total	12,395	45,462	10,881	40,923	17,809	41,202	12,797

Source: Mills 1979-83.
--- means no data were available.
a In 1977 through 1982, "other salt water" was divided between boat and shoreline.

Table 58. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Chum Salmon Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	63	39	100	276	194	458	923
Kachemak Bay	126	39	18	95	11	10	273
Other salt water[a]	0	0	91	86	22	0	
Other boat	---	---	---	---	---	---	31
Other shoreline	---	---	---	---	---	---	514
Saltwater total	189	78	209	457	227	468	1,741
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	0	0	0
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	0	0
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	0	0	0
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	0	0	0
Kenai River total	0	0	0	0	0	0	0
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	0	0	0
Swanson River	---	---	---	---	---	---	0
Other rivers	36	351	18	34	140	170	105
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	0	0	0	0	0	0	0
Freshwater total	36	351	18	34	140	170	105
Grand total	225	429	227	491	367	638	1,846

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

salmon (ibid.). Land-locked coho and kokanee are also taken from area lakes.

The Kenai River is the most heavily used stream on the Kenai Peninsula and is the most popular sportfishing river in the state (Kenai River Task Force 1983). Approximately 232,000 angler-days of sportfishing effort were expended on the Kenai River in 1982, nearly a 90% increase in effort since 1977 (table 8). This effort represented 14% of the total Alaska sportfishing effort in 1982 (Mills 1983). Most of the effort on the Kenai River is concentrated between Cook Inlet and the Soldotna Bridge (table 8). In 1982, the sport harvests of chinook, coho, sockeye, and pink salmon from the Kenai River were larger than the harvests of those species from any other river in the state (Mills 1983). The Kenai River chinook salmon harvest in 1982 was 49% of the chinook salmon harvest from the Kenai Peninsula Area and 14% of the total Alaska chinook salmon sport harvest. The 1982 Kenai River coho harvest made up 58 and 20% of the Kenai Peninsula Area and total Alaska sport coho harvests, respectively. The 1982 Kenai River sockeye harvest was the largest since the postal survey program began in 1977 and represented 50% of the Kenai Peninsula Area harvest and 38% of the total Alaska sport sockeye harvest. Finally, pink salmon from the Kenai River contributed 62% of the 1982 Kenai Peninsula Area sport harvest and 15% of the total Alaska sport pink salmon harvest. The pink salmon run into the Kenai River is an even-year run, and harvest falls to less than 200 fish in odd years (table 57).

As metioned, most of the effort on the Kenai River is concentrated on the lower river between Cook Inlet and the Soldotna Bridge (table 8). One major reason for the large percentage of angling effort and catch from the downstream section is that a significant portion of the second chinook salmon run does not migrate upstream of Soldotna (ADF&G 1984d). Since the late-run chinook salmon do not arrive in the upstream section in strength until the latter part of July, emergency closures, usually promulgated in latter July, essentially eliminate the fishery in this section. Also large catches in the lower river reduce the number of both early and late-run chinook salmon available to anglers further upstream. The chinook salmon harvest from the Kenai River has increased from 7,585 fish in 1977 to 10,418 in 1982 (table 51). Harvest was relatively low in 1980 because of turbid water conditions (Hammarstrom 1981b). Annual effort directed toward chinook salmon on the Kenai River averaged 79,961 angler-days in 1977 through 1982 (Hammarstrom and Larson 1983). This represents an average of approximately 47% of the total annual effort expended for all species of fish on the Kenai River in that time period. The sport fishery on late-run Kenai River chinook salmon has developed to the point that sport harvest is approaching the harvest level in the commercial fishery (ADF&G 1984d). To halt the rising harvest of late Kenai chinook salmon, the Board of Fisheries adopted in 1976 and amended in 1981 the Late Kenai King Salmon Management Plan, limiting the in-river sport harvest to the level of the east-side set net catch during regular fishing periods (ibid.). This plan has since been repealed (Logan, pers. comm.). In December 1982, the Board of Fisheries put restrictions on the amount of time open to sportfishing on the late run. All Mondays in July after July 4 were closed to fishing from boats, and fishing from registered guide vessels was prohibited on all Sundays in July (Hammarstrom and Larson 1984).

Prior to the development of the chinook salmon fishery, the Kenai River coho salmon fishery was of minor importance. Anglers confined themselves to bank fishing from a few readily accessible areas, and the harvest was insignificant in relation to total run-strength. The use of boats on the river opened previously inaccessible areas, and the coho salmon resource of the Kenai River now supports a major sport fishery (Logan et al. 1982). The early run of coho salmon is harvested by both commercial and recreational users. The late run is currently harvested by both recreational and personal use fishermen, under the Central and Northern District Personal Use Coho Management Plan (5 AAC 77.548) established by the Board of Fisheries in December of 1982 and amended in 1983. It is speculated that the large sport harvest in 1982 was partially due to the absence of a personal use harvest that year (Wallis and Hammarstrom 1983). Annual effort directed toward coho salmon in the Kenai River averaged 33,808 angler-days from 1977 through 1982 (ibid.). This number represents an average of approximately 19% of the total annual effort expended for all species of fish on the Kenai River in that time period.

The sockeye salmon harvest from the Kenai River from 1977 through 1981 ranged from 16,887 to 33,600, with a mean of 23,580 fish (Logan et al. 1982). The 1982 harvest, however, was especially large, with 50,103 sockeye harvested (table 55). High success rates during the 1982 season are attributed to relatively low, clear water and to angler techniques. Relatively clear water in 1982 prompted anglers to use coho flies in a technique similar to that used at the Russian River.

Success rates were high during the approximately two to three weeks sockeye salmon were available, which resulted in a record harvest for this species (Logan et al. 1982).

Pink salmon are also taken from the Kenai River. Much of the harvest of this species occurs in the vicinity of the Warren Ames Bridge near the mouth of the river, where concentrations of pink salmon, which have recently migrated from salt water, offer excellent fishing even for novice anglers (Hammarstrom 1981a). Anglers generally prefer other species of salmon to pink salmon, so in years when the catch per effort of other species is good, the harvest of pink salmon tends to drop (ibid.). The average even-year harvest of pink salmon from the Kenai River in 1978 through 1982 was 23,600 fish (table 57).

The Russian River, a clearwater tributary that enters the Kenai River between Skilak Lake and Kenai Lake, supports a large sport fishery for sockeye salmon. Coho and pink salmon are also taken from the Russian River. In 1977 through 1982, total annual sportfishing effort on the Russian River, as calculated from the sport fish postal survey, has averaged 63,900 angler-days (table 8). On site creel census data indicates that the majority of effort on the Russian River is directed toward sockeye salmon. The Russian River sockeye fishery is unique in that it is one of the few areas in North America where sockeye salmon will readily accept an artificial fly, the only terminal gear permitted under current regulations (Nelson 1980). The sockeye salmon fishery extends from a marker 548 m below Russian River Falls to a marker 1,646 m below the confluence of the Kenai and Russian rivers. A privately operated ferry at the Kenai and Russian rivers' confluence transports anglers to the south bank of the Kenai. In an average year, the confluence area receives 50% of all angler effort in the sockeye salmon fishery as fishermen try to intercept the runs prior to their entry into the Russian River (Nelson 1983).

The late run of sockeye salmon to the Russian River experiences a high exploitation rate in the commercial fishery prior to entering the Kenai River and also in the intense sport fishery before reaching their spawning grounds. This high exploitation rate has been made possible by the fact that the Russian Lakes system has generally produced greater returns per spawner than those observed in the remainder of the Kenai River drainage (ADF&G 1984d). Therefore, Kenai River escapement goals, designed to provide optimum numbers of spawners in the system as a whole, have provided a surplus in the Russian River. To prevent the growing sport fishery from overharvesting this stock, the Board of Fisheries in 1977 adopted the Russian River Sockeye Salmon Management Plan (5 AAC 21.361), which established escapement goals for both the early and late runs while recognizing the mixed- stock nature of the commercial fishery (ibid.).

Four streams south of the Kenai River receive fishing effort directed toward chinook salmon. These are the Kasilof River, the Ninilchik River, Deep Creek, and the Anchor River.

The Kasilof River is glacially turbid, much more so than the Kenai River, and until recently received little angling pressure (Hammarstrom 1979). Chinook salmon production in the Kasilof River, however, has been enhanced by the Division of FRED Crooked Creek Hatchery since 1976 (Waite 1983). The effort in the Kasilof River chinook fishery has increased from 1,750 angler-days in 1978 to 24,394 in 1983 (Hammarstrom, pers. comm.). The sport chinook salmon harvest estimated by on-site creel censuses has steadily increased from 251 chinook in 1978 to 4,361 in 1983 (ibid.). The 1984 catch was estimated to be over 5,138 fish (Logan, pers. comm.). The catch per hour of chinook on the Kasilof River in 1981 of 0.88 was the highest recorded for any Kenai Peninsula chinook salmon fishery (Logan et al. 1982). The fishing area for chinook on the Kasilof River is on the south bank, just downstream from the mouth of Crooked Creek (ibid.). The ADNR has recently purchased six acres of streambank property in this area for angler access (Logan, pers. comm.). Coho salmon, sockeye salmon, and a few pink salmon are also taken from the Kasilof (Mills 1982-1983).

The Ninilchik River, Deep Creek, and the Anchor River also support chinook and coho salmon harvests. The average annual effort on these three streams combined during the chinook salmon fishery from 1977 through 1982 was 33,500 angler-days (Hammarstrom and Larson 1983). Chinook salmon harvest is largest from the Anchor and Ninilchik rivers, averaging approximately 1,200 chinook salmon annually from each stream from 1977 through 1982 (table 51). Harvest from Deep Creek averaged 560 fish per year. Harvest levels from all these streams are affected by weather conditions. Heavy rains in the area result in high, turbid water that cannot be effectively fished. The relatively low harvests from the Anchor River in 1980 and 1982, for instance, were partially caused by poor weather conditions (Hammarstrom 1981b, Hammarstrom and Larson 1983).

The coho salmon harvest from the Anchor River is much larger than that from the Ninilchik River or Deep Creek. Harvest from the Anchor River has averaged 2,480 coho salmon annually from 1977 through 1982 (table 53). The Anchor River on an average represents about 60% of the total coho salmon harvest taken from the four major streams south of the Kenai River (Anchor River, Deep Creek, Ninilchik River, and Stariski Creek) (Logan et al. 1982).

An active marine fishery for chinook salmon takes place in waters off the mouth of Deep Creek. This fishery initially became popular in 1972, when anglers discovered that chinook salmon could be harvested in the area (Hammarstrom and Larson 1983). Early-run chinook salmon, which are taken from mid May to mid June, are probably bound for many systems in Cook Inlet but are heavily influenced by runs to the Kenai and Kasilof rivers. Late- run chinook salmon, which are taken from mid June through mid July, are bound almost entirely for the Kenai River (ibid.). The harvest of chinook from the Deep Creek marine fishery has averaged 3,590 from 1977 through 1982 (table 51). Annual effort in this fishery has averaged 21,200 angler-days from 1977 through 1982 (ibid.). Since this fishery is carried out in small boats, fog and rough seas greatly reduce angler effort. Fluctuations in harvest and effort in this fishery are more a function of local weather conditions than of abundance of fish (ibid.).

Anglers with boats on the Kenai Peninsula can also take chinook salmon in Halibut Cove on the southeast side of Kachemak Bay. These fish are planted as smolt in Halibut Cove Lagoon by the Division of FRED, and when they return they mill around in the lagoon, as there is no suitable spawning stream. Boat anglers in Kachemak Bay also harvest pink salmon in Tutka Bay Lagoon. These fish are largely of hatchery origin and are returning to the Tutka State Salmon Hatchery. Mud Bay on the north side of Homer Spit is a popular area for bank anglers or those with small skiffs to take coho salmon.

Resurrection Bay is also a popular marine harvest area for salmon in the Kenai Peninsula Area. Since 1961, the Resurrection Bay coho salmon recreational fishery has become the largest marine sport fishery for this species in Alaska (McHenry 1982). The Resurrection Bay coho harvest has averaged 16,400 fish from 1977 through 1982 (tables 53). Pink salmon, chinook salmon, and chum salmon are also harvested in lesser numbers from this area. Annual effort in the Resurrection Bay Recreational coho salmon fishery has averaged 24,100 angler-days from 1977 through 1982 (McHenry 1982, 1983).

A large percentage of the harvest is taken during the Seward Silver Salmon Derby, though this percentage has steadily decreased from 47% in 1978 to 25% in 1983 (McHenry 1983). Special prizes for the largest coho salmon and for several tagged coho salmon are offered during the salmon derby, and these prizes, together with a great deal of publicity, probably result in the large amount of effort expended during the derby. The coho salmon return to Resurrection Bay has been supplemented since 1964 by fingerlings planted in Bear Lake (McHenry 1982). Extensive studies have been conducted to determine the optimum stocking density for this lake and to monitor the success of the stocking program.

Commercial seining in Resurrection Bay is conducted under a policy developed by the Board of Fisheries in December 1976, which is designed to minimize conflicts between recreational and commercial users (Logan et al. 1982). It basically states that 1) no commercial fishery will occur until after August 15; 2) no commercial fishery will occur 48 hours prior to or after the Seward Silver Salmon Derby; 3) reasonable separation by area will be maintained by sport and commercial users; and 4) the fishery will be closely monitored by the Divisions of Commercial Fish, Sport Fish, and Protection staffs (ibid.).

Pink salmon and a few chum and chinook salmon are also taken in Resurrection Bay. The pink salmon run is an even-year run; however, fair numbers also return in odd years, and the catch does not fluctuate as dramatically as that of the Kenai River pink salmon (table 57). The chinook salmon are mostly immature and in their first and second ocean years. Origins of these stocks are unknown, as wild chinook salmon do not ascend Resurrection Bay streams (McHenry 1983).

Several lakes in the Kenai Peninsula Area are stocked with either land-locked coho salmon or with chinook salmon. Harvest of land-locked coho salmon from Kenai Peninsula lakes has averaged 3,330 from 1977 through 1982 (table 54). In 1984, Upper Summit Lake, Engineer Lake, and Scout Lake were stocked with chinook salmon (ADF&G 1984h).

Hidden Lake contains a natural population of Kokanee, along with a population of anadromous sockeye salmon. This lake is also regularly stocked with sockeye salmon. An annual average of 1,320 kokanee was taken from Hidden Lake from 1977 through 1982 (table 56).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; however, it is likely that, if the population of Southcentral Alaska continues to grow, sportfishing pressure on the Kenai Peninsula will increase. The ADF&G in a 1984 report to the Board of Fisheries predicted that, based on historical trends, the total number of anglers fishing in Cook Inlet (including northern Cook Inlet drainages) may increase from 143,147 anglers in 1982 to 264,752 in 1990 (ADF&G 1984d). This prediction includes anglers who fish entirely for resident species and do not enter salmon fisheries; however, these fishermen are believed to constitute a small percentage of the total (ibid.).

III. ARCTIC GRAYLING

A. Regional Summary

Grayling harvests have been consistently reported from all postal survey areas in the Southcentral Region with the exception of the PWS Area. The largest grayling harvests are taken in the Glennallen Area, generally followed by the East Side Susitna Drainage Area, the West Side Cook Inlet-West Side Susitna Drainage Area, and Knik Arm Drainage Area. From 1977 through 1982, the average annual arctic grayling harvest from the Southcentral Region was 55,600 fish.

B. Glennallen Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Glennallen Area and throughout the state is to optimize the survival and growth of resident fish and to provide diverse recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining angler participation and harvest in key fisheries; 2) cataloging and inventorying water bodies in the area to develop new fisheries and monitor existing ones, especially those that are maintained by stocking; 3) monitoring construction projects to prevent losses of fish and fish habitat and recommending mitigating measures when necessary; and 4) conducting life history studies of various fish, especially in highly exploited fisheries (ADF&G 1980).

2. Management considerations. Most of the grayling sport harvest in the Glennallen Area takes place on the Gulkana River and on lakes with natural or stocked grayling populations. Division of Sport Fish personnel have monitored the Gulkana River grayling fishery since 1968 by creel census and test fishing. From 1978 through 1982, all grayling caught during the test fishery were measured and aged. Data indicate there has been very little change in the average length of grayling caught in the test fishery since 1968,

though the maximum size range has diminished approximately 40 mm. In general, the length and age statistics indicate that the Gulkana River grayling population is stable and not yet overexploited. It is, however, impossible to confirm this with catch-per-unit-of-effort statistics, since most anglers cannot give an accurate account of how much time they actually fished during a three-to-four-day float trip (Williams and Potterville 1982). The present bag and possession limit for grayling in the Gulkana River is 10 fish (ADF&G 1984a). Area biologists feel that reducing this limit would have no effect on the standing crop of grayling because it is essentially a catch-and-release fishery (Williams and Potterville 1982). Four commercial float operators and an increasing number of private parties using the river, however, emphasize the need for continued monitoring of the fishery (Williams and Potterville 1983).

Tolsona Lake, which is about 20 mi west of Glennallen, was used as a grayling egg-take site for the statewide grayling lake-stocking program from 1965 through 1979. To maintain the population, Tolsona Lake was stocked with grayling fry each year, and this program appeared to be adequate until 1979, when the grayling population in the lake declined. This decline was concurrent with an increase in the sucker (<u>Catostomus catostomus</u>) population; however, reducing the sucker population in the lake by trapping and seining did not result in an increase in the grayling population (Williams and Potterville 1981). There is no obvious reason for the rapid decline of grayling in Tolsona Lake; however, it is no longer used as an egg-take site and is stocked annually with fry from other locations in an attempt to reestablish the population. Other lakes in the Glennallen Area are now being used as egg-take sites for the grayling-stocking program.

The land disposal program conducted by DNR has made large tracts of land in the Glennallen Area available for private ownership. Much of this land borders lakes and streams that support or have the potential to support fish. Retention of land for public recreation and access has become a very important facet of fisheries investigations in the Glennallen Area (Williams and Potterville 1983).

3. <u>Period of use</u>. Grayling fishing takes place throughout the summer months.
4. <u>Harvest methods</u>. In the Gulkana River, most grayling are taken by fishermen floating the river using canoes, rafts, and kayaks (Williams and Potterville 1982). Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs. The lower section of the Gulkana River from the Richardson Highway Bridge downstream to a marker 500 yd downstream of its confluence with the Copper River is a fly-fishing-only water from June 1 through July 31

(ADF&G 1984a). This regulation was passed to protect schooling salmon in that area (Williams 1979) but also affects grayling fishermen.

5. Fishery summary and significant use areas:
   a. Effort and harvest. In 1982, the harvest of grayling from the Gulkana River was 9,150 fish, which is the third highest grayling harvest from locations monitored in Alaska, led only by harvest from the Chena River and Tangle Lakes (Mills 1983). This harvest has increased from 3,360 in 1977 (table 59). Fishermen floating the river between Paxson Lake and Sourdough usually catch the majority of the grayling, though they keep very few of them. The prime grayling fishery is upstream from the mouth of the west fork of the Gulkana (Williams 1979). Float fishermen usually target on grayling, though they also harvest salmon and rainbow trout. From 1978 through 1980, on-site creel census data indicate that an average of 1,070 angler-days were spent by float fishermen each year on the Gulkana. This represents an average of 37% of the total angler-days (estimated by on-site creel census) spent on the Gulkana in those years (Williams 1979; Williams and Potterville 1980, 1981).

      Grayling are also taken from Lakes Louise, Susitna, and Tyone, along with several other Glennallen Area lakes, such as Tolsona, Elbow, Junction, Little Junction, Tex Smith, and Three-mile lakes, and from Mendeltna Creek (ADF&G 1984f). Some small lakes that are very accessible to anglers must be stocked on an annual basis to maintain an acceptable population (Williams and Potterville 1983).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Grayling are, however, popular and easy to catch, and it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on grayling in the Glennallen Area will increase.

C. Prince William Sound (PWS) Area
   1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the PWS Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the PWS Area are similar to those listed for the Glennallen Area.

Table 59. Glennallen Area (Sport Fish Postal Survey Area I) Arctic Grayling Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	4,150	3,462
Gulkana other	---	---	---	---	---	4,999	6,221
Gulkana total	3,355	7,494	8,726	6,776	9,158	9,149	9,683
Klutina River	---	---	---	---	---	---	399
Little Tonsina River	---	---	---	---	---	---	535
Other streams	---	---	---	---	---	---	4,657
Lakes Louise, Susitna, and Tyone	3,557	2,278	2,936	4,477	4,892	3,532	4,217
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	2,169	1,474	4,663	2,781	2,257	4,831	2,004
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	405	651	400	973	518	293	682
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	4,655
Other waters[a]	16,505	14,591	20,507	17,099	16,157	15,781	
Glennallen total	25,991	26,488	37,232	32,106	32,982	33,586	26,832

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

2. Management considerations. No significant grayling harvest from the PWS Area has been reported in the postal survey since it began in 1977. Area biologists, however, report that stocked grayling are harvested in the Cordova area (Williams and Potterville 1983).
3. Period of use. Grayling fishing takes place throughout the summer months.
4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Grayling harvest from the PWS Area is low. Grass Lake and Little Echo Lake near Cordova and Thompson Lake in Thompson Pass near Valdez were stocked with grayling in 1983 (ADF&G 1984h). Grayling are also taken from Pipeline Lake near Cordova, which has been stocked in the past (Williams, pers. comm.; ADF&G 1984h).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. No information was found in the available literature concerning projected increase in demand. Grayling are, however, found in streams along the route of the proposed Copper River Highway, which has been under study since at least 1949 (Williams and Potterville 1983). If the road is ever constructed, it is likely that fishing demand in the area will increase, and some restraints on limits, seasons, and bag limits may be necessary to protect the resource (ibid.).

D. Knik Arm Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Knik Arm Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide diverse recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining the environmental characteristics of the existing and potential recreational fishing waters and obtaining estimates of the sport fish harvest and angler participation rates; 2) evaluating the impact of water use and urban development projects on fisheries, aquatic life, and water quality of lakes and streams in the area; and 3) determining stocking measures (ADF&G 1980).
2. Management considerations. A large part of the fishing effort directed toward grayling in the Knik Arm Drainage Area takes place on stocked lakes. These lakes all have nearby

road access, and several are stocked frequently to maintain the population.

3. Period of use. Grayling fishing takes place throughout the summer; however, grayling are generally most popular in spring and fall, when fisheries for salmon are not active.
4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.
5. Fishery summary and significant use areas:
   a. Effort and harvest. In recent years, a large portion of the grayling harvest in the Knik Arm Drainage Area has been taken from Harriet and Canoe lakes in the Kepler Lakes complex near Palmer (table 60). These lakes are stocked regularly. Long Lake, which is also in the Kepler Lakes complex, was also stocked in 1981, 1983, and 1984. Other lakes containing grayling in the Knik Arm Drainage Area are Meirs Lake near Palmer, Seventeen Mile Lake near Sutton, Long Lake at mile 86 on the Glenn Highway, and Lower Bonnie Lake at mile 83 of the Glenn Highway.
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Grayling are, however, popular and easy to catch, and it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on grayling in the Knik Arm Drainage Area will increase. In a 1977 questionnaire regarding Cook Inlet basin stocked lakes, 11% of the respondents said they preferred to fish for grayling rather than for rainbow trout or land-locked coho salmon (Watsjold 1978).

E. Anchorage Area
1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Anchorage Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the Anchorage Area are similar to those listed for the Knik Arm Drainage Area. Much of the emphasis in the Anchorage Area is on determining stocking measures for area lakes.
2. Management considerations. Grayling were stocked in several Anchorage Area lakes in the late 1960's and early 1970's. It was hoped that if the stocked catchable rainbow trout were removed rapidly by the intense fishery, the grayling might survive in high enough numbers to provide an alternate fishery within the same lake (Redick 1970). These stockings,

Table 60. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Arctic Grayling Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	0
Little Susitna River	190	54	36	181	153	388	199
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	0	0	0	0	0	0	0
Cottonwood Creek	---	---	0	0	0	0	0
Other streams	---	---	---	---	---	---	398
Wasilla Lake	---	---	0	0	0	0	0
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	72	985	2,372	1,016	671	1,027	514
Lucille Lake	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0
Nancy Lake Rec. Area, including Nancy Lake	0	0	0	0	0	0	0
Other lakes	---	---	---	---	---	---	3,314
Others[a]	3,654	1,374	5,963	8,317	6,572	1,509	
Freshwater total	3,916	2,413	8,371	9,514	7,396	2,924	4,425
Grand total							4,425

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

however, did not result in self-sustaining populations, and harvest from the Anchorage Area is now negligible.

3. Period of use. Grayling fishing takes place throughout the summer.
4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Grayling harvest in the Anchorage Area is very low (table 61). A small harvest had been reported from Mirror Lake in 1977 and in 1979-1981, but none were taken in 1982 (table 61). Mirror Lake was last stocked in 1978 (ADF&G, 1984h).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Any increase in grayling fishing in the Anchorage Area will be contingent upon changes in the lake-stocking program that would result in grayling once again being stocked in Anchorage Area lakes.

F. East Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the East Side Susitna Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide diverse recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.
2. Management considerations. A significant management consideration for many East Side Susitna Drainage Area streams is the lack of sufficient public access to fishing areas (ADF&G 1984c). Access problems are discussed in more detail in section I.5.b. of this narrative. As the Susitna River basin continues to develop, grayling populations in currently remote areas may be subject to increased fishing pressure. The congregation of larger grayling at the mouths of only a few streams on the Susitna River between the Chulitna River confluence and Devil Canyon makes them vulnerable to overfishing (Sundet and Wenger 1984). Local residents have stated that fishing for grayling has deteriorated since 1970 because of increased fishing pressure (ibid.).

   In the area above Devil Canyon, increased sportfishing pressure caused by increased access to remote drainages as the access and transmission corridors for the proposed dam are developed could also result in overharvest of grayling (Sautner and Stratton 1984). Population modeling indicates that, because of the slow growth and development of grayling in the upper Susitna basin, even a small, increase in sport

Table 61. Anchorage Area (Sport Fish Postal Survey Area L) Arctic Grayling Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	0
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	187	0	9	77	48	0	0
Otter Lake	0	0	0	0	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	0	0	0	0
Sixmile Lake	0	0	0	0	0	0	0
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	0	0	0	0
Triangle Lake	---	---	---	0	0	0	0
C Street Lake	---	---	---	0	0	0	0
Beach Lake	---	---	---	0	0	0	0
Fish Lake	---	---	---	0	0	0	0
Cheny Lake	---	---	---	0	0	0	0
Other lakes	---	---	---	---	---	---	0
Eagle River	0	0	0	0	0	0	0
Ship Creek	0	0	0	0	0	0	0
Bird Creek	0	0	0	0	0	0	0
Twentymile River	0	0	0	0	0	0	0
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Others[a]	0	0	9	0	67	210	0
Freshwater total	187	0	18	77	115	210	
Grand total	---	---	---	---	---	---	0

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, the "others" category not divided between lakes and streams.

harvest would rapidly remove the large fish and decrease the density of grayling in the upper Susitna (Schmidt and Stratton 1984).

3. Period of use. Grayling fishing takes place throughout the summer. Watsjold (1980) noted that during the chinook salmon season at Chunilna (Clear) Creek, anglers who were not successful fishing for chinook often switched to fishing for other species, such as grayling. In 1979, approximately 260 grayling were taken from Chunilna (Clear) Creek during the chinook salmon season (ibid.), which is approximately 25% of the total harvest of grayling from Chunilna (Clear) Creek that year. It seems likely that anglers at other creeks also harvest grayling during salmon season when they are not successful in harvesting salmon.
4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Sportfishing for grayling in the Susitna River drainage occurs primarily around the mounths of clearwater tributaries (Sundet and Wenger 1984). Generally, the largest harvests of grayling in the East Side Susitna Drainage Area are taken from Willow Creek, Chunilna (Clear) Creek, and Montana Creek, which from 1977 through 1982 had average annual harvests of 1,320, 750, and 950 grayling, respectively (table 62). Good grayling fishing is also available in Caswell Creek, Sheep Creek, Honolulu Creek, and Troublesome Creek (ADF&G 1984g).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Grayling are, however, popular and easy to catch, and it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on grayling in the East Side Susitna Drainage Area will continue to increase.

G. West Side Cook Inlet-West Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the west-side area and throughout the state is to optimize the survival and growth of resident fish and to provide recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.

Table 62. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Arctic Grayling Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	1,483	208	1,654	1,863	1,188	1,520	1,794
Caswell Creek	---	---	345	353	144	252	315
Montana Creek	379	958	791	655	891	849	336
Sunshine Creek	---	---	0	0	57	42	31
Clear (Chunilna) Creek	486	859	1,045	1,348	996	943	1,553
Sheep Creek	317	461	645	725	872	723	839
Little Willow Creek	934	334	1,091	1,156	623	377	84
Kashwitna River	---	---	---	---	---	---	514
Other streams	---	---	---	---	---	---	1,625
Lakes	---	---	---	---	---	---	387
Others[a]	3,870	3,770	4,918	4,854	7,089	5,041	
Total	7,469	6,590	10,489	10,954	11,860	9,747	7,498

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

2. Management considerations. Many popular fishing streams in the west-side area are accessible only by boat or small plane; however, a few popular grayling streams can be reached from the road system. More information on access to west-side streams is given in section I.E.6. of this narrative.
3. Period of use. Grayling fishing takes place throughout the summer months. Many grayling are probably taken during the salmon sport harvest season by anglers who are not successful in harvesting salmon.
4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.
5. Fishery summary and significant use areas
   a. Effort and harvest. Generally, the largest harvests of grayling in the west-side area are taken from Lake Creek, Alexander Creek, and the Deshka River, which from 1977 through 1982 had average annual harvests of 1,870, 1,130, and 1,200 grayling, respectively (table 63). The Talachulitna River, which is popular with fishermen who float the river from Judd Lake to its confluence with the Skwentna, also provides a large harvest of grayling. Grayling harvest from the Talachulitna averaged 729 fish annually from 1977 through 1982. Many grayling caught on the Talachulitna are released, so harvest values do not necessarily reflect the extent of use of this area. In a 1974 creel census of the Talachulitna, it was found that 66% of the grayling caught were released (Kubik and Chlupach 1975). In 1975, 34% of the grayling caught were released (Kubik and Riis 1976).

      The East and Middle forks of the Chulitna River, which are crossed by the Parks Highway, and Moose Creek, which can be reached by the Petersville Road, are easily accessible grayling streams in the west-side area.
   b. Significant use areas. A series of maps at 1:250,000 scale have produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Grayling are, however, popular and easy to catch, and it is likely, that if the population of Southcentral Alaska continues to grow, fishing pressure on grayling in the west-side area will increase.

H. Kenai Peninsula Area
1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Kenai Peninsula Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish

Table 63. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Arctic Grayling Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	0	0	0
Shoreline	---	---	0	0	0	0	0
Total	---	---	0	0	0	0	0
Deshka River	631	579	1,463	1,817	1,255	1,457	1,280
Lake Creek	1,599	2,115	1,963	1,972	1,600	1,955	2,224
Alexander Creek	280	1,871	745	1,145	1,130	1,582	483
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	832	99	664	1,713	479	587	3,178
Chuit River	0	0	0	0	0	0	0
Theodore River	0	0	0	0	0	0	10
Lewis River	0	0	0	0	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	619	1,953	3,691	1,808	546	734	1,782
Shell Lake	0	0	0	0	a	0	0
Whiskey Lake	0	0	0	0	a	0	---
Hewitt Lake	0	0	0	0	a	0	---
Judd Lake	45	0	45	232	a	---	21
Other lakes	408	108	518	560	240[a]	210	346
Freshwater total	---	---	9,089	9,247	5,250	6,525	9,324
Grand total	4,414	6,725	9,089	9,247	5,250	6,525	9,324

Source: Mills 1979-84.

--- means no data were available.

a All lakes were reported together in 1981.

investigations in the area are 1) determination of the environmental characteristics of waters of the Kenai Peninsula, 2) evaluation of existing and/or potential fisheries, 3) evaluation of fishery rehabilitation measures and availability of sport fish egg sources, 4) investigation of land access, 5) evaluation and recommendations regarding enhancement projects, and 6) providing recommendations for the management of sport fish resources and directing the course of future studies (ADF&G 1980, Wallis and Hammarstrom 1983).

2. Management considerations. Arctic grayling are not native to the Kenai Peninsula; however, stocking efforts begun by the USFWS at Crescent Lake in 1952 have resulted in a few self-sustaining populations in streams of the Kenai and Granite Creek drainages (ADF&G 1978b, Nelson 1983). Lakes containing self-sustaining populations are remote, with access only by trail or float plane (ADF&G 1978b). Attempts have been made to establish harvestable populations in Bernice, Grewink, Seldovia, Iceberg, and Hazel lakes, which are more readily accessible (Wallis and Hammarstrom 1979; Logan, pers. comm.). None of these stocking or transplant efforts, however, has resulted in self-sustaining populations (Wallis and Hammarstrom 1979).

   Because of ever-increasing demand for recreational angling, increasing population, and recent legislative, and court decisions regarding land disposition, the problems of public access on the Kenai Peninsula have become acute. As a result, there is a need for the development of new sport fisheries in this area (ADF&G 1980).

3. Period of use. Grayling fisheries take place throughout the summer months. Crescent Creek and Lake are closed to fishing from April 15 through June 30 (ADF&G 1984a). Crescent Lake grayling congregate to spawn at the lake outlet during this time and are especially susceptible to overharvest (Engel 1973).

4. Harvest methods. Grayling can be taken with artificial lures, such as flies and spinners, as well as with salmon eggs.

5. Fishery summary and significant use areas:
   a. Effort and harvest. Grayling harvest on the Kenai Peninsula takes place at Crescent Lake and at lakes with more recently introduced populations such as South Fuller (Lower Fuller), Grayling Lake, Bench Lake, and upper and lower Paradise lakes. A few grayling are also taken each year at the confluence of the Russian and Kenai rivers (table 64) (Nelson 1983). At Crescent Lake, most of the fishing effort is concentrated along a 200 yd portion of Crescent Creek immediately below the

Table 64. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Arctic Grayling Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other salt water	0	0	0	0	0	0	0
Saltwater total	0	0	0	0	0	0	0
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	0	0	0
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	0	0
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	0	10	63
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	65	178	126
Kenai River total	187	90	127	17	65	188	189
Anchor River	0	0	0	0	0	0	0
Ninilchik River	0	0	0	0	0	0	0
Deep Creek	0	0	0	0	0	0	0
Stariski Creek	0	0	0	0	0	0	0
Russian River	37	18	9	69	119	34	10
Kasilof River					0	0	0
Swanson River	---	---	---	---	---	---	0
Other rivers	317	118	173	852	119	189	178
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	1,046	2,061	1,209	1,188	1,588	1,792	1,267
Freshwater total	1,587	2,287	1,518	2,126	1,891	2,203	1,644
Grand total	1,587	2,287	1,518	2,126	1,891	2,203	1,644

Source: Mills 1979-84.

--- means no data were available.

lake and along the shores of the lake near the outlet (Engel 1973).

   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. These maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Grayling are, however, popular and easy to catch, and it is likely, that if the population of Southcentral Alaska continues to grow, fishing pressure on grayling in the Kenai Peninsula Area will continue to increase.

IV. DOLLY VARDEN/ARCTIC CHAR

A. Regional Summary

Dolly Varden and arctic char are two closely related salmonids of the subfamily Salmoniae. Because of their similarilities they will be discussed jointly and referred to as char.

Char harvests are reported from all postal survey areas in the Southcentral Region. The largest char harvest is taken from the Kenai Peninsula Area, with an average of 61,530 char taken from that area annually from 1977 through 1982. The Kenai Peninsula char harvest contributed an average of 66% of the total Southcentral Region char harvest from 1977 through 1982. The second largest char harvest is taken from the Knik Arm Drainage Area, with an average annual harvest from 1977 through 1982 of 10,770, char or 12% of the Southcentral Region harvest. The total annual Southcentral Region char harvest averaged 92,170 fish from 1977 through 1982.

B. Glennallen Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Glennallen Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining angler participation and harvest in key fisheries; 2) cataloging and inventorying water bodies in the area to develop new fisheries and monitor existing ones, especially those that are maintained by stocking; 3) monitoring construction projects to prevent losses of fish and fish habitat, and recommending mitigating measures when necessary; and 4) conducting life history studies of various fishes, especially in highly exploited fisheries (ADF&G 1980).

2. Management considerations. The annual harvest of char from the Glennallen Area since 1977 has ranged from 835 in 1980 to 2,452 fish in 1981 (table 65). This is a relatively small sport fishery, which has not justified a large amount of population research or required any intense management.

Table 65. Glennallen Area (Sport Fish Postal Survey Area I) Char Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	0	0
Gulkana other	---	---	---	---	---	0	0
Gulkana total	0	0	0	0	0	0	0
Klutina River	---	---	---	---	---	---	1,039
Little Tonsina River	---	---	---	---	---	---	1,227
Other streams	---	---	---	---	---	---	1,446
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	797
Other waters[a]	2,251	904	5,890	835	2,452	2,148	
Glennallen total	2,251	904	5,890	835	2,452	2,148	4,509

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided between lakes and streams.

3. Period of use. Most char in the Glennallen Area are taken incidentally during fisheries for salmon (ADF&G 1977a); however, char can be harvested throughout the year.
4. Harvest methods. Char can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Very little information could be found on significant char harvest locations in the Glennallen Area. A creel census conducted in 1976 on the little Tonsina River, which crosses the Richardson Highway near pump station 12, documents a sport catch of 771 char. This census began June 16 and concluded September 30 (ibid.). Klutina Lake Outlet and some tributary streams to the Copper River also occasionally produce sport catches of char (ibid.).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with the report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. No information on projected increase in demand in the Glennallen Area could be found in the available literature.

C. Prince William Sound (PWS) Area
1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the PWS Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the PWS Area are similar to those listed for the Glennallen Area.
2. Management considerations. The annual harvest of char in the PWS Area from 1977 through 1982 averaged 6,470 fish (table 66). Char are taken throughout the PWS Area; however, overall effort levels are low, and most of the harvest is incidental to the salmon fisheries (ADF&G 1978a).
3. Period of use. Char can be taken throughout the year; however, most char in the PWS Area are taken incidentally during fisheries for salmon (ibid.).
4. Harvest methods. Char can be taken by rod and reel in fresh and marine waters and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. In the Cordova area, large harvests of char are taken from the Eyak River, with annual harvests from 1977 through 1982 ranging from 850 char in 1977 to 3,060 in 1980 (table 66). The Eyak River, however, is now collecting silty, glacial water from a meander of the Scott River, and sportfishing in this once clear water stream is declining. Char are also taken in marine waters in the Cordova area and in the Bering River, McKinley and Martin lakes, and lakes along

Table 66. Prince William Sound Area (Sport Fish Postal Survey Area J) Char Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Valdez Bay	594	877	691	1,128	97	356	262
Passage Canal	---	---	191	26	0	63	42
Other boat	---	---	---	---	---	---	21
Other shoreline	---	---	---	---	---	---	493
Other salt water[a]	---	---	464	250	162	210	
Saltwater total	---	---	1,346	1,404	259	629	818
Eyak River	854	866	2,863	3,057	1,577	2,348	430
Eshamy Cr. & Lagoon	b	f	0	172	162	0	0
Coghill River	b	389[g]	9	164	227	52	0
Shrode Creek	---	---	145	112	130	0	251
Pigot R. drainage	91[c]	145[c]	82	---	---	---	---
Copper River	---	---	---	---	---	---	0
Other streams	---	---	3,009	2,514	1,912	2,547	2,664
Eshamy Lake	56[b]	181[f]	273	69	22	0	63
Shrode Lake	34[d]	118[d]	136	0	54	---	---
Other lakes	---	---	1,654	594	875	660	471
Freshwater total	---	---	8,171	6,682	4,959	5,607	3,879
Others[e]	4,673	886					
Grand total	6,302	3,462	9,517	8,086	5,218	6,236	4,697

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, and Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

the Lake Elsner USFS trail (ADF&G, unpubl. data; USFS n.d.).

Char are taken from marine waters in the Valdez area and from the Robe River and Lake, the Lowe River (ADF&G, unpubl. data), Tsaina Lake, and the Tiekel River (Williams, pers. comm.). Char are also taken in several western PWS streams where harvest of salmon also occurs.

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. A significant increase in sport- fishing effort in the Cordova area is not anticipated until access to and within the area improves (Williams and Potterville 1983). It is, however, expected that Valdez will continue to grow and become more industrialized in the future, and demands on the resources of the Valdez area fishery will probably increase. The western PWS boat fishery, which originates from Whittier, is currently limited by access and the availability of boat slips in Whittier (PWS Regional Fisheries Planning Team 1983); however, development of the small-boat marina and recreational housing has recently resulted in an expansion of sportfishing effort (ADF&G 1980). It is anticipated that the Whittier area and western PWS will become a major sportfishing area for Anchorage area residents (ibid.).

D. Knik Arm Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Knik Arm Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide diverse recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining the environmental characteristics of the existing and potential recreational fishing waters and obtaining estimates of the sport fish harvest and angler participation rates; 2) evaluating the impact of water use and urban development projects on fisheries, aquatic life, and water quality of lakes and streams in the area; and 4) determing stocking measures (ADF&G 1980).

2. Management considerations. The Knik Arm Drainage Area char harvest has steadily increased from 7,540 fish in 1977 to 13,540 in 1982 (table 67). Many char are taken incidentally by salmon fishermen (ADF&G 1977b).

3. Period of use. Char are harvested throughout the year.

4. Harvest methods. Char can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.

Table 67. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Char Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	21
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	21
Little Susitna River	645	570	1,191	1,748	2,529	1,331	1,227
Knik River & tributaries, including Jim Creek	---	---	---	---	1,130	1,279	1,310
Wasilla Creek (Rabbit Slough)	328	325	364	189	690	1,289	1,290
Cottonwood Creek	---	---	191	439	67	10	157
Other streams	---	---	---	---	---	---	1,531
Wasilla Lake	---	---	264	181	38	63	167
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	0	0	0	0	0	0	0
Lucille Lake	0	0	0	0	0	0	0
Big Lake	4,953	5,433	4,227	7,585	7,741	8,793	6,126
Nancy Lake Rec. Area, including Nancy Lake	277	18	118	327	345	272	1,154
Other lakes	---	---	---	---	---	---	408
Others[a]	1,338	1,636	2,227	2,015	1,935	503	
Freshwater total	7,541	7,982	8,582	12,484	14,475	13,540	13,370
Grand total							13,391

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

5. Fishery summary and significant use areas:
   a. Effort and harvest. Big Lake, north of Wasilla, supports an active winter fishery for char (ADF&G 1977b). The char harvest from Big Lake has increased from 4,950 in 1977 to 8,790 in 1982 and has contributed an average of 60% of the Knik Arm Drainage char harvest (table 67). Char are also taken from the Little Susitna River, Wasilla Creek, and the Knik River and its tributaries. In the Little Susitna River, most char harvest takes place in the headwater reaches (Engel, pers.comm.).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; however, it is likely that if the population of Southcentral Alaska continues to grow, char in the Knik Arm Drainage Are will be subject to increases in fishing pressure.

E. Anchorage Area
1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Anchorage Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the Anchorage Are are similar to those listed for the Knik Arm Drainage Area. Much of the emphasis in the Anchorage Area is on determining stocking measures for area lakes.
2. Management considerations. Nearly all char harvest from the Anchorage Area is taken from rivers. The Anchorage Area harvest is relatively small, averaging 3,930 fish from 1977 through 1982, and has to date not justified a large amount of population research or required any intense management.
3. Period of use. Char can be harvested throughout the year; however, since most char in the Anchorage Area are taken from rivers, this is probably mainly a summer fishery.
4. Harvest methods. Char can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. The largest harvests of char from the Anchorage Area generally are taken from Eagle River, which has had an average annual harvest of 1,140 char from 1977 through 1982. Large harvests are also taken from the Twentymile River and smaller harvests from Ship Creek and Bird Creek (table 68). Char are also taken from Portage Creek, Campbell Creek, Peters Creek and Rabbit Creek (ADF&G, unpubl. data).

Table 68. Anchorage Area (Sport Fish Postal Survey Area L) Char Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	10
Jewel Lake	0	0	0	0	0	0	0
Campbell Point Lake	0	0	0	0	0	0	0
Sand Lake	0	0	0	0	0	0	0
Lower Fire Lake	0	0	0	0	0	0	0
Mirror Lake	0	0	0	0	0	0	0
Otter Lake	0	43	45	86	0	0	0
Clunie Lake	0	0	0	0	0	0	0
Gwen Lake	0	0	0	0	0	0	0
Sixmile Lake	0	0	0	0	0	0	0
Green Lake	0	0	0	0	0	0	0
Hillberg Lake	0	0	0	0	0	0	0
Triangle Lake	---	---	---	0	0	0	0
C Street Lake	---	---	---	0	0	0	0
Beach Lake	---	---	---	0	0	0	0
Fish Lake	---	---	---	0	0	0	0
Cheny Lake	---	---	---	0	0	0	0
Other lakes	---	---	---	---	---	---	315
Eagle River	868	1,357	1,300	818	1,245	1,247	1,269
Ship Creek	249	689	754	275	441	210	168
Bird Creek	676	689	300	207	125	105	220
Twentymile River	945	1,055	473	413	1,610	472	294
Campbell Creek	---	---	---	---	---	---	31
Other streams	---	---	---	---	---	---	577
Others[a]	1,302	431	891	1,808	1,581	859	
Freshwater total	4,040	4,264	3,763	3,607	5,002	2,893	2,874
Grand total	---	---	---	---	---	---	2,884

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, the "others" category was not divided between lakes and streams.

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. No information on projected increase in demand could be found in the available literature; however, it is likely that, if the population of Anchorage continues to grow, the fishing pressure on area streams will increase.

F. East Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the East Side Susitna Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.

2. Management considerations. Char harvest in the East Side Susitna Drainage Area has averaged 3,610 fish annually from 1977 through 1982 (table 69). The majority of char in this area are taken in conjunction with various salmon fisheries (ADF&G 1978b).

   Large char are found in a few lake and stream systems in the Susitna River basin above Devil Canyon in areas that may be affected by increased sportfishing pressure as the access and transmission corridors for the proposed dam are developed. These char are readily caught by hook and line and may provide a recreational sport fishery (Sautner and Stratton 1984). Special consideration, however, may need to be given to these large char because they are not widely distributed and little is known about their life history (ibid.).

3. Period of use. Char can be harvested throughout the year.

4. Harvest methods. Char can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.

5. Fishery summary and significant use areas:

   a. Effort and harvest. The largest harvests of char from the East Side Susitna Drainage Area are usually taken from Chunilna (Clear) Creek. Chunilna (Clear) Creek char harvest has ranged from 379 fish in 1977 to 1,817 in 1978. In 1979, 794 char were taken from Chunilna (Clear) Creek during the chinook season (Watsjold 1980), which is approximately 96% of the total harvest of char from Chunilna (Clear) Creek that year. Large char harvests are also taken from Willow, Montana, Sheep, and Little Willow creeks.

   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.

Table 69. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Char Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Willow Creek	863	280	618	636	249	262	336
Caswell Creek	---	---	91	83	38	73	157
Montana Creek	300	633	527	167	240	356	325
Sunshine Creek	---	---	264	39	10	42	84
Clear (Chunilna) Creek	379	1,817	827	751	1,418	1,069	1,962
Sheep Creek	94	108	127	83	57	409	52
Little Willow Creek	139	63	336	122	48	189	73
Kashwitna River	---	---	---	---	---	---	304
Other streams	---	---	---	---	---	---	786
Lakes	---	---	---	---	---	---	126
Others[a]	951	2,739	909	790	814	1,666	
Total	2,726	5,640	3,699	2,671	2,874	4,066	4,205

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

G. West Side Cook Inlet-West Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the west-side area and throughout the state is to optimize the survival and growth of resident fish and to provide recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.
2. Management considerations. Char harvest in the West Side Susitna Drainage Area has averaged 3,450 char annually from 1977 through 1982 (table 70). This is a relatively small harvest when compared to the number of salmon taken from the area and has to date not justified a large amount of population research or required any intense management.
3. Period of use. Char can be harvested throughout the year.
4. Harvest methods. Char can be taken by rod and reel during ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Char harvest from west-side streams has fluctuated a great deal since 1977 (table 70). Harvests of over 100 char are frequently taken from Lake Creek, Alexander Creek, the Chuitna (Chuit) River, the Theodore River, and Judd Lake. In 1973, Kubik and Trent (1974) noted that the Talachulitna River and Coal Creek, which drain into Beluga Lake, both contained excellent sport fisheries for char. The harvest of char in the Talachulitna reached 980 fish in 1980 but plumetted to only about 10 fish in 1981.
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report. The maps depict sportfishing areas for marine, anadromous, and selected freshwater fish.
6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. It is likely, however, that, if the the population of Southcentral Alaska continues to grow, fishing pressure on char in the west-side area will increase.

H. Kenai Peninsula Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Kenai Peninsula Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are 1) determination of environmental characteristics of waters of the Kenai Peninsula; 2) evaluation of existing and/or potential fisheries; 3) evaluation of fishery rehabilitation measures and availability of sport fish egg take sources; 4) investigation of land access; 5) evaluation and recommendations regarding

Table 70. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Char Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	173	0	57	0	42
Shoreline	---	---	209	0	19	0	0
Total	---	---	382	0	76	0	42
Deshka River	0	0	0	0	10	0	0
Lake Creek	122	154	164	121	67	482	262
Alexander Creek	53	136	182	353	287	42	136
Polly Creek	---	---	---	---	0	31	73
Talachulitna River	252	235	155	982	10	31	105
Chuit River	671	461	664	146	843	304	209
Theodore River	181	353	173	129	115	0	21
Lewis River	0	27	9	0	---	---	---
Kustatan River	---	---	---	---	---	---	136
Silver Salmon Creek	---	---	---	---	---	---	42
Other rivers	1,279	1,220	2,872	603	1,130	440	596
Shell Lake	0	0	0	0	a	0	0
Whiskey Lake	0	0	0	0	a	0	---
Hewitt Lake	0	0	0	0	a	0	---
Judd Lake	195	371	573	723	a	---	252
Other lakes	345	551	645	43	499[a]	818	1,049
Freshwater total	---	---	5,437	3,100	2,961	2,148	2,881
Grand total	3,098	3,508	5,819	3,100	3,037	2,148	2,923

Source: Mills 1979-84.

--- means no data were available.

a All lakes reported together in 1981.

enhancement projects; and 6) providing recommendations for the management of sport fish resources and directing the course of future studies (ADF&G 1980, Wallis and Hammarstrom 1983).

2. Management considerations. Kenai Peninsula rivers support the largest char fisheries in Southcentral Alaska. Char harvest from the Kenai Peninsula Area has ranged from 36,100 in 1977 to 80,520 in 1981 (table 71). Char are frequently taken incidentally during the sport fisheries for salmon; however, directed fisheries for char also take place on the Kenai Peninsula. Increased angler effort on streams that support native populations of char have made it imperative that the ADF&G obtain more complete information on run size and harvest levels in these streams in order to provide a basis for proper management (ADF&G 1980).
3. Period of use. Char harvest takes place throughout the year. In the Anchor River, harvest of sea-run char begins in about mid July, and the major effort from mid July to about mid August on this stream is directed toward char (Wallis and Hammarstrom 1979). The population of larger, spawning char shows up in early October and is harvested until the stream freezes (ibid.).
4. Harvest methods. Char can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Char are the object of a major sport fishery on the Kenai Peninsula, with large harvests being taken from many streams and lakes and from marine waters. The largest char harvests are usually taken from the Kenai River and the Anchor River, with average annual char harvests from 1977 through 1982 of 22,900 and 14,090 respectively (table 71). A large number of the char in the Kenai River are taken incidentally during the salmon harvest. Char are also harvested from the Russian River. Data indicate that anglers are seeking char prior to and after the sockeye salmon fishery in this stream (Nelson 1982).

      The Anchor River, which is one of the most popular fishing streams on the Kenai Peninsula, supports a good population of anadromous char, the target of many sport anglers. In 1980, it was noted that char harvested in the Anchor River during the early fishery from mid July to mid September are bright silver and obviously fresh from salt water. Many of these are small and are released. During the late fishery, from mid September to mid November, the char are larger and are brightly colored and sexually mature (Hammarstrom 1981a). Other streams south of the Kenai River, including Deep Creek, the Ninilchik River, and Stariski Creek, also produce

Table 71. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Char Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	603	325	382	164	313	526	493
Resurrection Bay	1,720	1,248	973	878	5,335	1,562	5,811
Kachemak Bay	3,676	2,007	2,018	3,685	3,434	2,862	3,053
Other salt water[a]	461	859	1,200	232	778	744	
Other boat	---	---	---	---	---	---	388
Other shoreline	---	---	---	---	---	---	556
Saltwater total	6,460	4,439	4,573	4,959	9,860	5,694	10,301
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	9,590	3,605	6,756
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	3,510	1,970	3,084
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	10,886	5,617	10,710
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	10,876	5,292	9,556
Kenai River total	7,423	17,140	34,687	26,794	34,862	16,484	30,106
Anchor River	9,222	17,357	21,364	10,948	15,271	10,375	17,277
Ninilchik River	424	1,003	2,390	853	875	514	199
Deep Creek	1,330	3,046	2,027	1,028	1,382	1,247	1,112
Stariski Creek	461	1,012	2,027	327	875	348	283
Russian River	914	2,558	3,718	2,256	2,905	1,730	587
Kasilof River	---	---	---	---	2,106	734	325
Swanson River	---	---	---	---	---	---	63
Other rivers	3,754	4,475	8,935	7,723	4,838	3,563	10,583
Hidden Lake	280	63	45	439	302	136	231
Canoe Lake system	1,086	1,157	445	1,300	1,112	1,153	2,906
Other lakes	4,749	4,330	6,490	7,937	6,134	2,725	7,457
Freshwater total	29,643	52,141	82,128	59,605	70,662	39,009	71,129
Grand total	36,103	56,580	86,701	64,564	80,522	44,703	81,430

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

good harvests of char (table 71). Char can also be taken from Salmon Creek near Seward (ADF&G 1984f).

Char are taken from several lakes on the Kenai Peninsula, including Jerome Lake, Summit Lake, Grouse Lake, and lakes in the Canoe Lakes system (ADF&G 1984f, 1984g). Lake fisheries for char take place in the summer and through the ice in winter. Some lakes, such as the Summit Lakes, contain populations of small, nonanadromous char, commonly known as golden-fins (Logan, pers. comm.).

Char are also harvested from marine waters of Resurrection and Kachemak bays. Char are harvested from shore or from boats. Fishing for char off the end of Homer Spit is especially popular. The saltwater char harvest from the Kenai Peninsula Area has averaged 6,000 fish from 1977 through 1982 (table 71).

6. Projected increase in demand. Little information could be found in the available literature concerning projected increase in demand for char on the Kenai Peninsula; however, it is likely that, if the population of Anchorage continues to grow, the fishing pressure on area lakes and streams will increase.

V. RAINBOW TROUT/STEELHEAD

A. Regional Summary

Rainbow trout harvests are reported from all postal survey areas in the Southcentral Region, though the PWS Area annual harvest is very small (less than 500 fish). Steelhead are harvested only from the Kenai Peninsula Area and the Glennallen Area, with the Kenai Peninsula harvest being by far the larger of the two. In 1977 through 1982, the average annual rainbow trout harvest from the Southcentral Region was 116,390 fish. The annual steelhead harvest averaged 1,560 fish. The largest rainbow trout harvests are taken from the Anchorage Area, the Knik Arm Drainage Area, and the Kenai Peninsula Area.

A large number of the rainbow trout harvested in the Southcentral Area are the result of the lake-stocking program carried out by the ADF&G. Studies designed to provide information for development of improved lake-stocking practices were initiated in 1973. These studies have been conducted mainly on selected Matanuska-Susitna Valley lakes. There are two long-range goals of the project: 1) to develop a lake-stocking manual with guidelines for determining optimum sizes, densities, times, species, and strains of fish for various lake types to achieve maximum survival, growth, and harvest potential; and 2) to develop equipment to efficiently sample stocked fish populations, with minimum detriment to harvestable stocks (Havens 1983).

A phase of the lake study program involved the selection of rainbow trout brood stock well suited for use in Alaska. Based on the data collected during this project and related hatchery observations, a strain of rainbow trout from the Swanson River on the Kenai Peninsula was selected as brood stock to be used for the lake-stocking program (Havens 1980). The Swanson strain had a significantly greater survival under all natural lake conditions examined than the other two strains examined (Havens 1983).

B. Glennallen Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Glennallen Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining angler participation and harvest in key fisheries; 2) cataloging and inventorying water bodies in the area to develop new fisheries and monitor existing ones, especially those that are maintained by stocking; 3) monitoring construction projects to prevent losses of fish and fish habitat and recommending mitigating measures when necessary; and 4) conducting life history studies of various fish, especially in highly exploited fisheries (ADF&G 1980).

2. Management considerations. Native stocks of rainbow trout in the Glennallen Area are reached primarily by fly-in and float fishermen. Stocked lakes, with rainbow trout fisheries that are usually managed on a put-and-take basis, are located within easy access from roads and receive a considerable amount of effort from sport fishermen in the Glennallen Area (ADF&G 1977a).

   The land disposal program conducted by the DNR has made large tracts of land in the Glennallen Area available for private ownership. Much of this land borders lakes and streams, which support or have the potential to support fish. Retention of land for public recreation and access has become a very important facet of fisheries investigations in the Glennallen Area (Williams and Potterville 1983).

3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in the spring and fall, when rainbow trout in lakes are actively feeding near the surface and those in streams are migrating to spawning or overwintering areas. Steelhead are available in the fall, when they enter the Copper River system, and in early summer, when they may be taken incidentally during the sport salmon fishery as they out-migrate (ADF&G 1977a).

4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter. Steelhead are taken by rod and reel.

   The lower section of the Gulkana River from the Richardson Highway Bridge downstream to a marker 500 yd downstream of its confluence with the Copper River is a fly-fishing-only water from June 1 through July 31 (ADF&G 1984a). This regulation was passed to protect schooling salmon in that area (Williams 1979) but also affects rainbow trout fishermen.

5. Fishery summary and significant use areas:

   a. Effort and harvest. The largest harvest of rainbow trout in the Glennallen Area is usually taken from the Gulkana River. Gulkana River harvests from 1977 through 1982 averaged 920 rainbow trout (table 72). On-site creel census data collected from 1975 through 1980 indicate that most of the Gulkana River rainbow trout are taken by anglers floating the river in the upper section from the mouth of Sourdough Creek upstream to the West Fork of the Gulkana River (Williams 1977, 1979; Williams and Potterville 1981). Postal survey data from 1982, however, indicate that in 1982 the majority of the rainbow trout were taken by other fishermen (table 72). Many of the rainbow that are caught are released. In 1979, it was estimated from on-site creel census data that 83% of those caught were released. In 1980, 43% were released (Williams and Potterville 1981). The catch of rainbow trout increased by over 100% in 1978 over 1977 but has remained close to the same level since then. The majority of the 1978 increase was in fish caught in the upper section by float anglers (Williams 1979).

      Rainbow trout are also taken from many lakes in the Glennallen Area. Large harvests are taken from Van (Silver) Lake near Chitina, which is frequently stocked to maintain the population. Other productive rainbow lakes include Mirror, Three-mile, Buffalo, Sculpin, North Jan, and Stelna lakes (ADF&G 1984f, 1984g).

      Only a small steelhead sport fishery exists in the Copper River system (table 73). Steelhead are taken in the Gulkana incidentally to the sport salmon catch (ADF&G 1977a). The Hanagita River supports a fly-in fall steelhead fishery (ibid.).

   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report that depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. Rainbow trout are, however, popular and easy to catch, and it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on rainbow trout in the Glennallen Area will increase.

Table 72. Glennallen Area (Sport Fish Postal Survey Area I) Rainbow Trout Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	272	419
Gulkana other	---	---	---	---	---	692	765
Gulkana total	447	940	982	956	1,253	964	1,184
Klutina River	---	---	---	---	---	---	0
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	135
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	348	461	245	207	540	681	231
Paxson & Summit lakes	305	316	473	293	216	293	157
Strelna Lake	218	190	9	155	119	210	136
Sculpin Lake	25	1,790	318	327	670	---	115
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	460
Other waters[a]	1,465	669	1,345	1,317	2,560	912	
Glennallen total	2,808	4,366	3,372	3,255	5,358	3,060	2,418

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

Table 73. Glennallen Area (Sport Fish Postal Survey Area I) Steelhead Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Gulkana float fishing (Paxson to Sourdough)	---	---	---	---	---	21	0
Gulkana other	---	---	---	---	---	31	21
Gulkana total	0	0	0	0	0	52	
Klutina River	---	---	---	---	---	---	0
Little Tonsina River	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	0
Lakes Louise, Susitna, and Tyone	0	0	0	0	0	0	0
Van (Silver) Lake	0	0	0	0	0	0	0
Paxson & Summit lakes	0	0	0	0	0	0	0
Strelna Lake	0	0	0	0	0	0	0
Sculpin Lake	0	0	0	0	0	---	0
Crosswind Lake	0	0	0	0	0	0	0
Hudson Lake	0	---	0	0	---	---	---
Other lakes	---	---	---	---	---	---	0
Other waters[a]	187	45	55	34	76	21	
Glennallen total	187	45	55	34	76	73	21

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "other" category was not divided bewteen lakes and streams.

C. Prince William Sound (PWS) Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the PWS Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the PWS Area are similar to those listed for the Glennallen Area.
2. Management considerations. Rainbow trout are found in only a few lakes that are stocked by the ADF&G (ADF&G 1978a). Steelhead harvest is not reported from the PWS Area.
3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall, when the rainbow trout in lakes are actively feeding near the surface.
4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Rainbow trout harvest from the PWS Area averaged only 285 fish annually from 1977 through 1979 (table 74). In the Cordova area, rainbow trout are taken from Crater Lake (Williams, pers. comm.), which was stocked with rainbow in 1977 (ADF&G 1984h). Cabin Lake, near Cordova, was stocked in 1983 (ibid.). In the Valdez area, rainbow trout are taken from Blueberry and Worthington lakes in Thompson Pass, both lakes having been stocked in 1983 (ibid.).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report that depict sportfishing areas for marine, anadromous, and selected freshwater fish.

D. Knik Arm Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Knik Arm Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area include 1) determining the environmental characteristics of the existing and potential recreational fishing waters and obtaining estimates of the sportfish harvest and angler participation rates; 2) evaluating the impact of water use and urban development projects on fisheries, aquatic life, and water quality of lakes and streams in the area; and 3) determining stocking measures (ADF&G 1980).
2. Management considerations. Much of the rainbow trout harvest in the Knik Arm Drainage Area is taken from lakes regularly stocked with trout from the state's hatchery program. Lakes within this area exhibit a broad spectrum of environmental

Table 74. Prince William Sound Area (Sport Fish Postal Survey Area J) Rainbow Trout Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Valdez Bay	0	0	0	0	0	0	0
Passage Canal	0	0	0	0	0	0	0
Other boat	---	---	---	---	---	---	0
Other shoreline	---	---	---	---	---	---	0
Other salt water[a]	0	0	0	0	0	0	
Saltwater total	0	0	0	0	0	0	0
Eyak River	0	0	0	0	0	0	0
Eshamy Cr. & Lagoon	b	f	0	0	0	0	0
Coghill River	b	0[g]	0	0	0	0	0
Shrode Creek	---	---	0	0	0	0	0
Pigot R. drainage	0[c]	0[c]	0	---	---	---	---
Copper River	---	---	---	---	---	---	0
Other streams	---	---	18	292	248	52	0
Eshamy Lake	0[b]	0[f]	0	0	0	0	0
Shrode Lake	0[d]	0[d]	0	0	0	---	---
Other lakes	---	---	127	26	54	377	1,185
Freshwater total	---	---	145	318	302	429	1,185
Others[e]	378	136					
Grand total	378	136	145	318	302	429	1,185

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.
b Data for 1977 are under the category, Eshamy Lake and Lagoon, and Coghill River and Lake (Mills 1979).
c Data for 1977 and 1978 are listed as Pigot River, not Pigot River drainage (Mills 1979, 1980a).
d Data for 1977 and 1978 are listed as Lake Shrode, Long Bay (Mills 1979, 1980a).
e In 1977 and 1978, the "others" category was not divided between lakes and streams.
f Data for 1978 are listed as Eshamy Lake and Lagoon (Mills 1980a).
g Data for 1978 are listed as Coghill River and Lake (Mills 1980a).

conditions, ranging from deep and infertile to very shallow and rich in nutrients. The presence or absence of sticklebacks, a potential competitor in each of the lake types, introduces an additional variable (Bentz 1983). In an effort to determine the optimum productive capabilities of each of the various lake types, numerous studies have been conducted on Matanuska-Susitna Valley lakes. Results of these studies have provided information for the statewide stocking program, and they are discussed in more detail in the regional section of this narrative (V.A.).

There is no steelhead harvest in the Knik Arm Drainage Area.

3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall when the rainbow trout in lakes are actively feeding near the surface and those in streams are migrating to spawning or overwintering areas.

   A 1977 questionnaire regarding stocked lakes in the Cook Inlet Basin asked what percentage of fishing time was spent during the winter; 26% of the respondents spent from 10 to 50% of their fishing time in the winter and only 5% spent more than 50% of their fishing time during the winter period (Watsjold 1978).

4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter. In a 1977 creel census of the Kepler Lakes area, it was found that shore fishermen slightly outnumbered boat fishermen. A check of fishing success for boat versus shore fishermen on Kepler and Bradley lakes revealed that boat fishermen had 71% better success than shore fishermen (Watsjold 1978).

5. Fishery summary and significant use areas:

   a. Effort and harvest. The largest harvests of rainbow trout from the Knik Arm Drainage Area are taken from Big Lake, which contains a natural population of rainbow trout, and from stocked lakes in the Kepler Lake complex, (table 75). Results of a 1977 creel census conducted from April 30 to September 5 at the Kepler Lakes complex showed that the largest number of angler-days were spent on Matanuska and Kepler lakes (ibid.). The 1978 creel census at the Kepler Lake complex from June 7 through July 1 showed that in that year Echo, Matanuska, Kepler, and Long lakes were most popular (Watsjold 1979). Harvest and effort in stocked lakes fluctuates depending on the survival of stocked fish and changes in the stocking program. For instance, the 1977 rainbow trout harvest from the Kepler Lake complex was low because in 1976 rainbow trout from the Swanson River strain were stocked in those lakes. Swanson River rainbow trout grow slowly and so could not

Table 75. Knik Arm Drainage Area (Sport Fish Postal Survey Area K) Rainbow Trout Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Fish Creek area	---	---	---	---	---	---	0
Boat	---	---	---	---	---	---	0
Shoreline	---	---	---	---	---	---	0
Total	---	---	---	---	---	---	0
Little Susitna River	843	886	1,391	852	2,692	1,551	1,290
Knik River & tributaries, including Jim Creek	---	---	---	---	0	0	0
Wasilla Creek (Rabbit Slough)	252	45	500	121	38	63	84
Cottonwood Creek	---	---	1,736	1,085	824	786	556
Other streams	---	---	---	---	---	---	1,490
Wasilla Lake	---	---	2,782	2,084	2,261	2,243	1,804
Finger Lake	0	0	0	0	0	0	0
Kepler Lake complex	1,822	5,180	3,372	5,906	8,200	7,325	3,986
Lucille Lake	0	0	0	0	0	0	0
Big Lake	3,906	4,845	2,882	5,398	9,810	9,369	4,102
Nancy Lake Rec. Area, including Nancy Lk	2,642	1,853	2,909	2,540	4,723	2,840	4,846
Other lakes	---	---	---	---	---	---	8,263
Others[a]	9,150	10,330	9,271	11,382	13,201	6,372	
Freshwater total	18,615	23,139	24,843	29,368	41,749	30,549	26,421
Grand total							26,421

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between streams and lakes.

be stocked until early October 1976 and did not enter the fishery until August of 1977 (Watsjold 1978).

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; however, it is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on rainbow trout in the Knik Arm Drainage Area will increase. In a 1977 questionnaire regarding Cook Inlet Basin stocked lakes, 70% of the respondents said they preferred to fish for rainbow trout rather than for grayling or landlocked coho salmon (ibid.).

   In time, some lakes now considered marginal for stocking because of limnological characteristics, naturally occurring competitor species, or lack of dedicated access will be needed to fulfill angling needs (ADF&G 1980).

E. Anchorage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Anchorage Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives in the Anchorage Area are similar to those listed for the Knik Arm Drainage Area. Much of the emphasis in the Anchorage Area is on determining stocking measures for area lakes.

2. Management considerations. With the exception of smelt, which are taken by dip netters in Turnagain Arm, rainbow trout contribute by far the largest sportfish harvest in the Anchorage Area. The annual harvest of rainbow trout has increased from 17,730 in 1977 to 49,240 in 1982 (table 76). This increase is due to an increase in angler effort (table 5) and to an increase in the number of rainbow trout stocked in Anchorage lakes. Until 1982, several Anchorage lakes were stocked with coho salmon; however, rainbow trout are now almost exclusively stocked in Anchorage lakes. Anchorage Area lakes stocked with rainbow trout are listed in the Rainbow Trout Distribution and Abundance narrative in this volume.

   In 1976, a creel census on four military reservation lakes (Green, Hillberg, Gwen, and Otter lakes) showed an estimated return of trout plants to the angler in each lake of 47% to 79% (Kubik and Wadman 1977). In a 1979 creel census, the average return to the angler of rainbow trout stocked in Fish, Green, Hillberg, and Triangle lakes, all on Elmendorf Air Force Base, was 55% (Kubik and Delaney 1980).

3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall when the rainbow trout in lakes are actively feeding near the surface.

Table 76. Anchorage Area (Sport Fish Postal Survey Area L) Rainbow Trout Sport Harvest, 1977-83

	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water	---	---	---	---	---	---	0
Jewel Lake	1,547	4,523	4,081	5,209	3,305	7,525	8,654
Campbell Point Lake	1,483	1,034	1,618	2,213	4,167	1,320	525
Sand Lake	653	1,960	1,036	2,066	1,638	3,689	692
Lower Fire Lake	1,618	2,111	5,535	4,073	1,456	1,352	2,192
Mirror Lake	176	215	164	0	0	0	3,797
Otter Lake	3,250	5,385	6,072	5,063	4,474	6,445	2,539
Clunie Lake	1,915	4,696	5,118	6,346	4,167	7,074	5,099
Gwen Lake	512	452	2,109	0	3,363	4,328	3,860
Sixmile Lake	470	344	1,245	0	0	1,499	2,948
Green Lake	1,418	2,348	3,981	3,866	1,935	4,747	3,598
Hillberg Lake	1,194	1,486	1,991	0	2,759	2,162	3,860
Triangle Lake	---	---	---	0	0	1,054	168
C Street Lake	---	---	---	0	0	1,735	493
Beach Lake	---	---	---	0	1,619	1,142	1,238
Fish Lake	---	---	---	0	0	814	451
Cheny Lake	---	---	---	0	0	635	2,413
Other lakes	---	---	---	---	---	---	1,784
Eagle River	292	0	482	585	201	734	283
Ship Creek	257	711	482	620	182	639	63
Bird Creek	0	0	0	0	0	0	0
Twentymile River	0	0	0	0	0	0	0
Campbell Creek	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	21
Others[a]	2,948	5,198	5,345	3,100	1,648	2,348	
Freshwater total	17,733	30,463	39,259	33,141	30,914	49,242	44,678

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, the "others" category was not divided between lakes and streams.

4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter. A few Anchorage anglers have canoes or inflatable rafts; however, most fishing on Anchorage lakes is from shore.
5. Fishery summary and significant use areas:
   a. Effort and harvest. Harvest and effort on Anchorage Area lakes vary depending on the current stocking program. Effort in recent years, however, has tended to be greatest on Jewel, Green, Hillberg, Clunie, and Otter lakes (table 5). Rainbow trout are also taken from Eagle River and Ship Creek, and from Campbell Creek, which was stocked with catchable-size rainbows in 1983 and 1984 (ADF&G 1984h).
   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report that depict sportfishing areas for marine, anadromous, and selected freshwater fish.

F. East Side Susitna Drainage Area
1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the East Side Susitna Drainage Area and throughout the state is to optimize the survival and growth of resident fish and to provide stet recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.
2. Management considerations. A significant management consideration for many East Side Susitna Area streams is the lack of sufficient public access to fishing areas (ADF&G 1984c). Access problems are discussed in more detail in section I.5.b. of this narrative. As the Susitna River basin continues to develop, the rainbow trout population may decline from the increased fishing pressure (Sundet and Wenger 1984).
3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall, when the rainbow trout in lakes are actively feeding near the surface and those in streams are migrating to spawning or overwintering areas.
4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter.
5. Fishery summary and significant use areas:
   a. Effort and harvest. The largest rainbow trout harvests in the East Side Susitna Drainage Area are taken from Willow, Montana, and Chunilna (Clear) creeks, with average annual harvests from 1977 through 1982 of 1,170, 1,280, and 1,020, respectively (table 77). These are popular salmon streams, and it is likely that many of

Table 77. East Side Susitna Drainage Area (Sport Fish Postal Survey Area M) Rainbow Trout Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Willow Creek	1,055	913	1,500	1,168	1,475	891	1,689
Caswell Creek	---	---	282	154	326	189	231
Montana Creek	727	1,193	1,536	854	1,111	2,243	1,332
Sunshine Creek	---	---	382	193	249	545	178
Clear (Chunilna) Creek	450	1,501	1,373	950	1,226	608	1,836
Sheep Creek	368	470	573	385	201	325	409
Little Willow Creek	224	334	345	353	374	335	514
Kashwitna River	---	---	---	---	---	---	357
Other streams	---	---	---	---	---	---	1,656
Lakes	---	---	---	---	---	---	1,437
Others[a]	2,401	1,519	3,472	2,658	3,851	2,400	
Total	5,225	5,930	9,463	6,715	8,813	7,536	9,639

Source: Mills 1979-84.

--- means no data were available.

a In 1977 through 1982, the "others" category was not divided between lakes and streams.

the rainbow trout are taken incidentally during the sport fishery for salmon. In 1979, approximately 510 rainbow trout were taken from Chunilna (Clear) Creek during the chinook salmon season (Watsjold 1980), which is approximately 89% of the total harvest of rainbow trout from Chunilna (Clear) Creek that year.

Rainbow trout in the middle Susitna River are vulnerable to sportfishing during their fall outmigrations. Local anglers take advantage of the outmigration at the mouth of Indian River, tributary to the Susitna, each fall (Sundet and Wenger 1984).

b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report that depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature. It is likely, however, that if the population of Southcentral Alaska continues to grow, fishing pressure on rainbow trout in the east-side Susitna area will increase. With the advent of recently proposed road construction for the Chase I, II, and III state subdivisions, Chunilna (Clear) Creek may be subject to a large increase in angling pressure in the future (ADF&G 1984c).

G. West Side Cook Inlet-West Side Susitna Drainage Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the west-side area and throughout the state is to optimize the survival and growth of resident fish and to provide recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are similar to those listed for the Knik Arm Drainage Area.

2. Management considerations. Many popular fishing streams in the west-side area are accessible only by boat or small plane. The Talachulitna River is managed by the ADF&G as a catch-and-release trophy rainbow trout fishery.

3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall, when the rainbow trout in lakes are actively feeding near the surface and those in streams are migrating to spawning or overwintering areas.

In a 1974 creel census of the Talachulitna River between Judd Lake and the Highline Lake area, it was noted that the catch of rainbow trout began to drop off in July and remained low through the end of the creel census on September 30 (Kubik and Chlupack 1975).

4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter. The Talachulitna River is a single-hook-only area.

5. Fishery summary and significant use areas:

   a. Effort and harvest. The largest sport harvests of rainbow trout in the west-side area are taken from the Deshka River, Lake Creek, and Alexander Creek, with average annual harvests from 1977 through 1982 of 3,350, 2,880, and 1,970, respectively (table 78). The Talachulitna River also supports an important rainbow trout fishery. Because this is a catch-and-release fishery, Talachulitna rainbow trout harvests are nonexistent, and the importance of this stream cannot be judged on that basis. The Talachulitna offers a high-quality fishing experience for anglers who float the river from Judd Lake to the Highline Lake area or to the confluence of the Talachulitna and Swentna rivers. Access and use of the Talachulitna are discussed in more detail in section I.E.6. of this narrative.

   b. Significant use areas. A series of maps at 1:250,000 scale have been produced for use with this report that depict sportfishing areas for marine, anadromous, and selected freshwater fish.

6. Projected increase in demand. Little information on projected increase in demand could be found in the available literature; it is likely, however, that, if the population of Southcentral Alaska continues to grow, fishing pressure on rainbow trout in the west-side area will increase. The recent opening of the Talachulitna and many other west-side streams to chinook salmon harvest may increase the incidental catch or harvest of rainbow trout during the salmon fishery in this area.

H. Kenai Peninsula Area

1. Management objectives. A primary goal of the ADF&G, Division of Sport Fish, in the Kenai Peninsula Area and throughout the state is to optimize the survival and growth of resident fish and to provide good recreational angling opportunities for the public. Research objectives that apply to resident fish investigations in the area are 1) determination of environmental characteristics of waters of the Kenai Peninsula; 2) evaluation of existing and/or potential fisheries; 3) evaluation of fishery rehabilitation measures and availability of sportfish egg sources; 4) investigation of land access; 5) evaluation and recommendations regarding enhancement projects; and 6) providing recommendations for the management of sportfish resources and directing the course of future studies (ADF&G 1980, Wallis and Hammarstrom 1983).

   A steelhead research project is also conducted on the Anchor River that has the following objectives: 1) to determine the size of steelhead stocks, 2) to determine steelhead instream behavior and intrasystem movement and migration, 3) to

Table 78. West Side Cook Inlet-West Side Susitna Drainage Area (Sport Fish Postal Survey Area N) Rainbow Trout Sport Harvest, 1977-83

Location	Harvest						
	1977	1978	1979	1980	1981	1982	1983
Salt water							
Boat	---	---	0	0	0	0	0
Shoreline	---	---	0	0	0	0	0
Total	---	---	0	0	0	0	0
Deshka River	1,556	3,634	3,182	4,305	3,631	3,804	2,434
Lake Creek	1,853	2,721	4,527	2,144	2,874	3,134	2,287
Alexander Creek	1,251	2,640	1,182	1,945	2,290	2,505	608
Polly Creek	---	---	---	---	0	0	0
Talachulitna River	0	0	0	0	0	0	0
Chuit River	509	443	336	301	642	199	441
Theodore River	415	226	609	250	1,092	199	430
Lewis River	34	54	118	9	---	---	---
Kustatan River	---	---	---	---	---	---	0
Silver Salmon Creek	---	---	---	---	---	---	0
Other rivers	1,677	1,528	2,709	1,722	872	597	2,917
Shell Lake	124	27	91	103	a	335	378
Whiskey Lake	45	0	0	0	a	84	---
Hewitt Lake	128	127	191	9	a	147	---
Judd Lake	68	0	100	86	a	---	0
Other lakes	770	1,618	573	2,092	1,629[a]	859	629
Freshwater total	---	---	13,618	12,966	13,030	11,863	10,124
Grand total	8,430	13,018	13,618	12,966	13,030	11,863	10,124

Sources: Mills 1979-84; Mills, pers. comm.

--- means no data were available.

a All lakes were reported together in 1981.

determine angler use and the effects of current harvest levels, and 4) to determine the need for supplementing steelhead stocks (Wallis and Balland 1983). The department's goal is to provide continued recreational angling for steelhead on Kenai Peninsula streams (ibid.).

2. Management considerations. Sportfishing effort on the Kenai Peninsula is far greater than in any other area of Alaska. There are two principal reasons for this: the availability of large stocks of salmon and good access to the area (ADF&G 1984d). The large amount of fishing pressure expended on the Kenai Peninsula has resulted in concern for the status of some rainbow trout stocks and the implementation of more restrictive harvest regulations in some locations. Rainbow trout are stocked in many Kenai Peninsula Area lakes to allow sustained harvest in heavily used areas. Rainbow trout from the Swanson River are used as brood stock for the statewide rainbow trout stocking program.

   Steelhead trout also support an important fishery in the Kenai Peninsula Area. The stocks of steelhead are entirely naturally produced at present, and it was doubted that they could sustain future pressures without harm to the stocks unless additional restrictions were imposed on the harvest or supplemental measures were undertaken (Wallis and Balland 1983). Consideration is being given to rearing steelhead in the Fort Richardson Hatchery to supplement Anchor River stocks. Many steelhead anglers who fish at Anchor River, however, oppose planting hatchery reared fish in the river. Steelhead anglers typically release a substantial portion of the fish they catch, and on the Anchor River the portion released has increased in recent years. As a result, the need for an enhancement program in streams containing natural steelhead populations is not as great as was anticipated (Wallis and Balland 1984).

3. Period of use. Rainbow trout can be taken throughout the year; however, fishing tends to be most productive in spring and fall when the rainbow trout in lakes are actively feeding near the surface and those in streams are migrating to spawning or overwintering areas. The steelhead harvest takes place from mid August through early November, with peak harvests usually occurring from mid September to mid October (Wallis and Balland 1981, 1982, and 1983). Steelhead streams on the Kenai Peninsula are closed to fishing from December 31 until the following July or August (ADF&G 1984a).

4. Harvest methods. Rainbow trout can be taken by rod and reel during the ice-free season and by jigging through the ice in winter. Portions of the Kenai River are restricted to fly fishing or artificial lures only during all or part of the year. Steelhead are taken by rod and reel. Only artificial

lures may be used on steelhead streams from September 16 through December 31.

5. Fishery summary and significant use areas:
   a. Effort and harvest. In 1982, 23% of the Southcentral Region rainbow trout harvest and 93% of the Southcentral Region steelhead harvest was taken from the Kenai Peninsula Area. Rainbow trout are harvested from lakes containing stocked or natural populations and from several Kenai Peninsula streams. The largest harvests of rainbow trout are usually taken from the Kenai River, the Russian River, and the Canoe Lake System (table 79). Average annual harvests from these three areas from 1977 through 1982 were 11,590, 1,900, and 5,630, respectively. The Russian River had been noted for its trophy rainbow trout fishery in the 1930's and early 1940's. This fishery, however, was apparently subject to overharvest, and the population began a rapid decline in the 1940's (Nelson 1983). Under state management, the bag and possession limit was 10 rainbow trout, only one of which could exceed 20 inches. There was no closed season. In 1980, regulations were amended to prevent fishing from April 15 to May 31 in the lower Russian River to protect rainbow trout during the spawning period (ibid.). In 1982, the bag and possession limit was further reduced to five (ibid.), and in 1984 the Russian River was made a catch-and-release-only fishery for rainbow trout (ADF&G 1984a).

      Rainbow trout are harvested in the Kenai River incidentally during salmon fisheries and in fisheries directed toward rainbow trout. For years, a small number of anglers harvested rainbow trout from the Kenai River at the inlet and outlet of Skilak Lake during the early spring. This fishery was not generally known to the majority of anglers. This fact, coupled with adverse weather conditions in March and April, effectively minimized angler participation until recent years (Wallis and Hammarstrom 1980). Since 1976, however, mild winter conditions have prevailed, and more and more anglers have participated in this fishery. An on-site creel census was conducted downstream from Skilak Lake from March 18 through May 20, 1979 (ibid.). Harvest was estimated to be 384 rainbow trout, 52% of which were larger than 508 mm (20 inches). Effort was estimated to be 929 angler-days (ibid.). In 1980, the Board of Fisheries decided to restrict this fishery by making the Kenai River from its confluence with the Moose River upstream to Kenai Lake a single-hook, artificial lure area from January 1 through May 31 (Hammarstrom 1981b).

Table 79. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Rainbow Trout Sport Harvest, 1977-83

	Harvest						
Location	1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	0	0	0	0	0	0	0
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other saltwater	0	0	0	0	0	0	0
Salt water total	0	0	0	0	0	0	0
Fresh water:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	2,938	2,787	2,507
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	3,132	2,179	2,476
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	6,491	4,863	5,654
Kenai River (Skilak inlet to Kenai Lake	---	---	---	---	6,124	2,844	3,021
Kenai River total	4,438	9,272	14,644	9,807	18,685	12,673	
Anchor River	1,027	551	1,000	345	151	147	504
Ninilchik River	170	217	382	91	162	52	31
Deep Creek	300	127	118	97	108	52	189
Stariski Creek	170	90	118	26	32	0	0
Russian River	769	2,423	3,109	2,566	1,437	1,077	462
Kasilof River	---	---	---	---	335	51	21
Swanson River	---	---	---	---	---	---	462
Other rivers	2,483	1,491	3,072	1,894	2,786	2,452	732
Hidden Lake	866	1,428	173	1,196	1,220	451	441
Canoe Lake system	5,861	4,393	4,009	6,905	6,177	6,443	6,241
Other lakes	7,017	5,198	7,736	9,535	11,048	7,734	9,646
Freshwater total	23,101	25,190	34,361	32,462	42,141	31,132	32,387
Grand total	23,101	25,190	34,361	32,462	42,141	31,132	32,387

Source: Mills 1979-84.

--- means no data were available.

Upstream from Skilak Lake, only artificial lures may be used from January 1 to December 31 (ADF&G 1984a).

In 1981, the Kenai River rainbow trout harvest increased; however, because of a reported absence of large fish, the Board of Fisheries felt that further restrictions were necessary to protect the spawning population (Wallis and Hammarstrom 1982). In 1982 and 1983, the Kenai River was open to rainbow trout fishing from Kenai Lake downstream to Cook Inlet only from June 15 through December 31. In 1984, the entire Kenai River was open only from June 15 to October 31 (ADF&G 1984a).

Rainbow trout are harvested from lakes in the Swanson River and Swan Lakes canoe routes. A 1975 survey indicated that these areas receive their heaviest use in July (Shon 1981). The canoe routes are used for many reasons other than fishing, such as canoeing, bird watching, photography, and berry picking; however, 30% of respondents in 1975 said fishing was the most important activity for them while on the canoe routes (ibid.). Lakes within the Swan Lake route that received the heaviest campsite use in 1975 were Spruce, Marten, and Swan lakes. Campsite use in the Swanson River canoe route was heaviest at Gene Lake (ibid.).

Several lakes in the Kenai Peninsula Area are regularly stocked with rainbow trout to provide productive fisheries in intensely used areas. More popular rainbow trout lakes include Jerome, Island, Longmare, Johnson, and Douglas lakes. A complete list of Kenai Peninsula Area lakes stocked with rainbow trout is included in the rainbow trout Distribution and Abundance narrative in this volume.

Steelhead are present in the Anchor River, Ninilchik River, Stariski Creek, Deep Creek, and Crooked Creek; however, the largest harvests are consistently taken from the Anchor River (table 80). Steelhead harvest from the Anchor River from 1977 through 1982 peaked at 1,750 in 1978 and was lowest in 1982 at 550. In 1982, creel census interviews showed that anglers kept only 36% of the steelhead they caught (Wallis and Balland 1983). During the years 1978-1981, anglers kept from 45% to 62% of the steelhead they caught (ibid.). If the harvest in 1982 is adjusted to reflect the low percentage of fish kept, the numbers caught in 1982 are comparable to catches in 1979, 1980, and 1981 (ibid.). Fifteen thousand to 20,000 angler-days annually are spent on the Anchor River in the summer-fall period, when steelhead are caught (ibid.). Dolly Varden and coho salmon are also caught during this period, and it is not possible to assign fishing effort to any one

Table 80. Kenai Peninsula Area (Sport Fish Postal Survey Area P) Steelhead Sport Harvest, 1977-83

Location	Harvest 1977	1978	1979	1980	1981	1982	1983
Salt water:							
Deep Creek finfish	5	36	9	9	11	8	52
Resurrection Bay	0	0	0	0	0	0	0
Kachemak Bay	0	0	0	0	0	0	0
Other salt water[a]	0	0	0	0	0	0	
Other boat	---	---	---	---	---	---	0
Other shoreline	---	---	---	---	---	---	10
Saltwater total	5	36	9	9	11	8	62
Freshwater:							
Kenai River (Cook Inlet to Soldotna Bridge)	---	---	---	---	0	0	0
Kenai River (Soldotna Bridge to Moose R.)	---	---	---	---	0	0	0
Kenai River (Moose R. to Skilak outlet)	---	---	---	---	0	0	0
Kenai River (Skilak inlet to Kenai Lake)	---	---	---	---	0	0	0
Kenai River total	0	0	0	0	0	0	0
Anchor River	1,072	1,754	782	841	777	551	1,101
Ninilchik River	60	90	127	290	302	127	126
Deep Creek	269	371	145	139	140	187	126
Stariski Creek	124	262	118	79	86	59	42
Russian River	0	0	0	0	0	0	0
Kasilof River	---	---	---	---	11	25	10
Swanson River	---	---	---	---	---	---	0
Other rivers	0	0	0	0	11	17	0
Hidden Lake	0	0	0	0	0	0	0
Canoe Lake system	0	0	0	0	0	0	0
Other lakes	0	0	0	0	0	0	105
Freshwater total	1,525	2,477	1,172	1,349	1,327	966	1,510
Grand total	1,530	2,513	1,181	1,358	1,338	974	1,572

Source: Mills 1979-84.
--- means no data were available.
a In 1977 through 1982, "other salt water" was not divided between boat and shoreline.

species; however, a large amount of the effort is directed toward steelhead trout.

6. Projected increase in demand. It is likely that, if the population of Southcentral Alaska continues to grow, fishing pressure on rainbow trout and steelhead in the Kenai Peninsula Area will continue to increase. The popularity and demand for steelhead fishing in Southcentral Alaska is growing rapidly, and the intensity of angling effort has increased dramatically on these few small streams during the last several years.

VI. ECONOMIC VALUE OF SPORTFISHING IN THE SOUTHCENTRAL REGION

A. Introduction

Relative to sportfishing in Alaska, the two measures of value for which estimates are made most frequently are "economic impact" and consumer's surplus." Economic impact is a measure of the expenditures and induced economic activities that result from sportfishing. However, because the services provided by the typical public recreation or sportfishing site are not marketed but are instead offered free of charge or at negligible prices, economic impact may not adequately represent the true value of a recreational fishery.

Although economic impact is often an important consideration, public agencies are generally mandated to consider social values on a broader scale. In the case of sportfishing and other recreational activities that involve nonmarketed goods and services, there have been several attempts to quantify consumer's surplus as a measure of social value. Consumer's surplus may be defined as the difference between the price that a consumer pays for a good or service (in this case a recreational activity) and the amount that he would be willing to pay rather than be deprived of the recreational activity. Although there is considerable controversy regarding the adequacy of consumer's surplus as a measure of social value, it can provide a measure (although incomplete) of the contribution of sportfishing.

Several techniques have been developed to estimate the consumer's surplus related to sportfishing at specific locations. Direct techniques have been used that attempt to evaluate the economic value by inquiring of the sport fishermen the most they would be prepared to pay for sportfishing access rather than be excluded (willingness to buy). Alternatively, sport fishermen might be asked the minimum amount they would have to be paid willingly abstain from the recreation (willingness to sell). An indirect approach, the travel cost method, which imputes willingness to buy from the recreationist's willingness to incur cost of travel to the sportfishing site in question, has also been used.

B. Data Summary

Data limitations preclude an effective economic evaluation of sportfishing activities in Southcentral Alaska. The National

Survey of Fishing, Hunting, and Wildlife Associated Recreation collected via a telephone and in-person questionnaire in 1980 by the U.S. Bureau of Census contains information on sportfishing expenditures by residents and nonresidents. These data were used to prepare estimates of economic impacts related to sportfishing in Southwest Alaska, but on the basis of a critical departmental review it was agreed that the National Survey incorrectly estimated expenditures related to sportfishing in Alaska. As a result, it was decided to remove the estimates from the guide for the Southwest Region and not attempt to use them for the Southcentral Region.

In order to estimate the level of consumer's surplus related to sportfishing, the Division of Sport Fish has used mail questionnaires to collect the required data for specific Southcentral Alaska drainages. Data were collected to enable both direct estimates (willingness to buy and willingness to sell) and indirect estimates (the travel cost method) of consumer's surplus. Although each of these techniques has limitations and the estimates are apt to vary with the technique employed, the exercise does provide the basis for estimating the consumer's surplus associated with sportfishing in specific drainages.

The Division of Sport Fish also plans to evaluate sportfishing in Southcentral Alaska as a whole during the 1985 season. The planned 1985 Division of Sport Fish study of Southcentral Alaska will provide the opportunity to improve the quantification of the very difficult and complex problem of measuring the value of nonmarketed goods and services in terms of both economic impact and consumer's surplus.

These data should be available in the future and should provide some useful insights into the value of sportfishing. Nevertheless, one should be cognizant of what consumer's surplus measures and what it does not measure, as well as the statistical reliability involved, before applying these estimates to critical situations. One should be fully aware that there are values, such as more desirable social behavior or improved public health, which are not normally measured as part of consumer's surplus, and that these values may be critical to specific decisions pertaining to resource allocation.

REFERENCES

ADF&G. 1957. Annual report for 1957. Rept. 9. Juneau. 124 pp.

________. 1959. Annual report for 1959. Rept. 11. Juneau. 116 pp.

ADF&G, comp. 1977a. A compilation of fish and wildlife resource information for the State of Alaska. Vol. 2: Sport fisheries. 234 pp.

________. 1977b. A fish and wildlife inventory of the Cook Inlet-Kodiak area. Vol. 2: Fisheries. 443 pp.

________. 1978a. A fish and wildlife resource inventory of the Prince William Sound area. Vol. 2: Fisheries. 241 pp.

ADF&G. 1978b. Alaska's fisheries atlas. Vol. 2 [R.F. McLean and K.J. Delaney, comps.]. 43 pp. + 153 maps.

________. 1980. July 1980-June 1985 Five-Year Federal Aid in Fish Restoration Contract Plan. Juneau.

________. 1983. Regulations of the Alaska Board of Fisheries for commercial fishing in Alaska. 181 pp.

________. 1984a. Alaska sportfishing regulations summary. Juneau. 32 pp.

________. 1984b. Sport fish survey. Div. Sport Fish. booklet. 44 pp.

________. 1984c. Fish and wildlife resources element for the Susitna area planning study. Div. Habitat, Anchorage. 236 pp. + appendices.

________. 1984d. Upper Cook Inlet salmon allocation issues. Rept. to the Alaska Board of Fisheries. 57 pp.

________. 1984e. 1984 supplement to Cook Inlet sportfishing regulations. 2 pp.

________. 1984f. Monthly fishing forecast. September 1984, Southcentral Alaska. Div. Sport Fish. 7 pp.

________. 1984g. Monthly fishing forecast. August 1984, Southcentral Alaska. Div. Sport Fish. 7 pp.

________. 1984h. Fish release records for regions 01, 02, and 03. Computer printous, 07 August 1984. Div. FRED, Anchorage. 209 pp.

________. Unpublished data. Data from postal survey returns. Div. Sport Fish., Anchorage.

Andrews, R. N.d. Quality fishing - a concept for Alaska sport fish management. One-leaf pamphlet. ADF&G, Juneau.

Bentz, R.W. 1982. Inventory and cataloging of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-D.

________. 1983. Inventory and cataloging of the sport fish and sport fish waters in Upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-D.

Blackburn, J., B. Bracken, and R. Morrison. 1983. Gulf of Alaska-Bering Sea groundfish investigations. ADF&G, Commerical Fisheries Research and Development Act. Proj. 5-49-R-1. 85 pp.

Browning, R. 1976. Portage area fisheries habitat inventory and analysis. BLM, Anchorage, AK. 92 pp.

Cook, D.R. 1984. Personal communication. Habitat Biologist, ADF&G, Div. Habitat, Anchorage.

Delaney, K., and K. Hepler. 1983. Inventory and cataloging of sport fish and sport fish waters of western Prince William Sound, lower Susitna River, northern Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-H.

Engel, L.J. 1967. Inventory and cataloging of the sport fish and its waters on the Kenai, Cook Inlet-Prince William Sound areas. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 8. Proj. F-5-R-8, Job 7-A.

________. 1973. Inventory and cataloging of Kenai Peninsula, Cook Inlet, and Prince William Sound drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Vol. 14. Proj. F-9-5, Job G-I-C.

________. 1985. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish., Palmer.

Hammarstrom, S. 1977. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 18. Proj. F-9-9, Job G-II-L.

________. 1979. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-II-L.

________. 1980. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-II-L.

________. 1981a. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-C.

________. 1981b. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-II-L.

________. 1984. Personal communication. Project Leader, ADF&G, Div. Sport Fish, Soldotna.

Hammarstrom, S., and L. Larson. 1982. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Job G-II-L.

________. 1983. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-II-L.

________. 1984. Evaluation of chinook salmon fisheries of the Kenai Peninsula. ADF&G, Fed. Aid in Fish. Rest. Ann. performance rept. Vol. 25. Proj. F-9-16, Job G-II-L.

Havens, A.C. 1980. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-III-D.

________. 1983. Population studies of game fish and evaluation of managed lakes in the upper Cook Inlet drainage. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-III-D.

Hepler, K. 1984. Personal communication. Asst. Area Mgt. Biologist. ADF&G, Div. Sport Fish, Anchorage.

Hepler, K.R., and R.W. Bentz. 1984. Chinook salmon population and angler user studies of upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 25. Job G-II-M.

Hepler, K.R., and S.W. Kubik. 1982. Inventory and cataloging of the sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-I-H.

Homer News, Inc. 1983. Homer tourist and recreation guide. 43 pp.

IPHC. 1983. Pacific halibut fishery regulations. 8 pp.

Kenai River Task Force. 1983. Final statement of findings. 33 pp. + appendices.

Kubik, S.W., and R.S. Chlupach. 1975. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. F-9-7, Job G-I-H.

Kubik, S.W., and K. Delaney. 1980. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-H.

Kubik, S.W., and J.C. Riis. 1976. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 17. Proj. F-9-8, Job G-I-H.

Kubik, S.W., and T.W. Trent. 1974. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 15. Proj. F-9-6, Job G-I-H.

Kubik, S.W., and R. Wadman. 1977. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 18. Proj. F-9-9, Job G-I-H.

________. 1978. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. F-9-10, Job G-I-H.

________. 1979. Inventory and cataloging of sport fish and sport fish waters of the lower Susitna River and central Cook Inlet drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-H.

Logan, S.M. 1984. Personal communication. Area Mgt. Biologist. ADF&G, Div. Sport Fish, Soldotna.

Logan, S.M., and the Kenai Peninsula Sport Fish Staff. 1982. Major recreational and personal use dip net fisheries of the Kenai Peninsula. Rept. to the Board of Fisheries. Div. Sport Fish. 33 pp.

McHenry, E.T. 1980. Coho salmon studies in the Resurrection Bay area. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-II-A.

________. 1981. Coho salmon studies in the Resurrection Bay area. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, G-II-A.

________. 1982. Coho salmon studies in the Resurrection Bay area. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job G-II-A.

________. 1983. Coho salmon studies in the Resurrection Bay area. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-II-A.

Mills, M. 1979. Statewide harvest study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job SW-I-A.

________. 1980. Statewide harvest study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job SW-I-A.

________. 1981a. Statewide harvest study - 1979 data. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 22. Proj. F-9-13, Job SW-I-A.

________. 1981b. Statewide harvest study - 1980 data. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 22. Proj. F-9-13, Job SW-I-A.

________. 1982. Statewide harvest study - 1981 data. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 23. Proj. F-9-14, Job SW-I-A.

________. 1983. Statewide harvest study - 1982 data. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 24. Proj. F-9-15, Job SW-I-A.

________. 1984. Statewide harvest study - 1983 data. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 25. Proj. F-9-16, Job SW-I-A.

________. 1983, 1984. Personal communication. Biometrician, ADF&G, Div. Sport Fish, Anchorage.

Morrison, R. 1982. Trip report Outer District rockfish survey, June 1-10, 1982. ADF&G, Div. Commer. Fish. Lower Cook Inlet Data Rept. 82-6. 20 pp.

Nelson, D.C. 1979. Russian River sockeye salmon study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job AFS-44-5.

________. 1980. Russian River recreational sockeye salmon fishery, 1980. Pages 61-69 _in_ ADF&G, Div. Sport Fish, rept. to the Board of Fisheries, 1980. 60 pp.

________. 1982. Russian River sockeye salmon study. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job AFS-44-8.

________. 1983. Russian River sockeye salmon study. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vol. 24. Proj. AFS-44, Segment AFS-44-9.

PWS Regional Fisheries Planning Team. 1983. Prince William Sound-Copper River Comprehensive Salmon Plan. Phase I:20 year plan (1983-2002). 176 pp.

Redick, R.R. 1970. Inventory and cataloging and population sampling of sport fish and sport fish waters of the Cook Inlet drainage. ADF&G, Fed. Aid in Fish Rest. Ann. progress rept. Vol. 11. Proj. F-9-2, Job 11-A.

Sautner, J.S., and M.E. Stratton. 1984. Access and transmission corridor studies. Part 1 in D.C. Schmidt, C.C. Estes, D.L. Crawford, and D.S. Vincent-Lang, eds. ADF&G Susitna Hydro aquatic studies. Rept. 4: Access and transmission corridor aquatic investigations (July-October 1983).

Schmidt, D.C., and M.E. Stratton. 1984. Population dynamics of arctic grayling in the upper Susitna basin. Part 2 in D.C. Schmidt, C.C. Estes, D.L. Crawford, D.S. Vincent-Lang, eds. ADF&G, Susitna Hydro Aquatic Studies. Rept. 4: Access and transmission corridor aquatic investigations (July-October 1983).

Shon, L.A. 1981. Wilderness use and perceptions of crowding on the Kenai Canoe Routes, Alaska. Thesis, Univ. Alaska, Fairbanks. 228 pp.

Skud, B.E. 1975. The sport fishery for halibut: development, recognition, and regulation. IPHC Tech. Rept. 13. 19 pp.

Sundet, R.L., and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below Devil Canyon. Part 5 in D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, eds. ADF&G Susitna Hydro Aquatic Studies. Rept. 2: Resident and juvenile anadromous fish investigations (May-October 1983).

U.S. Army Corps of Engineers. 1978. Kenai River review. Draft tech. rept. 334 pp.

USFS. N.d. MicKinley Lake-Pipeline Lakes trail system. Alaska Region Chugach National leaflet. 4 pp.

Waite, D.C. 1983. Crooked Creek chinook salmon 1979-1981. ADF&G, Juneau. FRED Rept. 14. Access No. CCI 011. 40 pp.

Wallis, J., and D.T. Balland. 1981. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 22. Proj. AFS-48, Segment AFS-48-1.

________. 1982. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 23. Proj. AFS-48, Segment AFS-48-2.

________. 1983. Anchor River steelhead study. ADF&G, Fed. Aid in Fish Rest. and Anadromous Fish Studies. Ann. performance rept. Vol. 24. Proj. F-9-15, Segment AFS-48-3.

Wallis J., and S. Hammarstrom. 1979. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-C.

________. 1980. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-C.

________. 1982. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. F-9-14, Job J-I-C.

________. 1983. Inventory and cataloging of Kenai Peninsula, and Cook Inlet drainages and fish stocks. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-C.

Watsjold, D. 1978. Inventory, cataloging, and population sampling of the sport fish waters of upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 19. Proj. F-9-10, Job G-I-D.

________. 1979. Inventory and cataloging of the sport fish and sport fish waters in the upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 20. Proj. F-9-11, Job G-I-D.

________. 1980. Inventory and cataloging of the sport fish and sport fish waters in upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-D.

________. 1981. Inventory and cataloging of the sport fish and sport fish waters in upper Cook Inlet. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-D.

Williams, F.T. 1969. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. progress rept. Vol. 10. Proj. F-9-1, Job 14-A.

________. 1970. Inventory and cataloging of sport fish and sport fish waters of the Copper River and Prince William Sound drainages and the upper Susitna River. ADF&G, Fed. Aid in Fish Rest. Ann. progress rept. Vol. 11. Proj. F-9-2, Job 14-A.

________. 1973. Inventory and cataloging of sport fish and sport fish waters of the Copper River and Prince William Sound drainages, and the upper Susitna River drainage. ADF&G, Fed. Aid in Fish Rest. Ann. progress rept. Vol. 14. Proj. F-9-5, Job G-I-F.

________. 1975. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 16. Proj. F-9-7, Job G-I-F.

________. 1976. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 17. Proj. F-9-8, Job G-I-F.

________. 1977. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 18. Proj. F-9-9, Job G-I-F.

________. 1979. Gulkana River. Pages 68-70 in A special report to the Alaska Board of Fisheries, 1979. ADF&G, Div. Sport Fish. 80 pp.

________. 1984. Personal communication. Area Mgt. Biologist, ADF&G, Div. Sport Fish., Glennallen.

Williams, F.T., and W.D. Potterville. 1980. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 21. Proj. F-9-12, Job G-I-F.

________. 1981. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 22. Proj. F-9-13, Job G-I-F.

________. 1982. Inventory and cataloging of the sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 23. Proj. 5-9-14, Job G-I-F,

________. 1983. Inventory and cataloging of sport fish and sport fish waters of the Copper River, Prince William Sound, and the upper Susitna River drainages. ADF&G, Fed. Aid in Fish Rest. Ann. performance rept. Vol. 24. Proj. F-9-15, Job G-I-F.

Personal Use Fishing

Salmon Personal Use Harvest

I. REGIONWIDE INFORMATION

Prior to 1978, the term "subsistence fishing" was loosely applied to a variety of noncommercial fisheries in Cook Inlet and Prince William Sound (PWS). That term was retained until the passage of the state subsistence statute in 1978. In the fall of 1980, to implement the subsistence statute, the Board of Fisheries developed 10 criteria to identify subsistence or "customary and traditional" fisheries (5 AAC 01.597). The 10 criteria were later condensed into 8 criteria by the Joint Boards of Fish and Game (5 AAC 99.010). The Board of Fisheries determined that within the Cook Inlet area only the communities of Port Graham and English Bay in Lower Cook Inlet (LCI) and Tyonek in Upper Cook Inlet (UCI) met the criteria established by board policy. The subsistence fishery in Cook Inlet has since been limited to these areas (ADF&G 1984), with the exception of a court-ordered subsistence fishery in Kachemak Bay. In the PWS area, subsistence fishing occurs along the Copper River from Slana to Chitina and in the Copper River delta-PWS area.

During the spring of 1981, the Board of Fisheries created a new fishery classification entitled "personal use." Since the State Subsistence Statute had redefined subsistence fishing, participants in noncommercial gill net fisheries not found to be "customary and traditional" were prohibited from fishing for salmon. There are areas, however, where harvestable surpluses of salmon periodically exist in excess of both spawning escapement needs and the needs of subsistence, commercial, and sport user groups. The board created the personal use classification to allow harvests in these instances (ibid.).

During the spring meeting in 1982, the board further stated that the taking of fish under personal use would be allowed when it did not jeopardize the sustained yield of a resource and either did not negatively impact an existing resource or was in the broad public interest (ibid.). This intent placed personal use on the same priority level as commercial and recreational use. In February 1985, the State Supreme Court overrode the board's definition of subsistence, and the status of personal use fisheries is currently under review. Fisheries that have been managed for personal use will be discussed in the following sections of this narrative. A set of maps depicting salmon personal use fishing areas during the period 1981 through 1984 have been produced and may be found in the reference map series that supplements this text.

II. UPPER COOK INLET (UCI) MANAGEMENT AREA

Little information exists regarding harvest levels and participation in subsistence fisheries in UCI before 1967. In the early 1950's, the federal government implemented regulations prohibiting subsistence fishing in freshwater streams around Anchorage. Additional stream closures came in 1952 and 1953, when Willow Creek, all tributaries to Knik Arm, and all streams and lakes on the Kenai Peninsula draining into Cook Inlet were closed to subsistence fishing. Knik Arm was closed to subsistence fishing in 1971 in an attempt to increase sockeye salmon escapements into Big Lake (ADF&G 1984).

Since statehood, permits have been required to subsistence fish in Cook Inlet. Between 1960 and 1980, subsistence fishing regulations fluctuated dramatically with regard to seasons, permits, gear, bag limits, and open periods. In 1978, the first year of the UCI Salmon Management Plan and of the subsistence statute, the number of salmon subsistence permits issued for UCI increased to 323, nearly four times greater than the previous seven year average of 87. The Board of Fisheries' concern about the rapid growth in the subsistence salmon fishery led to many changes in the 1979 subsistence salmon fishing regulations for UCI. These changes reduced fishing time and closed the entire Upper Subdistrict of the Central District, which contains the majority of Kenai Peninsula beaches accessible by road (ibid.).

These changes did not stabilize the number of people who obtained subsistence salmon permits. The Board of Fisheries further restricted the Cook Inlet subsistence fishery for the 1980 season by reducing the allowable gear length, reducing the permits from one per person to one per household, reducing the bag limit, and reducing the open fishing area (ibid).

Three personal use fisheries for salmon have been established in UCI since 1981. A dip net fishery on the Kenai and Kasilof rivers, which was the first such fishery established, was conducted under the Cook Inlet Personal Use Salmon Dip Net Fishery Management Plan. A gill net fishery around the mouth of the Kasilof River was the second personal use fishery created under the Central District Personal Use Sockeye Salmon Management Plan. A third personal use fishery, also for gill nets, was created under the Central and Northern District Personal Use Coho Salmon Management Plan. These three fisheries will be discussed in the following sections. Subsistence fisheries in the UCI area are discussed in the Upper Cook Inlet/Susitna Basin and Lower Cook Inlet/Kenai Peninsula subregional resource use assessments found in the subsistence and other local use of resources portion of this volume.

A. Cook Inlet Personal Use Salmon Dip Net Fishery Management Plan

The personal use dip net fishery is open for all salmon species except chinook salmon in areas and times specified by emergency order. This plan was implemented on the Kasilof River in 1981. Dip net catches of sockeye salmon in this system were 10,300 in 1981, 1,800 in 1982, and 3,600 in 1983. The dip net fishery conducted on the Kenai River in 1982 and 1983 was considerably less effective, with a sockeye harvest of 150 in 1982 and 6,000 in 1983. These personal use fisheries are not permitted in either the Kenai or Kasilof rivers until maximum escapement goals are projected. The maximum escapement goal for the Kenai River is 500,000 sockeye salmon and, for the Kasilof River, 150,000 sockeye salmon. The ADF&G may also allow the taking of salmon by dip nets in locations where artificially produced salmon stocks return to areas that do not have adequate spawning grounds available (ADF&G 1984).

B. Central District Personal Use Sockeye Salmon Management Plan

A noncommercial set gill net fishery in the Central District was permitted by court order in 1981 from August through September. The areas on the Kenai Peninsula opened for fishing were Salamatof, Kalifonsky, Coho, and Clam Gulch to Ninilchik beaches. Based on permit returns, the total catch was nearly 14,000 fish, of which 93% were coho salmon (Tarbox and House 1982). The highest catch per unit effort values were recorded on Salamatof Beach at the close of the season in September.

In 1982, the second UCI personal use fishery was created under the Central District Personal Use Sockeye Salmon Management Plan. The fishery was restricted to the mouth of the Kasilof River and opened in June. These restrictions in time and location changed the harvest to predominantly Kasilof River sockeye salmon, with a quota of 5,000 to 10,000 salmon on the fishery. Estimates of catch are provided by ADF&G personnel and confirmed by postseason permit returns. A total of 684 permits was issued in 1983; this was a slight increase from the 649 permits issued in 1982. In 1983, the fishery closed after seven days, with a harvest of 8,846 sockeye and 307 chinook salmon (ADF&G 1984). Intense crowding on the beaches occurred in both years. The requirement of minimum distances between nets limited the number of sites on the three miles of open beach, and the entire area was filled throughout the season.

C. Central and Northern District Personal Use Coho Salmon Management Plan

A third UCI personal use fishery was created by the Board of Fisheries in the spring of 1983. This gill net fishery extends from the Kasilof River northward to Point Possession along all east-side beaches of Cook Inlet open to commercial setnetting. This fishery is almost exclusively one for coho salmon bound for northern Kenai Peninsula streams, principally the Kenai River.

The fishery opened on September 15 with a single 24-hour period per week and a quota of 6,000 salmon. Monitoring was accomplished by aerial surveys and a mandatory call-in of catches. In total, 295 permits were issued (ADF&G 1984).

An aerial survey of the first opening counted 108 nets being fished, and catch reports resulted in a harvest estimate of 712 coho salmon (ibid.). Immediately following this initial period, the fishery was halted by a temporary restraining order in response to a lawsuit filed by the Kenai River Sportfishing Association (KRSA). An out-of-court settlement reached between KRSA and the State of Alaska provided for reopening of the fishery in October. No catch was reported from the few participants in the late fishery.

III. LOWER COOK INLET (LCI) MANAGEMENT AREA

A personal use fishery for salmon has been created in LCI. Sockeye salmon in China Poot Bay are harvested under the Cook Inlet Personal Use Salmon Dip Net Fishery Management Plan. Subsistence fisheries in the LCI area are discussed in the Kenai Peninsula and LCI subregional resource use assessments found in the subsistence harvest portion of this volume.

Leisure Lake, also named China Poot Lake, flows into the south side of Kachemak Bay. The ADF&G stocks the lake with sockeye salmon and may open a dip net fishery to harvest the returning salmon, because a large falls prevents the fish from reaching the lake to spawn. In 1980, nearly 1,000 fish, mostly sockeye salmon, were harvested by dip net in China Poot Bay (ADF&G 1982).

In 1982, an emergency order was issued to open the upper part of China Poot Creek to dipnetting. Fishing was restricted to the two large pools in the upper part of the stream to protect the natural run of pink salmon that were staging to spawn in the lower stream. The two-day fishing period resulted in a harvest of 1,320 sockeye salmon (Bechtol and Dudiak 1982).

IV. PRINCE WILLIAM SOUND (PWS) MANAGEMENT AREA

Personal use fishing for salmon in the PWS Area is permitted in selected areas of the upper Copper River. There was no designated personal use fishery in the PWS Area until 1984, when the dip net and fishwheel fishery on the upper Copper River near Chitina became a personal use fishery (Randall, pers. comm). Personal use catches are monitored through the use of permits that are available to Alaska residents only. The personal use harvest has been established under the Copper River Personal Use Salmon Management Plan. Subsistence fisheries in the PWS Area are discussed in the PWS and the Copper River/Wrangell Mountain subregional resource use assessments found in the subsistence harvest portion of this volume.

Prior to 1984, the upper Copper River salmon fishery was designated a subsistence fishery. Fish wheels were permitted along the river from Slana to Chitina, and dip nets were permitted in the Chitina area. In 1984, however, the fishery in the Chitina area was reclassified to personal use harvest. Dip nets were legal gear, and a small area for fish wheels was established (Roberson 1984a). Sockeye salmon are the target species, with chinook and coho salmon also harvested.

The unrestricted seven-day-per-week fishery during the 1981 through 1983 seasons was in contrast to the 1980 season, which was restricted for its entire duration and had special provisions for taking chinook salmon, which were present in normal abundance. During the period 1981 through 1983, no special restrictions were applied to any species. Fishing time restrictions in 1984 reduced the intense fishing effort on early sockeye and chinook salmon stocks (ibid.).

In 1982 through 1984, there were significantly more dip net and fish wheel permits issued than in previous years. In 1983, residents of the Copper River basin held 4.9% of the permits but caught 18.4% of the total catch. Dip nets were the choice of gear for 99% of the nonlocal residents (Roberson 1984b). The total reported catch in 1983 was the largest on record (table 1), larger than the combined subsistence/personal use catch of 1984, which was 65,918 fish (Roberson 1984b).

Table 1. Copper River Dip Net and Fish Wheel Salmon Harvest in Numbers of Fish,[a] 1974-84

Year	Permits Issued Dip Net	Permits Issued Fish Wheel	Sockeye Salmon	Chinook Salmon	Coho Salmon
1974	3,305	288	22,800	1,141	163
1975	2,452	350	13,320	1,705	---
1976	2,512	451	20,451	2,017	17
1977	3,526	540	35,363	2,171	454
1978	3,313	392	19,207	2,050	633
1979	2,730	470	22,138	2,372	705
1980	2,804	399	21,437	2,256	639
1981	3,555	523	53,008	1,913	849
1982	5,475	615	96,799	2,532	1,246
1983	6,911	630	100,995	5,421	1,690
1984[b]	5,311	17	44,737	1,555	579

Source: ADF&G 1983.

--- means no data were available.

a The fishery was a subsistence fishery along the Copper River from Slana to Chitina until 1984, when the Chitina area was designated for personal use harvest.

b Roberson 1984a. Data are from the personal use fishery only, with returns through October 17, 1984.

REFERENCES

ADF&G. 1982. Summary of the 1982 Kachemak Bay subsistence fishery. Rept. to Alaska Board of Fisheries. Div. Commer. Fish., Homer. 11 pp.

________. 1983. Prince William Sound Area annual finfish management report. Div. Commer. Fish., Cordova.

________. 1984. Upper Cook Inlet salmon allocation issues. Rept. to Alaska Board of Fisheries. 57 pp.

Bechtol, B., and N. Dudiak. 1982. Leisure Lake sockeye salmon overwintering study 1981-82. ADF&G, Div. FRED, Homer. 46 pp.

Randall, R. 1985. Personal communication. Area Mgt. Biologist, ADF&G, Div. Commer.Fish., Cordova.

Roberson, K. 1984a. Copper River subsistence and personal use salmon fishery management and research. ADF&G, Div. Commer. Fish. Prince William Sound Data Rept. No. 84-12. Glennallen. 21 pp.

________. 1984b. Copper River subsistence salmon fishery management and research. ADF&G, Div. Commer. Fish. Prince William Sound Data Rept. No. 84-6. Glennallen. 19 pp.

Tarbox, K.E., and D. House. 1982. Monitoring of the 1981 Upper Cook Inlet noncommercial set gill net fishery. ADF&G, Div. Commer. Fish. Upper Cook Inlet Data Rept. No. 81-2. Soldotna. 28 pp.

Shellfish Subsistence/Personal Use Harvest

I. REGIONWIDE INFORMATION

A limited subsistence/personal use harvest of shellfish that is primarily recreational occurs in the Southcentral Region. The region is divided into two regulatory areas: the Cook Inlet-Resurrection Bay area, which includes all waters from Cape Fairfield to Cape Douglas, and the Prince William Sound (PWS) area, which includes all waters from Cape Suckling to Cape Fairfield. A sportfishing license is required to take shellfish in the Cook Inlet-Resurrection Bay area, and no license is required in PWS. The seasons for all species are open all year, with the exception of a summer closure for king crab in Cook Inlet-Resurrection Bay. A series of reference maps of harvest areas for shellfish at 1:250,000 scale have been produced for this report and are available at ADF&G offices in the region. The categories of mapped information are species-specific and include the following:

- ° Personal use fishing areas
- ° Personal use historic fishing areas

II. COOK INLET-RESURRECTION BAY AREA

A. King Crab, Tanner Crab, Dungeness Crab, and Shrimp

A substantial subsistence/personal use fishery occurs mainly along the east shore of Cook Inlet and in Kachemak and Resurrection bays (ADF&G 1973). The Division of Sport Fish of the ADF&G conducted a creel census on all species landed from Kachemak Bay in the summer of 1978. The census, which consisted of interviews with recreational fishermen and aerial surveys of fishing grounds, estimated a total effort of 27,000 angler-days. The estimated harvests of crabs were 8,300 king crabs, 3,600 Dungeness crabs, and 2,900 Tanner crabs, with a ± 30% confidence limit (Davis 1983). Beginning in 1981, the Division of Sport Fish included shellfish in the annual creel census mail survey (Mills 1982 and 1983). The surveys showed that most of the catch and effort occurred in Kachemak Bay. The total effort in 1981 was 28,000 angler-days, and it decreased to 18,000 days in 1982 (table 1). The catch of king crab, Dungeness crab, and shrimp declined from 1981 to 1982, while the catch of Tanner crab remained nearly the same.

B. Razor Clams

An area of major importance in Cook Inlet is Clam Gulch beach on the east side of the inlet, which is approximately 10.5 km long. This beach accounts for over 50% of the subsistence/personal use clam harvest in Cook Inlet (Nelson 1982). Harvest of razor clams also takes place with less intensity along the whole east side of Cook Inlet between the Kasilof and Anchor rivers. Access is possibly the most important factor controlling intensity of use on each beach. Those with good, clearly marked access (such as Clam

Table 1. Kenai Peninsula[a] Sport Fish Saltwater Harvest in Numbers and Effort for Shellfish Species, 1981-82

Year/Location	Days Fished	King Crab	Dungeness Crab	Tanner Crab	Shrimp (Gallons)
1981[b]					
Resurrection Bay	1,145	54	173	140	65
Kachemak Bay	25,391	6,178	22,928	4,320	7,117
Other	1,178	227	562	292	432
Total	27,714	6,459	23,663	4,752	7,614
1982[c]					
Resurrection Bay	682	167	314	419	0
Kachemak Bay	15,712	1,981	9,956	4,234	5,009
Other	1,160	52	545	0	31
Total	17,554	2,200	10,815	4,653	5,040

a Kenai Peninsula (Sport Fish Area P) includes all salt waters around the Kenai Peninsula from Cape Puget to Portage Creek at Portage, including waters around Kalgin Island.

b Mills 1982.

c Mills 1983.

Gulch and Ninilchik Beach) attract large numbers of personal use diggers, including many from outside the local area. Razor clams are also harvested along the west side of Cook Inlet, although both the harvest and effort are significantly less than on the east side (table 2).

From the Kenai River south to the end of Homer Spit, the recreational harvest limit for razor clams is 60 per day. Although harvest of razor clams is permitted throughout the year, weather conditions generally confine digging activity to the months of March through August (ibid.). Activity is concentrated on days with low tides of -2 ft or lower. Harvest by local area residents on the Kenai Peninsula tends to take place in the early spring (March and April), whereas people from outside the local area harvest in the warmer months before salmon season (May and June), and tourists from outside Alaska tend to harvest during July and August (ibid.).

Table 2. Razor Clam Personal Use Harvest in the Southcentral Region Sport Fish Postal Survey Areas (Map 1) by Numbers and Percentage of Total State Razor Clam Sport Harvest,[a] 1977-82

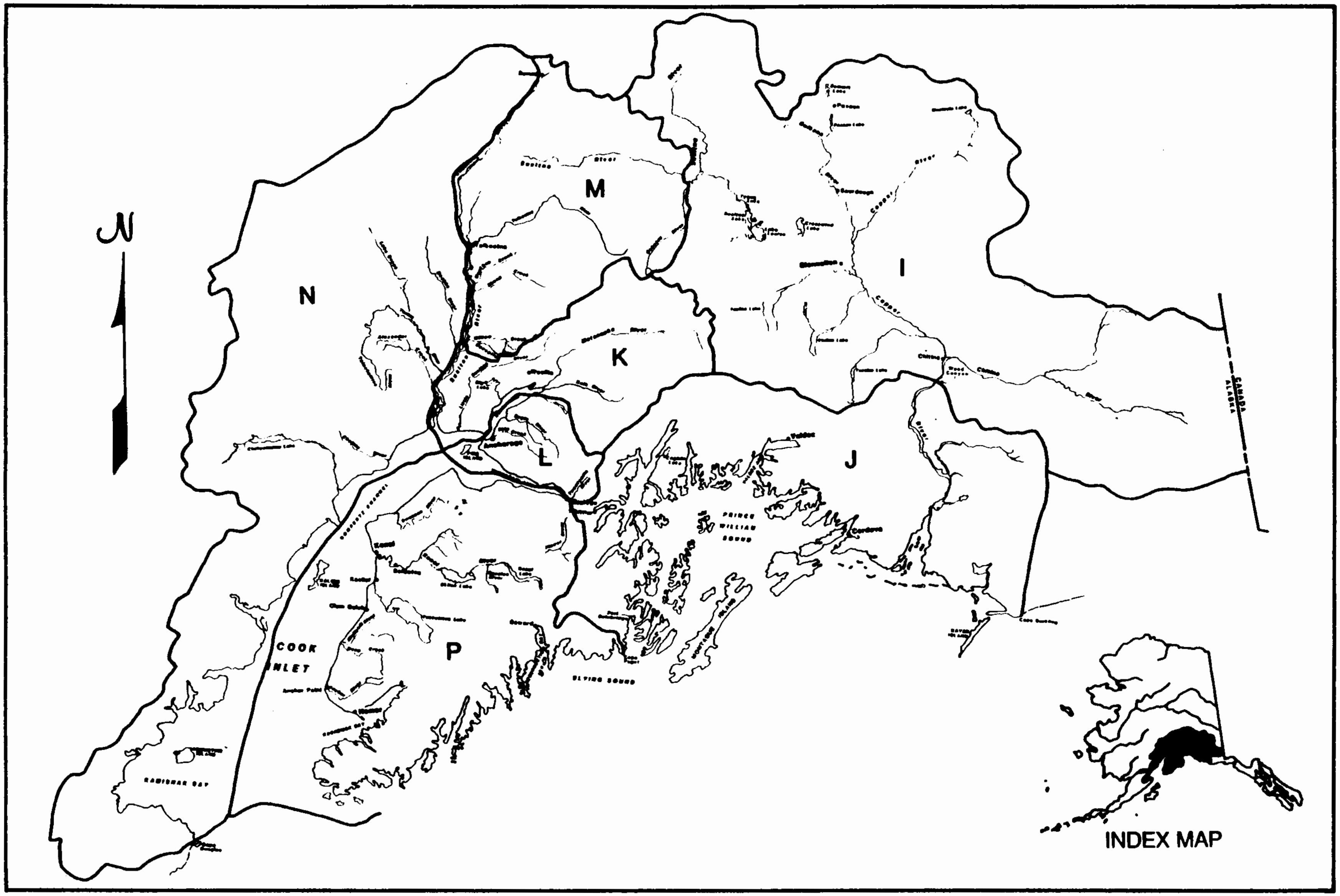
	1977		1978		1979		1980		1981		1982	
Area	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
PWS (Area J)	28,413	2.9	32,665	3.3	18,817	1.8	23,098	2.7	8,348	0.9	15,416	1.4
West Side Cook Inlet (Area N)	44,252 (896)	4.6	39,175 (800)	4.0	51,179 ---	4.9	53,934 ---	6.2	66,638 ---	7.3	89,599 ---	8.3
East Side Cook Inlet between Kasilof & Anchor Point (Area P)	871,247 (25,393)	90.6	896,667 (29,750)	91.4	966,677 (30,323)	91.3	771,603 (31,494)	88.8	829,436 (31,298)	90.5	963,994 (31,954)	89.6
All Alaska	961,695		981,111		1,058,969		869,067		916,471		1,075,637	

Source: Mills 1979-83.

--- means no data were available.

Note: Number of digger days effort is included in parenthesis below catch figures where available.

a The personal use harvest of razor clams is not usually reported in pounds; however, Nelson (1982) found that at Clam Gulch razor clams ranged from 2.7 to 4.2 per lb (round weight), and at Oil Pad Access Beach, south of Clam Gulch, clams ranged from 2.4 to 3.9 per lb.



Map 1. Southcentral Region sport fish postal survey areas.

III. PRINCE WILLIAM SOUND AREA

A. King Crab, Tanner Crab, Dungeness Crab, and Shrimp

Limited subsistence fisheries for shellfish occur throughout PWS and are primarily engaged in by recreational boaters. The main fishing area for Dungeness crab is in the Orca Inlet area adjacent to Cordova, and minor fisheries occur in Port Valdez and Passage Canal (ADF&G 1978). The harvest methods for all crab and shrimp species are unregulated, and no effort or harvest data are available.

B. Razor Clams

A small recreational harvest of razor clams takes place in PWS, averaging about 26,000 clams (approximately equivalent to between 6,190 and 10,833 lb [Nelson 1982]) from 1977 to 1980 (Mills 1983). Recreational harvest in PWS dropped to only 8,348 clams in 1981, but recovered somewhat in 1982 (table 2) (ibid.).

REFERENCES

ADF&G. 1973. Annual management report for the Cook Inlet Management Area. Div. Commer. Fish., Homer and Soldotna. 80 pp.

ADF&G, comp. 1978. A fish and wildlife resource inventory of the PWS Area. Vol. 2: Fisheries. Juneau. 241 pp.

Davis, A.S. 1983. Studies of king and Tanner crab in Lower Cook Inlet during 1982. Lower Cook Inlet Data Rept. 83-5. ADF&G, Div. Commer. Fish., Homer. 39 pp.

Mills, M.J. 1979 through 1983. Statewide Harvest Study - 1977 through 1982 data. Fed. Aid in Fish Rest. and Anadromous Fish Studies. Vols. 20-24, Study SW-I-A. ADF&G, Div. Sport Fish., Juneau.

Nelson, D.C. 1982. A review of Alaska's Kenai Peninsula east side beach recreational razor clam (*Siliqua patula* Dixon) fishery, 1965-1980. Unpubl. MS. ADF&G, Div. Sport Fish. 266 pp.

Subsistence and Other Local Use of Resources in the Upper Cook Inlet/Susitna Basin Subregion

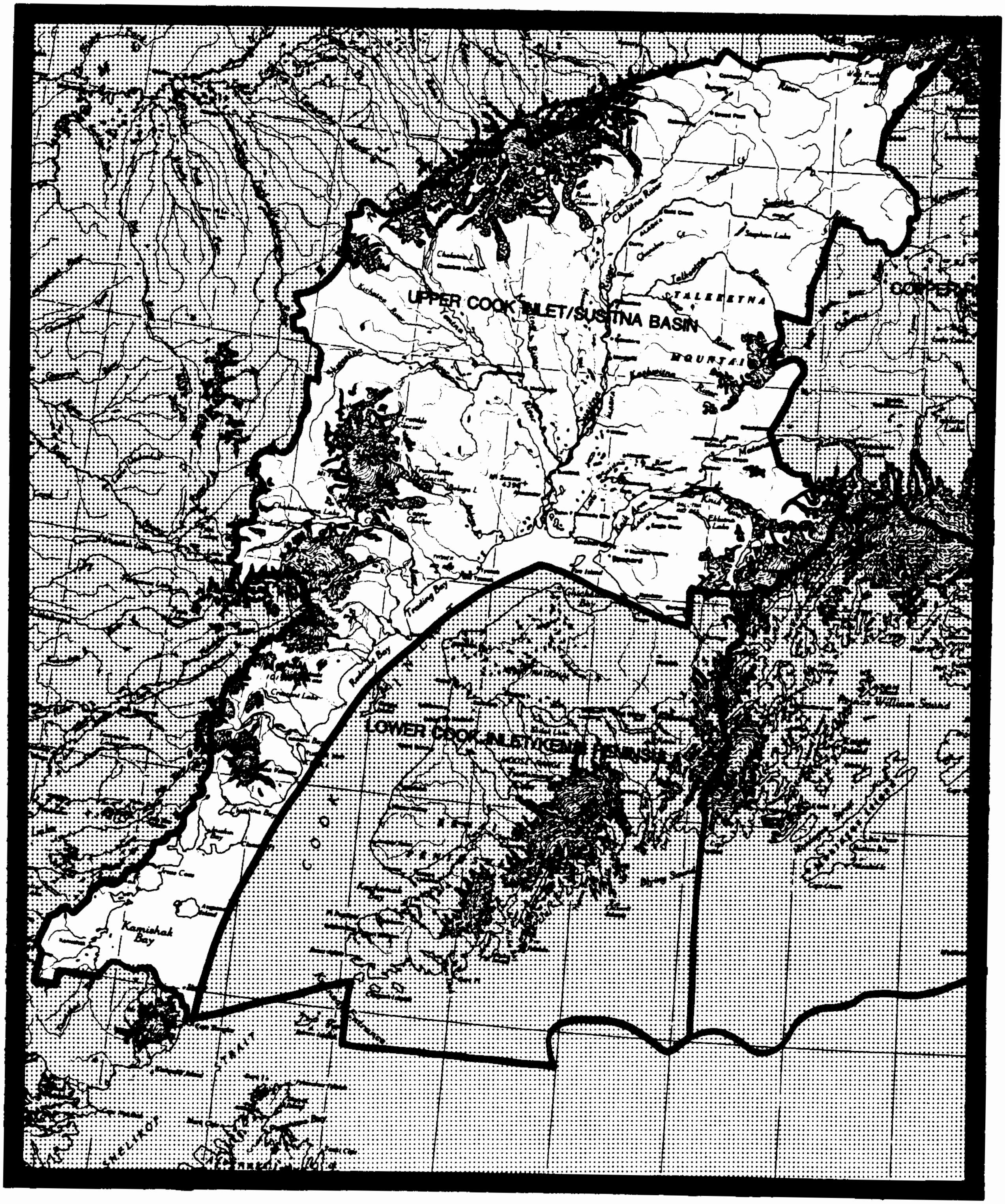
I. LOCATION AND ENVIRONMENT

This subregion consists of an area of approximately 25,000 mi^2 along the western and northern shores of Cook Inlet from Cape Douglas in the south to the upper reaches of the Susitna River in the north (see map 1). Four mountain ranges flank the area on three sides, forming the upper Cook Inlet basin. North of East and West Foreland, Cook Inlet forms a large tidal estuary branching into two narrow arms at its terminus, Knik Arm to the north and Turnagain Arm to the south. The Susitna, Matanuska, and Knik rivers and their tributaries are the major watersheds draining the upper Cook Inlet basin. Cook Inlet's western shore from the West Foreland south to Kamishak Bay is marked by a series of shallow bays. The Chigmit Mountains are a prominent feature, with three active volcanoes rising to more than 10,000 ft. The dormant Augustine Island volcano rises 4,000 ft above the reefs and shallows of Kamishak Bay.

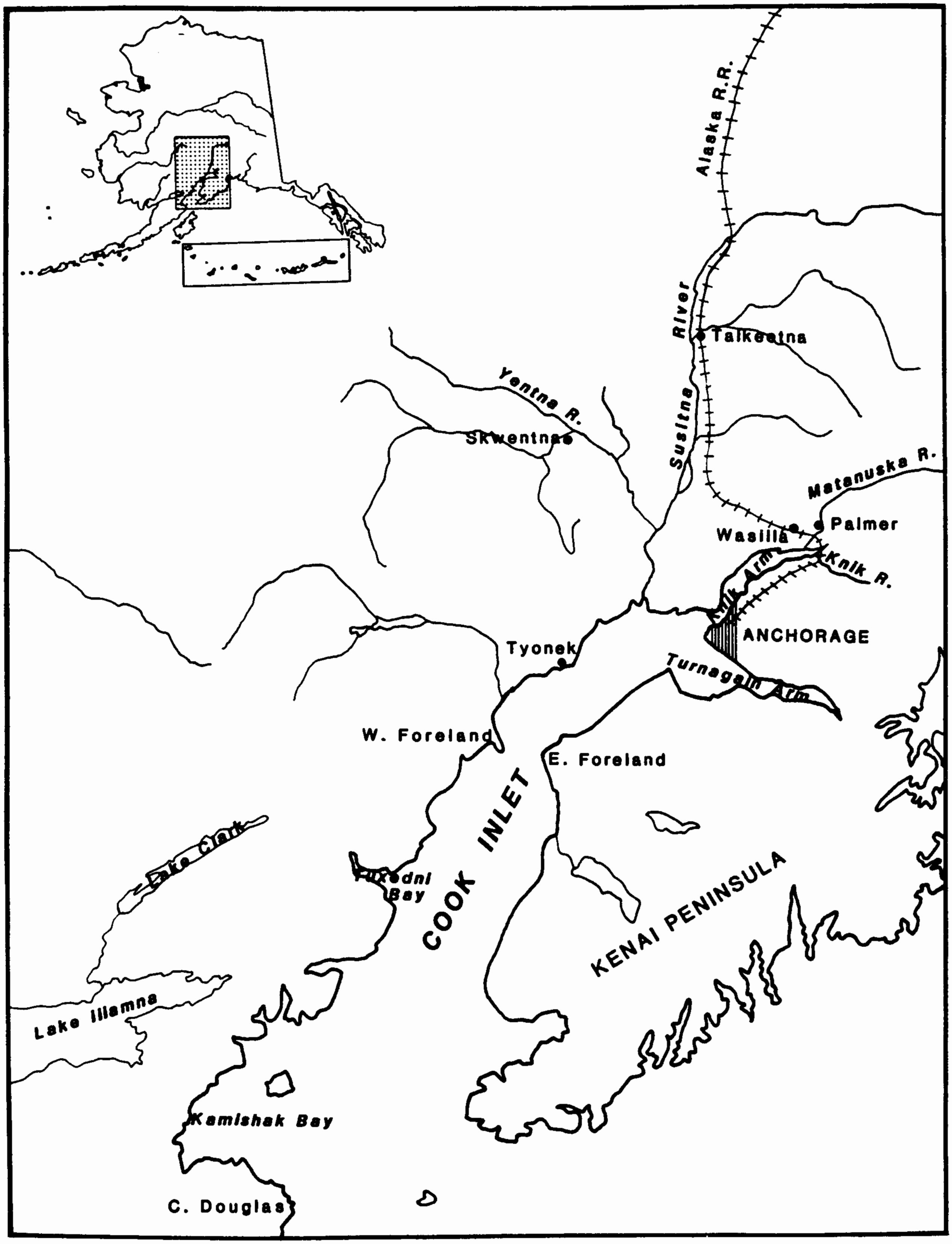
This subregion includes the metropolis of Anchorage and the nearby suburban and agricultural areas along Knik Arm and the Matanuska Valley, including Chugiak, Eagle River, Knik, Eklutna, Palmer, Wasilla, Sutton, and Chickaloon. Farther north the highway and railbelt communities of Big Lake, Houston, Willow, Trapper Creek, Talkeetna, Petersville, and Chulitna lie within the subregion. The highway communities of Girdwood and Portage along Turnagain Arm also lie within the area. Tyonek, on the upper west side of Cook Inlet, is the only sizable village outside the road system. The rest of the non-road-connected population is dispersed throughout the upper Inlet area, with a few small clusters at places such as Skwentna, Alexander Creek, and Beluga (see map 2).

This area is ecologically diverse. Climate ranges from a relatively warm and wet maritime climate along the lower west side of Cook Inlet to the cooler, drier climate of the upper Cook Inlet basin classified as "transitional" between the marine climate to the south and the continental climate of the interior (Selkregg 1975). In contrast to the usually ice-free lower inlet, Cook Inlet above the Forelands freezes four months out of the year but remains in a shattered condition because of the tidal action.

The varied climate and intricate geography of the subregion combine to create a wide range of habitats supporting an assortment of wildlife used by past and present human inhabitants for food and raw materials. Moose currently are common throughout the subregion. Black and brown bears are also found in the area, with notable concentrations of brown bears along the lower west side of Cook Inlet and Kamishak Bay.



Map 1. The Upper Cook Inlet/Susitna Basin subregion.



Map 2. The Upper Cook Inlet/Susitna Basin subregion showing place names discussed in this narrative.

Caribou from the Nelchina herd farther east are occasionally encountered within the subregion around the headwaters of the Susitna River. Heavy silt loads in upper Cook Inlet preclude the presence of some marine and intertidal species found in the lower inlet. Among marine mammals, sea otter, sea lion, harbor seal, and beluga whale inhabit Cook Inlet, with only the latter two species commonly found in the upper inlet. Five species of Pacific salmon seasonally migrate into the waters of Cook Inlet and the many rivers and streams in the subregion. Several species of clams and cockles occur along lower inlet beaches, along with herring, eulachon (hooligan), and tom cod. Freshwater fish include rainbow trout, Dolly Varden, grayling, whitefish, pike, and burbot. Migratory waterfowl are seasonally abundant in coastal wetlands and inland marsh areas. Small game and furbearers include porcupine, ptarmigan, snowshoe hare, spruce grouse, beaver, coyote, flying squirrel, lynx, marten, mink, muskrat, parka squirrel, red fox, red squirrel, river otter, weasel, wolf, and wolverine. Mountain sheep and goats are found in several mountainous areas of the subregion.

II. HISTORY AND PATTERNS OF HUMAN SETTLEMENT

A. Overview of Subregion's History and Settlement

The aboriginal inhabitants of the upper Cook Inlet area were a distinct society of the Tanaina (Dena'ina) Athapaskans known as the "Upper Inlet Tanaina." At the time of European contact, the Upper Inlet Tanaina were composed of several regional groups, which were further subdivided into local bands or villages (Kari and Kari 1982, Fall et al. 1984). Villages consisted of four or five large semisubterranean log structures, each occupied by several nuclear families belonging to the same clan (Osgood 1937). These dwellings were occupied throughout the winter and early spring. During the summer, families relocated to fish camps. In late summer and early fall, hunting groups traveling to the mountains occupied traditional temporary campsites along established travel routes. The land area encompassing the winter village site, summer fish camps, and fall hunting areas comprised the annual subsistence region, or territory, for each village (Fall 1981a).

Captain Cook's voyage into Cook Inlet in 1778 was the first recorded European contact with the Tanaina. Russian fur traders and missionaries of the Russian Orthodox Church were the first to establish non-Native outposts in the region in the late eighteenth and early nineteenth centuries. The Russian foothold in Cook Inlet survived early Tanaina resistance and hostilities to gain increased Tanaina acceptance during the mid nineteenth century (Townsend 1981). Epidemics devastated the Tanaina population during the 1830's. Survivors commonly abandoned traditional villages and concentrated in settlements developing around trading posts and missions at places such as Knik, Susitna Station, and Tyonek. European goods offered in trade for furs attracted growing Tanaina participation in the fur trade thoughout the nineteenth century.

The United States purchase of Alaska in 1867 brought continued developments to the Cook Inlet region. A cannery established at Kasilof on the Kenai Peninsula in 1882 and a saltery built near Tyonek at the mouth of the Chuitna River in 1896 serviced the emerging Cook Inlet commercial fishing industry (Fall 1981a). Gold was discovered along Turnagain Arm in 1888. The stampede that followed heightened mineral exploration activities. Subsequent discoveries of gold and coal in the Beluga, Yentna, Susitna, and Matanuska river drainages continued into the early decades of the twentieth century, bringing an increased network of roads and trails to the Cook Inlet basin (Bacon 1982).

The lower west side of Cook Inlet has long been and remains today one of the most remote and uninhabited regions of Southcentral Alaska. No permanent settlements are located on the western shore of Cook Inlet south of West Foreland. Extreme tides, shallow bays, reefs, and exposure to fierce storms from the Gulf of Alaska make access to the area by boat difficult. Both land and water access continue to be difficult. Snug Harbor, located on Tuxedni Channel, is the only safe anchorage between Cape Douglas and West Foreland. The Snug Harbor Packing Company operated a cannery at this location between 1919 and 1948 (USBSFW 1967). An unimproved road connects Lake Iliamna to Cook Inlet at Iliamna Bay and is sometimes used as an overland shortcut to and from Cook Inlet for boats participating in the Bristol Bay commercial salmon fishery.

Commercial fishing is an important economic activity in the subregion. Salmon are harvested from boats using drift gill nets and purse seines, and from beach sites using set gill nets at a few locations below West Foreland and in larger concentrations around Tyonek and Fire Island. Lower Inlet and Kamishak Bay waters are fished commercially for halibut, roe herring, and Tanner, Dungeness, and king crab by fishermen based in Kenai Peninsula communities (Terry et al. 1980).

Oil was reported on the west side of Cook Inlet in the vicinity of the Iniskin Peninsula by the Russians as early as 1853. The first oil claims were staked there in 1896, and six wells were drilled at Dry Bay and Oil Bay between 1898 and 1906 (Moffit 1927). Subsequent oil-drilling activity on the Iniskin Peninsula occured in 1936, 1954, and 1958 (Detterman and Hartstock 1966). Logistical difficulties and the relatively small quantities of oil found has prevented extensive development of the Iniskin Peninsula oil fields.

B. Specific Area Histories

1. Anchorage and the railbelt area. Anchorage was established in 1914 as a survey camp during construction of the Alaska Railroad. The ability of ships to anchor there gave rise to both its name and its growth from camp to town. By 1920, Anchorage had a population of almost 2,000 (Selkregg 1972). The railroad between Seward and Fairbanks was completed in 1923, creating a corridor for settlement along its route. Three hundred and fifty homesteads were filed in the Matanuska valley between 1915 and 1930 (Irwin 1968). Federal relocation programs of the New Deal organized rapid colonization of the Matanuska-Susitna valley by homesteaders and farmers in 1935 (ibid.).

   A lack of year-round roads to outlying areas encouraged commercial aviation operations. With aviation added to existing port and railroad facilities, Anchorage emerged as a transportation hub serving the entire Cook Inlet region and the vast interior to the north. By the 1940's, the Glenn Highway between Palmer and Glennallen was completed, along with roads to Wasilla, Willow, Big Lake, and Talkeetna (Selkregg 1972). Military bases established in Anchorage in 1939 and again in 1950 added both population and strategic importance to the Anchorage area. The discovery and development of Cook Inlet and Kenai Peninsula oil fields in the 1950's and 1960's ushered in the oil era to Anchorage as major oil companies and oil related industry located to Anchorage. As the state's largest city, Anchorage today remains a transportation hub and international air crossroads and serves as the headquarters for oil, finance, and state and federal government agencies (ibid.). The recent history of Anchorage has been marked by very rapid growth and expansion. Although population statistics will be discussed in more detail later, it is important to note in a historical context the emergence of Alaska's first metropolitan area. Neighboring, once relatively rural communities along Knik Arm and in the Matanuska Valley have, in the last decade, been absorbed into the growing metropolis of Anchorage.

2. Tyonek. The Tyonek area, on the upper west side of Cook Inlet, has for centuries been an important resource use area for Upper Inlet Tanaina. Tanaina Indians were present in the area at the time of the first European expeditions into Cook Inlet (Fall 1981a). In the 1790's, the Russians established an outpost at Tyonek (ibid.). This post was evidently destroyed in 1797 by Tanaina resisting Russian penetration into their territory. The Tyonek post was re-established in the mid nineteenth century and became the nucleus for area settlement.

Following the United States purchase of Alaska, an outpost of the the Alaska Commercial Company (ACC) was established at Tyonek and became the major ACC outlet in upper Cook Inlet. For a time around the turn of the century, Tyonek became the major disembarking and supply point for mining and exploration activities in upper Cook Inlet. Inundation by high tides forced relocation of the village in 1900 and again in the early 1930's to its present location 43 mi southwest of Anchorage. In the late 1930's, a village council government, which remains the governing body today, was established under the Indian Reorganization Act. Fishing and hunting continue to be vital social and economic activities to the residents of Tyonek (Fall 1983). Small-scale development of local timber, oil, and gas resources were encouraged by the community and took place in the 1960's and 1970's. Future development of Tyonek area coal, oil, gas, and hydroelectric potential are currently being assessed by outside firms (Darbyshire and Associates 1981).

3. Susitna and Yentna river area. The Susitna River and its major tributary, the Yentna River, drain a large region at the head of Cook Inlet. Traditionally, the Upper Inlet Tanaina occupied this area, and over 30 traditional village sites are recorded for the Susitna basin (Fall 1981a). Tanaina place name studies indicate Tanaina travel routes, campsites, and the importance of this region for hunting, fishing, and trading (Kari and Kari 1982). As many as 600 Tanaina inhabited the Susitna basin around the turn of the century (ibid.).

   Between 1898 and 1910, the Susitna River was explored by prospectors, scientists, and the military as interest in mineral extraction and travel routes to Alaska's interior heightened (U.S. Congress 1900). Gold was discovered in the Yentna River area around 1905, and placer mines were operated throughout the area into the early decades of this century, with concentrated activity around Fairview Mountain (Bacon 1982). Mining activity added a network of rudimentary roads and winter trails to the region (ibid.). In 1911, the Iditarod Trail was constructed and several roadhouses established along its route (Alaska Division of Parks 1974). The portion of this trail south of the Alaska Range fell into disuse following the construction of the Alaska Railroad in 1923 (ibid.).

   An epidemic of influenza in 1918 took a heavy toll of Tanaina in upper Cook Inlet. Most survivors relocated to Tyonek, and by the 1930's the Susitna basin population was reduced to a few scattered trappers and prospectors (Fall et al. 1983).

Within the past 30 years, settlement of the Susitna-Yentna basin has increased, largely as a result of federal homesteading and state land disposal programs. In addition to numerous dispersed cabins on lakes and streams, households have become concentrated at Alexander Creek, Lake Creek, and Hewitt Lake. The settlement of Skwentna, with its airstrip, school, and store is the focal point of a dispersed, year-round population in the upper Yentna River area. Several hunting and fishing lodges also operate seasonally in the Susitna-Yentna basin.

III. POPULATION

The size of the aboriginal population of the subregion is difficult to determine. The combined population of all Tanaina groups at the time of contact may have approached 5,000 (Townsend 1981). Outbreaks of epidemic disease during the nineteenth and early twentieth centuries reduced that number dramatically. By 1932, the entire Tanaina population was estimated to be 650 (Osgood 1937). The Upper Inlet Tanaina represented perhaps a third of that total.

Whereas natural resources such as furs, fish, and gold attracted early pioneers, it was development activities such as construction of the Alaska Railroad, homestead programs, the establishment of military bases, and oil and gas exploration that planted the seeds for major changes in the upper Cook Inlet population: changes from settlements to cities and an economic transformation from a regional population dependent on a subsistence-based economy of hunting, fishing, and gathering to a market economy centered around wage employment. During the twentieth century, human population has increased tremendously in upper Cook Inlet due to rapid in-migration from the continental United States. Today almost half the state's population resides within the boundaries of this subregion.

Table 1 gives population figures for communities of the subregion from 1880 to 1960 according to U.S. Census estimates, which no doubt underestimate the population of dispersed settlments and camps in the region. Population figures for upper inlet communities from 1970 through 1984 are presented in table 2.

The development and growth of Anchorage is responsible for the tremendous population increase in upper Cook Inlet over the last several decades. Until 1940, Anchorage exhibited only moderate growth.

Military base construction activities and newly stationed troops caused Anchorage's population to triple between 1940 and 1945 (Ender et al. 1978). The 1950's was another boom period for Anchorage. The Korean war caused an increase in military related construction activities, such as the DEW Line and White Alice installations and a network of new

Table 1. Population of Upper Cook Inlet and Matanuska-Susitna Communities, 1880-1960

Location	1880	1890	1900	1910	1920	1930	1939	1950	1960
Anchorage	---	---	---	---	1,856	2,277	3,395	11,254	44,237
Chickaloon	---	---	---	---	---	28	11	---	43
Chugiak	---	---	---	---	---	---	---	---	51
Eagle River	---	---	---	---	---	---	---	---	130
Eklutna	---	---	---	---	---	158	159	53	50
Girdwood	---	---	---	---	---	---	---	79	63
Knik	46	160	---	118	40	34	40	---	---
Montana	---	---	---	---	---	---	---	---	39
Palmer	---	---	---	---	---	---	150	890	1,181
Portage	---	---	---	---	---	---	---	34	71
Spenard	---	---	---	---	---	---	---	2,108	9,074
Susitna Sta.	90	142	---	233	48	52	12	---	42
Sutton	---	---	---	---	---	---	---	---	162
Talkeetna	---	---	---	---	70	89	136	106	76
Tyonek	117	115	107	---	58	78	136	132	187
Wasilla	---	---	---	---	---	51	96	97	112
Willow	---	---	---	---	---	---	13	---	78

Source: Rollins 1978.

--- means no data were available.

Table 2. Population of Upper Cook Inlet and Matanuska-Susitna Communities

Location	1970	1980	1984*
Anchorage Municipality	126,385	174,431	244,030
Anchorage Bowl	96,212	143,351	201,833
Military	24,031	17,346	16,463
Eagle River/Chugiak	5,832	12,858	24,202
Turnagain	310	876	1,532
Matanuska-Susitna Borough	6,509	17,816	34,068
Big Lake (CDP)**	36	410	---
Bodenburg Butte (CDP)	448	988	---
Houston City	69	370	739
Montana (CDP)	33	40	---
Palmer City	1,140	2,141	2,738
Sutton (CDP)	76	182	---
Talkeetna (CDP)	182	264	277
Wasilla City	300	1,559	3,548
Willow (CDP)	38	139	---
Eklutna	25	---	---
Girdwood	144	---	---
Skwentna	---	---	199
Tyonek	232	239	---

Source: USDC 1981.

--- means no data were available.

* 1984 figures are estimates obtained from the Municipality of Anchorage Planning Dept. and the Matanuska-Susitna Borough Planning Dept.

**(CDP)=Census Designated Place.

FAA facilities. As the state's transportaion hub, Anchorage demonstrated the ability to benefit from economic activity anywhere in the state (Fischer 1976). Steady growth in commercial and residential construction and new service industries accompanied each boom period in Anchorage. The 1964 earthquake paradoxically provided another boost for the Anchorage economy as federal disaster aid financed the major construction effort required to rebuild Southcentral Alaska. The development of the Kenai Peninsula oil field in the late 1960's and the construction of the Trans-Alaska Pipeline in the 1970's triggered new influxes of population and fueled the growth of service-related industries, financial institutions, government offices, and tourism to Anchorage.

Due to topography and land ownership, only 15% of the municipality's 1,700 sq mi is habitable (Selkregg 1972). Recent population growth has been forced northward along Knik Arm and into the Matanuska-Susitna Valley. The Eagle River-Chugiak population, for example, has grown from 5,832 in 1970 to an estimated 24,202 in 1984 (Municipality of Anchorage 1984). Rich farm lands, wildlife habitats, and the rural qualities of these outlying areas are undergoing rapid alteration because of this growth (Northern Consultants 1980). During a four year period in the 1970's, 25,521 acres of Mat-Su land were subdivided into 12,824 parcels to meet the demands of new area residents (ibid.). Anchorage's population is projected to reach 400,000 in the 1990's, growing to one million by the year 2025 (Fischer 1976). In addition to habitat change, rapid population growth concomitant to urban-suburban development creates growing numbers of increasingly mobile urban hunters and fishers competing for wild renewable resources both in the subregion and statewide.

IV. LAND STATUS

Land status within the Upper Cook Inlet/Susitna Basin Subregion is a complex mosaic of state, federal, Native, borough, municipality, and private land ownership. State lands include most of the Susitna basin, Chugach State Park, several state recreation areas and scenic easements along area rivers, and the Potter Point game refuge. Federal land holdings include military reservations, the Tuxedni Wildlife Refuge, withdrawls around airports, and the Alaska Railroad corridor (transferred to state ownership in 1985). A portion of the large Chugach National Forest lies within this subregion along Turnagain Arm. Borough lands from the Kenai Peninsula Borough, Matanuska Susitna Borough, and the Municipality of Anchorage (formerly the Greater Anchorage Borough) make up significant land holdings in the area. Private land holdings include homesites, Native allotments, homesteads, and mining claims. The Cook Inlet Native Corporation and land selections as provided for under the Alaska Native Claims Settlement Act also represent significant land withdrawals in the subregion.

V. USE OF FISH AND WILDLIFE RESOURCES BY LOCAL RESIDENTS

A. Traditional Subsistence Use

Historically, the uninhabited lower west side of Cook Inlet fell within the land use areas of several Tanaina Athapaskan and Eskimo groups. The Upper Inlet Tanaina, Iliamna Tanaina, Outer Inlet Tanaina of the Kenai Peninsula, and Eskimos from the lower Kenai Peninsula, Kodiak, and Lake Iliamna areas all made occasional use of the western shore of Cook Inlet and Kamishak Bay for harvesting sea otters and other marine resources (Kari and Kari 1982, Porter 1893).

The upper Cook Inlet area was exclusively Upper Inlet Tanaina territory. The Upper Inlet Tanaina adopted a generalized subsistence pattern of summer fishing combined with fall and winter hunting. Winter and spring trade between villages was also an integral part of their subsistence cycle, providing a means of distributing surpluses and preventing food shortages at critical times of the year. While adhering to this general subsistence pattern as a whole, local groups adopted regional subsistence strategies that optimized the use of resources in their locality. Fall (1981a) identifies three geographic divisions of the Upper Inlet Tanaina based on ecological differences and traditional subsistence patterns, as described below.

1. Coastal division. This group included Tyonek and the lower Susitna River villages. The coastal division was distinguished by access to marine mammals and an abundant fishery resource. With spring break-up, harvests of beaver, waterfowl, and trout initiated the annual subsistence cycle. From summer fish camps, seal, belukha whale, and eulachon were harvested for meat and oil. Using traps and dip nets, chinook, sockeye, coho, chum, and pink salmon were caught throughout the summer and dried for winter food and trade. Short fall hunting trips to inland areas for caribou, sheep, bear, and small game served to further supplement winter food supplies.

2. Interior Susitna basin division. This group included the Yentna and middle Susitna River villages. These Tanaina were largely dependent upon land resources and trade with coastal groups. Although salmon fishing remained an important summer subsistence activity, it was perhaps secondary in importance to the long fall hunting trips for caribou, moose, and sheep. Caribou surrounds or fences were used in traditional caribou hunting locations such as Rainy Pass. Small game and berries were also harvested on these fall expeditions, which sometimes lasted until after freeze-up before transporting large supplies of meat and skins back to the winter village.

Annual spring trading trips to the Susitna River delta were made to trade meat and skins with the coastal Indians in exchange for fish, oil, and other marine products.

3. Knik Arm division. This group included the villages along both sides of Knik Arm. These Tanaina combined aspects of the other two divisions, utilizing both marine and land resources and also relying on trade. Knik Arm streams lack the large runs of chinook salmon that ascend most Cook Inlet tributaries. Because of this, the subsistence pattern of Knik Arm Tanaina was distinguished by spring trips to fishing locations along lower Knik Arm at Fire Island and in the vicinity of present day Anchorage. Point Mackenzie, across Knik Arm, was a place where Knik Arm people met lower Susitna groups to trade and assist in harvesting eulachon, seal, and belukha. Following these spring trips, Knik Arm Tanaina fished for salmon at locations such as Big Lake, Fish Creek, and Wasilla Creek, which were closer to their winter villages. The Knik and Matanuska rivers provided travel routes for fall hunting trips for sheep, caribou, bear, marmot, and ground squirrel.

B. Historic Period Subsistence Patterns

Traditional Upper Inlet Tanaina subsistence and settlement patterns were altered by Euroamerican settlement and the fur trade during the nineteenth century. Traditionally, winter was a time of relatively low subsistence activity in the Tanaina annual cycle, a time for visiting, trading, and potlatching (Fall 1981a). Tanaina involvement in the developing fur trade has been previously discussed. This involvement drastically altered the Tanaina annual cycle by requiring extended periods away from the winter village. The period of disease in the 1830's, which devastated the Tanaina population, brought further changes in subsistence and settlement patterns. As mentioned earlier, surviving Tanaina abandoned traditional villages and began to concentrate in regional population centers, which were developing around trading posts and missions. In this manner, Upper Inlet Tanaina from sometimes distant villages were brought together, and in an attempt to adhere to traditional land use areas individuals were forced to travel long distances to hunt and fish (ibid.).

By the 1890's, conditions along Cook Inlet were rapidly changing. An influx of non-Native settlers increased competition for game, fish, and fur (Glenn 1900, Osgood 1901). Heavy commercial fishing by cannery operators had depleted salmon runs and seriously impacted the Native subsistence economy around Cook Inlet (Elliott 1900, Fall 1981a). Around the turn of the century, moose began to replace caribou as the most important large game animal (Fall

1981a). With this shift, the organized group caribou hunt of the past was to some extent replaced with a more individualized hunting effort.

The result of all these changes was an eroding of traditional Tanaina settlement and subsistence patterns. By the first decades of the twentieth century, most of the Upper Inlet Tanaina population was concentrated in Tyonek, Susitna Station, Knik, and Eklutna. Fur prices had declined dramatically, and the annual round began to incorporate seasonal wage employment as a supplement to trapping income. Tanaina were employed as freight and mail carriers, and many worked on construction of the Alaska Railroad (ibid.). While traditional foods continued to be very important, purchased, imported foods became an added feature to the local diet.

C. Contemporary Subsistence and Other Local Use of Wild Resources

Documentation of contemporary resource use by certain subpopulations of the subregion is not complete. More research is needed to better understand resource use by urban Natives, remote railbelt homesteaders, urban outdoorsmen, and residents of traditional Native communities now confronted with urban sprawl. Analysis of currently available data on contemporary use of fish and wildlife in the Upper Cook Inlet/Susitna Basin Subregion reveals three general use patterns corresponding to three geographic areas:

- Tyonek: characterized by a distinct village setting; a definite annual round of subsistence activities distinguished by the use of a wide range of marine and land resources; and a kinship based system for the harvest, processing, distribution, and exchange of wild resource products

- Susitna-Yentna River: characterized by a widely dispersed area population and an annual round of harvest activities emphasizing land resources

- Anchorage and the railbelt: characterized by an urbanized population connected by transportation networks, high levels of participation in a diversified industrial-capital economy, and wild resource use, which varies greatly among households and is secondary to the area economy

The use of wildlife resources in each of these areas will be discussed in detail below. All known resource harvest is described in this section; however, discussion of harvest that is currently not permitted by regulation does not constitute endorsement of such harvest by the Department of Fish and Game.

1. Tyonek:

a. Species used and annual round. In Tyonek, hunting, fishing, and gathering activities proceed according to a well-established annual round of activities. Harvest activities provide a major means of economic security for households and are perceived as central to the community's social well-being (Fall 1983). Production and processing of wild resources is a family based activity, and sharing, distribution, and exchange of resources among community members is common (ibid.). The species utilized and the annual round in Tyonek is depicted in figure 1.

The contemporary annual round of subsistence activities in Tyonek is described by Fall et al. (1984). A new annual round begins at the conclusion of the Russian Orthodox observation of Lent in April or early May, when the consumption of red meat is prohibited. Hunting of small game such as ptarmigan, spruce grouse, and hare resumes following Lent. Some beaver trapping takes place in nearby lakes and sloughs. With the departure of Cook Inlet ice and the advent of the first minus tides, clamming expeditions are organized to Redoubt Bay and Harriet Point south of West Foreland. Spring runs of eulachon (hooligan) are harvested with nets from the beach or by hand when schools become beached in a strong surf.

An intense chinook salmon fishing period begins in mid May. The large size and early arrival of chinook salmon make them a particularly important part of the community's subsistence resources. Salmon are harvested by Tyonek residents using set gill nets operated from traditional family fishcamps near the village. Participation in chinook salmon fishing is high. During the spring months in 1983, 81% of all Tyonek households were involved in catching or processing chonook salmon. About 10 families move to fishcamps as their permanent summer residence. Other families use fishcamps on an intermittent basis, returning to the village during closed fishing periods.

About 38% of all households also have members who fish commercially using set gill nets at the same sites used for subsistence fishing. Coho salmon are harvested for both subsistence and commercial sale, whereas sockeye, pink, and chum salmon are mostly harvested for commercial sale. Fishing for coho salmon continues into September. Freshwater fish such as Dolly Varden and

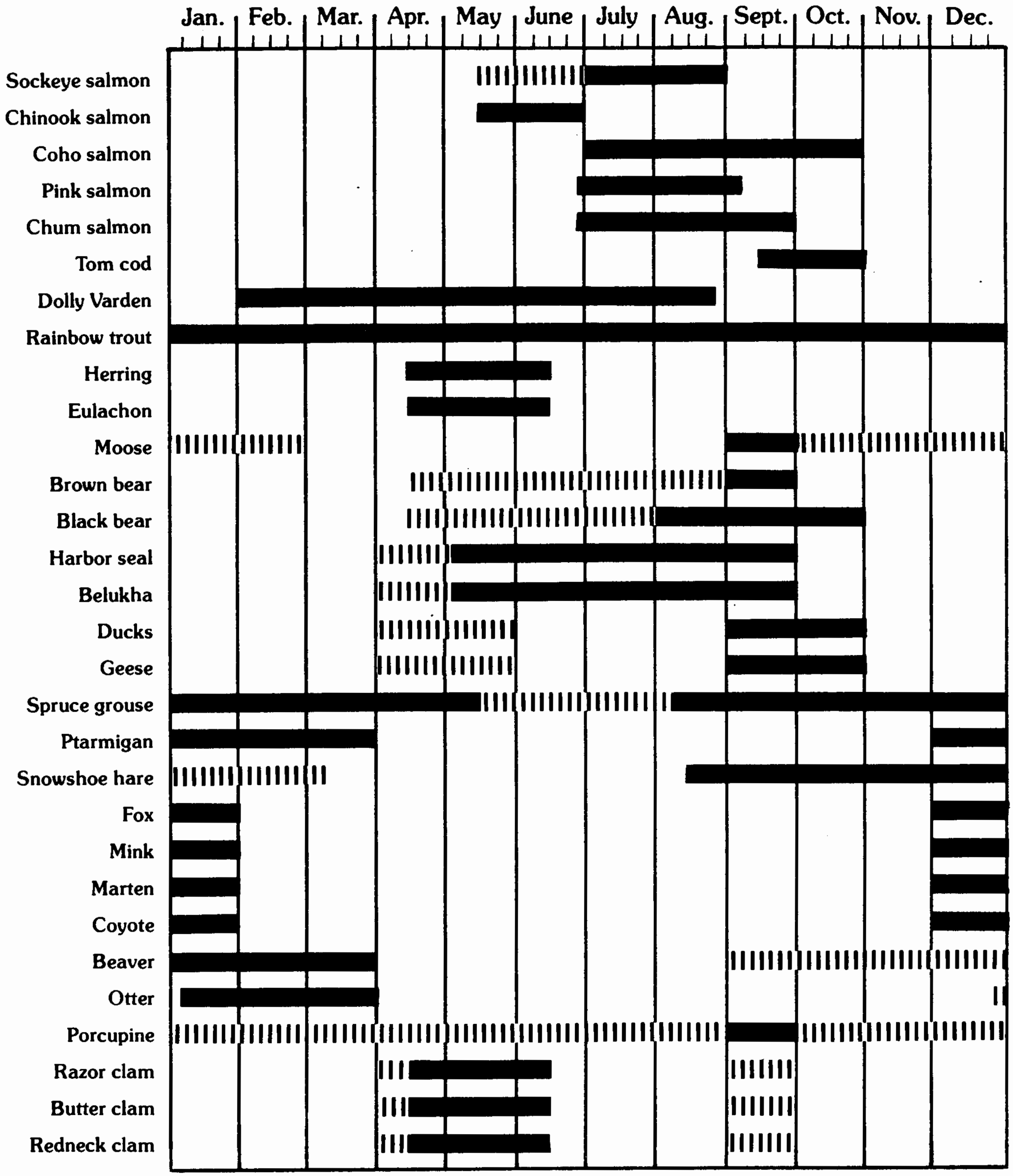


Figure 1. Annual round of harvest activities by Tyonek residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort (Foster 1982b).

(continued)

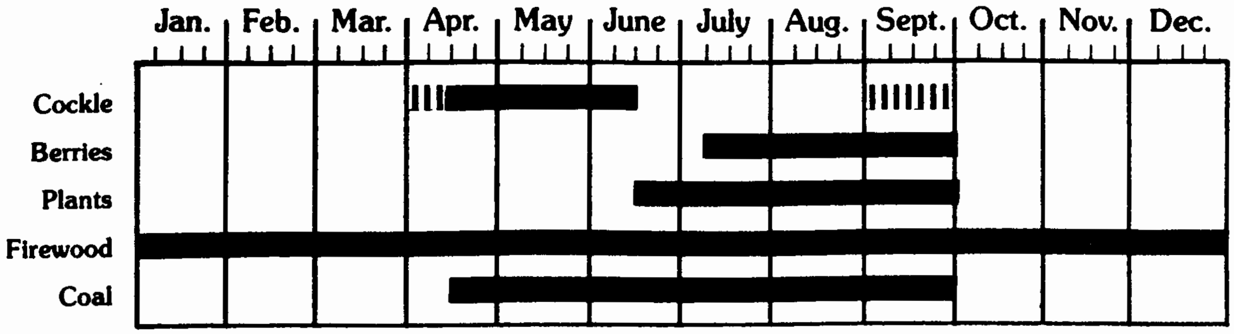


Figure 1 (continued).

rainbow trout are caught throughout the summer from local freshwater streams, using rod and reel.

Harbor seals are hunted on an opportunistic basis, sometimes in conjunction with salmon-fishing operations. During the summer, villagers also organize hunting trips along offshore areas for belukha whale.

Gathering of edible plants such as wild celery (*Angelica lucida*), wild rhubarb (*Rumex arcticus*), and rosehips (*Rosa acicularis*) occurs during the summer. Berries picked in season include high and low bush cranberries (*Viburnum edule*, *Vaccinium vitis-idaea*), salmon berries (*Rubus chamaemorus*), blueberries (*Vaccinium uliginosum*), and crow berries (*Empetrum nigrum*). Firewood is gathered throughout the year, but wood-gathering activities intensify around October.

In September, harvest efforts concentrate on moose. Access to moose hunting areas is through a network of local logging roads or by boat to nearby river drainages. Fall moose hunts frequently combine fishing and gathering activities. Black bear, porcupine, grouse, ptarmigan, waterfowl, and marine mammals are harvested on an opportunistic basis during fall hunts. Prior to regulatory changes in 1975, moose hunting continued into early winter. In 1983, a winter moose hunting season was reestablished in GMU 16B for subunit residents.

Winter is a time of relatively low activity in the annual cycle of Tyonek residents. Hunting for ptarmigan, spruce grouse, and hare continues through the winter, and trout are caught through the ice. A few Tyonek residents trap furbearers beginning in mid

November and continuing throughout the winter months. Trapping for beaver continues into March.

Despite a scarcity of local job opportunities, wage employment has become part of the annual cycle of almost all Tyonek households. Cash income is derived from a combination of seasonal or part-time employment such as commercial fishing and government transfer payments. Median household income in Tyonek was $10,750 in 1979, compared to $27,375 in Anchorage (U.S. Census 1980). The use of wild resources provides an important economic base for the majority of Tyonek residents. At the same time, subsistence activities tie the community together and provide a basis for group identity and community stability (Fall et al. 1983).

b. Harvest levels and use of fish and game. Specific resource harvests for the village, household participation rates, and mean household harvests for Tyonek between February 1983 and January 1984 are presented in table 3. The information was derived from a complete survey of 72 village households.

As shown in table 3, chinook salmon was the major wild food resource in Tyonek, providing more than two thirds of the mean annual household harvest by weight in 1983. Eighty-one percent of Tyonek households participated in the harvest of chinook salmon in 1983. Five traditional methods are used to preserve chinook salmon: smoking, canning, freezing, salting, and fermenting (Foster 1982b). Chinook salmon are very thoroughly utilized: the flesh is cut into steaks, fillets, and strips for smoking, while heads, tails, fins, backbone, roe and milt sacks, hearts, and stomachs are processed into a variety of traditional products (fig. 2). Besides chinook salmon, other species of salmon are harvested in smaller quantities for subsistence use (table 4).

After chinook salmon, moose makes the second highest contribution by weight to mean household harvest, 208 lb per household in the study year (table 3). Moose harvests for Tyonek from September 1979 to January 1984 are presented in table 5. Moose meat is hung in a cool place for aging prior to preserving. Some Tyonek residents lightly smoke moose during aging for added flavor (Fall et al. 1984). Choice cuts and portions of moose are eaten fresh, but most moose meat is frozen in freezers.

Table 3. Levels of Household Harvest and Use of Wild Resources, Tyonek, Feb. 1983-Jan. 1984

Resource	% Attempted Harvest	% Successful Harvest	Mean Household Harvest (LB)	Total Village Harvest*
Chinook salmon	81	78	652.0	2606
Sockeye salmon	61	54	13.0	226
Coho salmon	46	43	27.0	319
Pink salmon	10	1	.4	15
Chum salmon	13	4	2.2	26
Rainbow trout	13	13	4.0	194
Dolly Varden	11	11	2.3	169
Arctic grayling	1	1	.1	1
Whitefish	1	1	.1	6
Hooligan (5-gal buckets)	26	25	8.8	21
Belukha	11	4	9.7	1
Seal	7	0	0	0
Clams**(5-gal buckets)	18	15	16.3	78
Moose	69	35	208.3	30
Black bear	1	0	0	0
Spruce grouse	26	24	.5	79
Ptarmigan	10	7	.1	19
Duck	47	36	4.5	216
Geese	44	7	.4	9
Porcupine	17	14	.9	14
Red fox	1	1	---	2
Beaver	8	7	3.2	26
Plants (quarts)	64	64	12.0	865
Wood (cords)	60	58	---	142
Coal (5-gal buckets)	26	26	---	1220

Source: Fall et al. 1984.

--- means no data were available.

* Harvest given in numbers of animals, unless otherwise noted.

** Includes razor clams, surf clams, and cockles; most of the harvest is razor clams.

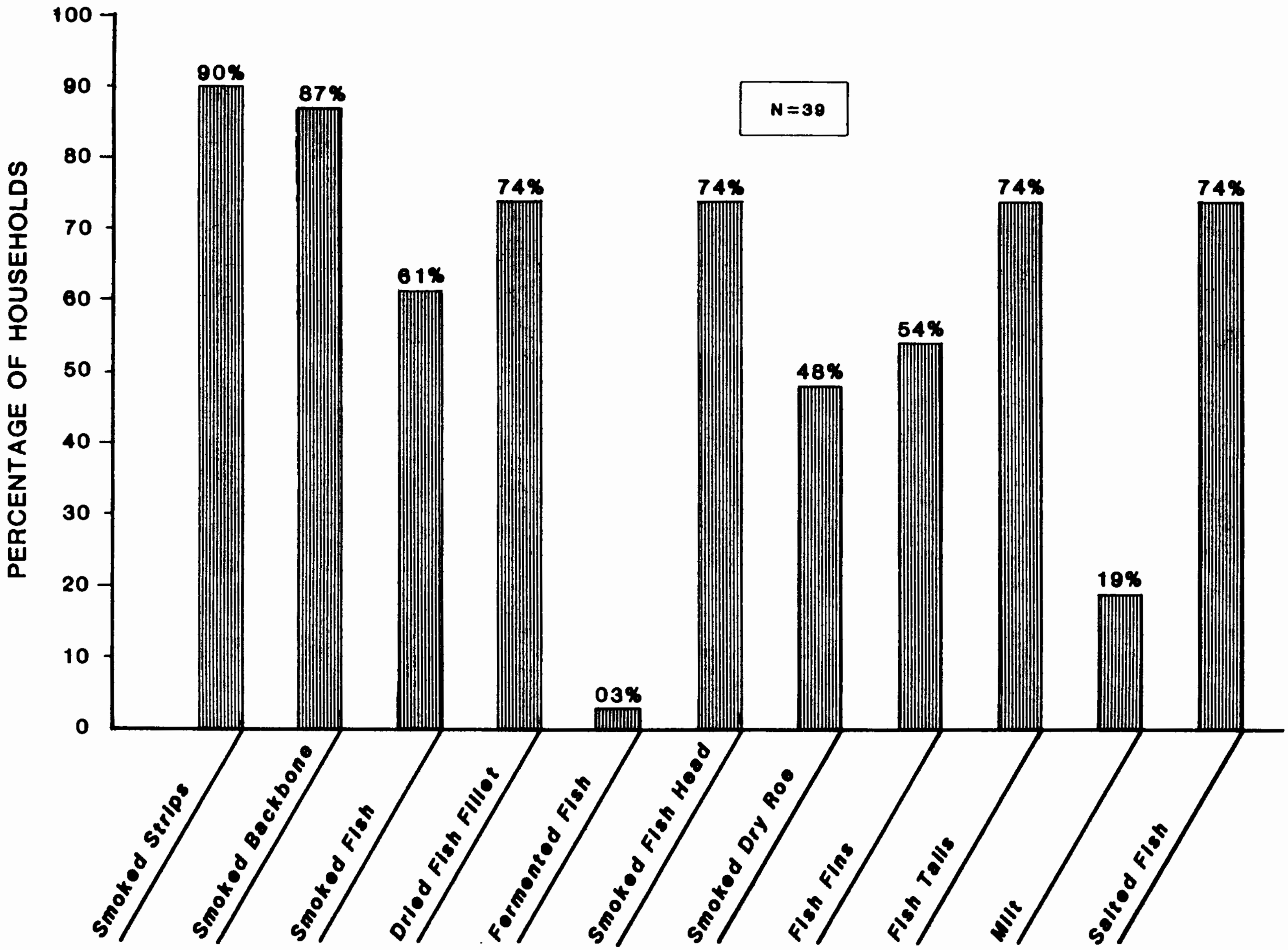


Figure 2. Percentages of Tyonek households processing each traditional salmon product (Foster 1982b).

Table 4. Tyonek Subsistence Salmon Harvest Data, 1980-84

	1980 N=67	1981 N=70	1982 N=69	1983 N=75	1984 N=71
Chinook salmon	1,936	2,002	1,565	2,705	2,354
Sockeye salmon	262	269	209	185	268
Coho salmon	---	64	113	40	---
Pink salmon	---	32	15	---	---
Chum salmon	---	13	4	2	---

Source: Fall et al. 1984, Ruesch 1983 and 1984.

--- means no data were available.

Table 5. Tyonek Moose Harvests, September 1979 through January 1984

Season	Number of Moose
September 1979	20
September 1980	---
September 1981	15
September 1982	9
September 1983	14
November 1983	1
January 1984 (emergency season)	14

Source: Fall et al. 1984.

--- means no data were available.

Marine mammals have long been a source of food for residents of Tyonek. As many as six or seven belukhas per year were harvested by Tyonek residents during the 1930's and early 1940's (Fall et al. 1984). Federal marine mammal regulations have allowed Alaska Natives to continue this tradition. Since the 1940's, Tyonek elders report a shift in hunting effort from marine mammals to moose (ibid.). In recent years, however, there has been renewed effort in organized hunting trips for belukha. From 1981 through 1983, one belukha was harvested each year. Eight households were involved in belukha hunting efforts in 1983. Belukha meat is eaten fresh after roasting or boiling and is also preserved by freezing. Belukha blubber is rendered into oil and refrigerated for use in cooking.

c. Distribution and exchange. Social relationships, especially kinship, shape harvest and processing activities as well as distribution and exchange of fish and game resources in Tyonek. Hunting and fishing groups are usually composed of relatives. Facilities and equipment such as fishcamps, nets, vehicles, and smokehouses are commonly shared, and wild resources are widely distributed throughout the village. For example, although only 15 moose were harvested by Tyonek hunters in 1981, 90% of Tyoneks's 75 households recieved moose meat (Fall et al. 1983). Extensive sharing occurs along kinship lines and, to varying degrees, across kinship lines. Resources requiring special equipment or skills to harvest, such as marine mammals or clams, may be harvested by a limited number of individuals and distributed throughout the village (see table 3)(ibid.).

Distribution of unprocessed products, such as a hind quarter of moose or a whole salmon, often occurs among members of the hunting or fishing party at the time of harvest (Foster 1982a). Distribution of processed products such as smoked salmon also occurs from the harvester to recipients, such the elderly or sick, who do not have the means to produce the products themselves. Resources are also shared during special social events such as potlatches, weddings, birthdays, and funerals (ibid.).

d. Harvest geography. Maps detailing the areas used for subsistence activities by Tyonek residents are available from the Division of Subsistence and are also included in the Atlas to the Southcentral Region. For Tyonek residents, most subsistence activities are concentrated between the Chuitna and Chakachatna rivers. Waterfowl hunting occurs in coastal marsh areas from the Susitna River mouth to West Foreland. Net fishing for salmon occurs along the shore of Cook Inlet from 1 mi south of the mouth of the Chuitna River to Granite Point, including beaches adjacent to the village and Beshta Bay south of the village. Moose hunting occurs along a limited network of local logging roads or in area river drainages accessed by skiff. Marine mammal hunting occurs offshore from the Susitna River to Redoubt Bay. Shellfish are harvested on beaches south of West Foreland between Redoubt and Tuxedni bays (Fall et al. 1984).

2. Susitna-Yentna rivers area. Fall et al. (1983) described the use of fish and game resources in the upper Yentna River area, which is presented here to represent the resource use patterns of residents of the Susitna-Yentna rivers area as a whole.

    a. Species used and seasonal round. The dispersed population of the Susitna and Yentna rivers area follows an annual round of subsistence activities as depicted in figure 3. With the breakup of ice on lakes and streams in April or May, fishing begins for rainbow trout, northern pike, arctic grayling, and whitefish. Spring hunts for brown and black bear begin in April or May and occur throughout the summer and fall. In May, chinook salmon ascend area streams and are harvested. Rod and reel is the primary method of harvesting salmon. Fishing for salmon continues thoughout the summer and into October. Spring and summer is a time for gathering edible plants such as mushrooms, berries, fireweed, and fiddlehead fern. Fishing for burbot occurs from July throughout late summer, fall, and winter. In September, there is heavy participation in moose hunting. Waterfowl are also harvested during fall hunts in September and October. Small game such as spruce grouse, snowshoe hare, and squirrel are harvested throughout the fall and winter. Beginning in November, participation in trapping occupies the winter months of many Susitna-Yentna residents. A variety of furbearers are trapped, including red fox, marten, mink, and weasel. Trapping for beaver and muskrat continues into April and May, when breakup marks the beginning of a new cycle.

    Full or part-time seasonal wage employment is part of the annual round of all households. Cash income is needed in order to purchase fuel, food staples, equipment, building materials, and other commodities not

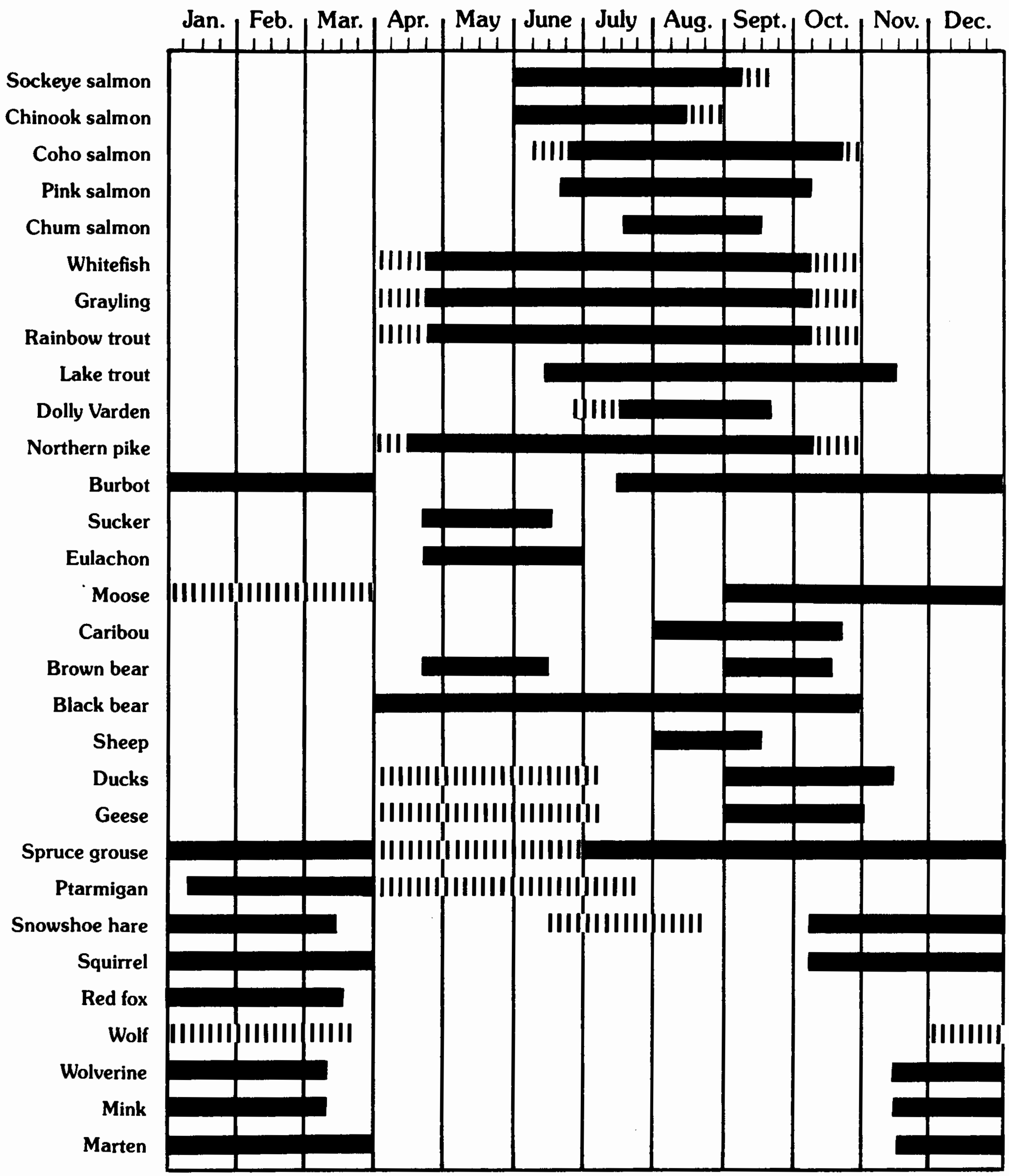


Figure 3. Annual round of harvest activities by upper Yentna River area residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort (Fall et al. 1983).

(continued)

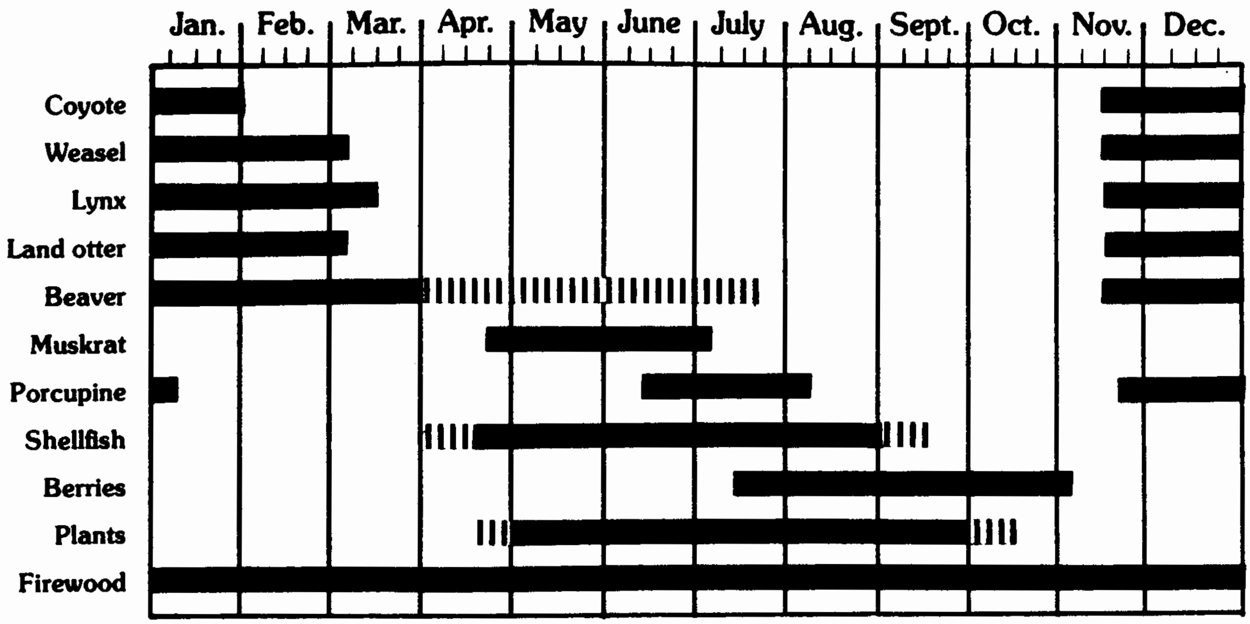


Figure 3 (continued).

produced locally. Because of the limited opportunities for full-time employment in the Susitna-Yentna area, most households combine several seasonal or part-time jobs during the year. In 1982, 52% of upper Yentna households had three or more sources of cash income during a single year (Fall et al. 1983). Trapping, guiding, and assisting at area lodges are examples of local seasonal jobs available to residents of this area.

b. Harvest levels and use of fish and game. The percentage of upper Yentna households harvesting specific resources and estimates of quantities harvested in 1982 are shown in table 6. The number of wild resources used by upper Yentna households is quite variable, with some area households using five resources or less, whereas others utilized more than 30 (fig. 4).

Moose is a particularly important resource to residents of the Susitna-Yentna area. Eighty-three percent of upper Yentna households participated in moose hunting in 1982 (Fall et al. 1983). Characteristics of Upper Yentna River moose harvest from 1980 to 1982 are presented in table 7. Timing of the harvest has much to do with how moose meat is preserved and distributed. A moose taken in warm weather is usually distributed to other households, allowing smaller portions to be consumed or preserved to prevent spoilage (ibid.). Lack

Table 6. Percentage of Surveyed Households Harvesting Resources and Estimated Quantity Harvested by 38 Upper Yentna Households in 1982

Resource	Percentage of Surveyed Households Harvesting	Estimated Quantity Harvested	
Wood	97	251-268*	387-427**
Moose	83	30	
Berries	83	431-446 qt	
Sockeye salmon	78	413-470	
Coho salmon	75	331-351	
Rainbow trout	72	482-520	
Chinook salmon	67	141-151	
Edible plants	50	156-160 qt	
Spruce grouse	50	141-171	
Pike	47	252-279	
Black bear	44	13	
Pink salmon	44	523-531	
Duck	42	138-148	
Arctic grayling	39	384-435	
Marten	39	296	
Beaver	39	195	
Hooligan	36	5,480-5,929	
Mink	36	126	
Burbot	36	131-144	
Weasel	33	82	
Ptarmigan	22	120	
Snowshoe hare	22	85	
Chum salmon	22	94-127	
Red squirrel	19	174	
Whitefish	19	45-61	
Shellfish	19	1,003-1,481***	
Coyote	19	9	
Lake trout	17	42	
Geese	17	4	
Lynx	17	3	
Red fox	17	8	
Wolverine	14	1	
Flying squirrel	14	20	
Dolly Varden	14	124	
Muskrat	14	155	
Land otter	11	20	
Porcupine	11	7	
Brown bear	11	1	
Wolf	6	0	
Caribou	6	1	
Sucker	6	200	
Dall sheep	3	1	

Source: Fall et al. 1983.

* Cords of birch, spruce, and cottonwood for firewood.

** Numbers of trees used in construction.

*** Razor, steam, and freshwater clams.

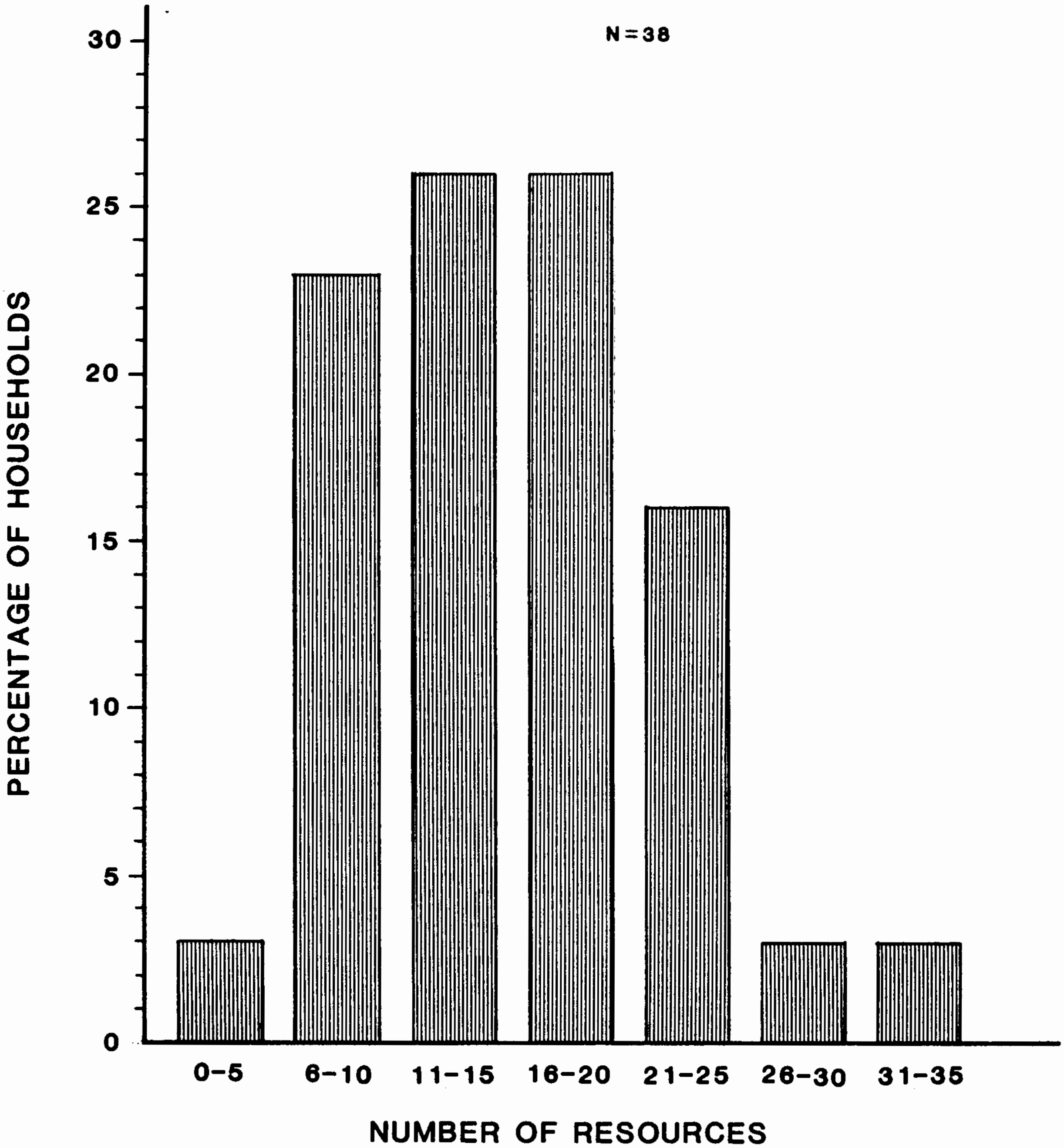


Figure 4. Number of resources harvested per household in the upper Yentna River area in 1982 (Fall et al. 1983).

Table 7. Moose Hunting Effort and Success (Percentage) of 38 Upper Yentna Households, 1980-82

Category	1980	1981	1982
Successful locally	63.1	52.6	63.1
Successful nonlocally	2.6	0.0	2.6
Unsuccessful	21.1	34.2	26.4
Did not hunt	13.2	13.2	7.9

Source: Fall et al. 1983.

of a continuous source of electricity makes preserving large quantities of meat in freezers impractical. Freezing moose outdoors following freeze-up is the preferred method of preserving moose. Canning, drying, pickling, freezing small quantities in freezers, and making sausage are also common preservation techniques (ibid.).

Salmon makes the second largest contribution of wild resources to the diets of residents in the Susitna-Yentna area. Canning is the dominant method of preserving salmon. Some households have smokehouses and lightly smoke salmon prior to canning for added flavor.

c. Harvest geography. Maps detailing the areas used for various subsistence activities by sampled residents of the upper Yentna river area are available through the Division of Subsistence and are also included in the Atlas to the guide for the Southcentral Region. In general, residents extensively utilize the land area immediately surrounding their individual household or a community such as Skwentna. Land use areas extend outward along area rivers and streams, as these provide major access corridors to hunting and fishing areas.

3. Anchorage and the railbelt. Urban life significantly influences the resource use patterns of residents of Anchorage, the Matanuska Valley, and the railbelt (in this section, "urban" includes the suburban periphery as well). Relationships between people and wild resources typically

acquire recreational qualities in an urban socioeconomic system. Residents of the Anchorage metropolitan subregion commonly engage in fishing, hunting, and gathering activities that are organized and valued as recreational pursuits and for the quality of food harvested. In addition to recreational use of resources, a smaller segment of Anchorage engages in fishing and hunting for commercial purposes as commercial fishermen or commercial guides. And as is discussed later on, subcommunities may exist in Anchorage, in the form of social classes or ethnic enclaves, that engage in patterns of resource use that display certain similarities with rural resource uses and that may fall under the classification of "personal use." This section briefly summarizes the primary resource patterns of the Anchorage-railbelt area. Readers are referred to other sections of this volume dealing with hunting, sportfishing, personal use fishing, and commercial fishing for further information on these kinds of resource use. As stated above, the current urban economy of Anchorage and the Matanuska Valley is based on finance, transportation, commerce, government, and services. The Anchorage-railbelt area has an "industrial-capital" economic system characteristic of the continental United States: most economic activity occurs within business firms (such as corporations or government agencies) usually distinct from family groups; economic activity is for commercial exchange through impersonal market mechanisms; and the family is a central consumption unit, not a production entity, as occurs in a subsistence-based socioeconomic system (Wolfe et al. 1984). The majority of people in an urban setting sell their labor as workers to firms and in wages. Work schedules are set by one's employer and typically entail time constraints of long, regular duration (ibid.).

In this type of socioeconomic system, fishing and hunting typically assume the character of recreational pursuits, scheduled by a person (or household) as a periodic break from more routine work activities. Fishing and hunting are no longer central social activities around which the community or family are organized. Instead, fishing and hunting are activities that are highly valued by urban residents because they represent a break or diversion from the more central work activities required within an industrial-capital system. On weekends, vacations, holidays, and "time-offs," substantial numbers of residents leave the urban area to fish, hunt, and gather wild resources on the Kenai Peninsula, Matanuska-Susitna basin, Copper River basin, and in other less urbanized areas of the state (Fischer 1976, Alves et al. 1978).

A substantial percentage of Anchorage and railbelt residents participate in this pattern of resource use. The Alaska Public Survey of a random sample of households in Anchorage (N = 2,476 households) and Palmer-Wasilla (N = 81 households) showed that in 1979, 60% of all respondents reported being involved in some fishing, hunting, or gathering activity during the past year (table 8). The most frequently reported activities were plant or berry gathering (42%, 54%), freshwater fishing (40%, 33%), saltwater fishing (27%, 32%), and moose hunting (13%, 21%). The mean number of hunting days reported by respondents who hunted during the study period are shown in table 9. The favorite food-gathering activity of all respondents was fishing (table 10). When asked to characterize their favorite food-gathering activity, 79% of the Anchorage sample defined their activity as recreational or mostly recreational, while 13% defined it as subsistence or mostly subsistence (table 11).

Quantifying the amount of wild resources harvested per household in the Anchorage-railbelt area is difficult. Responding to a general question of proportions, 93% of Anchorage respondents and 80% of Palmer-Wasilla respondents reported their personal harvest contributed some or none of their annual diet (table 12), while 5% and 20%, respectively, reported it contributed half of their yearly diet. This compares with responses from the upper Yentna River area, where residents reported on average that 62% of their diet was obtained from wild resources, and no households reported using no wild resources (Stanek 1982).

In a 1971 survey of 100 Anchorage households, Thomas et al. (1973) found that annual wild game consumption increased with a household's annual monetary income (table 13). This relationship may be due to an increased ability to afford recreational travel and equipment costs by households with greater incomes. Nevertheless, the mean peak consumption of 89.1 lb per household reported for the most productive Anchorage households in the sample were markedly lower than the mean annual levels in Tyonek (Fall et al. 1984). These differences in levels of use of wild resources undoubtedly are associated with basic differences between the socio-enonomic systems of urban Anchorage and rural Tyonek.

Whereas recreational use is the most widespread pattern of resource use by residents of an urbanized area, other patterns of resource uses also exist within segements of the urban population. Like most urban areas, the Anchorage-railbelt area contains a heterogeneous composite of neighborhoods, socioeconomic classes, ethnic enclaves, and

Table 8. Percentage of Sampled Households Participating in Food-Gathering Activities Within the Preceding 12 Months (1978-79)

Activity	Anchorage (N=2,476)	Palmer-Wasilla (N=81)
Moose hunting	13.2%	21.4%
Deer/elk hunting	1.4	7.1
Caribou hunting	4.9	7.1
Other big game hunting	2.5	0.0
Waterfowl	6.9	10.7
Other small game hunting	7.6	10.7
Trapping	1.3	0.0
Plant/berry gathering	42.2	53.6
Other food gathering	8.2	21.4
Noncommercial saltwater fishing	26.6	32.1
Freshwater fishing	39.9	33.3
Any big game hunting	15.0	28.6
Any small game hunting	11.7	17.9
Any hunting	18.7	39.3
Any food-gathering activity	60.1	60.0

Source: Clark and Johnson 1981.

Table 9. Days Per Year Participating in Food-Gathering Activities During 1978-79

Activity	No. Partic-ipants	Mean No. Days	Standard Deviation	No. Partic-ipants	Mean No. Days	Standard Deviation
Moose hunting	320	4.3	3.6	17	2.2	1.5
Deer/elk hunting	31	13.8	29.3	6	3.0	1.1
Caribou hunting	109	4.1	3.5	6	4.0	2.2
Other big game hunting	59	10.8	21.8	---	---	---
Waterfowl hunting	172	3.9	13.6	9	8.0	9.1
Small game hunting	183	2.3	5.6	9	1.0	0.0
Trapping	31	1.4	0.5	---	---	---
Other hunting	179	12.1	54.5	17	1.8	1.1

Source: Clark and Johnson 1981.

--- means no data were available.

Table 10. Favorite Food-Gathering Activity of Anchorage and Palmer/Wasilla Residents, by Percentage

Activity	Anchorage (N=2,476)	Palmer/Wasilla (N=81)
Moose hunting	6.9	0.0
Deer hunting	0.0	0.0
Caribou hunting	0.5	0.0
Other big game	0.0	0.0
Waterfowl hunting	0.9	0.0
Other small game	0.0	0.0
Salmon fishing*	5.0	0.0
Other fishing*	0.5	10.0
Crabbing*	1.4	0.0
Trapping	0.5	0.0
Berry picking	27.5	10.0
Clamming	0.5	10.0
Goat hunting	0.5	0.0
Upland bird hunting	0.0	0.0
Hunting (general)	4.6	20.0
Fishing (general)	49.1	50.0
More than one activity	1.4	0.0
Other activities	0.9	0.0
	100.0	100.0

Source: Clark and Johnson 1981.

* Noncommercial.

Table 11. Definition of Participation in Favorite Food-Gathering Activity in Sampled Anchorage Households, by Percentage

Activity	Percentage
Recreational	67
Mostly recreational	12
Neither/both	8
Mostly subsistence	8
Subsistence	5

Source: Clark and Johnson 1981.

Table 12. Amount of Yearly Diet from Personal Harvest, from Others, and Given or Traded Away by Anchorage and Palmer/Wasilla Residents

	Personal Harvest %		Given Away or Traded %		Received from Others %	
	Anchorage	Palmer/ Wasilla	Anchorage	Palmer/ Wasilla	Anchorage	Palmer/ Wasilla
All	0.0	0.0	0.3	0.0	---	---
Most	1.3	0.0	0.6	0.0	0.5	0.0
Half	5.4	20.0	3.2	0.0	1.6	0.0
Some	63.4	46.6	36.1	33.3	97.9	100.0
None	29.9	33.3	59.7	66.7	---	---

Source: Clark and Johnson 1981.

--- means no data were available.

Table 13. Effect of Household Income on Wild Game Consumption in Anchorage (N=100)

Household Income ($) (1971)	No. Households	Average Annual Household Game Consumption	Per Capita Annual Game Consumption
0- 5,999	10	23.8 lb	9.0 lb
6,000-11,999	21	30.7	10.4
12,000-17,999	24	80.0	19.8
18,000-23,999	18	87.5	23.4
24,000- over	14	89.1	21.3
Unknown	13	39.7	10.2

Source: Thomas et al. 1973.

other subgroups. Particular subgroups within the Anchorage-railbelt area undoubtedly exhibit patterns of resource uses that differ from the predominant recreational pattern this time, resource surveys applied to the state's urban areas have not been designed to identify and describe distinct resource use patterns of discrete subcommunities of the Anchorage-railbelt area.

Were such information available, it would likely show that even within the urban Anchorage-railbelt area there exist identifiable subcommunities in which the harvest of wild resources provides significant and particular social, economic, and nutritional values to the subgroup.

For instance, the traditional Tanaina villages of Knik and Eklutna now fall within the metropolitan shadow of Anchorage; their traditional hunting and fishing territories are bisected by roads and tranformed by encroaching suburban development. Yet, a recent study found that even while the land, society, and economy were undergoing extraordinary conversion around them, residents of Knik and Eklutna still considered the use of wild resources to be of cultural, economic, and nutritional importance (Fall 1981b). As another example, some portion of the Alaska Natives living in urban areas continue to place special values on wild resources, returning regularly to "home" communities to hunt and fish. It is also known that traditional food products commonly are sent by kin and friends in rural villages to kin and friends in urban areas to satisfy these personal, cultural needs, although the precise characteristics of this rural-to-urban flow of wild foods has never been studied. As another example, the Western "frontiersman" or "outdoorsman" traditions of certain Anchorage residents, traced as a personal family history from the continental United States, undoubtedly contain special values and relationships to wild resources and their use. These traditions are commonly passed on between members of outdoorsmen clubs and other voluntary associations within the urban setting.

Thus, it is a mistake to view the resource uses within the Anchorage railbelt area as a simple homogeneous recreational pattern. Other resource use patterns can be found in subgroups like formerly rural communities recently swallowed by expanding urban areas, formerly rural residents recently moved to the urban area, voluntary associations and families maintaining personal hunting traditions, as well as in socioeconomic groups like commercial fishermen and commercial guides. Some of these uses may eventually receive formal recognition as distinct types, perhaps falling within the "personal use" category, being neither precisely recreational, commercial, or subsistence in nature. These characteristics of these resource use patterns of urban subgroups await further study and description.

REFERENCES

ADNR. 1974. Alaska's historic roadhouses. Western Interstate Commission for Higher Education, Boulder, CO.

Alves, W., T. Lane, and M. Scott. 1978. The effects of regional population growth on hunting for selected big game species in Southcentral Alaska 1976-2000. AEIDC, Anchorage.

Bacon, G., ed. 1982. Cultural resource assessment: beluga study area, Southcentral Alaska. Chapters individually paginated in USDA, Susitna River basin study, cultural resource assessment of Willow-Talkeetna-Beluga areas. In cooperation with ADNR, N.P.

Clark, R.N., and D.R. Johnson. 1981. Selected findings of the Alaska Public Survey, 1979. USDA, Forest Service, Seattle, Wash.

Darbyshire and Associates. 1981. Socioeconomic impact study of resource development in the Tyonek/Beluga coal area. Anchorage.

Detterman, R.L., and J.K. Harstock. 1966. Geology of the Iniskin-Tuxedni Region, Alaska. U.S. Government Printing Office, Washington, DC.

Elliot, C.P. 1900. Salmon fishing grounds and canneries. Pages 738-739 in U.S. Congress, compilation of narratives of exploration in Alaska. U.S. Govenment Printing Office, Washington, DC.

Ender, R.L., J. Gehler, S. Gorski, and S. Harper. 1978. Anchorage socio-economic and physical baseline. Alaska OCS Socioeconomic Studies Program Tech. Rept. No. 12. Alaska OCS Office, Anchorage.

Fall, J.A. 1981a. Patterns of Upper Inlet Tanaina leadership, 1741-1918. Ph.D. Dissert., Univ. Wisconsin.

________. 1981b. Traditional resource uses in the Knik Arm area: historical and contemporary patterns. ADF&G, Div. Subsistence, Anchorage.

________. 1983. Tyonek: resource uses in a small, non-road-connected community of the Kenai Peninsula Borough. Pages 202-218 in R.J. Wolfe and L.J. Ellanna, eds. Resource use and socioeconomic systems: case studies of fishing and hunting in alaskan communities. ADF&G, Div. Subsistence, Anchorage.

Fall, J.A., D.J. Foster, and R.T. Stanek. 1983. The use of moose and other wild resources in the Tyonek and upper Yentna areas: a background report. ADF&G, Div. Subsistence, Anchorage.

________. 1984. The use of fish and wildlife resources in Tyonek, Ak. ADF&G, Div. Subsistence, Anchorage.

Fischer, V. 1976. Regional effects of Anchorage metropolitan growth. Joint-Federal State Land Use Planning Commission, Anchorage.

Foster, D.J. 1982a. Tyonek moose utilization. ADF&G, Div. Subsistence, Anchorage.

________. 1982b. The utilization of king salmon and the annual round of resources in Tyonek, Alaska. ADF&G, Div. Subsistence, Anchorage.

Glenn, E.F. 1900. A trip to the region of the Tanana, 1898. Pages 629-648 in U.S. Congress, compilation of narratives of exploration in Alaska. U.S. Government Printing Office., Washington, DC.

Irwin, D.L. 1968. The colorful Matanuska Valley. N.P.

Kari, J., and P. Kari. 1982. Denaina Etnena-Tanaina country. Alaska Native Language Center, Univ. Alaska, Fairbanks.

Moffit, F.H. 1927. The Iniskin-Chinitna Peninsula and the Snug Harbor District, Alaska. U.S. Government Printing Office, Washington, DC.

Municipality of Anchorage. 1984. Estimate of population. Anchorage.

Northern Consultants. 1980. A study of the economic needs of the Matanuska-Susitna Borough. N.P.

Osgood, C. 1937. The ethnography of the Tanaina. New Haven: Yale Univ. Press.

Osgood, W.H. 1901. Natural history of the Cook Inlet region, Alaska. Pages 51-87 in North American Fauna Series No. 21. U.S. Government Printing Office, Washington, DC.

Porter, R.P. 1893. Report of the population and resources of Alaska at the eleventh census: 1890. U.S. Government Printing Office, Washington, DC.

Rollins, A.M. 1978. Census Alaska: number of inhabitants 1792-1970. Univ. Alaska, Anchorage.

Ruesch, P.H. 1983. Annual management report 1981, Upper Cook Inlet Region II. ADF&G, Div. Commer. Fish, Anchorage.

________. 1984. Annual management report 1982, Upper Cook Inlet, Region II. ADF&G, Div. Commer. Fish, Anchorage.

Selkregg, L.L. 1972. Environmental atlas of the greater Anchorage Area Borough, Alaska. AEIDC, Anchorage.

________. 1975. Alaska regional profiles: Southcentral Region. AEIDC, Anchorage

Stanek, R.T. 1982. Unpublished data. ADF&G, Div. Subsistence, Juneau.

Terry, J.M., R.G. Scoles, and D.M. Larson. 1980. Alaska OCS Socioeconomic Studies Program, Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. BLM, Alaska OCS Office, Anchorage, Ak.

Thomas, W.C., C.R. Marsh, and C.A. Stephens. 1973. Economic analysis of red meat, fish, poultry and wild game consumption patterns in Anchorage, Alaska. Univ. Alaska, Institute of Agricultural Science Research Rept. 73-4.

Townsend, J.B. 1981. Tanaina. Pages 623-640 in J. Helm, Handbook of North American Indians. Vol. 6: The subarctic. Smithsonian Institution, Washington, DC.

U.S. Bureau of Sport Fish and Wildlife. 1967. Wilderness Study Area: Tuxedni National Wildlife Refuge, Alaska. U.S. Govt. Printing Office, Washington, DC.

U.S. Congress. 1900. Compilation of narratives of exploration in Alaska. U.S. Government Printing Office, Washington, DC.

USDC. 1981. 1980 census of population: general population characteristics, Alaska. Bureau of the Census, Washington, DC.

Wolfe, R.J., J.J. Gross, S.J. Langdon, J.M. Wright, G.K. Sherrod, L.J. Ellanna, V. Sumida, and P.J. Usher (consultant). 1984. Subsistence based economies in coastal communities of Southwest Alaska. ADF&G, Div. Subsistence, Juneau.

Subsistence and Other Local Use of Resources in the Lower Cook Inlet/Kenai Peninsula

I. LOCATION AND ENVIRONMENT

The Lower Cook Inlet/Kenai Peninsula Subregion is a diverse area in Southcentral Alaska that includes low hills to the south of Turnagain Arm, the mountains of the Kenai Range, including both the Harding and Sargent icefields, the steep fjords of the south and southeast Kenai Peninsula coast, low coastal areas along Cook Inlet, and the marine waters of lower Cook Inlet and Kachemak Bay. The boundaries of this subregion conform to Game Management Units 15 and 7. The subregion is entirely contained within the Kenai Peninsula Borough, which also extends west of Cook Inlet (map 1).

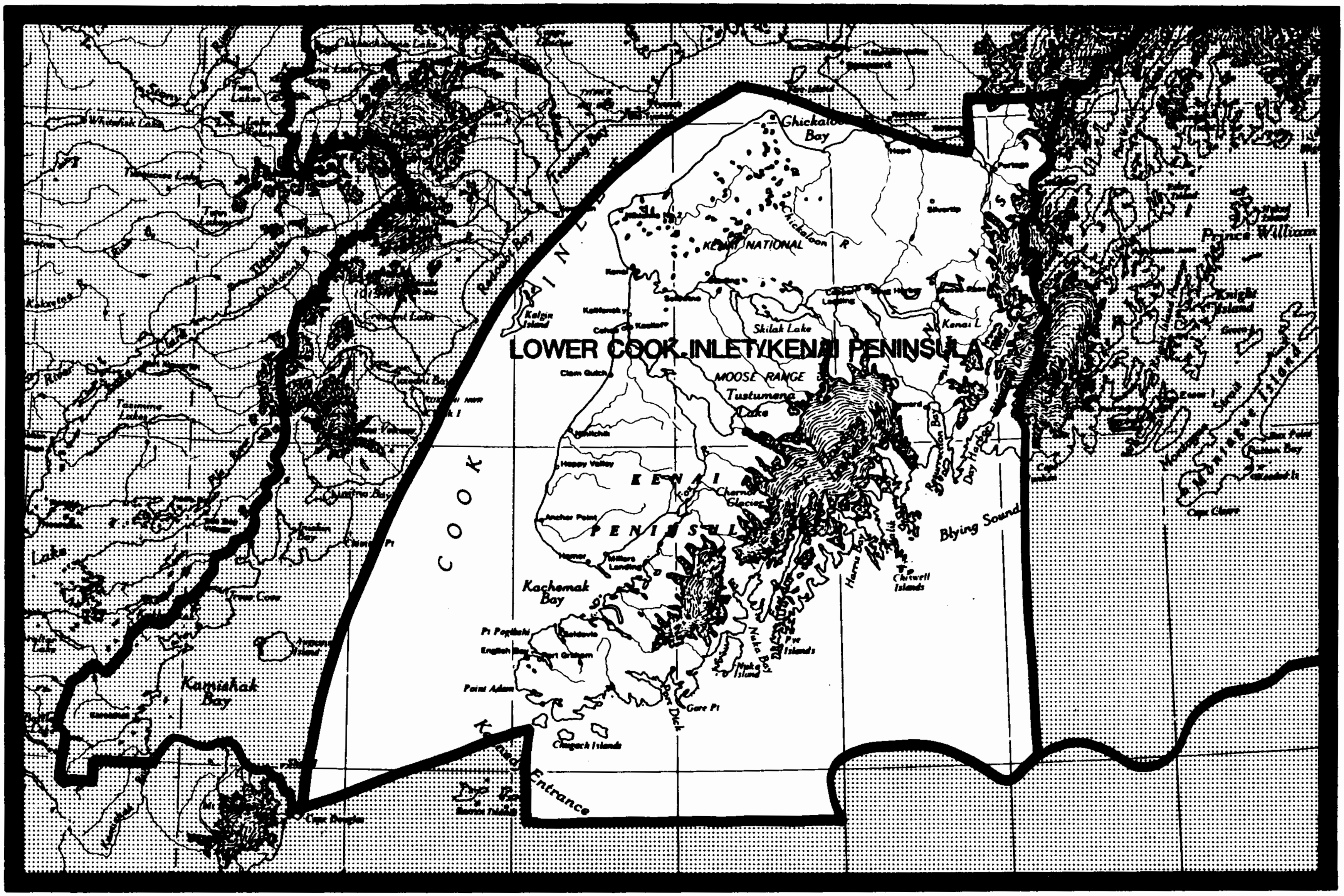
This subregion contains one of the state's most extensively used coastal areas because of its proximity to Anchorage and the railbelt and the access provided along the western peninsula by the highway system. The lowlands have always been the dominant physiographic feature permitting and encouraging human occupation. Upland areas, largely contained within the Kenai National Wildlife Refuge, the Chugach National Forest, and the Kenai Fjords National Park, also are used by local residents, other Alaskans, and visitors. Several industries depend directly on lands, waters, and fish and wildlife resources of this subregion, including gas and oil production and commercial and sportfishing. New and proposed development activities include oil development in lower Cook Inlet, other petrochemical industry, development of bottomfish fisheries, and expansion of the commercial fish-processing industry. In addition, recreational use of the subregion is expanding rapidly. The majority of the subregion's residents live along the coast and other road-connected areas.

Major communities in the subregion include Kenai, Soldotna, Seward, and Homer. A total of 21 communities are recognized by the U.S. Bureau of the Census (see table 1).

II. HISTORY AND PATTERNS OF SETTLEMENT

A. Prehistory

Research on the prehistory of the Kenai Peninsula has produced a general outline of the subregion's early inhabitants and settlements. There is good evidence of a sequence of many population movements by several different groups of people over at least the past 3,000 years. Early Eskimo influences from Kodiak Island, Prince William Sound, the Alaska Peninsula, and possibly from as far away as Norton Sound have been reported in the Kachemak Bay



Map 1. The Lower Cook Inlet/Kenai Peninsula subregion.

Table 1. Kenai Peninsula Population, Named Communities, 1890-1980

Community	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980
Anchor Point	---	---	---	---	---	20	---	171	102	226
Clam Gulch	---	---	---	---	---	---	---	---	47	50
Cooper Ldg.	---	---	---	---	---	---	60	88	31	116
English Bay	107	---	---	---	107	48	---	78	58	124
Fritz Creek	---	---	---	---	---	---	---	---	27	302
Halibut Cove	---	---	---	---	23	---	---	25	44	47
Homer	---	---	---	---	---	325	307	1,247	1,083	2,209
Hope	---	---	---	44	15	71	63	44	51	103
Jakalof Bay	---	---	---	---	---	---	---	---	---	51
Kachemak City	---	---	---	---	---	13	---	---	76	403
Kasilof	117	---	---	---	45	62	62	89	71	201
Kenai	264	290	250	332	286	303	321	778	3,533	4,324
Moose Pass	---	---	---	---	---	84	70	136	53	76
Nikishka	---	---	---	---	---	---	---	---	---	1,109
Ninilchik	81	---	---	87	124	132	97	169	134	341
Port Graham	---	---	---	47	---	93	92	139	107	161
Salamatof	---	---	---	---	---	---	---	---	---	334
Seldovia	99	149	173	258	379	410	437	460	437	479
Seward	---	---	534	652	835	949	2,114	1,891	1,587	1,843
Soldotna	---	---	---	---	---	---	---	332	1,202	2,320
Sterling	---	---	---	---	---	---	---	115	30	919
Rest of Kenai District	---	---	---	---	---	---	---	---	---	8,547
Total	668	439	957	1,420	1,814	2,510	3,623	5,762	8,673	14,720

Sources: 1890-1970 figures are from Rollins 1978; 1980 figures are from USDC 1980.

--- means no data were available.

areas (Braund and Behnke 1980). Tanaina Athapaskan Indians, currently living throughout the Cook Inlet area, evidently displaced the Eskimos sometime prior to the arrival of the Russians in the late 18th century (Reger 1974). Whether the Eskimos were driven out, died out, merged with the Tanaina, or left before they came is unknown.

The Kachemak Tanaina led a rich life, taking full advantage of the abundant fish, wildlife, and plant resources of the lower peninsula. In a number of respects, their way of life was almost unique for Athapaskans, notably their subsistence use of sea mammals and of skin boats and other Eskimo tools. The present communities of Port Graham and English Bay are still inhabitated by speakers of the Sugpiaq Eskimo, locally termed Aleut, but these people are thought to have derived from a migration more recent than that of the original Kachemak Eskimo (Workman 1974).

According to de Laguna (1956), there were Eskimo settlements along the southeast shore of the Kenai Peninsula in prehistoric times, and it is likely that settlements along this steep, rugged coastline still existed at the time of Russian contact. These Kenai Peninsula Eskimos are likely to have been more closely related to the Chugach Eskimo of Prince William Sound than to the Koniag Eskimo of Kodiak or the Eskimos of English Bay and Port Graham (Braund and Behnke 1980).

B. The Postcontact Period

At the time of the Russian exploration of this area almost 200 years ago, the Tanaina occupied most of the Cook Inlet area, including the lowlands and valleys of the western Kenai Peninsula. Kachemak Bay provides a reasonable southern boundary for historical Tanaina occupation, although the community of Seldovia was described as including both Indians and Eskimos in 1893 (ibid.).

In part due to their strategic location in Cook Inlet, the Tanaina established extensive trading networks between the coast and the interior, and with the Koniag and Chugach Eskimo to the south. Because of these contacts, it is likely that the Tanaina were aware of the Russian presence on Kodiak well before European exploration of Cook Inlet began in earnest.

It is estimated that the Tanaina population in the Cook Inlet region was about 3,000 persons in 14 settlements in 1805, some 20 years after Russian settlement began (Workman 1974). The Russians occupied several sites on the Kenai Peninsula in the early days of their exploration and occupation of Alaska, with consequent disruption of Native cultures through the introduction of a trading-based economy and the spread of European diseases. The cultural and physical dispersal of the Kachemak Bay Tanaina that began with European contact was nearly completed by the 1930's (Reger 1974).

The Kenai Peninsula was first sighted by Europeans when Vitus Bering, a Dane employed by the Russian Crown, sailed by in 1741. Reports of Captain Cook's exploration of the area and his highly profitable sale in 1778 of otter skins at Canton encouraged the Russian Shelikof to establish settlements on Kodiak Island in 1784 and on the Kenai Peninsula in 1786. The first of the Kenai outposts was Fort Alexander on Kachemak Bay, near present-day English Bay (ibid.).

A site at Kasilof, called Fort St. George, was also settled in 1786, and in 1791 a settlement at present-day Kenai, called Fort St. Nicholas, was founded. These forts became outposts of the newly formed Russian-American Company in 1799. Fur trading began in earnest, and the Russian Orthodox Church began to be established. Company settlements on the Kenai Peninsula became part of a network of outposts that served as base stations for expeditions to the north, for local coal mining operations, and for fur trading. Vancouver reported about 40 Russians Colonial citizens was established at Ninilchik in 1835, and a coal mining settlement at Port Graham was settled shortly thereafter. During these years, the Russian Orthodox Church increased its missionary activities, finally establishing a resident priest at Kenai in 1840 (Osgood 1937).

With the sale of Alaska to the United States, Fort St. Nicholas was turned over to General Davis of the U.S. Army. The fort was abandoned shortly thereafter, however, and the next several years are characterized by a lack of authority or governmental presence of any sort in the Kenai area. To a large extent, responsibility for handling problems of trade, commerce, and social organization passed from the Russian-American Company to the Alaska Commercial Company. By the turn of the century, American trappers and prospectors began arriving in the Kenai Peninsula area, and new communities such as Hope and Seward were founded (ibid.).

The community of Homer was developed by coal and gold prospectors in 1895, and the community of Anchor Point arose shortly thereafter as a stopover on the Kenai to Homer sled dog mail route. Cooper Landing began as a mining town; Moose Pass began as a construction camp during the building of the Alaska Railroad; the community of Nickolavesk was established by a group of Russian Old Believers. All of these settlements have been connected by road in the years since 1950. Coastal development has included services to the commercial fishing industry, which has been active since the 1920's. Ocean-going supply and passenger ships also serve the coastal ports, as they have since the turn of the century (Kenai Peninsula Borough 1977).

C. Present-Day Kenai Peninsula

The present-day Kenai Peninsula is an diversified as its history would indicate. Cultural groups include Eskimo, coastal Tanaina, Aleuts, Russians, and English-speaking caucasians. The area is developing a multifaceted economic base, including oil extraction and refining, government, trade, transportation, communications, commercial fishing, sportfishing, hunting, trapping, and tourism. Much of the population in this area has been centered in the Kenai-Soldotna area, which was the site of extensive oil development and support activity in the 1950's and 1960's. Other communities on the peninsula also have shown substantial growth. The Kenai Peninsula is now a popular recreational destination for Anchorage residents.

III. POPULATION

Population data for the subregion are included in table 1. In 1980, the total population for the subregion was 24,720. This represents an increase of approximately 280% since 1960. The increase is largely attributed to oil development activities in the Kenai-Soldotna area that have taken place since the 1950's. Residential development and industrial growth related to commercial fisheries have also been dramatic in the Homer area and in some other small peninsula communities.

Population projections were developed in 1979 by the Kenai Peninsula Borough in the course of developing its Coastal Development Program (Environmental Services Limited); projections were made for low, intermediate, and high growth scenarios, and reflected anticipated training and employment levels resulting from proposed industrial development.

For the low case, little growth occurs. Population for the borough declines from its 1978 level of 25,335 initially and then climbs to 26,749 by 1992. In the intermediate case, population is projected to increase from 25,335 in 1978 to 39,306 in 1992, an average annual growth rate of 4.6%. The high case projects a threefold increase in employment in the borough, resulting in a population of 55,056 by 1992. This reflects an annual rate of growth of 7.73% over the 15-year period.

IV. GENERALIZED LAND STATUS

The predominant land owner in the Lower Cook Inlet/Kenai Peninsula Subregion is the federal government, with over half of the subregion included in the Chugach National Forest, Kenai National Moose Range, and Kenai Fjords National Monument. The state is the second largest land owner, with the majority of its land holdings in the Kenai lowlands and Kachemak Bay area. The Cook Inlet Region, Inc., and Native village corporations are the third largest land holders. The relatively small acreage owned by the borough, cities, and private citizens (except Native corporation lands) is primarily located along the state highway system and along the northern shore of Kachemak Bay.

V. USE OF FISH AND WILDLIFE AND OTHER NATURAL RESOURCES

A. Historic Patterns of Resource Use

Indian and Eskimo groups of the Kenai Peninsula, like others in Alaska, led a way of life that made full and efficient use of the fish, wildlife, and plant resources near their villages and camps. The Tanaina travelled extensively throughout the peninsula and the Cook Inlet region generally, making use of resources in all environments. Hunting camps in the high country were used to obtain sheep, goats, caribou, moose, bear, and birds. Traplines for small game and furbearers were laid in the timbered lowlands. Villages and camps along lakes and streams were sites for harvest of salmon, trout, and numerous plants, including berries, spruce and birch bark, willow, and rosehips. Along coastal areas, numerous marine and intertidal species were harvested, including crabs, herring, halibut, seals, ducks and geese, swans, loons, seagulls, and seaweed (Kari and Kari 1982, Osgood 1974).

Harvest patterns that utilized all of these species and others remained essentially unchanged up until, and somewhat beyond, the time of Russian contact. Since that time, the developing fur trade, the construction of trading posts and other permanent settlements, and more recently the introduction of schools and compulsory education have led to changes in patterns of resource uses (Sherwood 1974).

B. Contemporary Patterns of Resource Use

The Kenai Peninsula today represents a complex area for socioeconomic study because of its large size and population, numerous settlements, and recent rapid socioeconomic changes. Research by the Division of Subsistence in several peninsula communities has outlined the general pattern of local resource uses on the Kenai

Peninsula. Information is presented here for the Kenai area (Kenai, Soldotna, North Kenai), the Homer area (Diamond Ridge, Fritz Creek, Kachemak City, Homer, Anchor Point), Ninilchik, Seldovia, English Bay, and Port Graham. Little information is available about local resource uses by residents of other peninsula communities.

1. <u>Species used and seasonal rounds</u>. Resources known to be harvested and used by Kenai Peninsula residents are listed in table 2. Patterns of use and harvest quantities differ greatly among communities, and some of these differences are outlined below. All known resource harvest is described in this section; however, discussion of harvest that is currently not permitted by regulation does not constitute endorsement of such harvest by the Department of Fish and Game.

Table 2. Resources Harvested by Residents of the Kenai Peninsula

<u>Fish</u>	<u>Birds</u>
Halibut	Waterfowl
Salmon	Ptarmigan
Trout	Spruce grouse
Herring	
Eulachon (hooligan)	<u>Shellfish</u>
Cod	Clams
	Crabs
<u>Mammals</u>	Shrimp
Moose	Mussels
Caribou	
Elk	<u>Other</u>
Beaver	Firewood, coal
Hare	Mushrooms
Black bear	Seaweed
Mountain goat	Beach greens
Porcupine	Berries

Source: Georgette 1983a.

2. <u>Patterns of harvest and use: Kenai-Soldotna area</u>. With the rapid population growth that has characterized the Kenai-Soldotna area over the last 20 years, the communities of Kenai, Soldotna, and North Kenai have become increasingly heterogeneous. Households surveyed by the Division of Subsistence and others have represented a broad spectrum of resource users. According to the Kenai Peninsula Borough (1977), a large proportion of households in this area harvested virtually no wild resources for domestic use (Kenai

41%, Soldotna 46%). Other households harvested wild resources (primarily chinook, sockeye, and coho salmon, halibut, clams, and moose) to varying degrees. In Kenai, the mean household harvest for the six major resources in 1982 was 122 lb the lowest of the Kenai Peninsula study communities (figure 1). Because some wild foods are distributed among households, amounts of resources used tend to be greater than resources actually harvested (Georgette 1983a).

Among Kenai Peninsula communities, Kenai-Soldotna is characterized by a high level of employment: 76% of household heads worked 12 months out of the year in 1982. Median household income was relatively high at $29,937. There is good evidence that in certain important respects the Kenai-Soldotna-North Kenai cluster displays many of the cultural and socioeconomic patterns of the Anchorage area and represents an extension of the Anchorage urban settlement pattern and economic system into the Kenai Peninsula (Georgette 1983a). In most Kenai-Soldotna area households, harvesting wild resources appears to be peripheral to wage employment and other activities. However, it is also apparent that in the Kenai-Soldotna area, and probably in Anchorage, there are some residents who still maintain an established tradition of local resource harvest and use. These households still engage in fishing and hunting activities as they existed prior to Kenai-Soldotna's recent economic transformation.

A 1982 Division of Subsistence survey (Georgette 1983a) in the city of Kenai found that for those households that use local resources, salmon was reported to be the most widely used, accounting for about 40% of the mean household harvest. Other frequently used resources in this area are clams, halibut, moose, and berries. Some households also use trout, herring, eulachan (hooligan), cod, shrimp, crab, ducks, spruce grouse, ptarmigan, hare, beaver, porcupine, elk, and caribou.

In 1982, about three-quarters of the mean household harvest of wild resources in Kenai was fish and other seafood and about one-quarter was game and plants (Reed 1985). Like the other Kenai Peninsula communities studied, Kenai residents focus attention upon fish much more than upon game animals (fig. 1).

Although the Kenai River, adjacent to the city, has developed a flourishing tourist trade based on sportfishing for chinook salmon, more Kenai-Soldotna households harvested sockeye salmon and coho salmon for their own consumption than chinook

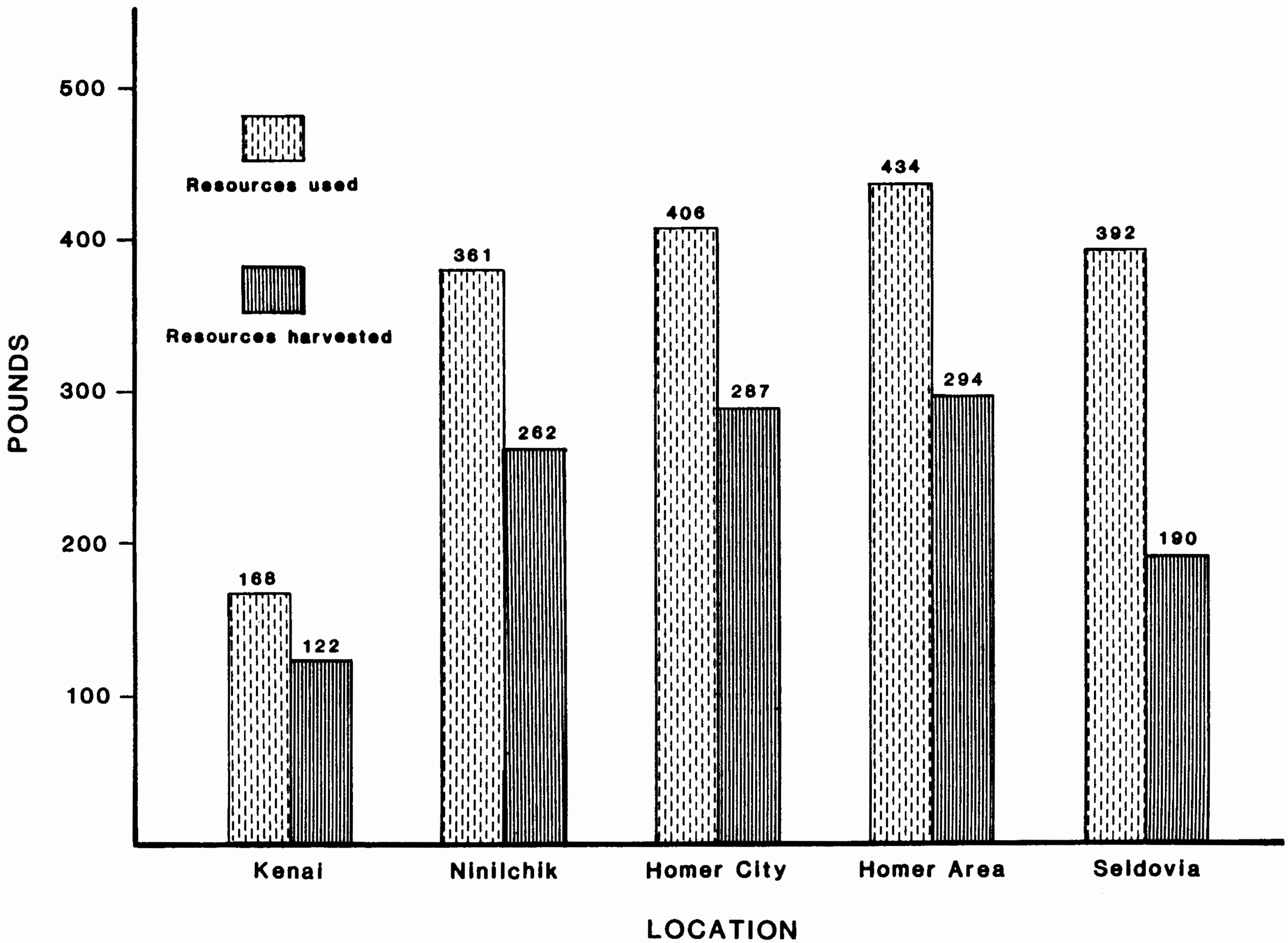


Figure 1. Mean household harvests and quantities used of six resources (chinook salmon, sockeye salmon, coho salmon, halibut, clams, moose, in pounds dressed weight), 1982.

salmon. Sockeye salmon were utilized by 59% of the area households in 1982. These were frequently caught at the mouth of the Kenai River with rod and reel. A few households took sockeye salmon from their commercial catch for home use, a few used the subsistence set net fishery in Kachemak Bay, and a few used the Kasilof River dip net fishery to obtain sockeye salmon. A mean household harvest of 15 lb of sockeye salmon (or about four dressed fish) was taken. Ten percent of Kenai-Soldotna households received sockeye salmon as gifts or shared products from another person's harvest (Georgette 1983a, Reed 1985).

The pattern of coho salmon utilization was similar to that of sockeye salmon. Sixty-four percent of Kenai households harvested coho salmon, most of which were caught with a rod and reel (41% of households). Again, very few coho salmon are taken from commercial catches or with noncommercial set nets and dip nets. The mean household harvest of coho salmon by Kenai residents was over 18 lb per year, or about four dressed fish.

Chinook salmon harvest patterns closely resemble those of sockeye and coho salmon harvests. Most are caught with rod and reel in the rivers (23% of households) and a few taken from commercial catch, set net, and dip net (ibid.).

Halibut is utilized by a majority of Kenai households (70.3%), but actual harvest of halibut is done by a much smaller number. Halibut are caught with rod and reel by 23% of Kenai's households. An average of 27.8 lb of halibut is harvested per household. Five percent of the households take halibut from commercial catches for personal consumption. Most households that consume halibut, however, obtain their fish through sharing part of other catches or by purchasing halibut in the grocery store. Almost 36% of the households surveyed share other halibut catches, and 20.4% purchase halibut. The average volume of halibut procured this way is 11 lb per household (ibid.).

Kenai-Soldotna households also appeared to desire both crab and shrimp from lower Cook Inlet, but most found it more convenient to purchase these items than to travel to where they could be harvested. Several households got crab and shrimp from commercial catches or set noncommercial pots on Cook Inlet or Kachemak Bay. Twenty-nine percent of the surveys households, however, purchased or received gifts of crab, and almost 42% got shrimp in the same way. Quantities of crab and shrimp utilized, surprisingly, were very small, the average household harvest totaling just under 2 lb (ibid.).

Clam digging was an activity in which over a quarter of Kenai households participated in 1982. Kenai-Soldotna residents usually travelled south to Clam Gulch or Nilnilchik beaches for razor clams at the time of the monthly minus tides. A household average of 7 lb of shucked clams was harvested. Clams were shared among 10% of the surveyed households.

Moose hunting was a topic of considerable interest to many Kenai-Soldotna households, and almost 30% reported hunting for moose in 1982. Most hunted within 25 mi of home, and occasionally residents reported taking a moose in their own or a neighbor's yard. People hunted on foot, with horses, vehicles, ATVs, boat, plane, and several procured road-killed moose (ibid.).

Although successful hunters were few (about 3% of all households surveyed), almost a fourth of Kenai households consumed moose meat. Like other wild resources utilized, quantities of moose were small, with an average of 10 lb per household and an average volume of moose meat shared of 11 lb per household (ibid.).

Kenai residents include those who have been residing on the peninsula and harvesting the resources there for a lifetime, and those only recently arrived. Twenty-three percent reported having harvested resources for three years or less. The average number of years of harvesting resources on the Kenai Peninsula for all households interviewed was 10.5 years.

Some long-term Kenai residents used more local resources than newcomers. Some long-term residents reported that they did not hunt or fish as much now as in the past, partly because of increasing competition and the "declining quality" and diminished stocks of favored local species (Georgette 1983a).

Sharing of fish and game among Kenai-Soldotna households was not extensive in comparison to some other areas of the state. Although some distribution and exchange was documented in the 1982 survey, especially among long-term residents and among families, no noncommercial sharing or exchange network existed to integrate large numbers of community members, as occurs in many rural Alaskan communities.

There are some indications that Kenai residents as a whole hunt and fish more often in areas off the peninsula than do residents of other Kenai Peninsula communities, possibly indicative of the Kenai-Soldotna's higher average incomes and greater economic opportunities (ibid.).

In summary, few Kenai-Soldotna households harvest large quantities of wild resources. A large percentage of the population makes no use of local resources at all. Of those who do harvest fish and game regularly, most value hunting and fishing activities for recreation and pleasure, healthy foods, and a perceived independence and self-sufficiency (ibid.).

3. Patterns of harvest and use: Homer area. Homer developed as a small-scale farming and ranching center and has included commercial fishing and fish processing as a significant economic sector. Homer serves as the primary center of commerce for about 1,700 residents of outlying areas and the small communities of Anchor Point, Fritz Creek, Nikolaevsk, and Kachemak City. All of these communities are considered here as part of the Homer area.

Homer's economy has three major sectors: commercial fishing, commercial services (including construction), and government agencies. In 1976, fishermen and related laborers accounted for 17.6% of Homer's work force; 41.1% of household heads were employed in commercial businesses or government jobs; about 10% reported their occupation as "farmer" or "homesteader." In 1976, the median family income was reported as $17,000 in the city and $11,300 for families living outside the city (Reed 1983a).

Like the Kenai area, the Homer area has recently experienced rapid growth and economic development. Homer area residents, however, display a wider variety of resource use patterns than do those of the Kenai area, making generalizations about resource use difficult. Eighty-four percent of the households sampled in 1983 by the Division of Subsistence participated in fishing or hunting in 1982. These households displayed variable patterns of seasonal activity, often scheduled around wage employment (ibid.). In the 1982 study, 30.5% of the sampled households reported that they relied on wild fish and game for most or all of their supply of meat and fish. Overall, resource-use surveys have indicated that Homer area residents use greater amounts of locally available resources than do persons in the Kenai area (fig. 1) (Reed 1983a, 1985).

The major resources harvested and utilized by Homer residents are salmon, halibut, crab, shrimp, and moose. Razor clams are also moderately important. Coho salmon are available through the Kachemak Bay subsistence set net fishery. However, rod and reel fishing in nearby spawning streams is also an important method by which Homer residents obtain both coho and chinook salmon.

Halibut is used by almost all households, about half through harvests and half through gifts. Likewise, crab and shrimp catches are widely shared, most of what is harvested coming from commercial pots. Considerable commercial shrimping takes place out of Homer, and many Homer residents purchase their shrimp from local suppliers (ibid.).

Homer City households do the greatest volume of moose harvesting of all the Kenai Peninsula study communities. Like Ninilchik, Homer is adjacent to the uplands where there is good moose habitat, so those who desire to hunt moose have ready access to them. Among the outlying Homer area households, moose meat is widely shared. Clams are easily accessible to Homerites also and are used by over one-half of the households, although their average volume of harvest is not large. Wild berries are another secondary resource, gathered by almost half the households (ibid.).

Numerous roads provide access to hunting and fishing areas around Homer. Access to marine resources is largely limited to those with a boat and motor, but many beaches are accessible from land. Gardening is a common food-producing activity (table 3). Homer area residents also make use of locally available spruce, alder, birch and coal for fuel and house logs.

Table 3. Percentage of Households Raising Gardens and Livestock

Location	Garden	Livestock
Kenai	37.6	4.1
Ninilchik	70.8	29.2
Homer City	38.1	8.2
Homer area	69.2	38.5

There is some evidence for greater use of resources by those living outside the Homer area than by those living within the city of Homer. For example, three times more coho salmon were harvested by Homer area residents than by city residents (Reed 1983a).

4. <u>Patterns of harvest and use: Ninilchik</u>. Resource uses by the residents of Ninilchik who were surveyed in 1982 displayed similarities to some households in Homer and Kenai, including teterogeneous resource use patterns, a fairly restricted list of species harvested (mainly salmon, halibut, clams, and moose), relatively low harvest levels, limited time invested in fishing and hunting, and relatively low distribution and sharing of fish and game products. The predominant pattern for these portions of the Kenai Peninsula in 1982 appeared to be one of "supplemental" fishing and hunting wherein resource procurement was scheduled around wage employment and supplemented other food sources (Georgette 1983b).

Target salmon species included chinook, sockeye, and coho salmon. Quantities of salmon harvested for personal consumption were relatively low in 1982 (compared with salmon harvested elsewhere on the Kenai Peninsula), and this is perhaps due to the large number of commercial fishing households in Ninilchik (41%), who were preoccupied during the salmon season with making a living and thus had not the time to put up fish for their own use.

Moose and clams were wild resource items of particular interest to Ninilchik residents in 1982, perhaps because of their local abundance. Moose are harvested in the fall after the fishing and tourist seasons are over. Since the harvest of moose requires both skill and technology not available to many, there is an extensive distribution of moose meat. In 1982, as much moose was shared as was harvested (ibid.). Clams are easy to get with limited technology and equipment, and the long (six-month) harvest season for them precludes conflict with other activities. That clams were not widely shared suggests a local attitude that they are so easy to get that anyone who wants them can get their own clams (ibid.).

Crab and shrimp species were widely utilized by the Ninilchik households in 1982 but were not considered major resources, as quantities consumed were very small, and most were purchased rather than harvested. The most likely reason for the lack of harvest of these was that they are not locally available (ibid.).

Harvest data for six species used by Ninilchik, Homer area and Kenai area residents in 1982 are displayed in table 4. Table 3 shows the percentage of respondents raising gardens and livestock. This information and the graph of harvest totals (fig. 1) shows Ninilchik to be on a par with Homer and notably higher than Kenai in overall harvest quantities.

Table 4. Resource Uses for Six Species, 1982

Location	Chinook Salmon				Sockeye Salmon				Coho Salmon			
	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested
Kenai (N=197	41	30	12	10	59	46	17	15	64	45	21	18
Ninilchik (N=24)	63	50	33	22	50	42	20	8	54	33	13	13
Homer City (N=97)	47	30	27	14	46	21	16	10	62	31	18	13
Homer area (N=76)	53	39	43	33	43	25	12	8	70	52	38	33
Seldovia (N=35)	49	11	16	6	66	26	27	16	69	40	27	23

Location	Halibut				Clams				Moose			
	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested	% Household Used	% Household Harvested	Mean* Pounds Used	Mean* Pounds Harvested
Kenai (N=197)	70	28	41.0	28.3	35	26	8	7	24	4	21.2	10
Ninilchik (N=24)	88	42	57.2	37.4	83	83	34	34	67	8	90.9	46.9
Homer City (N=97)	90	50	107.3	83	54	42	16	16	38	13	68.9	51.5
Homer area (N=76)	89	51	87	69	51	44	11	11	43	9	84	44
Seldovia (N=35)	97	34	60	28	89	69	27	22	40	3	18	13

Source: Reed 1985.

* Household mean for sampled households.

Wage employment in Ninilchik is more seasonal than in either Kenai or Homer. In 1982, only one-quarter of the heads of households were employed 12 months, whereas 49.7% were employed from 2 to 9 months. Commercial fishing was the primary employment source. About half of all family businesses are directly supported by heavy summer visitor traffic, and winter unemployment is high (ibid.).

5. Patterns of harvest and use: Seldovia. Seldovia presents a different resource-use picture from the above case communities, due in part to its relative isolation, south of Homer across Kachemak Bay, and its lack of a road connection to other peninsula communities. Seldovia's economy has been based on commercial fishing since the 1890's, and this industry currently accounts for about 85% of local wage employment. Employment in Seldovia is thus highly seasonal, and only 35% of the workforce held year-round jobs in 1982. Aside from fishing, the timber industry has provided some additional seasonal employment. Retired persons made up 6.5% of the population in 1982. Household incomes ranged widely in 1982 with 35% of all incomes under $12,000 and 16% over $45,000 (Hitchins et al. 1977).

According to Reed (1983b), significant utilization of wild resources compliments Seldovia's commercial fishing economy. In 1976, a survey indicated that 86% of the Seldovia population used local resources. Over 44% of households interviewed derived up to one quarter of their food from local resources, and 25% said local resources provided the majority of their sustenance.

Although moose are not available in the Seldovia area, harvest of marine and intertidal resources is extensive. The major wild resources harvested and utilized by Seldovians are salmon, halibut and bottomfish, crabs, and clams. Target salmon species are sockeye, coho, and pink salmon. Coho and pink salmon are the only salmon readily available in the vicinity of the community, but sockeye salmon are more desirable for canning (ibid.).

Halibut finds its way onto virtually all Seldovians' tables but not always by household harvest. Extensive sharing of halibut takes place, as is true with other bottomfish, in part because only a few people have the equipment to harvest them. Likewise, king and Dungeness crabs are consumed by almost everyone but harvested by only a few, mostly the commercial crabbers (ibid.).

Clam species are utilized by almost all households, and like Ninilchik, most households harvest their own. Still, clams are extensively shared in Seldovia, so many are received as gifts.

Shrimp appears to be a desired local resource, but since there are few commercial shrimp fishermen in Seldovia, this resource is usually purchased. Seldovians find that during shrimping season (fall), the waters are too rough for skiffs to operate noncommercial pots.

Berries are a significant resource to Seldovians, and they are gathered in the largest quantities of all the Kenai Peninsula study communities (ibid.).

Seldovia's coastal location is an important factor influencing the local harvest of foods, as is the fact that many people own skiffs and larger boats either for commercial fishing purposes or for recreation. Regulations also affect the availability of some resources. For example, in 1982 salmon were frequently purchased at cannery prices directly from fishermen, inasmuch as the subsistence gill net fishery did not begin until August 16, by which time few sockeye or chinook salmon were available in local waters (Reed 1983b).

6. <u>Patterns of harvest and use: Port Graham and English Bay.</u> Patterns of resource use by residents of English Bay and Port Graham are in many ways different from those of most other Kenai Peninsula residents. The two communities are different from other Kenai Peninsula communities: residents of English Bay and Port Graham are predominantly Native (79 and 87%, respectively); these neighboring villages have been outside the mainstream of recent economic activity and change that has affected other communities in the subregion; and their welfare has historically been closely linked to the harvest and use of local wild resources. The residents of English Bay and Port Graham harvest at least 107 different resources. Thirty-seven of these were found to be harvested by 25% or more of the households, according to a recent study by Stanek (1982b). These wild foods include up to 13 species of shellfish and other intertidal invertebrates that are utilized throughout eight months of the year by virtually all residents (Stanek et al. 1982b). Approximately 70 other resources for which only limited harvest data are available also are used by residents of these communities. Figure 2 illustrates the annual round of resource utilization for 36 species and species groups.

Harvest calendars for English Bay and Port Graham show that resources, especially salmon, clams, moose, and bear provide large quantities of food during a short period of the year and are preserved for use throughout the year. Other

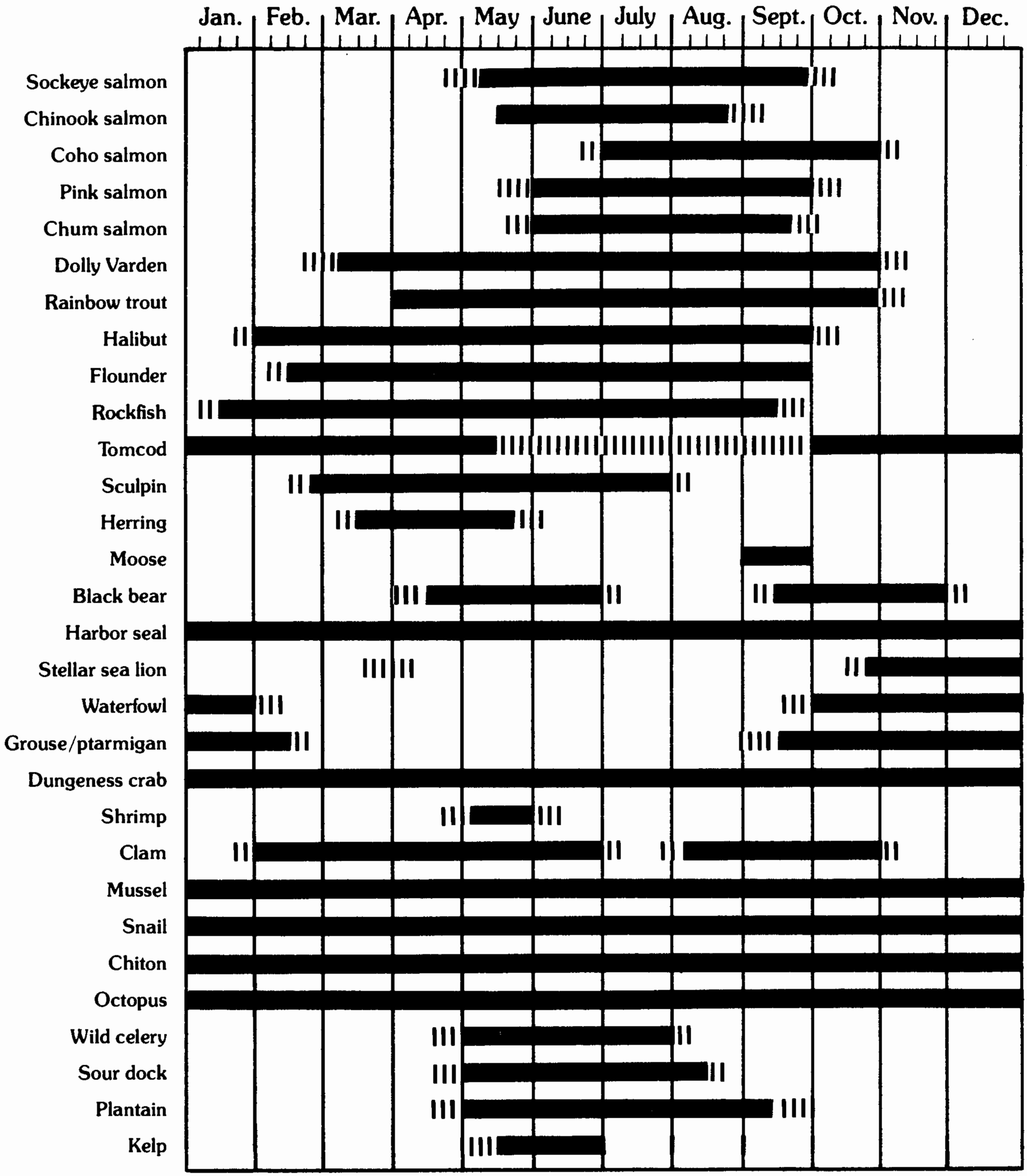


Figure 2. Annual round of resource utilization, Port Graham and English Bay, 1981-1982. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort (Stanek et al. 1982b).

(continued)

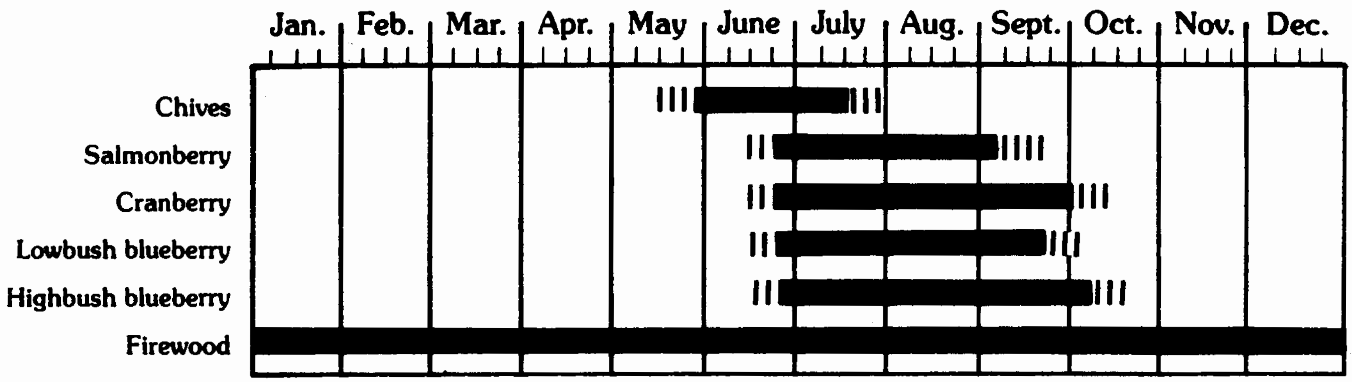


Figure 2 (continued).

resources like trout, cod, halibut, chiton, snails, and crabs are generally used fresh on a seasonal basis. Marine mammals, mostly harbor seals and sea lions, are highly valued, are harvested year-round, and are extensively shared. In general, locally procured foods are widely distributed among households in these communities. Salmon harvest has been documented in these communities with the use of harvest calendars, and data for 1979 through 1983 are presented in tables 5 and 6. Salmon taken in these years for domestic use was obtained through a combination of commercial, subsistence, and rod and reel fisheries. No differentiation is made in the data with regard to gear type.

Despite the evident extensive use of local resources, cash is an important, even vital, element in the economies of both Port Graham and English Bay. As one local resident explained, theirs is a "cash flow" type of subsistence. Among other things, money is needed to buy the equipment necessary for subsistence hunting and finfishing (Braund and Behnke 1980). For this reason, occasional economic setbacks, such as the closure of the cannery at Port Graham from 1960 until 1968, can be economically disasterous for local residents.

In essence, local resource harvest in English Bay and Port Graham appears to be part of a system of resource use that is important economically, socially, and culturally. The same is not as true for other Kenai Peninsula communities, where a greater number of economic alternatives to wild food harvesting exist today. Even so, many residents of both the upper and lower peninsula continue to harvest locally available resources because they value the self-sufficiency, health benefits, or family and cultural traditions accompanying these harvests (Stanek et al. 1982b, Georgette 1983a).

Table 5. Port Graham Salmon Harvests for Domestic Use

Yr/Mo	Chinook	Sockeye	Coho	Pink	Chum	Subtotal	Calendars	Harvest Days
1979								
Total	222	777	506	1,170	494	3,249	---	---
1981								
May	31	543	---	---	---	574	39/47	94
June	11	923	---	7	6	947	36/47	61
July	74	209	---	74	92	449	37/47	36
August	---	19	173	176	50	418	38/47	45
September	---	---	452	41	2	495	41/47	32
October	---	**	**	**	---	---	---	---
Total	116	1,694	625	298	150	2,883	---	268
1982								
May	32	264	---	---	3	299	36/36	46
June	34	442	1	37	31	545	37/38	107
July	28	74	4	465	68	639	38/38	63
August	4	5	209	229	76	523	34/35	73
September	---	13	294	120	15	442	28/34	59
October	---	**	**	**	---	---	---	---
Total	98	798	508	851	193	2,448	---	---
1983								
May	19	368	---	---	---	387	31	---
June	38	697	---	5	1	741	19	---
July	**	**	**	**	**	---	---	---
August	---	1	232	76	53	362	16	---
September	---	---	208	88	11	307	13	---
October	**	**	**	**	---	---	---	---
Total	57	1,066	440	169	65	1,797	---	---

Source: Stanek 1985.

--- means no data were available.

** Some harvest, no estimate.

Table 6. English Bay Salmon Harvests for Domestic Use

Yr/Mo	Chinook	Sockeye	Coho	Pink	Chum	Subtotal	Calendars	Harvest Days
1979								
Total	137	1,545	2,437	2,186	305	6,610	---	---
1981								
May	1	609	---	---	---	610	25/29	76
June	10	330	---	---	---	354	22/29	61
July	10	53	1	1	5	161	22/29	27
August	3	58	99	376	14	550	23/29	92
September	---	25	214	139	---	378	20/29	61
October	---	**	**	**	---	---	---	---
Total	24	1,075	314	621	19	2,053	---	317
1982								
May	2	259	---	---	7	268	36/36	79
June	2	809	1	3	1	816	31/31	115
July	4	70	---	101	---	175	31/31	37
August	5	427	143	977	18	1,570	25/29	127
September	---	19	756	724	10	1,509	27/29	150
October	---	---	405*	45*	---	450*	---	---
Total	13	1,584	1,305	1,850	36	4,788	---	508
1983								
May	---	807	---	---	---	807	22/28	---
June	---	655	---	---	---	655	17	---
July	**	**	**	**	**	---	---	---
August	---	210	65	363	10	648	14	---
September	---	112	302	---	---	414	10	---
October	**	**	**	**	---	---	---	---
Total	---	1,784	367	363	10	2,524	---	---

Source: Stanek 1985.

--- means no data were available.

* Estimate

** Some harvest, no estimate.

REFERENCES

Braund, S., and S. Behnke. 1980. Alaska OCS socioeconomic studies program, Lower Cook Inlet: petroleum development scenarios, sociocultural systems analysis. BLM, Anchorage.

de Laguna, F. 1956. The archeology of Cook Inlet, Alaska. The University Museum, Philadephia. 164 pp.

Environmental Services Limited. 1980. Kenai Peninsula Borough coastal development program. Part 1, background report, inventory and analysis, Anchorage.

Georgette, S.E. 1983a. Kenai: resource uses in a middle-sized, road-connected community of the Kenai Peninsula Borough. Pages 135-154 in Wolfe and Ellanna 1983.

________. 1983b. Ninilchik: resource uses in a small road connected community of the Kenai Peninsula Borough. Pages 170-188 in Wolfe and Ellanna 1983.

Kari, J., and P.R. Kari. 1982. Dena'ina Elnena-Tanaina Country. Alaska Native Language Center, Univ. Alaska, Anchorage.

Kenai Peninsula Borough. 1977. A profile of five Kenai Peninsula towns. Bureau of Managment and Urban Affairs, Anchorage Urban Observatory. Anchorage, AK.

Osgood, C. 1974. Tanaina tales. Page 9-19 in M. Sherwood, The Cook Inlet collection. Anchorage: Alaska Northwest Publishing Company, 1974.

Reed, C.E. 1983a. Homer: resource uses in a middle size, Road-connected community of the Kenai Peninsula Borough. Pages 154-170 in Wolfe and Ellanna 1983.

________. 1983b. Seldovia: resource uses in a small, non-road-connected community of the Kenai Peninsula Borough. Pages 188-202 in Wolfe and Ellanna 1983.

________. 1985. The role of wild resource use in communities of the central Kenai Peninsula and Katchemak Bay, Alaska. ADF&G, Div. Subsistence, Tech. Paper No. 106 (draft). Juneau.

Reger, D. 1974, Prehistory of the northern Kenai Peninsula. Pages 27-33 in J.C. Hornady, ed. The Native, Russian and American experiences of the Kenai area of Alaska. Prepared for the Conference on Kenai Area History, Kenai, Alaska.

Rollins, A.M., comp. 1978. Census Alaska: 1872-1970. Univ. Alaska, Fairbanks.

Stanek, R. 1985. Patterns of wild resource use in English Bay and Port Graham, Alaska. ADF&G, Div. Subsistence, Tech. Paper No. 104 (draft). Juneau.

Stanek. R., J. Fall, and D. Foster. 1982b. Natural resource harvests at Port Graham and English Bay, 1982: an interim report. Tech. Paper No. 32. ADF&G, Div. Subsistence, Anchorage.

USCD. 1980. Census of the population. Bureau of the Census.

Wolfe, R.J., and L. Ellanna, eds. 1983. Alaska resource use and socioeconomic systems: case studies of fishing and hunting in Alaska communities. Tech. Paper 61. ADF&G, Div. Subsistence, Anchorage.

Workman, W.B. 1974. Prehistory of the southern Kenai Peninsula. Pages 11-25 in J.C. Hornady, ed. The Native, Russian and American experiences of the Kenai Area of Alaska. Prepared for the Conference on Kenai Area History, Kenai, Alaska.

Subsistence and Other Local Use of Resources in the Copper River Basin/Wrangell Mountains

I. LOCATION AND ENVIRONMENT

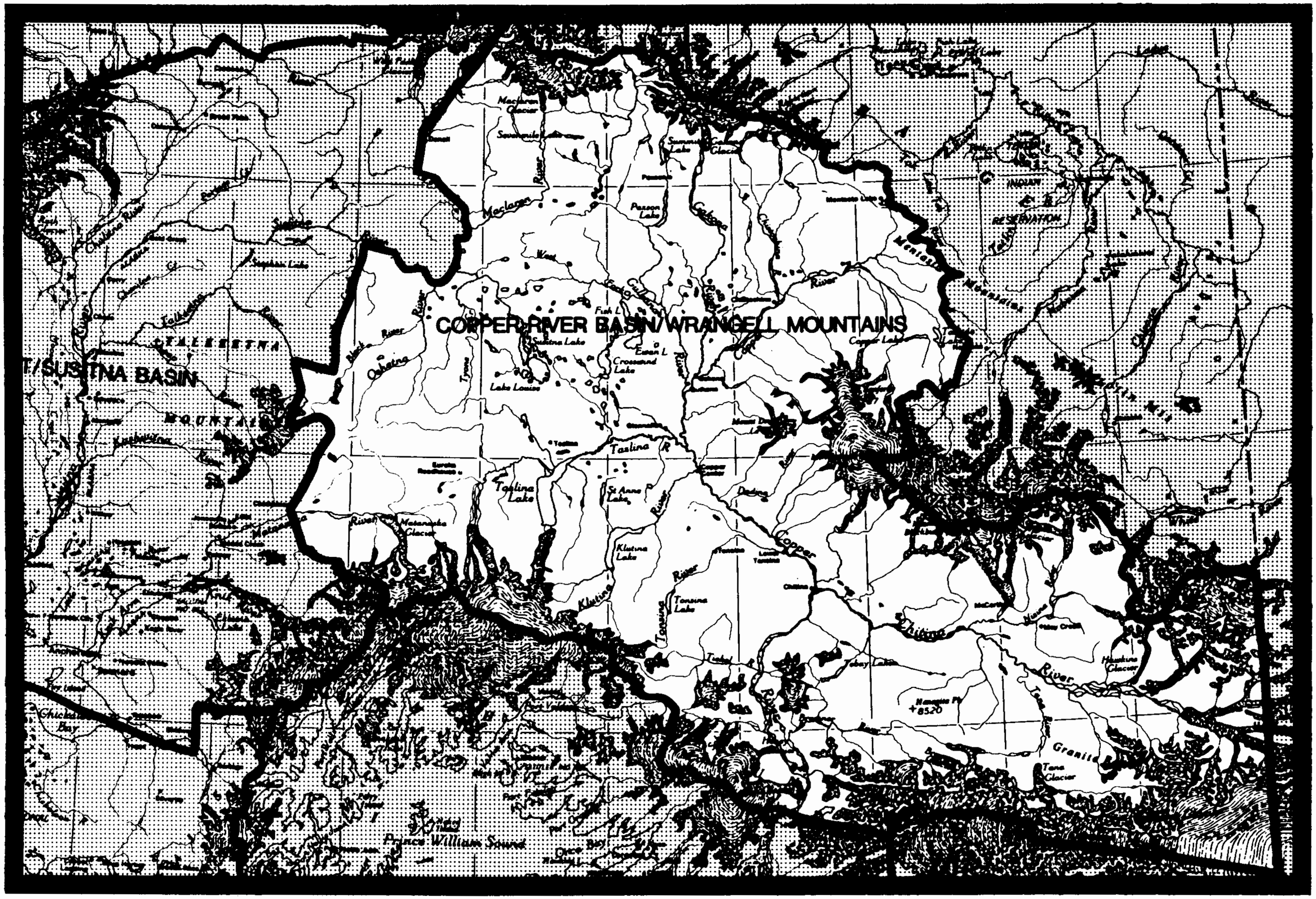
The Copper River/Wrangell Mountains Subregion encompasses some 30 million acres in Southcentral Alaska. Its boundaries, for the purpose of this study, are the Chugach Mountains on the south, the Canadian border on the east, the Alaska Range on the north, and the Talkeetna Mountains on the west (map 1). The game management units contained within these boundaries are 13A, 13B, 13C, 13D, and 11. The communities located within this subregion are listed in table 1.

The central portion of the region consists of a large basin, once an inland lake, drained by the Copper River and its tributaries, which are, for the most part, glacial streams carrying large amounts of silt and clay and occupying wide flood plains and braided channels. The Wrangell Mountains in the eastern portion of the region are among the most spectacular in North America, containing the largest concentration of peaks over 12,000 ft on the continent.

II. HISTORY AND PATTERNS OF HUMAN SETTLEMENT

A. Historic Patterns of Human Activity

The aboriginal inhabitants of the Copper River basin are the Athabaskan-speaking Ahtna, who may have occupied the region for at least the last 5,000 years (de Laguna and McClellan 1981). This aboriginal population is estimated not to have exceeded 2,000 people (Reckord 1983a). Archeological finds indicate that the activities and settlement patterns of the Ahtna were greatly influenced by the dynamic population and range fluctuations of large and small game species and by the cycles of fish runs. Groups of Ahtna occupying the region seasonally migrated between camps and semipermanent communities to gain access to fish and game resources. In the nineteenth century, the Ahtna were organized into a number of small bands, each with its distinctive dialect, fishing sites, and hunting territories. Settlements developed in large degree as people gathered to perform the tasks associated with seasonal resource harvests. Efficiency in the harvest and storage of foods was essential to avoid starvation in the lean months of the year. As recently as the twentieth century, large groups of Ahtna had well-defined territories extending away from the Copper River, portions of which were used seasonally for harvesting resources (ibid.).



Map 1. The Copper River Basin/Wrangell Mountains subregion.

Table 1. Historical Population of Copper Basin Communities

Community/Area	1910	1920	1930	1940	1950	1960	1970	1980	1983(est.)
Chistochina	---	---	---	34	31	28	33	55	65
Chitina	---	171	116	176	92	31	38	42	43
Copper Center	91	71	80	138	90	151	206	213	439
Gakona	---	---	---	46	50	33	88	87	79
Glennallen	---	---	---	---	142	169	363	511	861
Gulkana	---	---	---	25	65	---	53	104	115
East. Glenn Hwy.	---	---	---	---	---	---	---	---	182
Kenny Lake	---	---	---	---	---	---	---	342	357
Lake Louise	---	---	---	---	---	---	---	32	39
Lower Tonsina	---	---	---	---	---	---	---	---	35
Matanuska Glacier	---	---	---	---	---	---	---	---	174
Mentasta Lake	---	---	---	---	---	---	68	59	67
McCarthy Road	---	---	---	---	---	---	---	---	52
Nabesna Road	103	---	54	23	28	---	---	---	37
North Richardson Hwy.	---	---	---	---	---	---	---	---	32
Paxson/Sourdough	---	---	---	---	---	---	---	---	27
Sheep Mt.	---	---	---	---	---	---	---	---	59
Slana	---	---	---	---	---	---	---	49	43
South Wrangell Mtns.	---	904	637	77	37	---	---	25	32
Upper Tonsina area	---	---	---	---	---	---	---	---	228
Tonsina	---	---	---	---	---	---	---	135	---
Tok Road	---	---	---	---	---	---	---	---	121
Others*	---	---	---	---	---	---	---	847	---
Total*	---	---	---	---	---	---	---	2,426	3,087

Sources: 1910-1970 figures are from Rollins 1978; 1980 figures are from USDC 1980; 1983 figures are from Stratton and Georgette 1984 (Tonsina is included in the "upper Tonsina area" by Stratton).

--- means no data were available.

* Census data for areas apart from established communities have not been gathered systematically or for consistent reporting areas. Therefore, sum totals are not comparable for the subregion as a whole.

B. Changes in Settlement Patterns Following European Contact

Since historic contact, in the late 1700's, harvest patterns have undergone modification, especially in response to the fur trade as an element of the Ahtna household economy during the eighteenth and nineteenth century and more recent opportunities for wage employment after the 1940's. Recent settlement patterns and resources uses have reflected changes in the economic environment of the territory, state (since 1959), and region, changes that largely occurred as a series of "boom and bust" cycles.

The Copper River subregion remained essentially unsettled by non-Natives until the late 1800's, when a large influx of gold seekers began moving north to the Yukon River, Copper River, and Susitna River headwaters. This interest in mining and the subsequent development of mines in the interior led to the construction of a trail through the subregion from Valdez to Eagle in 1899. Valdez soon became the principal port to the interior and was linked to Fairbanks as the Valdez-Eagle trail became the Trans-Alaska Military Road and later, in 1918, the Richardson Highway. In general, road construction through the basin was not stimulated by economic conditions in the basin itself. The Trans-Alaska Military Road was built to support territorial military installations, provide access to interior gold fields, and allow construction of a telegraph line to Fairbanks.

During 1907-1915, a boom in the mining industry occurred in the region, which included productive sites at Katalla-Bering River, McCarthy-Kennicott, and the Kotsina, Bonanza, Mother Lode, and Jumbo mines in the Kennicott vicinity. In 1915, 297 men were employed in the two mines at Kennicott-Bonanza and Kennicott-Jumbo. In 1916, copper production peaked at 120,850,000 lb with a value of $32,400,000.

The towns created by the Copper River and Northwestern Railroad, which was completed in 1911 from Cordova to Kennecott, were booming as well. At this time, a few trading posts such as Gakona, which was established in 1905, and telegraph stations (Chistochina and Gulkana) became central places of Ahtna contact with whites for trade and work. Similarly, Copper Center, an Ahtna village on the Copper River, became the site of a trading post in about 1896 and developed into a mining camp when about 300 prospectors wintered there in 1898-1899. In 1901, its location on the Fairbanks-Valdez trail made it a natural telegraph station, and the town gradually grew into present-day Copper Center.

Events such as these marked significant changes in the lives of the original residents of the subregion, as new options appeared for obtaining food, clothing, and other imported material goods. But this period of relative prosperity was short lived. Postwar fur values and copper prices plummeted, and by the time of the great Depression mining activity was nearly at a standstill. By 1939, Kennecott had only two inhabitants.

C. Organization and Settlement of Communities

According to Reckord (1983a), the establishment of large villages near roadhouses, the developing road system, the building of one family trapping cabins, and labor migrations become important factors in twentieth-century settlement patterns.

Mandatory public education was an additional factor influencing settlement patterns and community growth in the 1940's and 1950's. According to local people, mandatory schooling precipitated the final exodus from Lower Tonsina to Chitina during this time and also a major resettlement from the Crosswind, Ewan, and Tyone lakes areas to Gulkana in the late 1940's.

D. Development of Transportation Routes

For most of the basin, the period after the mining boom, when both the Copper River railroad and the Richardson Highway were completed, until World War II was a quiet period. Despite continued traffic over the highway, there was no development in the basin other than a few roadhouses by 1920 (Stoltzfus 1982). During the 1920's, the Interior Department, in a move to help the new Alaska Railroad, levied a tax on freight trucked over the Richardson Highway. This discouraged any development in the basin for at least another decade, when military imperatives led to a lifting of the toll, and work was begun on the Glenn Highway. With this transportation link to the developing Anchorage area, the basin began to emerge both as a transportation hub and a residential area for new settlers. Development of these early transportation routes are probably most responsible for shaping the Copper Basin settlement patterns of today (ibid.).

Presently, main population centers in the Copper Basin are located along the area's highways, mostly on the Copper River's west bank. In addition, much of the population of the subregion resides along the road system but away from communities (see next section on Population).

Even with some recent economic development, the region's economy remains at the periphery of economic centers at Anchorage and Fairbanks. Commercial and wage activities are typically modest and relatively unreliable in most communities. Consequently, for many basin residents, the key to their continued residency is an economic strategy that combines seasonal wage employment with the harvesting of local fish and game resources. Information on current harvest patterns is contained in a later section of this chapter.

E. Population

The Copper River subregion had a total population of about 3,087 people in 1983 (table 1). This included residents of established communities as well as those living along the roads and in remote areas of the subregion. Table 1 summarizes United States census data for the Copper River/Wrangell Mountains communities and population estimates compiled during a 1983 survey by the Division of Subsistence (Stratton and Georgette 1984).

Census data for the region do not reflect the short-term population increases in the mid 1970's that resulted from construction of the Trans-Alaska pipeline; between 1974 and 1977 the influx of pipeliners and job seekers greatly increased the subregion's population. The population of the Glennallen pipeline camp peaked in the fall of 1975 and again in the spring of 1976, with over 1,000 workers. Another 1,400 employees lived in the Tonsina camp. Altogether, more than 2,600 workers lived in camps near Copper Center. The 1976 population of the subregion, estimated at 1,136, was more than tripled just by the addition of people living in camps. This growth spurt, too, was temporary, although many who had first moved or returned to the basin during the pipeline's construction chose to remain and seek other means of livelihood (Stoltzfus 1982, and Fall). By the end of 1976, the pipeline was basically completed in the basin. In March 1978, only 42 employees worked out of the Glennallen camp.

Overall, the communities of the subregion display different patterns of population change. Some, like Copper Center, Glennallen, and Kenny Lake have shown steady increase in population over the last two or three decades. Others, like Chitina and Nabesna have never recovered population levels lost after the closure of Kennicott area mines. Others, like Gakona and Mentasta Lake have grown moderately and stabilized over the last decade. Given the historic sensitivity of the basin's population to changing economic factors, it is difficult to predict future population levels.

III. GENERALIZED LAND STATUS

A patchwork quilt of land ownership in the Copper Basin, with complex and in some cases overlapping management jurisdictions, resulted from the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National

Interest Lands Conservation Act (ANILCA). Currently, the predominant land owners in the area are the Ahtna Native Corporation and the associated village corporations, and the Federal Government. There is a limited amount of private non-Native Corporation land in the area, generally limited to mining claims, state land disposals, and a few homesteads. This land is concentrated in the Chitina Valley, the Nabesna area and along the regional highways.

Virtually the entire Wrangell Mountains area is contained within the boundaries of the Wrangell/St. Elias National Park and Preserve, managed by the National Park Service.

IV. USE OF FISH AND WILDLIFE RESOURCES BY LOCAL RESIDENTS

A. Historic Patterns of Resource Use

According to a reconstruction by Reckord (1983a) of the Ahtna subsistence year, May or early June initiated the seasonal round of harvest activities, with the return of salmon to the river lowlands, lake outlets, or tributary streams and the gathering of people at their respective fishcamps. Using dip nets, a typical Ahtna household in a good year, harvested, dried or smoked and stored an estimated 5,000 salmon.

By mid August, salmon runs tapered off and big game hunting began for caribou, black bear, sheep, goats, and moose, continuing until snowfall. Berries and plants also were gathered, and these foods were cached until after freeze-up, when travel became easier. Winter harvest of large game animals, furbearers, and birds supplemented the supply of meat and fish. In the spring, species such as hare, whitefish, grayling, and muskrat became important food items because of their availability at this time, when other resources were scarce and travel was difficult (ibid.).

In summary, the Ahtna depended on a wide variety of meat, fish, berries, and other plant items. Of these food sources, salmon was the critically important resource in most of the basin. The abundance of salmon largely determined whether food supplies would last the winter and whether efforts should be made to make up shortages through other harvest activities, such as winter hunting for moose.

B. Contemporary Patterns of Resource Use

As described above, until the last decade of the nineteenth century, a foraging (subsistence-based) economy supported all the communities and the entire population of the Copper Basin region. Since that time, a series of economic transformations has occurred, largely in boom or bust cycles. Consequently, changes in population size and structure, settlement patterns, transportation systems, and wage employment opportunities have occurred. Today the Copper River basin is far more diverse than 90 years ago, when Ahtna bands had almost exclusive use of the region.

Nevertheless, research in the 1970's (e.g., Reckord 1983a) and 1980's (Stratton 1982a, 1982b, 1983; Fall and Stratton 1984; Stratton and Georgette 1984) revealed the continued use and significance of wild resource harvesting for many residents of Copper River basin communities.

1. Species used. In recent years, moose, salmon, and caribou have provided the bulk of the foods harvested by residents of the Copper River/Wrangell subregion, and, at least along the Copper River, salmon is the most important of these items in quantity. Besides these primary species, a wide variety of freshwater fish, small game, birds, and other large and small mammals are harvested as well (see table 2). Herbaceous plants, berries, and mushrooms are used extensively. Spruce and birch trees are used for heating homes, and some use of local timber occurs in construction (Stratton and Georgette 1984).

2. Harvest and use of local resources: overview. Tables 3, 4, and 5 provide an overview of annual harvests of fish and wildlife resources for the period June 1982 to May 1983 by households interviewed in a recent comprehensive Copper basin survey (Stratton and Georgette 1984). In these tables, "fish" includes salmon and other finfish; "big game" includes caribou, moose, sheep, goat, elk, bison, black bear, and brown bear; and "small game" consists of wildfowl and edible small mammals. Sharing of resources between households within a community and between communities is reflected by differences between harvest quantities (table 3) and use quantities (table 4). If the mean harvest quantity exceeds mean use levels, then resources are leaving a community for distribution elsewhere. If the reverse is the case, then resources are entering a community through sharing and distribution networks.

   These survey data reveal a diversity of harvest and use patterns, forming an intricate picture of resource use in the Copper basin. Mean household harvests ranged from 227 lb dressed weight in Glennallen to 1,233 lb in the Nabesna area. For 13 of 20 communities (65%), mean household harvests

Table 2. Currently Utilized Species: Copper River/Wrangell Subregion

Mammals	**Berries**
Moose	Blueberry
Caribou	Highbush cranberry
Black bear	Lowbush cranberry
Brown bear	Crowberry
Dall sheep	Red currents
Mountain goat	Black currant
Bison	Rasberry
	Nagoon berry
	Cloudberry
Fish	
Sockeye salmon	**Mushrooms**
Chinook salmon	Orange delicious
Landlocked coho slamon	Shaggy mane
Arctic grayling	Orange boletus
Whitefish	Meadow mushroom
Northern pike	Morel
Sucker	Puff ball
Lake trout	
Rainbow trout	
Burbot	**Wild Vegetables**
	Sourdock
Wildfowl	Fireweed
Ptamigan	Watercress
Spruce grouse	Lambsquarter
Ducks	Chickweed
Geese	Wild chive
	Indian potato
	Sweet vetch
Small Mammals	Rose hips
Porcupine	
Arctic ground squirrel	**Trees**
Lynx	Spruce
Snowshoe hare	Balsom poplar
Beaver	Birch
Coyote	
Red fox	
Marten	**Shrubs**
Marmot	Alder
Mink	Green willow shoots
Muskrat	Willow catkin
Weasel	
Wolverine	
Wolf	

Source: Reckord 1983a, Stratton 1982a,b.

Table 3. Mean Household Harvests of Wild Resources, in Pounds by Resource Category, Copper River Region, June 1982-May 1983

Community/Area	Fish lb	Fish % of Total	Big Game lb	Big Game % of Total	Small Game lb	Small Game % of Total	Plants/Berries lb	Plants/Berries % of Total	Mean Household Harvest	Per Capita Harvest
Chistochina	139	45	116	37	20	6	36	12	311	115
Chitina	221	65	77	22	21	6	24	7	342	190
Copper Center	316	83	42	11	8	2	18	5	383	113
East Glenn Hwy	227	56	124	31	26	6	28	7	404	144
Gakona	424	69	145	24	26	4	19	3	614	192
Glennallen	123	54	90	40	5	2	9	4	227	71
Gulkana	197	62	93	29	15	5	15	5	320	114
Kenny Lake	109	44	110	44	12	5	18	7	248	78
Lake Louise	229	51	130	29	21	5	68	15	448	172
Lower Tonsina	323	69	74	16	37	8	34	7	468	120
Matanuska Glacier	95	33	155	54	10	4	30	10	290	104
McCarthy Road	175	43	80	20	128	52	23	6	406	140
Mentasta	92	23	219	56	27	7	56	14	393	109
Nabesna Road	635	51	517	41	63	5	18	1	1,233	280
North Wrangell Mtns.	159	35	250	55	43	10	6	1	458	208
Paxson-Sourdough	122	37	239	58	31	8	20	5	441	164
Sheep Mtn	136	61	75	33	5	2	8	4	225	73
Slana	336	49	296	44	13	2	35	5	679	252
South Wrangell Mtns.	113	28	226	56	45	11	22	5	406	203
Upper Tonsina area	178	58	94	31	14	5	19	6	305	102

Source: Stratton and Georgett 1984.

Table 4. Mean Household Use of Wild Resources in Pounds by Resource Category, Copper River Region, June 1982-May 1983

Community/Area	Fish lb	Fish % of Total	Big Game lb	Big Game % of Total	Small Game lb	Small Game % of Total	Plants/Berries lb	Plants/Berries % of Total	Mean Household Harvest	Per Capita Harvest
Chistochina	229	47	195	41	20	4	38	8	482	179
Chitina	200	55	121	33	18	5	25	7	364	202
Copper Center	346	70	127	25	8	2	17	4	498	146
East Glenn Hwy	329	50	277	42	25	4	28	4	659	236
Gakona	442	64	200	28	25	4	19	3	686	208
Glennallen	134	55	96	39	8	3	9	4	246	77
Gulkana	176	44	180	45	32	8	15	4	403	134
Kenny Lake	151	56	91	33	12	5	18	7	272	85
Lake Louise	250	47	198	38	18	4	61	12	527	203
Lower Tonsina	338	70	74	15	37	8	34	7	483	124
Matanuska Glacier	142	36	219	55	10	3	27	7	398	142
McCarthy Road	230	53	58	13	127	29	20	5	434	150
Mentasta	220	38	292	50	23	4	51	9	586	163
Nabesna Road	680	50	599	44	63	5	15	1	1,357	308
North Wrangell Mtns.	189	8	1,974	90	43	2	6	*	2,212	1,005
Paxson-Sourdough	143	31	272	58	31	7	20	4	466	186
Sheep Mtn.	146	28	363	69	5	1	8	2	522	168
Slana	292	44	345	52	9	2	21	3	668	247
South Wrangell Mtns.	139	30	254	55	45	10	18	5	460	230
Upper Tonsina area	185	46	180	45	17	4	18	5	400	133

Source: Stratton and Georgette 1984.

* less than .5%.

Table 5. Number of Species Harvested and Used by Households, Copper River Region, June 1982-May 1983

Community/Area	Households Interviewed	Harvested Mean	Harvested Range	Used Mean	Used Range
Chistochina	22	7.1	1-17	10.6	2-18
Chitina	23	6.5	0-18	8.3	0-22
Copper Center	27	4.6	0-12	6.0	1-13
East Glenn Hwy.	15	10.1	2-17	12.3	2-20
Gakona	23	10.0	1-27	11.6	1-29
Glennallen	51	4.7	0-16	6.4	0-19
Gulkana	36	5.9	0-23	6.8	0-24
Kenny Lake	12	8.4	2-19	9.0	2-19
Lake Louise	13	12.8	1-24	15.4	7-26
Lower Tonsina	8	10.4	2-18	11.4	3-19
Matanuska Glacier	30	8.1	0-25	10.5	1-26
McCarthy Road	13	8.0	0-21	10.2	0-21
Mentasta	19	8.3	0-35	11.6	1-36
Nabesna Road	8	11.3	1-20	14.1	6-23
North Wrangell Mtns.	5	12.2	4-17	16.6	12-23
Paxson-Sourdough	10	10.0	1-22	11.4	4-22
Sheep Mtn.	9	6.7	1-12	9.0	4-19
Slana	16	9.6	3-21	11.6	5-25
South Wrangell Mtns.	15	11.8	2-20	15.1	6-26
Upper Tonsina area	15	5.9	0-18	8.2	0-20

Source: Stratton and Georgette 1984.

ranged between 290 and 470 lb. The composition of household harvests of wild resources also differed between communities. For example, salmon comprised over 50% of the mean household harvest of wild resources in communities bordering the Copper River, such as Chitina, Lower Tonsina, and Copper Center. In contrast, communities distant from reliable or highly productive fisheries, such as Mentasta and Paxson, harvested much higher proportions of game.

Survey data for communities of the Copper River basin (see tables 6-25) show further that the kinds of species harvested and the amount of total harvest are both decidedly related to geographic location. Hunting and fishing regulations were also found to affect harvest levels in that they set constraints on the availability of species, seasons, and methods of harvest. Likewise, bag limits for salmon limited the availability of this resource to fishermen. Other factors relating to resource harvest were the type and length of wage employment, the compositions of households, and a number of other environmental, economic, social, and cultural factors.

In summary, beginning in the late nineteenth century, the Copper basin and the surrounding region have undergone profound socioeconomic change. Population size and composition, transportation systems, settlement patterns, sociopolitical organization, and patterns of wage employment have all been altered, largely because of circumstances originating outside the region. But overall, this area has remained marginal to the economic development of other parts of Alaska. Within this process of change, patterns of wild resource use have changed as well and are today characterized by a greater diversity of patterns than those of 90 years ago.

Hunting, fishing, and gathering continue to play a significant role in the way of life of these communities. This is largely a consequence of economic marginality, accessable and relatively healthy populations of game and fish, and the presence of long-term or life-long users of these resources for whom fishing and hunting play a major role in the maintenance of their culture and way of life (Stratton and Georgette 1984). The following sections provide more detail about harvest patterns for caribou, moose, and salmon in the Copper basin.

3. Use of caribou. At present, caribou from the Nelchina and Mentasta herds occur in the Copper basin/Wrangell area. In the last decade, harvest of these herds has been carefully

Table 6. Chistochina: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=22)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	23	*	15	41	1	19
Sockeye salmon	23	24	100	77	45	188
Coho salmon	0	0	0	5	*	4
Lake trout	9	1	2	14	1	3
Burbot	9	*	*	14	*	1
Sucker	5	*	*	9	3	2
Arctic grayling	27	14	10	32	7	5
Whitefish	9	5	5	27	6	6
Halibut	5		2	9		2
Dolly Varden	9	6	6	0	0	0
Moose	14	*	68	64	*	121
Caribou	18	*	47	27	*	71
Dall sheep	0	0	0	9	*	4
Hare	55	6	9	55	6	9
Porcupine	32	*	2	32	*	2
Muskrat	27	2	1	27	2	1
Lynx	18	*	1	18	*	1
Coyote	9	*				
Fox	18	1				
Land otter	9	*				
Marmot	5	*				
Marten	9	*				
Ground squirrel	5	*				
Weasel	5	*				
Wolf	5	*				
Wolverine	5	*				
Ptarmigan	27	2	1	27	3	1
Spruce grouse	36	1	3	36	5	3
Ducks	23	1	2	23	1	2
Geese	5	*	1	5	*	1
Berries	73		34	90		36
Plants	23		2	27		2

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 7. Chitina: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=23)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	39	3	50	39	3	45
Sockeye salmon	48	35	146	87	30	125
Coho salmon	4	2	11	9	3	15
Rainbow trout	35	3	4	39	3	5
Lake trout	9	*	1	9	1	2
Burbot	9	*	*	9	*	*
Grayling	39	8	6	44	7	5
Whitefish	4	*	*	4	*	*
Halibut	4		1	4		1
Dolly Varden	9	2	2	9	1	1
Moose	4	*	65	65	*	104
Caribou	9	*	11	26	*	15
Dall sheep	0	0	0	22	*	2
Hare	48	8	13	48	7	10
Porcupine	4	*	*	9	*	*
Lynx	9	*	3	9	*	3
Coyote	13	*				
Marten	13	2				
Mink	13	*				
Weasel	4	*				
Wolf	4	*				
Wolverine	4	*				
Ptarmigan	13	*	*	13	*	*
Spruce grouse	35	3	3	30	7	3
Ducks	9	*	*	9	*	*
Berries	78		18	78		20
Plants	39		6	39		6

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 8. Copper Center: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=27)

Species	% Hslds. Har-vesting	Mean No. Har-vested	Mean Lb Har-vested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	37	1	20	41	2	32
Sockeye salmon	63	42	177	78	45	192
Coho salmon	19	6	37	26	6	39
Rainbow trout	7	1	2	11	1	2
Lake trout	4	1	3	4	1	3
Burbot	11	2	5	19	2	6
Sucker	4	*	*	0	0	0
Arctic grayling	15	5	4	19	6	4
Whitefish	7	1	*	15	2	2
Halibut	15		60	15		60
Dolly Varden	15	4	3	15	4	3
Shrimp	0		0	4		*
Pink salmon	4	*	2	4		*
Chum salmon	0	0	0	4	*	*
Other fish	7		1	7		2
Moose	0	0	0	48	*	73
Caribou	22	*	42	44	*	54
Hare	19	3	4	19	3	4
Porcupine	19	*	2	19	*	2
Beaver	4	*	*	4	*	*
Ptarmigan	4	*	*	4	*	*
Spruce grouse	11	*	*	11	*	*
Ducks	4	*	*	4	*	*
Berries	59		15	63		15
Plants	26		3	26		3

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 9. East Glenn Highway: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=15)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	47	2	34	60	2	42
Sockeye salmon	47	24	99	87	40	166
Rainbow trout	60	10	13	60	10	13
Lake trout	47	4	8	47	4	9
Burbot	60	9	22	67	10	24
Sucker	7	*	5	7	*	5
Arctic grayling	73	36	25	73	33	23
Whitefish	13	*	*	13	*	*
Steelhead	7	*	*	7	*	*
Halibut	13		16	27		39
Clams	7		*	7		*
Crab	0	0	0	7		3
Other fish	20		2	13		4
Moose	13	*	50	67	*	168
Caribou	33	*	61	53	*	80
Black bear	7	*	4	13	*	20
Brown bear	7	*	9	0	0	0
Dall sheep	0	0	0	13	*	9
Bison	0	0	0	7	*	*
Hare	47	13	20	47	13	20
Porcupine	7	3	2	7	3	2
Lynx	7	*	*	7	*	*
Muskrat	7	*	*	7	*	*
Coyote	7	*				
Marten	13	*				
Mink	7	*				
Ground squirrel	7	4				
Ptarmigan	47	4	2	40	4	2
Spruce grouse	40	2	1	40	2	1
Ducks	7	*	*	7	*	
Berries	93		24	93		24
Plants	60		4	60		4

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 10. Gakona: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=23)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	65	6	106	74	6	112
Sockeye salmon	74	54	225	96	57	239
Coho salmon	13	5	5	13	5	5
Rainbow trout	30	3	4	30	3	4
Lake trout	9	1	2	9	1	2
Burbot	39	16	37	39	15	37
Arctic grayling	74	25	18	74	25	17
Whitefish	22	9	8	22	9	8
Halibut	9		11	26		9
Dolly Varden	4	*	*	4	*	*
Hooligan	0	0	0	4	*	*
Clams	4		*	9		1
Pink salmon	4	2	6	4	2	6
Other fish	4		2	4		2
Moose	13	*	65	44	*	93
Caribou	30	*	57	61	*	77
Black bear	13	*	8	22	*	9
Dall sheep	4	*	3	9	*	4
Goat	0	0	0	4	*	*
Bison	0	0	0	4	*	*
Deer	13	*	13	17	*	16
Hare	48	9	13	48	9	13
Beaver	9	*	2	9	*	2
Muskrat	9	7	3	9	7	3
Lynx	4	*	*	4	*	*
Coyote	4	*				
Fox	17	1				
Marten	13	*				
Mink	13	*				
Weasel	4	*				
Ptarmigan	26	5	2	26	5	2
Spruce grouse	30	3	2	26	2	1
Ducks	22	2	3	22	2	3
Berries	87		15	89		16
Plants	35		3	44		3

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 11. Glennallen: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=51)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	47	1	20	63	2	31
Sockeye salmon	45	17	69	71	18	74
Coho salmon	12	2	10	14	1	8
Rainbow trout	2	*	*	2	*	*
Lake trout	10	*	2	12	1	2
Burbot	8	2	4	14	2	4
Sucker	2	*	*	2	*	*
Grayling	39	8	6	41	8	6
Whitefish	4	*	*	4	*	*
Steelhead	6	*	*	6	*	*
Halibut	4		10	16		6
Dolly Varden	2	*	*	10	*	*
Shrimp	0		0	2		*
Clams	4		*	4		*
Pink salmon	2	*	1	2	*	1
Other fish	6		*	6		*
Moose	12	*	59	39	*	54
Caribou	14	*	28	51	*	36
Black bear	2	*	1	4	*	2
Dall sheep	0	0	0	6	*	*
Bison	0	0	0	4	*	*
Deer	2	*	2	6	*	2
Hare	24	2	3	26	3	5
Porcupine	2	*	*	4	*	1
Lynx	8	*		0	0	0
Coyote	4	*				
Fox	6	*				
Mink	6	*				
Tree squirrel	2	*				
Wolf	2	*				
Wolverine	2	*				
Ptarmigan	12	2	1	12	2	*
Spruce grouse	22	1	*	22	*	*
Ducks	4	*	*	4	*	*
Berries	57		7	57		7
Plants	18		2	24		2

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 12. Gulkana: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=36)

Species	% Hslds. Har-vesting	Mean No. Har-vested	Mean Lb Har-vested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	58	3	55	56	2	40
Sockeye salmon	61	24	103	69	24	102
Coho salmon	17	*	6	17	*	5
Rainbow trout	14	1	2	14	1	2
Lake trout	6	*	1	3	*	*
Burbot	6	*	1	3	*	*
Sucker	6	11	8	6	11	8
Arctic grayling	33	9	6	28	8	6
Whitefish	14	4	3	11	3	3
Steelhead	6	*	3	6	*	3
Halibut	11		9	11		5
Shrimp	0		0	3		*
Pink salmon	0	0	0	3	*	1
Moose	14	*	69	28	*	115
Caribou	14	*	22	33	*	65
Dall sheep	3	*	2	3	*	*
Bison	0	0	0	3	*	*
Hare	19	4	5	28	14	20
Porcupine	14	1	5	17	1	5
Beaver	3	*	*	8	*	2
Muskrat	6	*	*	11	*	*
Lynx	14	*	*	14	*	*
Coyote	6	*				
Fox	11	*				
Land otter	3	*				
Marten	6	*				
Mink	6	*				
Wolf	6	*				
Wolverine	6	*				
Ptarmigan	11	2	*	11	2	*
Spruce grouse	19	2	*	19	2	*
Ducks	8	1	2	8	1	2
Berries	75		15	72		14
Plants	17		*	17		*

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 13. Kenny Lake: Summary of Household (Hsld.) Resource Harvest and Use June 1982 through May 1983 (n=12)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook	67	1	26	67	3	54
Sockeye salmon	83	18	74	92	19	82
Rainbow trout	17	3	4	17	3	4
Lake trout	0	0	0	8	*	*
Arctic grayling	33	5	4	33	5	4
Whitefish	8	*	*	8	*	*
Halibut	8		*	17		*
Dolly Varden	17	*	*	17	*	*
Other fish	8		*	8	*	*
Moose	8	*	83	25	*	65
Caribou	8	*	22	17	*	21
Black bear	8	*	5	8	*	5
Hare	17	4	6	17	4	6
Porcupine	0	*	*	8	*	*
Lynx	17	*	3	17	*	3
Coyote	17	*				
Fox	17	*				
Marten	8	*				
Mink	8	*				
Wolf	17	*				
Wolverine	8	*				
Ptarmigan	17	1	*	17	1	*
Spruce grouse	42	3	2	42	3	2
Ducks	8	*	*	8	*	*
Berries	83		17	83		17
Plants	67		1	67		1

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 14. Lake Louise: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=13)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	46	*	15	69	2	37
Sockeye salmon	31	2	9	54	3	12
Coho salmon	8	*	2	23	1	8
Rainbow trout	46	6	9	54	8	11
Lake trout	92	15	31	92	16	32
Burbot	85	21	50	85	21	51
Sucker	15	3	2	8	2	1
Arctic grayling	69	22	16	69	22	16
Whitefish	77	90	81	77	71	64
Halibut	8		11	31		14
Clams	15		4	31		4
Other fish				8		*
Moose	15	*	77	54	*	113
Caribou	31	*	50	77	*	73
Brown bear	8	*		0	0	0
Dall sheep	0	0	0	8	*	*
Bison	0	0	0	8	*	*
Deer	8	*	3	23	*	7
Hare	46	5	7	46	5	7
Muskrat	15	3	2	0	0	0
Lynx	23	*	*	0	0	0
Coyote	8	*				
Fox	23	2				
Land otter	8	1				
Marten	15	1				
Mink	31	*				
Weasel	8	*				
Wolf	15	*				
Ptarmigan	31	6	3	39	6	3
Spruce grouse	31	3	1	31	3	1
Ducks	46	4	6	46	4	6
Berries	85		62	85		55
Plants	46		6	46		6

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 15. Lower Tonsina: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=8)

Species	% Hslds. Har-vesting	Mean No. Har-vested	Mean Lb Har-vested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	50	1	18	50	1	18
Sockeye salmon	88	58	245	100	60	256
Coho salmon	25	3	19	25	3	19
Rainbow trout	25	7	10	25	7	10
Lake trout	13	*	*	13	*	*
Burbot	13	*	*	13	*	*
Arctic grayling	38	28	11	38	28	11
Whitefish	0	0	0	13	*	*
Halibut	13		13	13		13
Dolly Varden	13	3	3	13	3	3
Pink salmon	0	0	0	13	*	4
Chum salmon	0	0	0	13	*	1
Other fish	13		3	13		3
Moose	0	0	0	13	*	2
Caribou	38	*	64	50	*	62
Deer	13	*	11	13	*	11
Hare	75	14	21	75	14	21
Porcupine	63	2	8	63	2	8
Beaver	13	*	1	13	*	1
Lynx	25	1	4	38	*	4
Coyote	25	2				
Fox	13	*				
Marten	13	*				
Mink	25	*				
Wolverine	13	*				
Spruce grouse	50	7	4	50	7	4
Berries	75		27	75		27
Plants	75		10	75		10

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 16. McCarthy Road: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=13)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	31	2	33	39	2	38
Sockeye salmon	31	28	116	85	39	166
Rainbow trout	31	2	3	39	3	4
Burbot	39	8	19	46	8	19
Arctic grayling	15	2	2	15	2	2
Other fish	15		2	15		2
Moose	15	*	77	46	*	51
Caribou	0	0	0	8	*	4
Black bear	0	0	0	15	*	4
Deer	8	*	3	8	*	3
Hare	62	76	114	54	75	113
Porcupine	23	*	2	23	*	1
Beaver	8	*	2	8	*	2
Muskrat	23	3	1	15	2	1
Lynx	15	*	3	15	*	3
Coyote	23	1				
Land otter	8	*				
Marten	31	2				
Mink	23	*				
Weasel	8	*				
Ptarmigan	15	2	*	15	2	*
Spruce grouse	39	5	3	39	5	3
Ducks	23	2	3	23	2	3
Geese	8	*	*	8	*	*
Berries	77		18	92		15
Plants	46		6	54		6

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 17. Matanuska Glacier: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=30)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	10	*	3	23	*	25
Sockeye salmon	33	6	26	63	11	47
Coho salmon	20	3	20	30	4	19
Rainbow trout	23	5	7	37	5	7
Lake trout	10	*	1	10	*	1
Burbot	3	*	*	3	*	*
Grayling	27	12	9	30	13	9
Whitefish	7	*	*	7	*	*
Steelhead	3	*	*	3	*	*
Halibut	17		14	30		18
Dolly Varden	7	10	8	10	10	9
Shrimp	3		4	3		3
Clams	13		2	17		2
Crab	0	0	0	7		2
Pink salmon	7	*	1	10	*	1
Other fish	3		*	3		*
Moose	20	*	133	63	*	188
Caribou	10	*	17	33	*	26
Black bear	3	*	2	7	*	2
Brown bear	0	0	0	3	*	*
Dall sheep	0	0	0	3	*	*
Deer	3	*	3	13	*	*
Hare	20	3	4	20	3	4
Porcupine	3	*	*	3	*	*
Beaver	7	*	2	7	*	2
Lynx	7	*	*			
Fox	7	*				
Marten	3	*				
Mink	3	*				
Ground squirrel	3	*				
Tree squirrel	3	*				
Wolf	3	*				
Wolverine	3	*				
Ptarmigan	27	5	3	33	6	3
Spruce grouse	30	3	1	30	2	1
Ducks	7	*	*	7	*	*
Berries	90		28	93		26
Plants	48		2	53		2

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 18. Mentasta: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=19)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	16	*	11	47	2	36
Sockeye salmon	16	14	60	84	33	140
Coho salmon	5	*	*	11	*	2
Rainbow trout	5	3	4	16	3	6
Burbot	11	1	3	5	*	1
Sucker	5	3	2	5	3	2
Arctic grayling	21	9	6	26	8	5
Whitefish	21	6	5	79	22	25
Halibut	0		0	5		2
Clams	5		*	5		*
Crab	0		0	5		*
Other fish	5		*	5		*
Moose	32	0	158	90	*	187
Caribou	11	*	21	58	*	60
Black bear	16	*	15	16	*	20
Dall sheep	11	*	14	16	*	14
Deer	5	*	11	5	*	11
Hare	42	4	6	42	4	6
Porcupine	42	*	4	42	*	4
Beaver	11	*	8	5	*	7
Muskrat	21	3	1	16	2	1
Lynx	5	*	*	0	0	0
Coyote	16	*				
Fox	11	*				
Land otter	5	*				
Marmot	5	*				
Marten	5	*				
Mink	11	*				
Tree squirrel	11	1				
Weasel	5	*				
Wolf	5	*				
Wolverine	5	*				
Ptarmigan	16	1	*	11	*	*
Spruce grouse	32	3	2	21	2	1
Ducks	37	4	5	32	2	4
Berries	79		47	84		41
Plants	42		9	47		10

Source: Stratton and Georgette 1984.
* Less than 1.0.

Table 19. Nabesna Road: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=8)

Species	% Hslds. Har-vesting	Mean No. Har-vested	Mean Lb Har-vested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	13	*	5	38	*	8
Sockeye salmon	50	81	341	100	87	365
Coho salmon	0	0	0	13	1	8
Rainbow trout	13	3	4	13	3	4
Lake trout	25	8	15	38	8	15
Burbot	50	31	75	63	32	77
Arctic grayling	50	20	14	88	24	17
Whitefish	25	197	177	50	199	179
Halibut	13		4	25		7
Chum salmon	0	0	0	13	*	*
Moose	38	*	313	75	*	383
Caribou	63	1	154	75	1	161
Dall sheep	25	*	41	50	*	46
Goat	13	*	9	13	*	10
Hare	50	7	10	50	7	10
Beaver	25	1	10	25	1	10
Muskrat	13	3	1	13	3	1
Lynx	63	9	38	63	9	38
Coyote	38	2				
Fox	50	8				
Land otter	25	*				
Marten	25	5				
Mink	50	4				
Tree squirrel	13	*				
Wolf	25	1				
Wolverine	38	2				
Ptarmigan	38	7	4	50	8	4
Spruce grouse	25	1	*	25	1	*
Berries	88		17	88		15
Plants	50		1	50		1

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 20. North Wrangell Mountains: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=5)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	0	0	0	60	1	20
Sockeye salmon	0	0	0	40	5	26
Lake trout	80	50	100	20	50	100
Burbot	80	5	13	80	2	7
Arctic grayling	100	33	24	60	25	17
Halibut	0		0	20		1
Other fish	60		22	40		18
Moose	40	*	190	100	2	840
Caribou	20	*	50	100	4	480
Dall sheep	20	*	10	100	10	652
Bison	0	0	0	20	*	2
Hare	60	12	17	60	12	17
Porcupine	20	*	4	20	*	4
Muskrat	20	16	1	20	16	1
Lynx	40	9	16	40	9	16
Coyote	80	4				
Fox	60	11				
Marten	20	3				
Weasel	40	*				
Wolf	60	3				
Wolverine	60	4				
Ptarmigan	60	11	6	60	11	6
Spruce grouse	20	2	1	20	2	1
Ducks	20	1	2	20	1	2
Berries	60		4	80		4
Plants	60		2	60		2

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 21. Paxson-Sourdough: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=10)

Species	% Hslds. Har-vesting	Mean No. Har-vested	Mean Lb Har-vested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	40	1	24	50	1	25
Sockeye salmon	20	3	14	60	7	31
Coho salmon	30	2	10	30	2	12
Rainbow trout	20	1	2	20	1	2
Lake trout	50	5	10	50	5	10
Burbot	50	10	24	60	9	25
Sucker	10	2	1	10	2	1
Arctic grayling	60	23	16	70	24	17
Whitefish	30	13	11	30	13	11
Halibut	20		10	20		10
Clams	10		*	10		*
Moose	40	*	200	70	*	232
Caribou	20	*	39	30	*	40
Bison	0	0	0	10	*	*
Hare	10	*	*	10	*	*
Muskrat	10	1	*	10	1	*
Lynx	20	1	5	20	1	*
Coyote	10	1				
Fox	40	9				
Land otter	20	*				
Marten	30	7				
Mink	30	1				
Wolf	20	*				
Wolverine	10	*				
Ptarmigan	70	17.4	9	80	18	9
Spruce grouse	50	3	1	50	3	1
Ducks	30	6	9	30	6	9
Geese	20	*	4	20	*	5
Berries	80		18	80		19
Plants	10		*	10		*

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 22. Sheep Mountain: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=9)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	33	3	62	33	3	62
Sockeye salmon	33	4	17	44	6	24
Coho salmon	22	3	16	33	3	18
Rainbow trout	22	1	2	33	2	2
Lake trout	33	1	2	44	1	3
Burbot	11	*	1	11	*	1
Arctic grayling	22	5	4	56	6	4
Dolly Varden	11	3	3	11	3	3
Pink salmon	11	*	2	11	*	2
Other fish	11		27	11		27
Moose	11	*	56	67	*	195
Caribou	11	*	14	22	*	17
Black bear	0	0	0	11	*	3
Brown bear	0	0	0	11	*	3
Dall sheep	0	0	0	22	*	139
Bison	0	0	0	11	*	1
Deer	11	*	5	11	*	5
Muskrat	22	*	*	11	*	*
Lynx	11					
Fox	11					
Marten	11	8				
Mink	11					
Tree squirrel	11	2				
Weasel	11					
Wolf	11					
Wolverine	11					
Ptarmigan	33	9	5	44	9	5
Spruce grouse	11	*	*	11	*	*
Berries	89		7	89		7
Plants	22		1	22		1

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 23. Slana: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=16)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	31	*	11	38	*	14
Sockeye salmon	75	63	265	88	48	202
Coho salmon	6	2	10	6	2	10
Rainbow trout	0	0	0	6	*	*
Lake trout	19	2	5	19	2	5
Burbot	50	6	15	63	7	16
Arctic grayling	56	29	20	63	29	21
Whitefish	31	7	7	38	9	8
Halibut	6		2	25		16
Dolly Varden	13	2	2	13	2	2
Moose	44	*	219	56	*	231
Caribou	25	*	49	56	*	87
Black bear	0	0	0	6	*	3
Dall sheep	31	*	28	31	*	25
Hare	31	4	5	31	4	5
Beaver	6	*	*	0	0	0
Lynx	13	*	1	0	0	0
Coyote	19	*				
Fox	38	3				
Marten	19	*				
Mink	19	2				
Weasel	6	*				
Wolf	13	*				
Wolverine	13	*				
Ptarmigan	38	5	3	25	4	2
Spruce grouse	19	3	2	6	3	1
Ducks	6	*	1	6	*	1
Berries	88		35	87		21
Plants	25		*	25		*

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 24. South Wrangell: Summary of Household (Hsld.) Resource Harvest and Use, June 1982 through May 1983 (n=16)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	20	*	15	53	1	22
Sockeye salmon	40	16	67	93	19	78
Coho salmon	13	1	8	27	2	10
Rainbow trout	7	*	*	7	*	*
Lake trout	7	*	*	7	*	*
Burbot	27	2	4	27	2	4
Arctic grayling	13	2	1	13	2	1
Halibut	7		4	27		7
Dolly Varden	27	5	4	47	6	6
Shrimp	0		0	7		*
Clams	7		*	7		*
Crab	0		0	7		*
Pink salmon	7	1	3	7	1	3
Other fish	7		4	7		5
Moose	40	*	178	80	*	190
Caribou	7	*	9	27	*	18
Black bear	20	*	12	67	*	17
Dall sheep	13	*	9	27	*	10
Goat	7	*	5	13	*	6
Deer	13	*	14	13	*	14
Hare	53	17	31	53	17	31
Porcupine	20	*	3	20	*	3
Lynx	20	*	2	20	*	2
Coyote	13	*				
Marten	20	5				
Tree squirrel	7	1				
Weasel	7	*				
Wolverine	7	*				
Ptarmigan	33	4	2	33	4	2
Spruce grouse	67	12	6	73	12	6
Ducks	20	1	2	20	1	2
Berries	93		16	93		16
Plants	93		6	93		6

Source: Stratton and Georgette 1984.

* Less than 1.0.

Table 25. Upper Tonsina area: Summary of Household (Hsld.) Resource Harvest and Use June 1982 through May 1983 (n=15)

Species	% Hslds. Harvesting	Mean No. Harvested	Mean Lb Harvested	% Hslds. Using	Mean No. Used	Mean Lb Used
Chinook salmon	20	*	15	27	*	17
Sockeye salmon	53	30	126	67	31	124
Coho salmon	27	1	7	33	2	11
Rainbow trout	7	*	1	20	1	2
Lake trout	20	7	13	33	7	14
Arctic grayling	53	10	7	67	11	8
Whitefish	0	0	0	7	*	*
Halibut	0		0	13		*
Dolly Varden	13	4	4	13	4	4
Pink salmon	7	1	2	7	1	2
Other fish	13		3	13		3
Moose	7	*	53	40	*	120
Caribou	13	*	36	53	*	44
Black bear	0	0	0	7	*	9
Dall sheep	0	0	0	7	*	*
Goat	7	*	5	7	*	5
Bison	0	0	0	7	*	*
Deer	0	0	0	7	*	1
Hare	40	7	10	40	7	10
Porcupine	7	*	1	7	*	1
Lynx	0	0	0	13	*	2
Ptarmigan	27	2	1	33	3	1
Spruce grouse	33	2	1	33	2	1
Ducks	13	*	1	13	*	1
Berries	73		16	67		17
Plants	27		3	27		1

Source: Stratton and Georgette 1984.

* Less than 1.0.

restricted to allow for an increase in herd size to pre-1970 levels.

In 1977, the Nelchina and Mentasta caribou hunts were placed on a draw permit basis. In 1981, of 1,600 permits issued for the Nelchina herd, about 650 permits were actually hunted, with approximately 400 caribou harvested. A recent study of the 1982 Nelchina permit hunt showed that in that year the majority of the permit winners resided in the Anchorage (55.4%), Fairbanks (10.1%), and Palmer/Wasilla (15.1%) areas (Stanek 1981, Stratton 1982b). Use of the Mentasta herd has also been predominately by nonlocal hunters in recent years. Of the 350 Mentasta permits issued in the 1982 drawing, 36.3% were received by basin residents, 24.0% by those residing in the Anchorage area, 29.0% by Fairbanks area residents, 7.4% by Palmer/Wasilla residents, 18.6% by other Alaska residents, and 5.7% by nonresidents of the state (Stratton 1982b).

A court decision in 1980 concluded that subsistence uses were not adequately provided for under existing regulations. This prompted the creation of a subsistence hunt in 1981 in which a specific allocation of permits was made for local users. A winter season was provided for the subsistence hunt as well.

4. Use of moose. Throughout the subregion, moose appear to be one of the most highly valued of all food sources. Availability of moose varies from year to year, however, so hunting success by local residents is not assured. General harvest ticket and permit hunt data collected by the Division of Game, ADF&G, indicated that for the Chitina Valley and the eastern half of the Copper basin (GMU 11) 195 hunters killed 48 moose in 1983. Hunter success was 25%. Nonresident hunters killed 4 moose (8% of the total). For GMU 12, Subunits A, B, C, and D, 665 moose were taken by 2,318 hunters during 1983. Nonresidents took 34 moose, or 5% of the harvest. The overall success rate was 29%. In the subregion as a whole, highway vehicles were the most prevalent mode of transportation used by hunters, followed by off-road vehicles, airplanes, and boats (BGDIF 1983) (See the Use of Moose account in this volume for further details on hunter effort and harvest.)

   As is the case with caribou, the increasing use of moose by nonresidents of the basin is a source of concern to local residents. This has led to proposals for a subsistence permit moose hunt in the Copper River basin. In 1983, the Board of Game relaxed moose size requirements for 100 subsistence permit holders.

5. Use of fish. Fishing is by far the most important of all the resource use activities in the Copper River basin, in terms of the size of the catch. Salmon is the predominate resource used, with sockeye by far the predominant species. Arctic grayling also are caught in the Copper River area during the weeks preceding the salmon fishing seasons. Other fish, such as trout and burbot, usually caught by rod and reel in lakes and streams, are occasionally caught incidently with salmon. Community salmon harvest data are presented in table 6 for June 1982-May 1983.

   According to Stratton (1982a), local use of salmon on the Copper River predates Russian contact. The aboriginal harvesting technology included spears, fish traps, and dip nets made of woven spruce roots. Salmon were harvested in tributaries as well as in the main channel of the Copper River. Fish wheels were introduced to the Copper River basin region in the early 1900's and rapidly became the predominant method for harvesting salmon for subsistence uses.

   In recent years, dip nets have been commonly used, primarily by nonbasin residents, for harvest of Copper River salmon. Prior to 1983 the dip net fishery was managed as a subsistence fishery, but in 1984 two types of fishery were recognized in regulations: "subsistence" fishery for basin residents and a "personal use" fishery for nonbasin residents. The distinction is based on residency rather than gear type, so dip nets and fish wheels can be used in either category. In 1984, regulations allowed the use of dip nets from the downstream edge of the Chitina-McCarthy rivers bridge to a point roughly 5 mi downstream. Fish wheels were allowed in the portion of the river from the downstream edge of the bridge up to the confluence of the Slana and Copper rivers, near the community of Slana, a distance of approximately 120 river miles.

   a. The subsistence fish wheel fishery. Currently, Copper basin residents harvest salmon predominately with fish wheels. In 1982, 79%, and in 1983, 83% of the local subsistence permits issued were for fish wheels. In 1981, about 83% of the 409 basin households that held subsistence permits used fish wheels. The remainder of the permit holders fished with dip nets (fig. 1). The number of basin households harvesting salmon with fish wheels or dip nets has remained stable over the last three years (fig. 2).

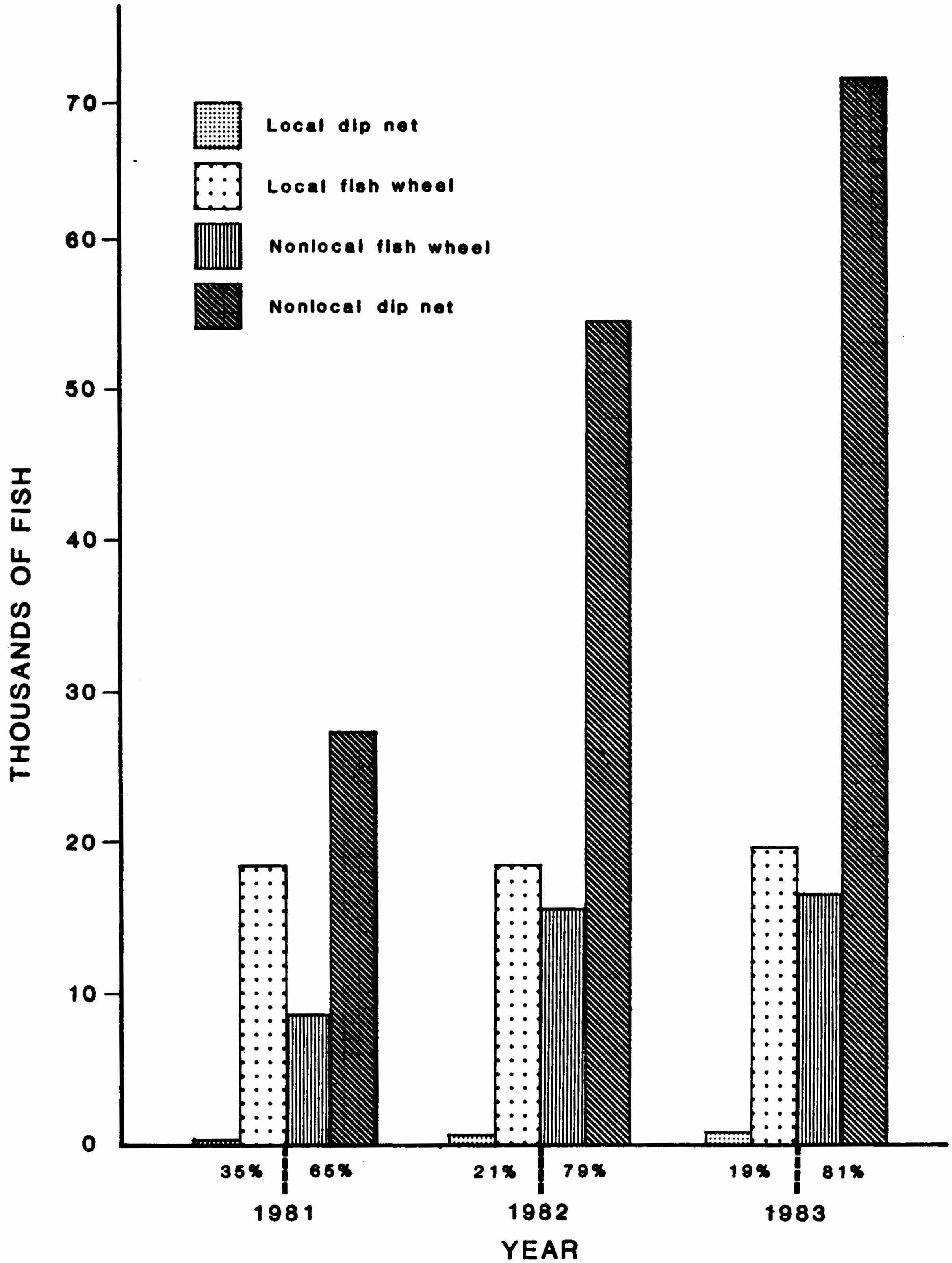


Figure 1. Number of salmon harvested, Copper River salmon fishery 1981-1983 (Fall and Stratton 1984).

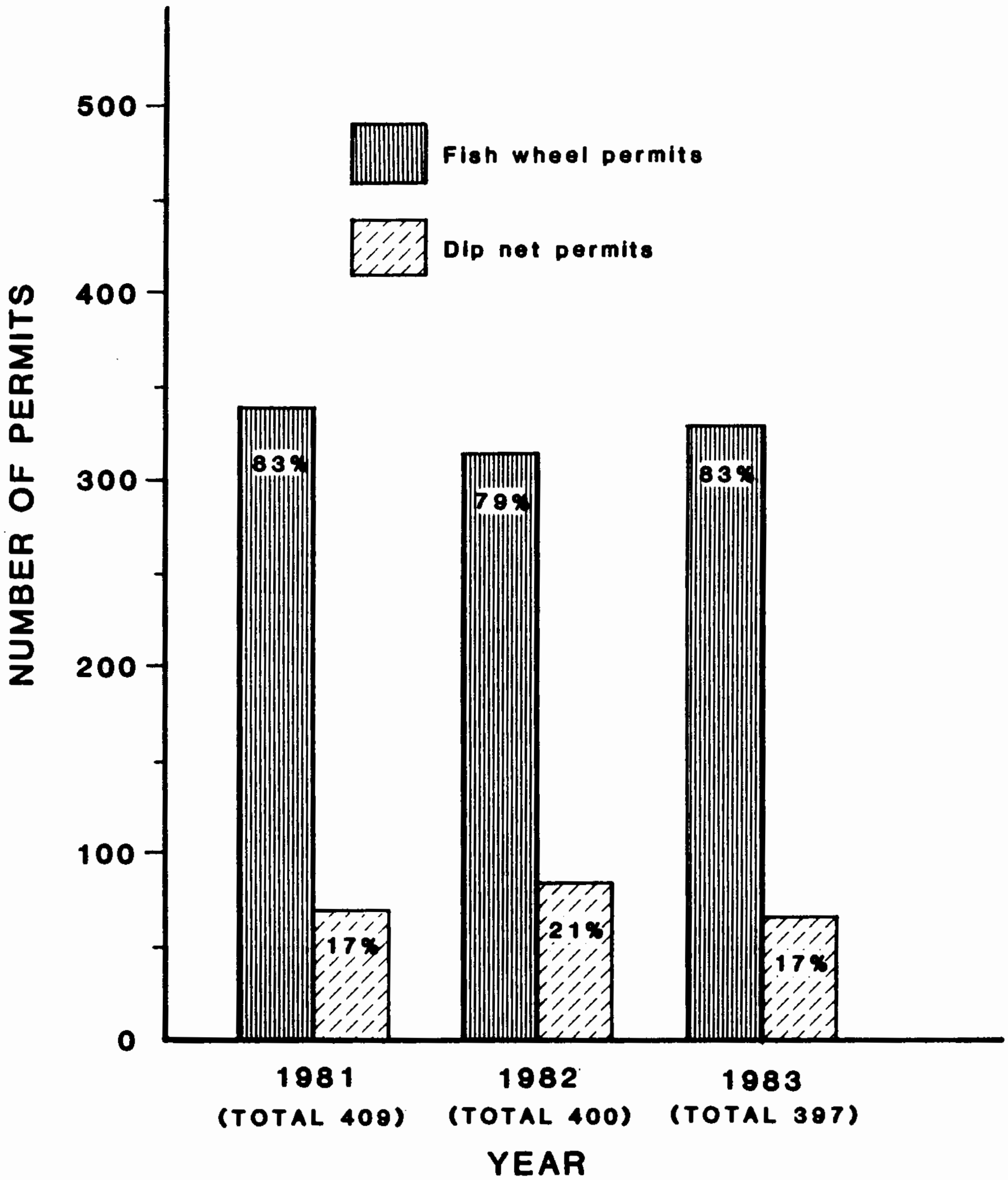


Figure 2. Local participation in Copper River subsistence salmon fishery, 1981-1983 (Fall and Stratton 1984).

Division of Subsistence research has found that a large portion of all households in the Copper River basin communities participate in the fish wheel fishery (table 26). For example, almost 60% of a random sample of Copper Center households harvested salmon with fish wheels during a study period spanning 12 months, from June 1982 to May 1983. Only 7% of the Copper Center sample took salmon with rod and reel, and none used dip nets. Most communities bordering the Copper River from Chitina to Slana displayed similar patterns. Conversely, residents of basin communities more distant from the river, such as Lake Louise, Paxson/Sourdough, and Sheep Mountain, harvested most of their salmon with rod and reel under sportfishing regulations (Fall and Stratton 1984). The efficiency of the fish wheel probably accounts for the prevalence of this fishing method. Reasons basin residents gave for using dip nets included the lack of time to invest in building and maintaining a fish wheel, the desire to harvest a few salmon quickly using inexpensive gear, and losing access to someone else's fish wheel they had used in the past (Stratton 1982a, Fall and Stratton 1984). Division of Commercial Fisheries permit data for the years 1948 to 1983 appear in table 27.

Of the participants in the fish wheel fishery who were interviewed in a 1982 Division of Subsistence study (Stratton 1984), nearly half had been involved for 10 years or less. Forty percent had a history of involvement in excess of 20 years. Nonlocal residents were characterized by a shorter history in the fishery, with 52% having five or fewer years experience. By comparison, 16.1% of the local sample had participated for only five years or less, while 51.8% had been in the fishery more than 20 years (fig. 3).

By regulation, fishing with fish wheels and dip nets opens June 1 and closed on September 30. Most sockeye and chinook salmon taken with fish wheels are caught in June and July, although sockeye salmon continue to be harvested in small numbers into September, and coho salmon are harvested in August and September (Stratton and Georgette 1984).

Figure 4 depicts the areas where fish wheels are commonly placed in the Copper River. In 1982, 104 fish wheels were located along the river in 13 separate and distinct areas. The presence of roads, proximity of a community, and long-established use of sites seem to be responsible at least in part for the clustering of fishing sites. Many fish wheels are operated from private property.

Table 26. Salmon Harvest and Use by Copper Basin Communities, June 1982-May 1983

	No.	% Har.* Salmon	% Using Salmon	Mean No. Har. per Hsld.*	Mean No. Used per Hsld.	% of Total Har. Composed of Salmon	% Using Fish Wheel	% Using Dip Net	% Using Rod/Reel	% Using Other
Chistochina	22	27.3	81.8	24.5	44.3	36.9	22.7	---	4.6	---
Chitina	23	47.8	87.0	39.3	35.0	60.5	43.5	4.4	---	---
Copper Center	27	66.7	85.2	49.4	53.4	61.4	59.3	---	7.4	---
Gakona	23	87.0	100.0	64.6	67.8	54.8	65.2	4.4	26.1	4.4
East Glenn Hwy.	15	53.3	86.7	25.4	41.9	33.7	33.3	6.7	26.7	---
Glennallen	51	58.8	92.2	19.2	20.7	43.5	37.3	5.9	21.6	---
Gulkana	36	75.0	86.1	28.3	27.4	51.2	52.8	---	27.8	2.8
Kenny Lake	12	91.7	91.7	18.9	22.4	39.9	75.0	16.7	16.7	---
Lake Louise	13	61.5	84.6	3.4	6.3	6.1	---	15.4	53.9	---
Lower Tonsina	8	87.5	100.0	62.5	63.8	60.3	37.5	50.0	---	---
McCarthy Road	13	30.8	92.3	28.3	41.0	36.8	30.8	7.7	---	---
Matanuska Glacier	30	43.3	76.7	9.7	15.4	16.7	3.3	6.5	23.3	10.0
Mentasta	19	15.8	94.7	15.1	35.7	18.2	36.8	5.3	---	5.3
Nabesna Road	8	50.0	100.0	81.5	88.6	28.1	62.5	---	12.5	---
Paxson	10	60.0	90.0	6.3	10.6	14.3	30.0	---	60.0	---
Sheep Mtn.	9	44.4	77.8	10.2	12.0	42.7	---	11.1	22.2	11.1
Slana	16	75.0	100.0	65.2	50.3	42.0	75.0	---	---	---
South Wrangell Mtns.	15	46.7	100.0	18.1	21.5	22.4	26.7	6.7	13.3	6.7
Upper Tonsina area	15	53.3	80.0	31.8	33.7	48.4	40.0	20.0	13.3	---

Source: Fall and Stratton 1984.

* Har. = harvesting; hsld. = household.

--- means no data were available.

Table 27. Copper River Subsistence Fishery Data, 1948-83

	Reported Catch		Permits Issued			Catch by Species			
Year	Dip Net	Fish Wheel	Dip Net	Fish Wheel	Total	Sockeye	Chinook	Coho	Estimated Total Catch
1948	5,100								
1949	5,500								
1952	2,136		Species Combined			1,601	535		
1954	3,145		and Gear Combined			3,057	88		
1955	2,086					1,767	319		
1957	7,753					7,241	281	108	
1958	13,263					12,909	354		
1960	1,179	5,660	44	33	77	6,739	136	25	8,803
1961	1,777	12,419	307	82	389	15,472	388	550	18,206
1962	3,203	11,101	435	117	552	14,543	848	381	18,486
1063	2,124	12,395	361	140	501	14,055	464	558	18,287
1964	4,133	7,749	794	200	994	11,915	725	103	16,340
1965	7,215	5,813	982	143	1,125	12,760	644	52	16,818
1966	7,452	9,188	1,132	138	1,270	16,718	555		21,896
1967	6,146	8,360	1,166	154	1,320	14,457	419		19,007
1968	8,040	6,071	1,235	143	1,378	14,819	644	233	20,283
1969	18,054	6,220	1,415	167	1,582	27,604	719	224	29,266
1970	22,700	9,886	3,220	267	3,487	36,500	427	554	42,757
1971	28,115	9,370	4,168	374[a]	4,542	37,517	1,363	363	48,449
1972	18,996	7,854	3,485	205	3,690	26,850	1,501	248[b]	32,468[b]
1973	16,407	10,943	3,840	305	4,145	27,350	1,846	51[c]	29,428[c]
1974	15,143	7,657	3,305	288	3,593	22,800	1,141	163[d]	26,001[d]
1975	7,694	5,626	2,452	350	2,802	13,320	1,705		15,357
1976	12,130	8,321	2,512	451	2,963	20,451	2,017	17	23,623
1977	22,612	12,751	3,526	540	4,066	35,363	2,171	454	41,815
1978	12,569	6,638	3,313	392	3,705	19,207	2,050	633	22,029
1979	11,887	10,251	2,730	470	3,200	22,138	2,372	705	30,963
1980	14,650	9,805	2,804	399	3,203	21,437	2,256	639	35,081
1981	28,872	26,924	3,555	523	4,078	53,008	1,913	849	68,746
1982	62,614	38,120	5,475	615	6,090	96,799	2,532	1,246	110,006[e]
1983	72,257	35,971	6,911	630	7,541	100,995	5,421	1,690	118,728[f]

Source: Randall et al. 1984.

a Last use of dip net/fish wheel combination permits.
b First issue of permits at Chitina.
c Last "blacklist" used.
d Issue of permits at Chitina and Glennallen only.
e Return requirement enforced.
f Through 1/19/84.

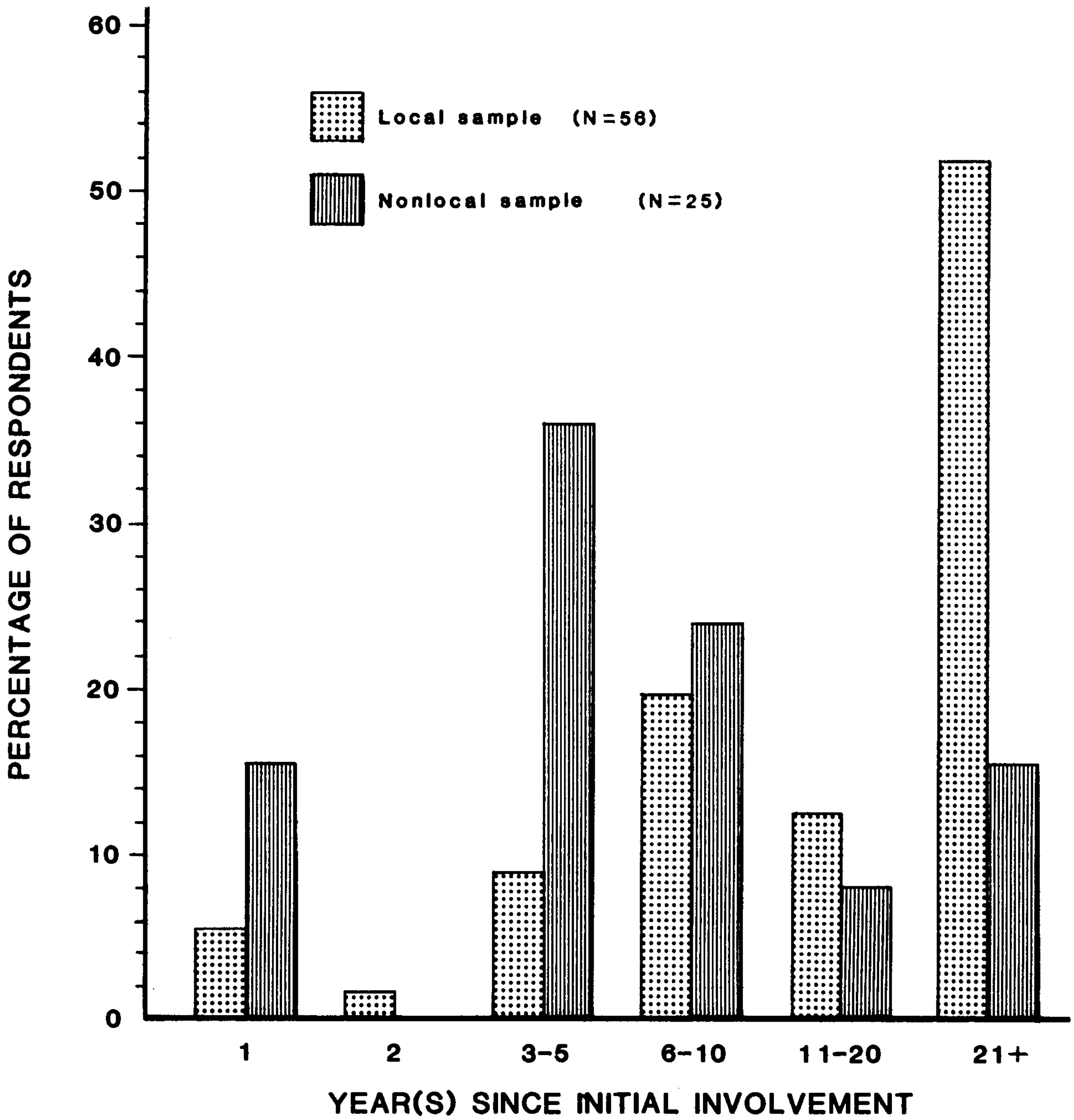


Figure 3. History of involvement in the Copper River fish wheel fishery by residency, fish wheel sample, 1982 (Stratton 1982a).

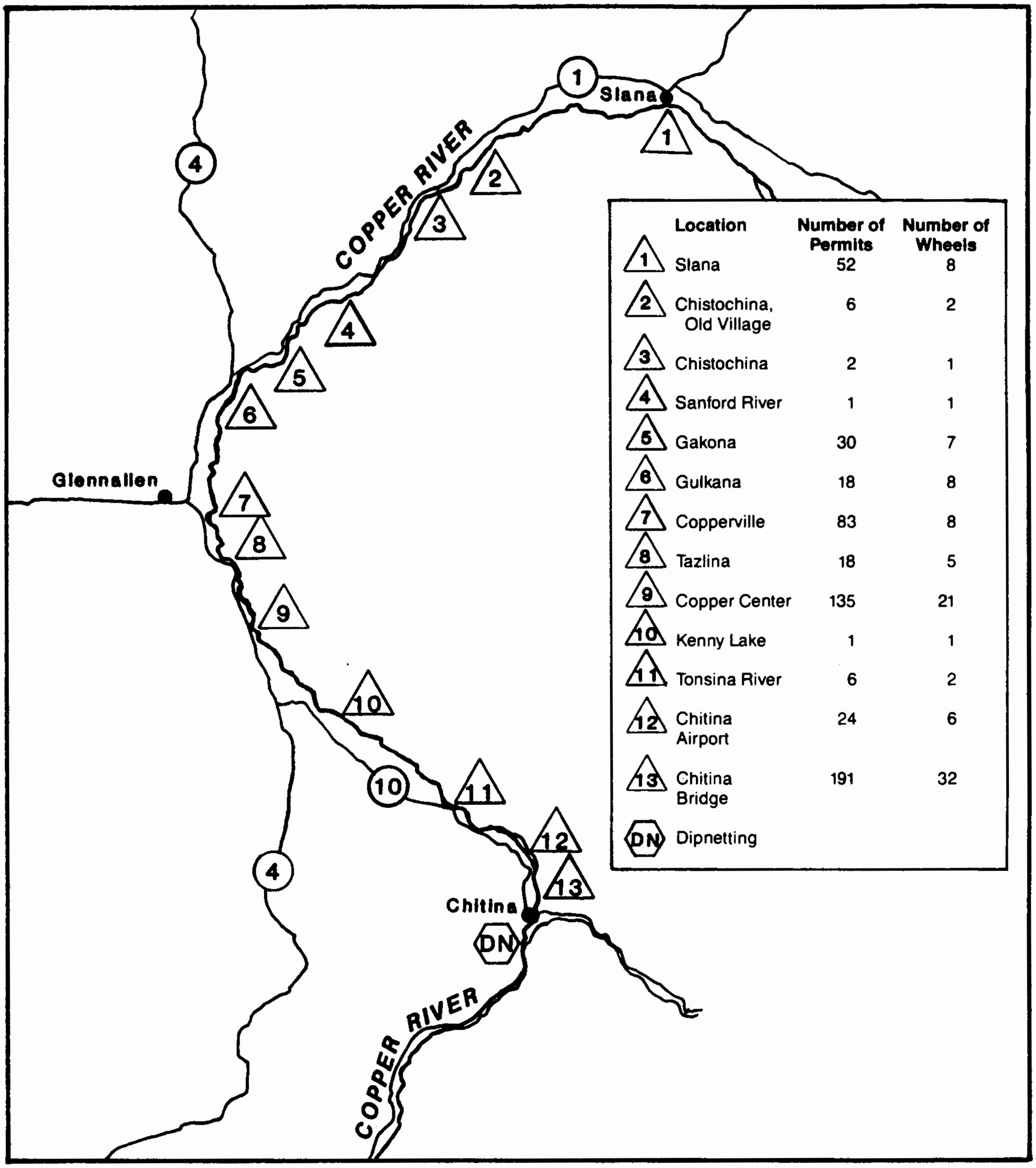


Figure 4. Estimated number of permits and fish wheels at 1982 Copper River fish wheel sites (Fall and Stratton 1984).

Other wheels are placed from sites recognized as "belonging" to certain families, and the right to use such a site may be inherited through lines of kinship (Reckard 1983b, Fall and Stratton 1984).

b. The dip net fishery. In 1984, the Board of Fisheries created a personal use category of dip net fishing on the Copper River. Previous to that time, all dip nets were regulated under the subsistence permit system. The "personal use" dip net regulations were established to accommodate a large influx of new dip netters from outside the basin. As reported by the Division of Commercial Fisheries, 6,842 permits for the Copper River dip net fishery were issued in 1983 (ADF&G 1983). In 1983, residents of Anchorage held 35.2%. Military permit holders accounted for an additional 13.2% of the permits (table 28).

Of the dip net permit holders interviewed in a 1982 survey, 41% indicated that was their first year in the fishery, and a total of 72.3% had a history in the fishery of five or fewer years. Only 14.5% of those interviewed had participated in the fishery 10 or more years (fig. 5) (Stratton 1982a). Non basin dipnetters most closely resemble the nonbasin fish wheel users in several respects, including a shorter history of involvement in the fishery than is true for local residents, a resource use pattern that includes the harvest of other fish and wildlife outside the Copper Basin, participation in other Alaska salmon fisheries, and fishing in groups that include both family and friends (ibid.).

The popularity of the dip net fishing site at Chitina is enhanced by the availability of road access and the quality of the scenery. Some more recent participants may have been crowded out of other fishing sites nearer to Anchorage. As the number of participants in the Copper River salmon fishery grows, the characteristics of the nonbasin residents will probably increasingly dominate the general pattern of use of both fish wheel operators and dipnetters (ibid.).

In 1983, the average catch of nonbasin dipnetters who received the household allocation of 30 salmon and returned their permits was 13.8 fish. For the permittees allocated 15 salmon, the average reported catch was 6.4 fish. Nonbasin dipnetters reported a total harvest of 68,500 salmon for 1983 (table 29). Of the total reported 1983 salmon harvest taken by nonbasin

Table 28. Residences of Copper River Dip Net Permit Holders, 1983

Community	No. Permits	%
Anchorage[a]	2,431	35.2
Cantwell	3	---
Central	1	---
* Chitina	10	0.1
Clear/Anderson[b]	21	0.3
* Copper Center	32	0.5
Cordova	2	---
Delta Junction	256	3.7
Dot Lake	5	0.1
Fairbanks[c]	2,470	35.7
* Gakona	3	---
* Glennallen	24	0.4
Healy[d]	8	0.1
Kenai Peninsula[e]	23	0.3
Military[f]	967	14.0
Northway	1	---
Palmer/Wasilla[g]	438	6.3
Sutton	6	0.1
Talkeetna[h]	5	0.1
Tok	16	0.2
Valdez	150	2.2
Northern Alaska[i]	13	0.2
Southeastern Alaska[j]	4	0.1
Western Alaska[k]	8	0.1
No address	7	0.1
Out of state	7	0.1
Total	6,911	100.0

Source: Fall and Stratton 1984.
--- means no data were available.
* Denotes Copper basin residents.

a Includes Chugiak, Eagle River, Girdwood, and Indian.
b Includes Nenana.
c Includes College, Ester, North Pole, Murphy Dome, Salcha, and Two Rivers.
d Includes McKinley Park.
e Includes Anchor Point, Clam Gulch, Cooper Landing, Homer, Kenai, Seward, Soldotna, and Sterling.
f Includes Eielson AFB, Elmendorf AFB, Ft. Greely, Ft. Richardson, and Fort Wainwright.
g Includes Big Lake, Houston, Willow; also some Glenn Highway residents in the Copper Basin.
h Includes Peters Creek and Gold Creek.
i Includes Barrow, Eureka, Galena, Huslia, Kotzebue, Nome, Selawik, and Venetie.
j Includes Juneau, Sitka, and Wrangell.
k Includes Atka, Bethel, Chevak, McGrath, Napakiak, Pilot Station, St. Paul, and Unalaska.

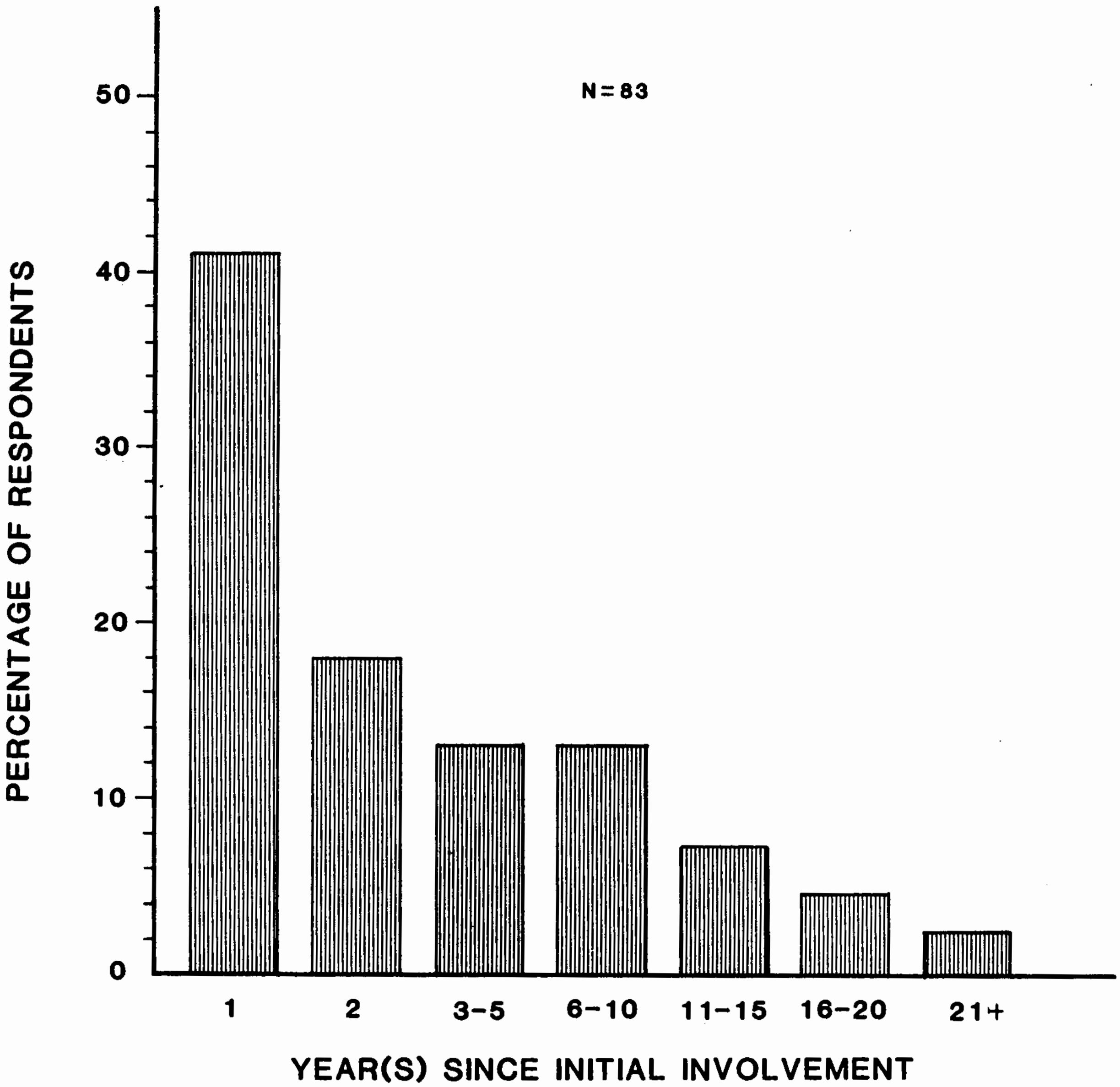


Figure 5. History of initial involvement in the Copper River dip net fishery, 1982 (Stratton 1982a).

Table 29. Average Catch per Returned Permit, Copper River Salmon Fishery 1983[a]

		Basin Residents			Nonbasin Residents		
Gear Type	Allocation	No. Permits	Average Catch	Total Reported Harvest	No. Permits	Average Catch	Total Reported Harvest
Dip net	15	25	7.7	192	1,105	6.4	7,094
	30	34	14.1	481	4,435	13.8	61,406
Fish wheel	15	17	11.7	199	6	12.7	76
	60-160	132	44.4	5,862	143	39.3	5,625
	200	36	59.6	2,144	21	64.2	1,348
	500	45	191.2	8,605	44	136.8	6,018
Total		289		17,483	5,754		81,567

Source: Adapted from Roberson 1983.

a Based upon permit returns through November 28, 1983.

residents, 81% was taken with dip nets (Fall and Stratton 1984).

Dipnetting occurs throughout the June 1 to September 30 season, but most of the effort and catch occurs in June and early July (Roberson 1983). Of an opportunistic sample of 85 dipnetters in 1982, about 20% of those interviewed planned to spend a day or less fishing; 33% planned to spend one weekend; another 33% planned one trip of three to five days. The remaining 17% planned to make more than one trip to Chitina (Stratton 1982a, Fall and Stratton 1984).

REFERENCES

ADOT/PF (Alaska Department of Transportation and Public Facilities). 1982. Draft interior transportation study: socioeconomic forecasts. DOT/PF Fairbanks Regional Office

BGDIF (Big game data index files). ADF&G, Div. Game, Anchorage.

Delaguna, F., and C. McClellan. 1981. The Ahtna. Pages 641-663 in J. Helm, ed. The handbook of North American Indians. Vol. 6: Subarctic. Washington: Smithsonian Institute.

Fall, J., and L. Stratton. 1984. The harvest and use of Copper River salmon: a background report. ADF&G, Div. Subsistence, Anchorage.

Ketz, J.A. 1983. Paxson Lake: two nineteenth century Ahtna sites in the Copper River basin. Alaska Archeological and Historic Preservation Cooperative Park Studies Unit, Univ. Alaska, Fairbanks.

Randall, R., P. Fudgin, M. McCurdy, and K. Roberson. 1984. Prince Willaim Sound area annual finfish management report. ADF&G, Div. Commer. Fish, Cordova.

Reckard, H. 1983a. That's the way we live: subsistence in the Wrangell-St. Elias National Park and Preserve. Alaska Archeological and Historic Preservation Cooperative Park Studies Unit, Univ. Alaska, Fairbanks, Occ. Papers No. 34.

________. 1983b. Where raven stood: cultural resources of the Ahtna region. Alaska Archeological and Historic Preservation Cooperative Park Studies Unit, Univ. Alaska, Fairbanks, Occ. Paper No. 35.

Roberson, K. 1983. Copper River subsistence salmon fishery management and research: December 1983. ADF&G, Div. Commer. Fish., Glennallen.

Rollins, A.M. 1978. Census Alaska: numbers of inhabitants 1792-1970. Univ. Alaska Anchorage Library.

Selkregg, L. 1974. Alaska regional profiles: Southcentral Region. Arctic Environment Information and Data Center, Univ. Alaska, Fairbanks.

Stanek, R. 1981. Nelchina caribou user group assessment. ADF&G, Div. Subsistence, Anchorage.

Stoltzfus, M.C. 1982. The Copper River basin regional planning model study: final report. For the Copper River Native Association, with assistance from Lois Berger and Associates, Anchorage.

Stratton, L. 1982a. The dip net and fish wheel fisheries of the Copper River, 1982. ADF&G, Div. Subsistence, Anchorage.

________. 1982b. Patterns of use of the Nelchina caribou herd. ADF&G, Div. Subsistence, Anchorage.

________. 1983. Copper basin caribou use: a research update. ADF&G, Div. Subsistence, Anchorage.

Stratton, L., and S. Georgette. 1984. Use of fish and game by communities in the Copper River basin, Alaska: a report on a 1983 household survey. ADF&G, Anchorage.

USDC. 1980. Census of the population. General Population Characteristics, Alaska.

Subsistence and Other Local Use of Resources in the Prince William Sound Subregion

I. LOCATION AND ENVIRONMENT

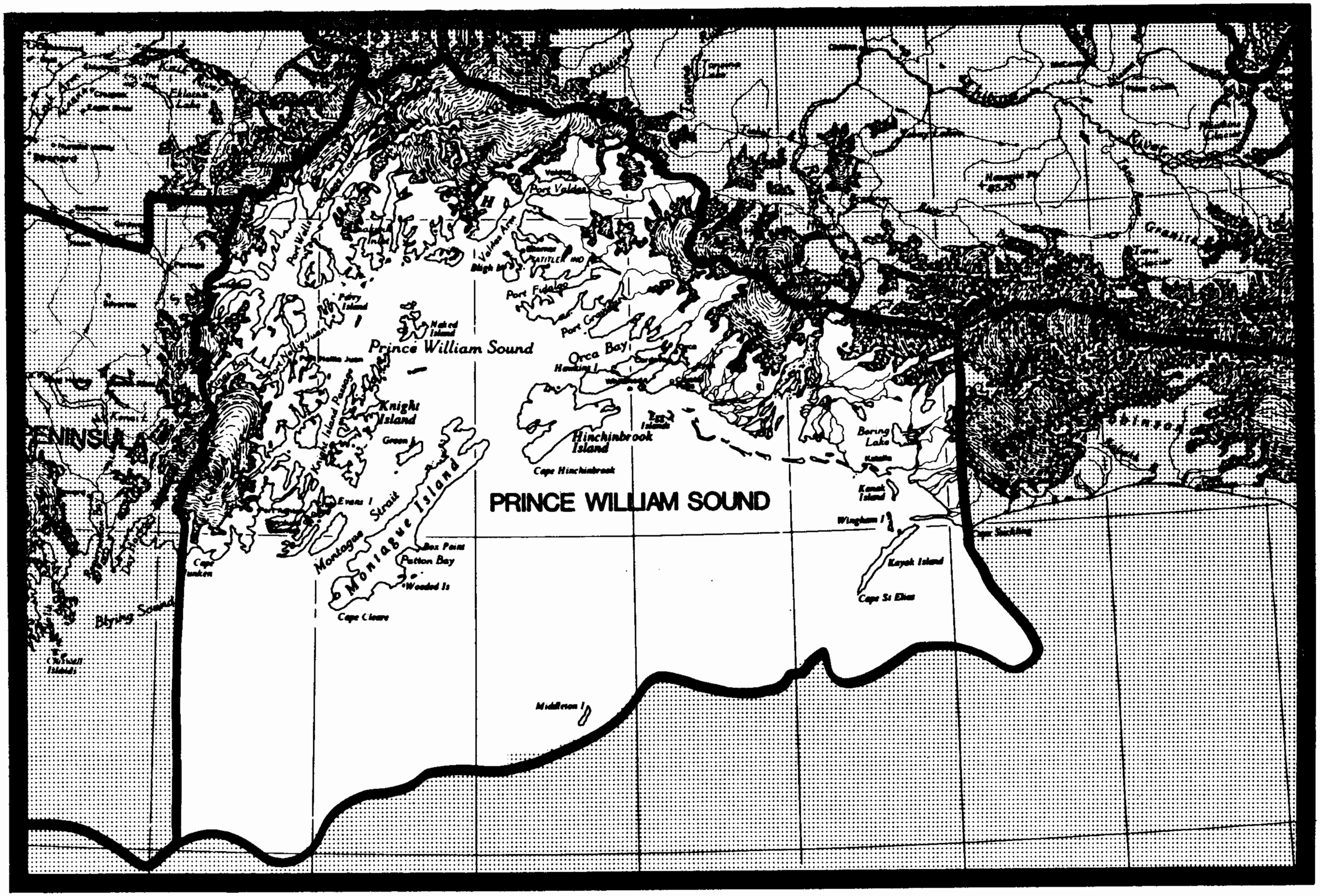
The Prince William Sound subregion exhibits geographic and topographic variability. The subregion includes marine, coastal, and upland areas rich in renewable and nonrenewable natural resources. The communities of Chenega Bay, Cordova, Tatitlek, Valdez, and Whittier are located in this subregion. The economic and social activities of the area have revolved around subsistence hunting and fishing, commercial fishing, and the extraction of copper, gold, and other minerals.

The marine area of the Prince William Sound subregion measures approximately 600 mi^2 and includes a varigated shoreline of over 3,500 mi. The subregion is bounded on the west by the Kenai Peninsula and the Kenai Mountains, to the north by the Chugach Mountains, to the east by the Bering Glacier, and on the south by the Gulf of Alaska. Montague and Hinchinbrook islands effectively shelter the sound from exposure to the Gulf of Alaska. The Cordova area and the Copper River delta, while not technically located in the sound, are closely associated by geographic proximity and by common historical and contemporary human uses of fish and wildlife. The approximate boundaries of the subregion are illustrated on map 1. They generally coincide with boundaries of Game Management Units 6B, 6C, and 6D, and include the western portion of 6A.

The climate of the area is largely maritime, characterized by moderate temperatures throughout the year and high precipitation during the summer months. Valdez experiences between 6 and 9 inches of rain during August and September, while Cordova receives 8 to 13 inches during the same months.

The combined effects of the varied ecological conditions and the high quality habitat found in the subregion contribute to the maintenance of healthy wildlife populations. Resources known to be used by Prince William Sound residents are listed in table 1. Black and brown bears are found throughout the area. Sitka black-tailed deer were transplanted into the area and are found on the islands within Prince William Sound and around Cordova. Moose populations have increased to approximately 700 animals from the original 20 moose transplanted near Cordova in 1949 (see the Distribution and Abundance narrative). Furbearers are also plentiful within the subregion.

Both migratory and nonmigratory waterfowl make use of Prince William Sound habitat. An important migration route for many species of waterfowl passes through the sound. Trumpeter swans reach their peak



Map 1. The Prince William Sound subregion.

Table 1. Renewable Resources Known to be Used in the Cordova/Eyak Area

Fish:

Arctic char
Eulachon (hooligan)
Black bass
Cod, gray
Cod, black
Ling cod
Tomcod
Dolly Varden
Eel
Flounder
Halibut
Herring
Herring eggs
Pacific ocean perch
Plaice
Pollock
Rockfish, red (snapper)
Rockfish, black (sea bass)
Salmon:
- Chinook
- Chum
- Coho
- Pink
- Sockeye

Sculpin
Smelt
Sole
Sturgeon
Trout:
- Cutthroat
- Steelhead
- Lake
- Rainbow

Whitefish

Invertebrates:

Chiton, black
Chiton, red
Clams:
- Butter
- Horse
- Littleneck
- Pink neck
- Razor

Cockles
Crabs:
- Dungeness
- King
- Tanner

Limpet
Mussel
Octopuse
Scallop
Sea urchin
Sea cucumber
Sea snail
Shrimp

Sea mammals:

Harbor seal
Sea lion
Porpoise

Land mammals, for meat:

Black bear
Brown bear
Beaver
Sitka black-tailed deer

Land mammals, for fur:

Beaver
Coyote
Fox
Land otter

Table 1 (continued).

Land mammals, for meat:	Land mammals, for fur:
Mountain goat	Lynx
Spruce grouse	Marten
Snowshoe hare	Mink
Lynx	Muskrat
Marmot	Squirrel
Moose	Weasel
Porcupine	Wolverine
Dall sheep	Wolf
Birds: ducks, geese, general	**Birds: sea ducks**
Brant	Bufflehead
Dabbling ducks (numerous species)	Sea ducks (numerous species)
Gadwall	Common eider
Mallard	Other eiders
Pintail duck	Goldeneye
Shoveler	Harlequin
Widgeon	Merganser
Dusky Canada goose	Oldsquaw
White-fronted Canada goose	Scaup
Snow goose	Common scoter
Ptarmigan, rock	Other scoters (numerous species)
Ptarmigan, willow	
Green-wing teal	
Duck eggs	
Birds: shorebirds and other waterfowl	**Seabirds:**
Coot	
Comorant or shag (esp. double-crested cormorant)	Glaucous-winged gull eggs
Sandhill crane	Young seagulls (numerous species)
Blue heron	
Loon	
Snipe	
Swan	

(continued)

Table 1 (continued).

Plants:	Plants: other
Bluberry	Clover
Lowbush cranberry	Cow parsnip (Heracleum lanatum)
Highbush cranberry	Oregon crabapple
Bog cranberry	Dandelion
Cloudberry	Fiddlehead fern
Crowberry	Goose tongue
Current	Onion grass
Black current	Beach greens
Red current	Mushrooms of many varieties
Elderberry	Wild onion
Nagoon berry	Indian rice (Kamchatka lily)
Mossberry	Sourdock
Raspberry	Twisted stalk
Salmonberry	
Strawberry	
Watermelonberry	
Other berries	

Source: McNeary 1978, The North Pacific Rim 1981, Stratton 1984.

densities in the Copper River delta and the Bering Glacier outwash plain. This same area also provides an important nesting area for dusky Canada geese. The numerous fjords and islands in the area provide habitat for many species of seabirds and shorebirds. Bald eagles, peregrine falcons, and other raptors also inhabit the coastline of the sound.

The waters of Prince William Sound provide habitat for marine mammals, including harbor seals, porpoise, sea lions, sea otters, and many species of whales. Including the large whales, these species have been important components in subsistence harvests of fish and game. The five species of salmon found in Prince William Sound are fished for commercial, sport, and subsistence uses. Similar uses are made of the major invertebrate species--Tanner, Dungeness, and king crab, shrimp, razor clam, and scallop found in the area. Subsistence use of other invertebrates also continues to take place. Halibut, flounder, plaice, Pacific perch, pollock, sablefish, sole, various species of rockfish, and other species of bottom fish are also found in Prince William Sound and are used extensively by commercial fishermen and area residents (see the Distribution and Abundance and Human Use sections).

II. HISTORY AND PATTERNS OF HUMAN SETTLEMENT

A. Historic Patterns of Human Activity

Aboriginal occupation of the Prince William Sound subregion dates back at least 3,000 years to a time when the Eyak Indians controlled territory north and southeast of present-day Cordova, on and around the Copper River delta. This location was both a rich one, in the midst of a natural resource bounty, and a strategic one. The Eyak became traders with the Tlingit Indians who lived to the south, the Ahtna Athapaskans of the Copper River area, and the Chugach Eskimo who came, later than the Eyak, to occupy much of the rest of Prince William Sound. Present native residents of the sound are mostly descendents of these Eyak Indian and Chugach Eskimo cultural groups. According to de Laguna (1967), the Eskimos using the territory in and directly adjacent to Prince William Sound were divided into three major groups: the Chugach (Chugachimiut), a related group, the Ugalakmiut, on Kayak Island, and the Unixkugmiut, on the southeast Kenai Peninsula. The Chugach were in turn divided into eight tribes. Oswalt (1967) considers the Ugalakmiut an Eyak Indian group and reports that the Chugach were divided into nine subgroups. The following description of them is taken from de Laguna (1967).

> These tribes . . . shared the same culture, spoke the same language, entertained each other at feasts, but were

politically independent. Each group appears to have had its own chief or leader and its principal village. The tribes sometimes raided each other but on other occasions might unite against common enemies such as the Tlingit, Tanaina, or Koniag . . .

Village sites were invariably on the shore, usually on protected waters, for travel in this area is practically restricted to boats. The village was frequently so placed that it commanded a view of the approaches, and a strategic position seems to have been more of a consideration than the neighborhood of a salmon stream or a particularly rich bed of shellfish . . . Temporary camps were, however, made at fish streams during the salmon runs.

Sea otter hunters made temporary camps on the exposed outer shores of Montague and Hinchinbrook Islands, but there were no permanent villages in these places because of the dangers of access. It would seem probable that the houses on Kayak, Wingham, and Middleton Islands were used only by hunting parties in summer. Our informant sometimes made a distinction between winter and summer villages and in other cases told us that certain settlements were inhabited throughout the year.

B. Changes in Human Activity Following European Contact

Vitus Bering saw Chugach hunting camps on Kayak and Wingham islands in 1741, but Captain James Cook, who visited Prince William Sound in 1778, was the first Europeon to meet their inhabitants. After publication of his journals in 1781, Cook was followed into Chugach territory by a procession of trappers, traders, explorers, and hunters of several nationalities. Russian domination was established in the area by 1800 (de Laguna 1967).

Russian contact had a profound influence on the aboriginal residents of Prince William Sound. In 1793, after a major battle with the Eskimo residents, the Russians established a trading post at Nuchek that rapidly dominated the sea otter and seal hunting trade along the coast. Nuchek also became an important Russian Orthodox Church center. When Nuchek was abandoned between 1925 and 1930, most of its residents moved to Cordova (deLaguna 1967; Stratton, pers. comm.; McNeary 1978).

C. Organization and Settlement of Communities

During the early 1800's, Native communities in the sound included the Eyak Indian village of Alaganik, which was abandoned in 1893 after a severe epidemic. The residents moved to the village of

Eyak. Tatitlek and Chenega, two of the original Chugach Eskimo villages, continue to be inhabited at the present time. Chenega was largely destroyed by the tsunami that accompanied the 1964 earthquake. The reestablished community has been relocated from Chenega Island to Evans Island and is now known as Chenega Bay. Prominent among the abandoned villages are Nuchek on Port Etches, Hitchinbrook Island; Kiniklik, in northwestern Prince William Sound; and Palugvik, on Hawkins Island, which was declared a National Historic Landmark in 1963 (Bennett et al. 1979).

Human activity in Prince William Sound historically focused on use of coastal and marine resources. The fur trade encouraged exploitation of sea otter populations throughout the 1800's. Commercial fishing for salmon and other species became important around the turn of the century; initially there was little local participation in this activity. This coastal and marine orientation has continued to the present time.

Other major activities in this subregion have been related to mineral exploration and development. Copper from the Copper River basin was traded through Prince William Sound to Indian tribes to the south before Russian contact. The area became an important transportation corridor for later gold and other mining activity.

D. Development of Transportation Routes

Although Native trade routes linking the coast with the interior were in existence well before the fur trade era and limited Russian exploration took place in the early 1800's, well-documented exploration of the interior from Prince William Sound by non-Natives did not take place until the end of the nineteenth century, following the purchase of Alaska from Russia. Gold discoveries on the upper Yukon spurred development of a town at the present site of Valdez, when ship passengers landed there seeking an "all-American" route to the Klondike, over the Valdez Glacier. Valdez, as the terminus of the Trans-Alaskan Oil Pipeline and the Richardson Highway, still serves as a major point of access and egress for both people and goods. The gold-rush trails and, much later on, railways and highways have tended to follow the trade routes first established by the area Natives.

III. POPULATION

The Chugach Eskimo population has been estimated to have been 1,600 persons and the Unixkugmiut population 600 persons at the time of first contact with the Russians. The imputed population density of about 15 per hundred square kilometers makes the Prince William Sound area the most densely populated Eskimo area after Kodiak Island (Oswalt 1967).

Early historical accounts estimated Eyak populations between 100 and 200 through most of the 1800's. The Eskimo population had decreased to 360 in 1818, dramatically lower than at the time of contact. The 1890 census showed a total of 587 Native people in a number of small settlements scattered throughout the region, making up almost 100% of the total population (ibid.). By the 1930's, the estimate was down to about 200 Eskimo and only 38 Eyak (Rollins 1978). By 1980, the population of the subregion was 5,530. About 12.6% of the population, or about 700, were Alaska Natives (ADL 1982, USDC 1981). Table 2 provides historical population data based on decennial census reports.

A. Prince William Sound Communities

1. Chenega/Chenega Bay. The original village of Chenega is thought to have been an ancient site, occupied continually until it was destroyed in the 1964 earthquake. Village residents have chosen a new location for the community at Crab Bay on Evans Islands, near the former site. The development and resettlement of Chenega Bay is underway, under the guidance of the Chenega Village IRA council and the Chenega Corporation, the village corporation established under ANCSA. The first construction was in 1982, when two families moved to the Crab Bay site. Since that time, 21 houses and a school have been constructed. In 1984, 19 families were in residence, giving the community a population of 59. The school is fully operative and has 19 students (Stratton, pers. comm.).

   The 1880 census showed a population for Chenega of 80 people, all Alaska Native. The 1891 census showed 71 people, again all Alaska Native. In 1950, the census showed 91 people (ibid.).

2. Whittier. The town of Whittier is located in northwest Prince William Sound. It was developed by the U.S. Army during World War II as a deep-water port for the purpose of transshipment of oil. At present, a train provides access through the Kenai Mountains to Anchorage and the interior.

   The community had a 1982 population estimated at 224. This is a decrease from the 1960 population of over 800 but an increase from 1970, when there were only 130 full-time residents (Rollins 1978, ADL 1982). The ethnic composition is predominatly non-Native, with the median age at 29 years (see tables 2 and 3).

3. Valdez. Valdez developed in 1897-1898, the early years of the gold rush to the interior, as a point of departure for gold seekers heading across the Valdez Glacier. It has

Table 2. Census Population for Prince Willaim Sound Subregion,1890-1980

Community	1890	1900	1910	1920	1929	1939	1950	1960	1970	1980
Chenega	71	140	---	---	90	95	91	---	---	---
Cordova	---	---	1,152	955	980	938	1,165	1,128	1,164	1,879
Dayville	---	---	---	---	---	54	---	---	---	---
Ellamar	---	---	98	106	---	---	23	---	---	---
Eyak	---	222	---	320	366	365	---	---	---	47
Fort Liscum	---	---	162	---	---	---	---	---	---	---
Katalla	---	---	---	84	44	23	---	---	---	---
Kiniklik	73	---	---	---	---	---	---	---	---	---
Latouche	---	---	---	505	339	40	---	---	---	---
Meakerville (Odiak Slough)	---	---	---	---	---	---	41	---	---	---
Nuchek	145	144	---	---	---	---	---	---	---	---
Orca Village	---	173	141	---	---	---	---	---	---	---
Palugvik	---	---	---	---	---	---	---	---	---	---
Point Whiteshed	---	---	---	---	---	---	32	---	---	---
Sawmill Bay	---	---	---	---	---	10	---	---	---	---
Tatitlek	90	149	156	187	70	75	89	96	111	68
Tiekel Railroad Station	---	---	120	---	---	---	---	---	---	---
Valdez	---	315	810	466	442	529	554	555	1,005	3,079
Whittier	---	---	---	---	---	---	627	809	130	198
Census totals	379	1,143	2,639	2,623	2,331	2,175	2,622	2,588	2,410	5,271

Sources: ADL 1982, Rollins 1978, USDC 1981.

--- means no data were available.

Note: Early census data are incomplete and may not list all communities in the subregion.

Table 3. Prince William Sound Subregion Demographic Profile

Community	Population in 1980	No. Hslds.[a]	Mean Hsld. Size	Median Age	% AK Native	Median Hsld. Income	Per Capita Income (1979)
Cordova	1,879	657	2.67	27.2	15%	$27,147	$13,359
Tatitlek	68	23	3.18	25	77%	---	---
Valdez	3,079	957	2.88	27	6%	$40,778	$13,371
Whittier	198	77	2.4	28.9	8%	$18,750	$11,283
Eyak and other unnamed communities	356	116	---	28.6	2%	---	---
Prince William Sound	5,580	1,830	---	27.3	---	---	---

Source: USDC 1981.

--- means no data were available.

a Hsld(s). means household(s).

continued in this role of a port of entry and exit for people and goods. As a result of damage from the 1964 earthquake, a new community was built outside the high risk area, about 4 mi from old Valdez.

The population of Valdez has changed dramatically in recent years, from 555 in 1960 to 1,005 in 1970 and a high of approximately 8,000 during construction of the Trans-Alaska Pipeline. The 1982 estimated population was 3,698 (Rollins 1978, ADL 1982).

The present economic base of Valdez is related to the oil pipeline terminal, the pipeline, and the docks. Other major employment categories in the Valdez area are those related to government employment, commercial fishing and processing, and freight transportation.

4. Cordova. The Cordova townsite was established in 1905 near the small village of Eyak at a time when mining, construction, and transportation of minerals were beginning to emerge as significant economic forces in the area. Some of the Eyak residents moved to Cordova. With the completion of the Copper River and Northwestern Railroad in 1910 and the activity at the Kennecott mines, Cordova's future seemed secure, but a drop in copper prices forced the closing of the mines in the late 1930's. Further south in Katalla, coal and oil resources that had been developed during this period also became uneconomic and stopped abruptly.

   Since that time, fishing and seafood processing have assumed an increasingly important role in the economic base of Cordova. Current developments in the seafood industry include substantial investments in salmon fishing, crabbing, herring roe, and aquaculture (see the Economic Value of Selected Fish and Wildlife Uses in Alaska volume of this series). Cordova's population has not experienced the rapid growth of many Alaskan communities, although it has grown from 938 in 1929 to 1,879 in 1980 (see table 2).

5. Tatitlek. Located in east Prince William Sound, approximately 40 mi northwest of Cordova and 22 mi south of Valdez, Tatitlek (the name means "windy place") has been continually occupied by Chugach Eskimo since they first moved into the sound. Census data show a population of 90 in 1890, and this number remained relatively stable into the 1970's (Rollins 1978). The 1980 population was 68 (USDC). Research conducted in 1983 recorded a population of 106 people in 31 households (Stratton, pers. comm.).

   Mining activity at the nearby Ellamar mine provided a period of economic prosperity from 1897 until the 1920's, after which time Ellamar became a ghost town, and the residents of Tatitlek once again depended almost entirely on use of local food resources.

   Little damage resulted at Tatitlek from the 1964 earthquake, and many Chenega people were resettled there. Many of these, however, later moved on to Cordova and Anchorage. Commercial fishing is the primary source of employment in the village, along with the school and the local IRA council.

IV. TRANSPORTATION

A. Type of Transport

The prominence that Prince William Sound was to attain as a port of entry to the interior of Alaska arose from explorations that began in 1884 when a U.S. Army party travelled north from Valdez over what was to become the Valdez Trail. The following year a party led by Lt. H.T. Allen successfully travelled from Prince William Sound via the Copper River to the Yukon River basin and established this as a possible parallel route from the coast to the interior gold fields. Efforts to develop one or the other of these routes were intense, and in 1900 a trail from Valdez to Fort Egbert, present-day Eagle, was started. Later, gold strikes in the vicinity of Fairbanks diverted interest away from Eagle, and the trail was rerouted accordingly, eventually becoming the Richardson Highway. The Copper River route was to become the location of the Copper River and Northwestern Railroad, which spurred mining developments in the McCarthy-Kennicott area (see McNeary 1978, Bennett et al. 1979, Meiners et al. 1977).

Another overland route from Prince William Sound went from Whittier over the 800 ft high Portage Pass to upper Cook Inlet and interior Alaska. Its usage was not as heavy as the routes into the interior from Valdez and Cordova; nevertheless, it was used as a shortcut by foot travelers between the sound and upper Cook Inlet (ADOT 1981). The route over Portage Pass was used continually until 1943, when the railroad was extended by the military through the construction of a railway tunnel and completion of the first dock on Passage Canal. This extension of the railroad to tidewater at Whittier was shorter than the route from Seward. Use of the Port of Whittier by the military continued until 1960, when it deactivated operations there. The railroad still operates, however, serving the rail barges that make regular stops at this port. Railcars on barges are pulled off for direct transport to Anchorage and Fairbanks. In connection with the Alaska Marine Highway, the Alaska Railroad line to Whittier provides a popular service to motorists traveling a loop from Anchorage to Valdez, to Whittier, and back to Anchorage. The rail distance from Whittier to Anchorage is 64 mi, and the trip takes approximately two hours (ADOT 1981).

The Alaska Marine Highway has operated in Prince William Sound since 1963. Currently, the motor vessels Bartlett and Tustemena operate between the ports of the West Kenai Peninsula, Kodiak, Seward, Whittier, Valdez, Ellamar, and Cordova. As is true with the marine highway system in general, ferry traffic in Prince William Sound is highly seasonal. Summer schedules of both the Tustemena and the Bartlett reflect the strong demand for the

Whittier-Valdez run; there are five round trips per week between these two communities, with only two for Cordova. Summer tourist traffic on this scenic Whittier-Valdez run, which passes the Columbia Glacier, interferes with its use by local residents wishing to drive from Portage because tourists' summer reservations have been made far in advance.

Personal boat traffic unquestionably plays a major role in Prince William Sound transportation patterns. Boat ownership appears high in all of the area's communities. Much of the travel associated with the fishing industry occurs with private boats or air-taxi services.

B. Ports and Harbors

1. Cordova. Cordova's existing port facilities include two major docks, a small boat harbor, and a few private docks associated with fish-processing plants. The Cordova Small Boat Harbor is currently being expanded, to bring its total capacity to 950 vessels.

2. Valdez. Valdez is the most northerly ice-free major port in North America. It enjoys natural deep water and is connected to interior Alaska by the Richardson Highway.

3. Whittier. Whittier is one of Alaska's ice-free ports. In 1967, the Army constructed a pipeline and the DeLong Dock facility for petroleum shipment to Elmendorf Air Force Base and Fort Richardson in Anchorage. The DeLong Dock is a floating dock measuring 680 ft by 90 ft, with a water depth alongside of 55 ft, and is used solely for military purposes. West of DeLong Dock is the hydrotrain terminal owned and operated by the Alaska Railroad. The 44,000 sq ft dock is used to offload railcars from barges for transport to Anchorage. The state ferry terminal is located west of the railroad dock.

   The Whittier Small Boat Harbor, located west of the Ferry Terminal, was recently expanded to accommodate approximately 330 vessels. Most boat owners who keep their boats in Whittier are recreational boaters and sport fishermen who reside in Anchorage or the Matanuska Valley. A few boats are used by Whittier residents for commercial fishing.

   Port facilities at the small fishing village of Tatitlek accomodate approximately 38 permanent and 34 seasonal vessels based at the harbor. A rock-rubble breakwater is planned that will provide additional protection for approximately 96 vessels.

V. GENERALIZED LAND STATUS

Virtually the entire Prince William Sound area is contained within the Chugach National Forest. Other major land owners are the Chugach Regional Native Corporation and the village corporations of Chenega and Tatitlek. The Chugach region, defined by the terms of the Alaska Native Claims Settlement Act (ANCSA), also includes the communities of Port Graham and English Bay, on the south shore of Cook Inlet.

VI. USE OF FISH AND GAME AND OTHER NATURAL RESOURCES

A. Historic Patterns of Traditional Resource Use

The Prince William Sound subregion contains two vastly different ecological and physiographic regions: the sound itself and the Copper River delta. The Prince William Sound area provides local residents with a source of marine mammals, marine fish, and marine and intertidal invertebrates. The Copper River delta provides moose, waterfowl, and freshwater and anadromous fish. Aboriginal uses of resources in this area show similar distinctions: the Chugach Eskimo hunted sea mammals and fished for salmon for food, while the Eyak Indians hunted bear, mountain goat, and waterfowl, and relied heavily on salmon for food. Both groups trapped furbearers to provide raw material for clothing and craft items. The Chugach Eskimos lived in the sound, while the Eyak Indians occupied the delta area.

Oswalt (1967) provides the following account of early subsistence resource uses among the Chugach Eskimo:

> In the Chugach area, king salmon began to arrive in early May, and from this time until August the other species of salmon included red, dog, humpback and finally silver salmon. As these species swam up spawning streams where long weirs had been built to restrict their movements, they were taken with darts with barbed heads. Another salmon fishing technique was to build a trap at the mouth of a spawning stream that had tidal flow. Salmon entered the trap on the incoming tide, milled about, and were stranded when the tide went out. Throughout the year the land mammal most hunted was the mountain goat, which was prime in the fall and was taken with bows and arrows. Bears were taken in snares and deadfalls and might also be hunted by a man wearing a bearskin and a helmet that looked like a bear's head. Small land mammals such as fox, river otter, marten or mink were caught in spring pole snares. A form of deadfall might also be employed. . . .

> Sea mammals were hunted in open water by men in one or two-holed kayaks using some form of harpoon as their principal weapon. Hair seals, sea otter, and whales were hunted throughout the year, whereas most sea lions were taken in the fall and fur seals in the spring. . . . Since sea lions were large, hunters cooperated in pursuing them and aided each other in towing them to shore. Hair seals were hunted at their breathing holes in the ice but rarely, if ever, were they stalked when they slept on the ice.
>
> Both large whales and sea otter were pursued in open water by hunters using kayaks. . . . The standard weapons were bows and arrows or light harpoon darts launched with the aid of a throwing board. . . The latter was headed with a barbed point which fitted directly into a socket piece. . . The copper arrowpoints were barbed and detached from the shaft in the same manner as a harpoon dart head. The arrows were held in a cylindrical wooden quiver which was attached to a kayak deck. . . .
>
> For the Chugach to hunt whales of large or small species, a great deal of esoteric knowledge was required. . . . In all likelihood the lance heads first were rubbed with a mixture of aconite poison and non-toxic ingredients. After a whale was lanced, it was not pursued. A ritual was performed, and the hunters returned home to wait for the animal to die and drift ashore. Other whaling techniques are reported, but the one just recounted seems likely to have been the local aboriginal form. . . .
>
> The most important sources of food were sea mammals and salmon, but these were supplemented with other foods obtained by hunting, fishing, or collecting. In the early summer cod and halibut were caught with barbed and weighted hooks. Both candlefish (hooligan) and herring were obtained in large numbers, possibly in dip nets. Birds were taken with bows and arrows as well as with gorges, while cormorants were caught in nets or clubbed to death while resting at night. A wide variety of shellfish, including clams, cockles, mussels, sea urchins, and sea slugs were collected from the beaches and were an important source of food when other forms could not be obtained. The plant foods included species of kelp and seaweed plus diverse berries, roots, tubers, and leaves. . . .

Historic patterns of resource use among the early Eyak residents of the eastern sound are outlined by Birket-Smith and de Laguna (1938).

Our native informants . . . recognized the salmon as the most important source of food in Eyak economy. . . . There were no family, moiety, or village rights over fishing camps and streams. This is explained by Abercrombie who says that there was no need for exclusive fishing rights, since there were so many salmon in the Copper River that the natives were able to catch their whole years' supply early in the season. . . .

Halibut were caught by hook and line from a canoe and might be taken in both summer and winter. . . . Trout and whitefish in the lakes were caught. . . . The Eyak never chopped holes in the ice for winter fishing.

The only sea mammals hunted by the Eyak were the seal and sea-otter. They did not hunt fur seals because they were afraid of them, but they killed the smaller harbor or hair seal. They did not hunt porpoises like their Eskimo neighbors, and they were afraid of the walrus because these animals were supposed to be transformed human beings. Walrus, moreover, always seem to have been scarce in this region. They did not hunt whales, but when a dead one was found they ate the flesh and the fat, and utilized the baleen.

Goats and bears were the most important land mammals hunted by the Eyak. The former were sought in the mountains above Mountain Slough. They were commonly driven toward hunters in ambush, but fences were not built for these drives, nor could fire be used because it was generally too wet. Dogs were trained to chase and hold a goat until the hunters could kill it. Goats were killed with arrows or with spears if the hunter could get close enough. . . .

Both brown and black bear were hunted. The Eyak sometimes went up Orca Inlet for bear, though this was trespassing on Eskimo territory. Bears were hunted in winter. Dogs would locate the dens and the hunters would tease the bear until it came out. A man stood above the hole and speared the bear as it emerged. Another method was to erect a number of spears in the ground, if a soft place could be found. The spears were set with their points inclined forward. A man would tease the bear, and when pursued would dodge behind the spears, allowing the bear to become impaled.

The beaver was not hunted under the ice in winter but was killed in spring and fall with a deadfall set on a beaver trail.

> Fox and lynx were killed with snares fastened to bushes. Other animals may have been killed in snares. . . . The fox is also caught in a pit.
>
> Mink and marten were taken in deadfalls. . . . The muskrat was shot with bow and arrow. The weasel or ermine was caught in a box trap, buried in the ground.
>
> The birds hunted by the Eyak included the various species of swan, duck, geese, ptarmigan, and grouse. The last two could be hunted during the winter, since they remained all year round. The other birds, however, were killed chiefly in August when they were moulting. . . .

The Eyak Indian and Chugach Eskimo socioeconomic systems began to change with the beginning of trade in sea otter pelts, first with the Russians in the early 1800's and later with American traders following the purchase of Alaska. In the early 1880's, the Eyak Indian territory became the center of activity related to the salmon industry, mining, and trading enterprises, and the traditional ways of life were changed significantly. In the late 1800's, the building of salmon canneries provided cash employment for both fishermen and cannery workers, although early participation of Prince William Sound Natives in the commercial fishing industry was limited.

Commercial fishing employment opportunities were and still are highly seasonal, however, and have not replaced the subsistence orientation of Natives and many non-Natives of the subregion. The Chugach Eskimo and Eyak Indians in Prince William Sound have consistently relied on the subsistence utilization of local fish and game resources as a major food source, as have other more recent arrivals to the subregion. Subsistence hunting and fishing continue to be major pursuits of some subregion residents during part of the year.

B. Contemporary Patterns of Resource Use

1. Species harvested and used. Table 1 presents a listing of fish and game resources known to be used in the Cordova/Eyak area, based on recent research (McNeary 1978, The North Pacific Rim 1981). Thorough baseline subsistence research in other communities has not been done. However, most of the species harvested and used in the Cordova/Eyak area are found throughout the Prince William Sound subregion, and the same species are probably harvested and used in other subregion communities as well. All known resource harvest is described in this section; however, discussion of harvest that is currently not permitted by regulation does not constitute endorsement of such harvest by the Department of Fish and Game.

As the table indicates, residents of Cordova/Eyak are known to currently harvest 31 fish species or resource categories, 19 invertebrates, 12 land mammals for meat, 12 land mammals for fur, 3 species of sea mammals, 33 bird species or resource categories, and 29 plant species. In addition to this list of species known to be used at the present time, other species are probably used on an occasional basis by community residents. Harvest and use of fungus species and of additional species of terrestrial plants and seaweeds, bottomfish, and birds probably occur but have yet to be documented.

2. Annual rounds of resource use. Figures 1 and 2 present the annual rounds for the Cordova and Tatitlek area. Seasonal round data for other communities are unavailable; however, similar patterns of resource harvesting probably occur in other communities in the Prince William Sound subregion where similar species distribution and abundance occur (Stratton, pers. comm.). These figures depict months during the year when harvesting for particular species typically takes place; intensity of effort is not shown.

   As can be seen in the two figures, many of the resources used by Cordova and Tatitlek residents are available and harvested throughout the year to some degree. Major harvesting activities occur each month, and there is less need to store and preserve fish and game for later use than in parts of Alaska with more strongly seasonal distribution and abundance of fish and game species.

   Despite this year-long availability, the majority of the harvests of many species are strongly seasonal. For example, although some salmon fishing goes on all year, most salmon are harvested during the months of May through October. Crab, shrimp, and halibut are seldom harvested during the months of November through March, when boating is difficult and the species are found mainly in deep water. Most deer hunting takes place after October, when cold weather forces deer to lower elevations. Hunters usually do not harvest seal and sea lion during the pupping season. Many people do not harvest shellfish during the period May through August.

3. Location of harvest activities. Residents of Cordova and Eyak harvest most of the fish and game they use in the lower reaches of the Copper River, the Copper River outwash plain, and the eastern part of Prince William Sound. According to McNeary (1978), harvest activity by members of these communities is particularly concentrated in Orca Inlet, in the Hawkins and Hinchinbrook islands area, and as far north as Port Gravina. The harvest activities of residents of Tatitlek, Valdez, and Whittier tend to be oriented to use of

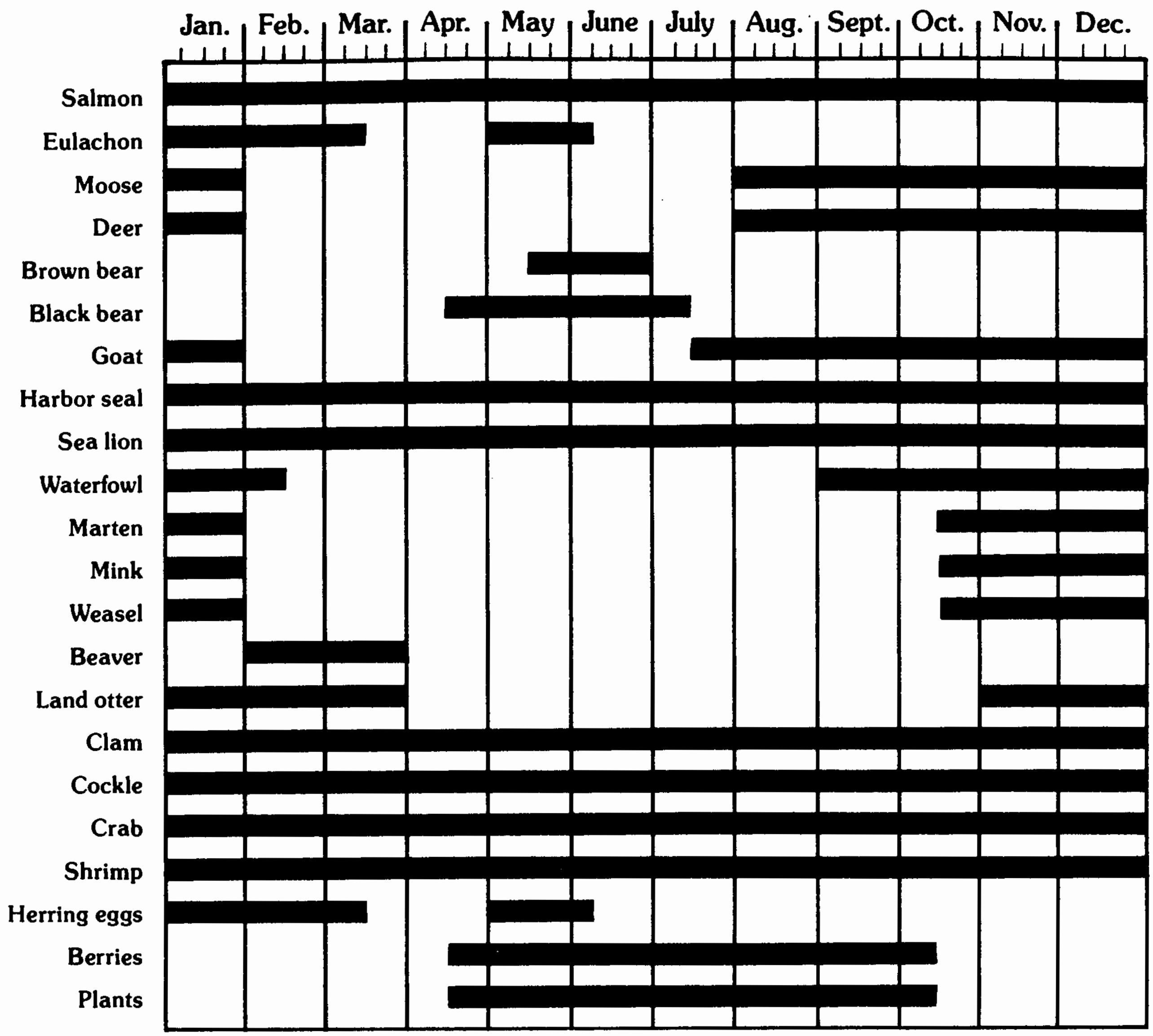


Figure 1. Annual round of harvest activities by residents of the Cordova area (adapted from McHenry 1978).

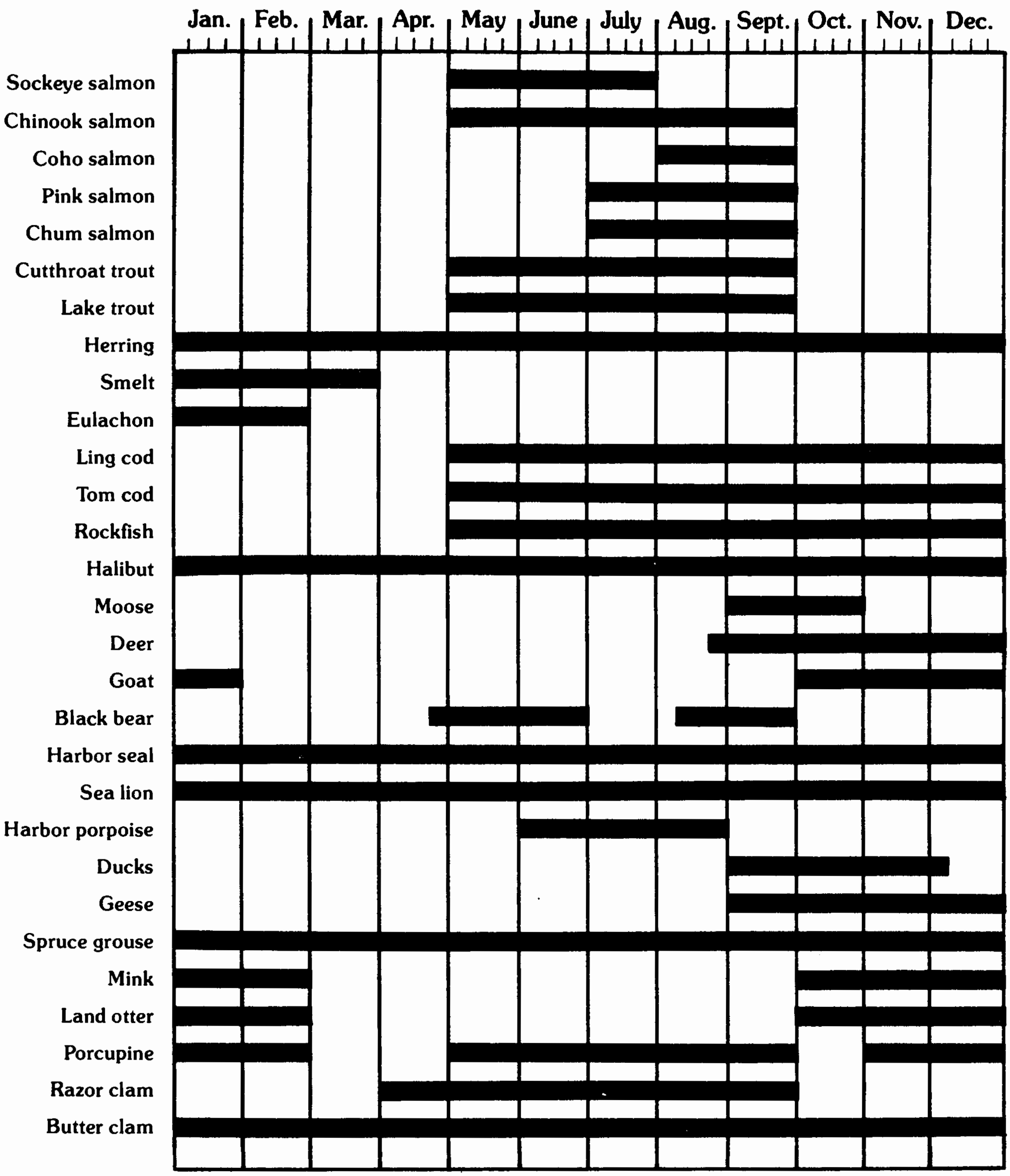


Figure 2. Annual round of harvest activities by residents of Tatitlek (Stratton, pers. comm.).

(continued)

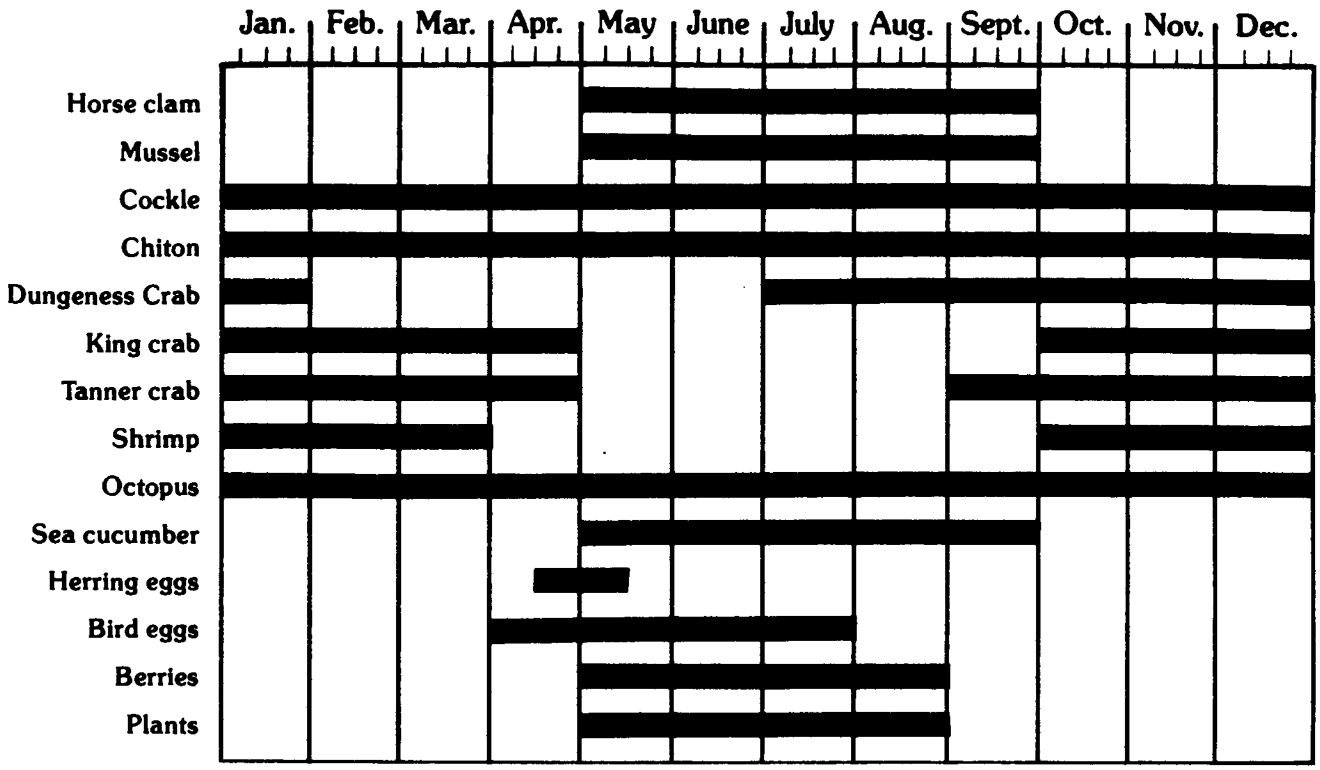


Figure 2 (continued).

the marine and coastal areas relatively near their communities.

Transportation is an important factor in determining where people go to harvest the fish and game they use. Road transport provides access to many hunting and fishing areas used by Cordova, Eyak, and Valdez residents, particularly for moose hunting and river and lake fishing for salmon and trout. For taking other species elsewhere in Prince William Sound, water transport provides access. According to McNeary (1978), travel in the eastern side of the sound is primarily by skiff, whereas larger boats are often used in the north and west. Float and wheel planes are used by some residents for hunting trips. All three means of transport are utilized to reach U.S. Forest Service cabins located in Chugach National Forest and private cabins, which are used as hunting and fishing bases.

4. Harvest levels. In terms of total harvest and participation, deer is the most commonly hunted species by local residents. Moose are hunted from the Valdez and Cordova road systems and in the lower reaches of the Copper River where there is water access. Goat hunting takes place above timber line in the mountains, particularly in the eastern part of the Prince William Sound subregion. Mountain goats may occasionally be found on the beaches of Bainbridge, LaTouche, and other mountainous islands.

   Under current federal regulations, only Alaska Natives can legally hunt sea mammals. Seals are hunted throughout Prince William Sound; sea lions are more often hunted in the western part of the sound.

   Trapping takes place in marine littoral areas and along the banks of the Copper River and other rivers in the subregion. On the mainland, land otter, mink, martin, and wolverine are the main species trapped (see table 1 for species listing). On the islands, land otter and mink account for most of the harvest.

   Intertidal areas, particularly the Copper River delta area, Orca Inlet, Sheep Bay, Simpson Bay, and north of Hawkins Inlet, are harvest sites for butter, littleneck, and razor clams, cockles, and other invertebrate species (see table 1 for listing). Depletion of these resources by sea otter predation may have limited harvest opportunities in recent years. Herring eggs on kelp are known to be gathered in the eastern part of Prince William Sound near Tatitlek (McNeary 1978) and may be gathered in other parts of the sound as well.

   King salmon are harvested primarily in the Copper River flats area. Pink and chum salmon are harvested throughout Prince William Sound. Harvesting of sockeye is concentrated in the northwestern and western sound in the Coghill and Eshamy districts and in the Copper River and Bering River area. Orca Inlet is a popular halibut fishing area; crab and shrimp pots are also set in this area.

   Salmon for home use are caught under subsistence and sport regulations. Fish caught under commercial regulations are also often kept for home use.

REFERENCES

ADL. 1982. Alaska population overview. Juneau.

ADOT. 1981. Prince William Sound transportation study. Anchorage.

Bennett, M.E., S.D. Heasley, and S. Huey. 1979. Northern Gulf of Alaska petroleum development scenarios sociocultural impacts. Tech. Rept. 36. Alaska OCS Office, Anchorage.

Birket-Smith, K., and F. deLaguna. 1938. The Eyak Indians of the Copper River Delta, Alaska. Copenhagen: Levin and Munksgaard.

deLaguna, F. 1967. Chugach prehistory: the archeology of Prince William Sound. Seattle: Univ. Washington Press.

McNeary, S.A. 1978. Local exploitation of D-2 lands in the Gulf of Alaska region. Anthropology and Historical Preservation Cooperative Park Studies Unit, Univ. Alaska, Fairbanks.

Meiners, A.H., W. T. Prodan, and N.C. Johannsen. 1977. Recreation, scenic and heritage areas of particular concern: Cape Puget to Cape Suckling, Alaska. Planning Section, ADNR, Div. Parks, Anchorage.

Oswalt, W.H. 1967. Alaska Eskimos. San Francisco: Chandler Publishing. 297 pp.

The North Pacific Rim. 1980. The Chugach Native region. Anchorage.

________. 1981. Chugach region community subsistence profiles. Anchorage.

Prince William Sound Regional Planning Team. 1983. Prince William Sound-Copper River Comprehensive Salmon Plan. Prince William Sound Aquaculture Corporation, Cordova.

Rollins, A.M. 1978. Census Alaska: number of inhabitants 1792-1970. Univ Alaska, Anchorage.

Stratton, L. 1984. Personal communication. Resource Specialist, ADF&G, Anchorage.

USDC. 1981. 1980 Census of the population, number of inhabitants. Washington D.C.

Appendices

A. Directory of Reviewers and Contributors

Arneson, P.	Nongame Biologist, ADF&G, Div. Game, Anchorage
Ball, R.	Game Biologist, ADF&G, Div. Game, Sitka
Ballard, W.	Game Biologist, ADF&G, Div. Game, Glennallen
Best, E.A.	Senior Biologist, IPHC, Seattle
Calkins, D.	Game Biologist, ADF&G, Div. Game, Anchorage
Campbell, B.	Asst. Waterfowl Biologist, ADF&G, Div. Game, Anchorage
Cannon, R.	Habitat Biologist, ADF&G, Div. Habitat, Anchorage
Coady, J.	Regional Supervisor, ADF&G, Div. Game, Region V, Nome
Conant, B.	Waterfowl Biologist, USFWS, Juneau, AK
Didrickson, J.	Area Mgt. Biologist, ADF&G, Div. Game, Palmer
Ellanna, L.	Deputy Director, ADF&G, Div. Subsistence, Juneau
Engel, L.J.	Area Mgt. Biologist, ADF&G, Div. Sport Fish, Palmer
Fall, J.	Regional Supervisor, ADF&G, Div. Subsistence, Region II, Anchorage
Faro, J.	Area Mgt. Biologist, ADF&G, Div. Game, Soldotna
Foster, D.	Fish and Game Technician, ADF&G, Div. Subsistence, Anchorage
Fridgen, P.J.	PWS Asst. Area Mgt. Coordinator, ADF&G, Div. Commer. Fish., Cordova
Georgette, S.	Fish and Game Technician, ADF&G, Div. Subsistence, Anchorage
Haanpaa, D.G.	Central Region Mgt. Coordinator, ADF&G, Div. Commer. Fish., Anchorage
Hansen, J.A.	Fishery Biologist, ADF&G, Div. FRED, Juneau
Harkness, D.	Area Mgt. Biologist, ADF&G, Div. Game, Anchorage
Heimer, W.	Game Biologist, ADF&G, Div. Game, Fairbanks
Hilsinger, J.R.	Central Region Mgt. Coordinator, ADF&G, Div. Commer. Fish., Anchorage
Hodges, J.	Raptor Biologist, USFWS, Juneau, AK
Holdermann, D.	Asst. Area Mgt. Biologist, ADF&G, Div. Game, Homer
Hughes, J.	Nongame Biologist, ADF&G, Div. Game, Anchorage
Jacobson, M.	Wildlife Biologist, USFWS, Raptor Management Studies, Juneau, AK
Kimker, A.T.	PWS/LCI Area Shellfish Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer
King, J.	Waterfowl Biologist, USFWS (retired), Juneau, AK
Kyle, S.C.	Fishery Biologist, ADF&G, Div. Commer. Fish., Homer
Lieb, J.	Asst. Area Mgt. Biologist, ADF&G, Div. Game, Glennallen
Logan, S.M.	Area Mgt. Biologist, ADF&G, Div. Sport Fish, Soldotna
McHenry, E.T.	Fishery Biologist, ADF&G, Div. Sport Fish, Seward
Melchior, H.	Furbearer Biologist, ADF&G, Div. Game, Fairbanks
Merritt, M.F.	Fishery Biologist, ADF&G, Div. Commer. Fish., Homer
Modafferi, R.	Game Biologist, ADF&G, Div. Game, Anchorage
Morrison, R.	Fishery Biologist, ADF&G, Div. Commer. Fish., Homer

Nichols, L.	Game Biologist, ADF&G, Div. Game, Cooper Landing
Pegau, B.	Area Mgt. Biologist, ADF&G, Div. Game, McGrath
Pitcher, K.	Game Biologist, ADF&G, Div. Game, Anchorage
Randall, R.C.	PWS Area Finfish Mgt. Biologist, ADF&G, Div. Commer. Fish., Cordova
Reed, C.	Resource Specialist, ADF&G, Div. Subsistence, Anchorage
Reynolds, J.	Area Mgt. Biologist, ADF&G, Div. Game, Cordova
Roberson, K.	Fishery Biologist, ADF&G, Div. Commer. Fish., Glennallen
Rothe, T.	Waterfowl Biologist, ADF&G, Div. Game, Anchorage
Ruesch, P.H.	UCI Area Finfish Mgt. Biologist, ADF&G, Div. Commer. Fish., Soldotna
Schneider, K.	Regional Research Coordinator, ADF&G, Div. Game, Region II, Anchorage
Schoen, J.	Game Biologist, ADF&G, Div. Game, Juneau
Schroeder, T.R.	LCI Area Finfish Mgt. Biologist, ADF&G, Div. Commer. Fish., Homer
Sellers, R.	Area Mgt. Biologist, ADF&G, Div. Game, King Salmon
Smith, R.	Area Mgt. Biologist, ADF&G, Div. Game, Kodiak
Sowls, A.	Seabird Biologist, USFWS, Migratory Bird Program, Anchorage
Spraker, T.	Area Mgt. Biologist, ADF&G, Div. Game, Soldotna
Stanek, R.	Resource Specialist, ADF&G, Div. Subsistence, Anchorage
Stratton, L.	Resource Specialist, ADF&G, Div. Subsistence, Anchorage
Sundet, R.L.	Fishery Biologist, ADF&G, Su-Hydro Project, Anchorage
Tankersley, N.	Game Biologist, ADF&G, Div. Game, Anchorage
Taylor, W.	Game Biologist, ADF&G, Div. Game, Anchorage
Timm, D.	Regional Mgt. Coordinator, ADF&G, Div. Game, Region II, Anchorage
Tobey, R.	Area Mgt. Biologist, ADF&G, Div. Game, Glennallen
Trapp, J.	Wildlife Biologist, USFWS, Marine Bird Management Program, Anchorage, AK
Williams, F.T.	Area Mgt. Biologist, ADF&G, Div. Sport Fish, Glennallen
Wolfe, R.	Research Director, ADF&G, Div. Subsistence, Juneau

B. Abbreviations

ACMP	Alaska Coastal Management Program
ADCED	Alaska Department of Commerce and Economic Development
ADCRA	Alaska Department of Community and Regional Affairs
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADL	Alaska Department of Labor
ADNR	Alaska Department of Natural Resources
ADR	Alaska Department of Revenue
AEIDC	Arctic Environmental Information and Data Center
AOU	American Ornithological Union
BBCMP	Bristol Bay Cooperative Management Plan
BLM	Bureau of Land Management
CFEC	Commercial Fisheries Entry Commission
CIRPT	Cook Inlet Regional Planning Team
EPA	Environmental Protection Agency
EPS	Environmental Protection Service (Canada)
ERL	Environmental Research Laboratory
FAO	Food and Agriculture Organization of the United Nations
GMS	Game Management Subunit
GMU	Game Management Unit
IMS	Institute of Marine Science
INPFC	International North Pacific Fisheries Commission
IPHC	International Pacific Halibut Commission
IUCN	International Union of Conservation of Nature and Natural Resources
ISEGR	Institute of Social, Economic and Government Research
LCI	Lower Cook Inlet
MMS	Mineral Management Service
NEGOA	Northeast Gulf of Alaska
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NPFMC	North Pacific Fishery Management Council
NPS	National Park Service
NWAFC	Northwest and Alaska Fisheries Center
NWR	National Wildlife Refuge
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OMPA	Office of Marine Pollution Assessment
PWS	Prince William Sound
PWSRPT	Prince William Sound Regional Fisheries Planning Team
UCI	Upper Cook Inlet
USDC	United States Department of Commerce
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USDL	United States Department of Labor
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

C. Wildlife Management Goals and Objectives

The following are the goals and subgoals that form the basis for wildlife management by the Alaska Department of Fish and Game. The first goal applies to all species managed by the department. Application of the second goal and the selection of one or more of its subgoals varies by species and/or area managed.

Outline: WILDLIFE MANAGEMENT GOALS*

I. TO PROTECT, MAINTAIN AND ENHANCE WILDLIFE POPULATIONS AND THEIR HABITATS FOR THEIR INTRINSIC AND ECOLOGICAL VALUES SO ESSENTIAL TO THE MAINTENANCE OF A HEALTHY ENVIRONMENT AND THE WELFARE OF MAN.

II. TO PROVIDE FOR OPTIMUM BENEFICIAL USE OF WILDLIFE BY MAN.

   A. To provide for subsistence use of wildlife by Alaskan residents dependent on wildlife for sustenance.

   B. To provide for diversified recreational uses of wildlife.

   C. To provide for scientific and educational use of wildlife.

   D. To provide for commercial use of wildlife.

* Source: 1980 ADF&G Wildlife Management Goals.

WILDLIFE MANAGEMENT GOALS

I. TO PROTECT, MAINTAIN AND ENHANCE WILDLIFE POPULATIONS AND THEIR HABITATS FOR THEIR INTRINSIC AND ECOLOGICAL VALUES SO ESSENTIAL TO THE MAINTENANCE OF A HEALTHY ENVIRONMENT AND THE WELFARE OF MAN.

Wildlife and man are interdependent constituents of an environment shared with all other living things. Recognition of this fundamental relationship is reason enough to preserve wildlife and to maintain its natural role in the environment. In addition, there is great value in assuring for man's benefit and enjoyment the continuance of an environment as biologically rich and diverse in the future as in the present. For the people of the State and the Nation Alaska's wildlife is an invaluable source of inspiration, sustenance, and recreational and economic benefits. It is capable of providing benefits to man in perpetuity if its welfare is safeguarded. Because wildlife is especially vulnerable to human activities, it requires the most careful stewardship man can provide.

The foremost consideration in protecting and maintaining indigenous wildlife populations is providing habitat in the amount, kind and quality necessary to meet the requirements of wildlife species. Wildlife populations cannot survive without adequate habitat, and efforts to protect animals directly without also protecting their habitat or correcting habitat deficiencies often prove to be ineffectual.

Alteration of habitat is one primary way man affects wildlife populations. Although some species can inadvertently benefit from certain habitat alterations resulting from man's activities, many others can be adversely affected. Long-term habitat degradation usually results in reduced numbers and fewer species of wildlife. Even where habitat are purposely modified to benefit populations of particular species, reductions in populations of other species may be unavoidable.

Protection, maintenance, and manipulation of wildlife habitat are important management activities of the Department. Important wildlife habitats will be identified and protective legislation, classification or designation of such habitats will be sought. Land management agencies, organizations, and individuals will be encouraged to protect wildlife habitats from degradation or to minimize adverse impacts of development or other land uses on land under their control. Where appropriate, habitat may be restored or improved to enhance selected wildlife populations.

Wildlife as well as its habitat must be protected from the detrimental influences of man. Disturbances injurious to wildlife must be minimized. Competition and conflicts with domestic animals must also be minimized and the introduction of undesirable exotic animals avoided. The introduction of diseases carried by domestic animals, transplanted wild animals, or animals kept as pets must be prevented. Use of wildlife must be regulated to ensure that allowable use tolerances are not exceeded. Illegal and wasteful uses must be controlled to assure protection of the resource and to maximize human benefits from its use.

Greater public appreciation for and awareness of wildlife and its requirements are necessary for public support for effective programs to protect and benefit wildlife. Successful, progressive wildlife management requires objective decisions based on the best biological information that can be gathered by competent professionals.

II. TO PROVIDE FOR OPTIMUM BENEFICIAL USE OF WILDLIFE BY MAN

Optimum beneficial use of wildlife is that use which 1) does not adversely affect the wildlife populations, 2) results in desirable products of use, and 3) is based on desirable allocations of such products among users. Such use, in the aggregate, serves to maximize benefits to be people of Alaska and the Nation.

Depending on the objectives of management, there are many levels and kinds of use which can be considered "optimum". Wildlife can support a variety of uses on a continual basis so long as its capability to sustain such use is not impaired. Because values placed upon wildlife vary, management must provide opportunities for an array of different uses if benefits are to be realized by all concerned. Also, because there are finite limits to wildlife populations and the uses they can support, management must provide for simultaneous uses wherever possible if benefits are to be optimized. Although different uses are generally compatible, some conflicts do occur, and sometimes provision for some uses may require the exclusion of others. Regulatory separation of incompatible uses in time and space can reduce conflicts and facilitate an optimum level and mix of beneficial uses.

Attainment of the following subgoals should ensure that the people obtain optimum beneficial use from Alaskan wildlife.

SUBGOAL A. To provide for Subsistence Use of Wildlife by Alaskan Residents Dependent on Wildlife for Sustenance.

Direct domestic utilization of wildlife is important to many residents for sustenance and to many other citizens as a valuable food supplement. Beyond directly satisfying food requirements, domestic utilization of wildlife helps preserve Alaskan cultures and traditions and gives gratification to the strong desire of many Alaskans to harvest their own food. These attributes of subsistence use are considered genuinely important to the physical and psychological well-being of a large number of Alaskans. Accordingly, subsistence receives priority among the various beneficial human uses.

Within legal constraints and the limits of resource capabilities, wildlife will be allocated to subsistence users on the basis of need. Needs of individuals, families, or cultural groups differ in type and degree and it is recognized that subjective judgement will be an unavoidable necessity in establishing actual need. Elements considered in establishing the level of need include cultures and customs, economic status, alternative resources (including availability of social services), place of residence, and voluntary choice of life style. Limitations on the productivity of wildlife stocks may limit continued increases in the number of subsistence users.

In some circumstances subsistence users also may be participants in recreational or commercial harvesting. Where subsistence users can satisfy their needs by recreational or commercial methods, special regulations for subsistence priority should be achieved by existing regulatory techniques, such as open and closed seasons, bag limits, control of methods and means of take, and controlled use areas. Even when special regulations are necessary, commercial and recreational uses might not need to be prohibited entirely prior to any restrictions on subsistence uses. But, in any case, traditional and customary subsistence users would continue to receive a priority harvest opportunity in regulatory systems.

Management of wildlife populations for subsistence use may involve manipulation of the numbers and/or sex and age structure of the population. Where possible, differential use or sex or age segments of wildlife populations will be used to accommodate subsistence or other use demands. Wildlife populations generally will be managed to optimize sustained productivity. Recreational and commercial uses will be permitted where and to the extent that they do not interfere with or preclude subsistence resource use.

SUBGOAL B. To Provide for Diversified Recreational Uses of Wildlife

In many areas of the state, recreation, in its various forms, is the dominant use of wildlife. In addition to sport hunting and trapping, recreational uses include observation and photography, both incidental to other activities and as the primary objectives, and wilderness experience, including the aesthetic rewards of being aware of or observing animals in natural interactions with their environment. The Department has the responsibility to provide for these diverse, yet generally compatible uses.

The emphasis of management for recreational use will be to provide opportunities for varied recreational experiences rather than to maximize the yield of animals, even though success in observing or taking animals is recognized as an important element in user satisfaction. Varied experiences are often provided through de facto differences in biological, physical, and demographic characteristics of various areas and through regulated factors such as participation rates, methods and means of use, timing of use, and bag limits.

Quality of experience is an important concern to many recreational users. Although aesthetics are a matter of individual preference, elements of quality most commonly identified include low user densities, controlled methods of transport, undisturbed wilderness character, minimal intrusions by other users, and a reasonable expectation of success. The opportunity to observe or be selective for large animals is another aesthetic consideration which may add significantly to the recreational experience.

At the other end of the recreational use spectrum are those uses allowing unrestricted opportunities for user participation. Beyond limiting use to optimum sustained yield levels, management for maximized opportunity provides for unlimited participation and traditional freedom of choice of access methods.

SUBGOAL C. To Provide for Scientific and Educational Use of Wildlife.

The Alaskan environment, including its wildlife, is a unique natural laboratory for the scientific study of ecosystems and wildlife biology, and for the educational enrichment of the people. Such studies are necessary to achieve a scientific basis for identifying and evaluating management options. Scientific study and education have taken place in many areas of Alaska, reflecting the general compatibility of such use with other uses of wildlife. Occasionally, undisturbed or closely controlled conditions are necessary study requirements and justify the designation of areas primarily for scientific and educational purposes. Requirements for such actions specify the extent to which other uses, both consumptive and nonconsumptive, would be encouraged or restricted. In some cases, intensive population or habitat manipulation may be necessary to achieve study objectives.

SUBGOAL D. To Provide for Commercial Use of Wildlife.

Commercial use of wildlife includes the direct consumptive and non-consumptive use of animals where sale of the products or by-products of animals is the primary objective. Indirect commercial use includes services which support recreational or other noncommercial users, and marketing systems utilized for wildlife products. Direct commercial use of wildlife in Alaska today is limited primarily to furbearers and marine mammals which have traditionally supported such use. Principal service industries include guiding, taxidermy, meat processing, photography, and wildlife-related tourist services.
Commercial uses of furbearer and marine mammal resources, responsible for much of the early exploration and settlement of Alaska, still support important industries in rural areas of the state and provide needed supplemental income to many bush residents. However, changing economic and social values and the increasing importance of recreational uses generally are reducing the relative economic importance of direct commercial uses of wildlife. On the other hand, industries serving the continually growing recreational uses of wildlife are becoming more important.

Management will provide for commercial use of wildlife only when it does not threaten the welfare of any wildlife resource, when it is in the economic interest of the people of Alaska, and when it is compatible with other uses. Where commercial use conflicts with other uses it will usually be restricted or eliminated in favor of other uses. Commercial activities which depend on recreational users will usually be restricted or eliminated in favor of other uses. Domestication of wildlife for commercial purposes usually will be opposed, but where allowed it will be strictly regulated to prevent abuse to the resource or inhumane treatment of individual animals.

WILDLIFE MANAGEMENT OBJECTIVES*

Based on these wildlife management goals and subgoals, objectives for the strategic management plans of individual species are selected from the following:

> To protect, maintain, and enhance the (species) population in concert with the components of the ecosystems and to assure its capability of providing sustained opportunities to
>
> 1) view and photograph wildlife;
> 2) subsistence use of wildlife;
> 3) participate in hunting wildlife;
> 4) hunt wildlife under aesthetically pleasing conditions;
> 5) be selective in hunting wildlife;
> 6) scientific and educational study of wildlife;
> 7) commercial use of wildlife;
> 8) protect human life and property in human-wildlife interactions.

Management objectives vary not only according to the concerned species, but also, in many cases, according to the areas involved and the demands made upon the wildlife resource. Because these demands can change with the passage of time, particular management objectives may need to be revised.

Examples of management guidelines are presented in the individual strategic management plans. These guidelines are used to qualify or quantify in a more specific way the recommended management under a specific set of objectives for any particular area. The guidelines are statements about the following:

1. The wildlife population: its size, sex, age structure, and productivity.
2. Use: season length and timing, bag limits, number or distribution of hunters or other users, access, transport, viewing, and aesthetic enjoyment.
3. Habitat: alteration or protection.

* Departmental memo, ADF&G, Division of Game, June 14, 1980.