Alaska Habitat Management Guide

Western and Interior Regions

Distribution, Abundance, and Human Use of Fish and Wildlife

Produced by
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Division of Habitat

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<u>Western Region</u>

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Many individuals have been involved in the production of this fourth Alaska Habitat Management Guide. All narratives were reviewed first by project staff and distributed for both technical and departmental reviews. The names of reviewers and other contributors are compiled in appendix A in volume 2.

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The process of developing the initial plan and procedures for this project involved a number of individuals who are not otherwise listed as authors and contributors. These include many staff within the Division of Habitat, as well as planners and research and management coordinators of other divisions. This group also includes all project team members and all ADF&G regional supervisors. Special mention should be made of the support from Alvin Ott and Lance Trasky, Regional Supervisors of the Division of Habitat for the Interior and Western regions (respectively), and of the contributions of Rai Behnert, who was the original coordinator of this project. We would also like to acknowledge the many contributions of John A. Clark, who was Director of the Division of Habitat until his death in 1985.

Introduction

Overview of the Habitat Management Guides Project

Background

Alaska is an immense and bountiful frontier, and until just recently it was all but inconceivable that we would ever need to worry about its capacity to sustain the wealth of fish and wildlife resources for which it is renowned. But the impetus of progress has not abated, and the pressure to develop our lands and waters intensifies daily. Every year more lands in Alaska are being proposed for uses other than as wildlife habitat, especially around cities, towns, and villages. These proposed uses include logging, mining, hydroelectric projects, agriculture, settlement, geothermal development, and oil and gas leases, among others. As the number of proposals and plans for development continues to increase, so does the need to carefully and efficiently evaluate their possible effects upon species and habitats and to recommend viable managerial options to guarantee that our valuable fish and wildlife resources and habitats are adequately protected and maintained. By using appropriate planning and managerial techniques most of the potential for damage and loss of access for human use can be avoided.

One of the responsibilities of the Alaska Department of Fish and Game (ADF&G) is to assist land managers by recommending to them the best ways and means, based upon the best available data, for protecting local fish, wildlife, and habitats against adverse effects and impacts. Because many proposals and plans for development and land uses require a rapid response from the department, there may not be enough time for staff to actually study the specific area in which the proposed development is to occur. However, the department still needs to accumulate and assess a wide variety of information in order to prepare recommendations for managing habitat. Therefore, the department initiated the Alaska Habitat Management Guides (AHMG) project to prepare reports of the kinds of information upon which its recommendations must be founded in order to responsibly and rapidly address land and water use proposals made by land managers. These guides are a major undertaking and will be of inestimable value to the state in its efforts to avoid or mitigate adverse impacts to Alaska's great wealth of fish and wildlife.

Purpose

The Alaska Habitat Management Guides present the best available information on selected fish and wildlife species: mapping and discussing their geographical distribution; assessing their relative abundance; describing their life functions and habitat requirements; identifying the human uses made of them, including harvest patterns of rural communities; and describing their role in the state's economy. This last kind of information, because of the variety of values humans place upon fish and wildlife, is not easily derived. There are, however, several methods to estimate some of the economic values associated with these resources, and such estimates have become particularly important in land use planning because many potentially conflicting uses must be evaluated in economic terms.

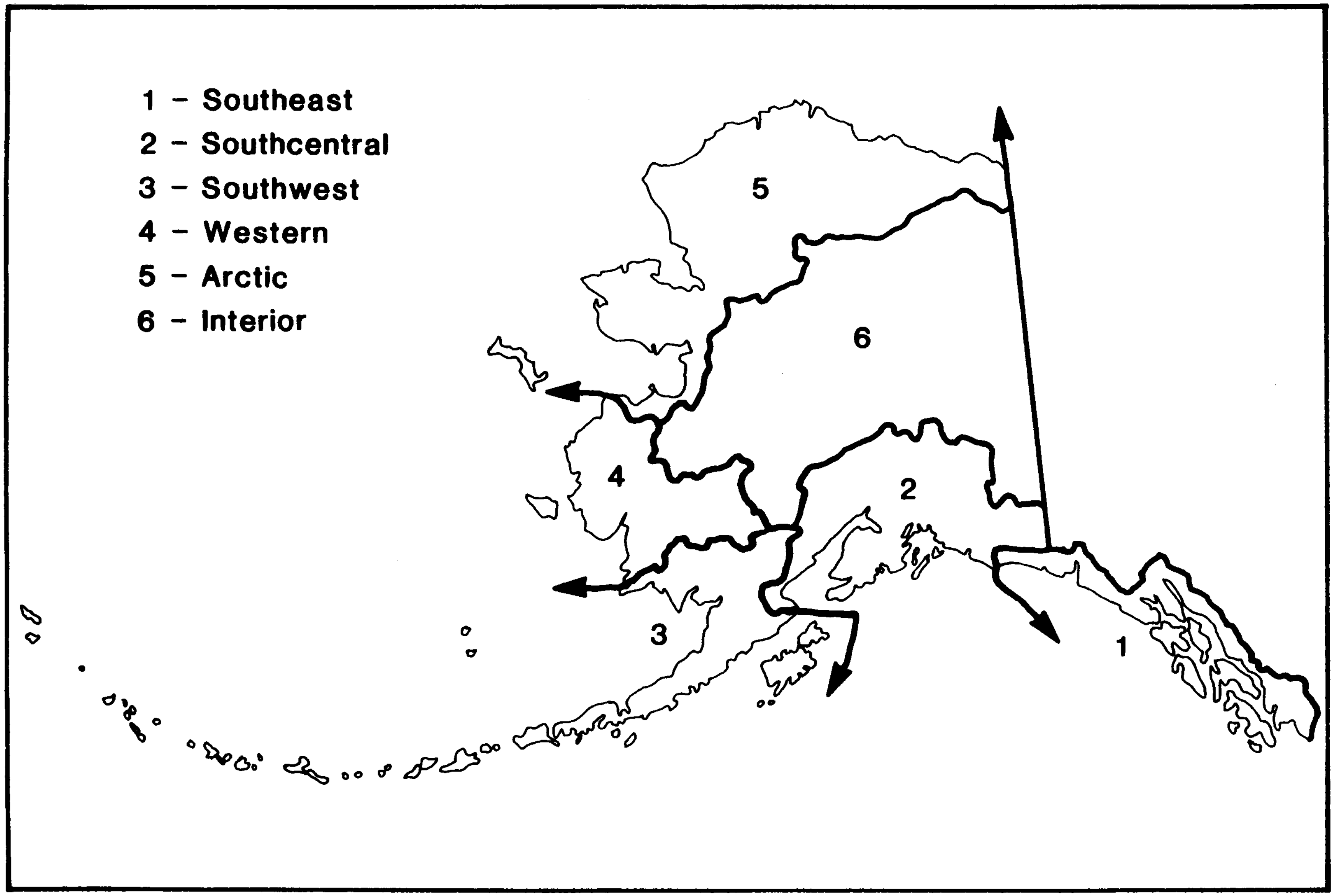
Essential to assessing what might happen to fish and wildlife if their habitats are altered is information about what effects or impacts are typically associated with particular kinds of development activities. The habitat management guides therefore also provide summaries of these known effects. This information, in conjunction with compiled life history information, will allow those concerned to estimate how sensitive a given species might be to a specific proposed activity - whether or not, and to what degree the fish and wildlife are liable to be impacted. The guidance offered (a compilation of existing options for habitat management) is not site-specific. Rather, it is general information available to those who seek to avoid adverse impacts without placing undue restraints upon other land and water uses.

The completed guides coverage of fish and wildlife resources encompasses the Fish and Game Resource Management Regions established by the Joint Board of Fisheries and Game (map 1). These regions provide the most inclusive and consistent format for presenting information about fish and wildlife resources and relating it to management activities and data collections efforts within the department.

Applications

The choice of the term "guides" rather than "plans" for the reports is consistent with the largely advisory role of the department with respect to land management issues. The guides will provide the department was well as other state, federal, and private land managers with information necessary for the development of land and water use plans. Thus, the guides themselves are not land management plans and do not provide for the allocation or enhancement of fish and wildlife. Information included in a guide will be used by the department's staff in their involvement in the land use planning endeavors of various land managers. For specific land use planning efforts, the department joins with other agencies to recommend particular uses of Alaska's lands and waters, as for example in plans by the Department of Natural Resources (Susitna Area Plan, Tanana Basin Area Plan, Southeast Tidelands Area Plan). The public, by means of the public review that is an integral part of land management agencies' planning processes, then has an opportunity to evaluate any recommendations made by the ADF&G that are incorporated by the land-managing agency.

The guides have been designed to provide users with interrelated subject areas that can be applied to specific questions regarding habitat management. Each type of data will be presented in a separate volume, as indicated in figure 1. Material from the AHMG database can be used, for example, to correlate information on species' seasonal and geographic habitat use with the written and mapped information on known distribution and abundance. The narratives and maps regarding human uses of fish and wildlife can be compared with abundance and distribution information to



Map 1. The six regions of the Alaska Habitat Management Guides.

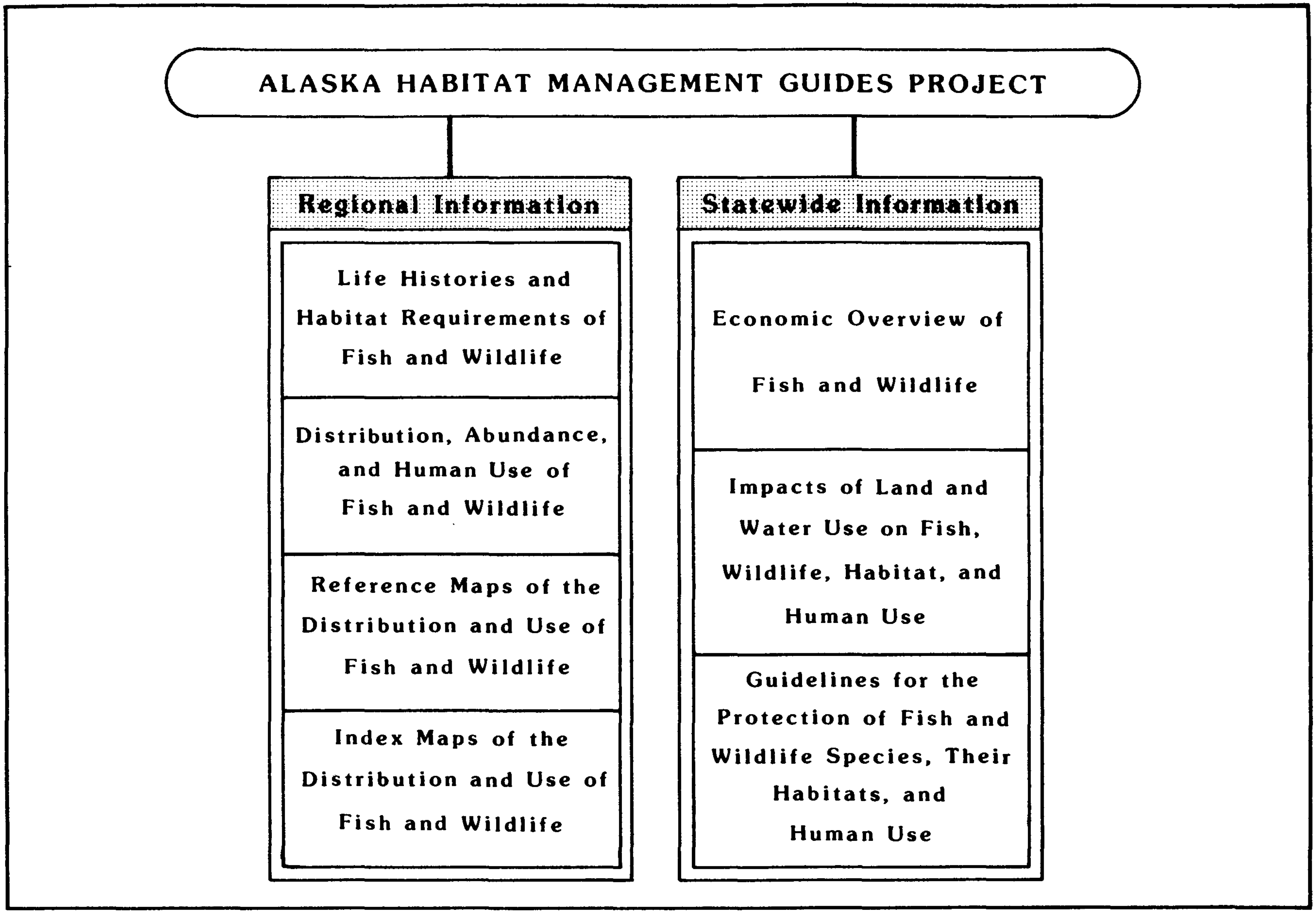


Figure 1. Types of narratives and maps produced by the Alaska Habitat Management Guides Project.

obtain an indication of the overall regional patterns of distribution, abundance, and human use for the species of interest. The specific information on habitat requirements also will relate directly to the information on impacts associated with land and water use. This in turn will form the basis for the development of habitat management guidance.

An additional purpose of this project is to identify gaps in the information available on species, human uses, and associated impacts. A particular species, for example, may be known to use certain habitats during certain season; yet information on the timing of these use patterns may be inadequate. In general, there is little documentation of impacts from land and water uses on species' habitats and on the human use of those species or on the economic values associated with the use of fish and wildlife resources.

To maintain their usefulness these habitat management guides are designed to be periodically updated as new research and habitat management options are reported to fill data gaps. Users of these guides are advised to consult with the appropriate species experts and area biologists, however, to check on the availability of more recent information.

Statewide Volumes

Besides the statewide volume detailing the regional life histories and habitat requirements of selected species of fish and wildlife, three other reports have been developed as statewide volumes, in which information is presented for statewide as well as for specific regional concerns. 1) The statewide volumes on impacts summarize the effects of major types of development activities and land and water uses of fish and wildlife, their habitats, and their use by people. The activities discussed are those actually occurring in the state or expected to occur in the future. This survey of impacts is founded upon the most recent pertinent literature. 2) The statewide habitat management guidance volume is a synthesis of information regarding habitat management based upon the impacts literature. The following uses of land and water resources and types of development occur or are likely to occur in Alaska, and they are, therefore, addressed in the statewide impacts and/or guidance volumes:

- Oil and gas development
- Harbors and shoreline structures
- Water development
- Placer mining
- Strip and open pit mining
- Underground mining
- Seafood processing

- Silviculture and timber processing
- Transportation - road, rail, air
- Transmission corridors
- Grain and hay farming
- Pipelines
- Geothermal energy development
- Red meat and dairy farming
- Settlement
- Fire management
- Offshore prospecting and mining
- Commercial fishing

Finally, 3) a statewide economic volume provides an overview of the role of fish and wildlife resource use in the regional and state economies. Fish and wildlife are renewable resources whose uses have historically formed the basis for human economies throughout the state. Although fish and wildlife use still plays a critical role in economies throughout the state, the growing complexity of the Alaska economy makes the valuation of these uses increasingly difficult. The recent growth in the Alaska economy has resulted in an increasing divergence between market and nonmarket use of the state's natural resources. This is further compounded by growing urbanization, which is often centered around a large-scale project in contrast to more dispersed rural resource utilization.

As the plans for development continue to increase, the need to evaluate the tradeoffs involved with sometimes competing land uses is necessary. Because of the wide variety of values (some of which are infinite), the task of translating the "infinite value" of wild resources into the more restrictive terms of economic assessment is difficult at best. Its inherent difficulty is compounded by the circumstance that the data necessary for such an assessment are, with few exceptions, incomplete or unavailable at the present time. The economic data on commercial fisheries, for example, are relatively complete; and in those regions with significant commercial fisheries the dollar value of the fish resource can be fairly accurately estimated. For other regions and other resources, however, economic analysis must remain partial or tentative until a sound database exists. Continuing effort is being made by the department and by other agencies to compile such a comprehensive database in order to more accurately describe the great economic value of fish and wildlife to the people both within and outside the State of Alaska.

Regional Volumes

Narratives. Regional information on the distribution, abundance, and human uses of selected fish and wildlife species is available for each region of the state. The narrative volumes for the Southwest, Southcentral, Arctic, and Western and Interior regions provide the most current estimates of species' distribution and relative abundance and delineate the regional and subregional patterns, locations, and types of human uses of fish and wildlife resources. The narrative information for Southeast Alaska is organized somewhat differently: a brief summary of the distribution and abundance of selected species is presented within the Alaska Habitat Management Guide Reference Maps for the Southeast Region, and more detailed information on the human use of fish and wildlife is available in the Division of Habitat technical report entitled Human Use and Economic Overview of Selected Fish and Wildlife in Southeast Alaska.

Regional versions of the final Life History and Habitat Requirements of Fish and Wildlife volume were released with the publication of each regional database. Although these volumes contain much of the same information found in the final report, the compiled volume supercedes each of the earlier regional volumes.

Western and Interior Regions

Organization and Use of the Guide

Narratives. The statewide life history volume and the guide to the Western and Interior regions are closely related and interdependent. The first highlights important aspects of selected species life histories, emphasizing the interrelationships of the species with their habitats. For many species the life histories include information for the Western, Interior, and Arctic, Southwest, and Southcentral regions. The distribution and human use volume for the Interior and Western regions provides the most current estimates of species' distribution and relative abundance and delineates the regional and subregional patterns, locations, and types of human uses of fish and wildlife resources. This volume provides an understanding of the importance of fish and wildlife to the people within and outside the Western and Interior regions.

Because of the wide spectrum of human fish and wildlife, this volume is divided into four topical categories. These include 1) hunting, 2) commercial fishing, 3) sportfishing, and 4) subsistence use. For categories 1 through 3, data are presented by selected species, and the information pertains to the entire region and the specific management areas within the region, as appropriate. All reports by species are based upon data collected by the Divisions of Game, Sport Fish, and Commercial Fisheries, as well as the Commercial Fisheries Entry Commission, the North Pacific

Fisheries Management, the National Marine Fisheries Service, and the International Pacific Halibut Commission.

For the fourth category of human use information, the Western and Interior regions have been discussed separately to portray patterns of subsistence use of local fish and wildlife resources. The patterns of use described in these narratives are based primarily upon community studies coordinated by the Division of Subsistence, with additional source materials from other anthropological studies on the history and patterns of activity in the subregions.

Maps. A major portion of the guides project in the Western and Interior regions was committed to the production of updated fish and wildlife maps at two scales of resolution. Species distributions and human use were mapped at a reference scale of 1:250,000 and then were mapped at the index scale of 1:1,000,000 for most subjects. Some reference maps for marine species were actually prepared at the 1:1,000,000-scale because that is the most appropriate scale to portray the level of detail of data on those species distributions. Reference maps are being reproduced as blue-line copies compiled in catalogues that are available at ADF&G offices of the region. Additional copies will be available for other users, at cost of reproduction, from our contract vendor. These maps can quite easily be updated. The index maps are being printed in color and will be included in atlases for all regions except Southeast. Habitat management concerns in Southeast Alaska do not require this resolution of information.

For the Western and Interior regions, there are approximately 945 reference maps that depict fish and shellfish species distribution, wildlife species distribution, subsistence, commercial, recreational, and general use of fish and wildlife.

Species Selection Criteria

Each species covered in the guides was selected because it met the following criteria: 1) its habitat is representative of some portion of the spectrum of the habitats in the Western and Interior regions (this criterion ensures that regional habitats are well represented); 2) it constitutes an important resource to human users in the region; 3) the species or its habitat is liable to be adversely affected by present or proposed land or water uses; and 4) adequate information on its life history, abundance, and distribution was available.

Based on the above criteria and the prioritized requests of each division, the species list for the Western and Interior regions was developed to include 29 individual species, plus species groups, dabbling and diving ducks (10), and geese (4). The individual species are as follows:

Belukha whale	Arctic char/Dolly Varden	Chinook salmon
Bowhead whale	Arctic grayling	Chum salmon
Pacific walrus	Broad whitefish	Coho salmon
Polar bear	Burbot	Pink salmon
Brown bear	Humpback whitefish	Sockeye salmon
Caribou	Lake trout	King crab
Dall sheep	Least cisco	Pacific halibut
Moose	Northern pike	Saffron cod
	Rainbow trout/steelhead	Shrimp
	Sheefish	Tanner crab
		Yellowfin sole

Many other species, including but not limited to the following, are also important to consider when making land or water management decisions or plans:

Muskox	Snowy owl	Alaska blackfish
Wolverine	Gyr falcon	Smelt
Beaver	Rough-legged hawk	Lingcod
Land otter	Golden Eagle	Hardshell clam
Mink	Ribbon seal	Starry flounder
Wolf	Bearded seal	Sand lance
Lynx	Spotted seal	Sculpin
Marten	Gray whale	Capelin
Spruce falcon	Seabirds	
Peregrine falcon	Shorebirds	
Loons	Grebes	
Tundra swan		

Limitations of Information

One goal of the guides project is to identify gaps in the documented information available when presenting data on species life history and habitat requirements, species distribution, abundance, and harvest, impacts from land and water development, and the value of human uses of fish and wildlife. Specific limitations of information are discussed in the text of each of the species narratives in each volume. However, major inadequacies in the database on species are highlighted below so that research on fish and wildlife resources may be directed toward rectifying them.

Within the Western and Interior regions, insufficiently documented areas for species include the following:

Mammals/Birds

- Waterfowl habitat preferences and requirements by season and life stage

- Capacity of drainages or other site specific areas to support wildlife populations

- Inventory of extent and quality of habitat
- Minimum usable home range size and optimum habitat characteristics
- Distribution and abundance of Dall sheep during winter and the breeding and lambing periods
- Habitat requirements and limiting factors for sheep in Tanana Uplands/-Yukon
- Factors influencing winter survival of younger age classes of sheep
- Importance of mineral licks to sheep
- Drainage-specific information on the number of hunters, trappers, effort, and harvest levels for each furbearer and game species
- Distribution and abundance of furbearer species
- Effects of fire on sheep and caribou range
- Recent hunter effort data for nonpermit caribou hunts
- Movements, population distribution, food habits and general ecology of caribou in Western Alaska, the upper Kuskokwim Valley, and portions of the Western Arctic caribou herd range and the central Yukon River drainage.

<u>Fish</u>

- Information specifically applicable to Alaska on the life cycle and habitat requirements of Pacific salmon, Pacific herring, crabs, and freshwater fish
- Utilization of nearshore habitats by shellfish, groundfish, Pacific herring, and Pacific salmon during their marine life-stage
- The seasonal movements and migrational patterns of salmon, marine fish and shellfish, and freshwater fish
- The overall population size estimate of groundfish species, crab, shrimp, herring, salmon, and freshwater fish, particularly for the commercially harvested species where present abundance estimates are based largely on samples of legal, harvestable individuals; along this line, almost nothing is known of the magnitude of the coho salmon runs in the regions
- The causes and extent of the natural fluctuations in populations of groundfish, shellfish, herring, and salmon

- The determination of the integrity of spawning populations (stocks) and their intraspecies interaction with other populations (i.e., for herring, crab, shrimp, groundfish, and salmon)

The subject of impacts to fish and wildlife from activities associated with land and water development is weakly documented in general, but it is especially lacking in empirical studies on impacts upon nearshore habitats and the cumulative effects of chronic, low-level impacts. Studies specific to Alaska are nearly nonexistent.

Finally, with the exception of the data on the commercial fishing industries, very little information is available regarding the economic value of fish and wildlife use, especially as regards sport hunting and fishing, whether guides or not, trapping of both sealed and unsealed species, and the various nonconsumptive uses of fish and wildlife. This last category includes such uses as photography, wildlife viewing, and various recreational activities that are not easily quantified.

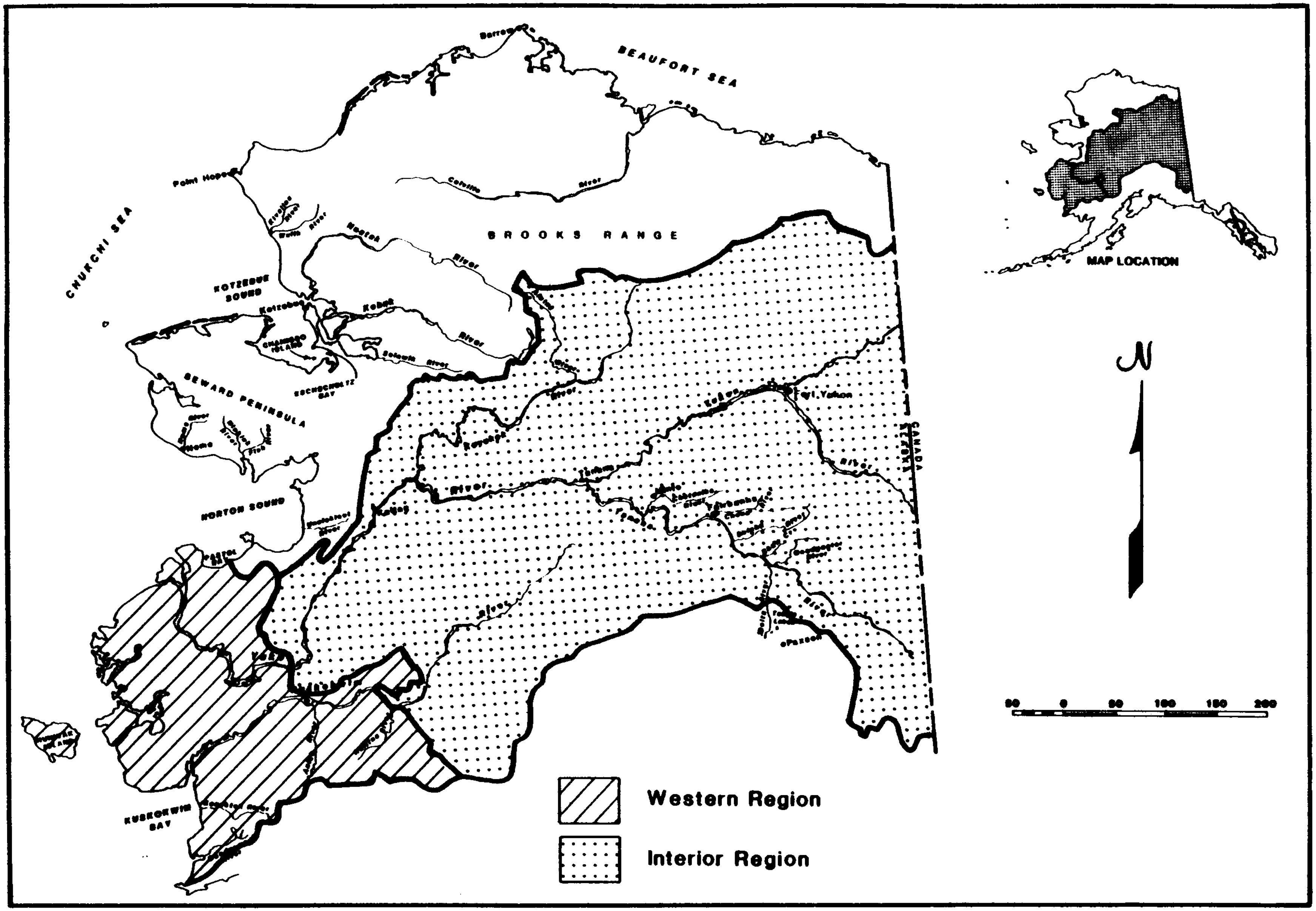
This regional guide to habitat management is conceived therefore as necessarily incomplete: as new research and habitat management options are reported, the guide will be periodically updated. Species experts and area biologists should be contacted regarding the availability of more recent information.

Overview of the Western and Interior Regions

The Western and Interior regions (map 2) include the Kuskokwim, Kaiyuh, Ray, White, and Crazy mountains and the southern slopes of the Endicott and Philip Smith mountains (eastern Brooks Range). A few of the larger river basins in the regions include the drainages of the Yukon, Andreafsky, Innoko, Koyukuk, Chandalar, Sheenjek, Porcupine, Tanana, Kantishna, Delta, Nabesna, Chisana, Fortymile, Kuskokwim, Kwethluk, Aniak, Holitna, Stony, Big, Kanektok, Arolik, and Goodnews rivers. Marine waters associated with the regions are comprised of the Kuskokwim, Hazen, Hopper, Kokechik, Scammon, and Pastol bays and Baird Inlet, and the Bering Sea to the west of the Yukon-Kuskokwim delta, including Nelson, Nunivak, and St. Matthew islands.

The biophysical, biotic, and human resources of the region are briefly summarized below. Readers desiring a more detailed and extensive discussion of these characteristics of the regions should consult the Alaska Regional Profiles.[1]

1 Arctic Environmental Information and Data Center. N.d. Alaska Regional profiles: Southwest Region, Yukon Region. Prepared for the Office of the Governor and Joint Federal/State Land Use Planning Commission.



Map 2. The boundaries of the Western and Interior regions.

Biophysical Features

The Yukon-Kuskokwim delta in the Western Region is in the transitional climatic zone, with a relatively narrow range of seasonal and diurnal temperatures as compared to the continental climatic zone of the Interior Region. In the continental climatic zone, temperatures are generally extreme in both summer and winter, and precipitation and wind are normally light. Fog, precipitation, and winds frequently occur along the coast of the Western Region. The weather in the regions is the result of the interaction among global air movements, land topography, and storms that move northeast across the Bering Sea and the North Pacific Ocean.

Sea ice formation in the Bering Sea begins in October. The ice pack persists through May, although the ice begins to melt, break up, and move northward in April.

The topography of the Western Region is dominated by the Yukon and Kuskokwim rivers and the marshy alluvial plain known as the Yukon-Kuskokwim delta. The topography of the Interior Region is also dominated by the Yukon and Kuskokwim rivers, although there are also extensive upland areas in addition to broad alluvial lowlands such as the Yukon and Minto flats. Permafrost is discontinuous throughout the regions. The entire marine area of the Western Region lies within the continental shelf.

Biota

The vegetation of the Western Region is primarily dry alpine tundra, wet tundra, and moist tundra. These highly varied tundra communities are comprised of herbaceous sedges, grasses, and low-growing forbs, lichens, and dwarf shrubs, with a greater percentage of shrubs where soil conditions are drier. The vegetation of the Interior Region is primarily closed and open canopied forests comprised of various associations of white spruce, black spruce, quaking aspen, white birch, balsam poplar, and tamarack trees. The treeline is at 1,000 ft or less along the lower Yukon, at 2,000 ft on southern slopes of the Brooks Range and northern slopes of the Alaska Range, and at 2,000 to 3,500 ft along the Alaska-Yukon border. Low and tall shrub communities comprised primarily of willow, alder, and shrub birch occur on floodplains, lowland boggy areas, and mountain slopes in both regions. Aquatic herbaceous communities are prevalent in lake-dotted wet tundra areas.

The variety of habitats in the Western and Interior regions support harvestable populations of caribou, moose, Dall sheep, brown and black bears, furbearers, waterfowl, small game such as ptarmigan and grouse, Pacific walrus, ringed, spotted, and bearded seal, belukha whale, and a wide variety of fish, including salmon, whitefish, northern pike, arctic grayling, char, herring, and Pacific halibut, to name a few.

Human Activities in the Regions

Many human activities in the Western and Interior regions revolve around the subsistence, recreational, and commercial uses of fish and wildlife. Commercial fishing, trapping, reindeer herding, guided hunting and fishing trips, fur tanning and sewing, and seafood processing are important segments of the local economics.

Service-related businesses and government provide the primary sources of wage employment in both regions. Fairbanks, McGrath, and Bethel are the employment centers of the area.

Marine Mammals

Belukha Whale Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

Information is organized and presented for the entire Western Region rather than by game management unit (GMU) because the data are not available by GMU.

A. Regional Distribution

Belukhas in Alaska comprise two stocks: the Gulf of Alaska stock and the Bering-Chukchi stock. Only whales of the latter stock occur in the Western Region (Seaman and Burns 1981).

Belukhas are present from spring through autumn along the coast from northern Kuskokwim Bay to the mouths of the Yukon River (ibid.). The earliest reported sighting along the coast was on 20 May 1978 near Cape Romanzoff; the latest was in mid November at Hooper Bay; and the largest was of over 100 whales in July 1981 off the mouths of the Yukon River (Frost et al. 1982). "Belukhas are often sighted and occasionally hunted by residents of Kipnuk, Toksook Bay, Tanunak, and Hooper Bay, where they are apparently more common in spring and autumn than in mid summer" (Seaman and Burns 1981). In recent years, belukhas have only occasionally been seen in Kuskokwim Bay, primarily near Quinhagak in summer (Frost et al. 1982). Although belukhas are present around Nunivak Island in the ice-free months, seasonal use patterns are unclear.

As the abundance of schooling fishes declines in coastal areas in autumn, most belukhas move offshore. Depending on the extent of the winter ice, much of the Bering-Chukchi stock of belukhas winters in the Western Region in the ice fringe (Harrison and Hall 1978, Seaman and Burns 1981). In March and April, belukhas are widely distributed as they begin to move coastward or north in shore leads.

B. Areas Used Seasonally and for Life Functions

For more specific distribution information, see the printed 1:1,000,000-scale Atlas that accompanies the Alaska Habitat Management Guide for the Interior and Western regions and the 1:250,000-scale reference maps located in ADF&G area offices. The following categories have been used to describe belukha distribution:

- Known movements associated with feeding
- Known major concentration areas

C. Factors Affecting Distribution

Although belukhas have occasionally been recorded outside their present range, there is no evidence that belukhas were ever abundant south of it (Lowry 1985). Predation by sharks (Chondrichthyes) and killer whales (*Orcinus orca*) and competition for food may be important factors in determining their southern limit (Sergeant 1978). Distribution of belukhas in Alaska is probably most affected by sea ice conditions and the distribution of prey (Lowry 1985). (For more details, see the belukha whale Life History and Habitat Requirements narrative.)

D. Movements Between Areas

See section A. above.

E. Population Size Estimation

Although records of belukha sightings are numerous, no comprehensive surveys have been undertaken to estimate the abundance of the Bering-Chukchi stock. Population estimation is complicated by the whales' large and seasonally variable range, the unknown degree of interchange of animals between summering areas, the dark and therefore inconspicuous color of juveniles, and the belukhas' habitat, which is usually either among ice floes or in turbid estuarine areas (ibid.). Most reliable estimates are from aerial surveys with assumed correction factors for unseen animals (Lowry et al. 1982). Current population estimates assume a limited interchange of animals between summering areas (Lowry 1985). Although some belukhas are thought to summer along the ice edge, little information is available with which to estimate their numbers; consequently, current population estimates can be considered conservative (ibid.).

F. Regional Abundance

Belukhas of the Bering-Chukchi stock migrate in and out of the Western Region at an unknown rate; a population estimate for the Western Region, therefore, is not possible or sensible. The minimum number of belukhas in the Bering-Chukchi stock is estimated to be 15,000 to 18,000 animals (Lowry 1985). Burns and Seaman (1985) estimate the western arctic belukha population, including animals in Soviet waters, to be in excess of 25,000 animals.

G. Historic Abundance

No estimates of former population abundance were found, although in the early to mid 1900's belukhas were reportedly more common near Quinhagak, Goodnews Bay, and Jacksmith Bay than they are now (Frost et al. 1982). Harvests were estimated to have been higher then also (Lowry 1985). It seems unlikely that population numbers have changed much from historic levels.

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Bowhead Whale Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

Bowheads in Alaska belong to the Western Arctic stock, which occurs in the Bering, Chukchi, and Beaufort seas. Information is presented for the entire western arctic stock rather than by game management unit because of the data available. For a more complete account of bowhead whale distribution and abundance, see that narrative in volume 2 of the Alaska Habitat Management Guide for the Arctic Region.

A. Regional Distribution

Bowheads probably occur in the Western Region only in winter (December-February). Most of the western arctic stock is thought to winter in polynyas south and west of St. Lawrence and St. Matthew islands and in the ice front, which, in years of extensive ice coverage, may extend as far south as the Pribilof Islands area (Braham et al. 1980, Brueggeman 1982). A portion of the population winters west of St. Lawrence Island in the Gulf of Anadyr, but the number is unknown.

Although some bowheads remained in the Bering Sea during ice-free months as late as the late 1800's and early 1900's, recent surveys indicate that few, if any, do so now (Bockstoce and Botkin 1980, Dahlheim et al. 1980).

B. Areas Used Seasonally and for Life Functions

No maps have been produced for bowhead whales in the Western Region because data are insufficient.

C. Factors Affecting Distribution

Bowhead whales apparently migrate in response to changes in ice conditions, moving north (out of the Western Region and into the Arctic Region) as leads open in the spring and south before freeze-up (Lowry et al. 1978, Ljungblad et al. 1985). Distribution of prey may determine whale distribution in summer (Wursig 1985). Although bowhead behavior and distribution have been shown to change in response to various types of human-caused disturbance (Reeves et al. 1984, Richardson et al. 1985), there is now very little human-caused disturbance in the Western Region; it is therefore probably not an important factor affecting <u>current</u> bowhead distribution in that region. (See the Impacts of Land and Water Use volume of this series for additional information regarding impacts.) When whaling began in the Bering sea in the mid 1800's, at least some bowheads summered in the Bering Sea; whalers then took more and more whales, and now most of the remaining population summers in the Canadian Beaufort Sea (Bockstoce and Botkin 1980). Nearly a century after the last major whaling efforts, the distribution of bowhead whales continues to be affected by historical whaling patterns (ibid). (For more information, see the bowhead whale Life History and Habitat Requirements narrative in volume 1.)

D. Movements Between Areas

Factors affecting movements between winter and summer areas are not known, but distributions of ice and food probably have some influence. In spring, bowheads move through the Strait of Anadyr and past the west end of St. Lawrence Island; some travel close to shore, and another group migrates farther offshore (Braham et al. 1980). A few whales pass around the east end of the island, although this does not appear to be as important a migration route (ibid.). Migration may occur in three or four waves segregated by age and sex, with younger individuals in the first waves and large males and females with calves in the last waves (ibid.). Waves may also be a result of the periodic opening and closing of the migration pathway (the ice leads)(Braham and Krogman 1977, Ljungblad et al. 1985). (See the bowhead whale Life History and Habitat Requirements narrative in volume 1 for more information, including autumn migration.)

E. Population Size Estimation

Estimates of present abundance of bowheads are based on counts of animals passing Point Barrow during spring migration. Counts have been conducted since 1978 on the shore-fast ice near Barrow. The technique assumes 1) that most of the population passes Point Barrow during the observation period; 2) that most of the whales passing the observation post are seen, recorded accurately, and not duplicated; and 3) that the number of whales passing the post during periods of poor visibility can be estimated accurately from the number of animals passing just before and after that period (Braham 1982, Krogman 1982, Zeh et al. 1985). Censusing procedures are continually being refined and assumptions tested to increase the accuracy of the estimates (ibid.).

F. Regional Abundance

Bowheads of the western arctic stock migrate in and out of the Western Region, and the proportion of the population in the region at any given time is not known; therefore, a population estimate for the Western Region alone is not possible. The current best estimate of bowhead numbers in the western arctic stock is 4,417 (95% Confidence Interval 2,613-6,221) (IWC in press). The estimated number of bowhead whales has increased since 1978, most likely due to increased census effort and improved techniques. The western arctic stock is probably increasing, but current information does not allow calculation of the rate of increase (Breiwick et al. 1984). The western arctic stock is the largest remaining stock of bowheads in the world (Braham 1982).

G. Historic Abundance

Breiwick et al. (1984), using estimates of removals, the range of estimates for the current population, mortality rates of 0.04-0.08, and recruitment rates of 0.01-0.05, estimated the western arctic bowhead stock to have been 14,000 to 26,000 whales before commercial whaling began in 1848. Commercial whalers killed approximately 19,000 to 21,000 whales during the period 1848-1915 (Bockstoce and Botkin 1980). Eberhardt and Breiwick (1980) estimated that the minimum population size, which occurred in about 1912, was not less than 600 whales.

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Pacific Walrus Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

Data are presented for the whole population of Pacific walrus rather than by game management unit (GMU) or region, because of the available information.

A. Regional Distribution

During winter, Pacific walruses are concentrated in two main breeding areas of the Bering Sea, one southwest of St. Lawrence Island and the other in northern Bristol Bay and outer Kuskokwim Bay (Fay 1982, Fay et al. 1984). From late March to June, as the pack ice recedes, the population divides into summering groups. Groups consisting almost entirely of males move into the Bristol Bay area, northern Alaska Peninsula, St. Matthew, Hall, Punuk, and Diomede islands, and several haulouts in Anadyr Gulf (ibid.). Other groups, consisting mostly of adult females, immature animals, and a few adult males move northward into the Chukchi Sea, where they summer along the southern edge of the ice near the Siberian and Alaskan coasts and occasionally as far north as 75° N. In October and November, the northern summering groups swim southward, usually ahead of the advancing ice, joining adult males moving north to terrestrial haulouts in the Bering Strait region (ibid.). By December and January, walruses again concentrate in the two main breeding areas (ibid.). (See section D. Movements Between Areas for more details.)

B. Areas Used Seasonally and for Life Functions

For more information concerning seasonal and life function use areas, see the 1:250,000-scale reference maps, located in ADF&G area offices, and the 1:1,000,000-scale maps in the Atlas to the guide for the Western and Interior regions. The following categories have been used to describe walrus distribution:

- Known haulout concentration areas
- Known migration patterns

C. Factors Affecting Distribution

In Alaska, two main factors affecting the distribution of walruses are water depth and the characteristics of sea ice (Lowry 1985). Walruses are primarily benthic feeders and, in the Bering-Chukchi region, seldom remain in water too deep for efficient feeding; they are rarely seen in water deeper than 100 m (ibid.). When the summer pack ice edge is over the deep water of the continental slope and the sea bed is not accessible to the benthic-feeding walruses, many animals may use terrestrial haulouts such as Cape Lisburne and Wrangel Island (Fay 1982). During much of the year, walruses are found in association with sea ice but are generally not found in areas where thick ice covers more than 80% of the sea surface (ibid.). The distribution of Pacific walruses has changed as their numbers have changed in response to exploitation and recovery (table 1, Fay et al. 1984). Disturbance by humans can affect distribution: increased vehicle traffic has apparently caused abandonment of a traditional terrestrial haulout in the Gulf of Anadyr (ibid.); the Pribilof Islands haulout areas have never been reoccupied following extirpation of the walrus herds by commercial hunters; and King Island, although not used as a haulout when the village on the island was inhabited, was used by thousands of walruses in summer (Frost et al. 1982) until increasing disturbance caused them to again abandon the island (Nelson, pers. comm.). (See the Life History and Habitat Requirements narrative in volume 1 of the guide for the Arctic Region for more information.)

D. Movements Between Areas

Fay's (1982, Fay et al. 1984) summarizations of walrus distribution by month are the basis of the following section.

1. January. Because of the lack of daylight and storms, few data are available for this month except from inhabitants of Diomede, St. Lawrence, and Nunivak islands and from an aerial survey of the Bristol Bay area. Most of the reported walruses from near the islands are subadult and adult males; the location of females and young is not known for this month but is assumed to be similar to that of February.
2. February. From aerial surveys and icebreaker cruises, it appears that animals are regularly clumped in two main areas, from the St. Lawrence polynya southward and in the area south of Nunivak Island and Kuskokwim Bay. Adult males and females, subadults, and young are found in these groups; the adult ratio is about 1 male to 10 females in areas where breeding activity has been observed.
3. March. Early in March, distribution is similar to that of February, with the main breeding herds still in place. Some animals begin the northward migration by the end of the month in some years, depending on ice conditions. Fay and Lowry (1981) found that although breeding activity continued south of Kuskokwim Bay, over 700 males had moved south into Bristol Bay in March, a large increase over the two months before. Small groups of subadult males were found nearer the southern edge of the pack ice.
4. April. Although two main groups are still distinguishable in April, the northward migration is clearly underway, and the two groups appear to spread and merge to a greater extent. Animals wintering near St. Lawrence begin to move north by the thousands through Anadyr Strait, between Gambell and Cape Chaplin, and females and young from the southern group move north around Nunivak Island. Adult and subadult males, presumably from the southern wintering group, congregate at terrestrial haulouts in the Bristol Bay area.
5. May. Females and young from the St. Lawrence wintering group continue passing through Bering Strait and appear to concen-

Table 1. Use by Walruses of Haulout Areas on Alaskan Shores of the Northern Bering Sea and Chukchi Sea in the Present Century

Haulout	1920's	1930's	1940's	1950's	1960's	1970-80's
Egg Is.	Unk.	Unk.	Unk.	None	None	Irreg.
Besboro Is.	Unk.	Unk.	Unk.	None	Irreg.	Irreg.
Cape Darby	Unk.	Unk.	Unk.	Unk.	None	Irreg.
Sledge Is.	Irreg.	Irreg.	None	None	None	Irreg.
Punuk Is. (summer)	Irreg.	Irreg.	Irreg.	Irreg.	None	Reg.
(fall)	None	Irreg.	Irreg.	Reg.	Reg.	Reg.
St. Lawrence Is. Kialegak Pt.	None	None	None	None	None	Irreg.
N.E. Cape	None	None	None	None	None	Irreg.
Salghat	Irreg.	Irreg.	None	None	None	Irreg.
C. Chibukak	Irreg.	Irreg.	None	Irreg.	Reg.	Reg.
King Is.	Unk.	Unk.	Unk.	None	None	Irreg.
Little Diomede	Unk.	Irreg.	None	None	Reg.	Reg.
Cape Thompson	Unk.	Irreg.	Unk.	None	None	None
Pt. Hope	Unk.	Irreg.	Unk.	None	None	None
Cape Lisburne	Unk.	Irreg.	Irreg.	None	None	Irreg.

Source: Fay et al. 1984.

trate along the Alaskan Chukchi Sea coast, although data from the Siberian coast are lacking. Males move only as far as Anadyr Gulf and the Chirikof Basin, where they congregate on the remaining ice long after the females and young have passed. Females from the southern wintering group are still moving up the eastern side of the Bering Sea to eastern St. Lawrence Island and Norton Sound. Males still occupy haulouts in the Bristol Bay area; another smaller group of males reoccupied the St. Matthew-Hall islands area in 1980, apparently for the first time in about 50 years.

6. June. Most females, young, and a few subadult and adult males have moved through Bering Strait by the end of June. Animals remaining behind are mainly adult males that summer principally in Anadyr Gulf, Bristol Bay (mainly in the Walrus Islands), eastern Navarin Basin (St. Matthew and Hall islands), and the Bering Strait area (the Punuk Islands). Walruses haul out intermittently on these islands during the summer between long feeding excursions that take them far out to sea (Fay, pers. comm.). Again, the concentration of sightings only along the Alaskan Chukchi coast may be due to a shortage of data from Soviet waters.
7. July-September. Virtually all female and young walruses are in the Chukchi Sea by July and remain there until October, separating into two main summering groups, one from about 170°W to the vicinity of Point Barrow, and the other along the northern coast of Chukotka to Long Strait and Wrangel Island. Although many of the animals as far west as Inchoun and Kolyuchin Bay are males, animals farther west and north are mostly females and young. Animals remaining in the Bering Sea and Bristol Bay are virtually all males.
8. October. Nearly all the animals summering in both the eastern and western Chukchi Sea converge on the northern coast of Chukotka in October before moving southeastward into Bering Strait ahead of the pack ice. The number of males in Bristol Bay declines and the number on the Punuk Islands increases as males summering in the Bering Sea move northward to meet the southward-moving females and young.
9. November. Overall walrus distribution in November is not well known, but thousands of walruses continue to haul out on the Punuk Islands until late November in most years.
10. December. Very little is known of walrus distribution in December. One cruise found walruses associated with the ice edge in the Bering Strait-Anadyr Gulf area; females and young were primarily along the coast, whereas adult males were found only in the strait between Cape Chaplin and St. Lawrence Island.

E. Population Size Estimation

Lowry (1985) reports:

Estimation of the actual abundance of walruses is complicated by many factors. The best method presently available is extrapolation of numbers counted from aircraft flown along transects over walrus range. Problems encountered include inaccuracies in the counts by observers, the vast size of the area to be covered, the unknown number of animals which are below the surface and therefore not counted, and the tendency of walruses to be clumped rather than randomly or uniformly distributed. The problems can, in part, be overcome by taking aerial photographs of large groups, organizing surveys properly in relation to known walrus behavior and distribution, and using statistical techniques for survey design and analysis . . . . Aerial surveys can and have provided reasonable estimates of abundance and clear indications of trends in numbers.

Soviet surveys have resulted in generally lower estimates than United States surveys. In Soviet surveys, walruses were counted or photographed along the Siberian coast, and a correction factor was added for walruses at sea and in American waters. About 60% of their estimate was based on actual counts from photographs of large herds on the ice and on terrestrial hauling grounds (Fay et al. 1984). Although statistical confidence limits are not available for Soviet estimates, techniques remained virtually unchanged through 1980, allowing more direct comparison of results from different years.

American estimates are based on strip surveys, which result in large variability and wide confidence limits. Techniques have changed over the years; some of the increase in population estimates may be due to change in coverage and refinement of technique.

F. Regional Abundance

The Pacific walrus population is being considered as a whole; regional abundance will be discussed in section II. A. Present Abundance.

II. PACIFIC WALRUS POPULATION

A. Present Abundance

Estimates of walrus abundance have changed drastically over the last 15 years, reflecting rapid growth of the population. The population was estimated at 101,000 in 1970 and at 136,000 in 1972 (Lowry 1985). Combined results of Soviet and American surveys in 1975 resulted in a mean estimate of 232,000 (Fay et al. 1984). Preliminary data from a coordinated Soviet-American survey conducted in September 1980 indicate that the population then numbered 246,000 walruses (Lowry, pers. comm.). Interpretation of survey data and population estimates are currently being reexamined by statistical experts, and new figures may be available soon (Lowry, pers. comm.).

Fay et al. (1984) report:

Since the late 1970's, the walruses have shown distinct signs of decreased fertility, highly variable fecundity, poor recruitment, declining physical condition, change in feeding habits, increase in average age, and increased natural mortality, all of which are characteristic of stabilization or decline (Eberhardt and Siniff 1977). We think that the population already reached its peak in the late 1970's and that it is on the way down again at this time. That its decline already has begun is suggested by the somewhat larger cohorts of young since the nadir in 1980, by the Eskimos' reports of increasing fatness, and by an apparently declining annual mortality on the Punuk Islands. We think that the population will continue to decline for some years, because the recruitment still is very low, the catches on both sides of the Bering Sea are still going up, and many of the adults are nearing the end of their natural life span. The fecundity rate probably will continue to decrease for some years yet, for the majority of females are well past their prime and capable only of producing less, not more, each year. But calf survival probably will rise markedly and soon result in substantial increases in recruitment. Meanwhile, the population will continue in a downward trend until the new recruits are abundant enough to produce cohorts sufficiently large to counterbalance the high mortality.

B. Historic Distribution and Abundance

The Pacific walrus population before the arrival of Europeans in the Bering Sea must have comprised at least 200,000 animals to have withstood the harvests that followed (Fay 1957). By the mid nineteenth century, the large herds of bull walruses that summered in Bristol Bay and about the Pribilof Islands were nearly extirpated by hunters for the Russian-American Company; herds on the ice to the north were probably little affected (ibid.). From 1848 through 1880, Yankee whalers took more and more walruses as whale populations declined until 1880, when the walrus population was reduced to about half its former size (Nelson and True 1887). Yankee whalers directed their hunting mainly toward females and young in the pack ice north of Bering Strait; hence their harvest was much more depletive than that of the Russians. Whalers continued to harvest walruses, although at a reduced rate, until about 1914, when the world market for walrus products collapsed (Fay et al. 1984). Walruses continued to be harvested by Natives of both Alaska and Siberia and by "arctic traders" who again virtually extirpated the southern herds of summering males in the Bering Sea, reducing the population still further. Walrus numbers increased to an estimated 250,000 by 1931 (Kibal'chich and Borodin 1982). The poorly regulated Soviet harvest from 1931 through 1956 again resulted in depletion of the walrus herds. Based on harvest levels, the population may have reached its lowest historical level in the mid 1950's (Fay 1982). Kleinenberg (1957) noted that of 33 former coastal concentration areas on the Chukchi Peninsula, only 3 remained in 1954. The population in 1960 was estimated at 70,000-100,000 (Fay 1982). Soviet walrus harvest from government-operated vessels was halted in 1962. The population has probably been increasing fairly steadily since the early 1960's.

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Polar Bear Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

The information is organized and presented for the Western Alaska subpopulation rather than by game management unit or region. Based on tagging study results, morphometrics, and tissue contaminant levels, Lentfer (1974, 1976) concluded that polar bears in Alaska belong to two at least partially discrete subpopulations, with the dividing line extending northwest from about Point Lay. Amstrup (pers. comm.), basing his conclusion on results of radio-tracking studies and several more years of tagging data, agrees that there are two populations but feels the placement of a dividing line is still uncertain.

A. Regional Distribution

Only bears from the western subpopulation occur in the Western Region. This subpopulation probably ranges from west of Barrow to Wrangel Island, although its distribution and degree of interchange with bear populations in Soviet waters is not well known (Lentfer 1983, Amstrup 1984). In winter, they regularly range as far as St. Lawrence Island and farther south, depending on the extent of the ice (Fay 1974). In winter, they range throughout the pack ice fringe and flaw zone; and during heavy ice years, when pack ice moves far south of its average winter extent, polar bears have been seen near Nunivak and the Pribilof islands (Lentfer 1982; Patten, pers. comm). During the ice-free season, polar bears are extremely rare in the Western Region, although they are occasionally seen. From 11 July through early August 1984, Patten (pers. comm.) reported that five to seven polar bears, including a female and cub, a three-year-old, and at least one "large bear" were seen along the coast from Kotlik to Newtok. Patten (pers. comm.) reported that three bears were seen in summer near Hazen Bay on the Naskonat Peninsula from 1978 through 1983 and that, during winters in the 1930's, polar bears were common near Nunivak Island.

B. Areas Used Seasonally and For Life Functions

For more information concerning seasonal and life function use areas, see the 1:250,000-scale reference maps, located in ADF&G area offices, and the printed 1:1,000,000-scale Atlas of the Alaska Habitat Management Guide for the Western and Interior regions. The following category has been used to describe polar bear distribution:

- General distribution

C. Factors Affecting Distribution

The distribution and types of ice affect the ability of polar bears to hunt, the availability of seals, and the movements of bears (Lentfer 1972). Changes in ocean currents and climate affect sea ice (Vibe 1967) and therefore the distribution of bears

(Lentfer 1972). Polar bear seasonal and life function use areas are primarily determined by sea ice characteristics in conjunction with ringed seal populations. (See the polar bear Life History and Habitat Requirements narrative in volume 1, and the Sea Ice narrative in volume 2 of the Alaska Habitat Management Guide for the Arctic Region for more information.)

Stirling (1974) stated:

> When possible, polar bears remain with the ice because of the greater accessibility of seals there. With the exception of females giving birth to cubs, polar bears do not den for the winter as do grizzly or black bears. Thus, they feed throughout the year and must, if possible, remain on ice near their food source.

Sex, age, reproductive status, suitable denning habitat, human hunting pressure, and habitat alteration all may affect polar bear distribution (Lentfer 1982, 1983). (See the polar bear Life History and Habitat Requirements narrative in volume 1 of the Alaska Habitat Management Guide for the Western and Interior regions for more detailed information.)

D. Movements Between Areas

Although previous mark-and-recapture studies yielded data on fidelity to particular areas in spring, the degree of intermixing between populations, and several population estimates, they did not give much information on seasonal movements and migration patterns; ongoing radio-tracking research should provide a clearer picture (Lentfer 1983, Amstrup 1984). Lentfer (1972) described autumn polar bear movements in Alaska:

> Polar bears generally first appear along Alaska's north coast in October, when shore-fast ice enables them to travel from drifting pack ice to the beach. The first bear sightings are reported to the east of Point Barrow and then to the southwest in the same sequence that fast ice forms. Eskimos indicate that polar bears travel from north to south in the fall, along the coast between Point Barrow and Cape Lisburne. Considering the two most productive bear hunting areas along this section of coast, bears are first taken by Eskimos in the northernmost Point Franklin area and then in the Icy Cape area to the south. Eskimos also report that, traditionally, bears are more numerous along the coast in years when winds from the north and west bring old ice to the coast than in years when newly frozen ice drifts in. Bailey and Hendee (1926) verify this and report that in the fall of 1921, old ice failed to come in and new ice formed for miles out from the shore. Consequently, few polar bears were killed between Barrow and Point Hope. In the fall of 1967, ADF&G personnel observed that winds brought more heavy ice than usual, and there were more bears along the coast than usual.

Bears of the western Alaska subpopulation range from west of Barrow to the southern edge of the seasonal ice (Lentfer 1982). Polar bear distribution is poorly known between breakup and freeze-up, but bears probably remain near the edge of the pack ice and not in the Western Region (Lentfer 1972, Stirling 1974). Mark-and-recapture studies from 1967 through 1976 indicate limited interchange between Alaska and the northwest mainland coast of Canada but not between Alaska and the rest of Canada, Greenland, or Svalbard (Lentfer 1983). Recovery of marked animals indicates some tendency for the same bears to occur in the same general area in late winter and early spring each year (ibid.). The rate of movement and distances travelled between marking and recovery sites, as well as the proportion of animals that move to a different area, are not significantly different for males and females or adults and subadults (ibid.). Recoveries indicate that a few marked bears have moved between Alaska and Siberia, but more work needs to be done in this area (Lentfer 1983, Amstrup 1984).

E. Population Size Estimation

Four principal sources of information have been used to derive population estimates for Alaskan polar bears: 1) multi-year mark-and-recapture data from 1967 through 1976 and from 1980 to the present; 2) single-season mark-and-recapture estimates that are available for several years; 3) catch-and-effort records from aerial trophy hunting; and 4) catch, effort, and aerial observation records kept in conjunction with mark-and-recapture work (Amstrup 1984).

Tovey and Scott (1958) were the first to report an estimate of the Alaskan polar bear population. Their estimate was based on the number of bears seen in the number of hours of aerial hunting time reported by aerial trophy hunters in 1956 and 1957, assuming an average flying speed and observation track width. Other estimates based on similar catch/effort data share the same potential biases (Amstrup et al. in press); all bears within the assumed 1/4 mi track width may not have been seen; search was not random in that both biologists and trophy hunters tended to concentrate search time in areas known to have high densities of bears; and much of the flying time recorded was spent following bear tracks, yielding higher encounter rates than random searches (ibid.). In spring, when most hunting and tagging studies were done, bears may be segregated by age, sex, and reproductive status; no effort was made to sample all segments of the population (ibid.).

Although estimates based on mark-and-recapture techniques provide probably the best population estimates of polar bears in Alaska, many of the assumptions for statistical treatment of the data are violated (Amstrup et al. in press, DeMaster et al. 1980). Annual rates of mortality for various age classes are not well known; bear movements and the area to which population estimates apply are not well understood; therefore, random mixing and equal probability of being marked cannot be assumed. Annual sample sizes have been small and variable, and variances of resulting estimates are large (Amstrup et al. in press).

F. Regional Abundance

See sections II.A. and III.A., below.

II. WESTERN ALASKA SUBPOPULATION

A. Present Abundance

Hearings on a proposal to waive the moratorium on taking polar bears imposed by the MMPA resulted in several estimates of the size of Alaskan polar bear populations. The conservative estimate finally adopted was 5,700, with approximately one-third of these in the northern stock and two-thirds (3,800) in the western stock (Schreiner 1979). Amstrup (1984), from earlier work by Eley (1976) and Amstrup (1981), calculated density figures of 70 km^2 per bear sighted in 1976 and 113 km^2 per bear sighted in 1981. Although many of the bears of the western subpopulation range into the Bering and southern Chukchi seas, most do not reside in those areas year-round and go north with the ice as it recedes in the spring. The amount of interchange with Soviet populations and the importance of the Wrangel Island core denning area to the population are not known (ibid.). Although it is possible to say that polar bears occur seasonally in the Chukchi Sea at densities at least comparable to those estimated for the Beaufort Sea, data are too few to give a more accurate estimate for the subpopulation than the one given in Schreiner (1979). Although Amstrup (1984) does not refer specifically to the western subpopulation, he states that the polar bear population in Alaska is about the same size as it was in the late 1950's and is generally stable.

B. Historic Distribution and Abundance

Elliott (1898) noted that the last polar bear seen on St. Paul, Pribilof Islands, was killed in 1848. He visited St. Matthew Island in August 1874 and reported 250-300 very fat healthy bears on the island, including females, males, and cubs (ibid.). Townsend (1887) found four polar bears on Hall Island (just off St. Matthew Island) in September 1885; his party shot one. Hanna (1920) visited St. Matthew Island and reported as follows:

> Captain Lane told me that bears were found up until sometime in the 90's when a party from the revenue cutter Corwin landed and shot 16. The old trails Elliott mentions are still plainly seen, worn deep into the tundra. Skulls of several animals were found, all with bullet holes in them, and two were preserved. Very probably a few bears still come down in winter on the ice pack but they have been hunted so much of late years that they can not be common.

The southern edge of the pack ice usually extends to or past St. Matthew Island, and recent sightings show that polar bears probably occur regularly on and around St. Matthew and Hall islands: military personnel saw four in 1943; Burns saw one in March 1976; and Schliebe, on a cruise in March 1984, saw 30 between St. Matthew and St. Lawrence islands (Schliebe 1983; Schliebe, pers. comm.). Recent summer expeditions to the island report no resident summer population of polar bears, although bones, trails, and dens can still be seen (ibid.).

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Terrestrial Mammals

Brown Bear Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

The following information will be presented on a regionwide basis, with area-specific information noted where available. Seven game management units (GMUs) are contained within the Western and Interior regions: GMUs 12, 18, 19, 20, 21, 24, and 25 (map 1).

A. Regional Distribution

Brown bears (Ursus arctos) occur throughout the Western and Interior regions. The highest densities occur in the mountains, foothills, and mountain valleys, while lower densities are found in the forested lowlands (ADF&G 1977). In the Yukon-Kuskokwim delta, brown bears occur in extremely low densities.

B. Areas Used Seasonally and for Life Functions

For information concerning areas used seasonally for specific life functions, see the 1:250,000-scale Reference Maps, available in ADF&G area offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions. Map categories for brown bear are as follows:

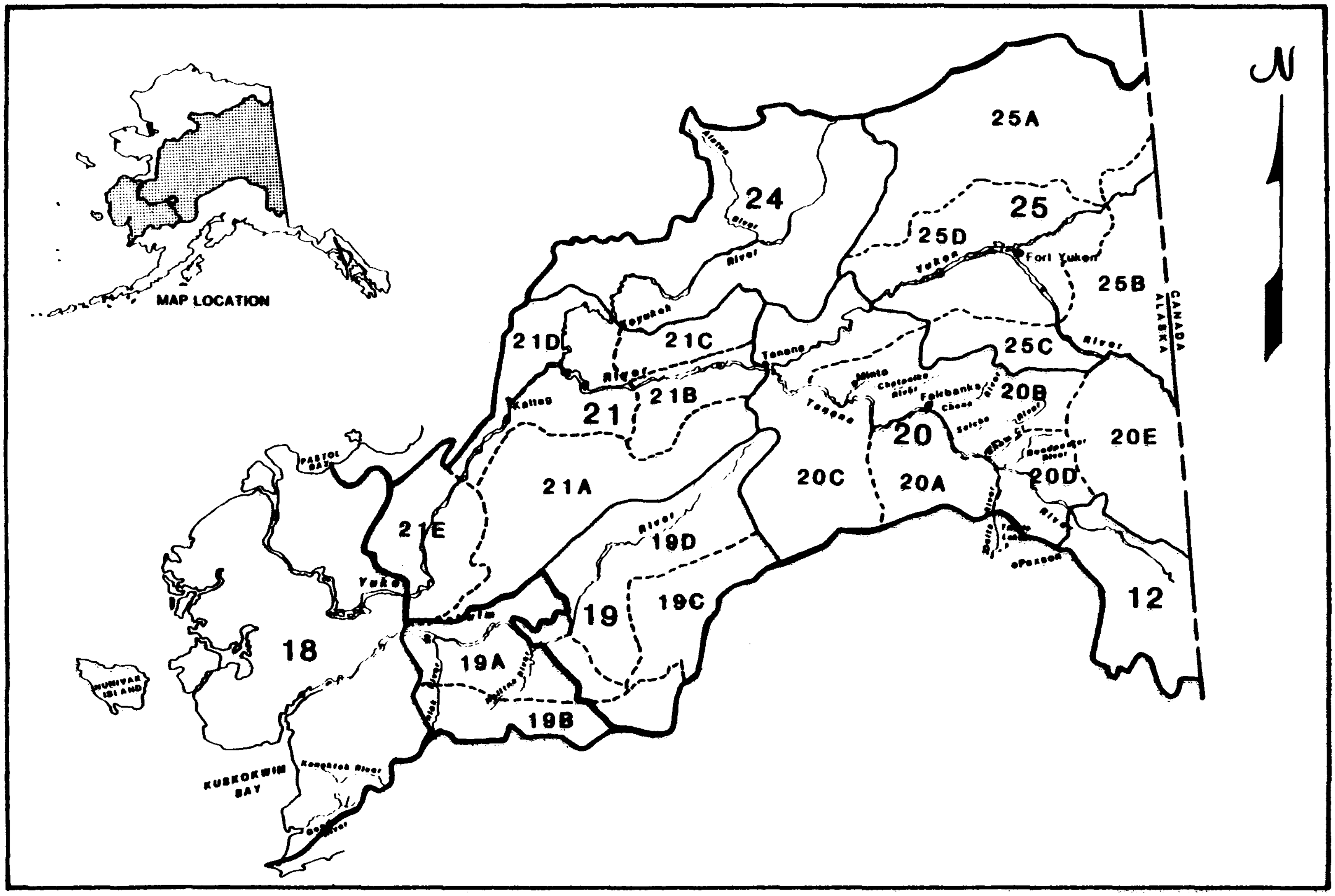
- General distribution
- Known spring concentration areas
- Known concentrations along fish streams
- Known concentrations in berry areas
- Known concentrations associated with mammalian food sources
- Known denning concentration areas

C. Factors Affecting Densities

The density of brown bears may vary seasonally in any one locality, depending upon available food sources (ibid.). Brown bear populations in GMU 18 are much more dependent on salmon than in the other GMUs in the Interior and Western regions. GMU 18 populations are probably more similar to GMU 17 populations than to GMU 19 or GMU 21 populations (Machida, pers. comm.). Human harvest of brown bears can affect the densities of brown bears, especially on a local scale (Reynolds 1984). In the Brooks Range, cub deaths caused by adult males has been documented; however, the affect of these deaths upon overall bear density is not known at this time (Reynolds 1976, 1980; Reynolds and Hechtel 1982). Ongoing research in the northcentral Alaska Range may provide additional information pertaining to cub mortality in that part of the Interior Region (Reynolds and Hechtel 1984).

D. Movements and Home Ranges

Studies underway in the northcentral Alaska Range indicate that home range sizes vary by sex and age of bears. Home ranges of males were large and included variable habitat from glacial moraine to the muskeg of the Tanana flats and traversed several river drainages. Females with young had relatively small home ranges that tended to be confined to a single river drainage.



Map 1. GMUs of the Western and Interior regions.

Frequently, these females were observed close to escape cover, possibly reflecting the propensity for adult males to stalk and kill offspring of adult females (Reynolds 1980; Reynolds and Hechtel 1982, 1984). Subadult female home ranges were variable, and subadult male home ranges were small compared to adult males. Additional data will have to be collected, however, before these data can be compared with home ranges from other areas (Reynolds and Hechtel 1984).

E. Population Size Estimation

A satisfactory method for determining brown bear densities in the Western and Interior regions has yet to be developed and tested. In their studies of brown bears in the northcentral Alaska Range, Reynolds and Hechtel (1984) made a tentative population estimate based on the direct count method (Reynolds 1974, 1976; Pearson 1976). This method is best employed in areas that are treeless and requires at least two years of intensive study to achieve meaningful results (Reynolds and Hechtel 1984). Miller and Ballard (1982) developed a density and biomass estimate for brown bears in the upper Susitna River in the Southcentral Region using a Peterson (mark-recapture) Index (Ricker 1975) corrected for biases. Corrections were for female bears with new-born cubs because they were less likely to be captured (marked) and therefore were underestimated in the population. The ADF&G, Division of Game, is currently developing additional studies to attempt to determine brown bear densities and population estimates.

F. Regional Abundance

Presently, few data are available describing the densities of brown bears in the Western and Interior regions.

1. GMU 12. Based on data from a study in another part of the Alaska Range, the GMU 12 bear density is probably 1 bear/39-52 km². Given these densities, the GMU 12 brown bear population is estimated at 430-570 bears (Kelleyhouse 1984).
2. GMU 18. GMU 18 contains approximately 11,000 mi² of fair-to-excellent brown bear habitat. Approximately 5,000 mi² of this habitat is in the Andreafsky and Chuilnak mountains and 6,000 mi² in the Kilbuck Mountains. Based on density estimates derived from research conducted in the western arctic, interior Alaska, and the Alaska Peninsula in habitats similar to GMU 18, the overall density of bears in these two areas is believed to lie between 1 bear/41 km² and 1 bear/91 km². Based on these density estimates, GMU 18 contains 300-700 brown bears. The population overall appears to be moderate in density and stable in number (Machida 1984).
3. GMU 19. From discussions with hunters and guides and personal observations, Pegau (1984) believes the brown bear population to be relatively low in the mostly timbered GMSs 19A and 19D. The population appears to be moderate in GMS 19C and increasing slightly in GMS 19B.

4. GMU 20. Casual observations and other indices suggest that in most of GMU 20 the brown bear population is moderate in size and stable (Jennings 1984). Reynolds and Hechtel (1984) tentatively have estimated the density of brown bears in their 3,400 km^2 study area in the northcentral Alaska Range (in GMS 20A) to be between 1 bear/53 km^2 and 1 bear/35 km^2. The minimum density is an underestimate because it does not include unmarked bears in the area that were not killed by hunters or observed during the study. Based on home ranges and the distribution of marked bears, they believe the available habitat may support an additional 18-38 bears. They therefore believe the density is similar to the density of 1 bear/41 km^2 reported by Miller and Ballard (1982) south of the Alaska Range in the upper Susitna River.

5. GMU 21. Field observations, nuisance reports, hunter sightings, and pilot observations indicate that the brown bear population in GMU 21 is of moderate density and apparently stable (Osborne 1984). The average density of brown bears in GMUs 24, 25, and 26 (GMU 26 is in the Arctic Region) is about 1 bear/259 km^2 (ranging from 1 bear/44 to 777 km^2). In GMU 24, the populations are probably stable or increasing. In GMU 25, numbers are probably increasing (Reynolds 1984).

G. Historic Densities

Little historic information is available concerning brown bear densities in the Western and Interior regions. Overall, brown bears appear to be as numerous as they have been in the past (ADF&G 1977).

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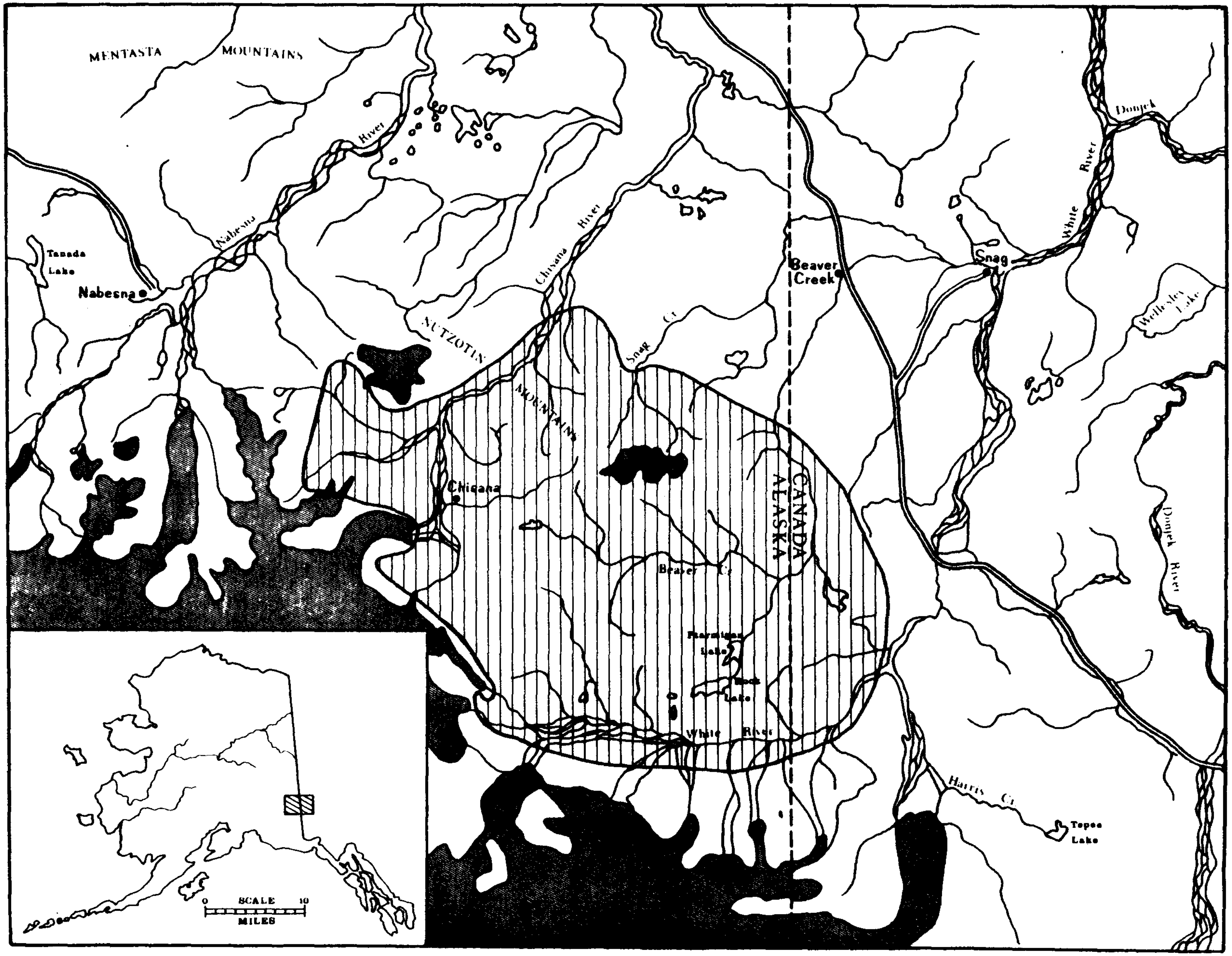
Caribou Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

Information will be organized and presented by individual caribou herds, because many caribou migrations cross state, regional, and game management unit (GMU) boundaries. These political jurisdictions 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.

A. Regional Distribution

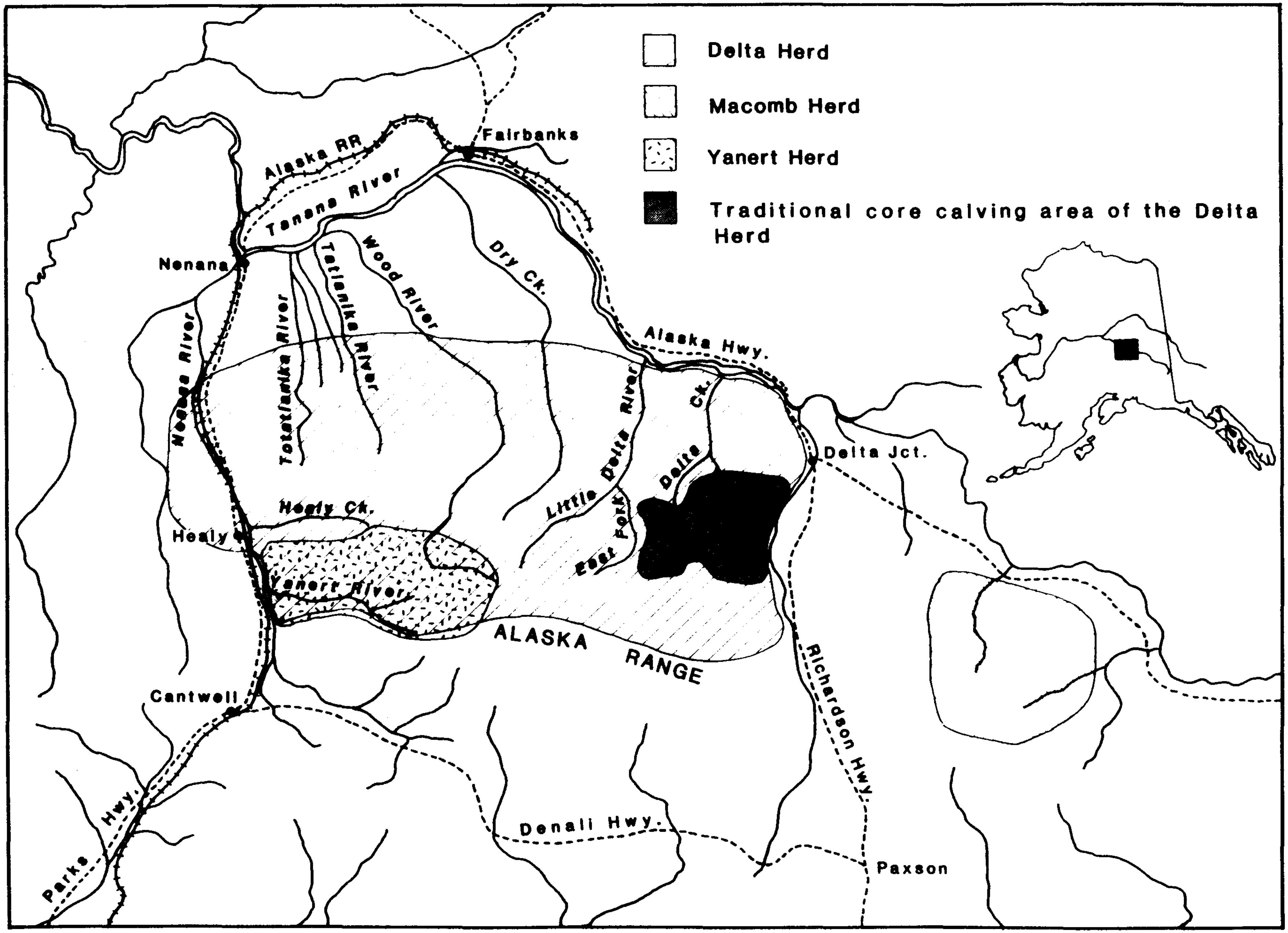
1. Chisana Herd. The Chisana Herd (CH) is one of several small caribou herds utilizing portions of the Interior and Western regions (see map 1). Skoog (1968) described the approximate range of the CH to include the area from the Nabesna River southeastward to the upper White River, extending northeast to the timbered portions of the upper Tanana River and of the middle White River. These animals range through the Nutzotin Mountains and along tributaries of the White and Chisana rivers (Hemming 1971).
2. Denali Herd. The Denali Herd (DH) is a relatively small caribou herd that ranges primarily on the north side of the Alaska Range in the vicinity of Denali National Park. The total area utilized by these caribou is approximately 5,000 km^2 (1,930 mi^2) (Boertje 1981).
3. Kilbuck-Kuskokwim Mountains Herd. The Kilbuck-Kuskokwim mountain range has historically been occupied by both caribou and reindeer (Patten, in press). Although the herd's range contains good caribou habitat, very low numbers of caribou are found in the area (ibid.). This herd is subject to intense hunting pressure (ibid.).
4. Andreafsky Mountains Herd. Very little is known of the distribution of caribou in the Andreafsky Mountains. Most of the animals are believed to be feral reindeer from the Stebbins herd or from Stuart Island (Machida, pers. comm.). In aerial surveys of this area during winter 1981-1982 and spring 1982, most animals were observed in the vicinity of Needle Mountain and Iprugalet Mountain on the East Fork of the Andreafsky River (Dinneford 1983). A 1 April 1983 aerial survey indicated fewer caribou in this area than the previous year (Machida 1984). Similar findings were noted during an aerial survey conducted during March of 1984 (Machida, pers. comm.). Under intense hunting pressure, it appeared that most of the caribou had moved eastward into the rugged and almost inaccessible portions of the Chuilnak and Anvik drainages (Machida 1984). In most



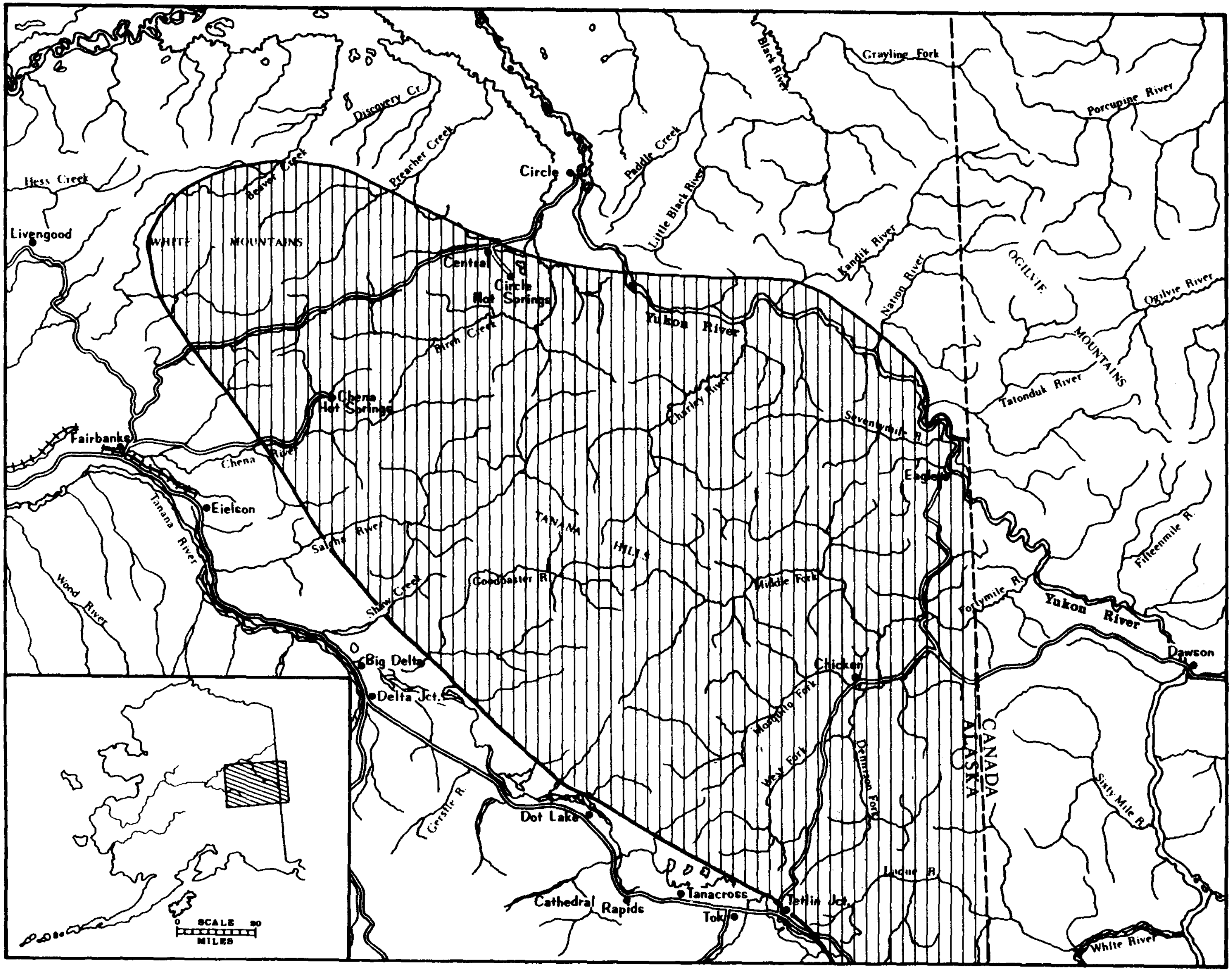
Map 1. Distribution of the Chisana Caribou Herd (Kelleyhouse, pers. comm.).

winters, hunters on snowmachines have found caribou in the uplands near the headwaters of the Andreafsky River, the East Fork of the Andreafsky River, and Otter Creek (Patten 1985a).

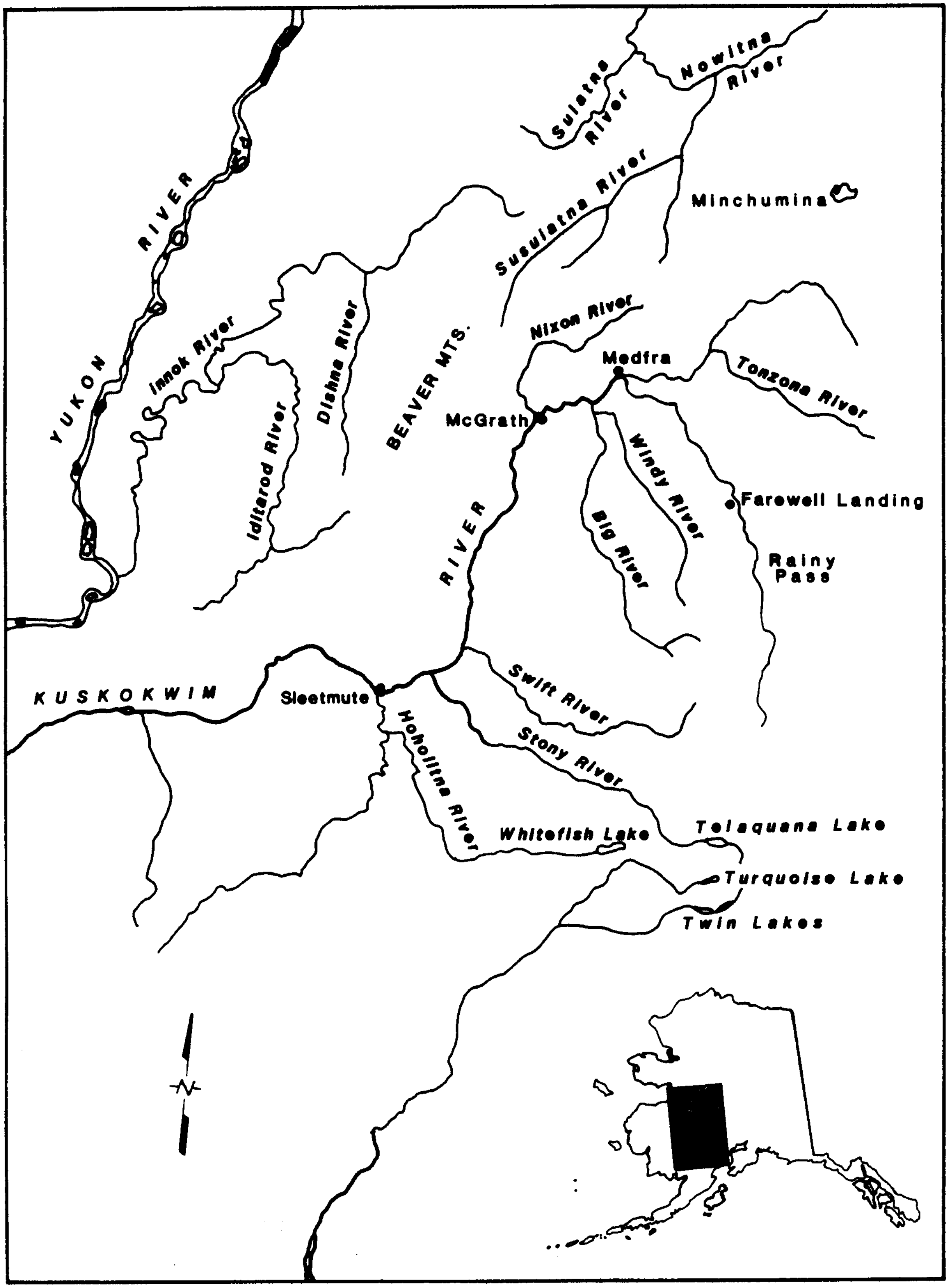
5. Delta Caribou Herd. The Delta Caribou Herd (DCH) (map 2) is one of several caribou herds (Denali, Delta, Macomb, Big River, Tonzona, etc.) that range along the northern slopes of the Alaska Range. This herd occupies a total range containing about 9,600 km^2 (3,700 mi^2) between the Nenana River-Parks Highway-Alaska Railroad on the west and the Delta River-Richardson Highway on the east (Davis et al. 1985).
6. Macomb Herd. The Macomb Herd (MH) is a small herd that occupies the area south of the Tanana River between the Delta and Robertson rivers (map 2). Most radiotelemetry locations for caribou from the MH occur on the Macomb Plateau between the Johnson and Robertson rivers (Johnson 1985).
7. Yanert Herd. Davis et al. (1982) confirmed the existence of a distinct herd of several hundred caribou occupying the Yanert River drainage and adjacent headwaters of the Wood River (map 2). The Yanert Herd (YH) appeared to exist as a separate herd, distinct from the Delta Herd, based on aerial observations by ADF&G staff and discussions with local residents familiar with that area. Until recently, no interchange of radio-collared caribou from the YH and DCH had been observed (ibid.). Davis and Valkenburg (1983) discussed apparent differences in calving behavior and calving success (calf recruitment) for these herds.
8. Fortymile Herd. The Fortymile Herd (FH) has experienced major changes in geographic distribution and significant population fluctuations over the last hundred years or so. Presently, the FH occupies much of the area between the Yukon and Tanana rivers south of the Steese Highway, with occasional use of portions of the Yukon Territory north of the Ladue River and south of the Yukon River (map 3).
9. Beaver Mountains Herd. The Beaver Mountains Herd (BMH) occupies a small mountain range (map 4) (Beaver Mountain) approximately 60 km (35 mi) west of McGrath. In late April 1982, six cows from the BMH, five cows from the Sunshine Mountain Herd (SMH), and nine cows of the Big River Herd (BRH) were radio-collared to determine the distribution and distinctness of these herds. Data obtained from the collaring effort supported the idea that the three herds were distinct entities.
10. Sunshine Mountain Herd. The Sunshine Mountain Herd (SMH) is characterized by small, widely scattered groups of caribou that occupy dense black spruce habitat throughout much of the year. Aerial surveys and observations of radio-collared animals indicated that SMH caribou aggregated for a short time during late winter and then dispersed widely from the Nixon Fork flats to the headwaters of the Susulatna River during calving in late May (Pegau 1984). After calving activity was completed, most caribou ranged from the black spruce bogs where they had calved



Map 2. Ranges of the Delta, Yanert, and Macomb caribou herds (Johnson 1985, Davis and Valkenburg 1985).



Map 3. Annual distribution of the Fortymile Caribou Herd in Alaska (Kelleyhouse, pers. comm.).



Map 4. The upper Kuskokwim River valley.

to areas above timberline on Cloudy, Cripple, and Sunshine mountains (ibid.). This behavior may represent some form of postcalving aggregation as demonstrated in other caribou herds. By late summer most caribou were in small groups (10 caribou) in heavy timber ranging from the upper Nowitna and upper Susulatna rivers to Ivy Creek on the Nixon Fork (ibid.). From late October through January 1983, the SMH remained scattered from the Nixon Fork flats to an area in the vicinity of the Nowitna River (ibid.). By early February, most caribou had moved from the Nixon Fork flats to the foothills between the Nowitna and Susulatna rivers and remained there until early April (ibid.). Caribou then drifted slowly as a group to the north side of Sunshine Mountain (ibid.). These movement patterns differed somewhat during the 1983-1984 period; caribou from the SMH never left the Nixon Fork flats as in previous years and remained in that area throughout the winter and even calved there in May 1984 (Pegau 1985). Following calving, caribou then dispersed to the Cripple, Cloudy, and Page mountain areas (ibid.).

11. Big River Herd (Farewell Herd). In the past, caribou from the Big River Herd (BRH) have often been considered part of the Mulchatna Herd or the Rainy Pass Herd. However, based on recent observations, the BRH apparently is a discrete herd. Caribou move into the Farewell area during late winter in most years (Pegau 1984). In 1983, this movement occurred in April, after which, in early May, the BRH moved west as a group along the foothills to the vicinity of the Big River. From here the herd dispersed and occupied habitats ranging from dense black spruce forest to the alpine tops of high mountain ridges in a similar pattern as the SMH (ibid.). Calving activity occurred from mid to late May, with nearly half of the radio-collared animals calving in the black spruce forest from the Big River to the Selatna River (ibid.). After the completion of calving activity, most caribou of the BRH left the black spruce forest and summered in the foothills of the Alaska Range, mainly east of the Big River (ibid.). The BRH wintered near McGrath along the lower portion of the Big River (ibid.).
12. Rainy Pass Herd. The Rainy Pass Herd (RPH) is found in the Alaska Range, mainly in the drainages of the South Fork of the Kuskokwim River and the Happy River (ibid.). The RPH ranges as far north as the Farewell area in early winter but leaves this area before the BRH arrives in late winter (ibid.).
13. Tonzona Herd. The Tonzona Herd (TH) was thought to have been derived from the Denali Herd (ibid.) but is now considered a distinct entity. The herd usually ranges from the upper drainages of the Tonzona River to the Purkeypile Mine during summer and fall and as far north as the Slow Fork Hills in the winter (ibid.).

B. Areas Used Seasonally and for Life Functions

See the 1:1,000,000-scale printed maps found in the Atlas to the guide for the Western and Interior regions and the 1:250,000-scale reference maps located in ADF&G offices.

The maps show the following categories:

- General distribution
- Known calving areas
- Known winter use areas
- Known migration patterns

C. Movements Between Areas

One of the most important aspects of caribou ecology is survival through adaptive behavior such as migratory movements. Sinclair (1983) proposed that the varying movement patterns (e.g., migration, emigration) of vertebrates have evolved in response to predictably changing food resources. It appears that caribou move to exploit optimal environmental conditions. Some migrations may have evolved to take advantage of favorable habitats, such as calving and breeding areas, or simply to find mates. Bergerud (1974) suggested that caribou interactions with wolves led to their gregarious nature and patterns of movement. For example, in northern British Columbia, Bergerud et al. (1984) hypothesized that female caribou movements from valley bottoms to high south-facing slopes for calving evolved as an antipredator tactic, mainly against wolves. Large groups of caribou cannot remain long in one place without depleting food resources. As a result, behavioral adaptations such as migration developed so that caribou could sustain themselves in relation to their varying forage supplies and avoid predation. 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 ranges or life-function area sizes have been determined. See the individual herd sections for more specific information on movements.

D. Factors Affecting Distribution

The following factors appear to affect the distribution of caribou:

- Availability of preferred forage
- Predation
- Availability of insect relief areas
- Local winter conditions (duration, snow depth and hardness, temperature)
- Summer forest fires
- Human activity (development projects, hunting)
- Population size of individual herds

E. Population Size Estimation

Hemming and Glenn (1968) first developed the Aerial Photo-Direct Count-Extrapolation (APDCE) technique to census the Nelchina Herd in 1967. After some refinements, the technique was first used in the arctic on the Western Arctic Herd in 1970 (Pegau and Hemming 1972). In 1973, the first rigorous APDCE census was conducted on the Fortymile Herd (Davis et al. 1978) and on the Denali Herd (Davis and Preston 1980). Davis et al. (1979) refined the APDCE technique to increase the accuracy and precision of population estimates. Whitten and Cameron (1980, 1983) described results using the "modified" APDCE technique on the Porcupine Herd in 1979 and 1982 and made recommendations for improvement. As currently used, the modified APDCE technique incorporates the use of radio-collared caribou to locate aggregations to be visually counted or photographed. Adjustments have also been developed that preclude relying on summer and fall composition data to extrapolate the population estimate (Davis and Valkenburg 1984). The modified technique has generally been used to census caribou herds in the Western and Interior regions since 1980.

F. Regional Abundance

Population estimates for caribou are usually not calculated at the regional level. Table 1 is a summary of the most recent published population estimates and caribou survey data by herd for the Western and Interior regions. By summing the most recent abundance estimates for the individual herds, a minimum regional estimate of 28,460 and a maximum of 30,729 caribou were obtained.

II. CHISANA CARIBOU HERD (CH)

A. Distribution

1. Calving area. Reynolds (1969) reported that Chisana caribou calving activity was not concentrated in any certain area. Caribou tended to calve alone or in pairs of cows. Local guides reported that calving activity occurs from the benchlands along Sheep Creek on Mt. Sulzer to the rolling hills north of Ptarmigan Lake. On June 17, 1972, small groups of caribou (105 adults, 20 calves) were observed, including cows with calves, scattered between the Chisana and White rivers, with most caribou found in Beaver Creek valley and Flat Creek flats in shrub-birch vegetation (BGDIF 1972). Although no traditional calving areas have been identified, postcalving groups have been observed on the alpine hills between Chisana and the Ptarmigan-Bray lakes area (ADF&G 1977).
2. Winter use area. Skoog (1968) presumed that some CH caribou wintered along the spruce-covered slopes northeast of Ptarmigan Lake and in alpine areas.

B. Movements

Information describing seasonal movement patterns for the CH is rare. Hemming (1971) mentioned an altitudinal shift between winter and summer ranges. In July, Chisana caribou often seek relief from biting insects by moving onto nearby glaciers, where cooler temperatures prevail.

C. Present Abundance

The Chisana Herd numbers approximately 1,000 caribou and is considered to be stable (Kelleyhouse 1985a). Currently, the herd contains about 3% of the estimated total caribou within the Western and Interior regions and less than one-tenth of one percent (0.1%) of the estimated 1983 statewide caribou population (450,000) (Hinman 1985).

Table 1. Most Current Population Estimates and Survey Results for Caribou Herds in Western and Interior Regions

Herd	Type of Survey	Date	Number Counted	Number Estimated	Source
Chisana	Aerial	Nov. 1981	885	1,000	Kelleyhouse 1983
Denali	Helicopter	June 1984	1,210	1,700	Buchholtz 1985
Kilbuck Mts.	Aerial	Aug. 1984	---	200	Patten in press
Andreafsky Mts.	APDCE	June 1984		400	Patten 1985a
Delta	APDCE	June 1984		6,300	Jennings 1985
Macomb	Aerial	Oct. 1983	500	700	Johnson 1985
Yanert	Aerial	June 1983		929	Davis and Valkenburg 1984
Fortymile	Photocensus	June 1984	12,356	14,000	Kelleyhouse 1985
Beaver Mts.	Photocensus	June 1983	1,164	1,200-1,500	Pegau 1985
Sunshine Mts.	Aerial	June 1983		525-750	Pegau 1984
Big River	Aerial	June 1983		650-750	Pegau 1984
Rainy Pass	Aerial	June 1983		1,500	Pegau 1984
Tonzona	Aerial	June 1983		1,000	Pegau 1984

--- means no data were available.

D. Historic Distribution and Abundance

During the late 1920's and early 1930's, large numbers of caribou from the Fortymile Herd utilized the upper drainages of the Chisana, Nabesna, and White rivers area each fall (Skoog 1968). When these movements ceased in the early 1930's, remnant groups of caribou remained on the northeastern slopes of the Wrangell Mountains. The Chisana Herd is thought to have been derived from such groups.

Based on discussions with local hunting guides and some brief aerial surveys, Skoog (1963, 1968) estimated 3,000 animals in this herd. By the early 1980's, this estimate had been reduced to less than 1,000 animals. The statewide decline in caribou numbers paralleled a decline in the Chisana Herd, which may not have been indicative of a decline in the population but rather of more intensive survey efforts. In October 1980, an ADF&G survey located 582 caribou in 51 aggregations (Kelleyhouse 1983a). An extensive aerial survey was conducted in late November 1981 by local hunting guides, Terry and Debby Overly, in which 885 caribou in 70 aggregations were actually observed. On the basis of this survey, the CH population estimate was raised to some number in excess of 1,000 animals (ibid.). Kelleyhouse (1985a) reported the CH to be stable and to contain 1,000 caribou. Local residents of Chisana believed this herd was perhaps twice as large in the 1960's (ibid.).

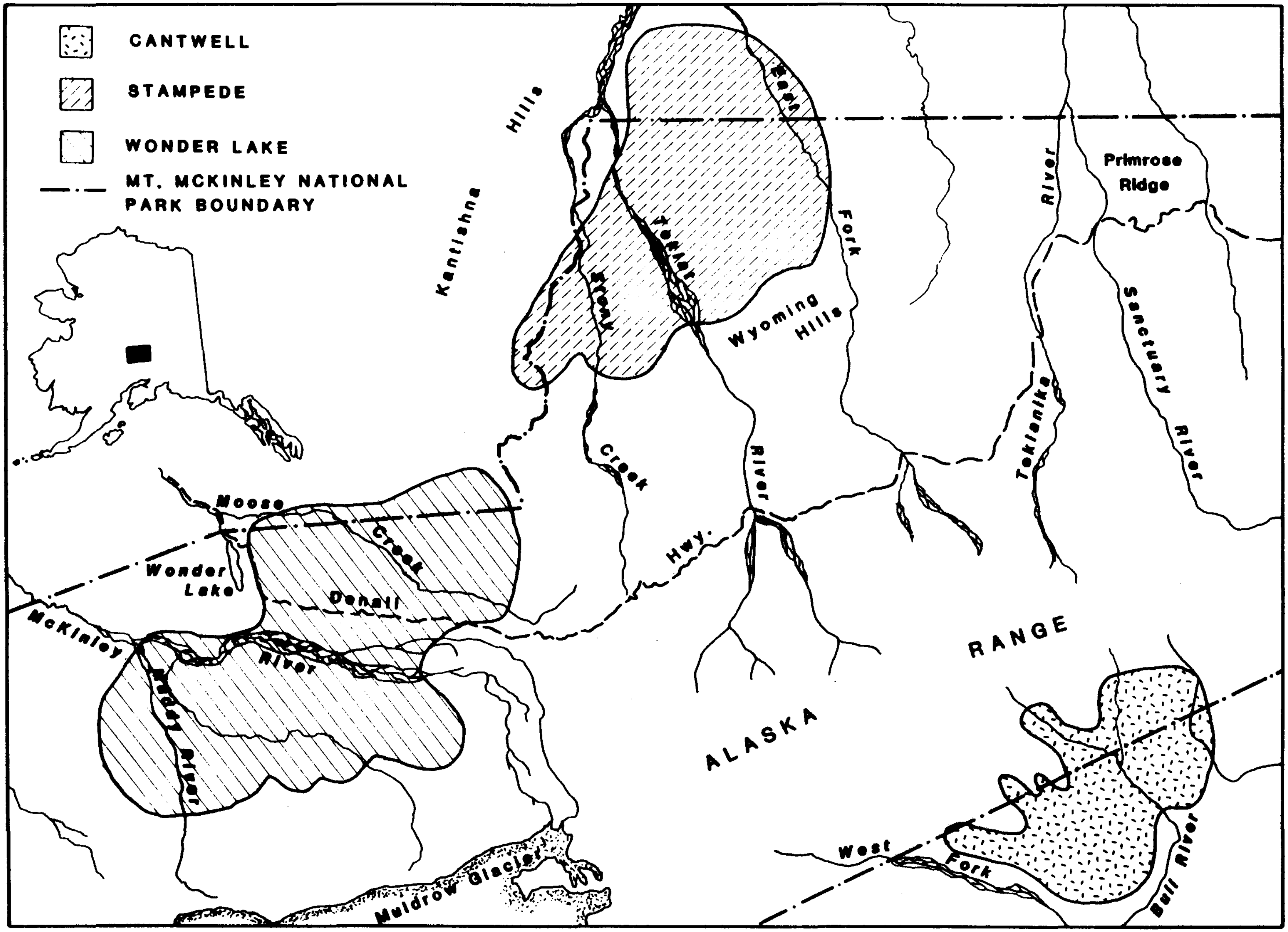
III. DENALI HERD (DH)

A. Distribution

1. Calving area. The Denali Herd utilizes three major calving grounds, as defined by Troyer (1981): the Stampede Calving Grounds (SCG), the Wonder Lake Calving Grounds (WCG), and the Cantwell Calving Grounds (CCG) (see map 5). According to Troyer (1981), the SCG included the flats and rolling hills between the East Fork and the Clearwater rivers. The area extends northward to the Stampede Road and southward to the base of the Alaska Range near the foot of the Wyoming Hills and Mount Sheldon. The northern portion of the SCG includes some wet lowlands, with sedges and grasses covering the rolling foothills. The area is generally snow-free by the time parturition is to occur.

The WCG consists of the region from the headwaters of Moose Creek south to Clearwater Creek and its tributaries, east to the foot of the Muldrow Glacier, and west to the Muddy River and Brooker Mountain. In Troyer's (1981) study, the WCG contained scattered snow patches during the calving period.

The CCG lies on the south side of the Alaska Range and includes the area between the headwater drainages of Cantwell Creek to the Chulitna River, all of the mountains and drainages of Easy Pass westward to West Fork, and the Dunkle Hills (Troyer 1981). From 1976 to 1980, radio-monitoring of 10 adult cows indicated that the CCG was the most important calving area (Duff and Singer 1982). Even when cows utilized other areas for calving, they often moved to the CCG postcalving (after the calf was



Map 5. Major caribou calving grounds of the Denali Caribou Herd (Troyer 1981).

about three weeks old) in mid June. From 1976 to 1982, an estimated 70, 54, 68, 42, 46, and 33% of the DH, respectively, used the CCG for calving and/or postcalving during those years. Troyer (1977) and Duff and Singer (1982) have reported data that suggest that calf survival may be better at the CCG. In years of heavy snowfall, most calving activity occurred on the south-facing slopes in the Cantwell Creek and Bull River drainages. In years of average or low snowfall, the Camp Creek flats, Colorado Creek, Costello Creek, and the Dunkle Hills were used more heavily. Hemming (1971) suggested that the phenology of plant growth on the south slopes of the Alaska Range may offer abundant succulent forage during June. Boertje (1981) observed that the main predators, wolves and brown bears, were at lower densities on the CCG than on the SCG. Brown bear densities south of the Alaska Range (CCG) were half (1 bear/28 km^2) those found on the north side of the range in the park, probably because of bear hunting in the Cantwell area (ibid.).

2. Winter use areas. From 1976 to 1980, almost the entire Denali Herd concentrated in the area around Wonder Lake and the McKinley River in early November (Troyer 1981). By late November, the herd split into two groups. About two-thirds of the herd gradually drifted northeast down through the Clearwater and Stony rivers into the Stampede flats toward the East Fork and Sushana Lakes area. Most caribou wintered around the Sushana Lakes, the Stampede Hills to the north, and in the Sushana Hills between the Teklanika and East Fork rivers. Troyer (1981) estimated two-thirds of the DH wintered in this region from 1976 to 1980. The remainder slowly moved westward from the Wonder Lake area, crossing the McKinley River and Slippery Creek to the Foraker River, then northward from the Foraker River and Slippery Creek into the spruce-covered lowlands about 25 km (15 mi) north of the old park boundary (ibid.).

B. Movements

1. Postcalving migration route. This route is generally used by cows from the Stampede Calving Grounds (SCG) or Wonder Lake Calving Grounds (WCG) (north of the Alaska Range) (Troyer 1981). Cows from the SCG usually move up the Stoney River through the mountains to the road in Denali National Park (Park Road) or up the Clearwater River to the headwaters of Moose Creek and then eastward along the Park Road to the Thorofare River area. Cows from the WCG also use the road corridor to reach the Thorofare area. The migration route follows the Park Road past Eielson Visitor Center up Stoney Hill and across the Toklat River to Polychrome flats. Caribou then leave the road on the east end of Polychrome flats, cross the East Fork of the Toklat River, and move over a 1,370 m (4,500 ft) pass just south of Sable Pass. The caribou then descend into the Teklanika River valley, move up the valley about 8 km (5 mi) and over a 1,670 m (5,500 ft) pass into Refuge Valley, and down

Refuge Valley to the Sanctuary River. Steep mountains divert the animals to the south over another 1,670 m (5,500 ft) pass that leads into the West Fork of the Windy River. The route continues west into Cantwell Creek and the Bull River, where caribou disperse onto the Cantwell Calving Grounds (CCG). The last two passes are very steep and snow-covered throughout the year and can be a source of mortality for three-week-old calves.

Troyer (1981) mentioned that the route from Thorofare to Cantwell had been used for many years. In fact, Murie (1944) reported the same pattern of movements in the 1930's and early 1940's. Migration activity usually begins in late May, with most of the caribou reaching the CCG by June 10 and some stragglers arriving as late as the end of June (Troyer 1981). Bulls generally do not migrate across the Alaska Range but linger in small groups from the Sanctuary River westward to the Wonder Lake area (ibid.).

2. Summer migration ("return migration"). In most recent years, caribou generally leave the CCG by mid July and migrate westward in comparatively larger groups than those of the eastward migration. The westward migration is essentially the same route along the Park Road to the Thorofare-Eielson area. At this point, most caribou leave the mountains and disperse toward Moose Creek and across the McKinley River (ibid.). Many caribou stop for a month or so to feed on the open tundra in the Gorge Creek-Upper Thorofare River area (Haber 1977).
3. Fall migration. In September and October, most caribou are generally distributed along the foothills between Wonder Lake and Slippery Creek (Troyer 1981). In some years, caribou concentrate from Clearwater Creek to the headwaters of Moose Creek. In any case, Troyer (1981) described a definitive eastern movement during the fall in 1976 through 1980, with most caribou concentrated around Wonder Lake and the McKinley River by late October. Caribou then dispersed to the winter ranges described previously.
4. Spring migration. In early April of each year of Troyer's study, caribou from the western wintering area made a rapid movement to the Stampede Calving Grounds. Caribou used the Bearpaw River to cross over the Kantishna Hills, while others migrated up the McKinley River to the Wonder Lake area and moved down the Clearwater River to the Stampede flats.

   There are insufficient data available to describe movements between areas for the remaining herds.

C. Present Abundance

Helicopter surveys of seven calving areas produced a count of 1,210 caribou, with an estimated minimum 1984 postcalving population of 1,700 animals (Buchholtz 1985). Overall herd productivity was high, as illustrated by the high rate of survival of calves born in 1983, a high ratio of short yearlings to cows (46:100, N=600), a pregnancy rate of 83%, and a high rate of calving success in 1984, which varied from 40 to 76 calves:100 cows (ibid.).

D. Historical Distribution and Abundance

Murie (1944), Skoog (1968), Buskirk (1976), and Haber (1977) have reviewed the historic distribution and abundance of the DH. Briefly, the DH is believed to have reached a population peak some time in the mid 1800's and was then followed by a decline through most of the late 1800's (Haber 1977). Caribou numbers in the Denali region began to increase again in the late 1800's and early 1900's (Skoog 1968). From the early 1900's to the early 1940's, a peak of 20,000-35,000 animals was reached and maintained throughout this period (Haber 1977, Murie 1944). By the late 1940's or early 1950's, herd numbers had declined to 6,000-9,000 caribou. The DH apparently stabilized at 7,000-9,000 caribou until 1962. Skoog (1963) estimated the herd at 12,000 caribou in 1963. A calving ground survey completed in June 1964 resulted in an estimate of 14,000 adults (Skoog 1968). Haber's (1977) ground counts during the spring migration period (June) for 1966 and 1967 numbered 8,000 animals. In an attempt to reconcile this figure with the earlier and later ground estimates (7,000-9,000), Haber (1977) suggested that a portion of the neighboring Nelchina Herd had temporarily joined the Denali Herd. However, from 1968 to 1974 the herd steadily declined from 8,000 to 1,500 caribou (Haber 1977). Buskirk (1976) estimated 1,000 caribou in the DH in 1975, whereas Troyer (1977, 1978, 1980) estimated that the DH maintained a stable population numbering approximately 900 to 1,500 animals between 1976 and 1980. Table 2 summarizes available population estimates for the DH.

Detailed descriptions of the historical distribution are sketchy and complicated. Haber (1977), Skoog (1968), Buskirk (1976), and Murie (1944) contain the best descriptions of use of the Denali area by the DH.

IV. KILBUCK-KUSKOKWIM MOUNTAINS HERD (KMH)

A. Distribution

1. Calving area. No specific calving area has yet been delineated for the Kilbuck-Kuskokwim Mountain Herd (KMH). Patten (1985a), however, observed newborn calves in a group of 10 caribou along Gold Creek near Kisaralik Lake on 18 May 1984. Dinneford (1983), on 14 May 1982, observed a total of 32 caribou with 4 newborn calves in Quicksilver Creek, North Fork Creek, and the Kisaralik River 3.2-8.0 km (2-5 mi) below Kisaralik Lake. Dinneford's (1983) and Patten's (1985a) observations of caribou calving occur in the same general area - the upper Kisaralik drainage.
2. Summer range. Caribou are generally found in small, widely scattered groups in alpine tundra and glacial cirques in late summer (Patten 1985a). Caribou occur in low densities in the Nishlik, Chikuminuk, upper Kisaralik, North Fork, and Quicksilver drainages, as well as near Kisaralik Lake, Canyon

Table 2. Population Size Estimates for the Denali Caribou Herd, 1919-84

Year	Estimate	Type of Survey	Source
1919	25,000	---	Skoog 1968
1922	30,000	---	Skoog 1968
1935	20,000	---	Murie 1935
1941	20,000-30,000	Ground counts	Murie 1944
1952	6,000 plus scattered bands	Ground counts	Haber 1977
1955	8000+	Ground counts	Haber 1977
1956	8,000	Ground counts	Haber 1977
1959	9,000	Ground counts	Haber 1977
1960	8,000-9,000	Ground counts	Haber 1977
1961	7,715+	Ground counts	Haber 1977
1962	8,000	Ground counts	Haber 1977
1963	12,000	Aerial survey	Skoog 1963
1964	14,000	Aerial survey	Skoog 1968
1966	8,000	Ground counts	Haber 1977
1967	8,000	Ground count/aerial survey	Haber 1977
1968	5,000	Ground count/aerial survey	Haber 1977
1969	4,500	Ground count/aerial survey	Haber 1977
1970	4,500	Ground count/aerial survey	Haber 1977
1971	3,000	Ground count/aerial survey	Haber 1977
1972	1,500	Ground count/aerial survey	Haber 1977
1973	1,500	Ground count/aerial survey	Haber 1977
1974	1,500	Ground count/aerial survey	Haber 1977
1976	900-1,200	Ground count/aerial survey	Troyer 1977
1977	900-1,200	Ground count/aerial survey	Troyer 1978
1978	1,200-1,500	Ground count/aerial survey	Troyer 1979
1979	1,200-1,500	Ground count/aerial survey	Troyer 1980
1980	1,000-1,200	Ground count/aerial survey	Buchholtz 1981
1981	1,200-1,500	Ground count/aerial survey	Buchholtz 1982
1982	1,200-1,500	Ground count/aerial survey	Buchholtz 1983
1983	900-1,200	Ground count/aerial survey	Buchholtz 1984
1984	1,700	Aerial	Buchholtz 1985

--- means no data were available.

Creek, Gold Creek, and Gold Lake (ibid.). In addition to these drainages, spring 1985 aerial surveys revealed caribou use in the Crooked Creek, upper Kwethluk River, and Heart Lake drainages (ibid.).

3. Winter use area. In aerial surveys completed in February 1985, caribou tracks indicated use of Crooked Creek between the Kwethluk and Kisaralik rivers (Patten in press). Caribou were also reported in low numbers in the upper Kisaralik drainage and in the headwaters of the Eek River.

B. Present Abundance

Patten (in press) estimated 200 animals in this herd. However, extremely heavy harvests during winter and early spring 1985 may have reduced the KMH to only a few animals. Citizens reported illegal and excessive harvests of at least 90-120 caribou in three separate instances by snowmachine party hunts in January, February, and March 1985. By April 1985, only a small number of caribou (possibly only five) remained in the northern Kilbuck Mountains. No caribou were observed calving in the upper Kisaralik-Gold Lake drainages in May 1985, in contrast to May 1982 and May 1984 (Dinneford 1983, Patten in press). USFWS helicopter surveys of the northern and central portions of the Kilbuck Mountains found no caribou in June 1985. These observations caused the Board of Game to close the hunting season in this area during the 1985-1986 regulatory year.

C. Historical Distribution and Abundance

Skoog (1968) reviewed the historical distribution and abundance of caribou in Western Alaska in great detail. Caribou numbers were believed to have peaked by the 1860's. During this peak, an apparently huge number of caribou ranged over the Yukon-Kuskokwim lowlands, Nunivak and Nelson islands and quite likely into the upper Kuskokwim River area. The predominant movement pattern was north-south, crossing the Yukon and Kuskokwim rivers. From 1875 to 1895, caribou distribution in the area changed radically. The north-south migrations ceased; caribou were exterminated from Nunivak Island and disappeared from the lowlands and hills of the lower Kuskokwim River, where they had been so numerous previously. Skoog (1968) attributed this disappearance of caribou to "large-scale slaughter of animals by Natives." However, a large remnant herd remained in the Kilbuck Mountains. After 1900, severe wild-fires destroyed much of the spruce forests with lichen understory upon which caribou were dependent (ADF&G 1977). The introduction of domestic reindeer herding in this area in the 1900's also negatively affected available caribou range. Some of these reindeer escaped from their normal range along the Bering Sea coast and by 1925 were ranging in portions of the Kilbuck and Taylor mountains (Skoog 1968). Mertie (1938) and various Alaska Game Commission reports in the 1930's showed no caribou along the lower Yukon and Kuskokwim rivers, a few scattered herds in the Kuskokwim Mountains, and only feral reindeer in the Kilbuck and Taylor mountains. There seems to have been little change since then. Presently, however, Patten (1985a) believes the KMH is derived from wild Mulchatna Caribou Herd (MH) stock and not feral reindeer or caribou-reindeer crosses descended from the escaped domestic stock of the 1920's and 1930's. Patten (1985a, in press) presents evidence showing the expansion of the KMH into the Kilbuck Mountains area. This area contains only a low-density caribou population and large areas of unoccupied habitat.

V. ANDREAFSKY MOUNTAINS HERD (AMH)

A. Present Abundance

No reasonably accurate population estimate has been made for the Andreafsky Mountains Herd. Rates of immigration from the Western Arctic Herd (WAH) vary annually, depending on winter movement patterns of the WAH (Patten in press). Winter weather conditions can greatly influence levels of harvest pressure from local hunters (ibid.). Because the AMH probably contains feral reindeer and reindeer-caribou crosses, historical and current escape rates of domestic reindeer can also influence AMH population estimates (ibid.). All of these factors have caused large discrepancies in reported population size, ranging from an estimated population of 200 animals (Machida 1984) and 400 animals (Patten 1985a) to 5,000 animals (Patten in press).

B. Historical Distribution and Abundance

There is very little historical information specific to the Andreafsky Mountains Herd. Skoog (1968) described the existence of a very large caribou population inhabitating the lower Yukon and Kuskokwim rivers and the Bering Sea coast from Bristol Bay to Norton Sound. Murie (1935) noted the regular northward movement of large numbers of caribou past St. Michael as well as a southerly movement through this area, across the Yukon River near present-day St. Marys, across the Kuskokwim River between the present locations of Bethel and Aniak, and into the Kilbuck Mountains. Skoog (1968) thought this huge caribou population extended from the Seward Peninsula in the north to the Kilbuck Mountains to the south, possibly southeast to the Alaska Peninsula, and probably east to the Alaska Range and the upper Kuskokwim River area as well. As previously mentioned, these migrations stopped in the 1870's, probably leaving the Andreafsky Mountains devoid of caribou. However, large herds of reindeer were introduced at the turn of the century along the Bering Sea coast. Davis (1978) suggested that the AMH may have originated from a group of feral reindeer, but the Western Arctic Herd occasionally ranges in the vicinity of the curent AMH range and could have given rise to the AMH or contributed to its growth.

VI. DELTA CARIBOU HERD (DCH)

A. Distribution

1. Calving area. The traditional core calving area lies between the East Fork of the Little Delta River and the Delta River

(see map 2) and is believed to have been used since at least the 1950's (ibid.). Table 3 describes the level of use of the core calving area from 1979 to 1983. Alternative areas used for calving in a year of lower use of the core area, such as 1981, include the higher ridges and plateaus bounded by Dry Creek, Iowa Ridge, and the East Fork of the Little Delta River, the upper Totatlanika River drainage, and the plateaus at the head of Lignite Creek (ibid.). In 1982, caribou appeared to be displaced from the traditional core area by a 100% snow cover of 15-45 cm depth that was heavily wind-packed and/or crusted (Davis and Valkenburg 1983). Caribou were able to utilize a snow-free area of tussock tundra habitat similar to that in the core area by moving a distance of 16 km (10 mi) to the northwest. As the calving period nears in late April and May, cows and short yearlings move into this area of mainly tussock tundra to feed on <u>Eriophorum</u> buds (Davis et al. 1982). Although most calves are born on tussock tundra, many others are born in areas of low shrub and spruce woodlands (Davis et al. 1985). During the calving period, bulls and other short yearlings remain widely scattered over the entire DCH range (Hemming 1971). Although the identification of peaks in calving activity may vary widely, depending on the definition, table 3 also presents annual peak calving dates.

2. <u>Winter use area</u>. There are very few published data describing the winter distribution of the Delta Caribou Herd. An aerial survey made in February 1964 indicated that most of the animals occupied the spruce flats and foothills between the Delta River and Dry Creek, with the largest concentrations between the Little Delta River and the Delta River (Lentfer 1965). The direction of observed caribou trails suggested use of the open ridges and plateaus at the headwaters of the Delta River, Delta Creek, and Little Delta River. Smaller groups of caribou were found near the head of the Tatlanika River and in the Tanana flats between Delta Creek and the Little Delta River. Davis et al. (1985) suggested that foothill areas appeared to be used more than the flats or mountainous areas. Ground vegetation in the foothills and mountains is frequently available to caribou during winter because of strong winds (ibid.). Since 1975, when the DCH began to increase in numbers, a consistent trend of caribou winter use in the extreme western portion of the herd's annual range has been very evident (Davis and Valkenburg 1984).

B. Present Abundance

Table 4 summarizes all available abundance estimates and count data for the Delta Herd. Based on the June 1984 photocensus, this herd numbered about 6,300 caribou (Jennings 1985). This estimate includes caribou occupying the Yanert River drainage. The average annual growth rate since 1979 is approximately 14%. Currently, the herd contains about 20% of the estimated total number of caribou within the Western and Interior regions.

Table 3. Peak Calving Period and Level of Use of the Core Calving Area for the Delta Herd, 1979-83

Year	Peak Calving Activity Period	% of Herd Calving In Core Area
1979	25-29 May	75-90+
1980	19-22 May	75-90+
1981	16-17 May	50
1982	23-26 May	5-10
1983	21 May	75-90+

Sources: Davis and Preston 1980; Davis and Valkenburg 1981, 1983, 1984; Davis et al. 1982.

Table 4. Available Abundance Estimates for the Delta Caribou Herd, 1957-84[a]

Year	Number Counted	Estimate	Source
1957	---	1,500	Davis et al. 1983
1963	---	5,000[b]	Skoog 1963
1964	---	5,000[b]	Lentfer 1965
1965-1970	---	5,000	Davis et al. 1983
1973	2,088	2,198-2,409[c]	Davis and Preston 1980
1979	3,160	3,700-3,961[c]	Davis et al. 1983
1980	3,156	4,194-4,448[c]	Davis and Valkenburg 1983; Davis et al. 1982
1981	---	4,180-5,320[c]	Davis et al. 1983
1982	6,111	6,500-7,500	Davis and Valkenburg 1983
1983	5,425	6,300	Davis and Valkenburg 1984
1984	---	6,300	Jennings 1985

--- means no data were available.

a Census methodology varied annually and should be considered for between-year comparisons.

b Excludes calves.

c Ranges are not confidence intervals but are extrapolations by two different methods.

C. Historical Distribution and Abundance

Early explorers such as Glenn and Mendenhall reported abundant numbers of caribou present on the uplands of the north side of the Alaska Range and the Delta River (Skoog 1968). The Yanert River was considered a very important hunting area for caribou by local Natives in the early 1900's (ibid.). Murie (1935) reported caribou movements at the head of Delta River occurring from 1918 through 1921. Murie also stated that caribou were common year-round residents of the upper Delta River area. Skoog (1968) pointed out that seasonal migrations of the Fortymile Herd and the Denali Herd, which had reached peak numbers in the 1920's, brought many caribou into the current range of the DCH. After the winter of 1931-1932, these massive migrations stopped. From the mid 1930's until 1954, caribou were scarce within the range of the DCH (Davis et al. 1983). Population estimates made during this period indicated several hundred resident caribou in the area (ibid.). Scott et al. (1950) described small scattered bands of caribou inhabiting the north slopes of the Alaska Range between Wood River and the Delta River. These caribou were found primarily along the headwaters of the drainages and were estimated to number 300 animals, with the greatest concentration in the vicinity of the Little Delta River. Watson and Scott (1956) later demonstrated that survey techniques used by Scott et al. grossly underestimated actual numbers. However, as Skoog (1968) pointed out, the distribution of caribou has not changed much since that time. In 1957, Olson (1957) reported that the DCH was increasing and numbered 1,000 to 1,500 caribou. Skoog (1963) estimated 5,000 caribou (excluding calves) in the DCH in 1963, using reconnaisance surveys and interviews with local residents. This large increase in DCH size may be attributed to an ingress of animals from the Nelchina Herd, which was expanding rapidly at that time (Skoog 1968). However, rapid growth following the wolf control initiated in 1954 could also explain the growth (Davis et al. 1983). From 1963 to 1970, population estimates for the DCH remained at the 5,000 level. In 1973, the first APDCE census of the DCH resulted in population estimates of 2,198 and 2,409 caribou (Davis and Preston 1980), based on two methods of extrapolating age and sex composition data. The first estimate is derived only from the calculated number of caribou photographed, whereas the second estimate attempts to account for the number of caribou missed by the photo coverage. Although no censuses were conducted from 1973 to 1979, available calf survival data suggest that the herd declined through 1975 and began increasing again in 1976 (Davis et al. 1983). Initiation of a wolf control program in early winter 1976, along with closure of the hunting season in 1974, resulted in increased calf survival and increased yearling recruitment into the population after 1975. From 1976 to 1984, the DCH displayed a general pattern of steady growth. Throughout this period, the distribution of the DCH has remained constant, lying between the Nenana River and the Delta River.

VII. MACOMB HERD (MH)

A. Distribution

1. Calving area. The main calving area was located south of Fish Lake in 1984 (ibid.), whereas in 1983 most calving activity occurred between the headwaters of Berry and Bear creeks (Johnson 1984).
2. Winter use area. Based on radiotelemetry data, it appears that most of the herd winters on the Macomb Plateau and Little Gerstle highlands (Johnson 1984, 1985). A small group of 35 caribou has been observed wintering in the upper Jarvis Creek drainage (Johnson 1984).

B. Present Abundance

In an extensive aerial census of the Macomb Herd completed in October 1983, almost 500 caribou were observed, resulting in a fall population estimate of approximately 700 animals (Johnson 1985). Herd composition data suggest the Macomb Herd is stable (ibid.). Johnson (1981) stated that the APDCE census technique could not be utilized for estimating the size of the Macomb Herd, because the herd does not sufficiently aggregate after calving to allow an accurate census.

C. Historic Distribution and Abundance

Davis and Preston (1980) stated that caribou had been calving on the Macomb Plateau since at least the mid 1950's. Skoog (1968) considered this subpopulation of caribou to be part of the Delta Caribou Herd (DCH), whereas Hemming (1971) designated the Macomb Herd as part of the Mentasta Herd. The Macomb Herd probably existed as a separate herd during that time, but survey efforts were not sufficient to allow its identification. On the basis of Skoog's (1968) definition of a herd, Davis and Neiland (1975) considered the Macomb Herd a separate distinct herd. Davis and Preston (1980) point out that both the DCH and the Mentasta Herd have used their own traditional calving areas. Sex and age structure and recruitment rates of the MH are different from those of the DCH or Mentasta Herd. Between October 1966 and March 1968, 205 Delta caribou were marked; none of these marked caribou have been observed east of the Delta River. The size of the MH does not appear to have fluctuated very much over time. The herd was estimated to number 800-1,000 animals in the mid 1970's (Johnson 1981). In the early 1980's, population estimates for the MH remained fairly constant at around 700 caribou (Johnson 1985).

VIII. YANERT HERD (YH)

A. Distribution

a. Calving area. From 1981 to 1983, most caribou of the YH calved at locations generally above 1,500 m (5,000 ft) and as high as 2,200 m (7,200 ft) (Davis and Valkenburg 1984). Calving caribou are widely scattered and often found on high, rocky ridges. This behavior is considered somewhat dissimilar to that reported for most barren-ground caribou and may well be an adaptive strategy to avoid predation by brown bears and wolves.

Most calving activity has been centered in the headwaters of the following drainages: Dean, Dick, Edgar, Big Grizzly, and Little Grizzly creeks (Davis et al. 1982, Davis and Valkenburg 1984).

B. Present Abundance

In a caribou census conducted on 14 and 15 June 1983 within the range of the DCH and the YH, 929 caribou were thought to be YH animals (Davis and Valkenburg 1984). Because the DCH was located in the upper Wood River drainage, an area frequently occupied by the YH, movements of caribou aggregations between the Yanert and Wood rivers confounded the census. Therefore, the 1983 estimate may be of questionable value. Observers censusing the YH in June 1982 counted 680 caribou (Davis and Valkenburg 1983).

C. Historic Distribution and Abundance

Because the existence of the YH was confirmed only in 1981, there is very little documented history associated with this herd (Davis et al. 1982).

IX. FORTYMILE HERD (FH)

A. Distribution

1. Calving area. Kelleyhouse (1981a) stated that the FH shifted calving areas more frequently than any other caribou herd in Alaska. From 1978 to 1983, the FH calved in the southern tributaries of the Seventymile River and the upper drainage of the Charley River (Kelleyhouse 1985b). However, in 1984 the FH calving area was closer to the traditional (pre-1978) calving area in the upper Birch Creek drainage (ibid.).
2. Postcalving area. In the last six years, since the FH shifted their calving area to the Seventymile River and the upper Charley River drainages, caribou have utilized the Mt. Harper area and occasionally the upper reaches of the Middle Fork of the Fortymile River in the postcalving period.
3. Winter use area. In recent years, most of the FH has wintered in the southern half of Game Management Subunit (GMS) 20E. In early 1982, FH caribou were scattered throughout the northwestern portion of GMS 20E and mingled with 5,000-15,000 caribou from the Porcupine Herd that were wintering south of the Yukon River (Kelleyhouse 1983b). In some years, significant numbers of FH caribou winter in the Ladue River drainage or the Dennison Fork.

B. Present Abundance

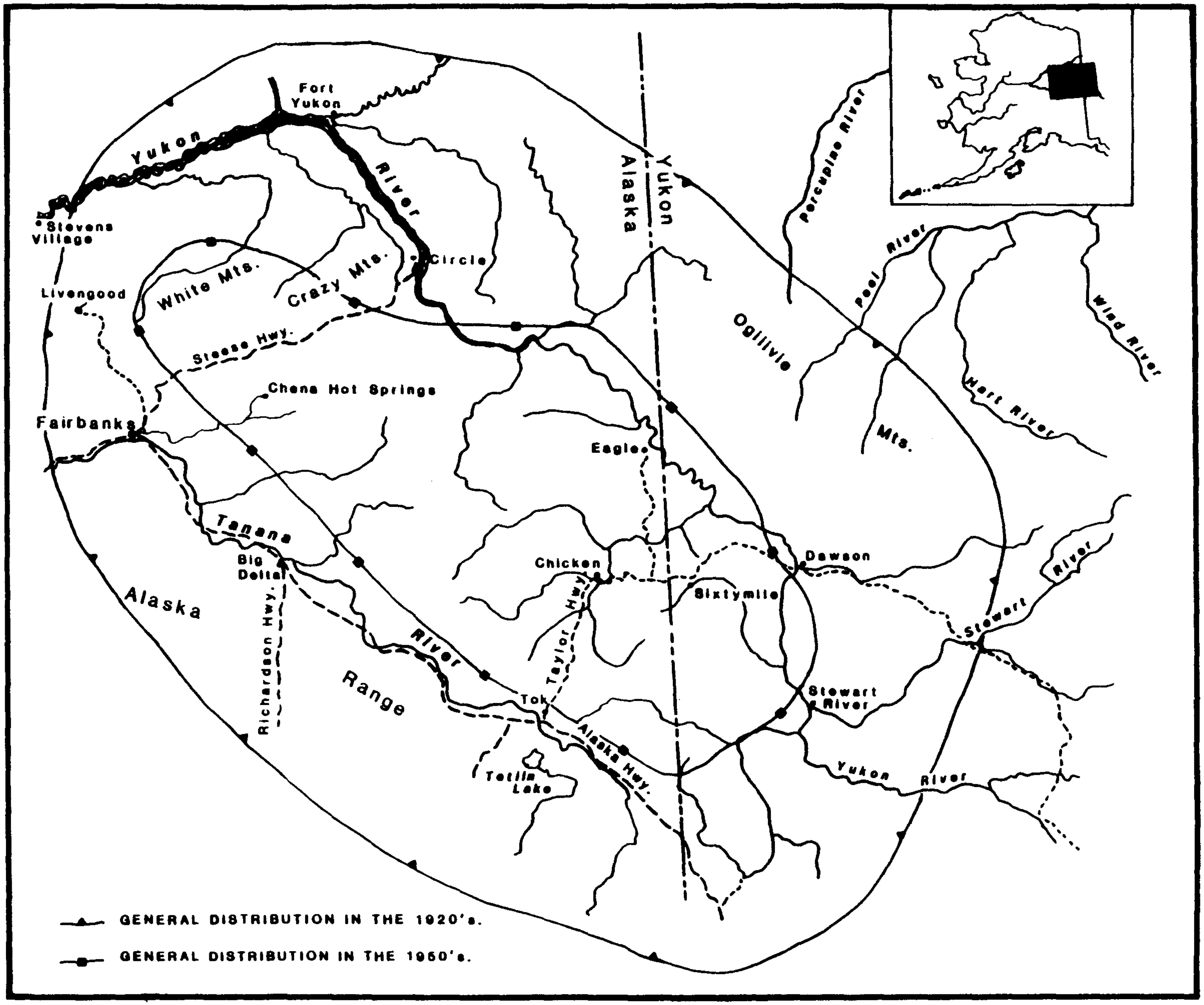
A photocensus of the Fortymile Herd (FH) was completed in June 1984. At that time, 12,356 caribou were counted, which was approximately the same known minimum number of caribou counted in the June 1983 photocensus (Kelleyhouse 1984, 1985b). The FH most likely contained 14,000 animals in 1983 (ibid.).

C. Historical Distribution and Abundance

Most of the printed historical information and many verbal records describing the Fortymile Herd have been summarized in great detail in Skoog (1956, 1968) and Murie (1935). The reader who desires more detailed information is referred to these sources. Most of the following account is derived from Skoog (1968).

Very little historical information exists that describes FH numbers and distribution prior to 1900. The earliest data indicate the distribution before 1900 was centered and ranged further east and southeast than in recent times, extending as far as the Skagway-Whitehorse area. All observations during the 1880-1900 period indicated that a large population of caribou occupied the Klondike country and other portions of southwest Yukon Territory but were scarce in the upper Tanana River region. At the turn of the century, the FH distribution is believed to have shifted to the northwest from the Whitehorse, Skagway area. From 1900 to 1920, herd numbers increased very rapidly, and the herd's range expanded in all directions (LeResche 1975). In the early 1900's, large numbers of caribou wintered near Dawson. Between 1906 and 1913, large fall migrations of caribou occurred in the Fairbanks-Circle area. In the fall of 1920, Murie (1935) described how he estimated a population of 568,000 caribou migrating across the Steese Highway northeast of Fairbanks. The main fall movement of FH caribou continued to the southeast, with most animals wintering in Canada along the hills adjacent to the Ladue, Sixtymile, Klondike, Steward, Pelly, and White rivers (Davis et al. 1978). By the mid 1920's, caribou numbers and distribution (see map 6) in east-central Alaska had probably peaked. In the winter of 1924, caribou were observed in the Whitehorse area and near the summits of the coast range above Skagway for the first time since before 1900 (Murie 1935). Many caribou were crossing the Tanana River, moving through Isabel and Mentasta passes into Southcentral Alaska, and extending as far as the Lake Louise flats and Copper Center. To the east, many animals were mixing with caribou from the Porcupine Herd wintering at the heads of the Porcupine and Peel rivers and in the Ogilvie Mountains (ibid.). To the northwest, seasonal movements across the Tanana at Nenana and the Yukon River between Rampart and Stevens Village were common during the 1920's (Skoog 1968).

Murie (1935) reevaluated his 1920 estimate of 568,000 caribou to between one and two million animals. In the late 1920's and early 1930's, the distribution and movements of FH caribou changed. The movements into Southcentral Alaska via Isabel and Mentasta passes ceased in 1931 (Scott et al. 1950). Throughout the 1930's, the main movement pattern of caribou from southeast to northwest remained but with ever-increasing movements to the northeast to winter in the Fort Yukon-Circle region (Skoog 1968). However, after 1939, caribou were once again scarce near Fort Yukon. Although actual observations did not exist, Skoog and others believed that large numbers of caribou had moved into the arctic regions. During the 1940's, the FH appeared to increase steadily, and the pattern of calving in the northwest and wintering in the southeast was maintained. In June 1953, Skoog (1956) estimated a herd size of 40,000 caribou, with high annual recruitment for the next few years. During the winter of 1956-1957, most of the FH wintered in the Ogilvie Mountains north



Map 6. Distribution of the Fortymile Caribou Herd (Davis et al. 1978).

of Dawson, an area also used by the Porcupine Herd. Skoog (1968) mentioned that in May 1957, as many as 30,000 caribou did not return to Alaska and were believed to have moved northward with the Porcupine Herd. Davis et al. (1978) pointed out that evidence also exists indicating that these animals ultimately did return to the FH.

The herd continued to grow steadily through the late 1950's and early 1960's and may have numbered about 50,000 animals in 1962 and 1963 (Skoog 1963, 1964). Davis et al. (1978), however, presented the possibility that a significant decline in numbers occurred from 1960 to 1964. The largest number of caribou observed and reported after 1960 was 26,000 in fall 1963 (Skoog 1964). Davis et al. (1978) suggested that the numbers of caribou observed by Skoog in fall 1963 may have comprised nearly the total population for the FH at that time. In any case, the limited population estimates made after 1963 suggested a lowered population from the 40,000-50,000 level to one that numbered 20,000-30,000 caribou. LeResche (1975) estimated the FH population to number 20,000 animals in 1969. Jennings (1972) further substantiated the ongoing rapid decline of the FH with an estimate of 10,000 caribou in fall 1972. In 1973, the first detailed census using the APDCE population estimation technique yielded an estimate of 5,312 caribou (Davis et al. 1978). This procedure was repeated the following year and resulted in an estimate of 4,041 animals in 1974. The decline in numbers of the FH was accompanied by a noticable decrease in size of the FH range. The herd became generally confined to an area between the Yukon and Tanana rivers. Hemming (1971) noted that from 1950 to 1965 the calving area shifted progressively east and south, across the Steese Highway. Jennings (1980) and Davis et al. (1978) both reported a minimum population estimate of 4,000 caribou in 1975. Jennings (1980) concluded that the population was still declining slightly through the winter of 1978. Poor survival of calves to the yearling age class precluded any growth of the FH during the mid-to-late 1970's. The condition of the FH range was considered good, and harvest mortality was minimal. Predation by wolves and brown bears was the main cause of the continued low recruitment into the reproductive age classes (ibid.). Another photocensus was conducted in June 1980 and indicated that FH numbers had almost doubled in size (8,000-10,000) since the last census in 1975 (4,000-6,000). Kelleyhouse (1981a) suggested that yearling recruitment data evaluated by Jennings (1980) may have underestimated the actual rates and also pointed out that other Alaskan herds have demonstrated the capacity to grow, through recruitment within the herd, at a rate fast enough to account for the apparently rapid growth in the FH since 1975. A photocensus in June 1983 yielded a minimum population estimate of 12,500 caribou, with herd size more likely at or greater than 14,000 animals (Kelleyhouse 1984). The increased hunter harvest of brown bears in the herd's postcalving area and a wolf reduction program in the FH's range may have resulted in the accelerated growth rate (ibid.).

X. BEAVER MOUNTAINS HERD (BMH)

A. Distribution

1. Calving area. The BMH has been observed calving in the Beaver Mountains since 1969 (Hemming and Pegau 1970). Pegau (1984, 1985) confirmed calving activity on the northwest side of the Beaver Mountains near the Windy Creek drainage in 1982 and 1983. However, in 1984, after moving from winter range to the area previously used for calving, the herd dispersed widely and calved from the Iditarod Lakes area to the lower Dishna River area (Pegau 1985). On 6 May 1982, a group of caribou moving south from the "traditional" calving area were observed with calves (Pegau 1984).

B. Present Abundance

In late June 1983, 1,164 caribou were counted in a census based on aerial photographs of almost the entire herd (Pegau 1985). This census indicated an estimated population of 1,200-1,500 caribou in the BMH. In a similar census completed at the same time in 1982, 713 caribou were counted (Pegau 1983). Previous population estimates ranged from 1,200 to 2,000+ during the 1970's to a low of 1,000 caribou in 1980 (ibid.). It appears that the BMH is currently at least stable or increasing slightly in numbers.

C. Historical Distribution and Abundance

The Kuskokwim Mountains have not supported great numbers of caribou in recent times. However, large herds were reported to occur in the Innoko River valley (Lutz 1960). At the turn of the century there were few caribou in the present range of the BMH, but many old trails were still evident (Dice 1921, Hemming 1971). Until the late 1930's, the area was occupied by the Twitchell reindeer herd (Pegau 1984). The Twitchell herd was abandoned in the early 1940's, and the remaining reindeer probably integrated with wild caribou in the area (Hemming 1971). Several traits typical of reindeer have been observed in the BMH: (1) reduced dispersal throughout the year, (2) occurrence of calving activity two to three weeks earlier than adjacent herds, and (3) observation of an animal with a pinto coat during caribou surveys in 1969, suggesting that at least one of the physical characteristics of domestic reindeer was still being expressed (Hemming 1971, Pegau 1984). A very small number of caribou were reported in the Kuskokwim Mountains west of McGrath (Scott 1952). The first calving observations along the crest of the Beaver Mountains were only reported in 1969 (Hemming and Pegau 1970).

XI. SUNSHINE MOUNTAIN HERD (SMH)

A. Present Abundance

Pegau (1984) estimated the population to number 525-750 caribou, based on a survey in June 1983. During late June 1982, 410 caribou were counted in five groups within the range of this herd, and 300-500 caribou believed to be SMH animals were observed during the winter of 1981-1982 in the Nixon River flats (Pegau 1983).

B. Historic Distribution and Abundance
No pertinent historical information was found.

XII. BIG RIVER (FAREWELL) HERD (BRH)

A. Present Abundance
The Big River Herd was estimated to number 650-750 animals during the 1982-1983 regulatory year (Pegau 1985). However, during summer 1983 two large groups totaling 325-375 caribou dispersed from the main herd and apparently did not return to the traditional calving area in 1984 (ibid.). The remainder of the herd utilized their normal range, but the size of the herd had diminished by half (ibid.).

B. Historic Distribution and Abundance
No pertinent historical information was found.

XIII. RAINY PASS HERD (RPH)

A. Present Abundance
Pegau (1984) estimated approximately 1,500 caribou in the Rainy Pass Herd.

B. Historic Distribution and Abundance
No pertinent historical information was found.

XIV. TONZONA HERD (TH)

A. Present Abundance
The Tonzona Herd contains less than 1,000 caribou (Pegau 1984).

B. Historic Distribution and Abundance
No pertinent historical information was found.

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Dall Sheep Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

In the Western and Interior regions of Alaska, Dall sheep are distributed throughout the Alaska Range from Lake Clark on the southwestern extreme of the range, north and east across the Alaska Range to the Tok area, and continuing into the Mentasta, Nutzotin, and northern Wrangell mountains near the Canadian border. Limited sheep distribution also occurs in the mountainous alpine regions of the Tanana-Yukon uplands. Portions of game management units (GMUs) or subunits (GMSs) within the Western and Interior regions where sheep occur include 12, 16B, 17B, 19B, 19C, 20A, 20C, 20D, 20E, and 25C. GMSs 16B and 17B are, respectively, located within the Southcentral and Southwestern regions' boundaries. Sheep populations in Alaska are recognized on a mountain range basis. Therefore, distribution and abundance information from these GMUs will be included in this discussion.

A. Regional Distribution

Sheep distribution in areas near the southwestern extreme of the Alaska Range is discontinuous, with sheep locally abundant in small pockets of distribution separated by areas with few or no sheep. Most of the sheep habitat in this area has been included within the boundaries of Lake Clark National Park/Preserve, established in 1980.

Distribution of sheep along the south slope of the Alaska Range is also discontinuous, with sheep occurring in some areas, separated from each other by areas of unsuitable habitat. There is probable interchange of sheep between the north and south slopes of the range in some of these areas of local abundance; however, the extent of interchange is unknown (Tobey, pers. comm.).

Distribution of sheep along the north side of the Alaska Range is continuous from at least the Windy Fork of the Kuskokwim River eastward to the Mentasta and northern Wrangell mountains near the Canadian border (ADF&G 1977).

In the Tanana-Yukon uplands, sheep occupy alpine areas of Glacier Mountain, the headwaters of the Charley River, Twin Mountain, West Point, Mount Sorenson, and the headwaters of the Salcha and East Fork of the Chena rivers. Sheep are also found in limited alpine habitat near Mount Victoria, Mount Schwatka, Mount Prindle, Lime Peak, Cache Mountain, and the White Mountains (ibid.).

Sheep distribution in this area is disjunct, with small groups widely scattered throughout limited available alpine habitat (ibid.).

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 summer range (Heimer 1973), although some researchers have identified several other seasonal use areas for mountain sheep (Geist 1971). Winter range is characterized by areas of low snow accumulation, higher elevations, wind-swept ridges, or other areas protected from snow. The entire mountain block that sheep inhabit is available to sheep populations for summer range. Mineral licks are visited by most, if not all, Dall sheep populations (Heimer 1973).

In the Tanana/Yukon uplands area, Dall sheep occupy about 1,954 mi^2 of alpine habitat in the eastern interior (ADF&G 1977). Sheep habitat in this area is limited and generally lower in elevation than in other areas of Alaska. Spruce forests are encroaching on sheep habitat in this area, and rugged, steep outcrops typical of sheep range elsewhere in Alaska are scarce (ibid.). Sheep must travel through forested areas to reach water or adjacent suitable sheep habitat. The scarcity of escape terrain and the necessity of travelling through forested areas make these sheep vulnerable to predators (ibid.). (For further information, see the 1:1,000,000-scale maps in the Map Atlas to the Western and Interior 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 licks of sheep in the Western and Interior regions.)

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.

Summer range use in some areas is affected by winter snow deposition and the timing of the snowmelt. 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 snowmelt (Heimer 1973).

The Tanana-Yukon uplands area is drier than other sheep range because of the light annual snowfall and dry interior climate and the rapid drainage provided by the porous sandstone and limestone substrate (ADF&G 1977). These conditions prevent snow from becoming a serious problem for sheep, except during heavy snow years. Sheep are therefore able to utilize most of the habitat available to them.

D. Movements Between Areas

In many areas, movements by Dall sheep between seasonal use areas are associated with mineral licks (Heimer 1973). In these areas, sheep travel from their winter range to the mineral lick, 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-late June (ibid.). Distances traveled one way range from 2 to 12 mi (3.2 to 20 km) (ibid.).

Tanana/Yukon uplands sheep are also associated with mineral licks, and several have been located. In April 1983, six ewe sheep were radio-collared in this area, to study seasonal lick movements and use areas (Jennings 1984a).

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. Sheep populations can fluctuate 15 to 20% annually, primarily because of natural conditions. If possible, it would be preferable to survey sheep populations on a more frequent basis to establish when these fluctuations occur (Heimer, pers. comm.).

Aerial survey information on population composition is presented in the form of total sheep observed, lambs observed, lambs per 100 "ewes," 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 "ewes."

F. Regional Abundance

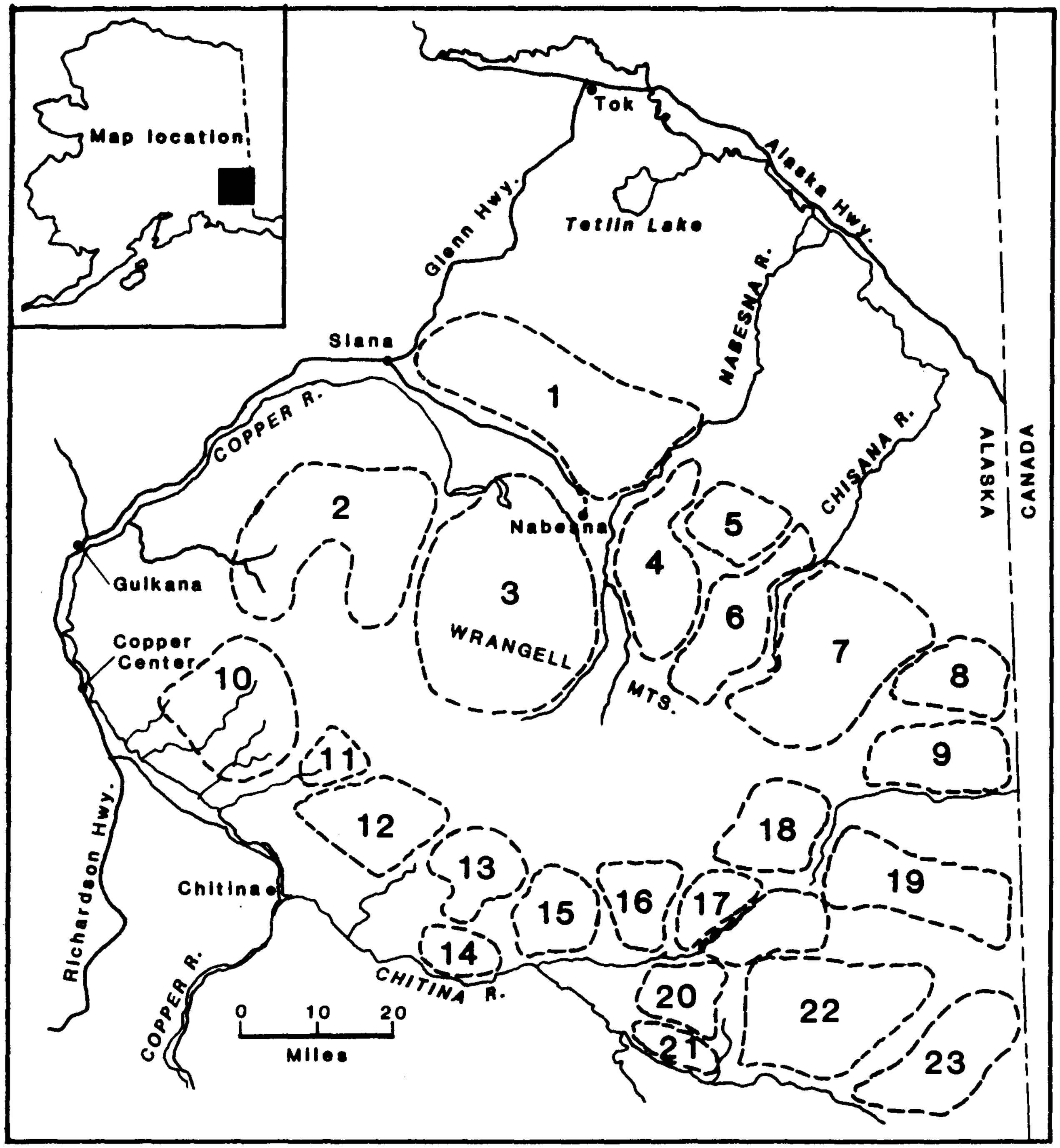
At least 70,000 Dall sheep are currently estimated to be present in the Alaskan sheep population (Heimer 1984). Approximately 24,000 sheep are present in the Western and Interior regions (ibid.). Densities and population composition vary by areas. Specific regional abundance information is given in the following paragraphs.

II. ALASKA RANGE

A. GMU 12 (Excluding Delta and Tok Management Areas)

In 1981-1982, the National Park Service (NPS) and the ADF&G determined Dall sheep distribution and abundance within the Wrangell-St. Elias National Park/Preserve (Singer 1982). Portions of GMU 12 were surveyed, including count units 1,3,4,5,6,7,8,9, and 19 (map 1). Other count units surveyed at that time are discussed in the Southcentral Region narrative.

1. Present abundance. During 1981-1982, a total of 6,397 sheep (table 1) were visually counted in six of nine count areas located in GMU 12 within Wrangell-St. Elias National Park/Preserve (map 1) (ibid.). Two count areas (1 and 5) were not surveyed during 1981-1982 but had surveys conducted in the early 1970's (Heimer and Smith 1979). One count area



Map 1. NPS survey areas in the Wrangell Mountains as listed in table 1 (Singer 1982).

(19) was not surveyed, and an estimate of sheep in this area was based on densities in adjacent areas (Singer 1982). 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 9,856 sheep.

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

Heimer (1984) states that approximately 12,000 sheep occur in this area. This estimate is based on aerial surveys conducted in the area mentioned above, plus additional surveys conducted in sheep habitat adjacent to Wrangell-St. Elias Park/Preserve.

2. Historic abundance. Historic information on Dall sheep populations in this area is very limited. It is possible that populations followed the general historic trend for sheep in Alaska, with high early 1900's populations decreasing because of hunting, intermittent severe weather conditions, and increasing predator numbers. Extensive mining operations and the accompanying high human population in this area during the early 1900's probably provided for an extensive harvest of sheep for food during all periods of the year. Severe winters during the late 1930's and early 1940's resulted in heavy winter sheep mortality in some areas of the state and possibly in this area also. Predator control reached a high point in the mid 1950's, and activity has since declined.

In October 1939, almost 500 sheep were observed in an area adjacent to Ptarmigan Lake in the southeast corner of GMU 12 (Scott et al. 1950). During an aerial survey of that area in September 1949, only 228 sheep were observed, with a total estimated population of not more than 300 animals (ibid.).

These surveys were pioneer efforts at estimating sheep distribution and abundance in Alaska utilizing aerial survey techniques. The aircraft available during that period 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 are not comparable to modern techniques or effort (Heimer, pers. comm.).

B. GMU 12, Tok Management Area

1. Present abundance. The Tok Management Area (TMA) encompasses portions of GMUs 12, 13C, and 20D. It includes that portion of the Alaska Range bounded on the east by the Glenn Highway, on the north by the Alaska Highway, and on the west by the

Johnson Glacier-Johnson River (ADF&G 1979). It is managed specifically for large-horned, trophy-class Dall sheep.

During 1983, limited aerial surveys were conducted in the TMA. Based on these surveys, the TMA sheep population was estimated to be approximately 2,000 sheep (Kelleyhouse 1984a). This is an increase of about 10% from the 1982 estimate of 1,800 sheep (Kelleyhouse 1984b). The 1982 estimate was made after the TMA sheep population had experienced some mortality in the older age classes as a result of the moderately severe winter of 1981-1982. Based on the 1983 surveys, this decline appears to have been temporary, and the sheep population is now considered to be stable (Kelleyhouse 1984a).

During 1984, aerial surveys were conducted in the portion of the TMA north of the Tok River, which is approximately one-half the total area of TMA (Kelleyhouse 1985). A total of 998 sheep were observed, including 279 rams and 190 lambs (ibid.).

Table 2 presents information from sheep surveys conducted in the TMA during 1974, 1980, and 1984. The 1980 effort is the only complete survey of the area. Surveys were attempted in other years but were incomplete because of inclement weather or limited funding, and results are not comparable. Limited composition information for years of incomplete surveys is available from ground survey work conducted at the Sheep Creek mineral lick. As seen in table 2, the percentage of lambs in the population has fluctuated but has averaged 22.6% during 1980-1984. The 1974 aerial survey results are not directly comparable to later surveys, primarily because of regulation changes for legal rams. Nonetheless, there has been an apparent population increase since 1974, as evidenced by the total number of sheep observed and the number and percentage of lambs in the population.

2. Historic abundance. No historic information pertaining to this particular area was located.

C. Delta Controlled Use Area

The Delta Controlled Use Area (DCUA) includes the drainages of the Delta River from McGinnis Creek south to Castner Glacier and the southern drainages of the Tanana River from the Delta River upstream to the Johnson River. Portions of GMSs 13B, 20A, and 20D are included in this area, which is managed for aesthetic hunting conditions (Larson 1981).

1. Present abundance. The present sheep population estimate for the DCUA is 1,500 animals (Johnson, pers. comm.). This estimate was derived from aerial surveys conducted in 1980, when 1,105 sheep were observed (table 3). This is lower than the 1,370 sheep observed during a 1974 survey but still relatively comparable. No additional aerial surveys have been attempted since 1980 (Johnson 1984).

Ground composition counts have been conducted at the Granite Creek mineral lick from 1979 through 1983. Only a portion of the population is observed during these counts, and all categories of sheep cannot be determined.

Table 3 provides the limited composition information available for this population. The percentage of lambs in the population dropped considerably in 1983 to 14%, indicating a very low production rate and subsequent recruitment into the population. The 1983 ratio of lambs/100 "ewes" (29) is the lowest since 1974 (ibid.). No explanation for this low production is available at this time.

2. Historic abundance. No historic abundance information was available for this area.

D. GMU 20-Alaska Range East (ARE)

The area designated as Alaska Range East (ARE) covers the Central Alaska Range east of Denali National Park, excluding the Tok Management Area and the Delta Controlled Use Area.

1. Present abundance. The sheep population in the ARE portion of GMU 20 is estimated to be more than 5,000 animals (Heimer 1984). The population is dense compared to other sheep populations in the state and is probably stable. Lamb survival and subsequent recruitment have fluctuated in recent years; however, variations have had a relatively minor effect on the overall population (Jennings 1984a). Composition and productivity data for this population is determined from ground observations conducted at Dry Creek mineral lick. This type of observation samples only a portion of the population, and not all categories of classification can be determined. Table 4 lists the limited population information available from these observations. Lamb production and survival has remained relatively high, except for 1982. The 1982 figure of 31 lambs/100 ewes is probably attributable to the severe winter conditions of 1981/1982 (ibid.).

Most ewes in this population exhibit alternate year reproduction (i.e., produce a lamb every other year), and therefore recruitment into the population is relatively low even in normal years (ibid.). However, recent observations of marked ewes in the population have indicated that consecutive year breeding and production has increased from a low of 6% (1977-1981) to 40% (1981-1984) (Jennings 1985). These changes in reproductive patterns may be related to an increase of mature rams in the population (ibid.).

2. Historic abundance. There is very little information concerning historic sheep populations in this area. However, based on incomplete aerial surveys, Scott et al. (1950) stated that an estimated 4,000 sheep inhabited the Alaska Range from the Canadian border to Lake Clark. These surveys were pioneer efforts at estimating sheep distribution and abundance in Alaska utilizing aerial survey techniques. The

aircraft available during that period 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 are not comparable to modern techniques or effort (Heimer, pers. comm.).

E. Tanana/Yukon Uplands - GMSs 20E and 25C

1. Present abundance. Sheep in this area are characterized by disjunct, low-density populations, which are probably slowly declining because of low production and survival (Jennings 1984a). The total sheep population in this area is estimated to contain 650 animals (Heimer 1984).

   In 1982, aerial surveys were conducted in this area to determine population composition. A total of 419 sheep were observed, which included 162 rams, 216 ewes, and 41 lambs (Jennings 1984a). The percentage of lambs in the population (10%) and the low lamb/ewe ratio (8 lambs/100 ewes) indicates very low production and recruitment into the population.

   Low recruitment into this population has only recently become apparent. Ground composition surveys conducted in 1980 and 1981 indicated good recruitment, with 66 lambs/100 ewes and 59 lambs/100 ewes, respectively (Jennings 1982, 1983). These ratios were determined from a relatively small sample size and therefore may not be representative.

2. Historic abundance. Scott et al. (1950) described the sheep in this area as small relict bands numbering only about 250 animals. No additional historic information was found for this area.

F. Alaska Range West (ARW) - GMSs 19C, 19B, 16B, and 17B

This area includes that portion of the Alaska Range west and south of Denali National Park extending to the area near Telaquana Lake and Lake Clark. Distribution of sheep is widely scattered, with areas of moderate sheep density separated by major river drainages or areas of nonpreferred habitat.

1. Present abundance. At least 4,000 sheep are estimated to occur in the western Alaska Range. The population trend is unknown, although it is thought to be stable overall (Pegau 1985).

   The Lake Clark National Park and Preserve now encompasses most sheep habitat in GMSs 17B and 19B of the Alaska Range. The NPS conducted helicopter aerial surveys of the park/preserve area in 1981. The total number of sheep observed was 805, which is considerably more than the previous total of 178 observed in 1974 (table 5). The total sheep population for the Lake Clark National Park/Preserve is estimated to be 1,000 animals (Pegau 1984).

   The apparent increase in sheep numbers in the Lake Clark Park/Preserve can be attributed partially to an increase in the area surveyed, an increase in time spent surveying, and different survey techniques. Sheep populations in this area were probably underestimated previously (ibid.).

The majority of sheep occurring in Alaska Range West are located in three areas of GMS 19C: Tonzona River, South Fork of the Kuskokwim River, and Windy Fork of the Kuskokwim River. The total sheep population in these areas is estimated to be about 2,000-2,500 animals.

Table 6 presents aerial survey information collected from these three areas. Surveys, in some cases, are not directly comparable from year to year because of slight differences in area surveyed.

There is an apparent increase in total sheep observed in these areas. This increase can be attributed to a possible real increase in the sheep population or to better survey effort and techniques. It is most probably a combination of those factors. Current population status is believed to be reflected by the most recent surveys.

2. Historic abundance. No specific historic abundance information pertaining to this area was located.

Table 1. Recent and Highest Previous Counts of Dall Sheep in Nine Count Units in Wrangell-St. Elias National Park/Preserve

Count Unit	Recent Count 1981	% Change From Last Previous Count	Last, Most Complete, & Accurate Count	Year of Last Count
1	---	*	1,072	1982
3	1,639	*	1,907	1973
4	1,366	*	699	1973
5	---	---	66[a]	1974
6	1,343	+140%	493[a]	1974
7	996	+190%	343[a]	1974
8	889	+388%	182[a]	1974
9	164	- 79%	763	1973
19	350	*	---	
Total count	6,397		5,525	
Count plus estimate for uncounted units	7,885		5,875	
Estimated population	9,856		7,344	

Source: Singer 1982.

--- means no data were available.

a Helicopter count.

* Boundaries changed or only part of the unit was counted. No comparisons were made.

Table 2. Composition of Sheep Observed in the Tok Management Area, 1974 and 1979-84

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1974	TMA	156*	103	220	760	1,266	---	17.4
1979	TMA	a	---	---	---	---	63	---
1980	TMA	151	279	394	859	1,698	69	23.2
1981	TMA	a	---	---	---	---	52	26.0
1982	TMA	---	---	---	---	---	---	---
1983	TMA	a	---	---	---	---	43	22.0
1984	TMA	279[c]	---	190	529	998[b]	45	19.0

Source: Kelleyhouse 1981, 1982, 1983, 1984a, 1985.

--- means no data were available.

* In 1974, legal rams were 3/4 curl; in 1980, legal rams were 4/4, full curl.

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

a No aerial surveys. Ground composition data only.

b Partial survey. Approximately 1/2 of TMA was surveyed.

c Includes sublegal rams.

Table 3. Composition of Sheep Observed in the Delta Controlled Use Area, 1974, 1979-83

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1974	DCUA	155	144	280	791	1,390	29	20.4
1979	DCUA	---	---	---	---	---	68	---
1980	DCUA	---	---	---	---	1,105	43	22.0
1981	DCUA	---	---	---	---	---	29	---
1982	DCUA	a	---	---	---	---	---	---
1983	DCUA	---	---	---	---	---	29	14.0

Source: Johnson 1983, 1984, pers. comm.

--- means no data were available.

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

a No reliable data from ground surveys.

Table 4. Composition of Sheep Observed at Dry Creek Lick, GMU 20, Alaska Range East, 1979-83

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1979	Dry Creek	---	---	---	---	---	65	---
1980	Dry Creek	---	---	---	---	---	69	---
1981	Dry Creek	---	---	---	---	---	60	---
1982	Dry Creek	---	---	---	---	---	31	---
1983	Dry Creek	---	---	---	---	---	55	---

Source: Jennings 1981, 1982, 1983, 1984a, 1984b.

--- means no data were available.

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

Table 5. Composition of Sheep Observed in the Lake Clark Area of the Alaska Range West, 1974, 1981

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1974	Telaquana Lake-Lake Clark	7[a]	---	53	118	178	---	3.0
1981	Telaquana Lake-Lake Clark	169[a]	---	193	596	805	---	2.4

Source: Pegau 1984.

--- means no data were available.

a Includes all rams observed.

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

Table 6. Composition of Sheep Observed in GMU 19C, Alaska Range West

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1974	Tonzona R.	---	---	42	---	234	27	18
1977	Tonzona R.-Dillinger R.	---	---	46	---	308	38	15
1978	Pingston Cr.-Dillinger R.	---	---	112	---	468	51	24
1969	S. Fork Kuskokwim	---	---	78	---	392	40	20
1972	S. Fork Kuskokwim	---	---	26	---	535	17	5
1975	Upper S. Fork (incomplete)	---	---	21	---	101	43	21
1973	Sheep Cr.-Windy Fork	---	---	71	---	325	81	22
1974	Sheep Cr.-Windy Fork	---	---	63	---	323	29	18
1975	Sheep Cr.-Windy Fork	---	---	31	---	225	41	14
1976	Sheep Cr.	---	---	62	---	329	36	19
1977	Sheep Cr.-Windy Fork	---	---	130	---	466	53	28

Table 6 (continued).

Year	GMU Area	Legal Rams	Sublegal Rams	Lambs	Unclass.**	Total	Lambs/100 "Ewes"	% Lambs
1978	Sheep Cr.- Windy Fork	---	---	116	---	555	40	21
1984	Sheep Cr.	---	---	116	---	485	45	24

Source: Pegau, pers. comm.

--- means no data were available.

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Moose Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

The following information is organized by game management unit (GMU) or, where information is available, by subunit (GMS)(see map 1.) The Western Region is composed of GMU 18 and GMSs 19A and B. The Interior Region is composed of GMUs 12, 20, 21, 24, and 25 and GMSs 19C and D.

A. Regional Distribution

In the GMU 18 portion of the Western Region, moose densities are extremely low, with the exception of the Yukon River drainage above Ohogamiut (Machida 1985). They are found throughout GMSs 19A and B of the region (ADF&G 1977). Moose inhabit all of the Interior Region except alpine areas (LeResche et al. 1974).

B. Areas Used Seasonally and for Life Functions

To supplement the distribution information presented in the text, a series of blue-lined reference maps has been prepared for each region. Most of the maps in this series are at 1:250,000 scale, but some are at 1:1,000,000 scale. These maps are available for review in ADF&G offices of the region or may be purchased from the contract vendor responsible for their reproduction. In addition, a set of colored 1:1,000,000-scale index maps of selected fish and wildlife species has been prepared and may be found in the Atlas that accompanies each regional guide.

The following categories of distribution were mapped:

° General distribution
° Known calving concentrations
° Known rutting concentrations
° Known winter concentrations

C. Factors Affecting Distribution

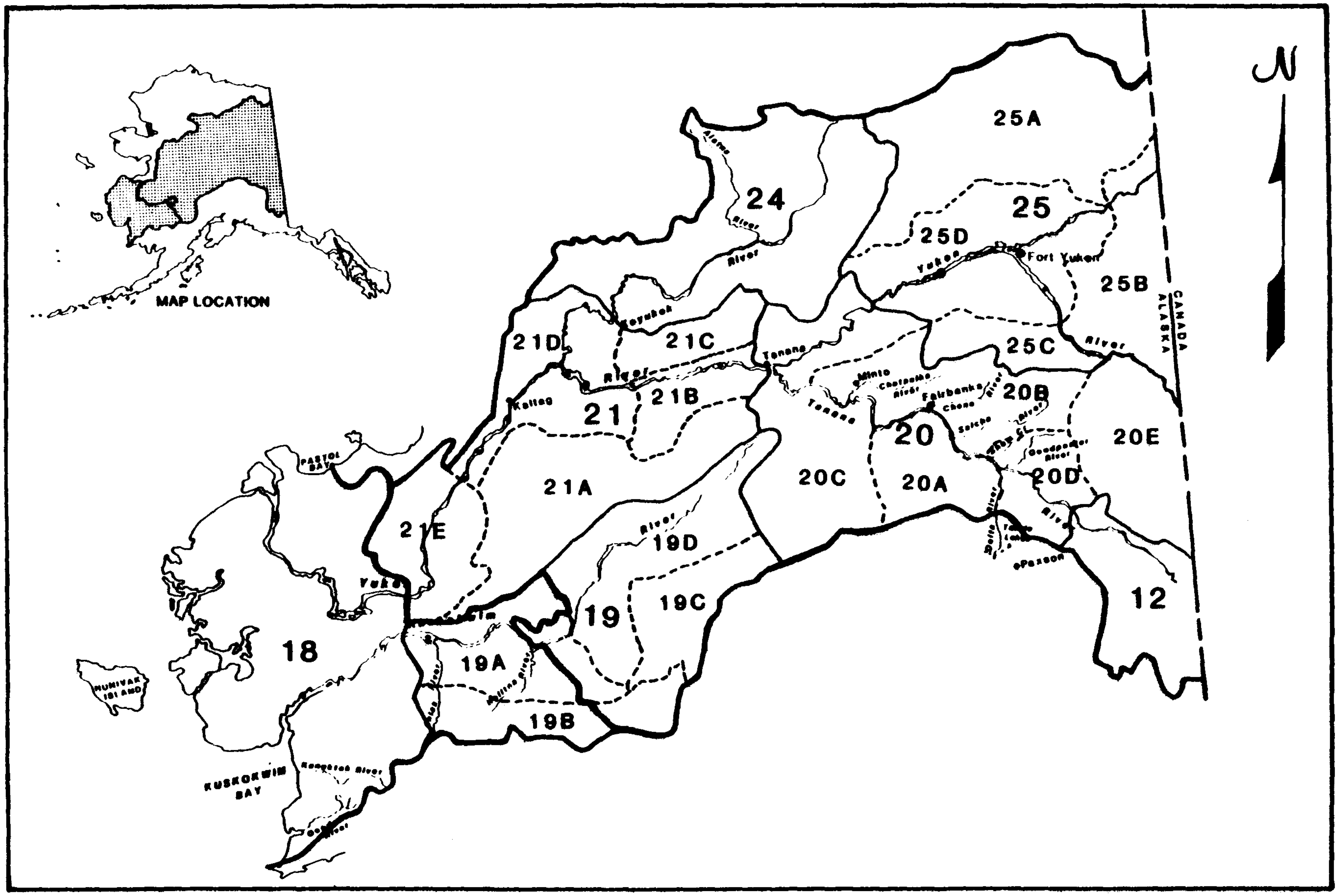
Numerous factors can influence the seasonal and long-term distribution of moose. Some of these factors are snow depth, elevation, range condition, fire, predator density, hunting pressure, and land use.

D. Movements Between Areas

The movements of moose can consist of local travel within seasonal ranges, migration between seasonal ranges, or dispersal to new ranges. Variable movements by individuals or segments of moose populations make it difficult to precisely delineate the patterns. Some animals may seasonally migrate during different times to different locations, for example, whereas others may remain resident throughout the year (Coady 1982).

E. Population Size Estimation

Abundance estimates are based on several techniques or combinations of techniques. Gasaway et al. (1981) have developed a sampling procedure for estimating moose abundance based on a stratified sampling design that includes estimating sightability



Map 1. GMUs of the Western and Interior regions.

under different environmental conditions. Such censuses have been conducted in portions of some GMUs within the Interior Region. The results from these censuses combined with fall composition counts in specific areas allow gross population estimates to be made for individual composition count areas. In some instances, gross estimates are extrapolated for subunits, 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, however. There are great differences among sampling intensities, the experience of pilots and/or observers, habitats, light conditions, and so forth, all of which can drastically alter estimates and jeopardize meaningful comparisons among areas.

Determining the number of moose present but not observed during aerial surveys is a major obstacle to making accurate estimates of population size (ibid.). 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 and by the experience level of the observer-pilot. 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 not necessarily present at the time of the survey, whereas fresh snow would permit an observer to "read" tracks more clearly and to locate the moose more readily.

F. Regional Abundance

Abundance estimates, where available, will be discussed by GMU and/or GMS.

G. Historic Distribution and Abundance

Moose distribution has changed little in the Western and Interior regions in the last 20-30 years; that is, no previously unoccupied range has been populated (LeResche et al. 1974). In the Yukon-Kuskokwim delta portion of the Western Region, moose densities have been and remain extremely low (LeResche et al. 1974, Machida 1985). In the remainder of the Western Region and in the Interior Region, changes in abundance have occurred. Apparently, moose numbers gradually increased during the late 1940's, 1950's, and early 1960's, reaching a maximum during the mid 1960's. Since then, moose numbers have declined because of severe winters. In addition to severe winters, predation has been a major contributing factor to reduced populations since 1971 (ADF&G 1977).

II. GMU 12

A. Present Abundance

Kelleyhouse (1985a) reports that "approximately 2,500 moose are thought to inhabit the 8,500 mi^2 Unit 12 area. Moose densities are low throughout much of the unit, and estimated densities range from 0.1 $moose/mi^2$ in the Tetlin-Northway flats to 1.0 $moose/mi^2$

in the Tok River drainage." Moose populations in most of the subunit are stable. In the Little Tok drainage, however, numbers may have declined in recent years but increased in the northwestern portion of the subunit (Kelleyhouse 1985a). Predation by bears (Ursus spp.) and wolves (Canis lupus) appears to be the primary mortality factor limiting moose populations in GMU 12 (ibid.).

III. GMU 18

A. Present Abundance

The moose population in GMU 18 remains extremely low, with the exception of the Yukon River drainage above Ohogamiut. It is believed that the moose population numbers 600 to 800 animals in GMU 18 and that the density in most areas of suitable habitat is less than 0.1 moose/mi^2 (Machida, pers. comm.). Suitable habitat is available along both the Yukon and Kuskokwim river drainages; however, heavy hunting pressure and out of season harvest effectively limit the moose population throughout the unit (Machida 1984, 1985).

IV. GMU 19

A. Present Abundance

Abundance estimates currently are not available for GMU 19. In Subunit 19A, the moose population appears to be increasing, and current recruitment should provide for its continued increase. The population in Subunit 19B appears stable. In Subunit 19C, however, the population may be declining. The population in most of Subunit 19D outside the Upper Kuskokwim Controlled Use Area is probably stable. In the controlled use area, the population level remains relatively low. Yearling recruitment and calf survival has continued to decline in the Cloudy and Sunshine mountains area (Pegau 1985).

V. GMS 20A

A. Present Abundance

Based on censuses conducted in 1978 and 1982 of the Tanana flats portion of Subunit 20A, the moose population in the area numbers about 4,000 animals. An estimated 4,000 additional moose inhabit the remaining foothills portion of the subunit (Haggstrom, pers. comm.). Currently, the population appears to be increasing, although the rate of increase may be declining. Increased predation due to higher wolf numbers in the area is probably responsible for the reduced rate of increase. In the foothills portion of the subunit, brown bears may be an additional factor negatively affecting the rate of increase. Brown bears are largely absent from the Tanana flats (ibid.).

VI. GMS 20B

A. Present Abundance

The moose population is estimated to be approximately 4,800 animals in GMS 20B. The average density estimate is 0.57 moose/mi^2 in the subunit (Crain and Haggstrom 1985a). The population appears to be increasing in the Chena drainage. Counts conducted during fall 1983 indicate that the moose density on the eastern side of the Minto flats is low and possibly increasing from very low densities, probably because of predator control in the central portion of Subunit 20B in previous years. Moose densities on the western side of the Minto flats and the Manley Hot Springs area are lower, and the population is either declining or stable at low densities. Population trends in the Salcha River drainage appear to be increasing in the lower third of the drainage but are largely unknown in the upper two-thirds of the drainage (ibid.).

VII. GMS 20C

A. Present Abundance

Little is known about the present abundance of moose in Subunit 20C other than that densities are low. Trend survey data from a portion of Denali National Park indicate that moose numbers continue to decline. Trends are unknown elsewhere in the subunit. Poaching and predation are thought to be substantial mortality factors in the subunit (Crain and Haggstrom 1985b).

VIII. GMS 20D

A. Present Abundance

The moose population varies throughout Subunit 20D. South of the Tanana River and downstream from Johnson River the population appears to be of medium density and to be increasing at about 5%/year. South of the Tanana and upstream from Johnson River the low-to-medium-density population appears to be increasing more slowly. North of the Tanana River limited data suggest a stable or declining low-density population (Johnson 1985).

IX. GMS 20E

A. Present Abundance

There are an estimated 1,400-2,000 moose in Subunit 20E. Densities are low at about 0.2 moose/mi^2 and likely declining in most of the subunit. It appears that wolves and brown bears may be significant mortality factors influencing the population (Kelleyhouse 1985b). Browse plant use is light and not limiting to population growth (ibid.). Implementation of the Fortymile Fire Management Plan will ensure a near-natural fire regime in much of the area, which will result in a more heterogeneous habitat mosaic than currently exists and provide for future habitat needs of moose (ibid.).

X. GMS 20F

A. Present Abundance

Few population data are available for Subunit 20F, but indices suggest a low and probably stable moose population. Although habitat appears to be generally in poor condition, it probably is not limiting the moose population size at present. Other factors, including predation and poaching, may be restricting the population to its current low level (Jennings 1985b). If recruitment improves and the moose population increases, it appears habitat may then become a major limiting factor. Fire management would then play an important role in habitat rehabilitation through prescribed burning and/or reduced wildfire suppression (ibid.).

XI. GMS 21A

A. Present Abundance

Moose population data are very limited for Subunit 21A. What limited data exist indicate a stable population (Osborne and Pegau 1985).

XII. GMS 21B

A. Present Abundance

A moose population census conducted during the fall of 1980 produced a population estimate of 2,700 moose in Subunit 21B (Osborne 1985a). Based on trend surveys since the 1980 census, a slight decline in moose densities is indicated in the area of the Nowitna-Sulatna confluence. Along the Yukon River, an increase has been observed. Elsewhere in the subunit, the population appears to be stable (ibid.).

XIII. GMS 21C

A. Present Abundance

Little useful information concerning the moose population in Subunit 21C is available. One trend area surveyed by BLM personnel in 1983 had an observed density of 0.67 moose/mi^2. The moose population in the Melozitna River drainage is low but thought to be stable (Osborne 1985b).

XIV. GMS 21D

A. Present Abundance

Along the Koyukuk River from the Kateel River mouth to Dulbi Slough, observed densities during November 1983 were high at 4-6 moose/mi^2. Both recruitment and mortality were estimated at 12%, and the population was stable. Moderate densities of 2.3-3.8 moose/mi^2 were observed along the Yukon River lowlands from Ruby to Last Chance. Lower densities of 1.5 moose/mi^2 were observed form Last Chance to Quail Island. Along the Yukon River lowlands, recruitment and mortality are estimated at 24%, and the population is stable. Observed early winter densities in the Nulato Hills and Kaiyuh foothills were 0.5-0.6 and 0.2 moose/mi^2, respectively. Population trends are unknown (Osborne 1985c).

XV. GMS 21E

A. Present Abundance

The few trend area counts and composition counts conducted in Subunit 21E indicate a healthy, probably increasing moose population (Osborne 1985d).

XVI. GMU 24

A. Present Abundance

Observed moose population densities in the Koyukuk River lowlands in the southern one-third of GMU 24 ranged from 1.0 to 3.3 moose/mi^2, and the population appears to be stable. Moose densities are very low at 0.3 moose/mi^2 in the Kanuti Flats portion of the Kanuti Controlled Use Area. The population appears to be stable in the Alatna Hills portion of the area but declining throughout the remainder of the area. That portion of GMU 24 lying north of Bettles has a moderate density of 0.9 to 1.5 moose/mi^2 and an increasing population (Osborne 1985e). Within the Kanuti Controlled Use Area, moose mortality currently is estimated at 17 to 20%, exceeding the recruitment rate of 6% (ibid.).

XVII. GMU 25

A. Present Abundance

Moose density is low in most of GMU 25, and population trends vary from stable to declining. The population in western Subunit 25D is critically low. An estimated 800 animals inhabit this area at an average density of 0.1 moose/mi^2. Movements of radio-collared moose in western Subunit 25D indicate that two distinct populations exist in the area. One was found in a relatively small area along the Yukon River corridor between Beaver Village and the lower mouth of Birch Creek. Another group occupies the remainder of western Subunit 25D. The two populations are distinct in several ways. Moose densities along the river corridor are about 0.2 moose/mi^2, while outside it the density is about 0.1 moose/mi^2. Moose are basically nonmigratory inside the corridor, whereas at least half the animals outside the corridor migrate between the Yukon Flats and the surrounding uplands. Calf survival to late winter 1984 was much greater (27% of the herd) within the corridor, compared to outside the corridor (9% of the herd). Data from the previous four years indicate that calf survival to fall was consistently higher inside the corridor than outside (31% vs 22% of the herds, respectively). Similarly, moose survival to 1.5 years of age was greater inside the corridor than outside (17% vs 10%, respectively) (Nowlin 1985). Hunting and wolf predation appear to be the most important sources of mortality. Hunters harvested between 20 and 35 moose (approximately 4% of the fall population) during the 1983-1984 hunting season. Wolves probably killed at least 120 moose (approximately 15% of the fall population) (ibid.).

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Birds

Ducks and Geese Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

Estimates of waterfowl distribution and abundance have been made in Alaska annually by the USFWS from the late 1940's to the present. Survey methods have been standardized (Hodges and Conant 1985) so data are comparable and are the basis of most of the discussion to follow. Because of USWFS survey design, distribution and abundance will be given for ducks and geese as groups with area- and species-specific information provided when available. Information is organized by survey area, with separate discussions for the Yukon-Kuskokwim Delta (YKD), Yukon Flats, Tetlin-Northway, Innoko, Tanana-Kuskokwim (including the Minto flats), and Koyukuk areas.

A. Regional Distribution

The Western and Interior regions contain some of the most productive and important waterfowl breeding areas in North America. Most of the waterfowl in the Pacific Flyway as well as birds from the Central and Atlantic Flyways breed in Interior and Western Alaska. Waterfowl breeding in the Arctic Region also may rest and stage in the Western and/or Interior regions, depending on their migration routes. In general, waterfowl arrive in the Interior and Western regions shortly before breakup in April or May and stay through freeze-up in October (USFWS 1964).

1. Yukon-Kuskokwim Delta. Most cackling Canada geese nest in the 30-km-wide coastal fringe of the delta from approximately 59°40'N to 63°15'N. The area from Nelson Island to Cape Romanzof supports the majority of the population, with nesting densities often exceeding 20 nests/mi² (Mickelson 1975).

White-fronted geese nest throughout the delta area, but spring breeding pair survey data show that they are more common within 30 km of the coast (Timm and Dau 1979).

About 90% of the world population of emperor geese nest on the YKD (ibid.), where they used to be plentiful at numerous locations around the mouth of the Kuskokwim River, on Nelson Island, and in Hazen Bay (Peterson 1985). Presently, they are numerous only at two locations on the YKD: Kokechik Bay (Igigak Bay) and along the Manokanak River in Hazen Bay (ibid.).

Spectacled eiders migrate along the offshore coastal fringe of the YKD in the shore leads and adjoining areas of broken and drifting ice (Dau and Kistchinski 1977). Spectacled eiders have not been observed nesting farther than 30 km inland on the YKD, and very few are found more than 20 km inland.

Inland from the coast, the country is drier and the climate less marine, resulting in slight vegetative changes; ducks rather than geese become the most abundant form of waterfowl (King 1972).

The north Yukon delta between Apoon and Kwikluak passes is used for fall staging by pintails (over 40,000 seen in early August) and for brood rearing by Taverner's Canada geese in July (Byrd 1983).

Snow geese, Taverner's Canada geese, and ducks migrate along the Yukon River from Russian Mission to Apoon Pass in late April and early May (ibid).

The lower reaches of the Kolomak, Kuttak, and Kwecharak rivers and the mudflats at the head of Kokechik Bay are major molting areas for white-fronted geese, emperor geese, brant, and cackling Canada geese (ibid.).

The Kashunuk River mouth area from the Tutakoke River mouth to the mudflats off old Kashunuk village is a principal molting area for brant (ibid.).

The Hazen Bay area, including the mouths and lower 3 mi of the Manokinak, Aknerkochik, Azun, and Narokachik rivers and the north side of the Naskonat Peninsula, is "probably the major molting area on the refuge for emperor geese and large numbers of cacklers, brant, and white-fronted geese," especially late in the brood-rearing period (ibid.).

The area surrounding Dall lake and between there and Baird Inlet is a major staging area for thousands of snow geese in late September and early October; hundreds of failed and nonbreeding white-fronted geese molt there in early July (ibid.).

Takslesluk Lake, about 40 mi northwest of Bethel, is a molting area for 8,000-10,000 ducks. The most commonly found species are greater scaup (mostly males) and oldsquaw; others are pintail, canvasback, lesser scaup, common and Barrow's goldeneye, and bufflehead (ibid.).

The bays around Nunivak Island are important for many species, including Steller's eiders in summer and autumn, oldsquaws in late autumn, and emperor geese in autumn. Bays with eel grass, such as Duchikthluk Bay, harbor thousands of nonbreeding brant in the autumn (ibid.). In July, mixed flocks of thousands of failed and nonbreeding Taverner's and cackling Canada geese molt on the shallow rocky lakes of Nunivak Island's interior.

2. Innoko. In July 1954, a waterfowl-banding party found ducks (and some geese) to be most numerous on the Innoko River and its tributaries between Holikachuk and the mouth of the Iditarod River, the lower part of the Iditarod River, and the lower Yetna River (Hooper 1954). Species banded included mallard, shoveler, wigeon, green-winged teal, pintail, white-fronted goose, and lesser Canada goose.

3. Koyukuk. White-fronted and Canada goose broods were counted on 58 3/8 mi of the Dulbi River in July 1984 (Motschenbacher 1984). Geese were concentrated in the marshy lower reaches of the Dulbi River, with the number of young increasing logarithmically with distance down the river.
4. Tanana-Kuskokwim (including the Minto flats). The Minto flats is an area of about 720 mi² that is a prime nesting area for greater and lesser scaup, pintail, green-winged teal, shovel, and American wigeon (Rowinski 1958; King, pers. comm.), as well as being a major stopover area for waterfowl during migration (ADF&G 1983).

   Toklat Springs, near the confluence of the Sushana and Toklat rivers, is critical overwintering habitat for a population of 500-600 mallards that is believed to be the northernmost overwintering waterfowl population on the North American continent (ibid.).

   Areas (besides the Minto flats) identified in the Tanana Basin Area Plan as "prime waterfowl habitat" are Lake Minchumina, upper Kantishna River, Bearpaw River drainage, Fish Lake wetlands, Shaw Creek flats, Lake Mansfield, Fish Lake, the Wolf Lake wetlands, Dot Lake-Sam Creek, Billy Creek wetlands, Mineral Lakes, and the Salchaket Slough and its tributaries (ADF&G 1983).
5. Yukon Flats. The Yukon Flats are important not only for duck and goose production but also as molting areas for waterfowl from other breeding areas and as a resting place for southward migrants each fall (USFWS 1964). Predominant species nesting on the flats are lesser scaup, pintail, American wigeon, and white-winged and surf scoter; other species known to nest on the flats include Canada and white-fronted geese, mallard, green- and blue-winged teal, shoveler, redhead, canvasback, common and Barrow's goldeneye, bufflehead, and red-breasted merganser (ibid.).
6. Tetlin-Northway. Portions of these wetlands are as productive as some of the best wetlands in Alaska, such as the Minto flats area and the most productive strata of the Yukon Flats (Spindler and Kessel 1977). Waterfowl usually begin to arrive in the area during the third week of April; spring migration extends through mid May for most species, but scaup continue to arrive through late May. Spring migrants concentrate in the small streams, ponds, and marshes that are usually the first to thaw. The nesting period is from mid May through early August.

   In 1977, Spindler and Kessel (1977) found the lowland small lake, pond, and marsh habitat of Scottie Creek and Tanana-Chiana valleys to be the most productive habitats in their 730 mi² study area along a proposed pipeline route. Densities that summer were as follows: Scottie Creek valley small lakes, ponds and marshes, 714.4 birds/mi² wetland habitat; Tanana-Chisana valley small lakes, ponds and marshes, 503.9 birds/mi^2, and large lakes, 479.4 birds/mi^2. Fewest birds were observed in the Chisana River area (78.0 birds/mi^2) and the small upland lakes, ponds, and marshes (95.5 birds/mi^2). Scottie Creek and the Tanana-Chisana valleys were the most productive areas (162.3 and 101.5 young birds/mi^2, respectively). Diving ducks, especially lesser scaup but also including bufflehead, canvasback, and white-winged scoter, were the most abundant birds in the study area and the most abundant group using large lakes, the Tanana-Chisana valley small lakes, ponds, and marshes, and the upland small lakes, ponds, and marshes. Dabbling ducks, especially green-winged teal, and American wigeon, were most abundant in Scottie Creek valley. Canada geese were most abundant along the Chisana River.

The flightless molting period extends from mid June to late July for dabbling ducks and from mid July to early September for diving ducks (ibid.). Important molting areas in Spindler and Kessel's (1977) study area are Midway, Deadman, Eliza, Yarger, Tlocogn, and Fish (near Northway), Tetlin, Gasoline, Fish, Dathlalmund, and Old Albert lakes, Scottie Creek Lakes #16 and #17, and Chisana Pond # 17A.

B. Areas Used Seasonally and for Life Functions

For more specific information on waterfowl distribution in Western and Interior Alaska, see the 1:1,000,000-scale index maps in the Atlas to the guide for these regions and the 1:250,000-scale reference maps in ADF&G offices. The following categories are mapped:

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

C. Factors Affecting Distribution

Arrival of waterfowl on the breeding grounds is determined more by photoperiod and weather along the migration route than by local snowmelt (Dau and Mickelson 1979); arrival dates are much more constant from year to year than are melt dates (Newton 1977). Distribution of nest sites on the breeding grounds may be determined by local patterns and timing of snowmelt, but regional distribution is more determined by distribution of habitat types. Once they have bred in an area, individually marked female geese usually return to breed in the same area year after year (see references in Newton 1977). For more detailed information of species habitat requirements and preferences, see the Alaska Habitat Management Guide, Life History and Habitat Requirements of Fish and Wildlife volume.

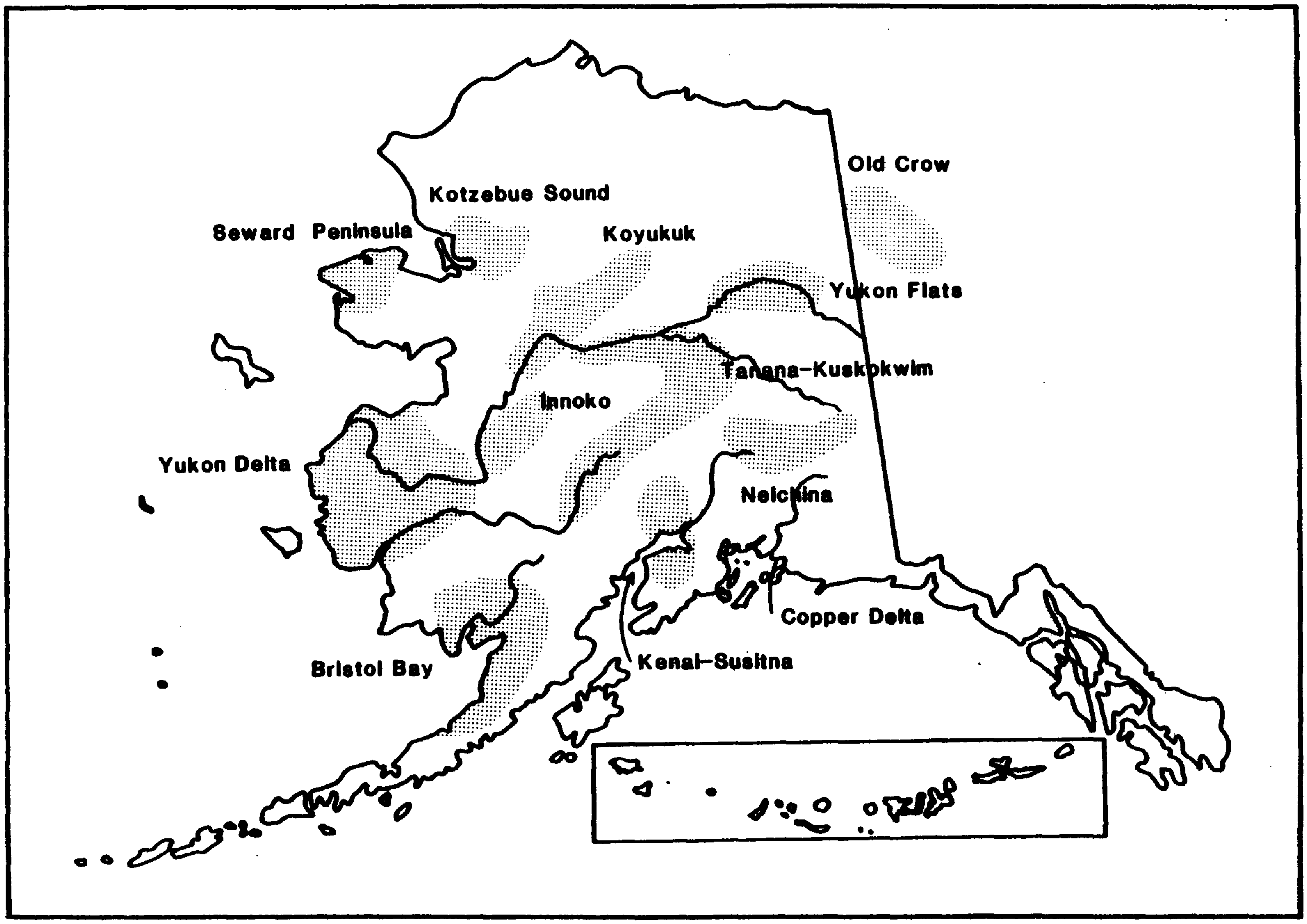
D. Movement Between Areas

Pacific black brant nesting on the YKD molt in or near the production areas (Dau and Hogan 1985).

Timm and Dau (1979) believe that over 95% of the Pacific Flyway white-fronted goose population is produced on the Yukon-Kuskokwim Delta. About 10% of the band recoveries from geese banded in the Innoko River Valley occurred in the Pacific Flyway; Lensink (1969) considered this 10% to represent molt migrants from the YKD. Survey and banding records indicate that in late September and early October most white-fronted geese from the YKD migrate nonstop more that 3,000 mi to major fall staging areas in northern California (Lensink 1985). Most white-fronts from the Innoko and Koyukuk river drainages and all from other Interior Alaska nesting areas are part of the mid-continent population and migrate directly from nesting areas to the Kinderly area on the Alberta-Saskatchewan border (ibid.).

E. Population Size Estimation

1. USFWS Alaska-Yukon Waterfowl Breeding Pair Survey. Breeding pair or breeding population surveys were begun in the late 1940's, primarily to measure the status of ducks in the major North American breeding areas. The surveys currently monitor waterfowl population and habitat changes over approximately 1.3 million square miles of breeding habitat within Alaska, Canada, and the northcentral states. The survey period in Alaska is from mid May through mid June, depending on the date of the spring ice breakup. Alaska is divided into 11 survey strata (map 1). A stratum is a specific geographical unit encompassing areas of similar habitat type and waterfowl densities. Strata 1-7 are grouped as Interior Alaska Taiga, and strata 8-11 are in the Coastal Alaskan Tundra. Transects within the stratum are a series of segments, usually parallel to each other, from 14 to 60 mi apart and equally spaced over the stratum. Alaskan 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.
   The species population index is $P = A*T/S*V$, where A = square miles in the stratum, T = total observed birds, S = square miles in the sample flown, and V = species visibility factor (Conant and Hodges 1984).
2. USFWS Alaska Duck Production Survey. Duck production in Interior Alaska has periodically been derived from surveys of 38 lakes on two study areas over the past 22 years (Conant and King 1982). Comparable data exist for 18 years from 4 large lakes near Tetlin and for 14 years from 34 lakes on the Yukon Flats (Hodges and Conant 1985). In 1983, the project was expanded to include additional areas in the Tetlin, Nowitna, Yukon Flats, Innoko, Kanuti, and Koyukuk NWRs in the Western and Interior regions, as well as Togiak and Selawik NWRs. Surveys are conducted in the second and third weeks of July; duck broods were counted while observers were either paddling or walking lake perimeters (ibid.).
3. Yukon-Kuskokwim Delta Surveys. Field studies on nesting populations of cackling Canada geese, emperor geese, Pacific white-fronted geese, and Pacific black brant have been conducted on the YKD each year since the late 1960's.



Map 1. USFWS waterfowl breeding population survey strata (Conant and Hodges 1985).

Studies have focused on aspects of breeding biology and ecology of all species of geese and estimates of population status and productivity of brant. Efforts to expand the database on population status and productivity were initiated in 1981 and continue through the present (Stehn et al. 1985). In summer 1985, aerial surveys were developed to provide an index to the annual number of pairs of cackling Canada, emperor, and white-fronted geese in the YKD (Butler 1985a). Development of a suitable management survey for the coastal zone of the YKD is expected to take three to four years (ibid.).

F. Statewide Abundance

The waterfowl breeding population survey showed that all species of dabblers declined significantly in 1985, with pintails and mallards well below average (see table 1). Total ducks were down 25% in 1984 from the long-term average. Although the survey was designed for ducks, geese are also recorded; goose numbers declined in 1985. Breeding population survey data are currently being computerized, and soon it will be possible to compare yearly and long-term data for each survey stratum and species.

II. YUKON-KUSKOKWIM DELTA

A. Present Abundance

In general, goose production on the YKD in 1985 remained depressed (Stehn et al. 1985).

Up to 50% of the world population of Pacific black brant breed on the coastal fringe of the YKD (Dau and Hogan 1985). In 1984, the maximum estimated number of brant nesting on the YKD was 16,267 when aerial survey results were added to estimated populations for the three main nesting colonies at Kokechik Bay, Tutakoke River, and Kigigak Island (Garrett and Wege 1985). The 1984 population was down 51% from the 1981 estimate (see table 2).

About 90% of the world population of emperor geese nests on the YKD (Peterson 1985). Although population levels of emperor geese have never been high (150,000 in the mid 1960's), recent surveys have shown a continuous decline of about 10% per year to a spring population of 71,200 in 1984 (ibid.).

Fall counts of white-fronted geese in California at Tule Lake and Klamath Basin (birds which virtually all nest on the YKD) indicate that the population has declined from nearly 500,000 geese in the late 1960's to fewer than 100,000 in recent years (Lensink 1985).

Dau and Kistchinski (1977) estimated that the YKD supports approximately 50,000 pairs of spectacled eiders in an average production year, with as many as 70,000 nesting pairs in a year of high productivity.

B. Historic Abundance

Cackling Canada geese were the most abundant species present on the YKD in the late 1940's and early 1950's, making up 60% of the fall flight (Butler 1985b). Cackler numbers from peak winter counts in California have dropped from 380,000 in 1965 to 26,200 in 1983 (ibid.).

Table 1. Alaska-Yukon. Status of Adjusted Waterfowl Breeding Population Estimates by Species and Strata, Comparing 1985 with 1984 and the 1975-84 Average (Estimates in Thousands)

	Strata							
Species	1-7	8-11	12	Total 1985	Total 1984	1975-84 Average	% Change from 1984	% Change from Avg.
Ducks:								
Dabblers:								
Mallard	122.8	62.2	1.7	186.7	432.4	283.0	-57	-34
Black duck	0.0	0.0	0.0	0.0	0.0	0.0	---	---
Gadwall	2.5	1.0	0.0	3.5	6.2	2.4	-44	-46
Am. wigeon	357.3	167.4	32.2	556.9	891.7	752.4	-38	-26
G.W. teal	164.0	119.8	8.3	292.1	344.2	290.1	-15	+1
B.W. teal	0.0	0.0	0.0	0.0	4.9	2.0	---	---
N. shoveler	118.4	70.6	4.2	193.2	257.8	245.8	-25	-21
Pintail	318.1	529.7	20.4	868.2	1,284.6	1,535.4	-32	-43
Subtotal	1,083.1	950.7	66.8	2,100.6	3,221.8	3,111.2	-35	-32
Divers:								
Redhead	0.0	0.0	0.0	0.0	0.3	4.2	---	---
Canvasback	58.1	6.3	15.0	79.4	117.7	97.1	-33	-18
Scaups	683.6	428.9	53.1	1,165.6	1,551.9	1,431.7	-25	-19
Ringneck	13.9	1.5	0.7	16.1	28.3	4.5	-43	+258
Goldeneyes	88.3	50.4	9.3	148.0	130.6	131.1	+13	+13
Bufflehead	46.6	6.9	0.0	53.5	54.9	79.9	-3	-33
Subtotal	890.5	494.0	78.1	1,462.6	1,883.7	1,748.4	-22	-16
Miscellaneous:								
Oldsquaw	106.2	379.4	27.4	513.0	465.1	720.5	+10	-29
Eiders	0.0	31.8	0.0	31.8	15.5	19.3	+105	+65
Scoters	106.5	224.1	31.5	362.1	452.4	469.0	-20	-23
Ruddy duck	0.0	0.0	0.0	0.0	2.2	0.2	---	---
Mergansers	9.3	29.7	0.4	39.4	31.7	12.1	+24	+226
Subtotal	222.0	665.0	59.3	946.3	966.9	1,221.1	-2	-23
Total ducks	2,195.6	2,109.7	204.2	4,509.5	6,072.0	6,080.7	-26	-26

Source: Conant and Hodges 1985. --- means no data were available.

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

Table 2. Estimated Numbers of Pacific Black Brant Nesting on the Yukon Delta NWR, 1981-84

Year	Total Brant Nesting at Three Major Colonies[a]	Total Brant Nesting on the Yukon Delta NWR[b]
1981	45,301[c]	67,783[c]
1982	24,005[d] (-47%)[e]	44,700[f] (-34%)
1983	22,508[g] (-06%)	33,000 (-26%)
1984	8,736[h] (-61%)	16,267 (-51%)

Source: Garrett and Wege 1985.

a The three major brant nesting colonies are located at Kokechik Bay, Tutakoke River, and Kigigak Island. The total number of birds estimated for these three colonies was determined by ground surveys.

b The total number of brant nesting on the Yukon Delta NWR is the sum of ground surveys at the three major nesting colonies and the sum of aerial surveys for the remaining colonies.

c Aldrich et al. 1981.

d Byrd et al. 1982.

e Percentage decline from previous year.

f Calculated estimate: the sum of brant nesting at the three major colonies (1982) plus the number of brant nesting elsewhere on the YKD as based upon the 1981 census of brant nesting areas.

g Masteller et al. 1983, Wege and Garrett 1983, and West et al. 1983.

h Scanlon and Jarvis 1984, Janik and Jarvis 1984, and Sedinger 1984.

C. Habitat and Enhancement Projects

A YKD goose recovery plan is currently being developed and should be available from the USFWS before this account is finalized.

III. INNOKO

A. Present Abundance

Duck production surveys were initiated in 1983 (see table 3) and are planned to continue yearly (Hodges and Conant 1985).

Table 3. Duck Production Surveys, Innoko, 1983-84

Year	Broods Found	Water Bodies Surveyed	Broods per Water Bodies	Average Brood Size
1983	128	57	2.2	4.3
1984	465	326	1.4	4.5

Source: Hodges and Conant 1985.

B. Historic Abundance

No information was found.

IV. KOYUKUK

A. Present Abundance

Duck production surveys were initiated in 1983 (see table 4) and are planned to continue yearly (Hodges and Conant 1985).

B. Historic Abundance

No information was found.

Table 4. Duck Production Surveys, Koyukuk, 1983-84

Year	Broods Found	Water Bodies Surveyed	Broods per Water Bodies	Average Brood Size
1983	229	243	.9	7.0
1984	407	231	1.8	5.0

Source: Hodges and Conant 1985.

V. TANANA-KUSKOKWIM (including the Minto flats)

A. Present Abundance

Duck production surveys were initiated in 1983 (see table 5) and are planned to continue yearly (Hodges and Conant 1985). Shepherd and Matthews (1985) estimate that duck production on the flats is about 75,000-150,000 ducks.

Table 5. Duck Production Surveys, Tanana-Kuskokwim, 1983-84

Year	Broods Found	Water Bodies Surveyed	Broods per Water Bodies	Average Brood Size
1983	560	167	3.4	6.0
1984	229	131	1.7	5.6

Source: Hodges and Conant 1985.

B. Historic Abundance

Waterfowl productivity for the Minto flats area was studied from 1962 through 1965 (Shepherd 1967). Both 1962 and 1964 were extremely late springs, and 1965 was moderately late; losses of young were high, and brood size was greatly reduced throughout much of the study. Total production for the flats was estimated at 75,000-150,000 ducks.

VI. YUKON FLATS

A. Present Abundance

Data on duck production for 34 lakes has been collected for the past 15 years by the USFWS Waterfowl Investigations team (see table 6). Beginning in 1984, the Yukon Flats NWR staff conducted additional waterfowl production surveys (McLean 1985). Conant's (1984) trend data indicate a decline in duck production on the flats, but two years of data from the additional areas surveyed by the refuge staff indicate the opposite trend (McLean, pers.comm.). Habitat differences and different patterns of human use in the two areas may explain part of the discrepancy (ibid.).

B. Historic Abundance

In 1964, the USFWS estimated that the Yukon Flats produced a fall flight of 1.5 million ducks "even in years when drought eliminates many other waterfowl breeding areas and scatters the waterfowl which might have nested there" (USFWS 1964).

Table 6. Comparative Brood Counts from Two Study Areas in Interior Alaska, 1961-84

Species	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1973	1974	1980	1981	1982	1983	1984	Average*	% Change from 1983	% Change from Avg.*
Tetlin																					
Dabblers																					
Mallard	34	14	23	2	3	9	13	13	10	12	2	3	---	1	1	2	4	2	8.2	-50	-76
Am. wigeon	74	18	23	6	7	36	28	39	47	11	---	7	3	6	6	2	14	19	19.2	+36	-1
G.W. teal	42	30	27	19	16	66	101	103	85	44	4	8	10	9	12	3	20	22	34.5	+10	-36
N. shoveler	2	1	---	---	---	---	1	7	4	6	2	---	---	---	---	---	4	6	1.8	+50	+233
Pintail	19	18	11	4	3	8	21	21	17	12	1	2	---	2	---	1	7	11	8.8	+57	+25
Subtotal	171	81	84	31	29	119	164	183	163	115	9	20	13	18	19	8	49	60	72.6	+22	-17
Divers																					
Canvasback	14	18	14	2	3	6	9	16	7	12	6	8	9	6	1	4	4	2	7.8	-50	-74
L. Scaup**	14	2	11	2	---	10	14	11	44	2	1	4	1	4	3	---	11	5	7.7	-55	-35
Subtotal	28	20	25	4	3	16	23	27	51	14	7	12	10	10	4	4	15	7	15.6	-53	-55
Total	199	101	109	35	32	135	187	210	214	99	16	32	23	28	23	12	64	67	88.1	+5	-24
Yukon Flats																					
Dabblers																					
Mallard			6	3	9	6	11	19	35	20	2	6	10		5	4	6	8	10.1	+33	-21
Am. wigeon			41	14	39	49	62	88	112	41	34	47	33		18	6	19	34	42.5	+79	-20
G.W. teal			16	7	18	52	47	44	48	28	16	28	23		11	8	29	23	26.5	-21	-13
N. shoveler			10	3	8	11	13	21	9	6	3	11	11		1	4	28	15	10.3	-46	+46
Pintail			30	---	16	19	44	39	26	13	9	16	19		3	3	17	5	17.3	-71	-71
Subtotal			105	27	90	137	177	211	230	108	64	108	96		38	25	99	85	106.7	-14	-20
Divers																					
Canvasback			8	1	13	15	16	18	18	5	12	13	34		---	6	14	8	12.1	-43	-34
L. Scaup**			9	---	12	49	61	65	87	14	22	70	49		15	8	54	30	36.3	-44	-17
Subtotal			17	1	25	64	77	83	105	19	34	83	83		15	14	68	38	48.4	-44	-21
Total			122	28	115	201	254	294	335	127	98	191	179		53	39	167	123	155.1	-26	-21
Dabbler total			189	58	119	256	341	394	393	193	73	128	109		57	33	148	145	179.3	-2	-19
Diver total			42	5	28	80	100	110	156	33	41	95	93		19	18	83	45	64.0	-46	-30
Grand total			231	63	147	336	441	504	549	226	114	223	202		76	51	231	190	243.2	-18	-22

Source: Conant 1984.

--- means no data were available.

* Average - Tetlin 18 years, Yukon Flats 15 years.

** Scaup hatch not normally complete at time of survey.

VII. TETLIN-NORTHWAY

A. Present Abundance

Eighteen years of comparable data exist on duck production from four large lakes near Tetlin (see table 6).

B. Historic Abundance

McKnight (1962) estimated the June 1961 waterfowl population of his 700 mi^2 study area at 55,077 birds. In 1977, Spindler and Kessel (1977) estimated the wetland bird population on their 730 mi^2 study area to be 101,251 (66,357-136,145; 95% confidence). Spindler and Kessel's (1977) estimate for the same general area was higher than McKnight's probably because they included shorebirds as well as the ducks, geese, loons, and grebes counted by McKnight; they included an additional 30 mi^2 of upland habitat; and 1977 was an invasion year, whereas 1961 was not. Prairie-pothole nesting waterfowl often invade subarctic and arctic regions during periods of drought in the prairie region (McKnight 1962, Hansen and McKnight 1964, Derksen and Eldridge 1980), and 1977 was such a drought-induced invasion year (Spindler and Kessel 1977). Therefore, waterfowl densities reported by Spindler and Kessel (1977) are higher than the long-term average for the region. Although population densities were higher than average, production was lower than expected because of abnormally high water levels that flooded many nests (ibid.).

VIII. MANAGEMENT HISTORY

The USFWS is responsible for management of Alaskan waterfowl and enforcement of the laws and agreements regarding them. Alaskan waterfowl have basically been managed like those of the Lower 48 except for the lack of enforcement of the prohibition against spring hunting and egging of the 1916 Migratory Bird Protection Treaty between the United States and Canada. A steady decline in the populations of four species of geese (black brant, greater white-fronted goose, emperor goose, and cackling Canada goose) that nest on the YKD and winter along the Pacific Flyway has prompted sport hunting groups to file a suit preventing USFWS from allowing subsistence harvest of the four species during the spring and summer closed season (Chandler 1985). Rather than blind enforcement of the hunting laws, the USFWS has chosen to try to find a better way to manage YKD geese by cooperating with the Association of Village Council Presidents, sport hunting groups, the California Department of Fish and Game, and the ADF&G in the 1984 Hooper Bay Agreement and the 1985 Yukon-Kuskokwim Goose Management Plan. The former requires local residents to stop hunting cackling Canada geese and restrict their harvest of white-fronted geese and brant to the periods before egg laying and after fall flight. The latter calls for a cooperative monitoring and law enforcement program in the local YKD communities and a total closure of cackling goose hunting in California for at least the 1984-1985 season (ibid.).

For the long term, the USFWS is requesting the U.S. Senate to ratify a Protocol on Subsistence Hunting of Migratory Birds, an amendment to the 1916 Migratory Bird Treaty with Canada, which would legalize subsistence hunting and give the secretary of the interior authority to regulate Native American hunting, thus providing a legal basis for cooperative agreements (ibid.). Canada signed the protocol in 1979, but United States ratification has been delayed because sport hunting and environmental groups object to the vague wording of the document. The USFWS is currently working with the Canadian Wildlife Service to resolve the problem (ibid.).

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Freshwater/Anadromous Fish

Arctic Char/Dolly Varden Distribution and Relative Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

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

A. Regional Distribution

Anadromous char are found south of the Kuskokwim River mouth in Kuskokwim Bay drainages such as the Goodnews, Arolik, and Kanektok rivers (ADF&G 1978, Alt 1977). Dwarf stream resident char and lake resident char are also found in Kuskokwim Bay drainages (Alt 1977). Stream resident char are found in tributaries of the Yukon and Kuskokwim rivers, but they rarely enter the main stem of these rivers (Alt 1980, 1977). Anadromous char are not found in the Yukon or Kuskokwim rivers (ibid.).

Lower Kuskokwim tributaries supporting fairly large populations of resident stream char include the Aniak, Kisaralik, Kwithluk, and Tuluksak rivers (ADF&G 1978, Alt 1977). In the Yukon River drainage, char are present as resident species in streams flowing into the Yukon River, from the Andreafsky River upstream to the Melozitna River. The Melozitna River is the furthest upstream where large-size resident char have been found, but dwarf-size resident char are present in small tributary streams further up the Yukon and in the Upper Tanana drainage (Alt 1981a, 1980).

B. Regional Distribution Maps

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:

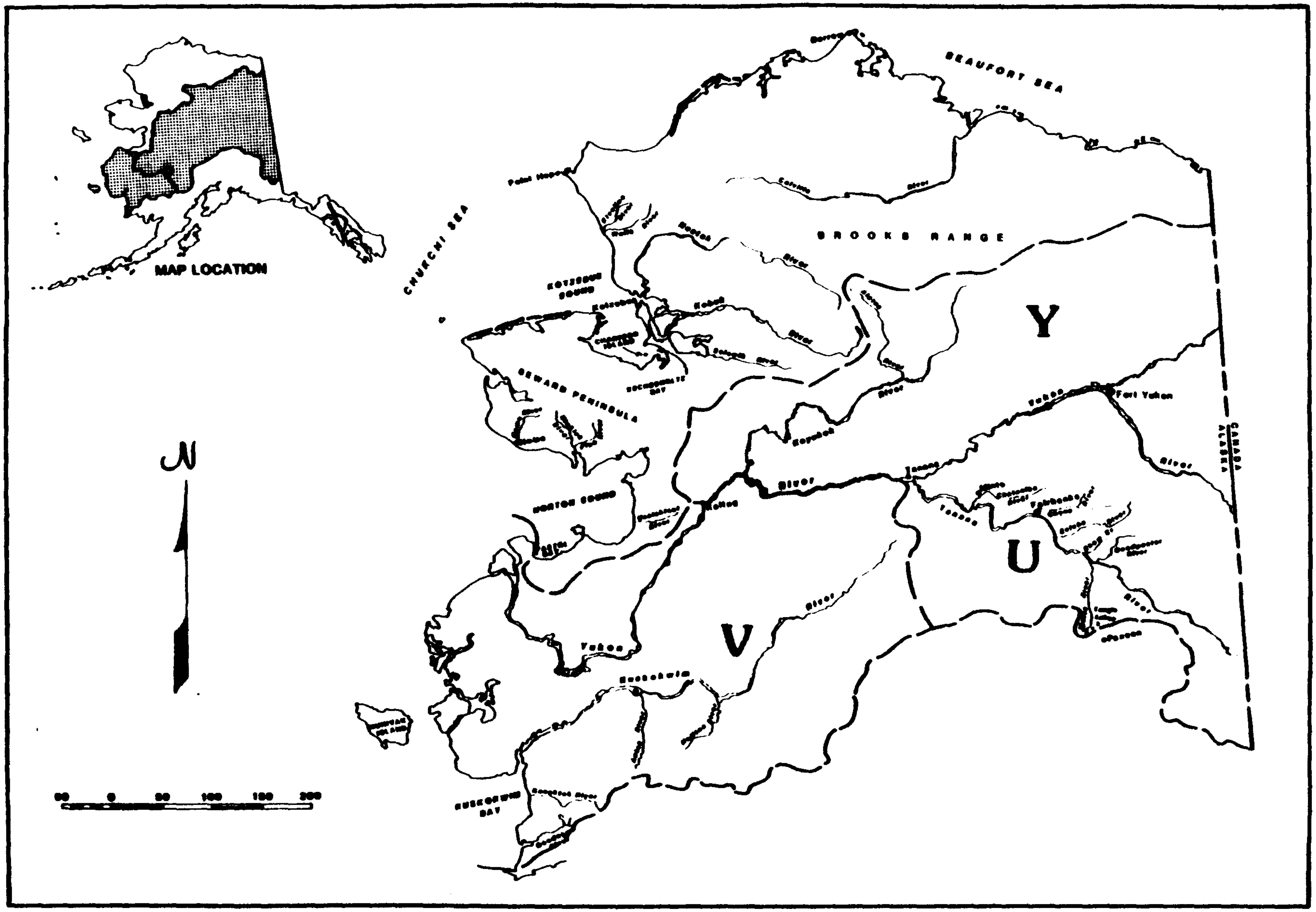
- General distribution
- Documented presence in stream or lake
- Documented spawning areas
- Documented overwintering areas
- Documented rearing areas

C. Factors Affecting Distribution

Water quality parameters, such as dissolved oxygen levels and temperature, and the physical characteristics of streams and lakes, such as depth, velocity, and substrate type, all influence char distribution. More details of char habitat requirements can be found in the Life History and Habitat Requirements narrative found in volume 1 of this publication.

D. Movements Between Areas

The general pattern of char movement is discussed in the Life History and Habitat Requirements portion of this account found in volume 1.



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

Anadromous char out-migrate shortly after spring breakup and feed at sea for four to eight weeks (ADF&G 1978). Char return to fresh water from July to September (ibid.). Anadromous char from Kuskokwim Bay drainages that will spawn in the current year begin entering the rivers in late June and early July to spawn (Alt 1977). Specific information on nonspawning anadromous char is not available, but Alt (1977) notes that they may enter Kuskokwim Bay drainages later in the fall. Village residents in the Kuskokwim area have reported large numbers of char moving upstream with the coho salmon in August and September (ibid.).

Most stream resident (nonanadromous) char are found in headwaters or in clearwater tributaries of major rivers (Armstrong and Morrow 1980). Stream residents probably overwinter in deep pools or move downstream to deep water near the mouth of tributary streams. Stream resident char in Kuskokwim River tributaries rarely enter the main Kuskokwim (Alt 1977). In Minook Creek, a small tributary of the Yukon River near Rampart, the char leave smaller tributaries, such as Little Minook Creek and Ruby Creek, in late fall and early winter, apparently spending the winter in the lower reaches of Minook Creek itself (Armstrong and Morrow 1980). During the summer, stream residents in the Kuskokwim and Yukon river drainages congregate in areas where salmon spawn to feed on the salmon eggs (Alt 1980, 1977; ADF&G 1978).

E. Population Size Estimation

The relative abundance of char in the Western and Interior regions has not been systematically assessed. Estimates of population size are based on rough measures of catch-per-unit-effort gathered during lake and stream surveys conducted with hook-and-line and gill nets.

F. Regional Abundance

Very little information on char abundance is available, and the information that has been collected applies only to specific lakes and streams. As a result, estimates of abundance cannot be appropriately made at the regional level. Abundance information is contained in the discussions of the postal survey areas which follow.

II. LOWER YUKON-KUSKOKWIM AREA DISTRIBUTION AND ABUNDANCE

The Lower Yukon-Kuskokwim Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands. This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River, nor any portion of the Tanana River watershed (ADF&G 1985).

Anadromous char are found in Kuskokwim Bay drainages south of the Kuskokwim River. Alt in 1977 described the char population as abundant in the Goodnews River system, the Kanektok River system, and the Arolik River system. Dwarf stream resident char are also found in these three rivers upstream of areas where anadromous char are found. In Kuskokwim Bay drainages, these nonanadromous dwarf char are mature at 130 to 160 mm fork length.

Char make up a large percentage of the fish found in lakes in the Kuskokwim Bay drainages. These lake-dwelling char are generally more abundant in lakes of the Goodnews system than of the Kanektok system, but the char in Kanektok system lakes are larger than those in the Goodnews lakes (Alt 1977). The largest catch per net night from gill nets set in Kuskokwim Bay drainage lakes was taken from Asriguat Lake in the Goodnews River system, with 18 char per net night (ibid).

In the Kuskokwim River drainage, stream resident char are abundant in the Aniak, Tuluksak, Kisaralik, Kasigaluk, Kwethluk, and Eek rivers (ibid.). Alt (1981b) took two char in a gill net set about 37 mi up the Holitna River. Char have also been found in Aniak Lake and in two lakes in the headwaters of the Kisaralik River, though their abundance was low in Aniak Lake (ibid.).

In the lower Yukon River drainage, large stream resident char have been found in a number of relatively swift-flowing tributaries entering the Yukon River from the north (Alt 1980, 1981a). The limit of their distribution is from the Andreafsky River to the Melozitna River, including the Nulato and Anvik rivers (Alt 1980, 1981a). During stream surveys of the Anvik River in June, char were first encountered 70 mi upstream. Char were abundant in the main river and sloughs of the Anvik from 70 mi upstream of the mouth to within 5 mi of the Swift River (Alt 1980). In the Andreafsky River, char are distributed throughout the main river to within about 15 mi of the mouth, and they are found in tributary streams (Alt 1981a). They are also found in the East Fork of the Andreafsky (ibid.). During surveys conducted in June on the Andreafsky River, char were generally located in areas with a gravel bottom and fairly fast current and occasionally in sloughs (ibid.). In the Anvik River in June, char were most widely distributed in pool and slough areas (Alt 1980). When salmon enter the Anvik and Andreafsky rivers, the char move into salmon spawning areas to feed on eggs (Alt 1980, 1981a).

A few char have been taken in gill nets in slower-moving-water areas of the lower Innoko River (Alt 1983). There is some evidence, however, that these fish are strays from another system and do not spawn in the Innoko (ibid.). Residents of the Innoko River area have reported catching small (less than 260 mm) char in the upper Innoko River in the fall, indicating that a population of dwarf char may be found in the upper Innoko and in Beaver and Folger creeks (ibid.).

Baxter (1978) has reported char from the Urumangnak River on Nelson Island.

III. SOUTH SLOPE BROOKS RANGE AREA DISTRIBUTION AND ABUNDANCE

The South Slope Brooks Range Postal Survey Area includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (ADF&G 1985). Large-size stream resident char are found in a few relatively swift-flowing tributaries entering the Yukon River from the north, including the Nulato and Melozitna rivers. In the Nulato River, char are distributed from the mouth upstream and are the most important species for sport fishermen in the area (Alt 1980). Local residents have indicated that char abundance in the Nulato increases upstream from the mouth. The Melozitna is the upper limit of distribution of large char in the Yukon River drainage. Char abundance in the Melozitna could be considered quite low (Alt 1984). They have been captured in the Melozitna system only in rapid-runoff mountainous type tributary streams such as Fox Creek and Grayling Creek or in adjacent areas of the Melozitna main stem (ibid.).

Dwarf stream resident char, which are seldom over 300 mm, have been taken from the Tozitna River and from small tributary streams further up the Yukon River (Alt 1980, 1981a, 1984). Alt (1984) noted that the abundance of char in the Tozitna River is very low.

Craig and Wells (1975) reported a population of moderate-size char (generally in the 300-to-350-mm range) from Redfish Lake about 13 km northeast of Arctic Village. ADF&G lake and stream surveys of the South Slope Area have not discovered char in any other South Slope lakes (Roguski and Spetz 1968, Kramer 1976, Pearse 1978) Craig and Wells speculated that the short distance between Redfish Lake and the continental divide suggests that the char in Redfish Lake may be a case of headwater-capture, in which geologic changes have caused the headwaters of a north-flowing drainage containing char to become part of the headwaters of an adjoining south-flowing drainage that did not originally support a population of char.

Netsch (1975), Hallberg (1975), and Pearse (1977), during stream surveys along the route of the Trans-Alaska Pipeline, reported small char (less than 285 mm long) from many streams along the Middle Fork of the Koyukuk River and the Dietrich River, including Marion Creek, Organo Creek, Slate Creek, Porcupine Creek, Rosie Creek, and several small unnamed streams. Pearse (1977) noted that the number of char in these streams appears to be low compared with other fish species.

IV. FAIRBANKS AREA DISTRIBUTION AND ABUNDANCE

The Fairbanks Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage (ADF&G 1985).

Dwarf stream-resident char populations have been documented in a few tributaries that enter the Yukon River from the south, in the Nenana River drainage, in a tributary of the Delta River, and in the Upper Tanana River drainage (Alt 1980, Armstrong and Morrow 1980, Morrow 1980, Peckham 1976, Pearse 1976). Upper Yukon River tributaries known to contain dwarf char include Minook Creek (Armstrong and Morrow 1980) and the Charley River (Morrow 1980).

In the Nenana River drainage, char distribution is known to include the Nenana River main stem, Riley Creek, which enters the Nenana at Denali

National Park, and Revine Creek, a tributary of the Yanert River (ibid.).

Pearse (1976) noted that char in the upper Tanana River drainage, are probably found in the Little Gerstle River and the Johnson River. Lake and stream surveys documented the presence of char in Sears Creek, Tok Overflow, which flows into the Tok River, and in the Little Tok River (Pearse 1976). Char have also been reported from the upper sections of Berry Creek (Pearse 1976) and Dry Creek (Morrow 1980) in the upper Tanana drainage. In mid summer, Valdez (1976) found char in upstream tributaries of the Johnson and Robertson rivers and throughout Berry, Bear, and Yerrick creeks. Van Hyning (1978) found char overwintering in upstream portions of Dry, Berry, and Bear creeks and the Tok Overflow. Van Hyning (1978) noted that char were generally the only fish other than sculpin found in upstream areas of these streams in the winter. Char are also found in Phelan Creek, which enters the Delta River above Fielding Lake (Peckham 1976).

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Arctic Grayling Distribution and Relative Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

In this report, distribution and relative abundance information for grayling will be presented by sport fish postal survey areas, shown on map 1. Information on the level of grayling sport harvest is contained in the Freshwater and Anadromous Fish Sport Use narrative found elsewhere in this volume.

A. Regional Distribution

Arctic grayling are found in nearly all freshwater habitats of the Western and Interior regions, including Nunivak Island, with the exception of the Yukon-Kuskokwim delta plain (ADF&G 1978). Grayling are present in both lakes and streams of the Western and Interior regions but are usually more abundant in streams (ibid.).

B. Regional Distribution Maps

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
- Documented overwintering areas
- Documented rearing areas

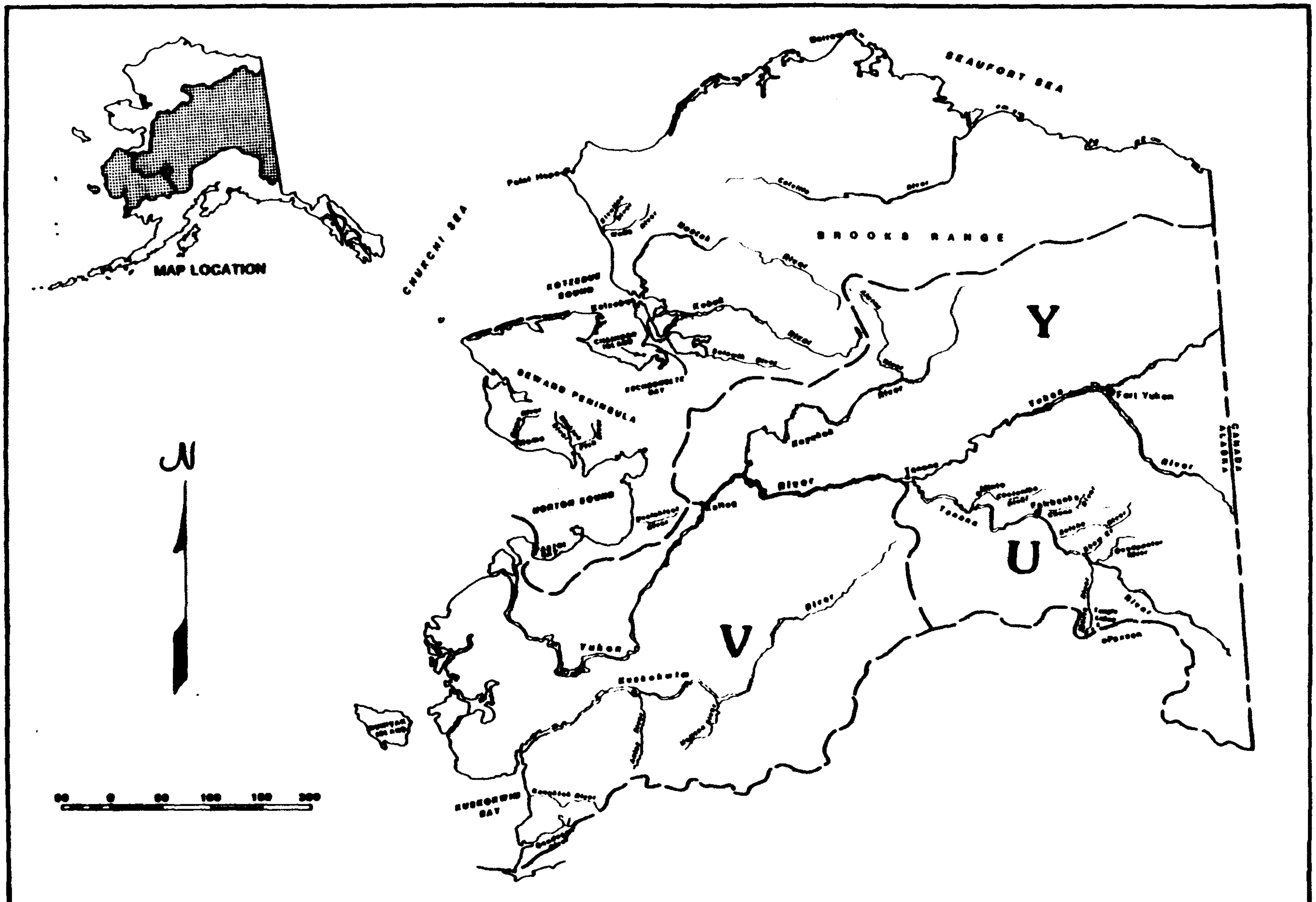
C. Factors Affecting Distribution

Water quality parameters, such as dissolved oxygen levels and temperature, and the physical characteristics of streams and lakes, such as depth, velocity, and substrate type, all influence grayling distribution. More details of grayling habitat requirements can be found in the Life History and Habitat Requirements narrative found in volume 1 of this publication.

D. Movements Between Areas

The general pattern of grayling movement is discussed in the Life History and Habitat Requirements portion of this account found in volume 1.

The seasonal pattern of grayling movements within a system is affected by each river or stream's source of water (Tack 1980) and therefore varies from system to system. Tack (1980) and Armstrong (1982) provide detailed descriptions of grayling movements in each of four different stream types found in Interior Alaska. Information contained in Tack (1980) and Armstrong (1982) is based largely on studies of grayling movements in the Tanana River drainage. More detailed information on recent studies of migration patterns of Tanana River drainage grayling populations is available in the Federal Aid in Fish Restoration report series, Jobs R-I and G-III-G. The reader in need of more extensive



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

information on grayling movements than is contained in this summary should see those reports.

Alt (1978a) stated that grayling in the Aniak River, tributary to the Kuskokwim River, evidently overwinter in the Kuskokwim River and the lower section of the Aniak. The fish move upstream after breakup and distribute themselves throughout the river. By July and August, grayling are seldom found in the lower reaches of Kuskokwim River tributaries or Kuskokwim Bay streams but are distributed in the mid-to-upper reaches of the swifter-flowing sections of the streams (ibid.).

The Chena River near Fairbanks is an example of an unsilted rapid-runoff stream. Grayling overwinter throughout the main stem of the Chena River from the mouth to 157 km upstream (Tack 1980). Chena River grayling begin an upstream spawning migration in late April to early May. This spawning migration occurs throughout the main stem and large tributaries, and spawning occurs throughout the main stem from 10 to about 240 km upstream (ibid.). After spawning, adults move primarily upstream to headwater tributaries where they spend the summer feeding (ibid.). Summer distribution remains fairly stable once the spring migration is completed. It is theorized that younger grayling concentrate in the lower 50 mi of the Chena River and then move upstream in their second and third years of life (Hallberg 1981).

The Delta Clearwater and Richardson Clearwater rivers, both tributaries of the Tanana River south of Fairbanks, are spring-fed river systems. There is little grayling spawning or rearing in these systems. Delta Clearwater and Richardson Clearwater grayling spawn in nearby Tanana tributaries. Evidence from returns of tagged grayling suggests that the Volkmar River, a bog-fed stream, is the major spawning area for Delta Clearwater grayling (Ridder 1983). Tributaries in the Shaw Creek drainage, also a bog-fed system, are major spawning areas for grayling that later migrate to the Richardson Clearwater (Ridder 1984). These tributaries include Caribou Creek and Rapids Creek (Ridder 1983, 1984). The Goodpaster River, a large rapid-runoff system, is also a source of grayling for the Delta Clearwater and Richardson Clearwater rivers (Ridder 1983). These spawning streams also possess summer and winter populations that do not out-migrate after spawning (Peckham 1976a).

Grayling enter the Delta Clearwater and Richardson Clearwater after spawning in the spring and remain in these streams to feed during the summer months. Grayling begin arriving in April, with the inmigration lasting into June (Ridder 1984). Juvenile and subadult grayling generally arrive directly from overwintering areas in the Tanana River and precede the adults and subadults who arrive from spawning streams (ibid.). Out-migration begins in late August or early September and is esentially complete by late November (ibid.). Delta Clearwater and Richardson Clearwater grayling probably overwinter in the Tanana River (Ridder 1981).

Grayling in some lake systems in the Tanana drainage have been found to spawn in inlet streams or in the lake outlet (Tack 1980). Grayling spawn in the outlet of Mineral Lake, a bog lake in the upper Tanana drainage, where the water is warmed by outfall from the shallow lake (ibid.). Most grayling that spawn in the outlet then migrate upstream through the lake and into Station Creek, the main rapid-runoff inlet; however, some migrate a short distance downstream, then up the Little Tok River or Trail Creek (ibid.). These migrations occur from late May to mid June. The grayling that feed in Station Creek during the summer all return downstream through Mineral Lake in the fall to overwinter somewhere below Mineral Lake, possibly as far away as the Tanana River (ibid.). Grayling in deep lakes in the Tangle Lakes system and in Fielding Lake are known to spawn in several rapid-runoff and bog-stream inlets (ibid.). It is known that no spawning occurs in the outlet of Fielding Lake; however, the relatively inaccessible outlet of Tangle Lakes has not been surveyed at spawning time (ibid.). In the Tangle Lakes system, grayling move out of the shallow lakes and river sections upstream to deeper holes of the lakes in August (Schallock 1966a).

E. Methods of Population Size Estimation

In most of the Western and Interior regions, estimates of grayling abundance are based on rough measures of catch-per-unit-effort that are gathered during lake and stream surveys conducted with hook-and-line and gill nets. In the Fairbanks Area, however, grayling stocks are subject to relatively heavy sportfishing pressure, and population abundance in some systems is more closely monitored. In the Fairbanks Area, grayling abundance is generally monitored by using mark-and-recapture techniques or through index counts.

Mark and recapture estimates are usually made by using either the Schnabel multiple-census mark-and-recapture method or the Petersen single-census method, though several other estimators have also been used. In the Petersen and Schnabel methods, grayling are captured by electrofishing, marked, and released in the same river section in which they were marked. In the following days, at least one more pass is made on the river with the electrofishing boat, and the percentage of marked fish from the catch is noted. From this, an estimate of the population size at the time of marking can be derived. The Schnabel method, which is used annually on the Chena River, requires that at least two recapture runs be made (Ricker 1975). The Petersen estimate requires only one recapture run (ibid.).

Several sources of bias are associated with mark-recapture estimates, especially those conducted in areas that are not strictly closed systems (Begon 1979, Holmes 1983). Confidence intervals around these estimates are quite wide and so should be evaluated only as general indicators of population trends (Holmes 1983, Hallberg 1981).

In the Delta Clearwater and Richardson Clearwater rivers, index counts of numbers of grayling captured during electrofishing in each of several river sections have been recorded since the mid 1970's. In this method, a single pass of the river is made with the electrofishing boat, and all stunned grayling are dipnetted from the river and counted. The grayling are then released within the section in which they were captured. Index counts from different rivers or even from different sections of the same river are not comparable because the efficiency of the method varies with different river conditions. Water clarity, river morphology, vegetation, depth, and weather conditions all affect the efficiency of electroshocking (Holmes 1983, Ridder 1984). Index counts do provide relative measures of population abundance in the same river section from year to year. These counts are more comparable from year to year if water depth, velocity, and turbidity are similar during the capture period each year (Tack 1972, Holmes 1984, Ridder 1984). Visual estimates of grayling numbers are also occasionally made (Ridder 1983,1984). These are generally done by two observers counting from the deck of a boat as it travels downriver.

F. Regional Abundance

Grayling abundance information that has been collected applies only to specific lakes and streams. As a result, estimates of abundance cannot be appropriately made at the regional level. Abundance information is contained in the discussions of the postal survey areas that follow.

II. LOWER YUKON-KUSKOKWIM AREA DISTRIBUTION AND ABUNDANCE

The Lower Yukon-Kuskokwim Sport Fish Postal Survey Area (map 1) includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands. This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985a). During surveys of the lower Kuskokwim River and Kuskokwim Bay drainages, Alt (1977) found grayling in all streams surveyed in the area. Grayling were abundant in tributaries of the Kuskokwim River, including the Aniak, Tuluksak, Kisaralik, Kasigluk, Kwethluk, and Eek river systems (ibid.). Grayling from Aniak River overwinter in the Kuskokwim River (ibid.). These grayling move up the Aniak River in the spring to distribute themselves along the river and most of its tributaries. Grayling were taken in late May 60 mi up the Aniak River and in the Salmon River (ibid.). Rearing grayling in Kuskokwim River tributaries were found in the main stem stream as well as in small gravel side streams (ibid.). Grayling have also been reported from the Holitna River drainage, Big River, and Highpower Creek in the Kuskokwim drainage (Alt 1972, 1981a; Baxter 1978).

Grayling abundance appeared to be lower in Kuskokwim Bay drainages south of the Kuskokwim River (Alt 1977). Alt (1977) estimated that only several hundred large grayling inhabited the Arolik River when it was surveyed in mid July, though other grayling may have been up tributary streams (ibid.). In the Kuskokwim Bay streams, rearing grayling were found only in the Goodnews River (ibid.).

Grayling were also abundant in lakes in the Kuskokwim River drainage, including Aniak, Kisaralik, and Kisaralik Lake #2 (ibid.). Alt (1977) noted that grayling were more abundant in Aniak Lake than in any other lake in the area. Grayling are apparently absent, however, from most lakes in Kuskokwim Bay drainages south of the Kuskokwim River (ibid.).

In the lower Yukon River drainage, grayling have been reported in the Andreafsky, Anvik, and upper Innoko rivers (Alt 1980, 1982, 1983). Grayling were not taken during surveys of the Bonasila and Khotol rivers, but Alt (1980) stated that they may have been present in headwater areas.

In the Andreafsky River, Alt (1981b) found grayling widely distributed from 57 mi upstream to within 10 mi of the mouth. They are also reportedly very abundant farther up the main Andreafsky and throughout the East Fork Andreafsky River (ibid.). They are also present in tributary streams (ibid.). In the Anvik River, grayling were first captured in shallow water 11 mi upstream from the mouth (Alt 1980). The area of best grayling habitat, with the heaviest concentration observed in sloughs and side channels, was betweem miles 70 and 95 of the Anvik River (ibid.).

In the Innoko River, grayling are found mainly in upstream mountain tributaries such as Folger Creek, Beaver Creek, and Tolstoi Creek, which is a tributary of the Dishna River (Alt 1983). The largest concentration of grayling observed was in Beaver Creek and in the Innoko River immediately downstream of Beaver Creek (ibid.).

III. SOUTH SLOPE BROOKS RANGE AREA DISTRIBUTION AND ABUNDANCE

The South Slope Brooks Range Postal Survey Area (map 1) includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (ADF&G 1985a). Grayling are found throughout the middle and upper Yukon drainages in Alaska (ADF&G 1978, Griffiths et al. 1974).

In the Melozitna River, grayling are generally most abundant in the tributaries and in the main Melozitna near mouths of tributary streams (Alt 1983). They are especially abundant in Hot Springs Creek (ibid.)

In the Tozitna River, grayling are distributed throughout the river, but in 1982 surveys they appeared more abundant above Dagislakhna Creek (ibid.). Largest numbers observed were in the pool areas near mouths of upriver tributary streams (ibid.).

In the Koyukuk River system, Netsch (1975) and Hallberg (1975) found grayling in streams along the route of the Trans-Alaska Pipeline. Netsch (1975) noted that Bonanza Creek, Fish Creek, Jim River, and Prospect Creek were productive grayling streams along the route of the pipeline in the South Slope Area. Netsch (ibid.) estimated by the

Petersen mark-and-recapture method that the number of grayling 200 mm long or longer in Jim River 1 mi upstream to 1 mi downstream of Prospect Camp was 3,496 in June and increased to 15,043 in October. Population estimates of grayling in the lower 1 mi of Prospect Creek were 1,572 in July and 1,210 in August (ibid.). No confidence limits were given for these estimates. Netsch stated that the grayling population rose in Jim Creek in autumn because of grayling moving out of small tributary streams to overwinter in Jim Creek (ibid.). Chihuly et al. (1980) found grayling in many tributaries to the Middle Fork of the Koyukuk River, including the Dietrich River. Grayling are also found in lakes of the Koyukuk River drainage, including Big (Bob Johnson) Lake and South Twin Lake at the headwaters of the South Fork of the Koyukuk, Wild Lake in the Wild River drainage, and HelpmeJack and Iniakuk lakes in the Alatna River drainage (Roguski and Spetz 1968, Kramer 1976, Pearse 1978).

In the Chandalar River region, Craig and Wells (1975) found grayling to be the most widely distributed and abundant fish species. They were found throughout the Chandalar River drainage. In the Chandalar River drainage, most streams used for grayling spawning were located in the region between Arctic Village and Vettetrin Lake (ibid.). During aerial surveys of this area, an estimated 300 to 800 grayling were sighted in several small streams only 3-5 km in length (ibid.). The Chandalar River itself may also be used by grayling for spawning (ibid.). Craig and Wells noted a general upstream movement of grayling past the Arctic Village area in May and speculated that the major grayling overwintering areas in the Chandalar drainage are downstream of Arctic Village (ibid.). Lakes in the Chandalar River drainage that have been surveyed by the ADF&G and found to contain grayling include Chandalar Lake, Squaw Lake, and Ackerman Lake (Roguski and Spetz 1968, Kramer 1976, Pearse 1978).

Grayling have also been taken in areas throughout the Porcupine River and its tributaries. In the Sheenjek River drainage, grayling have been found in Old Woman Creek, Monument Creek, Koness River, and Old John Lake (Craig and Wells 1975, Pearse 1978). In the Coleen River drainage, they have been found in Strangle Woman Creek, in Pass Creek (Craig and Wells 1975), and in the Coleen River main stem (Alt 1974). During sheefish investigations, Alt noted grayling throughout the Porcupine River main stem (Alt 1971, 1972, 1974), and in the Salmon Fork of the Black River (Alt 1978b).

In the upper Yukon, Alt has noted grayling in the Kandik River from 1 to 95 mi upstream (Alt 1971) and at the mouths of the Nation and Tatonduk rivers (Alt 1979).

IV. FAIRBANKS AREA

A. Distribution

The Fairbanks Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage (ADF&G 1985a).

Grayling are distributed throughout the Fairbanks Area and are the most intensely harvested sport fish in the area. Many extensive studies have been conducted on Fairbanks Area grayling populations, beginning in the early 1950's and continuing to the present (Armstrong 1982). The results of the majority of these studies are contained in Federal Aid in Fish Restoration quarterly and annual progress reports. They have also been summarized by Armstrong (1982). These reports contain much more detail about specific populations of grayling than can be included here. The reader should see these Federal Aid reports (such as Holmes 1983, 1984 and Ridder 1980-84) for additional details of life history and distribution patterns of grayling in the Fairbanks Area.

1. Yukon River tributaries. In tributaries entering the Yukon River from the south, grayling have been observed in the Charley River from above Copper Creek to its confluence with the Yukon River (Holmes 1983). They have also been observed throughout Beaver Creek and its tributary, Nome Creek (Hallberg 1982), and in Hess Creek (Chihuly et al. 1980). Grayling have been documented throughout the Tanana River system, with many Tanana River populations being extensively studied.
2. Chatanika River. Grayling are found in the Tolovana River (ibid.), and in its tributary, the Chatanika River. In the Chatanika River, grayling are common from the Elliott Highway bridge to the confluence with Goldstream Creek (Hallberg 1982). Schallock (1966b) hypothezized that most Chatanika River grayling overwinter in the lower Chatanika below the Elliott Highway. It is unlikely, however, that the lower 40 to 50 km of the Chatanika is used by grayling for overwintering because it becomes anoxic during the winter months (Tack 1980). If they do overwinter in the Chatanika it must be in the 100 km between the Elliott Highway and Minto flats (ibid.). Chihuly et al. (1980) found grayling in the Chatanika River main stem and rearing grayling in small tundra streams tributary to the Chatanika. Roguski and Spetz (1968) noted grayling in the upper Tatalina River, a tributary of the Chatanika River, and also mentioned reports of excellent sport catches of grayling from Washington Creek, a Tatalina River tributary. Chihuly et al. (1980) reported grayling overwintering in Washington Creek.
3. Chena River. Grayling are found throughout the Chena River drainage and are subject to an intense sport fishery in areas of the Chena accessible by road. Grayling overwinter in the Chena River from the mouth to at least 97.5 mi (157 km) upstream (Tack 1975). In the spring, spawning grayling are found in riffle areas throughout the Chena River main stem and in most major tributaries (Tack 1980). During 1971 and 1972 surveys, Tack noted that rearing grayling concentrate in

the lower 50 mi of the Chena River and move upstream during their second and third years (Tack 1971, 1972). The four major headwater tributaries of the Chena River, the East, North, South, and West forks, harbor mostly adult grayling, at least during the summer months (Hallberg 1978). Young-of-the-year grayling (YOY) can, however, be found in lesser concentrations throughout the system. Tack (1972) found YOY grayling in quiet backwaters throughout the East Fork of the Chena River from Van Curler's Bar to its confluence with the North Fork. Hallberg (1978) found YOY grayling in the lower 5 mi of the East Fork. Mature grayling are abundant in the upper East Fork during summer (Tack 1972, Hallberg 1978, Grabacki 1981, Holmes 1984). In the South Fork of the Chena, Tack found YOY grayling to be abundant from Beaver Creek to the confluence with the main Chena, but relatively few adults were seen during his July survey. Hallberg (1978) observed grayling of all age groups in the South Fork from Beaver Creek to the Chena Hot Springs Road in August. YOY were also found in the North Fork as far as the mouth of Monument Creek, and in the West Fork (Tack 1972).
In the summer, grayling move into Colorado Creek and Angel Creek, tributaries of the North Fork, to feed (Tack 1973). Hallberg (1978) observed juvenile and adult grayling in the North Fork from 1 mi above Boulder Creek to the Chena Hot Springs Road and in Frozenfoot and Olympia creeks, two tributaries of the West Fork. In the Little Chena River, Tack (1972) found grayling from Sorrels Creek to the Chena Hotsprings Road bridge (Tack 1972). In Badger Slough, grayling were found throughout the main river as well as its two main headwater branches in early May and were observed spawning on riffles from the Peede Road crossing upstream for 8 km (Tack 1976). Grayling probably also spawn in both headwater branches of Badger Slough (ibid.). Grayling enter Badger Slough beginning in early April and begin moving back into the Chena River in May, continuing that movement in June (ibid.).

4. Salcha River. In the Salcha River, grayling have been captured as far as 120 mi upstream from the mouth (Holmes 1984). As in the Chena River, larger grayling were found in the upstream sections (ibid.).
5. Goodpaster River. In a 1973 study of the Goodpaster River (Tack 1974), grayling were found throughout the entire reach surveyed, as far as 185 km (115 mi) upstream. Larger grayling were generally found in upstream reaches. Spawning grayling are found throughout the main stem of the Goodpaster (Tack 1980). Tack (1974) observed prespawning grayling moving upstream past 53 km in late April and early May. Gravid grayling move into both the North and South forks of the Goodpaster prior to spawning, but the extent of their upstream migration is not known (ibid.). Age two and three

grayling were found in small headwater streams of the Goodpaster, but larger grayling were not found until the stream was at least 2 m wide (ibid.). In the North Fork of the Goodpaster, adult grayling were predominant upstream from Central Creek to nearly the source. Subadults were dominant between 0 and 45 km on the North Fork and juveniles in the 53 km of the main stem (Tack 1980). In the South Fork of the Goodpaster, adults were dominant except in the uppermost 5 km, where only subadults were found (ibid.). Grayling that spawn in the Goodpaster may move out of the Goodpaster and into the Delta Clearwater and Richardson Clearwater rivers to feed during the summer months. Other grayling may remain in the Goodpaster through the summer. Grayling leave the upper forks of the Goodpaster before winter to avoid heavy icing (Tack 1980); however, some grayling probably overwinter lower in the Goodpaster (Ridder 1983).

6. Delta Clearwater River. Grayling enter the Delta Clearwater River from April through June. Immature grayling remain in the lower reaches of the river, but larger, mature grayling migrate directly to prime feeding habitat in headwater tributaries and upper reaches of the river (Schallock 1965, Pearse 1974, Tack 1980). Grayling do not spawn or rear in the Delta Clearwater, and they migrate out of the river in the fall. Pearse (1974) observed a few grayling still in the lower 1 mi of the Delta Clearwater in mid December, but all grayling were absent by March. The Volkmar River and the Goodpaster River are important spawning streams for grayling that feed in the Delta Clearwater during the summer (Ridder 1983).
7. Richardson Clearwater River. Grayling also enter the Richardson Clearwater River during the summer to feed, but, as in the Delta Clearwater, they do not spawn or overwinter there. Caribou Creek and Rapids Creek, tributaries of Shaw Creek, are major spawning areas for grayling that are found in the Richardson Clearwater during the summer (Ridder 1984).
8. Other upper and middle Tanana River tributaries. Grayling are found in the Delta River and its tributaries (Peckham 1976b, Carlton 1976). They occur in many smaller tributaries of the middle Tanana River, including Bear and McDonald creeks (Hallberg 1980), the Little Salcha River (Tack 1980), Clear Creek, which enters the Tanana River above the Richarson Clearwater (Ridder 1981), Kiana Creek (Ridder 1984), the Fivemile Clearwater (Hallberg 1980), and another Clear Creek (also known as Nelson Clearwater) that drains into Salchaket Slough (ibid.).
9. Fielding and Tangle lakes. Fielding Lake and the Tangle Lakes in the Delta River system contain grayling populations that are subject to an active sport fishery and have been extensively studied. Grayling in Fielding Lake spawn in small inlets to the lake, migrate back downstream to the lake

after spawning, and stay in the lake or its outlet all summer (Tack 1980). Grayling do not spawn in the outlet of Fielding Lake (ibid.). In the Tangle Lakes complex, grayling have been found during lake and stream surveys in Upper Tangle, Round Tangle, Long Tangle, and Lower Tangle lakes, and in the Tangle River (Heckart 1965, Peckham 1976b). Tagging studies have indicated that during the summer some grayling remain in the deep lakes of the Tangle Lakes complex, while others move into shallow portions during June and July (Schallock 1966a, Peckham 1976b). Grayling move from the shallow areas back into the deep lakes in August (Schallock 1966a). The stream section between Long Tangle and Lower Tangle lakes is apparently an important feeding area for grayling from much of the Tangle Lakes system (Roguski and Tack 1970).

10. Upper Tanana River drainage. Grayling are also abundant in streams of the upper Tanana drainage, though this area has generally not been as extensively studied as the middle Tanana. Grayling have been studied in Mineral Lake and its outlet, Station Creek, a tributary to the Tok River (Tack 1972, 1973, 1980). Grayling spawn in the warm waters of the Mineral Lake outlet stream and summer in Station Creek (the primary inlet to Mineral Lake) and the upper Little Tok River (Tack 1980). These grayling overwinter somewhere downstream of Mineral Lake, possibly in the Tanana River (ibid.). Grayling have been reported from the Gerstle River, Johnson River, Robertson River (Chihuly et al. 1980), Kalutna River, Nabesna River, and from the Chisana River system (Pearse 1975), and numerous smaller tributaries of the Tanana (Chihuly et al. 1980). In the Chisana River system, Scottie, Mirror, and Desper creeks are known to produce grayling (Pearse 1975, USFWS 1985).

B. Abundance

Population size estimates are made annually for some heavily exploited grayling populations and are also regularly made for other populations in the Fairbanks Area.

1. Chena River. The size of the grayling population in index sections of the lower 70 mi of the Chena River has been estimated by using the Schnabel mark-and-recapture technique annually since 1967. The total number of grayling greater than 150 mm (fork length) and the number in each age class is monitored. These estimates serve only as indicators of population trends and should not be interpreted to be exact measures of the number of individuals in the population (Hallberg 1981). Sections currently monitored are labeled 2b, 8a, Dam Site, 10a, and 12. Section 2b lies adjacent to Fairbanks, is easily accessible, and has over the years been exposed to heavy development. Section 8a is a 3-mi section approximately 15 mi upstream of Fairbanks, is fairly acessible, but has not yet experienced the development that section 2b has. The Dam Site is the 3-mi section (river

miles 46-49) directly upstream of the flood control structure and is studied to monitor any changes in the population structure as it relates to the flood control project. Section 10b is undeveloped, relatively inaccessible, with minimal angler utilization. Section 10b serves as a control area. Section 12 has been monitored only since 1983 and is located in the heavily fished portion of the river.

Grayling abundance in the lower river section (2b) increased during the early 1970's (table 1), possibly due to a recovery from the effects of the 1967 Fairbanks flood or because of enrichment of the lower river through the introduction of sewage and other wastes from the city of Fairbanks (Tack 1971). Population levels in the lower river dropped after 1972 and have never regained their former high numbers. This may be the result of the reduction of nutrients in the lower river beginning in 1976 when the City of Fairbanks and Fort Wainwright were changed to a new sewage disposal plant that empties into the Tanana River rather than the Chena (Hallberg 1979). This theory, however, has never been verified, and it is noteworthy that the population in the Dam Site section, which was never affected by the nutrient enrichment, has also dropped since 1973 (Hallberg 1982). The decrease in numbers in the lower river, which contains mostly small fish, has not been reflected in catch-per-unit-effort of anglers catching larger fish in the upper river. Because of the apparent continued good levels of recruitment, it is felt that the population of small fish in the Chena River system may not have actually declined overall but that the small fish may have redistributed themselves more evenly throughout the system (ibid.). A very weak age 3 (natal year 1979) year class in 1982 contributed to, but does not completely explain, the decline in section 2b in that year (Holmes 1983). High water levels in early summer of 1979 may have resulted in poor survival of the 1979 year class (ibid.). An exceptionally strong age 3 year class in 1983 accounts for the near doubling of the section 2b estimate in that year (Holmes 1984).

Population estimates consistently indicate a greater abundance of grayling in section 10b than in the other sections studied (table 1). There are three possible reasons for this: 1) less accessibility to anglers, 2) no development occurring in or along the river in this section, or 3) concentration of the grayling in this area to feed on eggs of chinook and chum salmon that spawn in the area (Hallberg 1982). In 1983, efforts were made to assess the abundance of grayling smaller than 150 mm fork length in the lower Chena by using mark-and-recapture population estimates and catch-per-unit-effort indexes for ages 1 and 2 grayling captured during electrofishing and catch-per-unit-effort from seine hauls for age 0 fish (Holmes 1984). It is hoped that

Table 1. Population Estimates for Arctic Grayling Greater Than 150 mm[a] Fork Length in Index Sections of the Chena River, 1968-83

River Section	Year	Date	Schnabel Estimate (gr/mi)	95% Confidence Interval
2b	1968	---	767	---
	1969	---	1,323	---
	1970	July 2-10	1,479	1,111-2,445
	1971	Aug. 30-Sept. 3	2,095	1,571-3,492
	1972	June 22-26	978	799-1,339
	1973	July 3-10	679	570-877
	1974	July 25-28	642	---
	1976	July 22-24	596	---
	1977	July 11-14	479	---
	1978	July 25-28	254	---
	1979	July 26-30	316	---
	1980	July 1-4	463	---
	1981	Aug. 7-10	419	357-628
	1982	July 16-20	185	127-283
	1983	July 13-15	346	268-424
	1984	July 16-18	338	267-429
8a	1979	Aug. 20-23	269	---
	1980	July 14-17	284	---
	1981	Aug. 3-6	359	262-494
	1982	July 13-15	139	96-211
	1983	July 5-7	190	130-872
	1984	July 3-6	223	152-344
Dam Site	1972	June 27-29	1,306	977,2,555
	1973	July 18-19	800	610-1,298
	1974	July 9-11	416	---
	1976	Aug. 4-6	464	---
	1977	July 26-30	437	---
	1978	Aug. 8-11	495	---
	1979	July 17-20	261	---
	1980	July 29-Aug. 1	339	---
	1981	Aug. 11-14	483	279-904
	1982	July 23-27	371	180-927
	1983	July 8-12	334	238-485
	1984	July 9-11	287	198-436

(continued)

Table 1 (continued).

River Section	Year	Date	Schnabel Estimate (gr/mi)	95% Confidence Interval
10b	1970	June 7-July 7	1,873	---
	1980	Aug. 12-15	1,163	---
	1981	July 21-24	1,391	745-2,845
	1982	July 28-30	1,400	847-2,500
	1983	July 19-21	1,458	1,035-2,141
	1984	July 19-20	788[b]	440-1,605
12	1983	July 19-21	333	221-531
	1984	July 31-Aug. 3	2,109	719-10,547

Sources: Holmes 1983, 1984, 1985; Hallberg 1982; Tack 1971, 1972, 1973, 1974.

--- means no data were available.

a Prior to 1972, population estimates were based on all sizes of grayling captured. To correct for this, the percentage of fish less than 150 mm in the sample used in the estimates was calculated and the original estimates reduced by that percentage to produce the numbers shown in this table (Hallberg 1979).

b Petersen estimate.

the estimates from one of these methods will prove to be correlated with the strength of year classes as they enter the fishery. If small year classes can be recognized before they recruit to the sport fishery, it may be possible to enhance year class strength through a stocking program (ibid.).

2. Delta Clearwater River. Abundance of grayling in the Delta Clearwater and Richardson Clearwater rivers has been monitored since 1973. These populations are monitored by using index counts of the number of grayling captured in a single run with an electrofishing boat over sections of the river. These index counts are not comparable between different sections of the rivers because electrofishing efficiency varies between sections. For the Delta Clearwater River, the index rates from the upper section are felt to be the most indicative of grayling abundance in the system because this section offers the best physical conditions for electrofishing (many riffle areas and narrow stream width) and is the least affected by weather conditions (Ridder 1980, 1982).

   Index counts of grayling in the lower section (miles 4-7) of the Delta Clearwater increased from 1977 through 1979 (table 2). This increase is probably due to the enhancement program that began in 1975. In this program, pond-reared fingerling grayling were transplanted into four spring areas located within the lower section of the Delta Clearwater. Fifty-two percent of the grayling captured in this section in 1979 had scale patterns characteristic of pond-reared fish (Ridder 1980). Similarly, fry plants totaling 100,000 fish made in the left fork of the Delta Clearwater in 1974 and 1975 plants of approximately 15,000 fish made at mile 15 of the upper section may have contributed in part to the large increase in the 1979 rate over previous years (ibid.). The reason for the low count of grayling in the upper section in 1978 is not known, but the lack of grayling in this section in 1978 was confirmed by visual observations and from angler interviews throughout the season (ibid.). The lack of new stocked fish in 1981 probably affected the lower river's capture rate in that year. However, weather conditions and especially the unseasonably low water levels in the lower 3 mi of the river made grayling difficult to capture that year and are felt to have had a greater effect (Ridder 1982). The low counts in the lower two sections of the river in 1981 are not felt to be accurate indicators of the population size. The low index counts in 1982, however, were supported by a sharp drop in the catch rate of anglers fishing for grayling on the river (Ridder 1983). Index counts dropped even more in 1983, though two more index runs over 3 mi of the lower section after the first index run gave capture rates of 10 and 7 grayling, levels close to prestocking counts from 1973-1976

Table 2. Numbers of Grayling Captured During Index Sampling on Sections of the Delta Clearwater River, 1973, 1975-83

Year	Date	Mile Sections 4-7	Mile Sections 8-13	Mile Sections 14-17.5	Total Captured
1973	June 27	7	20	66	93
1975	July 2	13	8	43	64
1976	June 30	11	27	41	79
1977	July 7	26	25	49	100
1978	July 10	39	28	9	76
1979	July 17	51	24	74	149
1980	July 15	39	45	98	182
1981	July 7	6[a]	27	40	73[a]
1982	July 15	27	18	18	63
1983	July 12	3	5	45	53

Sources: Ridder 1983, 1984.

a Weather conditions and unseasonably low water levels in the lower river made capture of grayling difficult and resulted in an unreliable count for 1981.

(Ridder 1984). It is probable that at least part of the decline in the Delta Clearwater stems from the normal mortality of individuals from the four year classes of grayling stocked between 1975 and 1978 (ibid.).

3. Richardson Clearwater River. Index counts from the Richardson Clearwater are generally higher than those from the Delta Clearwater. The greater frequency of riffle areas and a more confined channel in the Richardson Clearwater makes electrofishing more effective on this stream and results in larger index counts (Peckham 1978a). In 1973, 1977, and 1978 index counts on the Richardson Clearwater were conducted in August, when grayling were more concentrated in the lower section of the river. Beginning in 1979, counts were made in July, when the grayling are more dispersed. This resulted in a drop in the number of grayling captured (table 3) (Ridder 1980). The 1979 count is felt to be inaccurate because the morphology of the river at the start of the shocking run precluded effective capture of grayling (Ridder 1981). The low count in 1981 may be the result of grayling dispersing into the slough at the mouth of the Richardson Clearwater below the sample area in that year (Ridder 1982). In July of 1982, a Petersen mark-and-recapture population estimate was calculated for grayling from mile 8 to a point 4.75 mi downstream in the Richardson Clearwater. Results indicated a population of 1,582 grayling/mi, with 0.95 confidence interval of 935-2,857 (Ridder 1983). A visual population estimate was also made by two observers counting grayling from a boat between river miles 8 and 6. The estimate from this method was 1,175 grayling/mi, which is felt to be a minimum estimate because of difficulties observing grayling in riffles and turbulent runs (ibid.).
4. Goodpaster River. Population estimates of grayling in the lower Goodpaster River have been calculated for several years. These are usually Petersen single-census mark-and-recapture estimates, though in 1973 several other methods were also used (Tack 1974). Grayling are captured for these estimates by using electrofishing gear. One day is allowed for random mixing of marked fish in the population prior to a final electrofishing run to examine for recaptures (Peckham 1983).

   The low population estimate for Goodpaster River grayling in 1976 (table 4) may have been the result of low water levels in the Goodpaster that year that resulted in a reduced amount of grayling habitat (Peckham 1977). In 1977, a high population estimate was calculated for river miles 3 to 6; however, high water levels at the time of the recapture run had apparently resulted in an influx of large grayling into the area, causing a high percentage of unmarked fish in the recapture sample and a biased population estimate (Peckham

Table 3. Numbers of Grayling Captured During Index Sampling on Sections of the Richardson Clearwater River, 1973, 1977-83

Year	Date	Mile Section 1-7	Mile Section 7-8.5	Total Captured
1973	Aug. 1	75[a]	---	---
1977	Aug. 30	104	---	---
1978	Aug. 31	117	---	---
1979	July 17	63[b]	---	---
1980	July 17	73	97	170
1981	July 9	58	109	167
1982	July 20	165	159	324
1983	July 19	156	64	220

Sources: Ridder 1983, 1984.

--- means no data were available.

a Only the lower 4 mi were indexed in 1973 (Pearse 1974).

b The morphology of the river at the start of the shocking run precluded effective capture of grayling and resulted in an unreliable index count for 1979 (Ridder 1981).

Table 4. Population Estimates for Grayling Larger Than 150 mm in the Lower Goodpaster River, 1973-82

Year	Method of Estimate	Distance Surveyed (mi)	Population Estimate (gr/mi)	95% Confidence Interval[a]
1973	Schnabel	33[b]	770	758-807
1974	Petersen	33	323[c]	248-420
1975	Petersen	6[d]	760	597-964
1976	Petersen	6	563	392-839
1977	Petersen	6	604	478-763
1978	Petersen	6	749	587-983
1980	Petersen	6	819	579-1,053
1982	Petersen	6	281	197-351

Sources: Tack 1974, 1975; Peckham 1976, 1977, 1978, 1979, 1981, 1983.

a Confidence limits for 1974-82 calculated by this author using data from the original reports and Pearson's formula for confidence limits of R (number of recaptures) (Ricker 1975).

b Area from Goodpaster River mouth to the confluence of the North and South forks.

c Based on recaptures of fish marked in 1973, with an assumed constant rate of mortality for both marked and unmarked fish of 0.46. This should be regarded as a rough estimate (Tack 1975).

d Area from river miles 3 to 6 and river miles 15 to 18.

1978b). The 1980 estimate was the highest ever recorded for the Goodpaster. Record high population index counts were also observed in the Delta Clearwater River that year. The Goodpaster River's grayling population level dropped to a very low level in 1982, as did the Delta Clearwater's. Reasons for this apparent reduction in abundance are not known.

5. Other streams. Population estimates of grayling in the Chatanika and Salcha rivers were calculated in 1972 by using the Schnabel mark-and-recapture estimator (Tack 1973). For the Chatanika River from 2 mi above to 1 mi below the Elliot Highway Bridge the population estimate was 488 gr/mi. For the 3 mi of the Salcha River below the Redmond Creek confluence the estimate was 805 gr/mi. In both cases, however, very few recaptures were made, and these estimates should be regarded with caution (ibid.).

   The size of the Chatanika River grayling population was also estimated in 1982 and 1984 (Holmes 1983, 1985). The area surveyed was the 2 mi below the Elliot Highway bridge. The Schnabel estimate for grayling over 150 mm (fork length) was in 1982 was 271 grayling/mi, with a 95% confidence interval of 212 to 346 grayling/mi (Holmes 1983). The 1984 estimate was 388 grayling/mi, with a 95% confidence interval of 276 to 564 grayling/mi. (Holmes 1985). An attempt was made to conduct another population estimate on grayling in the Salcha River in 1981; however, no recaptures were made, so an estimate could not be calculated (Hallberg 1982).

C. Enhancement

Grayling have been stocked in many Fairbanks Area lakes to increase sportfishing opportunities (table 5). Grayling have also been stocked in the Delta River and in the Chena River. Many of the grayling stocked in these rivers are transported from the hatchery to rearing ponds such as West Pond and Left OP Lake to feed and grow for approximately three months before they are stocked in the streams in the fall.

Table 5. Water Bodies in the Fairbanks Area Stocked With Arctic Grayling, 1968-84[a]

Water Body	Community	Years Stocked
15 Mile Pond	Nenana	1968
17 Mile Pond	Nenana	1968
29.6 Steese Hwy. Lake	Chatanika	1977,78,84
30.6 Steese Hwy. Lake	Chatanika	1975,78,84
31 Mile Pit	Aurora Lodge	1967,69,73,75,78,83,84
31.6 Steese Hwy. Lake	Chatanika	1977,78,83,84
33.0 Steese Hwy. Lake	Chatanika	1977,78,84
33.5 Steese Hwy. Lake	Chatanika	1977,78,83,84
34.6 Steese Hwy. Lake	Chatanika	1975,78,83,84
35.8 Steese Hwy. Lake	Chatanika	1975,83,84
36.5 Steese Hwy. Lake	Chatanika	1977,78,83,84
81 Mile Pit	Shaw Creek	1973,77,81,83,85
Anderson Pit (rectan.)	Anderson	1977
Anderson Pit (round)	Anderson	1977
ARR #3	Fairbanks	1968
ARR #4	Fairbanks	1968
Bailey Pond	Chena Hot Springs	1968,69
Bathing Beauty Pond	Moose Creek	1975,78,83,84
Bear Lake	Eielson AFB	1970
Big lake	Ft. Greely	1967,70,72,73,77,78,83,84
Birch Lake Pit	Birch Lake	1975
Bolio Lake	Ft. Greely	1981,83,84
Chena Hot Spgs #30	Fairbanks	1983,84
Chena Hot Spgs #30.9	Fairbanks	1983,84
Chena Hot Spgs #32.9	Fairbanks	1984
Chena Hot Spgs #33.3	Fairbanks	1984
Chena Hot Spgs #38.8	Fairbanks	1984
Chena Hot Spgs #42.8	Fairbanks	1983,84
Chena Hot Spgs #45.5	Fairbanks	1983,84
Chena Hot Spgs #45.6	Fairbanks	1984
Chena Hot Spgs #47.9	Fairbanks	1983,84
Chena Lake	Fairbanks	1984
Chena River	Fairbanks	1984
Chet Lake	Ft. Greely	1976,85
Clear Pond	Clear	1970
Clearwater Lake	Delta Junction	1974
Coal Mine #3	Delta Junction	1978,85
Craig #1 Lake	Johnson River	1967,72
Craig Lake	Johnson River	1967
Delta Clearwater R.	Delta Junction	1974,75,76,77,78,79,83,84
Donnelly Creek Pond	Donnelly	1973

(continued)

Table 5 (continued).

Water Body	Community	Years Stocked
Dot Lake	Dot Lake	1967
Dune Lake	Nenana	1976,81,83,84
East Pond	Ft. Greely	1968,75,76
Eielson Pond #1	Eielson AFB	1968
Eielson Pond #2	Eielson AFB	1968
Engineers Hill Lake	Eielson AFB	1968,70,72,73,77,81
Ft. Greely #1	Ft. Greely	1977
Ft. Greely Lake	Ft. Greely	1983
Grayling Lake	Eielson AFB	1975,78,83,84
Hidden Lake	Eielson AFB	1975,78,83,84
Island Lake	Delta Junction	1984
J Lake	Ft. Greely	1976,85
Johnson Rd. Pit #1	Aurora Lodge	1976,78,84
Johnson Rd. Pit #2	Aurora Lodge	1975,76,78,84
Left O.P. Lake	Ft. Greely	1967,70,75,76,77,78,84,85
Lost Lake	Birch Lake	1968,70,76,83
Millers Pond	Fairbanks	1967
Nenana Pond	Nenana	1970
Nickel Lake	Ft. Greely	1976,83,85
Olnes Pond	Chatanika	1973
Otto Lake	Healy	1967,68,69,70,72,73,75
Phantom Pond	Delta Junction	1983
Sergeant's Pond	Ft. Wainwright	1967,68,70
Spade Lake	Ft. Greely	1983
Tar Kettle Lake	Eielson AFB	1975
Ten Mile Lake	Nenana	1968
Texas #2 Lake	Ft. Greely	1980
West Pond	Ft. Greely	1968,75,76,77,78,80,83,84,85

Sources: ADF&G 1984, 1985b; Kramer 1978, 1979; Peckham 1978; Peckham and Ridder 1979; Ridder 1980, 1983.

a Some 1985 stocking is included in this list; however, it is not a complete record for 1985.

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Broad Whitefish Distribution and Abundance
Arctic, Western, and Interior Regions

I. REGIONWIDE INFORMATION

In this report, distribution and abundance information of broad whitefish will be presented by ADF&G, Division of Sport Fish, postal survey areas (map 1). Information on the level of whitefish harvest as a group is contained in the Sport Fish Harvest narrative found elsewhere in this volume.

A. Regional Distribution

Broad whitefish are found in most of the major drainages entering the Bering, Chukchi, and Beaufort seas (Baxter 1973, Morrow 1980). The majority of broad whitefish in the arctic coastal plain occur in the Colville, Sagavanirktok, Topagoruk, Ikpikpuk, and Canning rivers (Kogl 1971, Bendock 1977, Bendock and Burr 1985, USFWS 1982). They are found in most major drainages from the Kuskokwim River, where they are common, to the Canadian border (ibid.). They occur in the Yukon River system from the mouth to the headwaters in British Columbia (Morrow 1980), including the Koyukuk, Porcupine, and Tanana river drainages in Alaska (Alt 1971).

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 include the following:

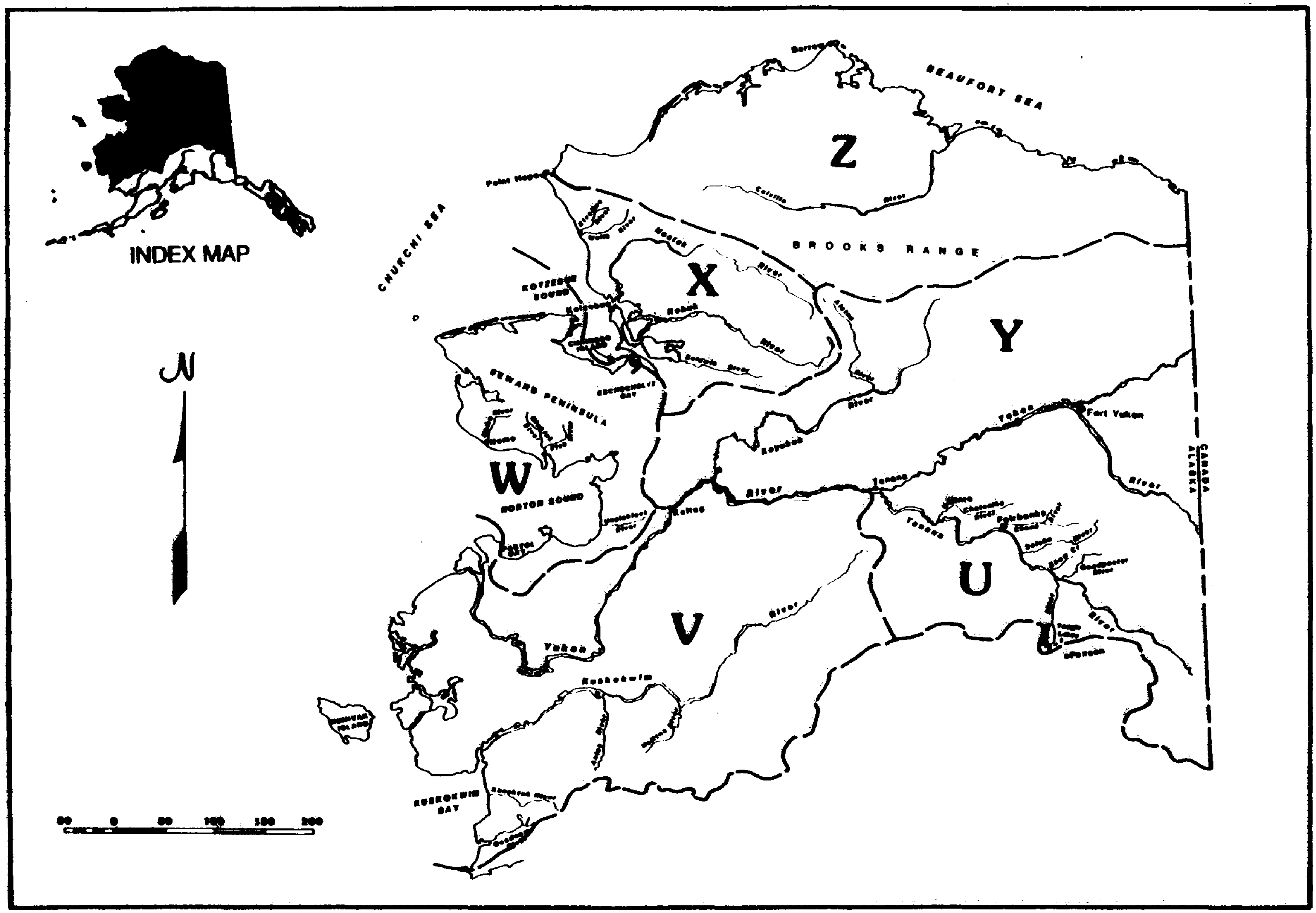
- General distribution
- Documented presence in stream or lake
- Documented spawning areas
- Documented overwintering areas
- Documented rearing areas

C. Factors Affecting Distribution

Water quality parameters, such as salinity, temperature, and dissolved oxygen levels, and physical characteristics of lakes, such as depth, velocity, and substrate type, all influence the distribution of broad whitefish. For detailed information, see the broad whitefish Life History and Habitat Requirements narrative in volume 1 of this series.

D. Movements Between Areas

1. Anadromous. On the North Slope, broad whitefish have been observed migrating out of larger rivers such as the Colville and Sagavanirktok during spring breakup in early June and into shallow bays and lagoons of the Beaufort Sea for summer feeding (Bendock 1977). Fish that had been feeding in coastal areas enter the Sagavanirktok River in late August to migrate to the spawning areas (ibid.). A sizeable spawning run moves up the Colville River in August (Bendock 1979). Alt and Kogl (1973) found that the Colville run is spread over several months and peaks in late July.



Map 1. Arctic, Western, and Interior regions sport fish survey areas.

After spawning, broad whitefish move downstream during freeze-up to overwinter under the ice in deeper freshwater pools, which are fed by springs or the interstitial flow of the major rivers.

2. Nonanadromous:

   a. Stream residents. In the lower Kuskokwim River, the population, which overwinters in the main stem of the river, migrates upstream during spring breakup in late May or early June to the summer feeding areas of the tundra lakes, ponds, and sloughs (Baxter 1973). A similar migration occurs in the Minto Flats area. Broad whitefish move in June from the Tanana, Tolovana, and Chatanika rivers to feed in the lakes and sloughs of the flats (Kepler 1973).

      Baxter (1973) noted that, in the Kuskokwim River area, the ripening females move downstream out of the tundra lakes, ponds, and streams in August and September and begin a slow migration up the Kuskokwim River. They are followed by the sexually developing males in September and October (ibid.). Apparently, in several stocks, there is a postspawning downstream migration of adults to overwintering areas in deep sections of rivers or in brackish water areas or lakes (ibid.).

   b. Lake residents. Little is known about the life history of lake resident broad whitefish. Bendock and Burr (1985) reported finding broad whitefish in several thaw and deflation lakes located within the central arctic coastal plain. Baxter (1973) reported that broad whitefish occur in lakes throughout the Yukon-Kuskokwim delta. An isolated population of broad whitefish occurs in Lake Minchumina, northwest of Denali National Monument (ibid.).

E. Population Size Estimation

Populations of broad whitefish have not been well studied in Alaska, and population size has not been estimated.

F. Regional Abundance

Only limited information on broad whitefish is available. Except for a few isolated cases, which only compare the abundance of broad whitefish relative to the abundance of other fish species, abundance has not been estimated.

II. WESTERN AND INTERIOR REGIONS

A. Fairbanks Area

The boundaries of the Fairbanks Area (Sport Fish Postal Survey Area U) are described in the Sportfishing Harvest narrative in this volume.

1. Distribution. Broad whitefish are widespread in the Minto Flats region of the Tanana River drainage (Alt 1972). They have been documented in the Tanana River 14 km upstream from the mouth of the Chena River (ibid.). (For additional information on distribution, see table 1).

Table 1. Collection Locations of Broad Whitefish (*Coregonus Nasus*) Within Sport Fish Postal Survey Area U

Drainage/Waterbody	Lat. N	Long. W
Yukon River		
Tanana River	65°10'	151°58'
Minto flats	64°43'	148°49'
Tolovana River	64°51'	149°50'
Chatanika River	65°06'	147°26'
Tatalina River	65°04'	149°17'
Lake Minchumina	63°53'	152°19'

Source: Alt 1972, pers. comm.; Baxter 1973.

B. Lower Yukon-Kuskokwim Area
The boundaries of the Lower Yukon-Kuskokwim Area (Sport Fish Postal Survey Area V) are described in the Sportfishing Harvest narrative in this volume.
1. Distribution. Broad whitefish are distributed throughout the lower Yukon and Kuskokwim rivers (Baxter 1973). Within the lower Yukon River, Alt (1983) reported that broad whitefish are very abundant in the Innoko River system. They are taken up the North Fork of the Innoko and below Dikeman (124 mi up the Iditarod River) (ibid.).
Alt (1972) reported that broad whitefish are distributed throughout the Kuskokwim River drainage. They were taken in the Big River, the South and East forks of the Kuskokwim River, and on spawning grounds in Highpower Creek (1,350 km up the Kuskokwim River) (ibid.). (For additional information on distribution, see table 2.)

C. South Slope Brooks Range Area
The boundaries of the South Slope Brooks Range Area (Sport Fish Postal Survey Area Y) are described in the Sportfishing Harvest narrative in this volume.
1. Distribution. Broad whitefish are widely distributed in the Yukon River and its tributaries, including the Porcupine and Koyukuk rivers (Alt 1972). (For additional information on distribution, see table 3.)

Table 2. Collection Locations of Broad Whitefish (Coregonus Nasus) Within Sport Fish Postal Survey Area V

Drainage/Waterbody	Lat. N	Long. W
Yukon River		
Alakanuk	62°40'	164°36'
Kotlik	63°02'	163°33'
Nanvaranak Lake	62°39'	163°37'
Fish Village area	62°20'	163°50'
Andreafsky	62°03'	163°10'
Marshall	61°53'	162°05'
Ohogamiut	61°34'	161°52'
Kakamut	61°38'	161°40'
Innoko River	62°00'	159°38'
Hather Creek	63°35'	158°18'
Yentna River	63°10'	158°16'
Iditarod River	63°02'	158°46'
Dishna River	63°36'	157°17'
North Fork of Innoko R.	63°49'	156°37
Kuskokwim River		
Kuskokwim Bay off Quinhagak	59°45'	162°00'
Kwegooyuk, mile 30 Kusko. R.	60°24'	162°16'
Kialik River, mile 42 Kusko. R.	60°25'	162°25'
Kutukhun Slough	60°36'	162°35'
Kinak River, mile 38 Kusko. R.	60°24'	162°50'
Eenayarak River	60°19'	161°25'
Johnson River, mile 66 Kusko. R.	60°38'	162°06'
Kasigluk, mile 33	60°52'	162°32'
Nunapitchuk, mile 32	60°53'	162°29'
Atmauthluk, mile 29		
Bethel, mile 86 Kusko. R.	60°48'	161°45'
Kwethluk, mile 104 Kusko. R.	60°49'	161°26'
Akiachuk, mile 112 Kusko. R.	60°54'	161°26'
Lower Kalskag, mile 184 Kusko. R.	61°31'	160°22'
Aniak, mile 224 Kusko. R.	61°35'	159°32'
Chuathpaluk, mile 236 Kusko. R.	61°34'	159°34'
Crooked Creek, mile 295 Kusko. R.	61°52'	158°06'
Holitna River, mile 341 Kusko. R.	61°41'	157°51'
Stony River Village, mile 369	61°47'	156°35'
McGrath, mile 511 Kusko. R.	62°58'	155°38'
Medfra, mile 582 Kusko. R.	63°06'	154°43'
Nikolai, Mile 626 Kusko. R.	62°58'	154°10'
Telida, Fish Creek Lake, mile 741 Kusko. R.	63°23'	153°16'
North Fork of Kusko. R.	63°07'	154°34'
South Fork of Kusko. R.	63°05'	154°39'

(continued)

Table 2 (continued).

Drainage/Waterbody	Lat. N	Long. W
East Fork of Kusko. R.	63°07'	154°35'
Highpower Creek	63°25'	153°07'
Big River	62°58'	154°53'
Yukon - Kuskokwim Delta		
Manokinak River	61°32'	164°00'
Kgun Lake	61°34'	163°45'
Tungaluk Slough	61°14'	165°20'
Kashunuk River	61°24'	165°11'
Chakaktolik	62°47'	163°38'
Black River		
Nunavakanuk Lake	62°02'	164°37'

Source: Alt 1972, 1982; Baxter 1973.

Table 3. Collection Locations of Broad Whitefish (*Coregonus Nasus*) Within Sport Fish Postal Survey Area Y

Drainage/Waterbody	Lat. N	Long. W
Yukon River		
Porcupine River	66°52'	143°42'
Dall River	66°00'	149°15'
Nulato	64°34'	158°06'
Koyukuk River	65°41'	156°24'

Source: Alt 1972, Baxter 1973.

III. ARCTIC REGION

A. Seward Peninsula-Norton Sound Area

The boundaries of the Seward Peninsula-Norton Sound Area (Sport Fish Postal Survey Area W) are described in the Sportfishing Harvest narrative in this volume.

1. Distribution. Broad whitefish are known to be present in Imuruk Basin proper as well as in the lower reaches of the three major rivers flowing into the basin: the Agiapuk, Kuzitrin, and Pilgrim rivers (Alt 1972). (For additional information on distribution, see table 4.)

Table 4. Collection Locations of Broad Whitefish (*Coregonus Nasus*) Within Sport Fish Postal Survey Area W

Drainage/Waterbody	Lat. N	Long. W
Norton Sound		
Saint Michael	63°29'	162°02'
Koyuk River, mile 5	64°55'	161°08'
Port Clarence		
Imuruk Basin	65°07'	165°45'
Agiapuk River, mile 3,7	65°10'	165°41'
Kuzitrin River	65°10'	165°25'
Pilgrim River	65°09'	165°13'

Source: Alt, 1972, Baxter 1973.

B. Northwest Alaska Area

The boundaries of the Northwest Alaska Area (Sport Fish Postal Survey Area X) are described in the Sportfishing Harvest narrative in this volume.

1. Distribution. Webb (1980) collected broad whitefish in Aliktongnak Lake and other unnamed lakes in the Noatak River drainage. They have also been observed in the Kobuk River drainage (Alt 1979). (For additional information on distribution, see table 5.)

C. North Slope Brooks Range Area

The boundaries of the North Slope Brooks Range Area (Sport Fish Postal Survey Area Z) are described in the Sportfishing Harvest narrative in this volume.

1. Distribution. Broad whitefish were captured along the arctic coast between the Topagoruk River and the eastern margin of Foggy Bay (Bendock 1977, Bendock and Burr 1985). They were

Table 5. Collection Locations of Broad Whitefish (Coregonus Nasus) Within Sport Fish Postal Survey Area X

Drainage/Waterbody	Lat. N	Long. W
Kotzebue Sound		
Kobuk River	66°54'	160°38'
Noatak River drainage		
Aliktongnak Lake	67°24'	162°41'
Unnamed Lake	67°29'	162°42'
Unnamed Lake	67°27'	162°33'

Source: Baxter 1973, Webb 1980.

found at stream and lake sites on the arctic coastal plain near Teshekpuk Lake (Hablett 1979, Bendock and Burr 1985). They were also captured throughout the summer in the main reaches of the Sagavanirktok and Colville rivers, and a large spawning run has been observed in the Colville at Umiat (Alt and Kogl 1973). Broad whitefish have been reported in the lower Canning River and may possibly use other systems to the east, although none were taken during a wide-scale sampling program in 1970 off the coast of the Arctic National Wildlife Refuge (USFWS 1972). (For additional information on distribution, see table 6.)

Table 6. Collection Locations of Broad Whitefish (<u>Coregonus Nasus</u>) Within Sport Fish Postal Survey Area Z

Drainage/Waterbody	Lat. N	Long. W
Arctic Coast		
Alaktak River	70°27'	154°54'
Teshekpuk Lake	70°35'	153°35'
Colville River,	70°10'	150°55'
Kalubik Creek	70°26'	150°06'
Kupigruak Channel	70°30'	153°23'
Itkillik River	70°09'	150°56'
Nechelik Channel	70°27'	151°04'
Tamayayak Channel	70°27'	151°02'
Nanuk Lake	70°19'	151°01'
Chandler River	69°27'	151°30'
Kachemach River	70°21'	150°40'
Umiat	69°22'	152°03'
Fossil Creek	69°18'	155°22'
Seabee Creek	69°22'	152°06'
Canning	70°04'	145°30'
Killik	69°01'	153°55'
Miluveach	70°23'	150°03'
Awuna River	69°03'	155°28'
Kikiakrovak River	69°59'	151°36'
Kogosukruk River	69°56'	151°35'
Anaktuvuk River	69°34'	151°28'
Sagavanirktok River	70°18'	147°52'
Barter Island	70°07'	143°40'
Inaru River	70°54'	155°59'
Topagoruk River	70°11'	155°57'
Ikpikpuk River	70°49'	154°19'
Oumalik Creek	70°04'	155°25'
Chipp River	70°44'	155°25'
Interlake Creek	70°20'	155°16'
Lake Betty	68°29'	156°30'
Sungovoak Lake	71°05'	156°30'
Pittalukruak Lake	70°50'	155°23'
Meade River	70°52'	155°55'
Okpiksak River	70°41'	156°37'
Fish Creek	70°22'	151°13'
Inigok Creek	70°10'	152°35'
Judy Creek	70°15'	151°45'
Kuparuk River	70°25'	148°52'
Migualiak River	70°39'	154°06'
Price River	69°53'	154°42'
Kalikpik River	70°27'	151°56'
Akmalik Lake	68°25'	154°04'
Imiaknikpak Lake	68°29'	154°03'

(continued)

Table 6 (continued).

Drainage/Waterbody	Lat. N	Long. W
Unnamed lake	70°32'	155°15'
Unnamed lake	70°07'	153°02'
Unnamed lake	70°02'	153°03'
Unnamed lake	70°01'	153°39'
Unnamed lake	70°09'	153°55'
Unnamed lake	70°03'	153°30'
Unnamed lake	70°34'	154°18'
Unnamed lake	70°18'	153°04'
Unnamed lake	70°01'	153°08'
Unnamed lake	70°22'	154°40'
Unnamed lake	70°04'	155°37'
Unnamed lake	70°39'	155°12'
Unnamed lake	70°32'	155°25'
Unnamed lake	70°26'	155°43'
Unnamed lake	70°20'	155°25'
Unnamed lake	70°09'	155°47'
Unnamed lake	70°06'	155°00'
Unnamed lake	69°51'	152°24'
Unnamed lake	70°03'	145°43'
Unnamed lake	70°01'	145°37'
Unnamed lake	70°18'	150°30'
Unnamed lake	70°12'	150°41'
Unnamed lake	70°17'	150°52'
Unnamed lake	70°24'	150°47'
Unnamed lake	70°26'	150°45'
Unnamed lake	70°18'	151°27'
Unnamed lake	70°24'	151°30'
Unnamed lake	70°25'	151°41'
Unnamed lake	70°06'	152°37'
Unnamed lake	70°18'	152°56'
Unnamed lake	70°25'	152°40'
Unnamed lake	70°26'	152°22'
Unnamed lake	70°40'	152°40'
Unnamed lake	70°19'	151°01'
Unnamed lake	69°57'	153°15'
Unnamed lake	69°53'	154°20'
Unnamed lake	69°58'	154°16'
Unnamed lake	70°18'	156°18'
Unnamed lake	70°49'	155°21'
Unnamed lake	70°42'	154°58'

Source: Alt 1972; Alt and Kogl 1973; Baxter 1973; Bendock 1977, 1979; Bendock and Burr 1985a,b; Hablett 1979.

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Burbot Distribution and Relative Abundance
Western and Interior Regions

I. REGIONWIDE

The distribution and abundance of burbot will be discussed by ADF&G, Division of Sport Fish, postal survey areas in this report (map 1). The Western and Interior regions include the Lower Yukon-Kuskokwim Area (Area V), the South Slope Brooks Range Area (Area Y), and the Fairbanks Area (Area U). Sport harvest information is presented in the Sport Use of Freshwater and Anadromous Fish narrative in this volume.

A. Regional Distribution

Burbot are distributed throughout the fresh waters of Alaska and have a nearly universal distribution in the Western and Interior regions (ADF&G 1978, Morrow 1980). Burbot are abundant in the Yukon, Kuskokwim, Tanana, and Koyukuk rivers and occur in many low-lying lakes and interconnecting waterways (ADF&G 1978).

B. Areas Used Seasonally and for Life Functions

A series of freshwater distribution maps at 1:250,000 scale has been produced for this report. The categories of mapped information are 1) general distribution, 2) documented presence in stream or lake, 3) documented spawning areas, 4) documented overwintering areas, and 5) documented rearing areas.

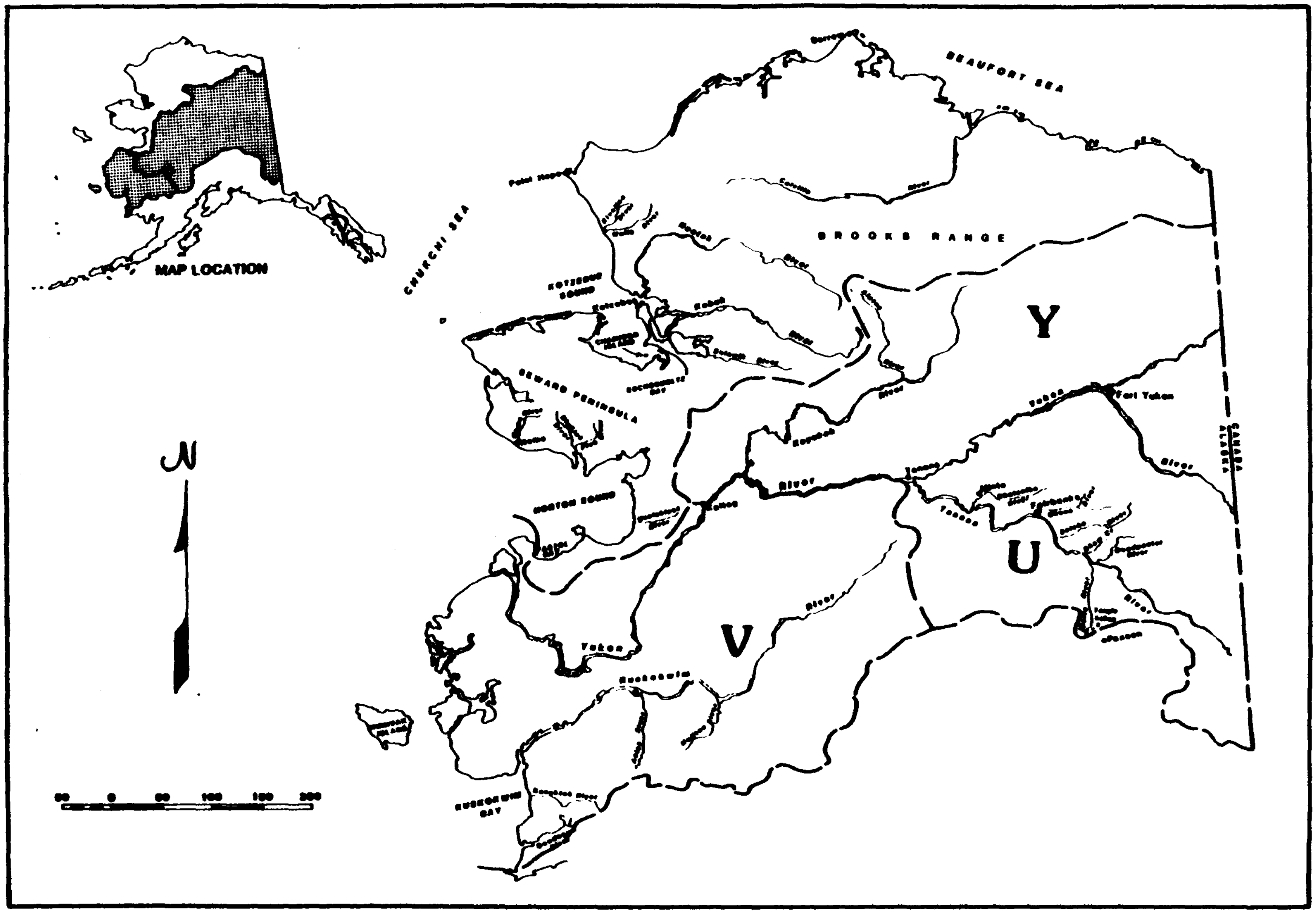
C. Factors Affecting Distribution

Burbot is the only freshwater species of the cod family (Gadidae) and generally avoids brackish waters. Salinity may limit its distribution, as it is absent from most islands within its range (Scott and Crossman 1973, ADF&G 1978). Temperature limits the development of burbot eggs and larvae. At water temperatures below 4°C, egg mortality increases, and larvae do not start feeding at temperatures below 8°C (Jager et al. 1979). More detailed information regarding factors that affect distribution appears in 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 may move to a feeding area after spawning (Morrow 1980). Populations of burbot in the lower Kuskokwim drainage have extensive upstream migrations to spawning grounds, and other burbot in the Western and Interior regions may have similar migrations (ADF&G 1978).

Four burbot were radio-tagged in the lower Chena and Tanana rivers in the fall to monitor their fall and winter movements (Hallberg 1984). All four fish showed some movement both upstream and downstream, moving from as far as 18 mi downstream to 7 mi upstream.



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

E. Population Size Estimation

Burbot have been sampled in many drainages of the Western and Interior regions; however, few abundance estimates are available. Sampling gear has included gill nets, seines, hook and line, fyke nets, and electrofishing. Catch rates of burbot from electrofishing are reported for some streams in the Fairbanks Area. Tack (1971) noted that burbot were not often encountered in electrofishing in the Tanana drainage but that they were probably represented fairly in the catch.

F. Regional Abundance

Burbot have been sampled most extensively in the Fairbanks Area, and catch rates from electrofishing are available for some areas. In the Lower Yukon-Kuskokwim Area, knowledge about burbot distribution is limited, and in the South Slope Brooks Range Area, distribution information is only available for a few lakes and streams.

II. LOWER YUKON-KUSKOKWIM AREA

The Lower Yukon-Kuskokwim Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all water flowing into Kuskokwim Bay; and adjacent salt water and islands (map 1). This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985).

Burbot are present in the lower Kuskokwim River drainage in the lower reaches of streams (Alt 1977). They are abundant in the lowland areas of the lower Kuskokwim drainage where they are used as a subsistence food. Burbot are present in low abundance in Kagati Lake, a deep lake at the head of the Kanektok River, which drains into Kuskokwim Bay (ibid.).

Alt (1980) reports that burbot are present in the lower Yukon drainage. High numbers of burbot were found in the lower Innoko River drainage, a tributary of the lower Yukon River (Alt 1983).

III. SOUTH SLOPE BROOKS RANGE AREA

THE South Slope Brooks Range Area includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (map 1) (ADF&G 1985).

Burbot are found in several tributaries and lakes of the upper Koyukuk River drainage. Burbot occur in the Kanuti River in the spring and in the Jim River in the summer (Chihuly et al. 1980, Netsch 1975). Mary Angel and Minnie creeks, tributaries of the Middle Fork Koyukuk, provide summer rearing habitat (Chihuly et al. 1980). Burbot are found in Dietrich River, another tributary of the Middle Fort Koyukuk (ibid.). Overwintering Creek, a spring-fed tributary to the Dietrich River, provides year-round habitat (ibid.). Netsch (1975) found burbot in Big Lake, in the Middle Fork Koyukuk drainage. Roguski and Spetz (1968) found no burbot in their test-netting of lakes on the south slope of the Brooks Range, but the stomach of a pike sampled in Wild Lake contained a burbot.

Burbot have been found in other tributaries of the Yukon River. Burbot are present in the Ray River (Netsch 1975), and the North Fork Ray River is used as a summer rearing area (Chihuly et al. 1980). In the Chandalar River, burbot are present but not abundant (Craig and Wells 1975), and a few burbot have been sampled in Ackerman, Squaw, and Chandalar lakes of the Chandalar River drainage (Pearse 1978). Craig and Wells (1975) also found burbot in a few lakes of the Sheenjik River drainage, a tributary of the Porcupine River.

IV. FAIRBANKS AREA

The Fairbanks Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages, as well as the entire Tanana River watershed. This area also includes the Alaska portion of the White River drainage (map 1) (ADF&G 1985).

Burbot are widely distributed in the Tanana drainage in larger glacial rivers and near the confluences of many tributaries (Peckham 1981). Lakes at elevations above 600 m generally have burbot populations (ibid.). Burbot are reported in George Lake (Mills 1979-1985) and in Fielding and Tangle lakes (Peckham 1977). One burbot was taken in deep water in Lake Minchumina (Kramer 1975). Burbot are the third most abundant species in Harding Lake; they are present during the summer and spawn in the lake in winter (Hallberg 1979).

Burbot are spring, summer, and fall residents of the Chatanika River, a Tanana tributary (Chihuly et al. 1980) and were found in the Tatalina River, a tributary to the Chatanika in the summer. Kepler (1973) reports finding few burbot in the Minto flats area in the summer.

Burbot are present in low abundance in the lower Chena River from mid May to early October (Mecum 1984) and were found in the Chena River near the confluence with the Tanana in lower sidechannel, groin, and main channel border areas (ibid.). Burbot were rare in clearer slough and tributary mouth habitats and absent from shallow main channel sandbar and sidechannel habitats, except during high river stages (ibid.). Tack (1975) found burbot at the mouth of the Chena in low abundance, from two to five fish per hour sampled by electrofishing.

Burbot occur throughout the lower reaches of the Salcha River in summer and winter and spawn in the Salcha during winter (Chihuly et al. 1980). Kramer (1975) found burbot in low abundance in the Salcha River, and Tack (1972) sampled one burbot per hour by electrofishing in the lower Salcha in July. Burbot also occur in Redmond Creek, a tributary to the Salcha, in the summer (Chihuly et al. 1980).

Further upstream in the Tanana drainage, burbot are found at Mile One Slough on the Delta Clearwater (Ridder 1983). They overwinter in Shaw Creek, a tributary to the Tanana near Delta Junction (Chihuly et al. 1980). Burbot have been sampled by electroshocking in the Goodpaster

River. Peckham (1978) found less than two fish per hour, and Peckham (1981) and Tack (1973) found three fish per hour in the Good Paster River. Near Tok, the Tanana River provides spring, fall, and winter habitat for burbot (Chihuly et al. 1980).

Burbot are found in the Chisana and Nabesna river drainages, at the headwaters of the Tanana River. They occur in deepwater habitats of the Chisana and Nabesna rivers but use shallow water in January and February for spawning (USFWS 1985). Chihuly et al. (1980) found burbot in Scottie Creek, a tributary of the Chisana River.

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Humpback Whitefish Distribution and Relative Abundance Western and Interior Regions

I. REGIONWIDE INFORMATION

The distribution and abundance of humpback whitefish will be discussed by ADF&G, Division of Sport Fish, postal survey areas in this report (map 1). The Western and Interior regions include the Lower Yukon-Kuskokwim Area (Area V), the South Slope Brooks Range Area (Area Y), and the Fairbanks Area (Area U). Sport harvest information is presented in the Sport Use of Freshwater and Anadromous Fish narrative in this volume.

A. Regional Distribution

Humpback whitefish are found in most of the Alaskan rivers that empty into the Bering, Chukchi, and Beaufort seas (Morrow 1980). Humpback whitefish reach their greatest abundance statewide in the Yukon and Kuskokwim drainages (Alt 1979a). They are found in all major tributaries of the Tanana drainage. Both anadromous and nonanadromous populations occur in Alaska. Whitefish are year-round residents of large, deep lakes, such as Lake Minchumina, and are summer residents of smaller lakes (ibid.).

B. Areas Used Seasonally and for Life Functions

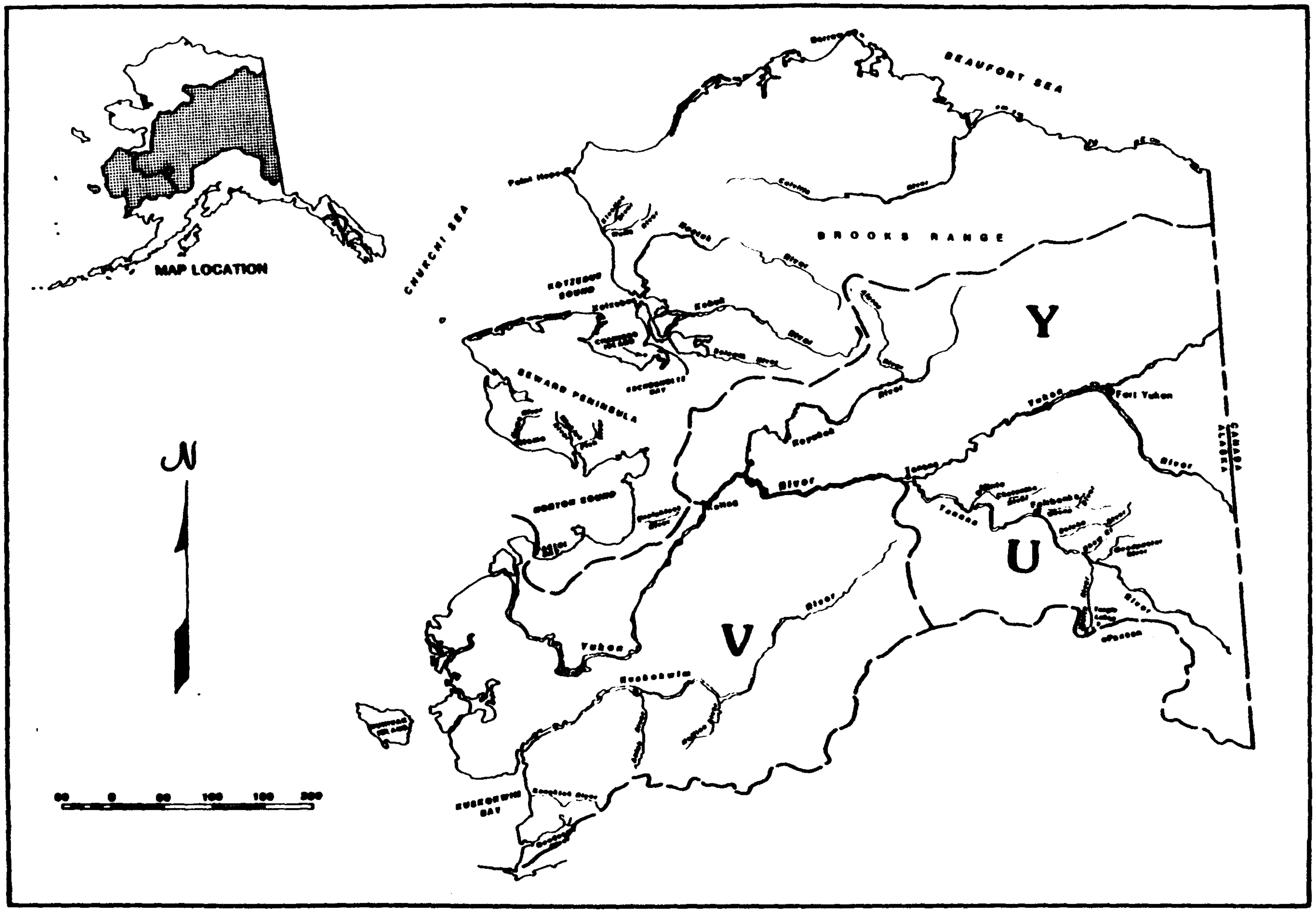
A series of freshwater distribution maps at 1:250,000 scale has been produced for this report. The categories of mapped information are 1) general distribution, 2) documented presence in stream or lake, 3) documented spawning areas, 4) documented overwintering areas, and 5) documented rearing areas.

C. Factors Affecting Distribution

Little information is available on pH, turbidity, dissolved oxygen, salinity, or temperature tolerances of humpback whitefish. Overwintering areas may be determined by presence of sufficient levels of dissolved oxygen (Bendock 1977). Humpback whitefish can tolerate brackish water, and some populations may winter in the sea near river mouths (Morrow 1980, McPhail and Lindsey 1970). More detailed information regarding factors that affect distribution appears in the humpback whitefish Life History and Habitat Requirements narrative in volume 1 of this publication.

D. Movements Between Areas

Humpback whitefish migrate upstream to feeding areas in the early summer and move further upstream to spawning grounds in the fall (Alt 1979a). In the Kuskokwim River system, the fish move from the main river into tributaries, such as the Aniak River, in late May for summer feeding (Alt 1977). Catches in August indicate movements either back into the Kuskokwim River or further up the tributaries into feeding or spawning areas. Tagging studies by Baxter (cited in Alt 1971) indicate that humpack whitefish may travel over 600 km up the Kuskokwim River to spawning grounds.



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

In the Innoko River, a tributary of the lower Yukon River, whitefish move from the Yukon into the lower Innoko during late May and early June (Alt 1983). Humpback whitefish were observed feeding in the slow-moving water of the main Innoko River in mid June (ibid.). After summer feeding, whitefish continue up the Innoko to spawning grounds and are abundant in the upper river and tributaries in September. Movement downstream to overwintering areas occurs in October and November (ibid.).

Migration patterns of humpback whitefish in the lower and middle Yukon River are not fully known, but both river-resident and anadromous populations probably exist (Alt 1980a). The anadromous populations overwinter in the lower Yukon River. After breakup there is an upstream migration in the main Yukon and tributary rivers. By late June, most whitefish have moved upstream in the tributaries to summer feeding areas in lakes and sloughs (ibid.).

E. Population Size Estimation

Humpback whitefish have been sampled in many drainages of the Western and Interior regions; however, few abundance estimates are available. Sampling gear has included gill nets, seines, hook and line, dip nets, fyke nets, and electrofishing. In some areas, sampling has been standardized to obtain estimates of fish caught per net hour, net day, or net night. Generally, sampling has not been standardized between years or between areas, so that only the relative abundance in an area can be assessed.

Population estimates of humpback whitefish were made for four years over a 22-mi section of the upper Chatanika River. In the first two years, 1972 and 1973, estimates were made using the Schnabel mark-recapture method (Kepler 1973, Kramer 1974). The Schnabel estimate is a multiple census method, which requires that at least two capture runs be made and that the population be constant, with no recruitment or mortality in the sample area during the censuses (Ricker 1975). Kepler (1973) noted that movement of fish between pools during the sampling period may have biased the results. In 1973, the Schnabel population estimates were correlated with visual counts made from a platform mounted on the bow of a flat-bottom boat (Kramer 1974). The visual counts agreed closely with the Schnabel estimates, and in 1974 and 1977 only visual counts were made (Kramer 1975, 1978).

F. Regional Abundance

Estimates of relative abundance of humpback whitefish will be discussed where applicable in the following sections.

II. LOWER YUKON-KUSKOKWIM AREA

The Lower Yukon-Kuskokwim Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands (map 1). This area does not include the Pastolik River drainage and waters flowing into

Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985).

Humpback whitefish are widespread in the lower Kuskokwim drainage and are found in the lower reaches of all Kuskokwim River tributaries (Alt 1977). They are not found in Kuskokwim Bay, however, and are absent from the bay drainages, such as the Goodnews, Arolik, and Kanektok rivers (ibid.). Humpback whitefish are abundant in the Eek River at the mouth of the Kuskokwim River and in the Kwethluk, Kasigluk, and lowre Aniak rivers. They are present in lesser numbers in the Kisarilik River (ibid.). Humpback whitefish have also been found farther upstream in the Kuskokwim in tributaries such as the Hoholitna and Big rivers and Highpower Creek (Alt 1972, 1981a).

In the lower Yukon River drainage, humpback whitefish have been found in many tributaries. A few whitefish were captured 6 mi up the Andreafsky River, a tributary of the lower Yukon River. All were prespawners, indicating that the Andreafsky River may serve as a spawning stream (Alt 1981b).

Humpback whitefish feed in the lakes and sloughs of the Innoko River, a major tributary of the lower Yukon (Alt 1980a). Large numbers of them enter Shageluk Lake in the spring for summer feeding and leave in the fall; the same pattern probably holds for lakes throughout the Innoko River drainage (Alt 1980b). Humpback whitefish occur in the Iditarod and Dishna rivers, tributaries of the Innoko River, and are one of the most abundant species in the Innoko drainage (Alt 1983).

Other Yukon River tributaries where humpback whitefish have been reported include the Anvik, Nulato, Yuki, and Nowitna rivers (Alt 1980a, 1978). Humpback whitefish spawn in the Sulukna River, a tributary of the Nowitna River (Alt 1978).

III. SOUTH SLOPE BROOKS RANGE AREA

The South Slope Brooks Range Area includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (map 1) (ADF&G 1985).

Humpback whitefish occur throughout the lower Koyukuk River drainage and in tributaries such as the Glissa River (Alt 1978) to as far upstream as the Jim River (Netsch 1975). Lakes in the Koyukuk drainage where humpback whitefish have been reported include Sithylemenkat (Pearse 1978) and Iniakuk (Roguski and Spetz 1968).

Humpback whitefish occur in the Melozitna and lower Tozitna rivers (Alt 1984), northern tributaries of the Yukon upstream of the Koyukuk River, and in the Ray and Dall rivers and Hess Creek (Alt 1974), tributaries near Rampart.

Humpback whitefish are found in the Chandalar River, a major tributary of the Yukon River (Alt 1974), and they are one of the most numerous species in Squaw and Chandalar lakes (Pearse 1978). They are also found throughout the Porcupine River and its tributaries (Alt 1974), including the Sheenjek (Pearse 1978), Black (Alt 1978), and Coleen rivers (Alt 1974). They are one of the most numerous species in Old

John Lake and also occur in Big Fish Lake of the Sheenjek drainage (Pearse 1978, Craig and Wells 1975). In the upper Yukon River, humpback whitefish have been found at the mouths of the Kandik and Tatondik rivers (Alt 1979b).

IV. FAIRBANKS AREA

The Fairbanks Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages, as well as the entire Tanana River watershed. This area also includes the Alaska portion of the White River drainage (map 1) (ADF&G 1985).

Humpback whitefish are present in both the Yukon and Tanana river drainages of the Fairbanks Area. Lakes at elevations below 600 m that connect to a river system generally contain populations of humpback whitefish (Peckham 1981). In Beaver Creek, a Yukon River tributary in the Yukon Flats area, humpback whitefish are found in the lower 2 mi (Hallberg 1982).

Humpback whitefish are found throughout the Tanana drainage from the lower river (Alt 1980b) to tributaries as far upstream as the Chisana River at the Yukon Territory border (USFWS 1985, Alt 1979a). Humpback whitefish were among the most abundant species caught in the Tanana River near Fairbanks from mid May to early October (Mecum 1984). Spawning, feeding, and rearing areas have been noted in the river system. Shallow backwaters of the Tanana drainage provide a critical habitat for young-of-the-year whitefish because few predators occur in these areas (ibid.).

A humpback whitefish population is present in Lake Minchumina, a large, deep lake of the Kantishna River drainage, a Tanana River tributary. They are found at all depths of the lake and are year-round residents (Kramer 1975, Alt 1979a).

In the Chena River, humpback whitefish are rarely encountered and only occurred in the lower Chena River in June and July (Tack 1971). In spring (April) and winter (December through March), they are abundant at the mouth of the Chena River, possibly migrating to and from other systems (Tack 1975).

Farther upstream on the Tanana River, humpback whitefish are present in the Delta Clearwater River, a spring-fed tributary of the Tanana (Ridder 1983). Peckham (1976) found them to be present in low numbers in the Goodpaster River, with less than one fish per hour sampled by electroshocking.

In the upper reaches of the Tanana River, humpback whitefish are found in the Nabesna and Chisana river drainages (USFWS 1985). They are present in creeks, such as Moose, Desper, and Scottie creeks, and in lakes, such as Weed, Fish, Gull, American Wellesley, East Wellesley, and Fish Camp lakes (USFWS 1985, Alt 1979a). Scottie Creek provides winter habitat for humpback whitefish, and local residents report large spring and fall runs (Chihuly et al. 1980). Moose Creek and Fish Lake are feeding areas, and humpback whitefish spawn upstream in the Chisana River (Alt 1979a).

Humpback whitefish have been studied more extensively on the Chatanika River, a tributary of the lower Tanana. Whitefish from the Minto flats area spawn in the Chatanika River (Alt 1971). Population estimates have been made for four years for the area of the river from 12 mi above the Elliott Highway bridge and the area from 10 mi below the bridge (table 1). The population estimates of humpback whitefish in the 22-mi section of the Chatanika River ranged from 8,000 fish in 1972 to 4,500 in 1974.

Table 1. Humpback Whitefish Population Estimates for the Chatanika River

Year	Elliott Hwy. Bridge 12 Mi Above Bridge	Elliott Hwy. Bridge 10 Mi Below Bridge	Total Number of Fish
1972[a,b]	5,000	3,000	8,000
1973[a,b]	5,000	2,000	7,000
1974[b]	2,800	1,700	4,500
1977[b]	---	2,500	2,500

Source: Kramer 1978.

--- means no data were available.

a Estimated by Schnabel mark-recapture method.

b Estimated by visual counts.

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Lake Trout Distribution and Relative Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

In this report, distribution and relative abundance information for lake trout will be presented by sport fish postal survey area, shown on map 1. Information on the level of lake trout sport harvest is contained in the Freshwater and Andadromous Fish Sport Use narrative found elsewhere in this volume.

A. Regional Distribution

Lake trout are distributed throughout many lakes and a number of rivers in the Yukon and Kuskokwim drainages (ADF&G 1978). They are commonly associated with deep, oligotrophic lakes located in the Brooks, Kuskokwim, and Alaska mountain ranges (ibid.). Lake trout are generally not found at lower elevations of the Yukon or Kuskokwim basins (Redick 1967, Morrow 1980).

B. Regional Distribution Maps

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 overwintering areas
° Documented rearing areas

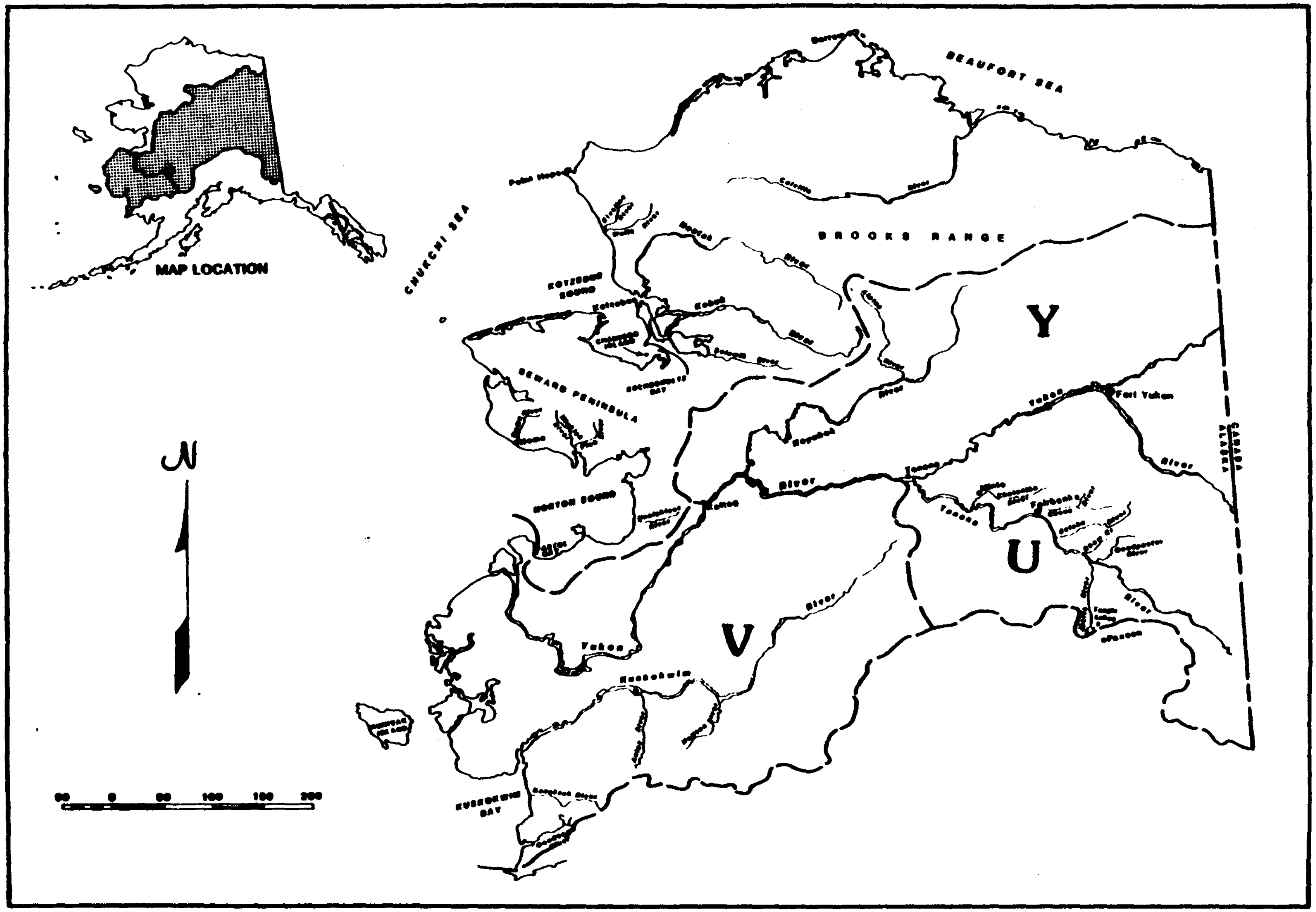
These maps are available for review in ADF&G offices of the region or may be purchased from the contract vendor responsible for their reproduction.

C. Factors Affecting Distribution

In most cases, lake trout inhabit waters with a temperature range of about 6 to 13° C (Martin and Olver 1980). The presence of clean rubble or gravel for spawning is also an important determinant for lake trout distribution. More details of lake trout habitat requirements can be found in the lake trout Life History and Habitat Requirements narrative in volume 1 of this publication.

D. Movements Between Areas

Whole populations of lake trout do not undertake movements in definite directions; however, individual lake trout travel extensively in their lake or stream environment. Lake trout generally feed near the water surface in the spring and then move into deeper areas as water temperatures rise in the summer. Alt (1977) noted that lake trout in Kuskowim Bay drainage lakes were generally most abundant near inlet and outlet streams in July, probably because of cooler water temperatures and greater abundance of food in these areas. In the fall, lake trout move to shallow, rocky areas to spawn, and they then disperse throughout the lake during the winter months.



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

E. Population Size Estimation

The relative abundance of lake trout in the Western and Interior regions' lakes and streams has generally not been systematically assessed. Estimates of population size are based on rough measures of catch-per-unit-effort gathered during lake and stream surveys conducted with gill nets and hook and line.

F. Regional Abundance

Very little information on lake trout abundance is available, and the information that has been collected applies only to specific lakes and streams. As a result, estimates of abundance cannot be apppropriately made at the regional level. Abundance information, where available, is contained in the discussions of the postal survey areas that follow.

II. LOWER YUKON-KUSKOKWIM AREA DISTRIBUTION AND ABUNDANCE

The Lower Yukon-Kuskokwim Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands. This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985).

Alt (1977) found lake trout in lakes near the headwaters of streams flowing into Kuskokwim Bay and in lakes at the headwaters of tributaries of the lower Kuskokwim River. Based on gill net catches, lake trout were the most abundant species found in the study area lakes during Alt's 1975 and 1976 surveys (Alt 1977). No lake trout were found in Eek Lake, which is at a low elevation, is shallow, and has a mud bottom (ibid.). They are probably also not found in other foothill lakes similar to Eek Lake (ibid.).

In most cases, lake trout were confined solely to lakes and the reaches of streams nearest the lakes (ibid.). In the Goodnews River, however, both immature and prespawning lake trout were found in deep pools, swift riffles, and along undercut banks along the entire length of the river to within 10 mi of the ocean (ibid.).

In Goodnews River drainage lakes, lake trout were abundant in North Middle Fork, South Middle Fork, Goodnews, and Canyon lakes (ibid.). They were also present in Kukaktlim and Asriguat lakes (ibid.). In the Arolik River drainage, lake trout were abundant in Arolik Lake and were found in the Arolik River in the area 2 mi downstream from the lake (ibid.). In the Kanektok River, lake trout are abundant in Kagati Lake (Alt 1977, Dlugokenski et al. 1983) and in Klak, Kanuktik, and Ohnlik lakes (Alt 1977).

In the Kuskokwim River drainage, lake trout were abundant in Aniak Lake, at the headwaters of the Aniak River, and in Kisaralik Lake and Kisaralik Lake #2 at the headwaters of the Kisaralik River (ibid.). Baxter (1978) reports lake trout in Whitefish Lake at the headwaters of the Hoholitna River, tributary to the Holitna River in the Kuskokwim drainage.

Lake trout have not been found in tributaries of the lower Yukon River from the Andreafsky River upstream to the Melozitna River (Alt 1980, 1981, 1983, 1984). Lakes in this area, however, have not been extensively surveyed.

III. SOUTH SLOPE BROOKS RANGE AREA DISTRIBUTION AND ABUNDANCE

The South Slope Brooks Range Postal Survey Area includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (ADF&G 1985). In the South Slope Brooks Range Area, lake trout have been found in lakes of the upper Koyukuk, Chandalar, and Sheenjek rivers. Within the Koyukuk drainage, they have been found during ADF&G surveys in Helpmejack and Iniakuk lakes in the Alatna River drainage (Roguski and Spetz 1968, Pearse 1978), in Wild Lake at the headwaters of the Wild River (Roguski and Spetz 1968, Pearse 1978), and in Big (Bob Johnson) and South Twin lakes in the Bettles River drainage (-Kramer 1976, Pearse 1978). In the Chandalar River drainage, lake trout have been reported from Chandalar Lake and Squaw Lake on the North Fork (Kramer 1976, Pearse 1978), from Ackerman Lake on the Middle Fork (Kramer 1976, Pearse 1978), and from Blackfish Lake on the East Fork (Ward and Craig 1974). In the Sheenjek River drainage, they have been found in Old John Lake, which is drained by Vaniticlese Creek, tributary to the Koness River (Craig and Wells 1975, Pearse 1978). Lake trout have not been reported from Porcupine River drainages above the Sheenjek River or from northern tributaries of the Yukon River in Alaska above the Porcupine River; however, lakes in these areas have not been extensively studied.

IV. FAIRBANKS AREA DISTRIBUTION AND ABUNDANCE

The Fairbanks Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage (ADF&G 1985).

Lake trout are found in lakes at the headwaters of the Delta River. They are the predominant species in Landmark Gap Lake, which drains through an outlet stream into Round Tangle Lake (Peckham 1972, 1976). They are also found in Glacier Lake, which drains through Rock Creek into Upper Tangle Lake (Peckham 1976); and in 16.8 Mile Lake, east of Round Tangle Lake (ibid.). In the Tangle Lakes system, lake trout have been found in Landlocked Tangle, Upper Tangle, and Round Tangle lakes (Heckart 1965, 1966, Peckham 1976). Based on 1964 lake survey gill net catches, the best population of lake trout in the Tangle Lakes system is probably found in Landlocked Tangle Lake at the southern end of this system (Heckart 1965, Peckham 1976).

Lake trout are a popular target of sport fishermen in Fielding Lake, which drains through Phelan Creek into the Delta River. Grayling are the predominant species in this lake, but fishing for lake trout also yields excellent results (Peckham 1976). Lake trout are also found in Two Bit and Boulder lakes, both close to Fielding Lake, and in Sevenmile Lake, south of Fielding Lake near the Denali Highway (ibid.). Two Bit and Boulder lakes were the source of lake trout stocked into Harding Lake, which is located near the mouth of the Salcha River, in 1963 (Heckart 1964). Some lake trout are still found in Harding Lake, and there is some evidence that this small population is naturally reproducing (Doxey 1984).

Elsewhere in the Tanana drainage, lake trout have been reported only from Monte Lake in the Robertson River drainage (Heckart 1966, Peckham 1983) and in Jatahmund Lake near the Nabesna River (USFWS 1985). Monte Lake was the source of lake trout stocked into Harding Lake in 1965 (Heckart 1966).

Lake trout are also found in several Alaskan lakes in the White River drainage. The White River flows into the Yukon River in Canada. These lakes include Rock Lake and Ptarmigan Lake, which flow into Beaver Creek via Ptarmigan Creek (Pearse 1975), and Beaver Lake at the headwaters of Beaver Creek (Namtvedt 1970, Pearse 1975).

V. ENHANCEMENT

Lake trout were introduced into Harding Lake in 1939, 1963, and 1965 as adults and, in 1967, as fingerlings (Doxey 1984). In 1965, Harding Lake was also stocked with 88,000 eyed lake trout eggs (Heckart 1966). The lake trout were stocked here because they are a desirable species for sport fishermen, and it was hoped they would be capable of competing with the northern pike population in the lake (Heckart 1964). Until 1981, there was no evidence of reproduction among the stocked lake trout. Since 1981, however, six lake trout have been taken during test netting that are too young to have been stocked in 1967, indicating that some natural reproduction must be taking place (Doxey 1984). The contribution of this stocking program to the sport fishery has, however, so far been negligible (ibid.).

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Least Cisco Distribution and Abundance
Arctic, Western, and Interior Regions

I. REGIONAL DISTRIBUTION

Both anadromous and freshwater forms of the least cisco are present and generally abundant throughout the inland areas of the Western and Interior regions and in the nearshore coastal marine zone of the Western Region. The species is present in most streams and lakes north of the Alaska Range (Morrow 1980). They ascend the Yukon River upstream at least as far as Circle (McPhail and Lindsey 1970). Alt (pers. comm.) found them within 20 mi of the Canadian border.

II. AREAS USED SEASONALLY AND FOR LIFE FUNCTIONS

Anadromous forms of least cisco generally spend the summer months feeding in the nearshore coastal marine zone and migrate into the lower reaches of coastal rivers and river deltas in the fall to spawn and overwinter. It is presumed that they cannot withstand the subzero temperatures and increased salinities present in this nearshore environment in winter. However, high productivity and abundance of food in the nearshore marine environment during summer allows greater growth rates and fosters the greater maximum age attained by the anadromous forms of least cisco (McPhail and Lindsey 1970, Scott and Crossman 1973).

A migratory freshwater form of least cisco also exists. In the Innoko River, a major tributary to the lower Yukon River, mature least cisco begin an upstream migration in late spring, or soon after ice-out. They move into lakes and sloughs to feed all along the migration route (Alt 1983). In late summer (August), they continue the upstream migration towards spawning areas. In the Innoko River, primary least cisco spawning areas are upstream of the junction of the North Fork Innoko River and the main Innoko River. The 80-mi section of river from Cripple to Ophir is very important spawning habitat for least cisco, as well as for other fish species (ibid.). Similar movements of least cisco were observed in the upper Chatanika River near Fairbanks (Kepler 1973). Least cisco spawning is confined to a stretch of river from 16 km below to 12 km above the Elliott Highway bridge. Individual spawning areas vary in size from 100 to 800 m in length and 15 to 22 m in width (ibid.). After spawning occurs, the adults apparently move downstream again (Alt 1983).

The demersal eggs incubate in gravel during the winter and hatch in late May or early June (McPhail and Lindsey 1970). Young-of-the-year least cisco migrate downstream to rearing areas in slower, deeper waters of the lower Yukon River (Alt 1983).

A series of least cisco distribution and abundance maps have been produced for this report. The categories mapped are as follows:

- Documented presence in stream or lake
- Documented spawning areas
- Documented overwintering areas

- Documented rearing areas
- Documented spawning and/or rearing in an unspecified portion of stream or lake
- Species known to be in the system

III. FACTORS AFFECTING DISTRIBUTION

Various forms of least cisco are present and abundant throughout the Western and Interior regions. The species, as is typical of Coregonids, shows a high degree of both morphological and behavioral differences between local populations. Some populations became landlocked and have evolved separately, whereas other populations of least cisco have recently invaded previously glaciated watersheds (Lindsey 1981). Interspecific competition, predation, migration patterns, and the physical and chemical characteristics of a system are some factors affecting least cisco distribution. (For more details, see the least cisco Life History and Habitat Requirements narrative in volume 1 of this report.)

IV. MOVEMENTS BETWEEN AREAS

In the Western and Interior regions, migratory and nonmigratory populations of least cisco are generally abundant. Nonmigratory populations are typically found in the numerous lakes of both regions. Migratory and/or anadromous forms of least cisco occupy the Yukon and Kuskokwim rivers and many of their tributary lakes and streams. Mature least cisco begin migrating upstream in the Yukon, Innoko, and Chatanika rivers in late spring, or soon after ice-out (Alt 1983, Kepler 1973). They move into numerous lakes and sloughs to feed during summer. In late summer (August), they continue their upstream migration to spawning areas (Alt 1983, Kepler 1973). At some time after spawning, they move downstream again (Alt 1983). Anadromous least cisco have a similar pattern of movement, but they spend the summer months feeding and migrating along the brackish, nearshore coastal zone (Barton 1979). In August and September, they begin a return migration to the river deltas and coastal streams to spawn. Spawning occurs in late September and October, after which the adults remain in freshwater deltas and river channels over winter.

Larval least cisco hatch in late May or early June. In the Innoko River, young-of-the-year soon after hatching begin a downstream migration to deeper, slower waters in the lower Yukon River, where they rear (Alt 1983). Kepler (1973) reported a similar downstream movement of young-of-the-year from the upper Chatanika River.

V. POPULATION SIZE ESTIMATION

In the upper Chatanika River, near Fairbanks, Kepler (1973) estimated that 16,500 least cisco spawned in the area between 12 km above and 16 km below the Elliott Highway bridge. This estimate of spawning abundance was derived from visual counts in the 1972 season (Kepler 1973). In 1983, placer mining in the headwaters of the Chatanika River caused excessive turbidity in the defined spawning area. Attempts to determine the abundance of spawning least cisco were precluded because of turbidity (Hallberg 1984).

Barton (1979) sampled nearshore coastal areas (0 to 6 m depth) of Norton Sound, Port Clarence, and the Yukon River delta from June through October in 1976 and 1977. Least cisco were present at all sample locations and were among the 10 most frequently encountered species in all areas. Abundance was indicated by catch-per-unit-effort (CPUE) data collected with beach seines and gill nets. Beach seine CPUE of least cisco was highest in the Imuruk Basin and in the Golovin Bay area. The Imuruk Basin was sampled only during two periods in 1977 (7-21 July and 22 August-6 September), and CPUE of least cisco was very high at both times. In the Golovin Bay area, CPUE of least cisco was highest between late July and early September. Beach seines tended to capture smaller and/or younger least cisco, whereas gill nets captured larger and/or older fish (Barton 1979). Gill net CPUE data indicated that high abundances of least cisco were present in Golovin Bay and inner Norton Sound (Cape Denbigh to Cape Stebbins) and in the Imuruk Basin and Port Clarence areas (ibid.). In Golovin Bay, gill net CPUE indicated relatively high least cisco abundance from early July through early October. In inner Norton Sound, least cisco were abundant, as indicated by gill net CPUE data, between late July and mid August. In Port Clarence, least cisco were abundant in gill net CPUE samples in July and early August but were significantly less abundant from August to October. Catches in the Imuruk Basin indicated very high relative abundance when sampled in late August and late September. Gill net sampling was not conducted during other periods in Imuruk Basin (Barton 1979).

No population or abundance estimates are available for other areas in the Western and Interior regions.

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Northern Pike Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

The distribution and abundance of northern pike will be discussed by ADF&G, Division of Sport Fish, postal survey areas (map 1) in this report. The Western and Interior regions include the Lower Yukon-Kuskokwim Area (Area V), the South Slope Brooks Range Area (Area Y), and the Fairbanks Area (Area U). Sport harvest information is presented in the Sport Use of Freshwater and Anadromous Fish narrative in this volume.

A. Regional Distribution

Pike are found in slow-moving waters of sloughs, interconnected lakes, and the lower reaches of large rivers. Pike distribution includes the lowland areas of the Yukon, Kuskokwim, and Tanana river drainages. The largest populations of pike are found in meandering river-slough areas such as the Yukon and Minto flats (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 1) general distribution, 2) documented presence in stream or lake, 3) documented spawning areas, 4) documented overwintering areas, and 5) documented rearing areas.

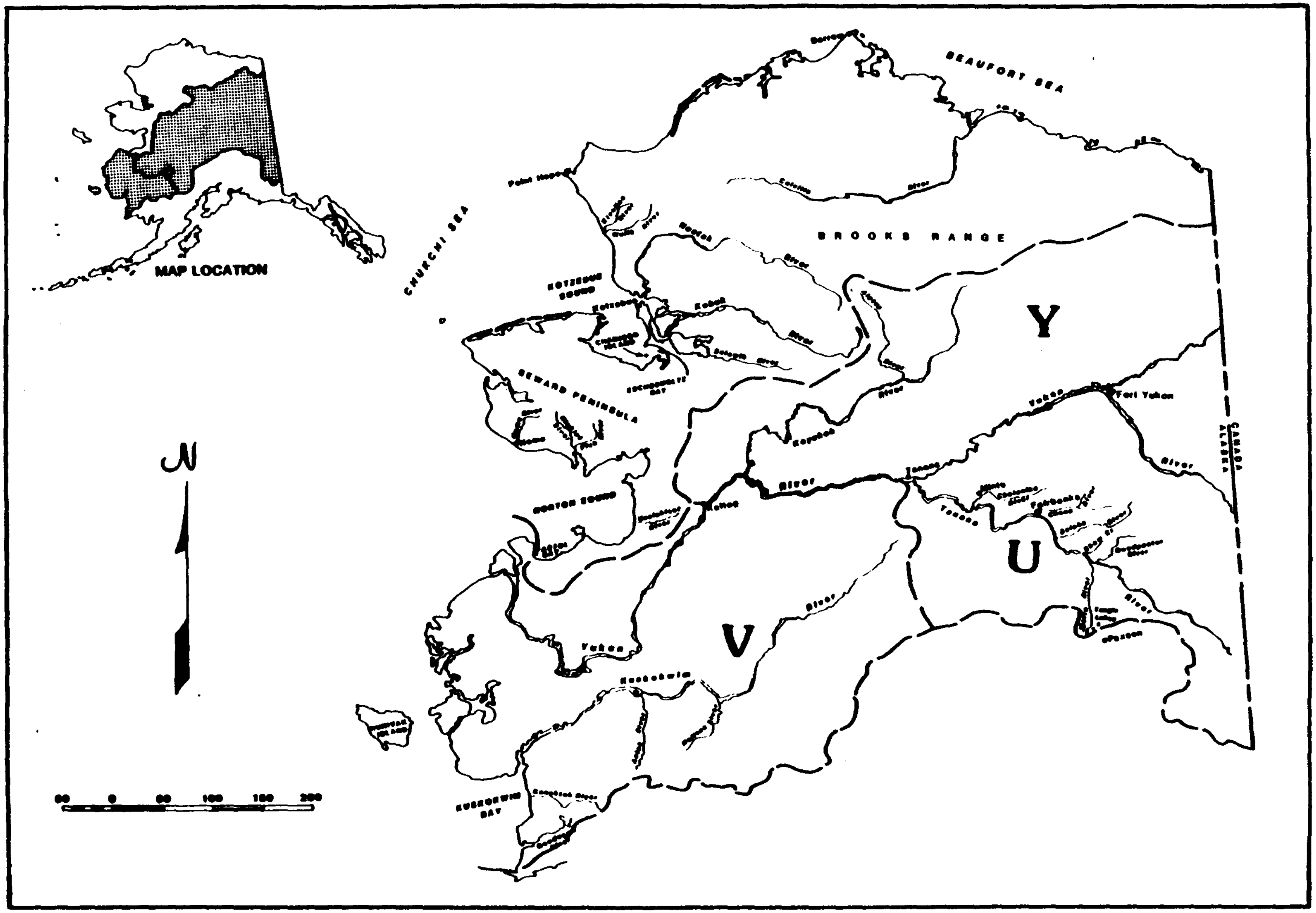
C. Factors Affecting Distribution

Pike summer distribution has been correlated with habitat characterized by shallow depths, proximity to shore, aquatic vegetation, and a mud bottom (Diana et al. 1977). Pike are a freshwater fish and can tolerate slightly brackish water (Scott and Crossman 1973). Pike occur in alkaline waters (McCarraher 1962).

Winter distribution of pike may be determined by dissolved oxygen concentration; that is, during the winter pike congregate in areas with deep, swift-moving water where dissolved oxygen concentrations are higher (Hallberg 1984). More detailed information regarding factors that affect distribution appears in the northern pike Life History and Habitat Requirements narrative.

D. Movements Between Areas

As indicated above, pike generally spawn and spend the summer in quiet, shallow areas and overwinter in areas with deeper, flowing water. In the Fairbanks area, Minto flats pike move up the rivers in spring before the ice melts. They spawn in shallow areas, then disperse for the summer. Adult pike usually move downstream in the fall before the waters freeze, and mature pike winter in the lower Tolovana or Tanana rivers. Some pike overwinter in areas of Minto flats such as Grassy Slough or the Chatanika River, which maintain good water flows throughout the winter (ibid.). Immature



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

pike remain longer in the main rivers of the flats before moving downstream (Cheney 1972).

Little is known about seasonal movements of pike in the Kuskokwim drainage, but they probably move out of the tributaries and into the main river in late fall and winter (Alt 1977). In early May before breakup, pike have been caught at the mouths of tributaries. These fish were probably moving upstream.

Pike movements in the Innoko River of the lower Yukon drainage are similar to those in the Kuskokwim. Pike overwinter in the main river and move into spawning areas located in tributaries during in May and June (Alt 1983). The pike then return to the main river and lower reaches of sloughs for feeding during the summer.

E. Population Size Estimation

Northern pike have been sampled in many drainages of the Western and Interior regions; however, few abundance estimates are available. Sampling gear has included gill nets, seines, hook and line, dip nets, fyke nets, and electrofishing. In some areas, sampling has been standardized to obtain estimates of fish caught per net hour, net day, or net night. Generally, sampling has not been standardized between years or between areas, so that only the relative abundance in an area can be assessed.

F. Regional Abundance

The largest populations of pike in the Western and Interior regions are found in meandering river-slough areas such as the Yukon Flats area in the upper Yukon River drainage and the Minto flats area in the Tanana River drainage (ADF&G 1978). Estimates of relative abundance will be discussed when available in the following sections.

II. LOWER YUKON-KUSKOKWIM AREA

The Lower Yukon-Kuskokwim Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands (map 1). This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985). Northern pike distribution includes the lowland areas of the Yukon and Kuskokwim rivers (ADF&G 1978).

Pike occur in many Kuskokwim River tributaries but are rare in the Kuskokwim Bay drainage, which includes the Goodnews, Kanektok, and Arolik rivers, which flow directly into Kuskokwim Bay (Alt 1977). No pike were found in the deeper Kuskokwim River lakes, but in shallow Eek Lake, northern pike were the only fish sampled (ibid.). Pike also occur at least 70 mi up the Eek River, which is slower moving than some of the other streams of the area. Pike have been sampled 16 mi up the Aniak River; above this point the current becomes quite swift and provides poor habitat for pike (ibid.). Pike occur in tributaries of the lower Kuskokwim, including the Aniak, Tuluksak, Kisaralik, Kasigluk, and Kwethluk rivers (ibid.). Farther upstream on the Kuskokwim, pike occur in the Holitna River and in tributaries of the Hoholitna River (Alt 1981).

Pike are distributed throughout most of the lower Yukon River and its lakes, sloughs, and slower-moving tributaries (Alt 1980). Pike are abundant in the lower reaches of the Andreafsky River, a tributary near the mouth of the Yukon River with slow-moving water and many sloughs (Alt 1981). Pike are present in many other tributaries of the lower Yukon River, such as the Nulato and Anvik rivers, which are swift-moving rivers with pike in upstream lake and slough areas (Alt 1980). The Khotol, Bonasila, and Innoko rivers are slower-moving streams in which pike are more abundant (ibid.). Even in these slower-moving streams, lakes and sloughs are the main pike habitat. No pike were captured in the main Innoko River, but they were numerous in side channels, lakes, and sloughs and were the most widely distributed fish in the Innoko drainage (Alt 1983). Pike have also been taken in the Yuki and Nowitna rivers, tributaries farther upstream on the Yukon River (Alt 1978).

III. SOUTH SLOPE BROOKS RANGE AREA

The South Slope Brooks Range Area includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (map 1) (ADF&G 1985).

Pike occur in many tributaries of the upper Yukon River and in lakes on the south slope of the Brooks Range. Pike are abundant in the slow-moving upper reaches of the Melozitna River (Alt 1981). Pike occur in the Chandalar River (Craig and Wells 1975), the Porcupine River (Alt 1974), and the Kandik, Nation, and Tatonduk rivers (Alt 1979).

Pike have been found in lakes of the Koyukuk River drainage, including Norutak, Helpmejack, Iniakuk, Big, Wild, and Sithylemenkat lakes (Pearse 1978, Roguski and Spetz 1968e, Kramer 1976). In the Chandalar drainage, pike are present in Squaw, Chandalar, and Vunittsieh lakes (Pearse 1978, Kramer 1976).

IV. FAIRBANKS AREA

The Fairbanks Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages, as well as the entire Tanana River watershed. This area also includes the Alaska portion of the White River drainage (map 1) (ADF&G 1985).

Pike are distributed throughout the waters of the Tanana River drainage, from headwater streams such as the Chisana River to Fish Lake near the mouth and in many other lakes (Cheney 1972). Lakes at elevations lower than 2,000 ft that connect to a river system generally contain native populations of northern pike, whereas landlocked lakes are usually barren (Peckham 1983).

Many of the larger lakes contain populations of pike. Lake George, on the upper Tanana River supports a large sport harvest of northern pike (ibid.). In Harding Lake, pike were the most abundant species (Hallberg 1979). Pike are also present in Healy, Tetlin, and Mansfield lakes along the upper Tanana River (Cheney 1972).

Pike are present in many tributaries of the Tanana River. Pike have been captured in the Goodpaster and Chena rivers but are not very abundant relative to the populations of grayling and round whitefish (Tack 1973, 1975).

Large populations of pike are present in the Minto flats (ADF&G 1978); pike are more abundant in the northwestern and southeastern sections of the flats (Cheney 1971). The northwestern section consists of the middle section of the Tolovana River, Montana Creek, Windy Lake, Uncle Sam Creek, and many connecting sloughs. The southeastern section consists of the lower Chatanika River, Goldstream Creek, Minto Lakes, and interconnecting sloughs. The other sections of the Minto flats are characterized by confined stream channels, few sloughs, and isolated lakes and ponds that are unsuitable pike habitat.

The Yukon Flats, a broad flood plain with numerous shallow lakes in the upper Yukon drainage, also supports large populations of northern pike (ADF&G 1978). In a survey of the lakes in the flats west of Circle City to the Dalton Highway bridge, pike occurred in the larger lakes with inlets and outlets (Hallberg 1983). Pike occur in many lakes of the Beaver and Birch Creek drainages (Kramer and Hallberg 1982). Pike have been taken 35 mi upstream in the Charley River, a tributary of the upper Yukon River (Holmes 1983).

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Rainbow Trout Distribution and Relative Abundance
Western and Interior Regions

I. REGIONAL DISTRIBUTION AND RELATIVE ABUNDANCE

Rainbow trout have a limited distribution in the Western and Interior regions. The Kuskokwim River represents the most westerly distribution of natural populations of rainbow trout in the world (Alt 1977). The Aniak River marks the farthest upstream location in the Kuskokwim River of a naturally reproducing population of rainbows (ibid.).

Rainbow trout are found in all major streams in the Kuskokwim River drainage except the Tuluksak and Eek rivers. They are not present in the tributary streams that enter the Kuskokwim from the north (ibid.). Rainbow trout have been captured at the junction of the Holitna and Kuskokwim rivers, 125 mi upstream from Aniak, but they do not enter the slow-moving water of the Holitna (ibid.). Rainbow trout in the Kuskokwim area are associated with swift-running streams, from the headwaters to near the mouths, and are seldom present in slower-moving streams or lakes (ibid.).

In the Kuskokwim Bay drainages, rainbow trout are present in Goodnews Lake, which forms the headwaters of Goodnews River, and they are abundant in the Goodnews River (Alt 1977, USFWS 1985). They are also present in Arolik Lake and abundant in Arolik River (ibid.). Major concentrations occur in the Kanektok River, and they are present in Kagati Lake and in Kanuktik and Klak creeks, tributaries to the Kanektok River (Alt 1977; USFWS 1983, 1985).

In the Kuskokwim River drainage, rainbow trout are abundant in the Kwethluk and Kasigluk rivers, tributaries of the lower Kuskokwim (Alt 1977). They are abundant in the Kisaralik and Aniak rivers but absent from Kisaralik and Aniak lakes (ibid.).

A number of lakes in the Tanana River valley near Fairbanks and Delta Junction are stocked with hatchery-reared rainbow trout to improve fishing opportunities for local residents (table 1).

II. REGIONAL DISTRIBUTION MAPS

A series of freshwater fish distribution maps at 1:250,000 scale have been produced for this report. The categories of mapped information are 1) general distribution, 2) documented presence in stream or lake, 3) documented spawning areas, 4) documented overwintering areas, and 5) documented rearing areas.

III. FACTORS AFFECTING DISTRIBUTION

One of the limiting factors of rainbow trout distribution in the area is water level fluctuations. Stranded juvenile trout have been found in pockets of water on gravel bars isolated from the main river (USFWS 1985). Alt (1977) found juveniles in slow-moving water of the main rivers, under tangled roots of downed trees, and at the edge of gravel bars in shallow water and in side streams.

Table 1. Water Bodies Stocked With Rainbow Trout in the Fairbanks Area, 1967-85[a]

Water Body	Community	Year(s) Stocked
81 Mile Pit	Shaw Creek	1966-68-71
Berry Pond	Dot Lake	1971
Birch Lake	Birch Lake	1966-72,74,76-84
Black Rapids Lake	Donnelly	1968-75
Bluff Cabin Lake	Delta Junction	1980,83,85
Chena Lake	Fairbanks	1982-84
Clear Lake	Clear	1972
Clear Pond	Clear	1966,68,73
Cool Lake	Fairbanks	1984
Craig #1	Johnson River	1969,71
Craig Lake	Johnson River	1966,68,71,74
Crystal Lake	Paxson	1974
Donna Lake	Gerstle River	1966,68-74,80,83,85
Dune Lake	Nenana	1984
Eielson Sewage Lagoon	Eielson AFB	1966
Four Mile Lake	Tetlin	1984
Ft. Greely #2	Ft. Greely	1974,82
Ft. Greely #7	Ft. Greely	1973,83
Ft. Greely #8	Ft. Greely	1973,83
Ft. Greely #9	Ft. Greely	1973,83
Geskakmina Lake	Nenana	1983,84
Hidden Lake	Eielson AFB	1982
Jan Lake	Dot Lake	1966,69,71,73,76
Kettle Rock Lake	Nabesna	1984
Koole Lake	Birch Lake	1974,78,80,82,83,85
Lisa Lake	Johnson River	1966,69,71,73,76,80,84
Little Donna Lake	Gerstle River	1966,68-74,79,83,85
Little Harding Lake	Aurora Lodge	1981
Little Lisa Lake	Johnson River	1971
Mark Lake	Ft. Greely	1966,68,69,71-73,80,82,83
North Twin Lake	Ft. Greely	1966,75,82,83
Quartz Lake	Big Delta	1971-77,79,80,82-85
Rainbow Lake	Big Delta	1971,74,79,83,85
Rapids Lake	Delta Junction	1980,84
Sansing Lake	Clear	1967
Slate Lake	Healy	1984
South Twin Lake	Ft. Greely	1966,82
Spencer Lake	Fairbanks	1967

Sources: ADF&G 1984, 1985.

a Some 1985 stocking is included in this list; however, it is not a complete record for 1985.

The distribution of adult rainbow trout appears to be related to the distribution of salmon. The trout feed on salmon fry and follow spawning salmon to feed on eggs and rotting carcasses (ibid.).

IV. MOVEMENTS BETWEEN AREAS

Rainbow trout populations in the Kuskokwim area are stream dwellers and seldom enter lakes. No anadromous populations exist in the area (ibid.). In the Aniak, Kisaralik, Kasigluk, and Kwethluk rivers, trout congregate in deep holes in the rivers during winter and are usually distributed farther downstream than in the summer (ibid.). After breakup, the trout disperse and begin an upstream movement (ibid.). During the summer, rainbow trout are scattered and difficult to sample. In fall, after the coho salmon migration has slowed and water levels drop, trout become more concentrated. In Kuskokwim Bay streams, residents report capturing rainbow trout closer to the mouth of the rivers during the winter and early spring than during the summer (ibid.).

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Salmon Distribution and Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

The five species of Pacific salmon indigenous to North America are found in the marine and fresh waters of the Western and Interior regions. The discussion of individual species' distribution and abundance will be presented by ADF&G commercial fisheries management area. There are two such management areas within the region: the Kuskokwim and Yukon areas. Each area is divided into districts that in turn may be separated into subdistricts for fishery management purposes, such as regulating seasons and weekly fishing periods. Maps found in the Western and Interior Regions Reference Map Atlas 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 Western and Interior regions' freshwater system 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. and III. 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 Western and Interior regions.

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 the 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 color maps contained in the Western and Interior Regions Index Map Atlas that accompanies this publication.

C. Factors Affecting Distribution

1. Fresh water. Water quality, quantity, and the waterbodies' 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 thermocline, salinity, currents, and the availability or location of food organisms probably all influence 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 litte 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 inlcuded in each species life history found in volume 1 of this publication.

Some information has been documented that indicates the routes and timing of adult salmon return to fresh water. Where appropriate, these data are presented in the management area narratives (sections II. and III. 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, subsistence, and sport harvest) and escapement figures (number of fish entering spawning areas). Escapement estimates are derived by using one or a combination of several measurement techniques. Aerial and ground survey counts, weir counts, tower counts, and hydroacoustic (sonar) 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 the experience of the persons counting the fish can affect ground, tower, and weir counts as well as aerial surveys. In addition, single survey estimates fail to account for fish arriving at the spawning area before and after the date of the survey (Buklis, pers. comm.).

The vast expanse of the Yukon and Kuskokwim drainages makes it extremely difficult to obtain escapement estimates from all areas where salmon spawn. Therefore, where feasible, hydroacoustic techniques have been implemented and towers and weirs constructed. Most of the abundance indices obtained are from aerial surveys. Attempts are made to fly key stream surveys annually to obtain a somewhat comparable database by which abundance can be assessed.

Salmon abundance estimates (total run strength) for an individual stream system are derived, where possible, by combining catch numbers (commercial, subsistence, and sport harvests) and escapement numbers. In many cases, however, run strength calculations for an individual stream system are difficult to arrive at because the fisheries are harvesting mixed stocks of fish. It is therefore difficult to define what proportion of the catch should be allocated to which stream system unless stock-identification techniques are implemented in the fishery (e.g., tagging, scale pattern analysis). Therefore, most of the abundance information presented in this narrative is estimated escapement in numbers of fish that have passed through the commercial fishery and have been enumerated in escapement systems.

In the narratives and tables that follow, care has been taken to document the location, if known, and methods used to gather escapement data, so that the approximate level of accuracy may be deduced (e.g., aerial surveys are less precise and complete 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, total run figures.

II. KUSKOKWIM MANAGEMENT AREA

The Kuskokwim Area consists of all waters of Alaska between the southernmost tip of Cape Newenham and the westernmost point of the Naskonat Peninsula, including the waters surrounding Nunivak and St. Matthew islands and those waters draining into the Bering Sea. The area contains five commercial fishing districts. Districts 1 (the Lower Kuskokwim River District), 2 (the Middle Kuskokwim River District), and 3 (the Upper Kuskokwim River District) are located within the confines of the main stem Kuskokwim River; Districts 4 and 5 (the Quinhagak and Goodnews districts) are located in coastal waters near the mouths of the Kanektok and Goodnews rivers, respectively. Detailed descriptions of the boundaries and maps depicting the districts are contained in the salmon commercial harvest narrative located in the Human Use portion of this volume.

The Kuskokwim River drainage is the dominant system within the Kuskokwim Area. The Kuskokwim River, second in Alaska only to the Yukon River in size and length, originates in central Interior Alaska near Medfra and flows southwest approximately 850 mi through the Kuskokwim Mountains and empties into Kuskokwim Bay on the Bering Sea. The river is heavily laden with silt throughout most of its length. The drainage area extends from the central Alaska Range in the east to the coastal Yukon-Kuskokwim lowland in the west. The Kuskokwim River valley is a wide, flat basin with numerous small ponds and lakes. Edging the Kuskokwim River valley to the west are the Kuskokwim Mountains. The Holitna lowland occupies the central portion of the basin between the Alaska Range and the Kuskokwim Mountains, with the Taylor Mountains-Nushagak Hills on the south. The lowlands of the upper Kuskokwim Area are an extension of the Tanana lowlands.

The Kanektok River is the major salmon-producing system emptying into the Quinhagak District. The river is a clearwater stream draining the Ahklun Mountains. It is some 80 mi in length from its Kuskokwim Bay mouth to its source in Lake Kagati. The area drained varies from mountains of apparently volcanic origin at the headwaters to tundra for the lower one-third of the river's length. The whole drainage is treeless, with scrub willow and alder being the largest forms of vegetation.

Following a general discussion (in sections A. and B. below) of salmon distribution and abundance within the Kuskokwim Area as a whole, are species-specific sections dealing with these same topics in greater detail. The species narratives are subdivided and organized by commercial fishing district.

A. Areawide Distribution

1. <u>All species summary</u>. Within Kuskokwim Area waters are found all five species of Pacific salmon native to North America. The presence of adult salmon has thus far been documented in 14 first-order mainland streams (those whose mouths are at salt water), which empty into Kuskokwim Bay and the Bering Sea (ADF&G 1984a). Chum salmon exhibit the widest distribution, having thus far been documented in 13 of these Kuskokwim Area first-order streams (ibid.). Chinook and pink salmon have each been observed in 11 such streams; sockeye and coho salmon have each been documented in 7 (ibid.). In addition, salmon have been observed in a number of Nunivak Island first-order streams as well. Adult chum, coho, pink, and sockeye salmon have thus far been documented in 19, 13, 8, and 1 Nunivak Island first-order streams, respectively (ibid.). It is suspected that each species may occur in additional Kuskokwim Area streams, although their presence is as yet undocumented.

2. <u>Run timing</u>. In terms of general run timing, adult salmon are present in Kuskokwim Area bays and estuaries from late May through mid September and are found spawning in fresh waters from mid July through mid to late October (ADF&G 1977). Specific salmon run timing within the Kuskokwim Area varies

by species, river system, and season. Throughout the area, chinook salmon generally exhibit the earliest run timing, and coho salmon demonstrate the latest. Run-timing information for each species is summarized for the Kuskokwim River as well as for the Quinhagak and Goodnews districts of the Kuskokwim Area in tables 1 and 2 and is presented in greater detail in discussions of the salmon species that follow in sections C.1., C.2., C.3., C.4., and C.5. Studies concerned with the emergence and out-migration of juvenile salmon in the Kuskokwim Area are lacking. Thus, specific out-migration timing of Kuskokwim Area salmon species has not been documented.

B. Areawide Abundance

1. <u>All-species summary</u>. The three major river systems within the Kuskokwim Area (the Kuskokwim, Kanektok, and Goodnews river systems) all support major annual runs of chinook, chum, and coho salmon (Huttenen 1984a). In addition, the Kanektok and Goodnews rivers support significant annual runs of sockeye salmon and even-year runs of pink salmon (ibid.). The Kuskokwim River also occasionally supports significant runs of sockeye salmon, although catches of this species are largely incidental (ibid.).

   In terms of general relative salmon abundance within the Kuskokwim Area as a whole, chum salmon are most abundant, followed in descending order by coho, chinook, sockeye, and pink salmon (ADF&G 1977). The considerable number of spawning streams scattered throughout the immense Kuskokwim Bay and River drainage has always precluded a complete collection of escapement data. No attempt has been made to estimate total drainage escapements from the limited available spawner counts nor to allocate catches to streams of origin. Therefore, most of the abundance information contained in this narrative is estimated escapement index counts in numbers of fish that have passed through the commercial fishery and have been enumerated in freshwater spawning systems.

2. <u>Enumeration methods and locations</u>. Escapement estimates within the Kuskokwim Area have been performed using a variety of methods. These include peak abundance aerial survey assessment, hydroacoustic sensing by side-scanning sonar, visual observations from both towers and weirs, and most recently drift gill net test fishing. The estimated escapements obtained via these methods for the years 1973 through 1983 are contained in tables 3, 4, 5, 6, and 7. Again it should emphasized that these estimates are only rough indices of abundance and because of limitations inherent to the surveying techniques are not necessarily indicative of total numbers of spawners (see section I.E. above). Only index counts obtained under survey conditions

rated as good or fair are presented, and care has been taken to document the methods used to obtain escapement data.

a. Aerial survey. The majority of escapement estimates made on Kuskokwim Area streams have been devised from aerial surveys. Although it is not currently feasible to survey all the spawning tributaries within the Kuskokwim Area, an attempt is made to census all of the known major spawning concentrations to provide escapement indices for those systems. Aerial surveys are flown annually on the Kwethluk, Kisaralik, Aniak, Salmon (Aniak), Kipchuk, Chukowan, Kogrukluk, Salmon (Pitka Fork), Kanektok, and Goodnews rivers to obtain escapement index counts of chinook, chum, and sockeye salmon in these systems. In addition to aerial surveys flown on these "key" streams, peak counts of salmon species in many additional area streams have been made over the years. It should be noted that escapement counts made from aerial surveys are only rough indices of abundance and because of limitations inherent to the survey technique are not necessarily indicative of the total numbers of spawners (see section I.E. above).

b. Sonar. In addition to aerial surveys, sonar has been used with varying degrees of success as a method to gauge escapement. In the Kuskokwim Area, the use of sonar was first attempted in 1978 on the Kwethluk River. However, large amounts of debris in the river resulted in significant numbers of false counts by the sonar unit. Because of the large proportion of false counts and the impossibility of interpretation, the Kwethluk River sonar data were judged totally unreliable (Schneiderhan 1979). The Kwethluk River sonar project was discontinued, and in 1979 the sonar unit was deployed to another lower Kuskokwim River tributary, the Kasigluk River. During the 1979 season, the sonar yielded escapement estimates of 11,301 chum salmon and 398 chinook salmon (Schneideran 1980). Largely because the side-scan sonar is relatively inefficient when fewer than 20,000-30,000 fish are counted, it was decided to relocate the sonar unit on the Aniak River the following season, where aerial surveys indicated chum salmon runs large enough to make full use of the sonar's capability (ibid.).

   The Aniak River sonar project, located approximately 12 mi upstream from the river's confluence with the Kuskokwim River, has been operated successfully since its inception in 1980. In its initial year of operation, the sonar was operated into September to allow escapement estimates to be made for coho salmon as well as for earlier-running chinook and chum salmon. Since 1981, however, the project has been terminated around the first week of August, with escapement estimates made only for chinook or chum salmon. Gill net test fishing is used in conjunction with the sonar in order to apportion escapement counts to species. Total escapement past the sonar site has been estimated by expanding the cumulative adjusted daily total to compensate for salmon that passed beyond the counting range of the side-scanning sonar (Schneiderhan 1984a).

Sonar has also been used to estimate escapement into the Kanektok River, the major salmon-producing system within the Quinhagak District (District 4) of the Kuskokwim Area. A side-scanning sonar unit was initially tested in the lower Kanektok River during late August of 1981. Since 1982, the Kanektok sonar has been operated at a site on the river about 5 mi upstream from the village of Quinhagak. All five species of salmon are counted at the sonar site, with sonar counts apportioned by species based upon Quinhagak District commercial catch composition (Schultz and Carey 1982). However, because of the uncertainty involved in assigning sonar echoes to particular species in this manner, the escapement estimates derived are considered preliminary. Further, the project normally terminates in early August, which is too early to allow a complete escapement estimate to be made on late-running coho salmon.

c. Counting tower. In addition to aerial surveys and sonar, counting towers have also been used to obtain Kuskokwim Area escapement data. The first counting tower in the Kuskokwim Area was established in 1960 on the Kanektok River about 6 mi upstream from its mouth. The following year the tower was relocated further upstream at a site near the outlet of Lake Kagati, where the project was operated during the 1961 and 1962 seasons.

A counting tower has also been operated on the Kogrukluk River, a tributary of the Holitna River in the upper Kuskokwim River area, at a site about 467 river miles upstream from the mouth of the Kuskokwim River. The tower was operated each season from 1969 through 1978, except in 1971. Annual escapement estimates for chinook, chum, sockeye, and pink salmon were obtained at this site, with the project normally terminated prior to the arrival of migrating coho salmon. In 1974, however, the tower was operated into September, and a portion of the coho salmon run (873 fish) was also counted (Kuhlman 1974). During the one season the tower was not operated (1971), a weir count was attempted to gauge escapement on the Kogrukluk River. However, high water and debris damaged the weir and limited the results (Yanagawa 1972b). The Kogrukluk weir project was discontinued, and the counting tower was reestablished the following season.

An additional counting tower has been operated on the Middle Fork of the Goodnews River since 1981 at a site located about 12 mi upriver from Goodnews Village. All five species of salmon are counted as they migrate past the tower site. However, the project is terminated too early in the season to estimate total coho salmon escapement (Schultz 1983).

d. Weirs. Weirs represent another escapement-monitoring tool successfully employed in the Kuskokwim Area. In 1976, the Ignatti weir was established on the Holitna River approximately 139 mi upstream from its confluence with the Kuskokwim River. From 1976 through 1980, counts were made only long enough into the season to obtain escapement counts for chinook, chum, and sockeye salmon. (Only small numbers of pink salmon migrate past the weir site and, being small enough to pass between the weir pickets, are not fully counted.) From 1981 on, however, the weir has been operated into September and October, allowing coho salmon escapement counts as well. The project has been judged successful as an indicator of escapements in the years 1976, 1978, 1979, and 1981 and only partially successful in 1977, 1980, 1982, and 1983 (Schneiderhan 1984b).

A weir was operated on another upper Kuskokwim River tributary, the Salmon River (Pitka Fork), in 1981 and 1982. The weir was operated primarily to monitor chinook salmon escapement and to assess the accuracy of aerial surveys flown on this tributary of the upper Kuskokwim River (Schneiderhan 1982).

e. Test fishing. A final escapement estimation technique employed in the Kuskokwim Area has been the use of drift gill net test fishing. At sites approximately 4 mi upriver from Bethel along both banks of the Kuskokwim River, drift gill net test fishing has recently been utilized in an attempt to estimate Kuskokwim River coho salmon escapement (Huttunen 1984b).

Inasmuch as Kuskokwim Area salmon distribution and abundance in general terms and the escapement-monitoring techniques employed in the area have been discussed, individual salmon species distribution and abundance will now be presented.

C. Species Distribution and Abundance

1. Chum salmon:

a. Kuskokwim River (Districts 1, 2, and 3). Although no spawning has been observed within the main river itself, the Kuskokwim River serves as a migration corridor for all five species of Pacific salmon bound for spawning tributaries along its course. Although the timing of migration and spawning varies by species, the spawning of individual species seems to take place more or less simultaneously in Kuskokwim River tributaries throughout the system (Schneiderhan 1979).

The majority of the chum salmon returning to the Kuskokwim River are four-year-old fish (ADF&G 1984c). Adult chum salmon spawn in tributaries widely distributed throughout the Kuskokwim River drainage. The fish have been documented in tributaries ranging from the Eek River, which is the first salmon system upstream of the mouth of the Kuskokwim River, upstream to the North, East, and South Forks of the Kuskokwim River, near the headwaters of the system (ADF&G 1984a, 1984b).

In terms of general run timing, chum salmon typically begin passing through the Lower Kuskokwim River District in early June and continue to run through mid August, with the peak of the run normally occurring from late June to early July (ADF&G 1977). Most of the chum salmon run has normally passed through the Lower Kuskokwim River District's commercial fishery by mid July (ADF&G 1984d). Chum salmon run-timing though the Middle Kuskokwim River District coincides closely with that of the Lower Kuskokwim River District, though the fish appear slightly later (ADF&G 1977).

Chum salmon spawning normally takes place in Kuskokwim River tributaries from mid July to mid August (ibid.). While conducting a survey of the Eek River, Baxter (1977a) found peak chum salmon spawning occurring during the third week of July. Similar timing has been observed in an important spawning tributary of the upper Kuskokwim River, the Kogrukluk River. Peak migration of chum salmon past the Kogrukluk counting tower in the vicinity of important spawning grounds has been observed to occur from mid to late July (Yanagawa 1972a).

Important chum salmon spawning streams are widely distributed throughout the Kuskokwim River drainage. Important spawning streams within the drainage include, but are not limited to, the Eek, Kwethluk, Kisaralik, Kasigluk, Aniak, Salmon (Aniak), Kipchuk, Tuluksak, Chukowan, Kogrukluk, Holitna, Hoholitna, Holokuk, George, Oskawalik, Salmon (Pitka Forth), Tatlawiksuk, and Cheeneetnuk rivers and Can Creek. Available chum salmon escapement estimates for the years 1973 through 1983 for these streams and additional streams as well are presented in table 3, with streams grouped by district.

b. Quinhagak District. Within the Quinhagak District, runs of chum salmon appear about the third week of June and extend through late July (ADF&G 1977). Spawning usually extends from mid July until mid August (ibid.). Major producing systems for which escapements are enumerated are the Kanektok and Arolik rivers. The Kanektok River has exhibited the largest run of chum salmon in the district, with counts ranging from 6,197 fish in 1976 to 229,290 chum salmon in 1978 (table 3).

c. Goodnews District. The chum salmon run typically arrives in the Goodnews Bay fishery around the third week of June, peaks during the first 10 days of July, and continues through the end of July (ADF&G 1977). Peak migration of chum salmon past the Goodnews counting tower, located about 14 mi upriver from the Goodnews Bay fishing district, has been observed to occur from mid to late July (Schultz 1982, 1983). Spawning in the Goodnews River system typically occurs from mid July to mid August (ADF&G 1977).

2. Coho salmon:

a. Kuskokwim River (Districts 1, 2, and 3). Although no spawning has been observed within the main river itself, the Kuskokwim River serves as a migration corridor for all five species of Pacific salmon bound for spawning tributaries along its course. Although timing of migration and spawning varies by species, spawning of individual species seems to take place more or less simultaneously in Kuskokwim River tributaries throughout the system (Schneiderhan 1979).

The majority of spawning coho salmon return to Kuskokwim River tributaries as four-year-old fish (ADF&G 1984c). The fish spawn in widely distributed tributaries throughout the Kuskokwim River drainage. Like chum salmon, coho salmon have been documented in tributaries ranging from the Eek River upstream to the North, South, and East Forks of the Kuskokwim River (ADF&G 1984a, 1984b).

Coho salmon exhibit the latest run and spawning timing of any salmon species in the Kuskokwim River system. The fish do not typically begin migrating through the lower Kuskokwim River until mid-to-late July and continue to run until early October (ADF&G 1977). Spawning normally takes place from mid September to late October (ibid.).

The late run timing of the species has contributed to the relative scarcity of historical coho salmon escapement data. Field projects concerned with escapement monitoring have in the past often been terminated prior to coho salmon spawning activity.

A recent attempt has been made to estimate the total coho salmon return to the Kuskokwim River. Using drift gill net test-fishing catches to generate abundance indices, Huttunen (1984b) estimated the total coho salmon return to the Kuskokwim River in 1983 to approach 336,000 fish. Approximately 197,000 of these fish were commercially harvested, yielding a rough total escapement estimate of 139,000 coho salmon to Kuskokwim River tributaries in 1983 (ibid.). Available coho salmon escapement estimates for the Kuskokwim River tributaries for the years 1973 through 1983 appear in table 4, with streams grouped by district.

b. Quinhagak District. Of the salmon species, coho salmon exhibit the latest run timing, typically passing through the commercial fishery from early August through late September (ADF&G 1977). Spawning occurs from mid September through much of October (ibid.). Although escapement estimates (table 4) appear minimal, the abundance of coho salmon in the district has been large enough to sustain an average commercial annual harvest of 250,000 fish for the period 1978 through 1982 (ADF&G 1983a).

c. Goodnews District. Coho salmon exhibit the latest run timing of the salmon species and normally begin running through Goodnews Bay in early August. They continue to run until mid September (ADF&G 1977). Spawning normally occurs within the Goodnews River drainage from mid September through much of October (ibid.).

   Available escapement estimates made on Goodnews District streams and lakes for the years 1974 through 1983 for coho salmon can be found in table 4.

3. Chinook salmon:

   a. Kuskokwim River (Districts 1, 2, and 3). Chinook salmon spawn in tributaries widely distributed throughout the Kuskokwim River drainage. Like chum and coho salmon, chinook salmon have been documented in tributaries all along the river's course, ranging from the Eek River upstream to the North, East, and South forks of the Kuskokwim River (ADF&G 1984a, 1984b).

   Chinook salmon are typically the first salmon species to arrive in the lower Kuskokwim River. Although their run timing varies somewhat in response to weather conditions and time of breakup, chinook salmon normally pass through the lower Kuskokwim River from late May through the end of June (ADF&G 1977). Chinook salmon run timing through the middle Kuskokwim River coincides closely with that of the lower river, although the fish appear slighly later (ibid.). Chinook salmon spawning normally occurs from mid to late July (ibid.). In studies conducted on three widely separated tributaries along the Kuskokwim River's course (the Eek, Hoholitna, and Salmon [Pitka Fork] rivers), peak chinook salmon spawning has been observed to occur during the last two weeks of July (Baxter 1977a, 1977b; Schneiderhan 1982).

Important chinook salmon spawning streams within the Kuskokwim River drainage include, but are not limited to, the Eek, Kwethluk, Kisaralik, Kasigluk, Aniak, Salmon (Aniak), Kipchuk, Tuluksak, Chukowan, Kogrukluk, Holitna, Hoholitna, Holokuk, Salmon (Pitka Fork), George, Oskawalik, Tatalawiksuk, Cheeneetnuk, Big Salmon Fork, Nixon Fork, and Gagaryah rivers and Bear Creek. Available chinook salmon escapement data for the years 1974 through 1983 are presented in table 5, with streams grouped by district.

b. Quinhagak District. Chinook salmon are usually the first species to arrive in the coastal waters of the Quinhagak District. The fish normally appear in the fishery the second week of June and continue to run until the beginning of July (ADF&G 1977). Spawning normally takes place from mid to late July (ibid.). Rivers within the district that are surveyed for chinook salmon include the Kanektok, Kanuktik, and Arolik rivers. Escapement indices indicate a peak count of 19,180 chinook salmon in 1978, with a fluctuating downward trend to 8,890 fish in 1983 (table 5).

c. Goodnews District. In terms of general run timing, chinook salmon usually appear in Goodnews Bay during the second week of June and continue to run until early July (ADF&G 1977). Peak chinook migration past the counting tower, located some 14 mi upriver from the commercial fishing district, has occurred from early to mid July (Schultz 1982, 1983). Spawning in the Goodnews River drainage normally occurs from mid to late July (ADF&G 1977). Escapement estimates for the Goodnews river system streams normally surveyed peaked in 1983, when 6,027 fish were counted from the Middle Fork tower (table 5).

4. Sockeye salmon:

a. Kuskokwim River (Districts 1, 2, and 3). Sockeye salmon have been documented in tributaries along the Kuskokwim River's course from the Eek River upstream to the South Fork of the Kuskokwim River (ADF&G 1984a, 1984b).

Migrating sockeye salmon normally pass through the lower Kuskokwim River from early June through mid July (ADF&G 1977). Peak spawning in Kuskokwim River tributaries appears to normally occur from late July to mid August. In surveys of the Eek River, a tributary of the lower Kuskokwim River, and the Hoholitna River, a second-order tributary to the upper Kuskokwim River, peak sockeye salmon spawning has been observed during the first and second weeks of August, respectively (Baxter 1977a, 1977b). Available sockeye salmon escapement estimates for the years 1974 through 1983 are presented in table 6.

b. Quinhagak District. Runs of sockeye salmon normally appear in the Quinhagak District about the third week of June and extend through late July (ADF&G 1977). Spawning typically occurs from mid August to late September (ibid.). Sockeye salmon-producing systems of the Quinhagak District include the Kanektok and Arolik rivers. Whereas the escapement indicies of sockeye salmon in the Kuskokwim River drainage are minimal, except for the Kogruklik River, significant returns of the species to the Quinhagak and Goodnews districts are evident (table 6). Escapement estimates on the Kanektok River reached a high of 113,931 fish in 1980 (table 6).

c. Goodnews District. Sockeye salmon are usually available to the Goodnews District fishery from mid June through July, peaking around the first 10 days of July (ADF&G 1977). Peak passage of sockeye salmon past the Goodnews tower some 14 mi upriver from the fishing district has been observed to occur in mid July (Schultz, pers. comm.). This species demonstrates greater abundance in even years than odd and typically spawns throughout the Goodnews River drainage through the month of July (ADF&G 1977).

5. Pink salmon:

a. Kuskokwim River (Districts 1, 2, and 3). Pink salmon are the least abundant and exhibit the most limited distribution of any salmon species found in the Kuskokwim River drainage. Pink salmon have thus far been documented in tributaries along the river's course from the Eek River upstream to the Holitna River and its tributaries (ADF&G 1984a, 1984b).

In terms of general run timing, pink salmon have been observed migrating through the lower Kuskokwim River in late June and early July (Baxter 1970). The fish appear to spawn in Kuskokwim River tributaries through late July (ADF&G 1977).

Kuskokwim River commercial harvests of the species reflect greater abundance of the fish in even years than in odd years. Pink salmon escapement estimates made on Kuskokwim River tributaries are extremely limited. Available pink salmon escapement estimates for the years 1973 through 1983 are presented in table 7, with streams grouped by district.

b. Quinhagak District. The pink salmon run into the Quinhagak District normally commences about the third week of June and extends through late July (ibid.). Spawning occurs throughout the month of July (ibid.). The Kanektok River is the major producing system of the district, with escapement estimates of up to 596,990 pink salmon recorded in 1980 (table 7).

c. Goodnews District. Run timing and spawning of pink salmon in this Goodnews District is believed to be generally the same as for pink salmon in the Quinhagak District. Available escapement data for the district indicate returns of lesser magnitude than those found in the Quinhagak District (table 7).

III. YUKON MANAGEMENT AREA

The Yukon River is the largest river in Alaska, draining approximately 35% of the state, and is the fifth largest river on the North American continent. The river originates in British Columbia, Canada, within 48 km (30 mi) of the Gulf of Alaska and extends over 3,700 km (2,300 mi) to the Bering Sea. The river system drains an area of about 531,000 km² (330,000 mi²) (Barton 1984).

The Yukon River supports five species of Pacific salmon (Oncorhynchus sp.). Chum salmon are the species of greatest abundance, followed in order of magnitude by chinook, coho, and limited numbers of sockeye salmon (ADF&G 1978). Pink salmon may have been the species second in abundance after chum salmon during recent even-numbered years. Their numbers as represented by harvest figures, however, are very limited because of the lack of commercial markets and a subsistence preference for chinook and chum salmon (Buklis, pers. comm.).

The size of the Yukon River drainage prohibits the feasibility of obtaining complete salmon escapement data for the entire drainage. In past years, escapement estimates of as many spawning areas as possible have been attempted within the constraints of available fiscal and manpower resources and in accordance with favorable weather conditions (Barton 1984). Estimates have been obtained by aerial and ground surveys, counting towers, weirs, and, more recently, side-scan sonar. A special effort has been directed toward ensuring that representative, or "index," streams or spawning areas have been surveyed annually to determine trends in abundance. More comprehensive enumeration projects are primarily limited to the Andreafsky, Anvik, Sheenjek, Fishing Branch, Salcha, and Delta rivers and the Whitehorse Fishway. A comprehensive summary of historical escapement data is summarized by Barton (1984). A complete bibliography of literature regarding Yukon River salmon fisheries has been compiled by Buklis (1985).

A. Chum Salmon

1. Distribution. Two distinct runs of chum salmon return to the Yukon River to spawn, summer and fall chum salmon. Summer chum salmon generally utilize spawning areas in the lower and middle portion of the Yukon River watershed and some tributaries to the Koyukuk and Tanana rivers. Fall-run chum salmon primarily spawn in spring-fed upwelling areas in upper river streams and sloughs of the watershed (Barton 1984, Buklis and Wilcock 1985). Major producing systems for summer chum salmon are the Andreafsky, Anvik, Rodo, Nulato, Koyukuk, Tozitna, Chena, and Salcha rivers. Fall chum salmon have

been primarily documented in the Porcupine and Tanana river systems in Alaska. Fall chum salmon are also present in the Yukon Territory of Canada (Bergstrom, pers. comm.).

2. Abundance. Chum salmon are the most abundant species in the Yukon River drainage and are a very important component of the commercial and subsistence fisheries.

   a. Summer chum salmon. The summer run of chum salmon is greater in magnitude than the fall run. Summer chum salmon are characterized by early run timing from the end of May until mid July, rapid maturation in fresh water, and small body size (2.7 to 3.2 kg, or 6 to 7 lb) than fall chum salmon (Buklis and Barton 1984, Barton 1984). Adults range in age from three to six years, although more tnan 90% of the fish are usually four- and five-year-old salmon (YTC 1985). Spawning activity involving summer chum salmon usually peaks from early to mid July in the lower Yukon River and from early to mid August in the Middle Yukon tributaries (ADF&G 1978).

      Summer chum salmon spawn primarily in streams tributary to the lower Yukon, the Koyukuk, and the Tanana rivers in Alaska. The Anvik River supports the largest spawning population, and other important tributaries include the Andreafsky, Nulato, Melozitna, Hogatza, Gisasa, and Salcha rivers. Spawning is usually completed by early August.

      Escapements for most major stocks appear strong in recent years, exceeding escapement objectives (YTC 1985). Escapement estimates for the Anvik River have ranged from 262,854 summer chum salmon counted in 1977 (combined tower and aerial counts) to a peak count of about 1.5 million salmon in 1981 (sonar count) (table 9). Estimates of summer chum salmon in the East Fork of the Andreafsky River have ranged from 66,471 fish in 1979 to 223,485 fish in 1975 (table 9).

      Estimates of total run were obtained by tag recapture studies in 1970 and 1971. The total run estimates for these two years were 3.6 and 1.6 million fish, respectively. Minimum estimates of total run size determined from harvest levels and observed escapement indices ranged from 1.2 to 5.6 million fish, annually, during the period 1975-1981 (YTC 1985).

      Yukon River chum salmon (both fall and summer runs) spend one winter incubating in the gravel. The fry migrate to the Bering Sea shortly after emergence from the gravel in the spring (ibid.). Summer chum salmon fry from the Anvik River have been present over two months after breakup of river ice. It is believed that chum salmon fry outmigration in the Anvik River probably peaks around early June (Buklis 1983).

b. Fall chum salmon. Fall chum salmon are distinguished by later run timing, usually extending from mid July to early September, robust body shape, and brighter silver coloration than summer-run chums (Barton 1984). As with summer chum salmon, the majority (90%) of the adult fish are usually four- and five-year-old salmon (YTC 1985). Although there is considerable overlap in both physical characteristics and timing of entry into the Yukon River, by 15 July the majority of chum salmon entering the Yukon River are considered fall chum salmon (Buklis and Barton 1984). Fall chum salmon exhibit a pulse type entry pattern into the Yukon River delta area. This is characterized by a large number of fish passing through the area during a short period of time, followed by a period of a few days with very few fish migrating through the area. The mid point of the fall chum salmon run is usually during the first week of August (Bergstrom, pers. comm.).

There is further evidence that fall chum salmon bound for the Porcupine River system and Yukon Territory streams are the earlier-run fall chum salmon, occurring from late July to early August. The later run of fall chum salmon, taking place from mid August to early September, are destined for the Tanana River drainage (ADF&G 1984e).

Tagging studies have shown that Porcupine and Upper Yukon River fall chum salmon are also distinguished from Tanana River fall chum salmon by their orientation along the north bank of the Yukon River near Galena, as opposed to the south bank orientation of Tanana River fall chum salmon (YTC 1985). A comprehensive description of the biology and stock status of fall chum salmon in the Yukon River drainage is summarized by Buklis and Barton (1984).

Escapement indices begun in 1973 for fall chum salmon show a serious recent decline, during the 1980's for the major spawning areas, including the Sheenjek, Fishing Branch, and Toklat rivers. Escapement objectives have not been achieved in recent years for these spawning areas, and there is reason for concern over conservation of these stocks. Average aerial survey escapement indices decreased by 28, 54, and 78% in the Sheenjek, Fishing Branch, and Toklat rivers, respectively, between the period 1976-1979 and the period 1980 to 1983 (YTC 1985). The Sheenjek River sonar count of 25,000 chum salmon in 1984 was the lowest since sonar enumeration was initiated in 1981 (table 10). The aerial survey count of 5,600 fish in the Fishing Branch River in Canada during the same year was the lowest since the early 1970's. A peak aerial survey estimate of 15,900 fish in the Toklat River in 1984 was below escapement objectives and continues the recent trend of poor escapements to that system. Escapements to the Delta River (Tanana River system) has been relatively more stable than in other major spawning areas. The 1984 aerial escapement survey estimate of 12,300 chum salmon for the Delta River exceeded the escapement objective (YTC 1985).

Yukon River chum salmon (both fall and summer runs) spend one winter incubating in the gravel. The fry migrate to the Bering Sea shortly after emergence in the spring. Fall chum salmon fry leave the Delta River for downstream migration in the Tanana and Yukon rivers from April to mid May (Buklis and Barton 1984).

B. Chinook Salmon

1. Distribution. Chinook salmon spawn in tributary streams throughout both the Alaskan and Canadian sections of the Yukon River drainage and are the most widely distributed of the five salmon species within the drainage. Spawning has been documented in more than 100 streams throughout the drainage, ranging from 137 km (85 mi) from the mouth of the drainage to 3,046 km (1,892 mi) from the river mouth. Major producing systems include the Andreafsky, Anvik, Nulato, Chena, and Salcha rivers in Alaska and the Big Salmon, Little Salmon, Teslin, and Nisutlin rivers and the main stem Yukon River in Canada (Barton 1984).

2. Abundance. Chinook salmon are the salmon species second in abundance to chum salmon in the Yukon River drainage. This species is important to both subsistence and commercial fishermen.

   Estimates of total run size using tag and recovery methods between 1966 and 1970 ranged between 161,000 and 600,000 chinook salmon (YTC 1985). Table 11 presents escapement estimates of selected index areas for the years 1975 through 1984.

   Estimates of run magnitude within the Canadian portion of the drainage were 29,000 fish in 1973, 11,000 to 37,000 fish in 1974, increasing to 37,000 and 48,000 chinook salmon in 1982 and 1983, respectively (ibid.).

   Most escapement estimates for chinook salmon have been obtained by aerial and boat survey. The fishway located at Whitehorse, however, has provided the longest, most continuous record of chinook salmon escapements since 1959 (YTC 1985), although other index areas have been surveyed consistently since the 1960's.

   Low escapement levels of the mid 1970's for chinook salmon improved in most areas from 1978 through 1984. Record escapements were documented in most index streams surveyed during 1980 and 1981 (table 11). The improved harvest and escapement levels in recent years have been attributed to time and gear restrictions placed upon the Alaska commercial fishery, reduced interception of chinook salmon in high seas fisheries, and favorable environmental conditions (ADF&G 1984e, YTC 1985).

Aerial survey data suggest that the Tanana River drainage (primarily the Salcha and Chena rivers) is consistently the largest producer of Yukon River chinook salmon (McBride and Wilcock 1983).

Age at maturity for Yukon River chinook salmon ranges from four to seven years. Most fish spend two years in fresh water and two to five years in the marine environment. Age differences are apparent by sex. Female chinook salmon return to the Yukon River primarily at ages 6 and 7, whereas males mature at ages 4, 5, and 6. Consistent differences in age and sex are apparent between spawning populations in different sections of the river. The proportion of older chinook salmon increases in spawning populations, moving progressively upriver. This trend also translates into an increase in the proportion of females in spawning populations moving progressively upriver. Most fish that spend three years in fresh water have been found in Canadian spawning populations (YTC 1985).

Scale pattern analysis has been used to estimate the contribution of stock groupings (lower, middle, and upper) of Yukon River runs to the commercial harvest taken within the river. In 1982 and 1983, the composition of the commercial catch was derived for the entire Yukon River harvest. The Alaskan stock contribution to the Alaskan harvest (commercial and subsistence) was estimated at 42 and 53%, with the Canadian contribution estimated at 58 and 47%, for each year, respectively. Stock composition estimates for the entire drainage harvest in 1982 and 1983 were 38 and 49%, respectively, Alaskan origin fish. The Canadian contribution was estimated at 62 and 51%, respectively (ibid.).

Chinook salmon enter the Yukon River soon after ice breakup during June and early July (Barton 1984). About 60 days are required for chinook salmon to migrate from the river mouth to upper river tributaries (ADF&G 1978). Reports of earlier times that chinook salmon have reached upriver locations are as follows: Galena in mid June; Rampart in late June; Eagle in early July; Tanana River drainage and Nenana River in late June and early July, respectively; Chena River in late July; and the Salcha River in late July (ADF&G 1978).

Peak of spawning occurs in the lower and middle river tributaries from late July to mid August, and in the upper river tributaries from mid to late August (table 8) (Buklis, pers. comm).

C. Coho Salmon

1. Distribution. Within the Yukon River drainage, coho salmon have been documented to spawn in widely scattered areas

throughout the Yukon River system. Tributaries in which coho salmon have been documented are the Andreafsky, Chuilnak, Delta Clearwater, Innoko, Bonanza, Anvik, Tanana, Hodzana, Porcupine, Kandik, and Totonduk rivers and Birch and Beaver slough/creeks. At this time, major coho salmon spawning areas appear to be located in the tributaries of the upper Tanana River drainage and the Porcupine River watershed (McBride et al. 1982; Barton 1984; ADF&G 1985; Buklis, pers. comm.).

2. Abundance. Escapement data for coho salmon in the Yukon River are very limited. Comparative historical escapement data are available only from the Tanana River drainage in Alaska. Escapement levels appear to have been stable there from 1973 through 1984 (YTC 1985). A record high of 11,000 coho salmon were observed in the Delta Clearwater River (a tributary of the Tanana River) in 1984 (ibid.). Additional coho salmon escapement information is presented in table 12.

   Coho salmon usually return to the Yukon River as four-year-old fish. They usually enter the lower Yukon River about one week later than fall-run chum salmon, in late July (ADF&G 1985, 1978). The coho salmon run in the lower river usually peaks about mid August. In the upper Yukon Area, coho salmon are present from mid August until late September or early October (ADF&G 1985).

   Spawning occurs in the Tanana River drainage from late September through November (Barton 1984).

   Total run estimates of coho salmon are not available. In fact, the magnitude of the coho salmon resource is unknown. The coho salmon return has been strong enough to support subsistence and commercial fisheries in Alaska and Canada, with combined catches for the period 1975 through 1984 ranging from 2,546 fish in 1975 to 131,376 fish in 1984 and averaging 44,130 coho salmon, annually (ADF&G 1984e, YTC 1985).

D. Pink Salmon

1. Distribution. Pink salmon have been caught in the main stem of the Yukon River as far upstream as Ruby (ADF&G 1984e); however, this species spawns primarily in the lower portion of the Yukon drainage, downstream from the village of Grayling.

2. Abundance. Yukon River pink salmon exhibit even-year run strength (YTC 1985). Pink salmon enter the Yukon River from late June through mid July (Barton 1984). Pink salmon escapements are not targeted for enumeration. Available data have been obtained incidentally to surveys of other salmon species. Limited escapement data indicate that the Andreafsky River system supports the largest spawning population of pink salmon within the Yukon River drainage. Aerial surveys have accounted for an index count of about 139,000 pink salmon in the Andreafsky River in 1980

(table 13). The magnitude of the Anvik run appears to be considerably less, with survey index counts of 500 or fewer fish (Barton 1984). Run timing of pink salmon in the Anvik and Andreafsky rivers is similar, occurring coincidentally with the mid-June-to-late-July escapement of summer chum salmon (Buklis 1983). The size of the total run of pink salmon into the Yukon River drainage in unknown.

E. Sockeye Salmon

1. Distribution and abundance. Sockeye salmon are rarely found in the Yukon River. They have been reported in catches in the main Yukon River upstream to Rampart (ADF&G 1984c). Spawning areas have not been documented by the ADF&G; however, local residents have reported sockeye salmon spawning in the Innoko River (Barton 1984). There are no estimates of sockeye salmon abundance or run size for the Yukon River drainage.

Table 1. General Salmon Run Timing in the Kuskokwim River, by Species[a]

Species	Timing of Migration Through Lower Kuskokwim R. District	Spawning	Emergence from Gravel	Smolt Out-migration
Chinook	Late May - late June	Mid July - late July	---	---
Chum	Early June - mid Aug.	Mid July - mid Aug.	---	---
Sockeye	Early June - mid July	Late July - mid Aug.	---	---
Pink	Late June[b] - ?	Through July	---	---
Coho	Mid July - early Oct.	Mid Sept. - late Oct.	---	---

Source: a ADF&G 1977, unless otherwise noted; b Baxter 1970; c Baxter 1977a, 1977b.

--- means no data were available.

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 in the Quinhagak and Goodnews Districts of the Kuskokwim Area by Species

Species	Adults Present in Bays and Estuaries	Spawning	Emergence from Gravel	Smolt Out-migration
Chinook	Early June - early July	Mid July - late July	---	---
Chum	Mid June - late July	Mid July - mid Aug.	---	---
Sockeye	Mid June - late July	Mid Aug. - late Sept.	---	---
Pink	Mid June - late July	Through July	---	---
Coho	Early Aug. - late Sept.	Mid Sept. - late Oct.	---	---

Source: ADF&G 1977.

--- means no data were available.

Note: Early = 1st to 10th of month, mid = 11th to 20th of month; late = 21st to 30th/31st of month.

Table 3. Chum Salmon Escapement Index Counts in Kuskokwim Area Streams by District, 1974-83[c]

Year	District 1: Lower Kuskokwim River						District 2: Middle Kuskokwim River					
	Kwethluk[a] River	Kisaralik[a] River	Eek[b] River	Eek[b] River Middle Fork	Kasigluk[b] River	Canyon[b] Creek	Aniak[a,e] River	Aniak[a] River	Salmon[a] River (Aniak)	Kipchuk[a] River	Tuluksak[b] River	Fog[b] River
1974	---	---	---	---	1,830	---	---	---	312[g]	45[g]	---	---
1975	---	---	---	6,050	---	---	---	12,025	1,620	905	---	---
1976	7,576	10,921[i]	1,084[d]	---	5,860	167	---	8,385	---	1,425[i]	5,463	---
1977	19,621	---	---	---	14,349	---	---	---	625[i]	---	2,071[g]	---
1978	3,220	2,100[i]	164[g]	---	4,097	---	---	---	330	---	2,007	---
1979	4,739	---	---	---	11,301[e]	---	---	---	---	---	---	---
1980	---	---	9,563	---	---	---	1,091,286[e]	---	14,815[i]	1,260	56,035	---
1981	5,496	7,508	---	---	---	---	526,320[e]	97,275	2,380	---	---	---
1982	---	40	74	---	---	---	389,226[e]	31,990	175	---	---	---
1983	6,432	3,060	922	---	2,560	---	114,222[e]	10,091	992	---	1,662	319[g]

(continued)

Table 3 (continued).

Year	District 3: Upper Kuskokwim River									
	Chukowan[a] River	Kogrukluk[a] River	Kogrukluk[a,f] River	Holitna[b] River	Holokuk[b] River	George[b] River	North[b] Fork George River	Crooked[b] Creek	Oskawalik[b] River	West[b] Fork Oskawalik River
1974	---	---	---	---	---	---	---	---	---	---
1975	550	3,973	---	11,167	672	---	---	---	2,273	169
1976	696	378	8,046	154,262	2,276	1,298	200	20	1,596	---
1977	---	606[g]	10,388	---	9,340[g]	---	---	---	8,682	---
1978	172[g,i]	---	47,099	23,133	---	---	---	---	---	---
1979	---	---	13,966	---	862	---	---	---	---	---
1980	---	3,500	41,717	---	13,185	---	---	---	12,508	---
1981	---	---	56,495	---	---	---	---	---	---	---
1982	180	---	41,218	13,188	635	---	---	---	2,079	---
1983	---	---	7,958	9,060	301	---	---	---	602	---

(continued)

Table 3 (continued).

Year	District 3: Upper Kuskokwim River (continued)							District 4: Quinhagak		District 5: Goodnews Bay		
	Big[b] Salmon Fork	Can[b] Creek	Cheen-eetnuk[b] River	Gagaryah[b] River	Pitka[b] Fork	Salmon[b] River Pitka Fork	Tatlawiksuk[b] River	Kanektok[a] River	Arolik[b] River	Goodnews[a] River	Goodnews[a,h] Middle Fork	Goodnews[b] River South Fork
1974	---	---	---	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	---	---	---	---	---	1,090	---	---
1976	---	1,366	516	---	---	---	5,600	6,197	---	16,900[g]	---	1,010[g]
1977	50[g]	4,770	880	100[g]	5,700	50[g]	---	32,157	10,182	15,993[g]	---	---
1978	---	292	---	28[g]	---	---	---	229,290	---	---	---	---
1979	---	---	---	---	---	---	---	---	---	8,349	---	---
1980	---	---	---	---	---	---	---	25,950	---	1,975	---	1,854[g]
1981	---	---	---	---	---	---	---	66,849	6,340	---	21,827[h]	---
1982	---	---	---	---	---	---	---	8,820	---	9,700[g]	6,767[h]	---
1983	---	---	211	---	---	---	---	9,360	---	---	15,548[h]	520

Source: a ADF&G 1983a; b ADF&G 1983b.

--- means no data or only data obtained under poor conditions were available.

c Counts are peak counts from aerial surveys, unless otherwise noted. Only counts obtained under survey conditions rated as good or fair are presented.

d Boat survey.

e Sonar counts.

f Ignatti Weir count.

g Survey conditions rated as good by surveyor.

h Tower count.

i Less than entire river surveyed.

Table 4. Coho Salmon Escapement Index Counts in Kuskokwim Area Streams by District, 1974-83[a]

	District 1: Lower Kuskokwim River			District 2: Middle Kuskokwim River					
Year	Kwethluk River	Kisaralik River	Eek River	Aniak River	Aniak River	Salmon River (Aniak)	Kipchuk River	Tuluksak River	Granite River
1974	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	---	---	---	---	---
1976	---	---	5[b]	---	36	---	---	---	---
1977	---	---	---	---	---	---	---	---	---
1978	---	---	---	---	140[g]	151[g]	11[g]	64[g]	---
1979	---	---	---	---	---	---	---	---	---
1980	---	---	---	81,566[c,h]	7,035	412[g]	209	---	---
1981	---	---	---	---	---	---	---	---	---
1982	---	---	---	---	---	---	---	---	---
1983	809	406	---	---	765	34[g]	---	373	6[e]

(continued)

Table 4 (continued).

	District 3: Upper Kuskokwim River (continued)							District 4: Quinhagak	District 5: Goodnews Bay	
Year	Kogrukluk River	Hoholitna River	Cheeneetnuk River	Gagaryah River	Nixon Fork	Salmon River (Pitka Fork)	Tatlawiksuk River	Kanektok River	Goodnews River	Goodnews River Middle Fork
1974	873[f]	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	---	---	---	---	---	---
1976	---	---	101	10	10	---	31	---	---	---
1977	---	---	---	---	---	---	---	---	---	---
1978	---	---	---	---	---	---	---	---	---	---
1979	---	---	---	---	---	---	---	---	---	---
1980	---	27[b]	---	---	---	89	---	69,325	23,671	2,865
1981	11,532[d,h]	---	---	---	---	---	---	---	---	---
1982	35,565[d,h]	---	---	---	---	---	---	9,700	---	275
1983	8,327[d,h]	---	---	---	---	---	---	---	---	---

Source: ADF&G 1983b, unless otherwise noted.

--- means no data or only data obtained under poor conditions were available.

a Counts are peak counts from aerial surveys, unless otherwise noted. Only counts obtained under survey conditions rated as good or fair presented.

b Boat survey.

c Sonar count.

d Ignatti weir count.

e Foot survey.

f Tower count.

g Survey condition rated as good by surveyor.

h ADF&G 1983a.

Table 5. Chinook Salmon Escapement Index Counts in Kuskokwim Area Streams by District, 1974-83[c]

	District 1: Lower Kuskokwim River						District 2: Middle Kuskokwim River					
Year	Kwethluk[a] River	Kisaralik[a] River	Eek[b] River	Eek River Middle Fork	Kasigluk[b] River	Canyon[b] Creek	Aniak[a,e] River	Aniak[a] River	Salmon River (Aniak)	Kipchuk[a] River	Tuluksak[b] River	Fog[b] River
1974	---	---	---	---	11	---	---	---	35[g]	75[g]	---	---
1975	---	---	---	73	---	---	---	202	32	94	---	---
1976	997	873[i]	618[d]	---	---	198	---	281[i]	---	177[i]	139	---
1977	1,999	---	258	---	155	---	---	---	520[i]	---	437g	---
1978	1,722	2,417[i]	741[g]	---	130	---	---	---	322	---	403	---
1979	822	---	---	---	398[e]	---	---	---	---	---	---	---
1980	---	---	2,378	---	---	---	56,469[e]	---	1,186[i]	193	1,035	---
1981	2,034	940	---	---	---	---	42,060[e]	10,094	828	---	---	---
1982	---	81	326	---	---	---	33,864[e]	2,210	126	---	---	---
1983	471	476	258	---	4	---	4,910[e]	2,149	231	202[g]	36[g]	

(continued)

Table 5 (continued).

Year	Chukowan[a] River	Kogrukluk[a] River	Kogrukluk[a] River	Salmon[a] River (Pitka Fork)	Holitna[b] River	Holokuk[b] River	Chineekluk[b] Creek	George[b] River	Oskawalik[b] River	West[b] Fork Oskawalik River	Tatla-wikruk[b] River
	District 3: Upper Kuskokwim River										
1974	---	---	---	---	---	---	---	---	---	---	---
1975	667[i]	1,080	---	---	672	17	---	---	71	36	---
1976	727	702[i]	5,507[f]	1,149[g,i]	4,867	126	15	199	204	---	212
1977	---	1,342[g]	1,385[f]	1,930[g]	---	60	2	---	277	---	---
1978	1,064[g,i]	---	13,132[f]	1,083[g]	7,233	---	---	---	---	---	---
1979	---	---	10,125[f]	667	---	45[g]	---	---	---	---	---
1980	---	540	6,572[f]	1,450	---	157	---	---	102	---	---
1981	---	---	16,075[f]	1,474	---	---	---	---	---	---	---
1982	236	---	5,505[f]	419	1,123	42	4	---	100	---	---
1983	---	---	3,600[f]	572	1,369	33	---	---	43	---	---

(continued)

Table 5 (continued).

Year	Cheeneetnuk[b] River	Gagaryah[b] River	Bear[b] Creek	Big[b] Salmon Fork	Blackwater Creek	Can[b] Creek	Jones[b] River	Nixon[b] Fork	Soda[b] Creek	Sullivan[b] Creek
	District 3: Upper Kuskokwim River (continued)									
1974	---	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	---	---	---	---	---	---
1976	1,201	663[g]	182[g]	46	---	10	---	188	34	13[g]
1977	1,407[g]	897[g]	---	203	---	14	50	---	---	---
1978	268	504[g]	227	---	60	23	---	---	---	---
1979	---	---	---	---	---	---	---	---	---	---
1980	---	---	---	---	---	---	---	---	---	---
1981	---	---	---	---	---	---	---	---	---	---
1982	---	---	127	---	---	---	---	---	---	---
1983	173	---	---	---	---	---	---	---	---	---

(continued)

Table 5 (continued).

	District 4: Quinhagak			District 5: Goodnews Bay		
Year	Kanektok[a] River	Kanuktik[b] River	Arolik[b] River	Goodnews[a] River	Goodnews[a,h] River Middle Fork	Goodnews River South Fork
1974	---	---	---	---	---	---
1975	---	---	---	829	---	---
1976	3,079	97	---	1,150[g]	---	5[g]
1977	5,787	---	2,740	2,163[g]	---	---
1978	19,180	---	---	---	---	---
1979	---	---	---	635	---	---
1980	6,172	---	---	1,228	---	150[g]
1981	15,900	---	1,307	---	3,688[h]	---
1982	8,142	---	---	1,990[g]	1,395[h]	---
1983	8,890	---	---	2,600	6,027[h]	141

Source: a ADF&G 1983a, b ADF&G 1983b.

--- means no data or only data obtained under poor conditions were available.

c Counts are peak counts from aerial surveys, unless otherwise noted. Only counts obtained under survey conditions rated as good or fair are presented.

d Boat survey.

e Sonar count.

f Ignatti weir count.

g Survey conditions rated as good by surveyor.

h Tower count.

i Less than entire river surveyed.

Table 6. Sockeye Salmon Escapement Index Counts in Kuskokwim Area Streams and Lakes by District, 1974-83[c]

	District 1: Lower Kuskokwim River			District 2: Middle Kuskokwim River		District 3: Upper Kuskokwim River						
Year	Kisaralik[a] River	Eek[b] River	Eek R.[b] Middle Fork	Aniak[a] River	Salmon R.[a] (Aniak)	Chukowan River	Kogrukluk[a] River	Kogrukluk[a,e] River	Holitna[b] River	Holokuk[b] River	Oskawalik[b] River	Tevyaraq[b] Lake
1974	---	---	---	---	---	---	---	---	---	---	---	---
1975	---	---	79	125	---	184	646	---	387	5	15	---
1976	---	292[d]	---	---	---	76	97[h]	2,302[e]	2,632	---	---	---
1977	---	---	---	---	---	---	614[g]	1,112[e]	---	---	---	---
1978	20[h]	---	---	---	---	---	---	1,656[e]	---	---	---	950[g]
1979	---	---	---	---	---	---	---	2,432[e]	---	---	---	---
1980	---	527	---	---	---	---	980	3,200[e]	---	50	---	2,895[g]
1981	---	---	---	---	---	---	---	17,702[e]	---	---	---	---
1982	---	175	---	20	30	1,372	---	11,724[e]	1,235	---	---	---
1983	---	---	---	50	---	---	---	681[e]	20	---	---	380[g]

(continued)

Table 6 (continued).

Year	Kanektok[a] River	Arolik[b] River	Kagati[b] Lake	Arolik[b] Lake	Goodnews[a] River	Goodnews[a,f] Middle Fork	Kukaktlim[b] Lakes	Potholes[b] Lake	Awayak[b] Lake North	Goodnews[b] Lake	Middle[b] Goodnews Lakes
	District 4: Quinhagak				District 5: Goodnews Bay						
1974	---	---	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	3,335	---	---	---	---	---	---
1976	2,936	---	20,000	---	5,940[g]	---	2,330[g]	320[g]	260[g]	1,170[g]	1,730[g]
1977	6,304	2,456	---	---	4,271[g]	---	---	---	---	6,605	---
1978	44,215	---	---	---	---	---	---	---	---	---	---
1979	---	---	---	---	987	---	---	---	---	---	7,555
1980	113,931[g]	---	---	---	30,239	---	---	---	---	45,400[g]	13,203[g]
1981	49,175	5,110	---	---	---	217,702[f]	---	---	---	---	---
1982	55,950	---	---	---	19,160[g]	56,255[f]	---	---	---	---	---
1983	2,340	---	---	---	5,450	25,816[f]	---	---	---	4,200	4,350

Source: a ADF&G 1983a, b ADF&G 1983b.

--- means no data or only data obtained under poor conditions were available.

Note: Survey conditions rated as fair, unless otherwise noted.

c Counts are peak counts from aerial surveys, unless otherwise noted. Only counts obtained under survey conditions rated as good or fair are presented.

d Boat survey.

e Ignatti weir count.

f Tower count.

g Survey conditions rated as good by surveyor.

h Less than entire river surveyed.

Table 7. Pink Salmon Escapement Index Counts in Kuskokwim Area Streams by District, 1974-83[a]

	District 1: Lower Kuskokwim River		District 2: Middle Kuskokwim River		District 3: Upper Kuskokwim River				District 4: Quinhagak		District 5: Goodnews Bay		
Year	Kwethluk River	Eek River	Aniak River	Tuluksak River	Holitna River	Chukowan River	Holokuk River	Oskawalik River	Kanektok River	Arolik River	Goodnews River	Goodnews River Middle Fork	Goodnews River South Fork
1974	---	---	---	---	---	---	---	---	---	---	---	---	---
1975	---	---	---	---	---	---	---	---	---	---	---	---	---
1976	---	285[b]	---	---	---	---	---	---	39,759	---	4,720[c]	12,905[c]	315[c]
1977	---	---	---	---	---	---	---	---	---	---	---	---	---
1978	100[c]	---	---	---	---	---	---	---	522,450	---	---	---	---
1979	---	2,412	---	2,300	---	---	5,475	120	---	---	1,736	1,415[c]	---
1980	---	---	---	---	---	---	---	---	596,990	---	94,930[c]	18,965	4,207[c]
1981	---	---	---	---	---	---	---	---	---	200	---	---	---
1982	---	---	270	---	---	15	---	---	67,621	---	2,100[c]	2,325[c]	---
1983	---	---	---	---	520	---	---	---	---	---	---	---	---

Source: ADF&G 1983b.

--- means no data or only data obtained under poor survey conditions available.

Note: survey conditions rated as fair, unless otherwise noted.

a Counts are peak counts from aerial surveys unless otherwise noted. Only counts obtained under survey conditions rated as good or fair are presented.

b Boat survey.

c Survey conditions rated as good by surveyor.

Table 8. General Salmon Run Timing in the Yukon River, by Species and by River Section

	Lower River (Mouth to Lower Koyukuk)[a]				Middle River (Tanana and Upper Koyukuk River Tributaries)[b]			
Salmon Species	Timing of Migration into Lower River	Timing Of Spawning	Emergence From Gravel	Out-migration	Timing of Migration Into Middle River	Timing Of Spawning	Emergence From Gravel	Out-migration
Summer chum	End of May-mid July	July-early Aug.	---	Ice breakup through July	Early July to mid Aug.	Mid July-Aug.	---	---
Fall chum	Mid July-early Sept.	---	---	---	Mid Aug. to late Sept.[d]	Mid Oct.-early Nov.	Early Apr.-early May	Apr.-mid May
Chinook	Ice breakup (mid May)-mid July	Early to late July	---	Ice breakup through July	Late June	Mid-late Aug.	---	Ice breakup through July
Coho	Late July-early Sept.	---	---	---	Mid Aug. to late Sept.	Late Sept.-late Nov.	---	---
Pink	Late June-mid July	---	---	---	---	---	---	---
Sockeye	---	---	---	---	---	---	---	---

(continued)

Table 8 (continued).

	Upper River (Upstream of Tanana River Drainage)[c]			
Salmon Species	Timing of Migration Into Upper River	Timing of Spawning	Emergence From Gravel	Out-migration
Summer chum	---	---	---	---
Fall chum	Late July-early Aug.[e]	Mid Sept.- late Oct.	---	April-mid May
Chinook	July	Mid to late Aug.	---	Ice breakup - July
Coho	Mid Aug.-early Oct.	---	---	---
Pink	Not found in this portion of the Yukon River drainage			
Sockeye	Not found in this portion of the Yukon River drainage			

Source: ADF&G 1978 and 1984; Barton 1984; Buklis and Barton 1984; Buklis 1983 and pers. comm; Bergstrom, pers. comm.; Wilcock 1985 and pers. comm.

--- means no data were available.

a Tributaries that drain Andreafsky and Kaltag hills; river miles 100 to 600.

b Includes Tanana River drainage and upper Koyukuk; main stem river miles 601 to 695 and tributaries in Tanana and Koyukuk watersheds up to 1,300 mi from mouth of Yukon River.

c The area that drains the Pelly (Romanzof) and Big Salmon mountains; upstream of main stem river mile 700, including tributaries up to 1,800 mi from mouth of Yukon River. (Wilcock 1985).

d Bound for the Tanana River drainage.

e Bound for the Porcupine River and Yukon Territory streams.

Note: Early = 1st to 10th of month; mid = 11th to 20th of month; late = 21st to 30th/31st of month.

Table 9. Escapement Estimates in Numbers of Fish of Summer Chum Salmon in the Yukon River Drainage, 1975-84[a]

River System	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Andreafsky River										
East Fork	223,485	105,347	112,722	127,050	66,471	36,823[b]	81,555[f]	7,501[b,g]	110,608[c]	70,125[c]
West Fork	235,954	118,420	63,120	57,321	43,391	115,457	---	7,267	---	238,565
Total	459,439	223,767	175,842	184,371	109,862	152,280	---	---	---	308,690
Anvik River[e]	845,485	406,166	262,854	251,339	280,537[c]	492,676[c]	1,479,582[c]	444,581[c]	362,912[c]	891,028[c]
Rodo River	25,335	38,258	16,118	17,845	---	---	---	---	---	---
Nulato River										
North Fork[j]	87,280	30,771[b]	58,275	41,659	35,598	11,244[b]	---	---	19,749[i]	---
South Fork	51,215	9,230[b]	11,385	12,821	1,506	3,720[b]	14,348	---	1,263[i]	---
Total	138,495	40,001[b]	69,660	54,480	37,104	14,964	---	---	21,012	---
Gisasa River	56,904	21,342	2,204[b]	9,280[b]	10,962	10,388	---	334[h]	2,356[b]	---
Hogatza River										
Clear Creek	7,610	9,356	6,437	2,716	5,132	12,375	---	4,198	14,051	---
Caribou Creek	14,745	11,388	4,297	2,386	9,089	7,411	---	786	14,090	---
Total	22,355	20,744	10,734	5,102	14,221	19,786	---	4,984	28,141	---
Tozitna River	3,512	725[b]	761	2,262	---	580	---	874	1,604	---
Chena River	2,702[d]	685	610	1,609	1,025	338[b]	3,500[b]	1,509	1,907	1,861
Salcha River	7,573	6,474	677	5,405	3,060	4,140	8,500	3,756	716	9,810

Source: ADF&G 1984, Barton 1984.

--- means no data were available.

a Escapement estimates represent peak counts from aerial surveys, unless otherwise noted.

b Poor survey.

c Sonar estimate.

d Boat survey.

e Best estimate of escapements (combined tower, sonar, aerial, and boat surveys).

f Sonar estimate was 147,312.

g Sonar estimate was 180,078.

h Surveyed late in the season.

i Surveyed early in the season.

j Includes main rivers.

Table 10. Escapement Estimates in Numbers of Fish of Fall Chum Salmon in the Yukon River Drainage, 1975-84[a]

River System	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Upper Toklat River[b]	42,418[c]	35,190	21,800[c]	35,000	96,550[c]	23,054	13,907	3,309[e]	15,105[e]	15,861
Lower Toklat River	35,867[c,d]	2,000[c,d]	---	---	64,540	2,140	---	---	---	---
Upper Tanana River										
Benchmark #735 Slough	---	336	1,270	1,705[c]	2,714	1,900[e]	168[c]	---	---	---
Delta River	3,089[e]	5,498	17,925	10,051	8,125	4,637	22,375[e,n]	3,433[e]	7,230[e]	12,327[e]
South Bank Tanana River[g]	---	4,979	3,797	5,700	20,820	3,444	7,063	---	1,350[c]	2,150
Bluff Cabin Slough	5,000[c,d]	3,197	6,491	5,340	6,875	3,190	6,120	1,156[e]	12,715[e]	4,017[c]
One Mile Slough	745[d]	1,552	1,900	475	3,850[c]	885[c]	632	---	1,115[c]	560[c]
Upper Tanana River total	8,834[k]	15,562	31,383	23,271	42,384	14,056	36,358	4,589[k]	22,410[k]	19,054[k]
Tanana River indices total[d]	87,119[k]	50,752	53,183	58,271	203,474	39,250	50,265	7,898[k]	37,515[k]	34,915[k]
Porcupine River										
Sheenjek River	78,060	11,866	20,506	14,610[c]	41,140	13,027	69,043[i]	29,093[i]	45,733[i]	25,120[i]
Fishing Branch River[h]	353,282[j]	13,450	32,500	15,000	44,080	20,319[c]	10,549[c,k]	5,846	10,000	5,570
Porcupine River indices total	431,342[l]	25,316	53,006	29,610	85,220	33,346	79,592[l]	34,939[l]	55,733[l]	30,690[l]
Yukon River tributaries										
Chandalar River	6,345[c,k]	58[c,k]	4,183	---[f]	---	2,607	4,906[m,k]	1,145[m]	---	---
Kluane River[h]	362[e,f]	20[f]	3,555	0[f]	4,640	3,150	25,806	5,378[e]	8,578[e,k]	7,200
Yukon River (Ft. Selkirk to Carmacks)[h]	7,671	---	---	---	---	---	250[k]	1,020	7,560	2,800

Source: ADF&G 1984, Barton 1984.

--- means no data were available.

a Escapement estimates represent peak counts from aerial surveys, unless otherwise indicated. Survey rating is fair-to-good, unless otherwise noted.

b Includes the areas of Toklat River in vicinity of roadhouse, Shushana River, and Geiger Creek.

c Poor survey; very minimal or rough estimate.

d Combined aerial and ground surveys.

e Foot survey.

f Survey rating not given.

g Richardson Highway Bridge to Blue Creek.

h Yukon Territory stream.

i Sonar estimate.

j Weir count.

k Incomplete survey.

l Figure includes a weir or sonar count - not comparable.

m Fair-to-poor survey.

n Peak count was 10,664 fish.

o Upper and Lower Toklat River counts included in Tanana River index.

Table 11. Escapement Estimates in Numbers of Fish of Chinook Salmon in the Yukon River Drainage, 1975-84

River system	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Andreafsky River										
East Fork	993	818	2,008	2,487	1,180	958[b]	2,146[f]	1,274	2,720[g]	2,473[g]
West Fork	301	643	1,499	1,062	1,134	1,500	231[b]	851	---	1,993
Total	1,294	1,461	3,507	3,549	2,314	2,458	2,377[b]	2,125	2,720[b]	4,466
Anvik River[d]	730	1,154[h]	1,371	1,324	1,484	1,330	807[b]	---	653[b]	641
Nulato River[l]										
North Fork	123	471	286	498	1,093	954	---	---	526	---
South Fork	81	177	201	422	414	369	791	---	480	---
Total	204	648	487	920	1,507	1,323	791[b]	---	1,006	---
Gisasa River	385	332	255	45[b]	484	951	---	421	572	---
Tozitna River	202	42[b]	123	194	---	257	---	51	388	---
Chena River	316[c]	531	563	1,726	1,159	2,541	600[b]	2,073	2,553	501
Salcha River	1,055	1,641	1,202	3,499	4,789	6,757	1,237[b]	2,534	1,961	1,031
Tatchun Creek[i]	175	52	150	200	150	222	133[e]	73	264[e]	161[c]
Little Salmon River[i]	---	---	171	330	489[b]	296[b]	670	403	101[b]	434
Big Salmon River[i]	153[b]	86[b]	316[b]	524	632	1,568	2,411	757	540	1,044
Nusitlin River[i]	363[b]	152[b]	77[b]	484[b]	896[b]	1,852	2,189	779	903	1,178
Whitehorse Dam[j]	313	121	277	725	1,184	1,383	1,539	473	905	977[k]

Source: ADF&G 1984, Barton 1984.

--- means no data were available.

a Escapement estimates represent peak counts from aerial surveys unless otherwise noted.

b Incomplete or poor survey conditions resulting in low counts.

c Boat survey.

d Best escapement estimate from combined tower, sonar, aerial, and boat counts.

e Foot survey.

f Sonar estimate was 5,343.

g Sonar estimate.

h Also include 93 chinook salmon observed in Yellow River.

i Yukon Territory streams.

j Fishway counts.

k An additional 65 chinook salmon were taken for artificial spawning.

Table 12. Escapement Estimates in Numbers of Fish of Coho Salmon in the Yukon River Drainage, 1975-84[a]

River system	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Nenana River										
Lost Slough	943	118	524	350	227	499	274	---	766	2,677
Clear Creek[b]	---	13	---	---	---	---	---	---	---	2,600[b,c]
Wood Creek[b]	---	---	310[c]	300[c]	---	1,603[c]	849[h]	1,436[h]	1,044[h]	8,805[h]
Seventeen Mile Slough	956	281	1,167	466	1,987	592	1,005	---	103	---
Nenana River total	1,899	412	2,001	816	2,214	1,091	2,128	1,436	1,913	14,082
Delta Clearwater River[d]	5,100[e]	1,920[e]	4,793[e]	4,798[e]	8,970[e]	3,946[e]	8,563[e,f]	8,365[e,f]	8,019[e,f]	11,061[e]
Clearwater Lake and Outlet	1,575[d,e]	1,500[d,e]	730[d,e]	570[d,e]	1,015[d,e]	1,545[d,e]	459	---	253	1,368
Richardson Clearwater River	4[g]	80[g]	327	---	372	611	550	---	88	428

Source: ADF&G 1984, Barton 1984.

--- means no data were available.

a Escapement estimates represent peak counts from aerial surveys, unless otherwise noted. Survey rating is fair-to-good, unless otherwise noted.

b Survey by Div. FRED.

c Foot survey.

d Surveyed by Division of Sport Fish.

e Boat survey.

f Population estimate.

g Poor survey.

h Weir count.

Table 13. Escapement Estimates of Pink Salmon in Numbers of Fish in the Yukon River Drainage

Tributaries	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Andreafsky	50,940[a]	16,200	26,870	990	2,100	138,195	1,475	---	---	---
Anvik	---	519	357	249	---	---	---	---	---	---

Source: Barton 1984.

a Includes salmon carcasses.

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Sheefish Distribution and Relative Abundance
Western and Interior Regions

I. REGIONWIDE INFORMATION

A. Regional Distribution

In the Western and Interior regions, sheefish are found in the Kuskokwim and Yukon river drainages. These sheefish can be separated into three groups: the Minto flats and upper Yukon river nonanadromous populations, the lower and middle Yukon River anadromous population, and the Kuskokwim River anadromous population. Sheefish have also been stocked in several Interior Region lakes. The range of each of these populations will be described in the following narrative.

B. Regional Distribution Maps

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 overwintering areas
- Documented rearing areas

These maps are available for review in ADF&G offices of the region or may be purchased from the contract vendor responsible for their reproduction.

C. Factors Affecting Distribution

Alt (1973) discusses factors that may be responsible for the very limited distribution of sheefish in Alaska. Sheefish have such stringent spawning ground requirements that only a few spawning bars are available in all of Alaska's rivers (ibid.). Another factor may be the lack of delta areas for rearing. Interconnected lakes and sloughs and slow-moving deep-water areas of lower rivers are biologically rich and apparently quite important for growth and survival of young sheefish (ibid.). Velocity barriers may also limit the distribution of sheefish. Sheefish will not ascend streams with rapid current or even the slightest falls (ibid.). Sheefish are not generally found in salt water, and saltwater barriers may limit their range expansion into the Seward Penninsula area and from Kotzebue Sound into northwestern Alaska (ibid.).

D. Movements Between Areas

Anadromous sheefish migrate upstream in early spring. Sheefish feed in tributaries and at mouths of clearwater streams during the summer. Spawners then complete their migration to upstream spawning areas in the fall (August through early October). Downstream migration takes place under the ice, with spent fish probably reaching brackish water overwintering areas in mid winter. Fry leave spawning areas during the spring floods and rear in interconnected sloughs and lakes of the lower rivers (Alt 1977, 1981).

Movements of nonanadromous sheefish are not as well understood. It is known that the Minto flats sheefish population overwinters in the lower Tolovana and Tanana rivers, enters the Minto flats area to feed in late May after breakup, and spawns in the Chatanika River (Alt 1977). The Nowitna River sheefish population overwinters in the main Yukon River near the mouth of the Nowitna (Alt 1975) and feeds in the Nowitna River as far as 115 km upstream (ibid.). This population spawns in the Sulukna River, 290 km up from the Nowitna River mouth (Alt 1978). Immature sheefish from the Nowitna population rear in the numerous sloughs and interconnected lakes of the lower Nowitna as well as in the slow-moving waters of the main river (Alt 1979). Nonanadromous sheefish in the Porcupine River probably overwinter either in the lower Porcupine River or in the Yukon River near the Porcupine River mouth (Alt 1972). The Porcupine River population migrates upstream to spawn in the upper Porcupine River in Alaska and Canada (Alt 1972, 1974, 1975).

E. Population Size Estimation

The relative abundance of sheefish in Western and Interior region streams has not been systematically assessed. Estimates of population size are generally based on rough measures of catch-per-unit-effort gathered during stream surveys conducted with gill nets and hook and line. The status of sheefish populations in stocked lakes is also evaluated using gill nets and hook and line.

F. Regional Abundance

Very little information on sheefish abundance is available, and the information that has been collected applies only to specific lakes and streams. As a result, estimates of abundance cannot be appropriately made at the regional level. Abundance information, where available, is contained in the descriptions of each group that follow.

II. KUSKOKWIM RIVER POPULATION DISTRIBUTION AND ABUNDANCE

Alt (1981) summarizes the movements and distribution of sheefish in the Kuskokwim River. In April and May, sheefish migrate up the Kuskokwim River from overwintering areas in brackish water and lakes and sloughs in the lower reaches of the Kuskokwim. Feeding areas in the Kuskowim River include lakes and sloughs of the lower Kuskokwim, the area around the mouths of the Aniak and George rivers, and sections of the Holitna and Tatlawiksuk rivers (ibid.).

The Holitna River system is a major feeding area. Sheefish arrive there in early June, with smaller fish arriving first. Cutbank, 20 mi up the Holitna River, is the major sheefish feeding area (ibid.). The majority of sheefish arrive at Cutbank in late June and July to feed on chum salmon smolt when the chum salmon out-migration is at its peak. Sheefish in this area are mainly immatures and adults that will not spawn in the current year (nonspawners). Sheefish normally leave this area by late July. If water levels are high or if the chum salmon out-migration is of short duration, the sheefish may be found here for only a short time or not at all (ibid.). Other Holitna River feeding areas include the area around the Holitna River mouth where prespawners, nonspawners, and a few immature fish are found in late June and July. Immature sheefish are found in various areas above the islands 1 mi up from the mouth from early June to early July (ibid.). Immature sheefish also feed on chum salmon smolt at river mile six of the Holitna in mid June to early July (ibid.). A few sheefish are found at mile 40 of the Holitna in July, feeding on salmon and lampreys (ibid.). Titnuk Creek, 55 mi up the Holitna, generally has a few small immature sheefish feeding on lampreys and whitefish in the deep hole at its mouth in July (ibid.). In the Hoholitna River, a tributary of the Holitna, there are generally a few sheefish at the fifth bend about 6 mi upstream from the mouth in July and August (ibid.). A few immature and nonspawning sheefish were taken near the mouth of Townsite Creek, tributary to the Hoholitna, in mid September (ibid.). It is not known how long sheefish are found in that area.

Sheefish do not spawn in the Holitna River (Alt 1971, 1972, 1981). In July and August, feeding prespawners move out of the Holitna to the Kuskokwim River and migrate toward upstream spawning areas. Nonspawners and immature sheefish leave the Holitna River by late August and early September to migrate downstream to overwintering grounds (Alt 1981). A few feeding fish are still up the Holitna and Hoholitna rivers as late as early October. It is possible that a few sheefish overwinter in deep holes of the upper and middle Kuskokwim River (ibid.).

The two known spawning areas for Kuskokwim River sheefish are Big River and Highpower Creek (Alt 1981, 1972). It appears that considerably more sheefish spawn at Big River than at Highpower Creek (Alt 1981). Sheefish spawn over a 2 mi stretch of Big River aproximately 40 to 42 mi upstream from the mouth. The best spawning area is probably 2 to 2.5 mi above the last large meandering bend of the river. Sheefish enter Big River from late July through early September and probably arrive at the spawning grounds from early August through early October. Sheefish that spawn in Highpower Creek are on the spawning grounds in late September (ibid.). These sheefish spawn in the lower 200 m of Highpower Creek, mainly in the vicinity of one gravel bar (Alt 1972). The postspawning migration to overwintering areas takes place under the ice, with sheefish present in the vicinity of Bethel by early November (ibid.).

Though formal population estimates are not available, the Kuskokwim River sheefish population is probably quite small (Alt 1981). There has been concern in recent years that commercial and subsistence salmon gill nets on the lower Kuskokwim River have cropped many of the large prespawning sheefish females from the population before they migrate upstream to spawning grounds (ibid.). Area residents have also speculated that people from the village of Telida are depleting the spawning population in lower Highpower Creek (ibid.). Population studies from 1978 through 1980 found that some large (over 25 lb) female sheefish are able to reach the spawning grounds at Big River despite fishing pressure. However, the skewed sex ratio (6 females to 27 males in a sample of sheefish taken in gill nets at the Big River spawning grounds) may indicate that fishing is taking an inordinate number of females from the population (ibid.). Males in this sample of mature fish included seven age classes, ranging from ages 4 to 12. The six females included only four age classes, from ages 8 to 12. The early age at maturity and large number of age classes of males is a healthy sign; but the small number of age classes of females and the late age at maturity in this sample may indicate that the population is in jeopardy (ibid.). Alt (1981) found no evidence of a significant change in the number of sheefish feeding in the Holitna River in 1978-1980 from the numbers he observed in 1967-1971.

III. LOWER AND MIDDLE YUKON RIVER ANADROMOUS SHEEFISH DISTRIBUTION AND ABUNDANCE

The majority of the sheefish in the Yukon River in Alaska belong to a large anadromous population that overwinters in the lower Yukon River and nearby brackish water (Alt 1982). This population spawns in the Koyukuk and Alatna rivers and somewhere in the Yukon River upstream of the Dalton Highway bridge (ibid.).

An early spring upstream migration of sheefish that will spawn in the current year (prespawners) occurs in the main Yukon River near St. Marys during breakup and before the chinook salmon run (Alt 1981). After this main migration, a few prespawners still remain in the lower river and travel upstream slowly as the summer progresses (ibid.). Many lakes, sloughs, and tributaries in the lower river also contain summer populations of immature and nonspawning sheefish (ibid.). A few feeding sheefish are found in the lower reaches of the Andreafsky (Alt 1981), Bonasila, Anvik, and Khotol rivers (Alt 1980).

Feeding sheefish are also found in the Innoko River. Sheefish are found in the lower Innoko River by late May. In the Innoko River, sheefish migrate upstream at least as far as the mouth of the Dishna River and possibly up to Folger Creek (Alt 1983). They also enter the Iditarod River, tributary to the Innoko, but are probably not found in smaller Innoko tributaries (ibid.). Most feeding probably occurs in the Innoko River from the mouth of Red Wing Slough up to the mouth of the Iditarod River and in the lower Iditarod River (ibid.). Feeding areas are scattered, but Shageluk Eddy, the lower Innoko, and the mouths of Holikachuk, Reindeer, and Paimiut sloughs, as well as the bluff 8 mi upstream of Shageluk, are favorite feeding areas (ibid.). Sheefish do not spawn in the Innoko, and by August most prespawners have left to join the upstream spawning migration in the Yukon River (ibid.).

A segment of the Yukon River anadromous sheefish population spawns in the Koyukuk River drainage. The main run of these sheefish enters the Koyukuk River during August and early September (Alt 1979) and spawns during the last days of September and first days of October (Alt 1975). These fish spawn in the Koyukuk River in the vicinity of Hughes (Alt 1968, 1969) and approximately 55 mi up the Alatna River in the vicinity of Siruk Creek (Alt 1970). Sheefish do not travel up the Koyukuk River past Allakaket (Alt 1969). Rearing sheefish have not been found in the Koyukuk River, indicating that rearing and overwintering both take place in the lower Yukon River (Alt 1979).

In 1969, an attempt was made to conduct an aerial survey count of the number of sheefish on the Koyukuk and Alatna river spawning grounds (Alt 1970). A total of 2,615 sheefish were counted; but the count was unreliable, and this enumeration probably represented only a fraction of the total spawning population (ibid.).

Another segment of the Yukon River anadromous sheefish population spawns somewhere in the Yukon River drainage above the Dalton Highway bridge. Sheefish are found at the mouth of the Melozitna River in June and July (Alt 1981). The upstream limit of sheefish in the Melozitna is a deep hole 7 mi upstream (Alt 1984). Sheefish do not spawn in the Melozitna but rather use the lower river for summer feeding before proceeding further up the Yukon River to spawn (ibid.). A few sheefish are also found at the mouth of the Tozitna River (Alt 1981, 1984). These sheefish are also probably part of the Yukon River anadromous population (Alt 1984).

The main body of the Yukon River spawning population migrates past Rampart in September (Alt 1973, 1974, 1975), although some may reach the area above Tanana by late July (Alt 1979). In the Yukon River above the mouth of the Koyukuk River, anadromous sheefish probably intermingle with nonandromous stocks. Sheefish have been found at the mouth of Ray and Dall rivers and Hess Creek immediately after breakup in the spring. Sheefish, however, do not spawn in these tributaries, and those found here are probably members of a nonanadromous population that spawns further up the Yukon River (Alt 1975). Sheefish have also been found in the Hodzana River (Alt 1972) and in Birch Creek and the Nowitna River (Alt 1972, 1978). Nowitna River sheefish are a local population that spawn in the Nowitna (Alt 1978). Sheefish probably also spawn in Birch Creek (Alt 1972).

Spawning grounds for Yukon River anadromous sheefish are probably in the area of Fort Yukon or downstream from there (Alt 1979). The Porcupine River drainage contains populations of nonanadromous sheefish, but few, if any, anadromous sheefish enter the Porcupine River to spawn (Alt 1975, 1978).

IV. NONANADROMOUS SHEEFISH DISTRIBUTION AND ABUNDANCE

Several populations of nonanadromous sheefish are found in the middle and upper Yukon River drainage. In many areas, these sheefish probably intermingle with anadromous sheefish that spawn in the Yukon River drainage somewhere above the Dalton Highway bridge. The Nowitna River supports a nonanadromous population of sheefish that spawn in the Sulukna River, tributary to the Nowitna (Alt 1978). Sheefish are not found in the Nowitna River above the Sulukna River mouth (ibid.). These fish feed in the lower reaches of the Nowitna and probably overwinter in the main Yukon River not far from the mouth of the Nowitna (Alt 1975). Sheefish rear in numerous sloughs and interconnected lakes of the lower Nowitna as well as in slow-moving waters of the main river (Alt 1979).

Nonanadromous sheefish are also found in the Minto flats area. Sheefish probably do not overwinter in Minto flats because Minto flats waters become oxygen deficient in the winter (Alt 1977, Cheney 1972). Sheefish enter Minto flats after breakup in May and feed in the area during the summer (Alt 1969, 1977). The spawning population begins migrating up the Chatanika River in late June (Alt 1968, 1977) and reaches the vicinity of the Elliott Highway bridge in late August and September (Alt 1968, 1977). Spawning occurs in the upper Chatanika River in late September and early October (Alt 1968, 1977). These fish then migrate downstream to overwinter in the lower Tolovana or Tanana rivers (Alt 1968, 1977). Tag returns indicate that not all Minto flats' sheefish spawn above the Elliott Highway bridge (Alt 1969). Most of the population probably spawns farther down the Chatanika (Alt 1969). Log jambs and shallow water make spawning in the Tolovana River unlikely (Alt 1970).

Sheefish are also found in the upper Tanana River. These fish may either be part of the Minto flats spawning population or may constitute separate local populations (Alt 1979, 1980). Sheefish have been found in the lower Tanana in mid May at the mouths of the Cosna, Tolovana, and Chitanana rivers and Baker Creek (Alt 1979) and in June in the Nelson Clearwater River (Nagata 1967). They are also regularly found in the lower Chena River (Alt 1973, 1977), and in 1972 one sheefish was taken from a Tanana River slough between Delta and Tok (Alt 1973).

Some sheefish are found at the mouths of Ray and Dall rivers and Hess Creek immediately after breakup (Alt 1975). These fish are probably members of a local nonanadromous population. During the summer, they move into the lower reaches of these tributaries to feed, but they are absent from these areas by early October (Alt 1975). The spawning portion of these fish probably leaves the tributary mouths and travels up the Yukon River to spawn (ibid.). Sheefish have also been taken from Birch Creek and the Hodzana River (Alt 1972). Sheefish have been found in upper Birch Creek near the Steese Highway in the fall and probably spawn there (ibid.). Immature sheefish have been taken in the lower 4 km of the Chandalar River (Alt 1978), and mature and immature sheefish have been taken from the main Yukon River and sloughs of the Yukon River near Beaver (ibid.). It is not known whether these are part of the Yukon River anadromous population or local nonanadromous stocks. One sheefish tagged at the mouth of Hess Creek in 1974 was captured in 1977 in the Black River (tributary to the Porcupine River), indicating that some of the sheefish found at the mouths of middle Yukon tributaries during the summer may be of Black River origin (Alt 1978).

Nonanadromous sheefish are known to spawn in the upper Porcupine River and in the Salmon Fork of the Black River (Alt 1974, 1978). Sheefish also rear and overwinter in the Porcupine River (Alt 1975), but they have not been found in the Sheenjek River or the Coleen River (Alt 1974). The Black River population of Porcupine River sheefish spawns in the Salmon Fork of the Black River near Kevinjik Creek (Alt 1978). Prespawners have been observed in the vicinity of the spawning grounds as early as late August. Low catches in gill nets indicate that this is not a large population (ibid.). Overwintering areas for these fish are probably in deeper holes of the slow-moving Black River (ibid.). Mature and immature sheefish are taken by residents of Chalkytsik (125 km up the Black River) immediately after breakup in May (ibid.).

In the upper Yukon, sheefish are found at least in the mouths of all tributary rivers (Alt 1973). The spawning grounds of these sheefish have not been located, but age 0 and age 1 sheefish have been taken in the delta areas at the mouths of the Charley, Kandik, Nation, Tatonduk, and Seventymile rivers, indicating that spawning probably occurs in the lower reaches of these five rivers (Alt 1971, 1979). These sheefish probably overwinter in the upper Yukon vicinity (Alt 1971). Limited survey information indicates that the spawning population of these upper Yukon sheefish is quite small (ibid.).

V. ENHANCEMENT

Sheefish have been stocked in many lakes in the Fairbanks area in an effort to provide diverse fishing opportunities for area residents (table 1). The stocking program has been hampered by the difficulties involved in obtaining ripe eggs from a species that spawns in remote areas of Alaska while ice is forming on the rivers. Hatching and rearing sheefish to fingerling size have also met with limited success until recent years (Alt 1980).

Sheefish stocked in lakes that do not contain populations of forage fish grow well during the first years of life, but after three to four years their growth slows (ibid.). Sheefish stocked in lakes containing rainbow trout, grayling, or coho salmon, however, also may not grow well because of competition for food (Alt 1978, 1979, 1980). Sheefish have survived and grown for several years in some lakes, and in Four Mile Lake near Tok a naturally reproducing population has been established (Alt 1980, 1984).

Table 1. Water Bodies in the Interior Region Stocked With Sheefish, 1968-84

Water Body	Community	Years Stocked
Birch Lake[a]	Birch Lake	1974
Bullwinkle Lake	Delta Junction	1984
Chatanika River	Chatanika	1985
Clear Pond	Clear	1970,72,73,77
Craig Lake	Johnson River	1981,84
Donnelly Dome Pond[b]	Delta Junction	1977
Earthmover Pit	Clear	1984
Eielson Cooling Pond	Eielson AFB	1977,78,79,81
Engineer Hill Lake	Eielson AFB	1970
Four Mile Lake	Tetlin	1968,69,84
Ft. WW Cooling Pond	Ft. Wainwright	1977,81
Grayling Lake	Eielson AFB	1984
Gull Lake	Ft. Greely	1981
Harding Lake	Aurora Lodge	1982,84
Island Lake	Delta Junction	1979
Lakeview Pond	Fairbanks	1981
Lost Lake	Big Delta	1973,84
Manchu Lake	Ft. Wainwright	1978,81
Mile 1239 Lake	Northway	1969
Mile 1242 Lake	Northway	1969
Nenana Pond	Nenana	1984
North Pond	Ft. Greely	1977
Sansing Lake	Clear	1977
Siver Fox Pit	Aurora Lodge	1969,81,84
South Pond	Ft. Greely	1977
Texas #2 Lake	Ft. Greely	1981
Walden Pond[b]	Chena Hot Springs	1978,79
Weigh Station Pond	Fairbanks	1981,84
White Alice #1 Lake	Anderson	1981
White Alice #2 Lake	Anderson	1981

Sources: ADF&G 1984, 1985; Alt 1971, 1973, 1975, 1978, 1979.

a Seventeen fingerlings transferred from Lost Lake.

b Transferred from Eielson Cooling Pond.

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Marine Fish

Pacific Halibut Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

Relative to the southern Bering Sea and northern Pacific Ocean, the eastern Bering Sea has had a history of limited distribution and abundance of halibut. The halibut population in the eastern Bering Sea was drastically reduced by overharvest in 1962 and 1963 (NPFMC 1984). Since the mid 1960's, the halibut stocks have recovered to some extent, but the Western Region has not supported a substantial commercial fishery. (See the Halibut Commercial Harvest narrative in this volume for a description of management area boundaries and more information on the fishery in the region.)

II. REGIONAL DISTRIBUTION

Pacific halibut are found throughout the marine waters of the Western Region. Their distribution is seasonal and is directly related to bottom temperatures (St.-Pierre 1984), as discussed below.

III. AREAS USED SEASONALLY AND FOR LIFE FUNCTIONS

Halibut typically occupy water of 3 to 8°C, and their seasonal distributions are influenced by changing water temperatures (Thompson and Van Cleve 1936). In the shallow, shelf area of the Bering Sea, water temperatures drop to 0°C or lower during winter, while the surface is covered with ice. At this time, both young and adult halibut concentrate in the deeper, warmer waters along the outer edge of the continental shelf (up to 1,100 m) (St.-Pierre 1984). Adults are known to spawn between October and March in these areas in depths ranging from 220 to 450 m (St.-Pierre 1984, Terry et al. 1980). During the spring and early summer, however, the bottom temperatures rise in the shallow shelf zone, and halibut move into this area (50 to 150 m depths) (Gusey 1979). The shallow coastal zone provides a suitable nursery environment for young halibut and feeding grounds for the larger juveniles and adults (Best 1981). Adults are found as far north as St. Lawrence Island in a sparse distribution during the summer and early fall, while young halibut (2 to 4 years) are abundant further south in the Bering Sea (Gusey 1979, Dunlop et al. 1964). Most of the fish have been located at depths from 25 to 150 m (Best, pers. comm.) during this time, but some individuals occupy depths from 90 to 400 m (Pereyra et al. 1977).

A series of halibut distributions maps at 1:1,000,000 scale has been produced for this report and is found in the Reference Map Atlas for the Western and Interior regions. The categories of mapped information are as follows:

- Winter distribution - December through April
- Spring distribution - May and June
- Summer/fall distribution - July through September

IV. FACTORS AFFECTING DISTRIBUTION

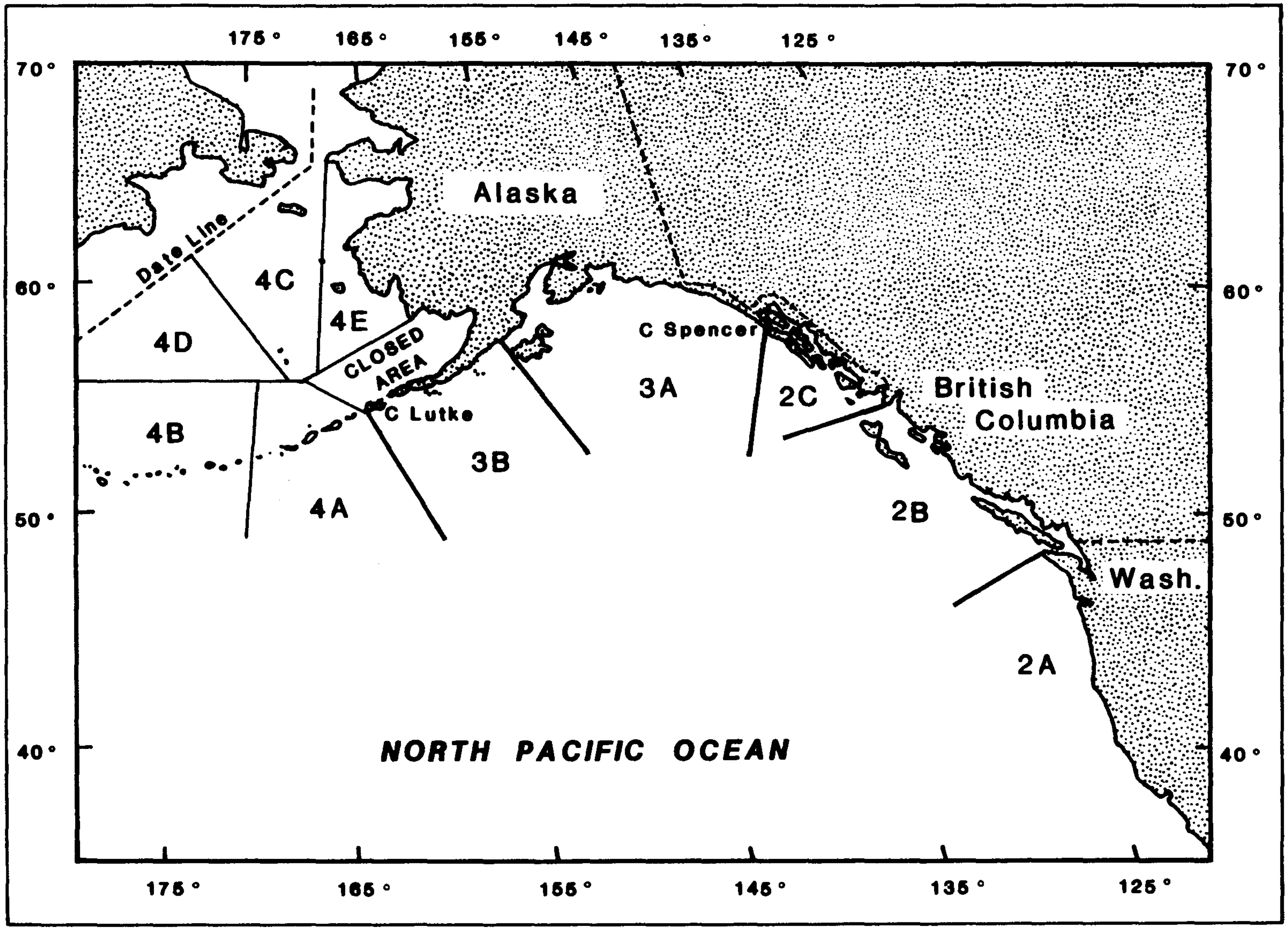
Water temperature is an important factor determining halibut distribution. The cooling of bottom temperatures in winter on the shallow continental shelf causes halibut to concentrate in the deeper, warmer waters along the edge of the shelf. Halibut are known to spawn throughout the winter in these areas. The summer movement into shallower water is associated with rising temperatures and increased feeding (St.-Pierre 1984). (For more details refer to the Pacific halibut Life History and Habitat Requirements narrative in volume 1 of this report).

V. MOVEMENTS BETWEEN AREAS

All life history stages of the halibut are associated with movements between the deep waters (300 to 1,100 m) off the edge of the continental shelf, and the shallow shelf waters. Populations tend to concentrate in the deeper, warmer waters (approximately 3-4°C) (Rigby, pers. comm.) during winter and for the duration of spawning. Eggs, larvae, and postlarvae are pelagic at depths down to 686 m and are carried by westward ocean currents for great distances (Gusey 1979). In spring and summer, populations of young and adult halibut migrate and disperse into the shallower coastal waters. Extensive tagging studies have been conducted by the IPHC in an effort to define halibut movements. Results document that a high proportion of adults are tagged in the Bering Sea and recovered in the Gulf of Alaska, but no recoveries of adults released in the Gulf of Alaska have been made in the Bering Sea (Bell 1981). Ocean currents and the halibut life cycle suggest that some of the young in the shallow areas of the Bering Sea are probably produced from spawning south of the Alaska Peninsula (Dunlop et al. 1964). The pelagic eggs and larvae produced by eastern Bering Sea spawners probably remain in the Bering Sea and may be carried to the Asian Coast (Best 1981).

VI. POPULATION SIZE ESTIMATION

In the past, halibut stock assessment methods relied heavily on trends in catch, effort, and catch per unit effort (CPUE) data. Also data from age composition, tagging studies and juvenile surveys have been examined. However, changes in gear and methods of fishing since 1981 made it more difficult to compute a standardized CPUE for stock assessment. Catchability has varied, probably in relation to these gear changes as well as other factors, in recent years (IPHC 1984a). Alternatively, in 1976, the IPHC began using cohort analysis in halibut stock assessment, providing estimates independent of CPUE and effort data (IPHC 1977). In 1983, population estimates, in the form of biomass and annual surplus production estimates, were made for individual halibut regulatory areas (map 1) (ibid.). The Western Region is encompassed by regulatory area sections 4C, 4D and 4E, but population estimates are available only for the combined area 4. Sections 4C, 4D, and 4E comprise only a small proportion of the major halibut populations present in all of area 4. Biomass estimates were also determined in 1983, using a migratory catch-age analysis, in an



Map 1. Regulatory areas for the Pacific halibut fishery (IPHC 1985).

effort to reduce the negative effect of CPUE on estimates. Annual surplus production, the sum of catch and change of biomass in each regulatory area, is calculated for each regulatory area (ibid.). Sensitivity analyses of this method of population estimation indicate it is not as reliable as a total population estimate for all regulatory areas (ibid.).

VII. REGIONAL ABUNDANCE

Estimated halibut biomass for area 4 during the period 1967-1983 has averaged about 15 million pounds. Estimated total surplus production, including incidental losses, in 1983 was 3.4 million pounds in Area 4 (IPHC 1984a). Biomass estimates for the years 1980 - 1983 indicate a very gradual population increase is now occurring in Area 4 (ibid.).

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Pacific Herring Distribution and Abundance
Western Region

I. REGIONWIDE INFORMATION

Pacific herring are found throughout the Western Region. The Western Region is divided into five districts for management of the commercial herring fishery: Cape Romanzof, Nunivak Island, Nelson Island, Goodnews Bay, and Security Cove. The boundaries of these districts are mapped in the herring Human Use narrative in this volume. The boundaries have changed in response to improved knowledge of the stocks and development of the fishery (Francisco, pers. comm.). Distribution and abundance information specific to the districts is presented following the regional information.

A. Regional Distribution

The greatest abundance of spawning herring in the eastern Bering Sea occurs in the Bristol Bay area. Smaller concentrations occur to the north in the Western Region (Wespestad and Barton 1981). Generally, sexual maturity is attained at an earlier age in the southern Bering Sea than in northern areas (Barton and Steinhoff 1980). The mean length for each age class progressively decreases northward from Togiak to Norton Sound (Lebida et al. 1985).

Herring spawn on many different substrates within the region but were usually observed spawning intertidally in areas with rocky outcroppings along cliffs or bluffs on _Fucus_ (Barton et al. 1977). Herring spawn in shallow mud or sand bays on eelgrass, ryegrass, or sedge (ibid.). Under dense spawning conditions, herring spawning was also seen on _Laminaria_, bare rocks, gill nets, and subtidally to depths of 5 m.

B. Areas Used Seasonally and for Life Functions

A series of herring distribution maps has been produced for the Western Regional guide. The categories mapped are 1) known spawning areas at 1:250,000 scale, 2) known summer concentrations at 1:1,000,000 scale, 3) known fall concentrations at 1:1,000,000 scale, and 4) known overwintering areas at 1:1,000,000 scale.

C. Factors Affecting Distribution

In the Bering Sea, temperature may have the greatest influence on the seasonal distribution of herring (Wespestad and Barton 1981). Herring are found in a wide range of depths and salinities. More detailed information appears in the herring Life History and Habitat Requirements narrative in volume 1 of this report.

D. Movements Between Areas

Herring schools usually appear in nearshore areas early in the spring, almost immediately following ice breakup, and migration and spawning proceed in a northward direction along the coast (Barton et al. 1977). Herring apparently remain in coastal waters after spawning. Concentrations begin reappearing in offshore waters around Nunivak Island in August (Wespestad and Barton

1981). The distribution of herring between the time they leave the spawning grounds and the time they reappear in offshore waters is unknown. Concentration on the winter grounds begins in October and continues into winter.

A major herring wintering area occurs northwest of the Pribilof Islands, in deep water along the continental shelf break (ibid.). Mature fish arrive at the wintering area before immature fish. In mild winters, herring concentrate farther north and west, and in severe winters they move south and east (ibid.). Dense schools are found during the day near the bottom at depths from 105 to 137 m and at water temperatures of from 2 to 3.5°C. Diurnal migrations occur in early winter, and as the season progresses movements diminish and herring remain on the bottom during the day and slightly off bottom at night (ibid.).

E. Population Size Estimation

Herring biomass is estimated through aerial survey observations and then adjusted for the presence of nonherring pelagic fish species (Lebida et al. 1984). Test fishing with variable-mesh gill nets is used to estimate age composition and the occurrence and relative abundance of other schooling fishes. Surface areas of herring schools are calculated by aerial surveys and then are multiplied by a tonnage conversion factor to estimate the total biomass. The ADF&G uses a relative abundance index (RAI) as the standardized unit of surface area of herring schools. One RAI unit is the equivalent of a fish school with a surface area of 50 m^2. Conversion factors are used for different depths of water to convert school surface areas to biomass (ibid.). These conversion factors are obtained from capturing schools of known area and depth and are adjusted as more data are obtained each year (Fransisco, pers. comm.). The results of estimates from aerial surveys can be biased by visibility and the presence of other species of schooling fish, such as capelin, smelt, and sand lance.

F. Regional Abundance

The 1984 spawning biomass of herring in the eastern Bering Sea was estimated to be 155,100 metric tons (Lebida et al. 1984). Of this total biomass, 67% occurred in the Togiak District of the Southwest Region and 14% occurred in the Norton Sound District of the Arctic Region. The remainder of the biomass was distributed as follows: 3% in the Security Cove District, 2% in the Goodnews Bay District, 6% in the Nelson Island area, 4% in the Nunivak Island area, and 4% in the Cape Romanzof District (ibid.). More detailed information on herring biomass follows in the management area sections.

II. GOODNEWS BAY AND SECURITY COVE DISTRICTS

A map of this area and a description of the boundaries are provided in the herring Human Use narrative in this volume.

A. Distribution

The arrival of herring in the Security Cove and Goodnews Bay districts usually occurs from early to mid May (ADF&G 1985a). Spawning herring are usually present until June. Most of the herring spawn subtidally in areas from the north shore of Cape Newenham to Chagvan Bay and in portions of Goodnews Bay (ibid.). The dominant spawning substrate is eelgrass in shallow subtidal areas (Barton and Steinhoff 1980). Ice-scouring has occurred in Goodnews Bay, with the abrasive action of winter sea ice destroying eelgrass beds.

B. Abundance

In both the Security Cove and Goodnews Bay districts, ages 6 and 7 herring represented over 70% of the spawning biomass in 1984 (Lebida et al. 1984). Age 4 herring comprised about 1% of the population. Biomass estimates of spawning herring from aerial surveys are available from 1978 through 1984 (table 1). In Security Cove, the herring biomass ranged from 19,500 metric tons in 1979 to 1,100 metric tons in 1980. In Goodnews Bay, the highest estimates occurred in 1979, with 6,700 metric tons, and the lowest in 1980, with 1,100 metric tons.

III. NUNIVAK ISLAND AND NELSON ISLAND DISTRICTS

A map of this area and a description of the boundaries are provided in the herring Human Use narrative in this volume.

A. Distribution

The arrival of herring in the Nunivak and Nelson islands area occurs from early May to early June, depending on ice and weather conditions (ADF&G 1985b). Peak spawning probably occurs one to two weeks after that of the Togiak District and is similar to that of the Cape Romanzof District (ibid.). Spawning grounds are still being identified at Nunivak Island but appear to be widespread (Francisco, pers. comm.). _Fucus_ is the dominant vegetation in the intertidal zone at Nelson Island. Heaviest herring spawn on Nelson Island occurs north of Cape Vancouver on Chinit Point, where the _Fucus_ is most abundant (Barton and Steinhoff 1980). However, herring spawn is found about equally distributed over _Fucus_ and bare rocks in the area.

B. Abundance

The ADF&G has not conducted test fishing in the Nunivak Island area. Test fishing within the Nelson Island area was conducted during 1978, 1980, and 1981 (ADF&G 1985b). In the Nelson and Nunivak islands area, ages 6 and 7 herring comprised 78% of the subsistence catch in 1984 (Lebida et al. 1984). Biomass estimates of spawning herring from aerial surveys are available from 1978 through 1984 for Nelson Island and for several of those years for Nunivak Island (table 1). Herring biomass at Nelson Island has ranged from 3,600 metric tons in 1981 to 10,000 metric tons in 1984. The spawning biomass at Nunivak Island was estimated at over 6,000 metric tons in 1983 and 1984.

Table 1. Biomass Estimates of Herring from the Western Region

Year	Biomass (metric tons)[a]				
	Security Cove	Goodnews Bay	Nelson Island	Nunivak Island	Cape Romanzof
1978	1,200	400	5,400	731	2,700
1979	19,500	6,700[b]	5,400[b]	---	2,700[b]
1980	1,100	1,100[b]	5,400[b]	---	2,700[b]
1981	7,500	3,900	3,600	17	4,400[c]
1982	4,600[b]	2,400[b]	3,600[b]	---	4,400[c]
1983	5,800	2,900	6,600	6,900	5,000
1984	4,600	3,700	10,000	6,074	5,500

Source: Lebida et al. 1984.

--- means no data were available.

a Biomass estimates were calculated from aerial surveys and analysis of data from test fishing and were adjusted for the presence of nonherring pelagic species.

b Incomplete data due to inclement weather and/or turbid waters; the biomass estimates are questionable and are based on 1978, 1979, or 1981 data.

c No aerial surveys were made; the 1981 estimate was based upon the assumption that the commercial harvest represented 15% of the total biomass; the 1981 estimate was used for 1982.

IV. CAPE ROMANZOF DISTRICT

A map of this area and a description of the boundaries are provided in the herring Human Use narrative in this volume.

A. Distribution

A spawning population of herring occurs at Cape Romanzof, and spawning may occur from mid May to late June (Geiger, pers. comm.). *Fucus* is the dominant intertidal vegetation, and spring storms may uproot beds of *Fucus*, destroying spawning habitat. In addition to the loss of herring spawn from the destruction of substrate, intertidal egg loss was observed from the desiccation of eggs and *Fucus* (Barton and Steinhoff 1980). Mortality of spawn in the area has also been attributed to melting snowbanks, which create an influx of cold, fresh water onto intertidal spawn. Spawning is primarily intertidal, and coastal observations have shown that spawn survival in this region is low (ibid.).

B. Abundance

In the Cape Romanzof area, ages 6 and 7 herring comprised over 60%, and age 4 herring comprised less than 1% of the population in 1984 (Lebida et al. 1984). Biomass estimates of spawning herring are available from 1970 through 1984 (table 1). Herring biomass has ranged from 2,700 metric tons in 1978-1980 to 5,000 metric tons in 1983 and 1984.

Biomass has been estimated by aerial surveys when possible; however, poor weather conditions and turbid water have often made aerial survey estimates unreliable. Quantitative spawn deposition surveys were begun in 1981, and the methodology has improved annually. The size of spawning stocks is estimated by calculating abundance from total spawn deposition on intertidal spawning grounds (Whitmore 1983). Spawn deposition surveys may be used to estimate stock size as the methods improve.

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Saffron Cod Distribution and Abundance
Arctic and Western Regions

I. REGIONWIDE INFORMATION

Saffron cod (Eleginus gracilis Tilesius) occur throughout the Arctic and Western regions and are known to be locally abundant in Norton and Kotzebue sounds and adjacent sections of the northern Bering and southeastern Chukchi seas (Wolotira et al. 1979). In these areas, saffron cod are utilized for subsistence needs by local residents of the nearby coastal villages. There is basically no commercial harvest of saffron cod; thus management areas and plans are nonexistent for this species. In 1983, one local fisherman from Nome caught and sold 2,548 lb (4,348 fish) of saffron cod. During 1980, one fisherman harvested 89 lb (98 fish) of saffron cod and sold them to residents in Nome. These fish, along with other subsistence harvests, are typically used for dog food, crab bait, and human consumption (ADF&G 1983). The potential for a saffron cod commercial fishery exists in the Norton Sound area, but present marketing conditions are undetermined, and interest by local residents appears low (ibid.). Wolotira (1985) reviewed and analyzed resource information from trawl surveys conducted in 1976, 1979, and 1982 and discussed the commercial potential of the resource.

II. REGIONAL DISTRIBUTION

Saffron cod are distributed throughout the nearshore coastal zone of the Arctic and Western regions (Andriyashev 1954, Craig and Haldorson 1981, Morrow 1980). The northern Bering Sea is the center of distribution for the saffron cod; specifically, Norton and Kotzebue sounds are the primary areas of abundance (Wolotira et al. 1979).

III. AREAS USED SEASONALLY AND FOR LIFE FUNCTIONS

A saffron cod distribution map has been produced for this report. The category mapped is general distribution at 1:1,000,000 scale.

IV. FACTORS AFFECTING DISTRIBUTION

Physical factors such as temperature, salinity, and the availability of habitat probably affect distribution of saffron cod. Ecological factors such as competition for food and space may also affect distribution. (For more details, see the saffron cod Life History and Habitat Requirements narrative in volume 1 of this publication.)

V. MOVEMENTS BETWEEN AREAS

Saffron cod are thought to make seasonal movements in relation to depth and distance offshore. Information that is presently available, however, indicates varying degrees of this movement, by sample location and time of sampling. Generally, saffron cod reside in the coastal zone, coming close to shore to spawn under the ice in fall and winter in river mouths, bays, and inlets; then adults move into deeper water (30-60 m) in spring and summer to feed (Morrow 1980, Svetovidov 1948, Andriyashev 1954). In the Bering and Chukchi seas, bottom trawl samples detected large concentrations of saffron cod in the nearshore zone (0-30 m) from September through October and failed to find significant numbers of saffron cod in the deeper waters (greater than 30 m) at that time (Wolotira et al. 1979, Lowry et al. 1983). (For more details on movements of saffron cod, see the Life History and Habitat Requirements narrative in volume 1 of this report.)

VI. POPULATION SIZE ESTIMATION

Demersal trawl studies have been conducted in the eastern Bering Sea, Norton Sound, and the southeastern Chukchi Sea by the National Marine Fisheries Service (NMFS) in 1976, 1979, and 1982 to determine the distribution, abundance, and population characteristics of saffron cod (Wolotira 1985). To date, these are the only studies known to have accomplished an intensive evaluation of the saffron cod resource in Western and Arctic Alaska.

The assumptions made for demersal trawl surveys point to the limitations of data interpretation. It is assumed that trawl samples are representative of the density and composition of the animals in the sample area and that the trawl equipment performs consistently between stations. Also, it is assumed that populations remain static: i.e., that no shifts in abundance occur within the survey area and that no animals move in and out of the survey area (Wolotira et al. 1979). However, it is known that trawls, like most fishing gear, are selective in relation to mesh size and dimensions of the net. Also trawling is limited to sampling of smooth substrates, and animals encountered over rough and/or rocky bottoms are not adequately sampled (ibid.). Thus trawl samples represent an "apparent" distribution and relative abundance that are a function of the vulnerability and accessibility of a species to the gear. In most cases, the vulnerability and accessibility are unknown (ibid.).

VII. REGIONAL ABUNDANCE

Large concentrations of saffron cod were documented from trawl survey data collected in 1976 and 1979 by the NMFS in the northeastern Bering Sea from Norton Sound to Cape Newenham and west to the 50 m depth contour. From the 1976 survey results, the Norton Sound resource was estimated at 750 million fish, with an associated biomass of 16,500 metric tons (table 1) (Wolotira 1985). From 1979 survey data, the Norton Sound population appeared to have decreased to 630 million fish, although the apparent biomass had increased to 50,000 metric tons (ibid.). The Bering Sea, from Norton Sound south to Cape Newenham, was also surveyed in 1979, and an estimate of 1.5 billion fish, with an associated biomass of 60,000 metric tons, was made (table 1) (Wolotira 1985).

The difference in population size and biomass in Norton Sound observed in the 1976 and 1979 data are apparently related to the size and age composition of the stock. In 1976, approximately 66% of all saffron cod collected in Norton Sound were less than 12 cm in length. In 1979, less than 5% of the estimated population in Norton Sound was smaller

Table 1. Estimated Biomass and Population Size of the Saffron Cod Resource In Norton Sound and the Northeastern Bering Sea[a]

Year of Survey(s)	Region Surveyed	Area Surveyed (Km^2)	Estimated Biomass (95% Confidence Interval (Metric Tons)	Estimated Population Size (95% Confidence Interval x 10^6)
1976	Norton Sound	41,444	16,570 (12,393-20,747)	757.71 (578.91-936.51)
1979	Norton Sound	57,471	50,621 (35,825-65,417)	632.99 (507.94-758.03)
1979	Nearshore from Kuskokwim Delta to Norton Sound	168,575	58,291 (38,378-78,204)	1,460.30 (753.58-2,167.08)

Source: Wolotira 1985.

a Information derived from 1976 and 1979 trawl surveys of the NMFS.

than 13 cm (ibid.). Wolotira (1985) interpreted that data from the two surveys indicate a strong variation in year-class strengths. He noted that the 1976 year class was numerically dominant, and by 1979 it still comprised a large portion of the population (five times more abundant than three-year-olds in the 1976 population).

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Yellowfin Sole Distribution and Abundance
Western Region

I. REGIONAL DISTRIBUTION

Yellowfin sole occur throughout the Western Region along the continental shelf and slope waters from depths of 5 to 360 m (Bakkala 1981). In the summer, yellowfin sole are distributed in waters of less than 100 m from the Alaska Peninsula to as far north as Norton Sound (Bakkala et al. 1982). Main concentrations of yellowfin sole in the Western Region are limited to waters south of Nunivak Island during the summer (ibid.).

Spawning of yellowfin sole occurs from July through September. Densities of eggs indicate that a major spawning area is located south and southeast of Nunivak Island in depths from 15 to 75 m (ibid.). Kashkina (1965) noted a concentration of eggs between Nunivak Island and St. Lawrence Island at depths of 20 to 45 m.

II. AREAS USED SEASONALLY AND FOR LIFE FUNCTIONS

A yellowfin sole distribution map at 1:1,000,000 scale has been produced for the Western Regional guide. The categories mapped are 1) known summer distribution, 2) known summer concentration areas, and 3) known spawning concentration areas.

III. FACTORS AFFECTING DISTRIBUTION

Water temperatures may influence the seasonal movements and distribution of yellowfin sole. Offshore movements in fall and winter may be a response to the colder bottom water temperatures in nearshore areas. Summer distributions from year to year may differ with the changing temperatures of the bottom water (Bakkala 1981). The extent of ice cover may influence the inshore migration, inasmuch as yellowfin sole follow the receding ice edge (ibid.). More detailed information appears in the yellowfin sole Life History and Habitat Requirements narrative in volume 1 of this report.

IV. MOVEMENTS BETWEEN AREAS

Yellowfin sole migrate from waters of the outer shelf of the eastern Bering Sea, which they occupy during winter and early spring, to central and inner shelf regions in summer (Bakkala et al. 1982). The migrations to deeper water in winter may be a response to low bottom water temperatures and to the advance of ice that covers large shallower portions of the eastern Bering Sea in winter and spring (Bakkala 1981, Bakkala et al. 1982). During winter, ice covers much of the waters of the Western Region, and yellowfin sole are found in deeper water to the south and west.

Yellowfin sole form two large northern and southern wintering concentrations in the eastern Bering Sea, and these two concentrations have different migration routes. The largest concentration winters near

Unimak Island and summers in the Southwest Region. The second largest is located west of St. Paul Island (Bakkala 1981) and probably migrates inshore between St. Paul and St. Matthew islands, forming summer concentrations near Nunivak Island (ibid.). The independent movements of these two wintering concentrations have led to speculation about the existence of two separate spawning stocks. Research indicates that the biochemical genetic variations in yellowfin sole from the northern and southern areas are not significantly different (Grant et al. 1981), and the population is assumed to consist of a single stock.

V. POPULATION SIZE ESTIMATION

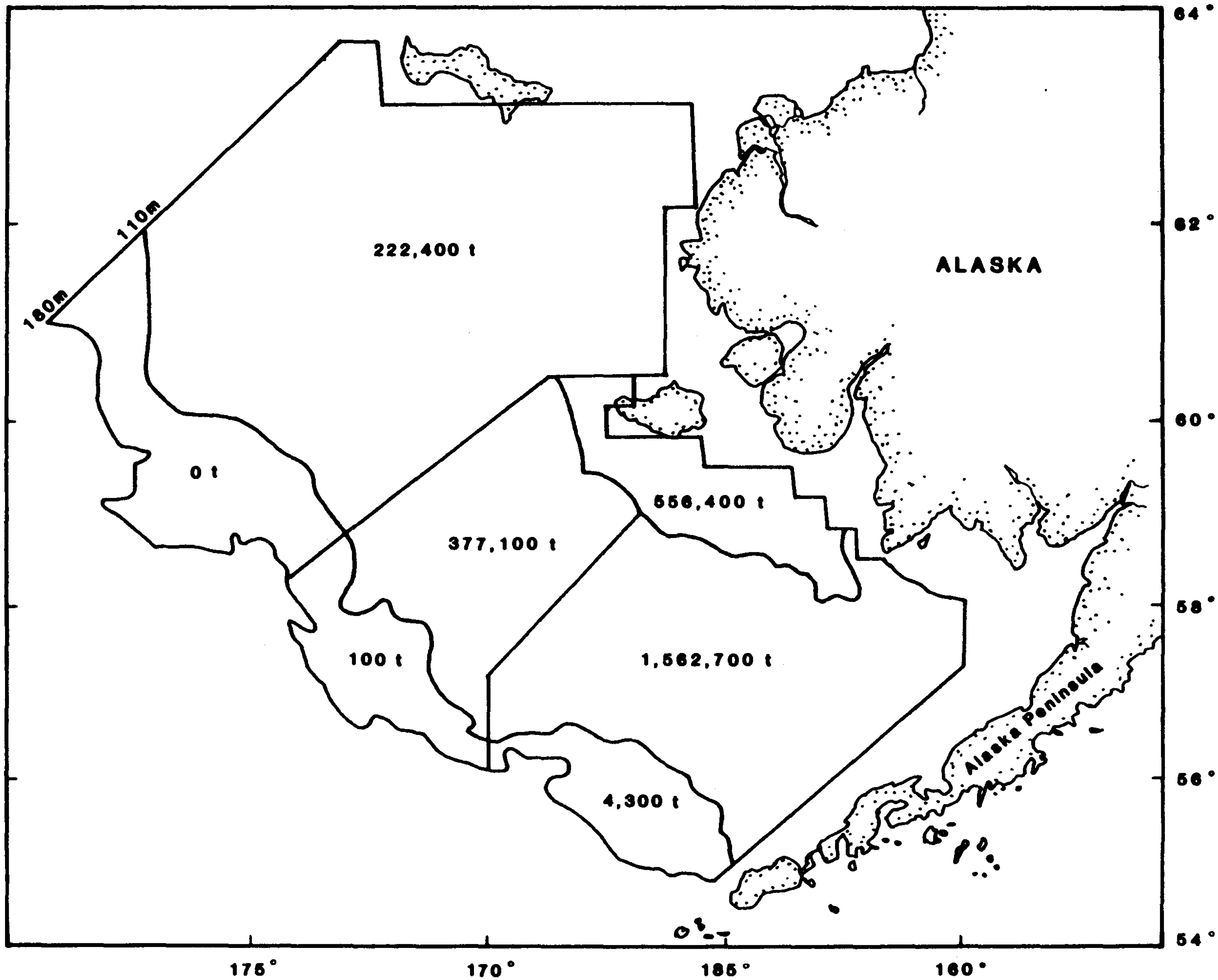
The National Marine Fisheries Service (NMFS) has estimated the population size of yellowfin sole. The two sources of information used by the NMFS to analyze trends in relative abundance are pair-trawl data from the Japanese commercial fishery and bottom-trawl survey data from the Northwest and Alaska Fisheries Center resource assessment surveys (Bakkala and Wespestad 1984). The catch-per-unit-effort data obtained from the bottom-trawl surveys may be biased by the gear type and size and how well the gear maintains bottom contact. Biomass estimates were derived using the area swept method, where fish encountered in the area sampled are assumed to be representative of the entire area.

VI. REGIONAL ABUNDANCE

The biomass of yellowfin sole from the entire eastern Bering Sea and Aleutian Islands area, which includes the Western Region, was estimated to be 3.95 million metric tons in 1983 (ibid.). An area around Nunivak Island, which includes the nearshore waters of the Western Region shallower than 40 m, accounted for approximately 500,000 metric tons of yellowfin sole in 1982 (Bakkala et al. 1985). Bakkala et al. (1985) report biomass estimates for yellowfin sole for several subareas of the Western Region (map 1). Biomass is lower in the area between Nunivak and St. Lawrence islands and declines in offshore areas deeper than 110 m.

Intense foreign fishing lowered the abundance of yellowfin sole from 1959 through 1962, and the population remained at a low level until the early 1970's (Bakkala et al. 1982). Since the 1970's, the biomass of the stock has increased. The primary reason for this increase has been the recruitment to the population of a series of strong age classes originating in 1966 through 1970 (ibid.). A new series of strong year classes, from 1973 through 1976, has also entered the population (ibid.).

In addition to biomass estimates, estimates of maximum sustainable yield (MSY) and equilibrium yield (EY), used in managing the population, may be helpful in understanding the status of the yellowfin sole stock. The MSY is the largest average catch that can be taken from a stock over a period of years. The concept of MSY is applicable to a long-lived species such as yellowfin sole, in which variations in biomass are buffered by the presence of many year classes in the fishery (NPFMC 1979). The EY is the maximum annual or seasonal harvest that will maintain the stock at the same level of abundance in



Map 1. Yellowfin sole biomass estimates in metric tons (t) by subarea from 1982 bottom trawl surveys (Bakkala et al. 1985).

succeeding years. The EY differs from the MSY because the sustainable level of abundance is usually less than the maximum. The MSY for the Bering Sea and Aleutian Islands area is estimated to be 150,000-175,000 metric tons (NPFMC 1984). The Bering Sea and Aleutian Islands yellowfin sole population is considered to be in good condition, and the EY is estimated to be 310,000 metric tons (ibid.).

Water temperatures in the eastern Bering Sea may affect the year-class strength of yellowfin sole (Bakkala 1981). Year classes originating in the years when June bottom water temperatures ranged from 2 to 4.5°C were stronger than those originating in years when bottom temperatures were near 1°C (ibid.).

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Shellfish

King Crab Distribution and Abundance
Arctic and Western Regions

I. REGIONWIDE INFORMATION

King crabs are found throughout the Western Region and in the Arctic Region as far north as Kotzebue Sound. The Northern District of the Bering Sea Statistical Area (Area Q) includes waters of both the Arctic and Western regions for management of the species. In 1984, the Northern District was divided into three sections: Norton Sound Section, St. Matthew Island Section, and St. Lawrence Island Section. Prior to 1984, the St. Matthew Island and St. Lawrence Island sections were combined in the General Section. The boundaries of these management areas are mapped in the king crab Human Use narrative in this volume. Distribution and abundance information in this report will be presented for two areas: the Norton Sound Section, and the combined St. Matthew-St. Lawrence islands sections.

A. Regional Distribution

Two species of king crab are commonly found in the Western and Arctic regions, with red king crab (Paralithodes camtschatica) being the most common. The distribution of red king crab covers much of the eastern Bering Sea and is generally associated with the continental land mass. A concentration of red king crabs occurs in Norton Sound (Otto 1981). Blue king crab (P. platypus) tends to be associated with the offshore areas near St. Lawrence and St. Matthew islands (ibid.). The Norton Sound red king crabs are considered to be a separate stock from those in the southeastern Bering Sea, and the blue king crabs of the Pribilof and St. Matthew islands are also separate stocks (ibid.).

Brown king crabs (Lithodes aequispina) are found in the eastern Bering Sea along the continental shelf break in deeper waters (ibid.). National Marine Fisheries Service (NMFS) trawl surveys have not sampled this species in waters shallower than 128 m. No estimates of brown king crab abundance are available; therefore, brown king crab will not be discussed in this report.

B. Areas Used Seasonally and for Life Functions

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

- General distribution
- Known concentrations of females
- Known concentrations of males

C. Factors Affecting Distribution

Many factors affect the distribution of king crabs, including temperature, salinity, and substrate. In NMFS surveys, red king crabs were not found in the Bering and Chukchi seas, where deeper and colder waters occurred. The distribution of blue king crabs in the same area was associated with depths over 25 m and bottom temperatures less than 4°C (Wolotira et al. 1977). (See the king crab Life History and Habitat Requirements narrative for more details.)

D. Movements Between Areas

General information on king crab migration is discussed in the Life History and Habitat Requirements narrative. The ADF&G has conducted tagging studies of male red king crabs in Norton Sound during the summer commercial fishing season. Tagged crabs released south of Nome were found to move southwesterly as the season progressed (Powell et al. 1983). Sublegal males free for one year were recaptured 19 to 37 km south or west from their point of release. Legal size males free for one year showed more random movement, and most were recaptured within 28 km. Winter tagging studies conducted in nearshore waters south of Nome indicate that crabs found in nearshore waters during the winter and spring migrate offshore during the summer (ADF&G 1983a).

E. Population Size Estimation

The NMFS has conducted otter trawl surveys to estimate the population size and biomass of king crabs in the Western and Arctic regions. Catches from standardized trawls are used to calculate population size, using the area-swept technique, which assumes that the trawl obtained samples that represented the density and diversity of species in the sampled area and that the trawl's performance was constant from station to station (Wolotira et al. 1977). The ADF&G has also conducted research pot fishing in this area. Catches from pot fishing have been analyzed in conjunction with tag and recovery data utilizing the Peterson mark-recapture formula to obtain estimates of population size (Powell et al. 1983).

F. Regional Abundance

Detailed abundance information for king crab follows in the Norton Sound and St. Matthew-St. Lawrence islands sections.

II. NORTON SOUND SECTION

A map of this area and a description of boundaries are provided in the king crab Human Use narrative.

A. Distribution

Blue king crabs are only rarely found in Norton Sound or Kotzebue Sound, and trace amounts have been sampled in the southeastern Chukchi Sea (Wolotira et al. 1977; Schwarz, pers. comm.). Red king crabs are concentrated in Norton Sound, with the highest catch rates in trawl surveys occurring in outer Norton Sound and low catches in inner Norton Sound. Only trace amounts of red king crab were sampled farther north in Kotzebue Sound (ibid.). The Norton Sound red king crabs are the northernmost stocks fished commercially. Exploratory commercial fishing north of Norton Sound, near the Diomede Islands, Kotzebue Sound, and off Point Hope found few red king crabs (Powell et al. 1983).

Within Norton Sound, postrecruit male crabs were distributed over a large area southeast of Sledge Island, whereas smaller males were found northeast of this area, with intermingling occurring along the borders (ibid.). Female crabs were usually found northeast of the schools of males. Concentrations of females in Norton Sound have been found south of Cape Nome, off the northern coast east of Nome, in the mouth of Norton Bay, west of Stuart Island, and in the shallow 18 m Egavik trench (ibid.).

Knowledge of king crab distribution in Norton Sound has come from research and commercial fishing, which usually occurs from late June through early October. The distribution of crabs during the rest of the year is poorly understood.

B. Abundance

Six different research surveys, conducted in Norton Sound in 1976, 1979, 1980, 1981, and 1982, provided data from which estimates of the population of legal-size male red king crabs were made. Sampling was done by the NMFS with trawls in 1976, 1979, and 1982 and by the ADF&G with pots in 1980, 1981, and 1982. Estimates of population in 1977 and 1978 were made using the 1976 and 1979 trawl data, the size of crabs in the 1977 and 1978 commercial catches, and assumptions about molting, growth, recruitment, and mortality (Powell et al. 1983). The initial trawl estimate for 1979 was increased by the amount of the commercial harvest, because the survey occurred after the commercial harvest (ibid.). The initial 1980 estimate was also changed when it was discovered that inaccurate catch statistics had been reported (ibid.). The current best estimates of the legal male red king crab population for Norton Sound during the period 1976 through 1982 have ranged from 3.7 million crabs in 1977 and 1978 to .4 million in 1982 (table 1).

In 1976, when monitoring of the Norton Sound king crab population first began, the population was mainly composed of sublegal and recruit crabs (ADF&G 1983b). The legal male population peaked in 1978. Recruitment was low after 1978, and the population declined to a record low in 1982. Beginning in 1981, the numbers of sublegal crabs began to increase, and by 1983 recruitment into the legal male population also began to increase (ibid.). Winter pot surveys conducted near Nome in 1983 found that nearshore abundance of crabs was greater than in the past several years (ADF&G 1983a).

III. SAINT MATTHEW-SAINT LAWRENCE ISLANDS SECTIONS

Prior to 1984, the St. Matthew Island and the St. Lawrence Island sections were combined and called the General Section. A map of this area and a description of boundaries are provided in the king crab Human Use narrative.

A. Distribution

Red king crab stocks outside the Norton Sound section are widely and sparsely distributed (ADF&G 1983c). Small red king crab commercial catches have been reported south of Cape Romanzof, around Nunivak Island, and west of Cape Newenham (ADF&G 1980).

Blue king crabs have localized distributions, occurring in concentrations around the St. Matthew and St. Lawrence islands areas. The St. Lawrence Island crabs occur in concentrations southwest of Port Clarence and south of the Bering Strait (Wolotira et al.

Table 1. Population Estimates of the Legal Size Male Red King Crab Population in Norton Sound

Year	Number of Crabs (Millions)	Pounds of Crab[a] (Millions)
1976	3.1	8.1
1977	3.7	10.0
1978	3.7	11.0
1979	3.0 (1.8)[b]	9.0 (5.4)[b]
1980	1.9 (3.9)[c]	6.6 (13.4)[c]
1981	1.3	4.7
1982	.4[d]	1.3[d]
1983		1.6[e] (2.6)[f]

Source: Powell et al. 1983.

a Prior to commercial harvest.

b Initial trawl survey estimate made after commercial harvest.

c Initial estimates based on inaccurate catch statistics.

d Postseason estimate (ADF&G 1983a).

e ADF&G pot survey estimate (ADF&G 1983b).

f NMFS trawl survey estimate (ADF&G 1983b).

1977). Small research and commercial catches of blue king crabs have been reported around St. Lawrence Island and all the way to the USA-USSR convention line toward the Chukotsk Peninsula (Wolotira et al. 1977, ADF&G 1980). It is likely that the stocks extend westward across the convention line, but the extent of this westward distribution is unknown (Wolotira et al. 1977).
Concentrations of blue king crabs occur around the St. Matthew Island area (Otto et al. 1984a). Overall distributions within this area do not vary much from year to year. Most crabs were sampled at depths of 35 to 110 m at bottom temperatures from -1.0 to 3.0°C (ibid.). Legal-size males and prerecruits have been sampled south and west of the island, mainly at depths from 55 to 75 m (Otto et al. 1984b).

B. Abundance

Reliable estimates of the St. Lawrence Island blue king crab stocks are not available. Information from NMFS trawl surveys and commercial fishing indicates that the stocks are stable, with a wide distribution in sparse concentrations (ADF&G 1981). Population estimates of blue king crab in the St. Matthew Island area have been made from NMFS trawl surveys. The total number of crabs during the period 1978 through 1984 has ranged from 13.7 million in 1982 to 4.3 million in 1984 (table 2). The populations were highest in 1982 and have been declining since then. From 1983 to 1984 the populations declined by over 50%, and continued declines in recruitment are expected in 1985 (Otto et al. 1984a).

Table 2. Annual Abundance Estimates in Millions of Crabs for St. Matthew Island Blue King Crabs from NMFS Surveys

	Males		Females		Total Number of Males and Females
	Less Than 119 mm[a]	Greater Than 119 mm[a]	Less Than 80 mm[a]	Greater Than 80 mm[a]	
1978	8.0	1.8	0.8	0.4	11.0
1979	7.2	2.2	1.7	0.9	12.0
1980	5.6	2.5	0.8	2.2	11.1
1981	3.0	3.1	0.0	0.5	6.8
1982	5.8	6.8	0.4	0.7	13.7
1983	3.4	3.5	0.2	2.4	9.6
1984	2.0	1.6	0.2	0.5	4.3

Source: Otto et al. 1984a.

a Carapace length; categories reflect small average size of blue king crabs in the area; 80 mm is the median size at maturity for females.

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Shrimp Regional Overview
Western Region

I. INTRODUCTION

Pink shrimp (Pandalus borealis) and humpy shrimp (P. goniurus) are the more abundant shrimp species inhabiting Bering Sea waters within the Western Region. Japanese and Soviet fishing fleets exploited these shrimp populations during the 1960's and early 1970's. Continued depressed stock condition, however, has prevented a directed commercial fishery by either domestic or foreign fishermen in recent years.

II. DISTRIBUTION AND ABUNDANCE

A. Distribution

Surveys performed by the NMFS have found pink shrimp (Pandalus borealis) to occur northwest of the Pribilof Islands and in Bristol Bay. Pink shrimp appear to be dispersed over much of the continental shelf at mid depths (USDC 1979). This species appears to require relatively warmer water temperature than other shrimp species and has been found near the continental shelf edge, where there are intrusions of warmer water. Humpy shrimp (P. goniurus) also occurs in the Bering Sea (and Western Region) and has comprised a large share of the shrimp catch from the Gulf of Anadyr and along the Koryan coast of the western Bering Sea. Humpy shrimp tolerate sustained low temperatures and therefore have been found in shallower shelf waters, where a residual water covering depresses water temperatures (Morris 1981, Balsiger 1979). Coonstripe shrimp (P. hypsinotus) and sidestripe shrimp (Pandalopsis dispar) are also found in the Bering Sea. Documentation of the distribution of coonstripe shrimp has been mostly restricted to Herendeen Bay on the north side of the Alaska Peninsula and Norton Sound. Sidestripe shrimp distribution overlaps with the distribution of pink shrimp. Sidestripe shrimp are found along the shelf edge, primarily following the 100-m isobath (Anderson, pers. comm.).

B. Abundance

Currently, shrimp stocks in the eastern Bering Sea are very depressed from historic abundance levels, even though significant commercial exploitation of shrimp in the Bering Sea has not occurred since the mid 1960's (Morris 1981, Balsiger 1979).

III. MANAGEMENT HISTORY AND REPORTED USE

A. Boundaries

The ADF&G shrimp Statistical Area J, or the Westward Registration Area, includes all Pacific Ocean waters south of the latitude of Cape Douglas (58°52'N), west of the longitude of Cape Fairfield (148°50'W), east of 172°E, and seaward to the 300-fathom (549-m) depth contour, and all Bering Sea waters east of 172° east longitude (ADF&G 1985). Within Bering Sea waters of Statistical Area J are found the North Peninsula and Aleutian districts (map 1). The Western Region addressed in this narrative shares borders with both of these districts; however, because distribution of shrimp extends beyond the boundaries of the Western Region, the following discussion reflects fishing activity involving shrimp in the Bering Sea north of Cape Sarichef. (For information regarding shrimp harvest south of Cape Sarichef and the south side of the Alaska Peninsula, see volume 2 of the Alaska Habitat Management Guide for the Southwest Region.)

B. Harvest Summary

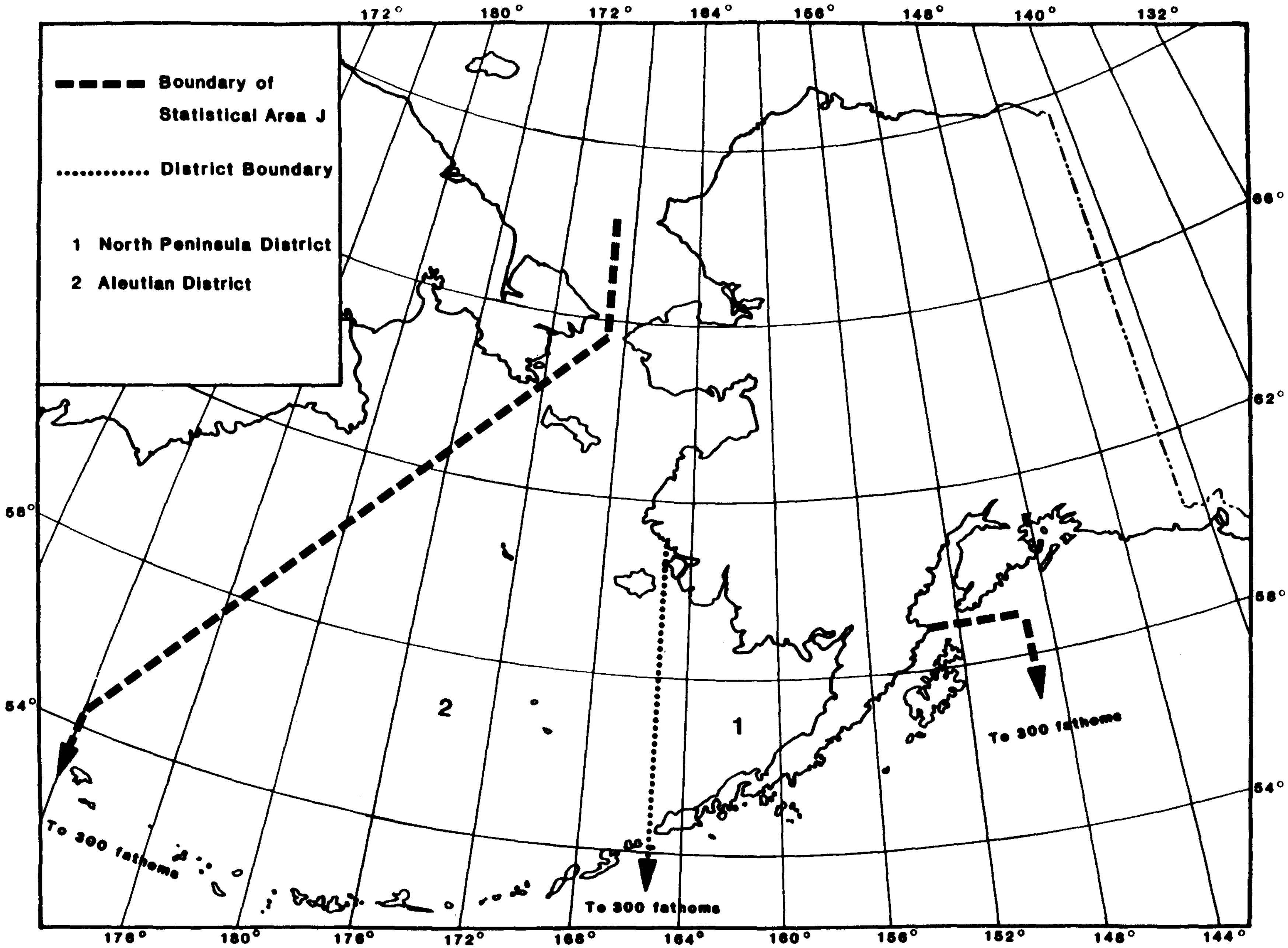
Based on commercial harvest activity, the presence of pink shrimp has been documented in waters northwest of the Pribilof Islands and within the Bristol Bay area. The Bering Sea supports good shrimp habitat, shallow water, and substrate conducive to trawling. Directed fishing pressure upon both pink and humpy shrimp in the eastern Bering Sea was by foreign fleets and was short-lived (USDC 1979).

Japanese fishermen began the exploitation of shrimp in the eastern Bering Sea during the 1960 season incidentally to a fishery directed upon yellowfin sole. Effort grew from 16 trawlers and one factoryship in 1961 to 38 trawlers and three factoryships in 1963. Peak harvest of 29,536 metric tons occurred during the 1963 season (table 1). Most of the harvest was taken from waters near the Pribilof Islands. The Japanese catch declined rapidly, finally ending by the 1977 season (ibid.).

During the late 1960's, Japanese shrimping operations gradually moved north into Soviet waters. The fishery was centered in the Gulf of Anadyr and achieved catches up to almost 13,000 metric tons. By 1972, catches had dropped considerably. The fleet then moved to Cape Navarin and into the northcentral Bering Sea along the United States-USSR convention line of 1867 and eastward along the Bering Sea shelf (ibid.). The 1975 and 1976 seasons marked the end of the Bering Sea shrimp trawl fishery, with the exception of 613 metric tons that were harvested by Japan in the months of January and February of 1977 prior to initiation of the FCMA (ibid.).

Participation in the eastern Bering Sea shrimp fishery by the Soviet Union was minimal. Six factoryships arrived on the grounds in 1963 and operated for one month. The Soviet fleet moved their operation from the Bering Sea to the Gulf of Alaska near Kodiak Island the following year. Information regarding the Soviet fishery is unavailable (ibid.). The fishery continued through 1973, with activity primarily focusing on the Kodiak and Shumagin islands area (ibid.).

With the exception of one delivery of 20.5 metric tons taken from the Pribilof Island area in 1978, there has been no directed fishing pressure upon pink shrimp by domestic fishing fleets (ibid.).



Map 1. Shrimp commercial fishing districts of the Bering Sea in Statistical Area J (ADF&G 1985).

Table 1. Commercial Harvest of Shrimp in Metric Tons by Foreign Fishermen in the Eastern Bering Sea, 1960-77

	Catch	
Year	Japan	USSR
1960	680	0
1961	14,117	0
1962	18,387	0
1963	29,536	---
1964	20,880	0
1965	9,765	0
1966	2,935	0
1967	3,302	0
1968	12,736	0
1969	9,506	0
1970	6,156	---
1971	2,855	---
1972	222	---
1973	155	---
1974	103	0
1975	3,557	0
1976	2,203	0
1977	613	0

Source: USDC 1979.

--- means no data were available.

IV. MANAGEMENT OBJECTIVES AND CONSIDERATIONS

Usually, marine fisheries occurring within 3 mi of shore are managed by the State of Alaska and from 3 to 200 mi by the U.S. Department of Commerce, National Marine Fisheries Service. Currently, shrimp occurring within the 200-mi limit in the Bering Sea are managed under provisions of the Preliminary Fishery Management Plan. The plan prohibits foreign fishing but allows domestic harvest under established guidelines (Anderson, pers. comm.).

A directed fishery for shrimp in the eastern Bering Sea has not occurred since 1977. During the late 1960's and early 1970's, some shrimp stocks were exploited in the Gulf of Anadyr off of the Soviet coast and in the northcentral area of the Bering Sea. Shrimp fisheries in the eastern Bering Sea were not regulated until 1977. With implementation of the Fisheries Conservation and Management Act, prohibitions were placed on retention of shrimp by any nation other than the United States within the United States jurisdictional waters in the Bering Sea.

Currently, shrimp populations in the Bering Sea are low in abundance. There is no directed commercial or domestic exploitation upon these populations at this time (Morris 1981). Incidental catches of sidestripe and pink shrimp, however, are sometimes found in the Japanese pollock fishery. The catch is not documented and the magnitude of this incidental harvest is unknown (Anderson, pers. comm.).

V. PERIOD OF USE AND HARVEST METHODS

A directed fishery for shrimp in the Bering Sea has not occurred since the 1970's. No specific quotas or fishing seasons have been established for the domestic shrimp fishery in the Bering Sea (USDC 1979).

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Tanner Crab Regional Overview
Arctic and Western Regions

I. INTRODUCTION

Statistical Area J, or the Westward Registration area, includes all Pacific Ocean waters south of the latitude of Cape Douglas (58°52'N), west of the longitude of Cape Fairfield (148°50'W), east of 172° east longitude, and shoreward of the 400-fathom (732-m) depth contour, and all Bering Sea waters east of 172° east longitude. Area J is divided into the Kodiak, South Peninsula, Eastern Aleutians, Western Aleutians, Bering Sea, and Chignik districts (ADF&G 1984). With the exception of the Northern Subdistrict of the Bering Sea District, information regarding Tanner crab fisheries in Statistical Area J has been presented in volume 2 of the Alaska Habitat Management Guide for the Southwest Region.

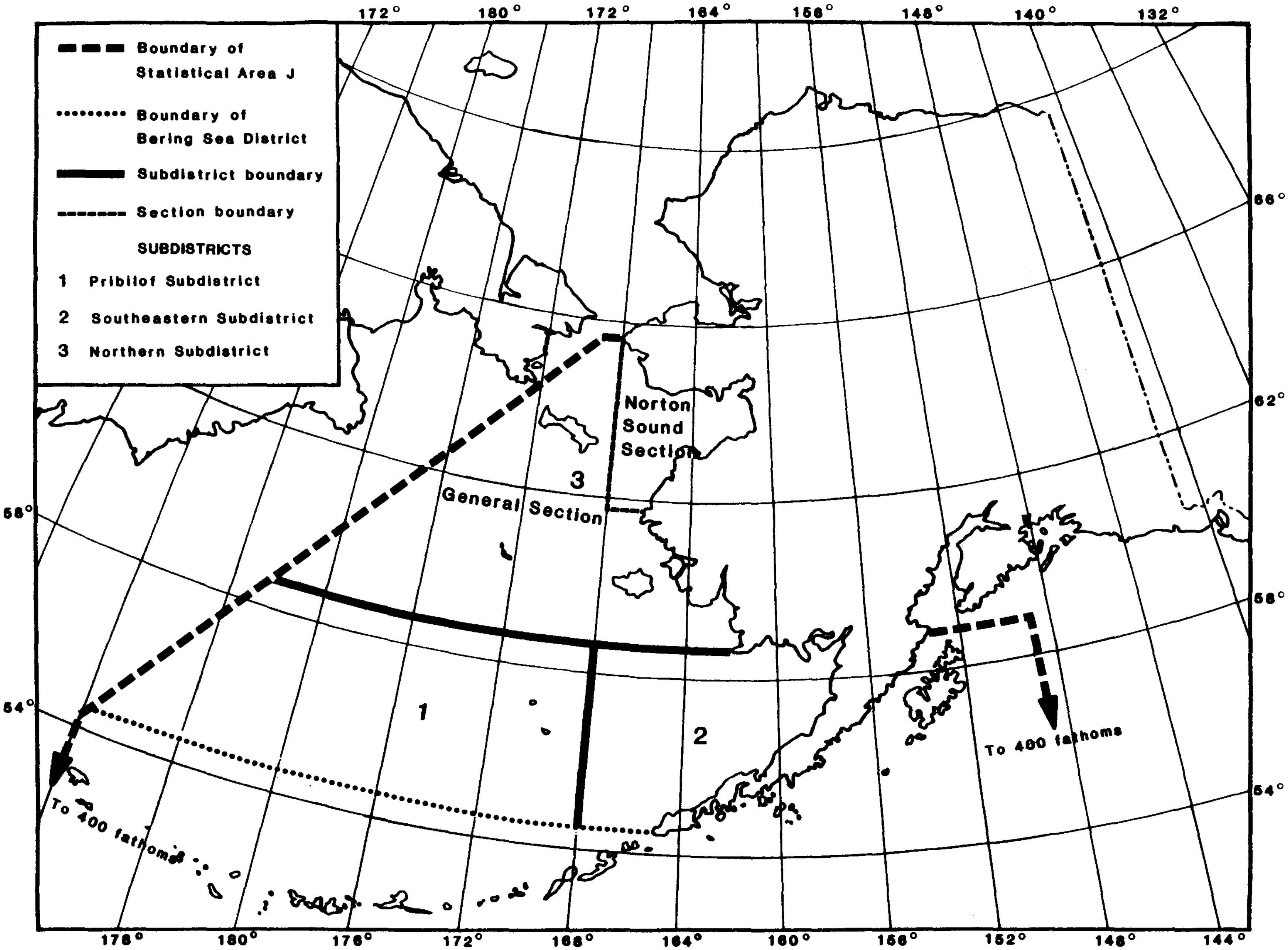
The Bering Sea District consists of all Bering Sea waters of Statistical Area J north of 54°36' north latitude. The Southeastern, Pribilof, and Northern subdistricts are contained within the Bering Sea District (map 1). Only the Northern Subdistrict occurs within the boundaries of the Arctic and Western resource management regions addressed in this volume.

The Norton Sound Section of the Northern Subdistrict includes all waters of the Bering Sea east of 168° west longitude and north of the latitude of Cape Romanzof. The General Section consists of all waters of the Northern Subdistrict not included in the Norton Sound Section (ibid.). Information presented in the following narrative will encompass the marine area covered by the Northern Subdistrict, which corresponds to that area represented by the combined Arctic and Western regions.

II. DISTRIBUTION AND ABUNDANCE

Two species of Tanner crab are commercially harvested in the Bering Sea. Distribution of Chionoecetes bairdi, the larger of the two species, is strongly associated with the coast of the Alaska Peninsula, continental slope areas, and the Pribilof Islands (Otto 1981). Recent trawl surveys have located C. bairdi in a broad band extending from inner Bristol Bay westward along the outer continental shelf edge to 178° west longitude (Otto et al. 1984b). The second Tanner crab species, C. opilio, occurs from the Bering Strait south to Unimak Island, with the exception of the northern or eastern shores of Bristol Bay and immediately south of Nunivak Island (Otto 1981, Otto et al. 1984b). A hybrid of these two species is also present, occurring within the zone of C. bairdi and C. opilio (Otto et al. 1984b).

Trawl surveys for Tanner crab in the Bering Sea are performed by the NMFS to obtain abundance estimates and information regarding reproductive condition, size, and distribution of male and female crabs.



Map 1. Tanner crab fishing subdistricts and sections of the Bering Sea District in Statistical Area J (ADF&G 1984).

Not only is the distribution of *C. opilio* in the Bering Sea extensive, but population size is immense, exceeding that of *C. bairdi*. Within this area, there are geographic clines in average size and in reproductive parameters. Clines are gradual and continuous and therefore are not indicative of separate stocks. The entire Bering Sea population of *C. opilio* is managed as one stock (Otto et al. 1984b, Otto 1981). Specifically, in the Northern Subdistrict total population estimates (male and female combined) peaked in 1979 at 22,832.4 million crabs and dropped gradually to 1,910.7 million crabs (table 1) during the 1984 survey (Otto et al. 1984b). The total population estimate for *C. bairdi* in the Northern Subdistrict has ranged from a high abundance of 358.3 million crabs in 1982 to a low of 29.0 million crabs (table 1) in 1984 (ibid.).

III. MANAGEMENT HISTORY AND REPORTED USE

Foreign and domestic crab fleets were originally attracted to the southeastern Bering Sea by the availability of the larger and more valuable red king crab (*Paralithodes camtschatica*). With development of markets and processing techniques, Tanner crab became a targeted species (Somerton 1981).

Between 1953 and 1964, Japanese and Soviet fleets caught Tanner crabs usually as an incidental catch of the king crab and groundfish trawl fisheries. Available data, though limited, indicate that annual production, at least by the Japanese mothership fleet, during this time was probably fewer than 1,000,000 Tanner crabs per year (Otto 1981).

In 1964, when the Soviet and Japanese king crab fisheries were at their peak, negotiations began between the United States, Japan, and the USSR. These negotiations restricted foreign harvest quotas of king crab and encouraged exploitation of Tanner crab as a substitute species. The initial fishery targeted exclusively on *C. bairdi* because of its larger size.

In 1965, approximately 1.7 million Tanner crabs were taken by Soviet and Japanese fleets. The fishery expanded rapidly during the following years, and in 1968 the United States entered the Tanner crab fishery, although fishing remained incidental to king crabbing until 1974 (Otto 1981).

By 1969, the direct harvest of *C. bairdi* increased to the level where foreign fishing quotas appeared necessary. As a result of restrictions imposed by the United States, foreign vessels began directing their effort toward *C. opilio* (Armstrong et al. n.d.).

As total landings of Tanner crab from the eastern Bering Sea increased (from 12 to 24 million crabs from 1967 to 1970), so did American interest in the fishery. Consequently, through a series of bilateral agreements and United States harvest quotas, foreign participation in the eastern Bering Sea Tanner crab fishery was gradually reduced and forced to fish areas to the north and west (ibid.). Foreign catches declined in 1971 and again in 1972, when the USSR left the fishery (Otto 1981).

In 1974, a directed United States Tanner crab fishery began, with the target species *C. bairdi* (ADF&G 1982). The fishery was, and continues

Table 1. Annual Abundance Estimates (Millions of Crabs) for Tanner Crabs in the Northern District from NMFS Surveys

C. bairdi

Size[a]	Males: Less Than 85	Males: 85-129	Males: Greater Than 129	Males: Total	Females: Less Than 85	Females: Greater Than 84	Females: Total	Grand Total
1978	66.0	7.5	0.6	74.1	121.2	7.8	129.0	203.1
1979	26.7	3.8	0.1	30.6	48.0	3.5	51.5	82.1
1980	44.0	0.3	0.1	54.4	100.3	9.3	109.6	164.1
1981	23.3	24.4	0.4	48.1	51.1	3.9	55.0	103.1
1982	12.6	39.4	2.6	54.5	288.4	15.4	303.8	358.3
1983	17.3	15.7	0.8	33.8	53.0	2.2	55.1	89.0
1984	6.7	8.0	0.3	15.0	13.0	1.0	14.0	29.0

C. opilio

Size[a]	Males: Less Than 110	Males: Greater Than 109	Males: Total	Females: Less Than 65	Females: Greater Than 64	Females: Total	Grand Total
1978	1,344.6	10.6	1,355.2	1,464.4	29.7	1,494.2	2,849.3
1979[b]	10,213.0	6.5	10,219.5	12,563.0	49.9	12,612.9	22,832.4
1980	1,989.4	4.2	1,993.6	2,966.5	46.0	3,012.5	5,006.0
1981	934.4	6.5	940.9	1,137.4	46.9	1,184.4	2,125.3
1982	1,292.2	10.9	1,303.1	1,036.2	96.9	1,133.1	2,436.2
1983	1,274.0	9.2	1,283.2	1,161.6	15.3	1,176.9	2,460.0
1984	1,030.1	20.0	1,050.0	854.8	5.9	860.7	1,910.7

C. bairdi - *C. opilio*

Size[a]	Males: Less Than 110	Males: Greater Than 109	Males: Total	Females: Less Than 65	Females: Greater Than 64	Females: Total	Grand Total
1978	0.6	0.1	0.7	0.3	0.7	1.0	1.7
1979	1.1	0.4	1.5	2.0	1.6	3.6	5.1
1980	1.3	0.7	2.0	4.6	10.9	15.6	17.6
1981[c]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	1.3	0.1	1.4	12.0	50.1	62.1	63.6
1983	0.4	0.0	0.4	0.8	3.7	4.5	4.9
1984	4.3	0.0	4.3	7.4	0.4	7.8	12.1

Source: Otto et al. 1984.

a Carapace width (mm).

b Survey estimates of the smallest size groups in 1979 are not comparable to other years because of large differences in area coverage.

c All estimates less than 0.05 in 1981.

to be, conducted north of the Alaska Peninsula and near the Pribilof Islands (Otto 1981). After the directed United States fishery began, *C. bairdi* catches grew from 2,300 metric tons in 1974 to 10,100 metric tons in 1976 and peaked at 30,030 metric tons in 1978 (ibid.). With a decline in *C. bairdi* abundance, United States vessels moved north and began catching *C. opilio* (Somerton 1981). Landings of *C. opilio* exceeded those of *C. bairdi* by almost three million pounds during the period 1980 through 1982, although *C. opilio* continues to command a considerably lower ex-vessel price (Armstrong et al. n.d.). In 1981, because of increased United States participation in the *C. opilio* fishery, foreign fishing was eliminated (Somerton 1981). Today, all Tanner crab fishing in the southeastern Bering Sea (except for incidental catch) is conducted aboard American vessels and is directed at both *C. bairdi* and *C. opilio* (Armstrong et al. n.d.).
Prior to the 1982-1983 fishery, commercial exploitation of Tanner crab occurred primarily in the Southeastern and Pribilof subdistricts of the Bering Sea. The fishery harvested about 26.1 million pounds of *C. opilio* during the 1982-1983 fishery, increasing to 26.8 million pounds during the 1983-1984 fishery. During the 1982-1983 fishery, 1.4 million pounds of the total *C opilio* harvest was taken in the Northern District. The Northern District catch increased to 3.1 million pounds during the 1983-1984 fishery (Griffin, pers. comm.). The harvest of *C. bairdi* in the Northern District was incidental to that of *C. opilio*, reaching .048 million pounds during the 1982-1983 season (ADF&G 1985). Declining catches of *C. bairdi* in the Southeastern and Pribilof subdistricts of the Bering Sea has resulted in effort directed toward *C. opilio* (Otto et al. 1984a). The total harvest of Tanner crab (*C. bairdi* and *C. opilio*) in the Bering Sea for the 1982-1983 and 1983-1984 seasons averaged 4.0 million pounds per year. Of this average, about 89% of the harvest was *C. opilio* (Griffin, pers. comm.). *C. opilio* from the Northern subdistrict accounted for about 8.5% of the total Bering Sea *C. opilio* harvest during the 1982-1983 and 1983-1984 seasons (ADF&G 1985).

IV. MANAGEMENT OBJECTIVES AND CONSIDERATIONS

The Tanner crab fishery within 3 mi of the shoreline is managed by the State of Alaska and the 3 to 200-mi area by the NMFS. Management is directed by a policy jointly developed by the Alaska Board of Fisheries and the North Pacific Management Council. Because Tanner crab distribution is not restricted by state/federal jurisdictional boundaries, problems can arise when state and federal policies conflict. Regulations, though nonexistent during the first two years of the Tanner crab fishery, have since evolved to accomplish the following objectives:

1. To maximize yield from harvestable surpluses. This is to be accomplished by season and gear restrictions to increase meat yield per individual crab and reduce mortality on sublegal crabs.
2. To maximize the reproductive potential of the Tanner crab stocks. This is to be accomplished by a) imposing seasons, gear restriction, size, and sex limits, and harvest levels to protect

crabs during the reproductive period; b) minimizing mortality on female crabs due to handling or harvest; and c) assuring full female fertilization by providing adequate numbers of mature males for breeding.

3. To seek economic stability in the Tanner crab industry. This is to be accomplished by avoiding overcapitalization based on levels of population abundance that may not be sustained over time by a) regulating annual harvest to discourage too rapid expansion of harvesting and processing capability until resource potential can be better evaluated and b) by stabilizing harvest levels within the range of natural recruitment fluctuation, 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, age classification, and refinement of population assessment are needed to forecast abundance and harvest levels for the fishery and to ensure compatible management policies.

To prevent overexploitation of given Tanner crab populations, superexclusive and nonexclusive registration areas have been established. Vessels or gear registered for fishing in a superexclusive area may not be used to take Tanner crab in any other registration area during that registration year. A vessel or gear may register for one or more of the nonexclusive registration areas; however, a vessel or gear so registered may not be used to take Tanner crab in a superexclusive registration area during that registration year. The registration year extends from August 1 through July 31. The Bering Sea District is one of four nonexclusive registration areas (ADF&G 1984).

Bering Sea Tanner crab stocks are managed by two agencies. The domestic fishery is managed by the State of Alaska. The NMFS is responsible for regulating the foreign fishery (NPFMC 1981). Management is under the joint policy established by the Alaska Board of Fisheries and the NPFMC. As with other Tanner crab fisheries, regulations governing the fishery involve sex, gear type, season, and size. Guideline harvest levels are determined annually by the state. The harvest levels are based on population estimates and biological data provided from trawl surveys performed by the NMFS (ADF&G 1983). Identification of hybrid *C. opilio* and *C. bairdi* crabs is difficult, which may provide loopholes in closure dates of the season on *C. bairdi*. The large area and remoteness of the fishery and movement of processing facilities to offshore/on-the-grounds locations makes acquiring in-season biological and harvest data difficult for in-season management decisions.

V. PERIOD OF USE AND HARVEST METHODS

Harvest seasons for Tanner crab have been designed to prevent fishing during soft-shelled and reproductive stages of the species' life cycles. In the Bering Sea District, which includes the Northern Subdistrict, male Tanner crabs could be harvested from 12:00 noon January 15 through 12:00 noon June 15, except male Tanner crabs other than C. bairdi may be taken or possessed from 12:00 noon January 15 through 12:00 noon August 1. The Norton Sound section of the Northern Subdistrict is closed to the taking of Tanner crab (ADF&G 1984). Tanner crab may be harvested with pots and ring nets (ibid.). Regulations stipulate that only male crabs may be possessed. Sex and size stipulations ensure that male Tanner crabs remain in the breeding population at least one season before they are harvested. Until June 1982, a size limit had not been imposed on C. opilio, as most of the catch was greater than 4.3 inches. A minimum size limit as measured by shell width was established for the 1983 season at 3.1 inches (78 mm) in carapace width. For C. bairdi, the minimum size limit is 5.5 inches (140 mm) in carapace width.

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Human Use of Brown Bear
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Human use data in the following sections are presented by game management units (GMU) and subunits (GMS) (see map 1). Data are presented for calendar years 1979 through 1984 and include reported resident and nonresident hunter harvest, reported defense of life and property kills (DLPs), and total reported harvest. Reported harvest data are obtained from sealing certificates. All people who harvest a brown bear are required to have the hide and skull sealed by an authorized representative from the ADF&G. The data obtained form these certificates represent successful hunters only. No information is available concerning those hunters who hunted brown bear but were not successful.

B. Regional Summary of Hunting

1. Regional summary of human use information. Within the Western and Interior regions, which are composed of GMUs 12, 18, 19, 20, 21, 24, and 25, brown bear harvest has ranged from 55 in 1961 to 187 in 1981. The average annual harvest from 1961 to 1984 has been about 120 brown bears (ADF&G 1985).

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.

II. GMU 12

A. Boundaries

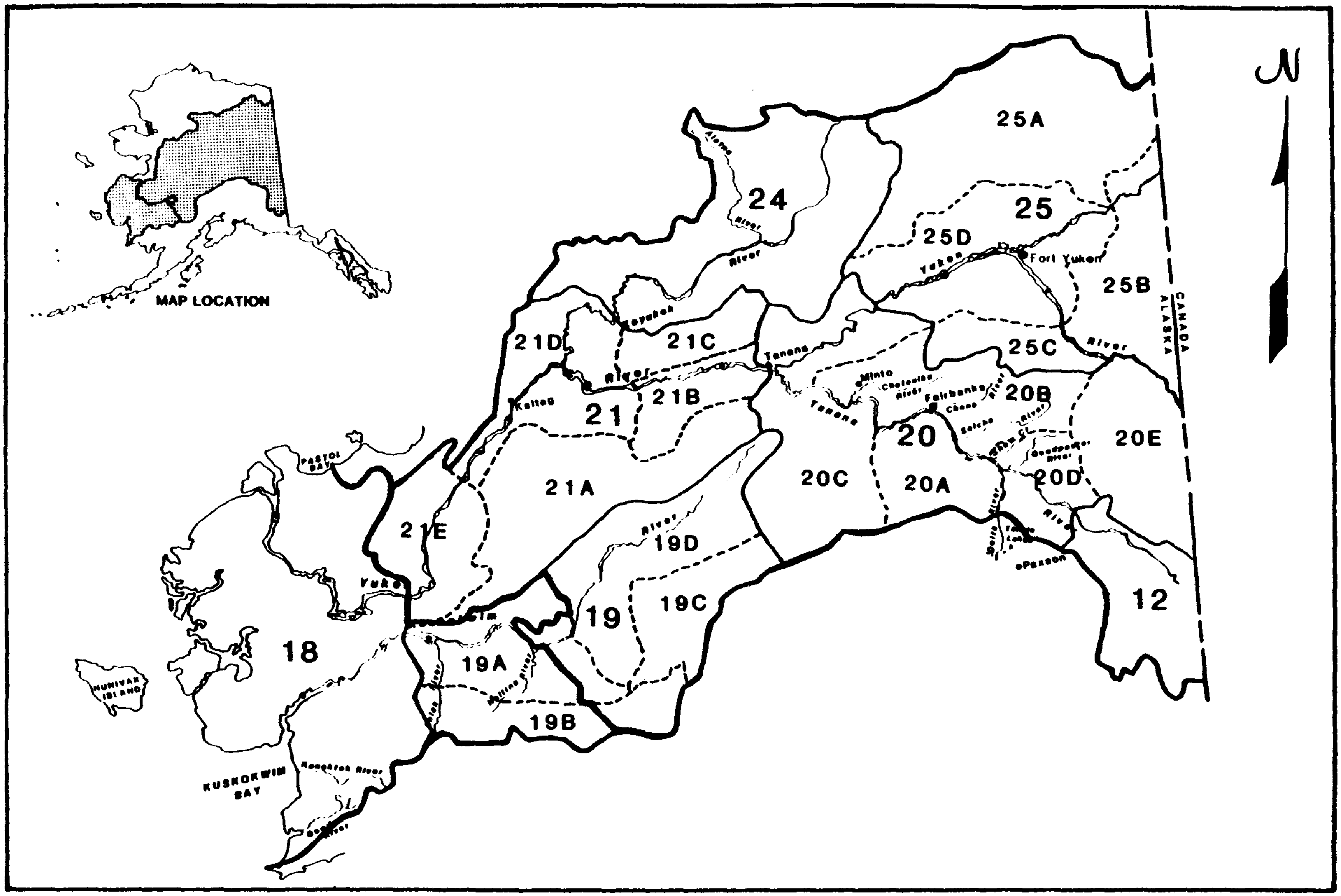
GMU 12 basically encompasses the upper Tanana and White rivers. (See map 1 and the latest GMU boundary descriptions.)

B. Management Objectives

The Yukon-Tanana Brown Bear Management Plan pertains to GMU 12. The management objective is to provide the greatest sustained opportunity to participate in hunting brown bear (ADF&G 1977, Bos 1980).

C. Management Considerations

Little is known about the brown bear population in GMU 12. Population estimates are based upon studies conducted elsewhere in the Alaska Range. Brown bears appear to be relatively abundant and well distributed throughout the unit (Kelleyhouse 1984a).



Map 1. GMUs of the Western and Interior regions.

D. Period of Use

The hunting season dates have fluctuated considerably over the past 24 years. During the 1960's, the spring and fall seasons ran for a total of 154 days; the season dropped, however, to a total of 21 days by 1971. Since then, they have gradually increased until the 1984 and 1985 seasons, when season dates ran from September 1 through June 10 for a total of 283 days. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 1 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.

Table 1. Reported Brown Bear Harvest Data for GMU 12, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	10	12	0	22
1980	8	9	0	17
1981	13	9	0	22
1982	10	9	0	19
1983	10	3	0	13
1984	20	16	1	37

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been resident in Alaska for at least 12 months.

The reported harvest of brown bears in GMU 12 has remained relatively consistent until 1984. Since the 1982-1983 regulatory year, brown bears taken in GMU 12 do not count against the bag limit in other units of one bear in Alaska every four regulatory years, thus allowing hunters the possibility of taking more bears. During 1984, the resident brown bear tag was not required in GMU 12. These two regulatory relaxations are probably partially responsible for the increased harvest during 1984.

F. Significance of Particular Use Areas

The brown bear harvest in GMU 12 is generally well distributed throughout the mountainous portion of the unit (Kelleyhouse 1982, 1984b).

III. GMU 18

A. Boundaries

GMU 18 includes the Yukon-Kuskokwim delta. (See map 1 and the latest GMU boundary descriptions.)

B. Management Objectives

The Yukon-Kuskokwim Brown Bear Management Plan pertains to GMU 18. The management objective is to provide the greatest sustained opportunity to participate in hunting brown bear (ADF&G 1977, Bos 1980).

C. Management Considerations

The number of brown bears killed in defense of life and property and for subsistence use is unknown. Local residents are reluctant to report such kills; however, it is believed the unreported kill is low during normal years (Machida 1984). During April and May of 1985, however, the spring thaw was unusually late, and hunters using snowmobiles harvested a record number of bears in the lower Kuskokwim and Kilbuck mountains (Machida, pers. comm.). Little is known about the brown bear population in GMU 18. Although current harvest is low, a future increase is likely. Open terrain characterizing the unit makes the bears extremely vulnerable, especially to hunters using aircraft (ibid.).

D. Period of Use

Brown bear hunting season lengths ranged in length from a total of 154 days during the 1960's to 47 days from the mid 1970's through 1984. The current 1985-1986 hunting season runs from September 10 through October 10 and from April 10 through May 25 for a total of 77 days. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 2 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.

Table 2. Reported Brown Bear Harvest Data for GMU 18, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	3	8	1	12
1980	1	13	0	14
1981	3	21	0	24
1982	1	13	0	14
1983	4	12	0	16
1984	1	10	2	13

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

Most of the reported brown bear harvest in GMU 18 is by guided nonresident hunters. Prior to 1979, little or no harvest of brown bears was reported in GMU 18. The increase, beginning in 1979, appears to be related to guides moving into the area and offering bear hunts (Nelson 1980, Dinneford 1981).

F. Significance of Particular Use Areas

Brown bears are primarily restricted to two population centers in GMU 18: the Andreafsky and Chuilnak mountains and the Kilbuck Mountains. Most of the reported harvest comes from these two areas (Machida 1984).

IV. GMU 19

A. Boundaries

GMU 19 includes the middle and upper Kuskokwim River drainages. (See map 1 and the latest GMU boundary descriptions.)

B. Management Objectives

Three brown bear management plans pertain to GMU 19: The Yukon-Kuskokwim, Farewell, and South Kuskokwim brown bear management plans (ADF&G 1977, Bos 1980). The management objective of the Yukon-Kuskokwim plan is to provide the greatest sustained opportunity to participate in hunting brown bear. The Farewell plan's objective is to provide sustained opportunities to hunt brown bear under aesthetically pleasing conditions. The South Kuskokwim plan's primary objective is to provide sustained opportunities to be selective in hunting brown bear; its secondary objective is to provide sustained opportunities to hunt brown bear under aesthetically pleasing conditions (Bos 1980).

C. Management Considerations

The brown bear population in GMS 19B appeared to have declined during the late 1970's and early 1980's as a result of overharvest (Pegau 1982). Beginning in the fall of 1981, a drawing permit system was implemented for GMS 19B that has effectively reduced the harvest, and the population appears to be rebounding (Pegau 1984a). Beginning in 1974, the brown bear harvest in GMUs 17 and 19 has been influenced by the alternate-year closure of GMU 9 brown bear seasons. When the GMU 9 season is closed, the harvest markedly increases in GMUs 17 and 19 (Pegau 1982). Most of the brown bear harvest in GMU 19 is associated with guiding activities (ibid.).

D. Period of Use

Brown bear seasons have ranged in length from 154 days during the early to mid 1960's to 47 days since 1974. The current brown bear season in GMU 19 runs from September 10 through October 10 and from May 10 through May 25. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 3 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.

Table 3. Reported Brown Bear Harvest Data for GMU 19, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	12	55	0	67
1980	3	53	1	57
1981	5	32	0	38
1982	2	16	1	19
1983	4	30	1	35
1984	6	13	0	19

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

The decrease in harvest that occurred after the 1980 hunting season was the result of implementation of a permit drawing system in GMS 19B that limited the number of hunters able to hunt in the subunit. The decline from the 1981 to the 1982 season was due to fewer guides with fewer clients operating in the GMU. Many guides who operated in GMU 19 attributed the decline in clients to the overall poor worldwide economy during 1982 (Pegau 1984b).

F. Significance of Particular Use Areas
Until the drawing permit system was initiated in GMS 19B, most of the brown bear harvest during the 1970's and early 1980's in GMU 19 was in the Nushagak Hills in GMS 19B (Pegau 1982). Up until 1971, most of the harvest had come from Subunit 19C, and since 1981 this subunit has accounted for most of the brown bear harvest in the GMU (Pegau 1982, 1984a, 1984b).

V. GMU 20

A. Boundaries
GMU 20 basically consists of the central Tanana-upper Yukon valley. (See map 1 and the latest GMU boundary descriptions.)

B. Management Objectives
Two brown bear management plans pertain to GMU 20: the Yukon-Tanana and the Central Alaska Range brown bear management plans (ADF&G 1977, Bos 1980). The Central Alaska Range plan has a primary management objective to provide sustained opportunities to hunt brown bear under aesthetically pleasing conditions. The secondary objective in the Central Alaska Range plan and the primary objective in the Yukon-Tanana plan is to provide the

greatest sustained opportunities to participate in hunting brown bear (Bos 1980).

C. Management Considerations

In much of GMU 20, brown bear management may involve temporarily reducing bear numbers in order to enhance ungulate survival and population recovery (Jennings 1984).

D. Period of Use

The length of brown bear hunting seasons has ranged from a combined total of 154 days during the early 1960's to a low of 21 days in 1971. With the exception of GMS 20E, the current hunting season in GMU 20 runs from September 1 through November 30 and April 1 through May 31. The season in GMS 20E runs from September 1 through June 10. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 4 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bears are not required to report.

Table 4. Reported Brown Bear Harvest Data for GMU 20, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	32	7	0	39
1980	34	15	1	50
1981	35	26	5	66
1982	36	15	2	53
1983	47	12	5	64
1984	55	15	2	72

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

The general trend has been an increasing harvest in GMU 20, primarily in GMS 20E. Liberal hunting seasons and bag limits (bears taken in GMS 20E do not count against the bag limit in other units of one bear every four regulatory years) appear to be the reason for the increasing trend in harvest.

F. Significance of Particular Use Areas

Most of the harvest of brown bears occurs along rivers and near other access points (Jennings 1981).

VI. GMU 21

A. Boundaries

GMU 21 basically consists of the middle Yukon River valley from Tanana to Paimiut. (See map 1 and near the latest GMU boundary descriptions.)

B. Management Objectives

The Yukon-Kuskokwim Brown Bear Management Plan pertains to GMU 21. The management objective is to provide the greatest sustained opportunity to participate in hunting brown bear (ADF&G 1977, Bos 1980).

C. Management Considerations

Presently, interest in brown bear hunting in GMU 21 is low. The annual harvest of bears in the unit has had an insignificant impact upon the bear population. Nuisance bears are a problem around fish camps, smokehouses, and trapping camps, primarily along the Yukon and Koyukuk rivers (Osborne 1984).

D. Period of Use

Season lengths have varied form the current 177-day season to 47 days during the mid 1970's and early 1980's. Currently, the brown bear seasons in GMSs 21B, D, and E are from September 1 through December 31 and from April 1 through May 25. In GMSs 21A and C the seasons are from September 10 through October 10 and from May 10 through May 25. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 5 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.

Table 5. Reported Brown Bear Harvest Data for GMU 21, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	2	2	1	5
1980	11	0	1	12
1981	3	7	2	12
1982	5	5	3	13
1983	2	4	1	7
1984	3	1	0	4

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

Harvest of brown bears in GMU 21 is relatively insignificant compared to the size of the GMU and the bear population. Since 1961, the average annual take has been between three and four bears.

F. Significance of Particular Use Areas
Within GMU 21, the Nulato Hills is a major hunting area.

VII. GMU 24

A. Boundaries
GMU 24 consists of the Koyukuk River drainage north of and including Dulbi Slough. (See map 1 and the latest GMU map and boundary descriptions.)

B. Management Objectives
Two brown bear management plans pertain to GMU 24: the Brooks Range and Upper Yukon-Porcupine brown bear management plans. The management objective of the Brooks Range plan is to provide the greatest sustained opportunity to hunt brown bear under aesthetically pleasing conditions. The objective of the Upper Yukon-Porcupine plan is to provide the greatest sustained opportunity to participate in hunting brown bear (ADF&G 1977, Bos 1980).

C. Management Considerations
Because of the low reproductive capacity of brown bears in the Brooks Range only 2 to 4% of the population should be harvested annually (Reynolds 1984a, 1984b). A permit system established by the Board of Game in the Brooks Range has effectively prevented overharvest of the brown bear population (ibid.).

D. Period of Use
The length of brown bear hunting seasons has ranged from a combined total of 180 days in the mid 1960's to no open hunting season in 1971. Currently, GMU 24 has three sets of hunting seasons that apply to individual portions of the GMU: a September 1 through October 31 and May 10 through 31 registration permit hunt, a year-round registration permit hunt, and a September 1 through December 31 and May 10 through 25 hunting season. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data
Table 6 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.
The registration permit system for portions of GMU 24 has effectively limited brown bear harvest in those areas. A large portion of the GMU is within Gates of the Arctic National Park, where hunting is limited by registration permit, and only local residents are allowed to hunt in the park. Hunting pressure in the remainder of the GMU is low. Harvest appears to be within sustainable levels throughout the GMU (Reynolds 1984b).

Table 6. Reported Brown Bear Harvest Data for GMU 24, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	0	7	0	7
1980	7	13	0	20
1981	5	6	2	13
1982	2	1	1	4
1983	8	4	1	13
1984	4	3	0	7

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

F. Significance of Particular Use Areas
No information was available about areas where brown bear harvest was relatively more significant.

VIII. GMU 25

A. Boundaries
GMU 25 includes the Yukon Flats, the Chandalar, Porcupine, and Black river drainages, and Birch and Beaver creeks. (See map 1 and the latest GMU boundary descriptions.)

B. Management Objectives
Three brown bear management plans pertain to GMU 25: the Brooks Range, Upper Yukon-Porcupine, and Upper Birch-Preacher-Beaver Creek brown bear management plans. The management objectives of the Brooks Range and Upper Birch-Preacher-Beaver Creek plans are to provide the greatest sustained opportunity to hunt brown bear under aesthetically pleasing conditions. The objective of the Upper Yukon-Porcupine plan is to provide the greatest sustained opportunity to participate in hunting brown bear (ADF&G 1977, Bos 1980).

C. Management Considerations
Because of the low reproductive capacity of brown bears in the Brooks Range only 2 to 4% of the population should be harvested annually (Reynolds 1984a, 1984b). A permit system established by the Board of Game in the Brooks Range has effectively prevented overharvest of the population (ibid.).

D. Period of Use
The length of brown bear hunting seasons has ranged from a combined total of 180 days in the mid 1960's to no open hunting

season in 1971. Currently, GMU 25 has three sets of spring/fall hunting seasons that apply to individual portions of the GMU: September 1 through October 31/May 10 through 31; September 1 through October 10/May 10 through 25; and September 1 through November 30/April 1 through May 31. (See the latest Alaska Game Regulations for the current season and limits.)

E. Human Use Data

Table 7 presents reported harvest data for the years 1979 through 1984. These data represent only successful hunters. Unsuccessful hunters of brown bear are not required to report.

Table 7. Reported Brown Bear Harvest Data for GMU 25, 1979-84

Year	Harvest by Residents*	Harvest by Nonresidents	DLP	Total Harvest
1979	13	11	1	25
1980	4	11	0	15
1981	13	8	1	22
1982	9	10	0	19
1983	5	14	0	19
1984	11	4	1	16

Source: ADF&G 1985.

* Residents are hunters whose legal residence is Alaska and who have been residents of Alaska for at least 12 months.

Since 1978, the harvest of brown bears has increased because of additional guides establishing exclusive areas in the GMU, but the harvest has not been excessive and has remained relatively stable for the past six years (Reynolds 1984a, 1984b).

F. Significance of Particular Use Areas

As in GMU 24, no information was available about areas where brown bear harvest was relatively more significant.

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Human Use of Caribou
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The following herds are found in the Western and Interior regions: Chisana, Denali, Kilbuck-Kuskokwim mountains, Andreafsky, Delta, Macomb, Yanert, Forty-mile, Beaver Mountains, Sunshine Mountain, Big River, Rainy Pass, Tonzana, Porcupine, and Western Arctic. (See the Distribution and Abundance section for more information on these herds.)

Human use information for caribou in the Western and Interior regions will be discussed in detail only for the Delta (DCH), Fortymile (FH), Chisana (CH), and Macomb (MH) caribou herds. Reported harvest data will be presented by regulatory year (1 July-30 June) for each herd. Harvest data for the remaining herds are of questionable value because of a widespread lack of reporting, particularly in rural areas. Because the unreported harvest of these herds often exceeds the reported harvest, the harvest cannot be discussed in any detail. Harvest data are relatively more accurate for those herds for which a hunting permit is required (i.e., the Delta and Macomb herds) or where a larger percentage of the hunters are from more urban areas (i.e., the Delta, Chisana, and Fortymile herds).

B. Regional Summary of Hunting

1. Brief regional summary of human use information. Human use of caribou in the Western and Interior regions of Alaska has oscillated widely because of fluctuations in 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 these regions underestimates the actual number taken, because of the widespread lack of compliance in returning harvest report cards. Thus it is difficult to compare caribou human use data from these regions with those from the other regions or from the state as a whole.

Many caribou herds in the Interior Region have never experienced intensive sport hunting. The Chisana, Denali, Porcupine, and most of the herds in the upper Kuskokwim valley have not been subjected to heavy human use by nonlocal residents because of their relative inaccessibility and the ability of other more accessible herds in the state to satisfy this demand. In the Western Region, caribou have also not been exposed to heavy sport hunting because of the relatively small size of the local human population and the limited access to the area. Subsistence use of caribou has been locally important, but in a sporadic fashion, to those villages that take advantage of the variable movement patterns of caribou that occasionally do bring them within reach of a village. The reported combined harvest of caribou for the Delta and Fortymile herds has ranged from 114 animals in 1980-1981 to 894 animals in 1983-1984. In addition, the reported harvest for the remaining herds within the Western and Interior regions amounted to 143 caribou during the 1983-1984 regulatory year (Hinman 1985).

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. Caribou hunting is controlled under the Alaska Game Regulations.

II. DELTA CARIBOU HERD (GMS 20A)

A. Boundaries

The Delta Caribou Herd is primarily hunted in GMS 20A.

See map 1 and the current Alaska Game Management Unit map, which provides a geographical description and delineates the boundaries of the areas listed in the Alaska Game Regulations.

B. Management Objectives

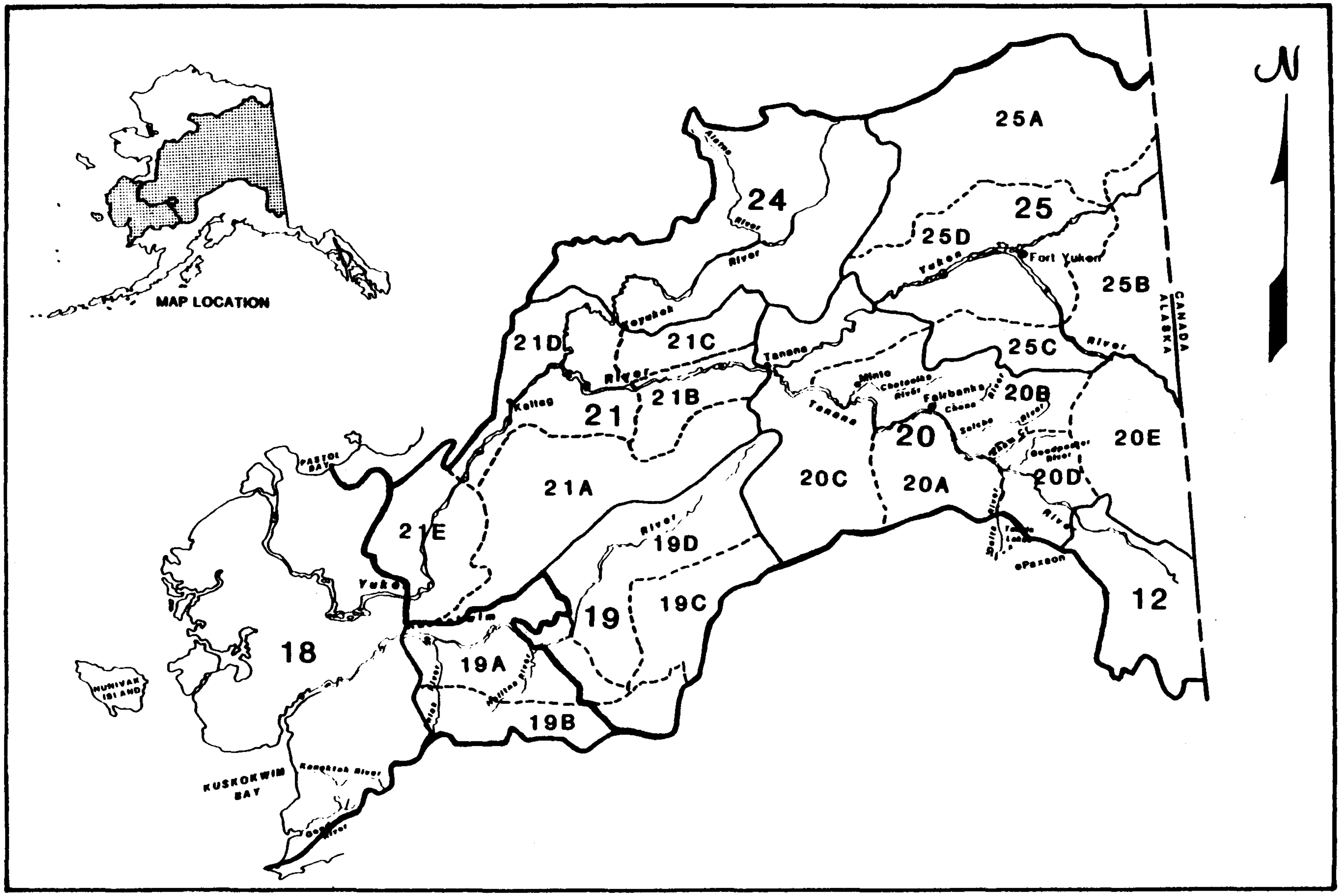
Most of the present range of the Delta Caribou Herd (DCH) lies in GMS 20A and is located within the geographical area of the Delta Caribou Management Plan (ADF&G 1984a). The primary objective is "to protect, maintain, and enhance the caribou population in concert with other components of the ecosystem and thereby assure perpetuation of the population and its capability of providing:

1. sustained high opportunities to participate in hunting caribou,
2. sustained opportunities to be selective in hunting large male caribou,
3. continued opportunities for viewing, photographing, and enjoying caribou, and
4. continued opportunities for scientific and educational study of caribou."

See the Caribou Management Policies (ADF&G 1980), which reflect current Division of Game and Board of Game philosophy on caribou management in Alaska.

Management guidelines include the following:

- ° Maintain a minimum precalving population of 5,000-6,000 caribou in the DCH.
- ° Adjust seasons, bag limits, and methods and means of hunting to meet management objectives.



Map 1. GMUs of the Western and Interior regions.

- Protect and prevent loss of habitat by entering into cooperative management programs with public and private landowners.
- Maintain public involvement in caribou management issues.
- 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.

See the Delta Caribou Management Plan (ADF&G 1984a) for a more detailed description of these guidelines.

C. Management Considerations

1. Mineral development potential. Numerous mining claims, coal leases, and mineral and gravel deposits exist within the known winter range of the DCH. Future development of these materials could result in habitat loss or deterioration and a reduced aesthetic quality of the area.
2. Land ownership. Military ownership and use of restricted areas (firing ranges, low-level jet airways) located within the range of the DCH may reduce the aesthetic appeal of the area. One of these restricted areas includes almost the entire traditional calving area of the DCH. These restricted areas are sites of regular bombing, strafing, and artillery firing. Low-flying military aircraft use the area almost daily, and ground training exercises occur intermittently (Davis et al. 1985).
3. Wildfires. Davis et al. (1985) noted that few fires covering more than 40 ha (100 acres) have occurred within the DCH's range in the past 30 years. However, thunderstorms do occur often during summer in the Alaska Range. In June 1971, lightning strikes caused a 7,082 ha (17,500 acres) burn about 10-20 km (6-12 mi) northwest of the traditional calving area. Davis et al. (1985) described two recent fires caused by artillery bombing. A 46,450 ha (115,000 acres) fire burned to the northern edge of the traditional core calving area producing smoke throughout the calving and postcalving periods in 1979. In 1983, a 20,235 ha (50,000 acres) fire, which began on 9 May 1983 and lasted until August, burned a major portion of the traditional eastern core calving area, producing smoke throughout the calving and post-calving periods. The presence of heavy smoke in 1979 and 1983 had no apparent adverse effects on productivity or survival (Davis et al. 1985).
4. Predation. Davis et al. (1983) and Davis and Preston (1980) pointed out that wolf predation had a negative effect on the DCH during the 1970's. There have been two effective wolf control programs within the range of the DCH. The herd grew rapidly during both of these periods, 1954-1963 and 1976-1981. The data from the latter period support the observed correlation between lower wolf numbers beginning in 1976 and increased survival of calves. Gasaway et al. (1983) pointed

out that, under similar weather conditions and hunting pressure, the Macomb and Denali herds remained stable while the Delta Herd increased following wolf reduction within the range of the Delta Herd. Calf survival rates increased significantly in the area with wolf control and increased less dramatically in the ranges of the two adjacent herds without wolf control (ibid.).

D. Period of Use

Table 1 summarizes season lengths and bag limits from 1968 to the present. Liberal hunting seasons (August 10-March 31) and bag limits (three caribou) resulted in intensive hunting pressure and harvest until 1973, when the limit was reduced to one caribou. The 1973-1974 season was closed by emergency order on 20 September in an attempt to slow the decline in the DCH. Sport hunting remained closed until the fall of 1980, when hunting was initiated again under a drawing permit system. In fall of 1983, a general hunting season (no permits required) was held for the DCH. The hunt was closed by emergency order on 28 October after available information indicated the allowable harvest had been attained. The 1984 hunt was managed on a permit basis with split seasons.

E. Human Use Data

Table 2 summarizes data describing the harvest of DCH caribou under harvest regulations. During the 1983-1984 and 1984-1985 hunting seasons, most hunters (88 and 93%) of the DCH were Alaskan residents and, in particular, lived in the Fairbanks area (55 and 63%), the Anchorage-Matanuska Valley area (11 and 13%), and the Clear area (11 and 8%) (ADF&G 1984b, 1985). In 1983-1984, three-fourths of the harvest was obtained by the end of September, with successful hunters and all hunters as a group averaging about four days afield (ADF&G 1984b). Almost half (48%) of all successful hunters used aircraft, with another third of the successful hunters using ORVs (ibid.). Hunters transported by airplane showed an 81% success rate, with ORV hunters at 65%. More than 85% of all caribou bagged were males. This type of hunting, where many hunters use aircraft to reach areas that they then hunt on foot, frequently provides a high level of enjoyment per animal harvested.

F. Significance of Particular Use Areas

The more important use areas are summarized in table 3, which accounts for about 95% of all hunting activity on the DCH. Hunters in the Little Delta River drainage had the highest success rate of the four major areas, but expended the most effort to kill their caribou. Successful hunters in the Nenana River area expended the least amount of effort but had the lowest success rate.

III. FORTYMILE CARIBOU HERD (GMU 12 and GMSs 20E, 20B, 20D, 25C)

A. Boundaries

The Fortymile Caribou Herd is hunted in GMU 12 and in GMSs 20B, 20C, 20D, and 20E.

Table 1. Hunting seasons and Bag Limits for the Delta Caribou Herd[a], 1968-85

Year	Season	Bag Limit
1968-69	Aug. 10-Mar. 31	Three caribou
1969-70	Aug. 10-Mar. 31	Three caribou
1970-71	Aug. 10-Mar. 31	Three caribou
1971-72	Aug. 10-Mar. 31	Three caribou
1972-73	Aug. 10-Mar. 31	Three caribou
1973-74[b]	Aug. 10-Dec. 31	One caribou
1974-75[c]	Aug. 10-Sept. 20	One caribou
1975-76 through 1979-80		No open season
1980-81	Sept. 1-Sept. 30	One male by drawing permit; 200 permits issued.
1981-82	Aug. 10-Sept. 30 Nov. 15-Dec. 31	One caribou by drawing permit Aug. 10-Sept. 30; 150 permits issued, up to 25 issued to nonresidents Antlered caribou could be taken Nov. 15-Dec. 31 by registration permit. A total of 400 caribou could be taken.
1982-83	Aug. 10-Sept. 30 Dec. 1-Mar. 31	One caribou by drawing permit Aug. 10-Sept 30; 175 permits issued, up to 30 issued to non-residents. Antlered caribou could be taken Dec. 1-Mar. 31 by registration permit. A total of 500 caribou could be taken.
1983-84[d]	Aug. 10-Mar. 31	One caribou
1984-85	Aug. 20-Sept. 20 Feb. 1-Mar. 31	One caribou by registration permit only; 600 caribou could be taken. The Aug. 20-Sept. 20 season was closed when 300 caribou were taken; the Feb. 1-Mar. 31 season was closed when the total harvest reached 600 caribou.

Source: Davis and Valkenburg 1984.

a Subunit 20A and part of 20C.

b Amended by emergency announcement to close 20 Sept.

c Amended by emergency announcement to No Open Season.

d Amended by emergency announcement to close Oct. 28.

able 2. Reported Human Use Data for the Delta Caribou Herd, 1980-84

	1980-81[a]	1981-82[a]	1981-82[b]	1982-83[a]	1982-83[b]	1983-84[c]	1984-85[b]
No. permit applicants	640	938	880	1,011	1,538	---	1,500
No. permits issued	204	150	880	175	1,538	---	1,500
No. successful hunters	110	87	179	104	169	692	414
Total hunters	125	108	460	122	---	1,029	---
Transportation mode of % successful hunters:							
Aircraft	77	56	---	49	30	48	32
Horse	11	---	---	15	0	5	2
Motorbike (3-wheeler)	2	---	---	2	1	0	52
ORV	10	---	---	21	5	33	8
Highway vehicle	0	---	---	12	2	8	2
Snowmachine	0	---	68	0	45	1	0
Dog team	0	---	---	0	8	0	0
Unknown	0	---	---	0	8	5	1
Boat	---	---	---	---	---	1	3
Total resident hunters (%)	---	---	---	84	---	88	93
Successful resident hunters (%)	---	---	---	72	---	86	93

ources: ADF&G 1984b, 1985; Jennings 1981, 1983, 1984; Sexton 1982, 1985 or memos.

--- means no data were available.

a Drawing permit hunt.

b Registration permit hunt.

c General harvest.

Table 3. Significant Harvest Areas for the Delta Caribou Herd, 1983

Location	No. of Hunters[a]	No. of Hunter-Days	No. of Successful Hunters[a]	No. of Successful Hunter-Days
Wood River	182	707	137	524
Little Delta River	122	658	105	564
Tanana Flats-Dry Creek	54	210	41	169
Tatlanika Creek	38	145	37	139
Totatlanika River	164	632	127	464
Delta Creek	21	94	16	78
Nenana River	380	1,464	182	594

Source: ADF&G 1984b.

a Includes only those hunters who reported days hunted.

See map 1 and the current Alaska game mangement unit map, which provide a geographical description and delineate the boundaries of the areas listed in the Alaska Game Regulations.

B. Management Objectives

According to the Fortymile Caribou Management Plan, the primary management objective is to provide the greatest opportunity to participate in hunting caribou (ADF&G 1977). Under this objective, maximization of participation in hunting does not mean maximization of the opportunity to kill caribou. Caribou management will consider participation more desirable than success. Opportunities to hunt may have to be limited to maintain harvests within the sustainable yield of a caribou herd. Harvest restrictions will usually involve altering bag limits, methods and means of taking caribou, and lengths and timing of seasons before limiting numbers of hunters. Time allowed for a hunt will be limited before limiting numbers of hunters. A secondary objective is to provide an opportunity to view, photograph, and enjoy caribou. The Taylor Highway and the Steese Highway pass through the general distribution of the Fortymile Herd (FH), offering access to "nonconsumptive" users as well as hunters.

Revised management guidelines include the following:

- Allow for limited harvests until the population increases to a minimum of 50,000 caribou, after which harvests may be increased to a level that will provide for further herd growth.
- Maintain a minimum population of 15,000 caribou.
- Maintain a minimum posthunting season population sex ratio of 35 bulls per 100 cows.
- Encourage public viewing and photography of caribou, and enhance viewing facilities.
- Discourage land use practices that adversely affect caribou habitat.
- Encourage fire management policies that will provide for a near-natural fire regime.

C. Management Considerations

1. Predation. Caribou predation by wolves, brown bears, and even golden eagles is believed to be the greatest source of mortality in the FH (Kelleyhouse 1985). The cessation of wolf control efforts during winter 1983-1984 contributed greatly to a decrease in caribou survival rates (ibid.).
2. Mineral development. Mining within seasonally important life function areas is the greatest potential threat to the FH (Kelleyhouse 1983). Mining projects in the Glacier Mountain-North Peak-Mt. Eldridge area within the FH calving grounds on the south side of the Seventymile River and the traditional postcalving area in the Mt. Harper area could cause negative impacts on the herd (ibid.). Development of an asbestos mine in the Slate Creek area just south of a calving area could be a source of considerable disturbance to the FH (ibid.). A proposed company town of 1,500-2,000

people with the development of road access for ore products would increase hunting pressure and disrupt a historical fall migration route. A proposed extension of the Alaska Railroad through the Ladue River valley would increase caribou mortality due to train-caribou collisions, especially in winters with deep snowcover (Kelleyhouse 1984).

D. Period of Use

Table 4 summarizes season lengths and bag limits for the FH from 1975 to 1985.

The FH has been hunted regularly since gold rush days and may have been altered in numbers and composition by human utilization (LeResche 1975). From the early 1950's to the present this herd has been an important resource. In the early 1950's, a trend toward longer seasons and increasing bag limits was initiated as the herd increased to about 50,000 animals (Davis et al. 1978). In 1955, the bag limit was increased to two caribou from 20 Aug. to 30 Nov. and in 1957 was raised to three caribou from 20 Aug. to 31 Dec. In 1963, the season was lengthened to 10 Aug.-31 Mar., where it remained through 1972. The season length and bag limit were reduced in 1973 from almost an eight-month season to a two-month season and from three caribou to one caribou. In 1977, the season length was shortened even further because of poor recruitment rates. By 1981, the FH had shown strong indications of a turnaround, and a longer season was instituted by adding a second split season during the winter. In the following year, the bag limit was increased to two bulls. Because of the lack of wolf control, the bag limit may have to be reduced in the near future.

E. Human Use Data

Table 4 presents information on total reported harvest and estimated harvest.

For the 1983-1984 regulatory year, most hunters (over 90%) of the FH were Alaskan residents (ADF&G 1984b). Almost 40% of all Alaskan resident hunters were successful. Eighty-six percent of all successful hunters were residents. Approximately half of the harvest was taken by the end of September, with the remainder spread through the winter season. About 93% of all aircraft hunters and 58% of all snowmachine hunters shot at least one bull. Hunters using highway vehicles and/or hunters on foot were not as successful, and only 27% managed to bag a caribou. Of those hunters reporting transport means, 38% used highway vehicle/foot, 26% used aircraft, and 20% used ORVs. From a total of 378 reporting hunters, 58% did not shoot a caribou, 24% shot one bull, and 17% shot two bulls. About one-third of those hunters reporting their city of origin came from the Fairbanks area, almost 22% from Tok, and 16% from the Anchorage-Matanuska valley area. Both successful hunters and all hunters as a group spent almost five days in the field, which was above the 1983-1984 statewide average of slightly more than four days.

Table 4. Hunting Seasons, Bag Limits, and Harvest for Fortymile Caribou Herd, 1975-86

Year	Season Length	Bag Limit	Total Reported Harvest	Estimated Harvest
1975-76	Aug. 10-Sept. 20	One caribou	34	---
1976-77	Aug. 10-Sept. 20	One caribou	33	---
1977-78	Sept. 1-Sept. 15	One caribou	60	---
1978-79	Sept. 1-Sept. 15	One caribou	16	32
1979-80	Sept. 1-Sept. 15	One caribou	9	24-29
1980-81	Sept. 1-Sept. 15	One bull	10	30-60
1981-82	Aug. 10-Sept. 20 Dec. 1-Feb. 28	One bull	45	100
1982-83	Aug. 10-Sept. 20 Dec. 1-Feb. 28	Two bulls	110	165
1983-84	Aug. 10-Sept. 20 Dec. 1-Feb. 28	Two bulls	200	250-300
1984-85	Aug. 10-Sept. 20 Nov. 20-Feb. 28	Two bulls; however, only anterless bulls may be taken Dec. 10-Feb. 28		
1985-86	Aug. 10-Sept. 20 Nov. 20-Feb. 28	Two bulls (same as 1984-85)		

Sources: ADF&G 1975-86.

--- means no data were available.

F. Significance of Particular Use Areas

The more important use areas during the 1983-1984 hunting season are summarized in table 5.

IV. CHISANA HERD

A. Boundaries

The Chisana Herd (CH) is hunted in GMU 12.

See map 1 and the current Alaska game management unit map, which provides geographical description and delineates the boundaries of the areas listed in the Alaska Game Regulations.

B. Management Objectives

According to the Chisana Caribou Management Plan, which applies to that portion of GMU 12 lying east of the Nabesna Glacier and river and south of the Alaska Highway, the primary management goal is to provide the greatest opportunity to participate in hunting caribou (ADF&G 1976).

Management guidelines include the following:

° Maintain limited harvests to allow for an increase in the caribou population.

° Encourage fire suppression on caribou calving grounds and selected wintering areas.

° Discourage land use practices that adversely affect caribou habitat.

C. Management Considerations

1. Predation. Predation by wolves, brown bears, and other smaller predators such as golden eagles, coyotes, and lynx is thought to be the primary factor affecting the CH (Kelleyhouse 1984).
2. Lack of basic management data. Very little information exists describing movements and herd distribution. A rigorous census of the CH has never been undertaken. Lack of these data makes management of the herd more difficult. This information is necessary to more effectively determine allowable harvests as well as impacts of competing land uses.
3. Mining activities. In calving areas, mining activities could cause serious impacts, such as calf abandonment or actual loss of habitat.
4. Access. Poor accessibility for hunters has been one factor that has traditionally limited the harvest of CH caribou.

D. Period of Use

Prior to the 1978-1979 regulatory year, the season was Sept. 1-15, with a bag limit of one caribou. Because of low calf production and survival, the bag limit was restricted to one bull, with the same season length. In 1983, the season was lengthened by five days to last from Sept. 1 to Sept. 20 to allow for a slightly higher harvest and to align season closing dates for all ungulates in GMU 12, thus simplifying the regulations.

E. Human Use Data

Table 6 summarizes available human use data from 1980 to 1984. In most years, from one-half to two-thirds of all hunters are Alaskan

Table 5. Significant Harvest Areas for the Fortymile Caribou Herd, 1983-84

Location	No. of Hunters[a]	No. of Hunter Days	No. of Successful Hunters[a]	No. of Successful Hunter Days
GMS 20B				
Chena River	10	37	1	6
Salcha R.-Birch Ck.	11	67	2	7
Tolovana River	5	57	---	---
GMS 20D				
GMS 20E				
Yukon R.	19	64	4	10
Fortymile R.	14	66	3	14
South Fork-Fortymile R.	14	61	6	28
Dennison Fork and West Fork of Fortymile R.	54	242	23	90
Mosquito Fork of the Fortymile R.	49	215	33	154
West Fork of Fortymile R.	7	76	6	64
Middle Fork of Fortymile R.	43	211	40	199
GMU 20E-Unknown	70	293	14	74
GMS 25C				
Birch Ck.	21	70	4	16
Crooked Ck.	13	71	1	2

Source: ADF&G 1984b.

--- means no data were available.

a Includes only those hunters who report days hunted.

Table 6. Reported Human Use Data for the Macomb Caribou Herd, 1977-84

Year	Season Length	Bag Limit	Number Permits Issued	Number of Appli-cations	Reported Harvest	Number of Hunters	Success Rate(%)
1977-78	Sept. 1-Sept. 15*	One caribou			86	---	---
1978-79	Aug. 10-Sept. 30	One bull	70	---	16	48	33
1979-80	Aug. 10-Sept. 30	One bull	70	218	20	39	51
1980-81	Aug. 10-Sept. 30	One bull	70	170	12	42	29
1981-82	Aug. 10-Sept. 30	One bull	70	192	20	39	51
1982-83	Aug. 10-Sept. 30	One bull	140	254	40	83	48
1983-84	Aug. 10-Sept. 30	One bull	140	341	11	63	17

Source: ADF&G 1975-76.

* Season closed by emergency order on September 8.

--- means no data were available.

residents. Nonresidents hunters, however, because they area accompanied by a guide, have a higher success rate (usually greater than 90%) in bagging a caribou than resident hunters. The overall success rate has ranged from 57% to approximately 95%. Generally more than half of all successful hunters use aircraft as the primary means of transportation, with the remainder using horses. These proportions can vary annually but do illustrate the remoteness of the CH range and the minimal amount of available access for hunters. In 1983, successful hunters and all hunters as a group spent slightly more than five days in the field (ADF&G 1984b). Most resident hunters come from the Fairbanks vicinity, the local area (Tok, Glennallen, Northway, etc.), and southeast Alaska.

F. Significance of Particular Use Areas

Most caribou are harvested out of the Chisana and White river drainages, with some caribou killed in the Beaver Creek drainage (Kelleyhouse, pers. comm.).

V. MACOMB HERD

A. Boundaries

The Macomb Herd is hunted in GMS 20A.

See map 1 and the current Alaska game management unit map, which provides a geographical description and delineates the boundaries of the areas listed in the Alaska Game Regulations.

B. Management Objectives

The Macomb Caribou Herd is also included in the Delta Caribou Management Plan (ADF&G 1984a). (See section II.B. for a description of management objectives and guidelines that also apply to the Macomb Herd.)

C. Management Considerations

1. Predation. An increase in calf and yearling survival in 1981, the first year after wolf control was initiated, indicates that wolf predation on young caribou could be an important mortality factor (Johnson 1985). Brown bears are relatively abundant on the Macomb Plateau and may also be responsible for the high summer mortality rate (50% in some years).
2. Access. Institution of the Macomb Plateau Controlled Use Area regulation restricts access to nonmotorized means (except float planes on Fish Lake) during the caribou hunting season. The main access routes to the Macomb Plateau are two horse trails from the Alaska Highway and one lake for float planes. Access outside the controlled use area includes bush landing strips and ATV, horse, and foot trails. Differences in accessibility can result in a poorly distributed harvest. For example, in 1982, 83% of the harvest came from the controlled use area (Johnson 1984) as a result of relatively easy access. MH caribou receive light hunting pressure in other portions of their range.

D. Period of Use

A summary of season lengths and bag limits from 1977 to 1984 may be found in table 6. In fall 1977, an excessive caribou harvest caused the season to be closed early by emergency order. It was apparent that the annual harvest was exceeding the annual increment. A permit drawing hunt was instituted the following year.

E. Human Use Data

Table 6 shows drawing permit hunt data and reported harvests from 1977 through 1983. Most hunters of the MH have been Alaskan residents. In 1983, only 32% of the total number of hunters were GMS 20D residents, with 45% of the successful hunters being local residents of 20D (Johnson 1985). Almost 58% of the permits issued annually from 1978 to 1983 have been used, and approximately 38% of those who did hunt bagged a caribou. In 1983, all hunters spent slightly less than three days in the field, with successful hunters averaging just over two days afield. More than half the hunters (51%) walked into their hunting areas, and 30% used horses as a transportation means. Almost two-thirds of the successful hunters (64%) used horses. Most (73%) of the harvest was taken before the end of August.

F. Significance of Particular Use Areas

The Macomb Plateau area is probably the most heavily used area for hunting Macomb caribou (Johnson, pers. comm.), with almost all caribou being harvested from the controlled area in most years. Other important use areas include the Little Gerstle and Jarvis creek drainages.

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Human Use of Dall Sheep
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

A. Introduction

In the Western and Interior regions, Dall sheep inhabit mountainous terrain within Game Management Units (GMUs) 12, 20, and 24 and Game Management Subunits (GMSs) 19B, 19C, 24, and 25A and C. These GMUs and GMSs encompass the Tanana-Yukon uplands and portions of the Alaska Range. GMS 16B, located within the Southcentral Region, also includes portions of the Alaska Range and will be addressed in this narrative. Harvest information discussed here will be presented on a GMU basis or, where data are available, on a GMS or management area basis (map 1).

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 Western and Interior regions.

B. Regional Summary of Hunting

The Interior Region, which includes the Alaska Range and northern Wrangell Mountains, is well known for the opportunities it offers to hunt Dall sheep. The Alaska Range is continuous alpine country and is considered to contain classic Dall sheep habitat (Heimer 1984). Its sheep population supports about 700 hunters annually, with a harvest of about 300 rams.

The Tanana/Yukon uplands area, which is also within the Interior Region, is characterized by relatively low rolling hills, with alpine habitat separated by broad timbered valleys. This area supports about 40 hunters annually, with a harvest averaging about 16 rams per year (ibid.).

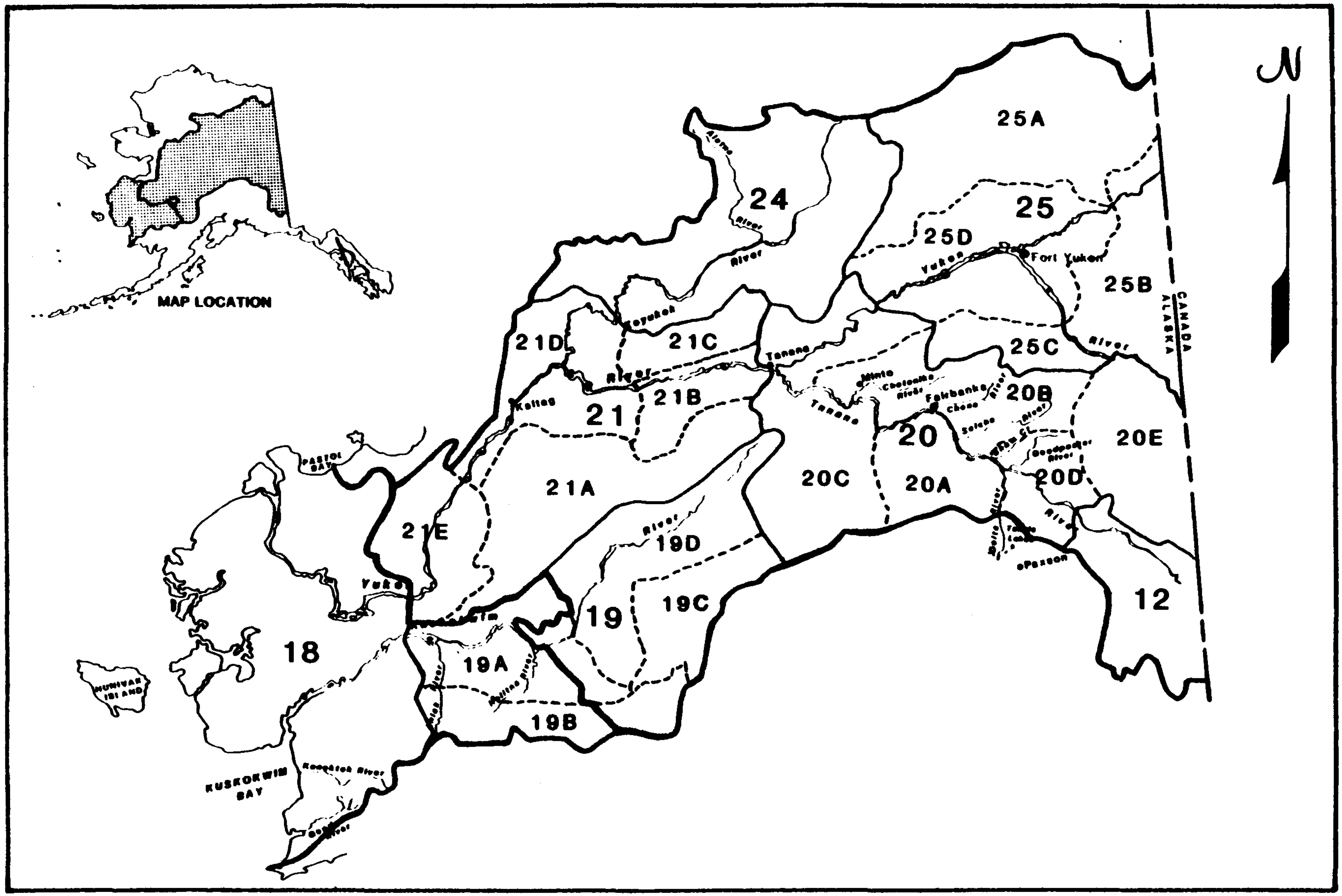
The Western Region, which includes portions of the Alaska Range, also provides good sheep hunting opportunities. The sheep population in this area supports approximately 200 hunters annually, with a harvest of about 100 7/8 curl or larger rams (ibid.). Lake Clark National Park/Preserve has withdrawn some sheep habitat in the park area from hunters; however, the preserve areas are still available to sheep hunters.

From 1980 to 1984, the total harvest in the Western and Interior regions has ranged from 338 in 1980 to 548 in 1982, with total effort (expressed in hunter-days) ranging from 4,727 days in 1981 to 6,513 days in 1983 (ADF&G 1980-1984).

C. 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 are managed for specific objectives, such as aesthetic hunting conditions or trophy class animals. The Tok Management



Map 1. GMUs of the Western and Interior regions.

Area, for example, is managed for trophy class Dall sheep. For specific information on open areas, seasons, and restrictions, see the most recent edition of the Alaska Game Regulations.

In 1980, large areas of Alaska were placed in new national parks 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 remain open for subsistence hunting by local residents only. National park/preserve lands are currently managed to allow consumptive use of game resources under regulations established by the Board of Game.

II. TOK MANAGEMENT AREA

A. Boundaries

The Tok Management Area (TMA) encompasses portions of the Alaska Range within GMU 12 and GMSs 13C and 20D (map 2). See the most recent Alaska Game Regulations or the latest GMU map for the exact legal boundary description.

B. Management Objectives

The ADF&G has developed the Tok Dall Sheep Management Plan for this area. The primary objective of this plan is to provide sustained opportunities to be selective in hunting sheep; the secondary objective is to allow sheep hunting under aesthetic conditions (ADF&G 1980).

To accomplish these objectives, the number of hunters is limited to 120 by permit drawing, with harvest for these permits restricted to full curl rams. Current regulations appear to be meeting management objectives, and the population is relatively stable (Kelleyhouse 1984).

Beginning in 1974, a lottery permit ewe hunt was established for this area by the Board of Game. In 1977, the hunt was changed to a registration hunt. It was felt that sheep in this area could withstand additional harvest if it was directed at portions of the population other than mature full curl rams. In June 1985, the Board of Game eliminated this hunt.

C. Management Considerations

Current hunter distribution within the TMA is acceptable, and no areas of excessive ram harvest have been noted. Type of access is not restricted, and hunters utilize all methods to gain access to remote areas of the TMA.

Initial participation in the registration ewe hunt was high, and harvest was concentrated in the Sheep Creek and Dry Tok drainages. This may have contributed to localized short-term declines in sheep populations in the Dry Tok drainage. Ewe harvests in the Dry Tok drainage are currently closed (Kelleyhouse 1981).

D. Period of Use

The hunting season for full curl rams in the TMA is from 10 August through 20 September. The hunting season for the registration ewe hunt is from 25 September through 30 October. (See the latest edition of the Alaska Game Regulations for current seasons and restrictions.)

E. Human Use Data

Hunters who receive a permit for the TMA must return the completed permit to the ADF&G regardless of their success. Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter permits.

Table 1 presents Dall ram harvest information for the TMA from 1979 through 1984. Data are presented by year and indicate total harvest and number of hunters. Effort, expressed in hunter-days, is not available for most years. Ewe hunt information is presented in table 2.

The largest reported harvest in the TMA during this period occurred in 1981, with 49 sheep taken by 83 hunters for a success rate of 59%. Hunter participation was similar in 1982 and 1983, although the harvest declined about 20% to 38 and 39 rams, respectively. Reported harvest and participation declined again in 1984 to 30 rams and 56 hunters, respectively. Poor weather conditions during most of the 1984 hunting season are probably responsible for this decline.

As mentioned, all access methods are permitted in the TMA. Many hunters use highway vehicles to arrive at access points on the perimeter of the TMA. Another major access is by light plane.

Table 1. Dall Sheep Harvest Information, TMA Ram Hunt, 1979-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	35	86	---
1980	44	100	---
1981	49	83	---
1982	38	81	---
1983	81	---	
1984	30	56	325

Source: Kelleyhouse 1981, 1982, 1983, 1984a, 1984b; ADF&G 1979-85.

--- means no data were available.

Table 2. Dall Sheep Harvest Information, TMA Ewe Hunt, 1979-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	29	95	---
1980	11	66	---
1981	5	---	---
1982*	0	0	0
1983	5	---	---
1984	7	25	---

Source: Kelleyhouse 1981, 1982, 1983, 1984a, 1984b, 1985.

--- means no data were available.

* Hunt cancelled due to excessive winter mortality.

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 presented in table 3 indicates that in the TMA most human use occurred in area 06, the Tok River drainage. A total of 144 days were spent by 25 hunters to harvest 13 sheep. This represents 44% of the effort, 45% of the hunters, and 43% of the harvest. The high use of this area can be attributed to relatively easy access from several points along the Glenn and Alaska highways, including a foot trail along the Tok River and several light airplane access points.

Table 3 presents ram harvest information only. Ewe hunt information is not available in this format; however, ewe harvest is localized in Clearwater and Sheep creeks north of the Tok River (Heimer, pers. comm.). These areas are readily accessible from the Glenn and Alaska highways.

Table 3. Sheep Ram Harvest and Hunter Data for TMA, 1984

Unit	Subunit	Minor	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
12	Z	06*	144	25	13
12	Z	04	56	10	5
12	Z	03	11	2	
12	Z	02	5	1	
Subunit total			216	38	18
13	C	05	13	2	1
Subunit total			13	2	1
20	D	15	66	11	8
20	D	13	30	5	3
Subunit total			96	16	11
Area total			325	56	30

Source: ADF&G 1979-85.

* Area receiving most use by hunters.

III. DELTA CONTROLLED USE AREA - PORTIONS OF GMSs 20A, 20D, AND 13B

A. Boundaries

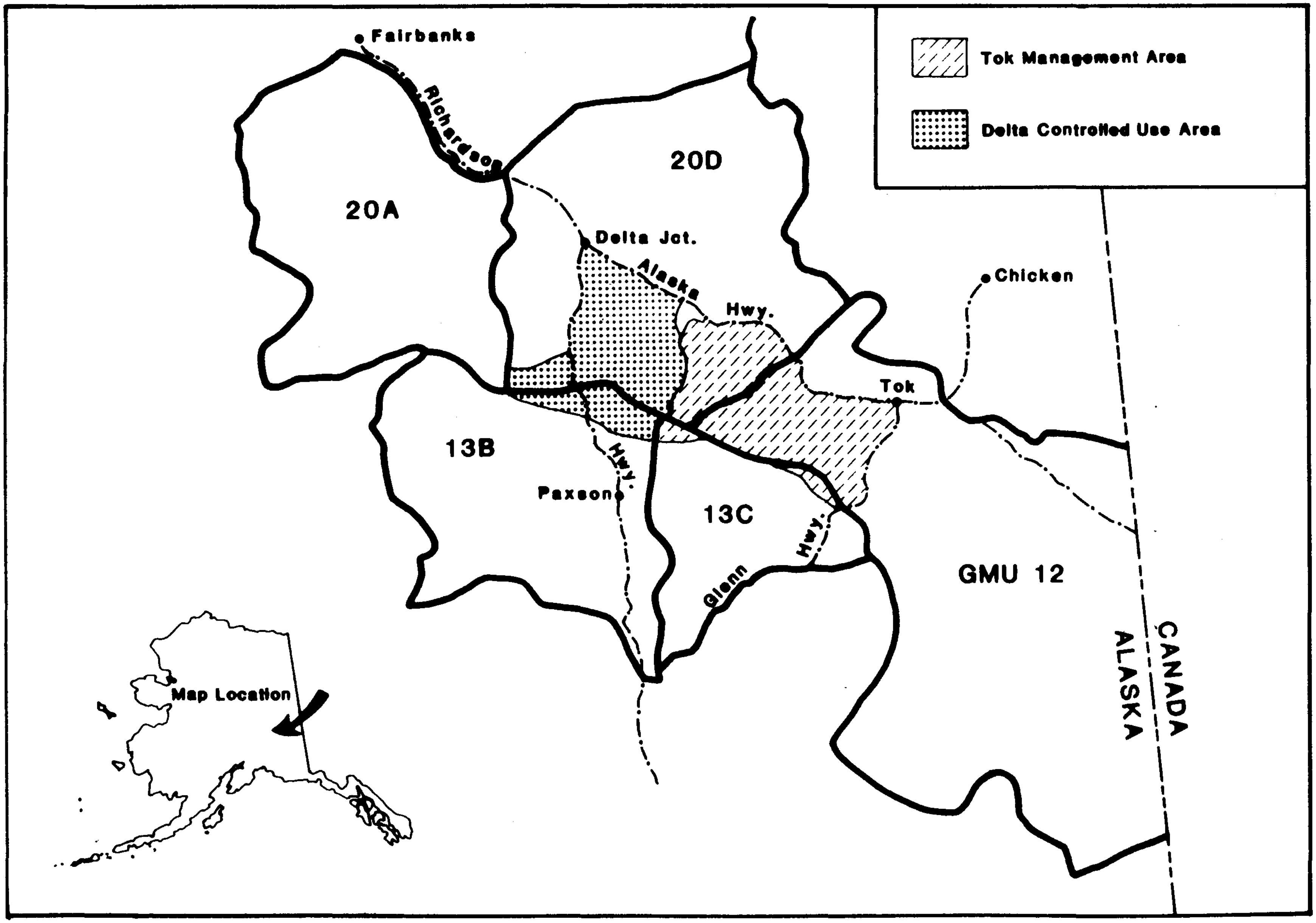
The Delta Controlled Use Area (DCUA) includes portions of the Alaska Range within GMSs 13B, 20A, and 20D (map 2). See the most recent Alaska Game Regulations or the latest GMU map for the exact legal boundary descriptions.

B. Management Objectives

The ADF&G has developed the Delta Sheep Management Plan for this area. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977). To provide for this objective, hunting is by permit, and only 150 permits are offered. Seventy-five permits are issued for the first portion of the season, which allows foot access only, and an additional 75 are issued for the second portion, which allows access of all types. Legal animals are rams with full curl horns or larger.

C. Management Considerations

Most of this area is accessible from the Richardson and/or Alaska highways. The split season permit hunt, however, has maintained harvest and hunting pressure at desired levels and prevented



Map 2. Locations of the Tok Management Area and the Delta Controlled Use Area (ADF&G 1984).

overcrowded hunting conditions and overharvest in areas adjacent to these access points.

D. Period of Use

The current use period is from 10 August through 20 September. As mentioned, 75 permits are issued for the period 10 August through 25 August, and an additional 75 are issued for the period 26 August through 20 September. (See the most recent Alaska Game Regulations for current seasons and restrictions.)

E. Human Use Data

Hunters receiving a permit for the DCUA must return the completed permit form to the ADF&G regardless of their success. Human use information reported here is obtained from ADF&G statistical reports derived from returned hunter permits.

Table 4 presents Dall sheep harvest information for the DCUA from 1980 through 1984. Data are presented by year and indicate total harvest and total hunters. The number of hunter-days is not available for all years.

Table 4. Dall Sheep Harvest Information, Delta Controlled Use Area, 1980-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1980	30	78	---
1981	30	80	---
1982	41	85	---
1983	30	78	---
1984	19	65	242

Source: Johnson 1982, 1983, 1984a, 1984b; ADF&G 1979-85.

--- means no data were available.

The largest reported harvest occurred in 1982, when 41 rams were harvested by 85 hunters, for a success rate of 48%. Reported harvest and participation are remarkably similar for 1980, 1981, and 1983, with either 78 or 80 hunters harvesting 30 rams each year. In 1984, only 19 rams were harvested by 65 hunters, which represents a 37% decrease in the harvest from 1983 and a 54% decrease from 1982. Poor weather conditions in the Alaska Range during the hunting season are the probable cause for the low hunter success.

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.

Table 5 presents harvest and hunter data for the DCUA for 1984. Area 09, the Delta River drainage within GMS 20D, received the most use by hunters during the period. Thirty-one of 65 hunters (48%) hunted in this area; they spent 112 of 242 days of effort (46%) harvesting 7 of 19 sheep (37%). This area has good access for foot hunters from points along the Richardson Highway and also provides access for hunters using ATVs and airplanes.

IV. GMU 12 - EXCLUDING TMA AND DCUA

A. Boundaries

GMU 12 encompasses the area drained by the upper Tanana River and its tributaries from the Robertson River to the Canadian border.

Table 5. Sheep Harvest and Hunter Data for DCUA, 1984

Unit	Subunit	Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
20	A	08	32	8	3
Subunit total			32	8	3
20	D	09*	112	31	7
20	D	11	25	6	4
20	D	10	22	7	1
20	D	12	19	5	1
Subunit total			210	57	16
Area total			242	65	19

Source: ADF&G 1979-85.

* Area receiving most use by hunters.

This area includes the eastern portion of the Alaska Range and the North Wrangell, Mentasta, and Nutzotin mountains. (See the most recent Alaska Game Regulations or the latest GMU map for the exact boundary description.)

B. Management Objectives

In 1980, portions of GMU 12 were placed in the new Wrangell-St. Elias National Park/Preserve and the Tetlin National Wildlife Refuge. The NPS and USFWS are mandated by federal law to manage game resources utilizing plans developed by the ADF&G unless those plans are incompatible with NPS or USFWS policy. The management plans for Wrangell-St. Elias Park/Preserve and the Tetlin NWR are in preparation by the NPS and USFWS, and final decisions concerning management policy will be determined at a future date.

The ADF&G has developed the Wrangell-Mentasta Mountains Sheep Management Plan for this area. The objective of this plan is to provide the greatest opportunity to participate in hunting sheep (ibid.).

C. Management Considerations

Expanded mining activity in the Chisana area could result in disturbance to sheep and possible population decline. Limitations on resource developments in areas critical to sheep, through mutual agreements with land-managing agencies, may limit the impacts of land development on sheep.

The nature of the NPS's policy regarding future hunting opportunities within the park and preserve is undetermined. Until now, the NPS has allowed 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 opportuntunities for hunters in this area.

D. Period of Use

The hunting season for Dall sheep in GMU 12 begins on 10 August and extends through 20 September. Beginning in 1984, minimum horn size for legal rams was full curl. (See the most recent 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 and GMS 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 6 presents Dall sheep harvest information for GMU 12 from 1979 through 1984. Data are presented by year and indicate total harvest, total hunters, and number of hunter-days.

The number of hunters in this area has increased annually, except for 1980 and 1984, and reached a high in 1983 with 440 participants. In 1980, confusion about federal land withdrawals and subsequent public access to hunting areas probably contributed to the smaller number of hunters. In 1984, inclement weather conditions during the sheep hunting season appears to have limited participation, effort, and success.

Table 6. Dall Sheep Harvest Information, GMU 12 (excluding TMA and DCUA), 1979-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1979	193	350	---
1980	212	324	---
1981	228	399	---
1982	227	431	---
1983	200	440	2,523
1984	137	361	1,962

Source: Kelleyhouse 1981, 1982, 1983, 1984a, 1984b; ADF&G 1979-85.

--- means no data were available.

The 1984 harvest 137 rams is the lowest recorded during this period. The largest reported harvest occurred in 1981, with 228 rams harvested by 399 hunters, for a success rate of 57%.

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 presented in table 7 indicates that area 08, the Nabesna River drainage, received the most use by hunters during 1984. A total of 1,055 days (54%) were spent by 208 hunters (58%) to harvest 67 sheep (49%).

This area has long been recognized for its sheep hunting opportunities and in addition provides good access from the Nabesna road and numerous airplane access points. This area is now included within the Wrangell-St. Elias Preserve, which allows general harvest activities.

Table 7. Sheep Harvest and Hunter Data for GMU 12Z, Excluding TMA and DCUA, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
08*	1,055	208	67
10	360	58	30
09	275	44	26
06	74	18	8
00	136	26	3
04	13	3	1
07	49	4	2
Subunit total	1,962	361	137

Source: ADF&G 1979-85.

* Area receiving most use by hunters.

V. GMS 16B

A. Boundaries

GMS 16B covers the southern slope of the Alaska Range from the southwestern corner of the Denali National Park (including the preserve area) to the Lake Clark National Park boundary. See the most recent Alaska Game Regulations or the latest GMU map for the legal boundary descriptions.

B. Management Objectives

The Rainy Pass Sheep Management Plan developed by the ADF&G applies to this area. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977).

C. Management Considerations

Hunter access, and therefore harvest pressure, is restricted in this area to relatively few landing areas and lakes. Distribution of harvest pressure is therefore limited and directed at sheep populations adjacent to these access points. Decreasing quality of the hunting experience in localized situations could result if these conditions continue.

D. Period of Use

See section X.D.

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU and GMS 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 8 presents Dall sheep harvest information for GMS 16B for 1983 and 1984. Human use information prior to this period is not available on a subunit basis. Data are presented by year and indicate total harvest, total hunters, and number of hunter-days.

Table 8. Dall Sheep Harvest Information, GMS 16B, 1983-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1983	11	22	168
1984	14	29	230

Source: ADF&G 1979-85.

Effort, expressed in hunter-days, increased 27% in 1984. Harvest and number of hunters also increased in 1984 by 21 and 24%, respectively.

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.

Table 9 presents sheep harvest and hunter data for GMS 16B for 1984. These data indicate that area 06, the Skwentna River drainage, received most hunter use during this period. A total of 14 of 29 hunters (48%) expended 127 of 230 total days (55%), harvesting 7 of 14 sheep (50%).

VI. GMS 19B

A. Boundaries

This GMS encompasses portions of the southwestern Alaska Range near Telaquana Lake and also portions of the Lake Clark Preserve

Table 9. Sheep Harvest and Hunter Data for GMS 16B, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
06*	127	14	7
11	43	5	1
09	20	4	3
00	12	2	2
08	10	1	1
16	8	1	0
12	7	1	0
17	3	1	0
Subunit total	230	29	14

Source: ADF&G 1979-85.

* Area receiving most use by hunters.

--- means no data were available.

area, created in 1980. See the most recent Alaska Game Regulations or the latest GMU map for the legal boundary descriptions.

B. Management Objectives
See section X.B.

C. Management Considerations
In 1980, most of the available sheep habitat in this area was included within the boundaries of the Lake Clark National Park/Preserve. Hunter activity and harvest declined in this area from 1977 through 1982 (Watson and Heimer 1984) but now appear to have stablized (Pegau 1984). Approximately 250 sheep are available to hunters in the preserve portion; yet only two to seven hunters have reported hunting in the preserve in each of the last five years (ibid.).

D. Period of Use
See section X.D.

E. Human Use Data
Beginning in 1962, hunters were required to return harvest reports specifying the GMU and GMS 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 10 presents Dall sheep harvest information for GMS 19B for 1980-1984. During this period, harvest activity in GMS 19B peaked

Table 10. Dall Sheep Harvest Information, GMS 19B, 1980-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1980	4	6	37*
1981	6	9	45*
1982	10	34	163*
1983	5	11	66
1984	8	15	64

Source: ADF&G 1979-85; Pegau, pers. comm.

* Total hunter-days were determined by multiplying mean days hunted for the entire Alaska Range by the number of hunters for GMS 19B.

in 1982 and then declined slightly thereafter. Ten rams were killed in 1982 by 34 hunters, over twice as many hunters than during any other year. Reasons for this large increase in activity are not apparent at this time. Effort, expressed in hunter-days, is not directly comparable between years; however, there is an apparent peak of activity during 1982, with 163 hunter-days expended.

Harvest activity has remained relatively constant in this area, with slight increases in total harvest and number of hunters in 1984 as compared with 1983.

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 indentifying each UCS minor tributary.

Table 11 indicates that reported human use in this GMS during 1984 was evenly distributed between two areas: the Telequana River drainage and the Stony River drainage. Each area had a harvest of four sheep, and the Telequana drainage had one more reported hunter and six more days of effort.

Table 11. Sheep Harvest and Hunter Data for GMS 19B, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	Successful Hunters
13	35	8	4
14	29	7	4
Subunit total	64	15	8

Source: ADF&G 1979-85.

VII. GMS 19C

A. Boundaries

This GMU encompasses the Alaska Range west of the Denali National Park, including the preserve portion created in 1980. See the most recent Alaska Game Regulations or the latest GMU map for the legal boundary descriptions.

B. Management Objectives

The Farewell Sheep Management Plan developed by the ADF&G applies to portions of this area. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977).

C. Management Considerations

Hunter activity and harvest declined in this area from 1979 through 1982 (Watson and Heimer 1984) but now appear to have stabilized near the long-term average (Pegau 1984). This decline was probably due in part to the enactment of the Alaska Native Claims Settlement Act of 1979 and the subsequent land withdrawal (Watson and Heimer 1984).

Much of this area is highly mineralized and will probably experience increased mining activity and associated development in the future. Important lambing and wintering areas could be destroyed, resulting in displacement and/or actual loss of sheep (ADF&G 1977). Additional study is needed to identify important sheep habitat that may be impacted by developmental activities.

D. Period of Use

The hunting season in this area has been from 10 August through 20 September since statehood. From 1979 to the present, legal rams must have 7/8 curl horn or larger; prior to that, 3/4 curl horn rams were legal.

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU and GMS 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 12 presents Dall sheep harvest information for GMS 19C for 1980-1984. Data are presented by year and indicate total harvest, total hunters, and number of hunter-days.

Table 12. Dall Sheep Harvest Information, GMS 19C, 1980-84

Year	Harvest	No. of Hunters	Hunter-Days
1980	56	100	610*
1981	61	92	460*
1982	61	106	509*
1983	63	127	651
1984	84	131	670

Source: ADF&G 1979-85; Pegau, pers. comm.

* Total hunter-days for 1980-82 were determined by multiplying mean days hunted for the entire Alaska Range West by the number of hunters for GMS 19C.

Sheep harvest in GMS 19C has remained relatively stable except for 1984, when it increased by 25%. The number of hunters remained stable during 1980-1982 but increased in 1983 by about 17% and then remained stable in 1984. Total effort figures are not directly comparable, but there appears to have been an increase in effort during the 1983 season. Harvest activity had been declining in this area; however, these increases appear to have reversed that trend.

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 area 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.

Table 13 provides harvest data for GMS 19C for the 1984 season. Area 05, Windy Fork of the Kuskokwim River, received the most human use during this period. This area accounted for 208 of 670 days of effort (31%), 43 of 131 total hunters (33%), and 28 of 84 sheep harvested (33%).

Table 13. Sheep Harvest and Hunter Data for GMS 19C, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
05*	208	43	28
14	85	20	13
08	78	12	8
06	64	10	6
00	57	12	6
07	48	8	8
09	42	8	5
03	29	4	1
11	26	5	2
04	22	6	6
12	10	1	0
13	1	1	0
10	---	1	1
Subunit total	670	131	84

Source: ADF&G 1979-85.

* Area receiving the most use by hunters.

VIII. GMS 20A

A. Boundaries

This area encompasses the central portion of the Alaska Range east of Denali National Park. (See the most recent Alaska Game Regulations, or the latest GMU map for legal boundary descriptions.)

B. Management Objectives

The ADF&G has developed the Central Alaska Range Sheep Management Plan for this area. The objective of this plan is to provide the greatest sustained opportunity to participate in hunting sheep (ADF&G 1977).

C. Management Considerations

Mining and prospecting activity is increasing in this area, and subsequent development of some claims is expected. Mineral licks are extremely important habitat for sheep and are often associated with mineral claims of potential commercial value. All sheep mineral licks have not yet been documented. Development of any mining claims in the area should take place only after research has been conducted to determine the relationship between sheep and the mineralized area.

D. Period of Use

The hunting period for sheep in this area is 10 August to 20 September, unchanged since statehood (ibid.). Legal horn size has increased from 3/4 curl to 7/8 curl in 1979 and to full curl in 1984 (ADF&G 1984). (See the latest 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 reports derived from returned hunter reports.

Table 14 presents Dall sheep harvest information for GMS 20A for 1983 and 1984. Human use information prior to this period is not available by subunit. Data are presented by year and indicate total harvest, total hunters, and number of hunter-days.

Table 14. Dall Sheep Harvest Information, GMS 20A

Year	Harvest	No. of Hunters	No. of Hunter-Days
1983	103	210	1,204
1984	108	300	1,514

Source: ADF&G 1979-85.

Harvests in this GMU remained similar from 1983 to 1984, while the number of hunters and total effort increased considerably. In 1984, total hunters increased by 33% while effort increased by 20%. Reasons for this increase are not directly attributable to any one factor; however, the human population of Fairbanks has increased rapidly, and additionally, access to this GMS is good and readily available. GMS 20A is considered to be classic Dall sheep habitat, and further increases in human use can be expected. Few roads or trails enter into GMS 20A, and access is primarily by light aircraft. Registered guides operate within the GMS, providing access by horses in some areas.

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 15 indicates that two areas in GMS 20A received most of the 1984 sheep hunting pressure: 1) the Wood River drainage (04) and 2) the Nenana River drainage within GMS 20A. The Wood River area had the largest harvest (43) and the greatest number of days hunted (486). This represents 40% of the total harvest and 32% of the total effort for GMS 20A. The Nenana River drainage received the second highest effort in total days hunted (478) and had the greatest number of hunters for all reported areas (116). This represents an additional 32% of the effort and 39% of all hunters.

Table 15. Sheep Harvest and Hunter Data for GMS 20A, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
04*	486	85	43
01*	478	116	27
06	190	29	14
07	113	16	8
02	66	14	2
08	55	11	3
05	48	11	6
03	47	10	5
00	31	8	
Subunit total	1,514	300	108

Source: ADF&G 1979-85.

* Areas receiving most use by hunters.

IX. GMS 20C

A. Boundaries

GMS 20C encompasses the area immediately north and northwest of Denali National Park. (See the most recent Alaska Game Regulations or the latest GMU map for legal boundary descriptions.)

B. Management Objectives

The Central Alaska Range Sheep Management Plan developed by the ADF&G applies to the eastern portion of the GMU. The primary objective of this plan is to provide the greatest sustained opportunity to participate in hunting sheep (ADF&G 1977).

C. Management Considerations

Expanded development of coal deposits in the Usibelli/Healy area could cause displacement of sheep or damage to habitat in that area.

In 1980, the boundaries of Denali National Park/Preserve were expanded. This action withdrew most of the available sheep hunting areas north and west of the old boundary by placing them in park status. Relatively limited sheep harvest activity occurred in this area, and the actual loss to hunters was minimal.

D. Period of Use

The hunting period for sheep in this area is 10 August to 20 September, unchanged since statehood (ibid.). Legal horn size has increased from 3/4 curl to 7/8 curl in 1979 and to full curl in 1984 (ADF&G 1984). (See the latest 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 and GMS 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 16 presents Dall sheep harvest information for GMS 20C for 1983 and 1984. Human use information prior to this period is not available on a subunit basis. Data are presented by year and indicate total harvest, total hunters, and total hunter-days.

Table 16. Dall Sheep Harvest Information, GMS 20C, 1983-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1983	21	88	367
1984	0	8	21

Source: ADF&G 1979-85.

Harvest, effort, and total hunters decreased dramatically in this GMU from 1983 to 1984. There was no reported harvest in 1984, effort declined over 94%, and total hunters declined over 90%. This decrease in effort and harvest is a result of a GMU boundary change for the 1984 season. The GMS 20A boundary was extended westward to the Parks Highway, resulting in the inclusion of a portion of GMS 20C. Harvest from that area is now included in the GMS 20A harvest figures, with the subsequent decline in GMS 20C use.

F. Significance of Particular Use Area

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.

Table 17 indicates that area 06, the Nenana River in GMS 20C, received the most hunter use during 1984. This area is near Denali National Park and the Parks Highway and allows relatively easy access for hunters.

Table 17. Sheep Harvest and Hunter Data for GMS 20C, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
06*	16	6	0
00	3	1	0
05	2	1	0
Subunit total	21	8	0

Source: ADF&G 1979-85.

* Area receiving the most use by hunters.

X. GMS 20E - GLACIER MOUNTAIN CONTROLLED USE AREA (GMCUA)

A. Boundaries

The Glacier Mountain Controlled Use Area (GMCUA) is located in the northeastern corner of GMS 20E. (See the most recent Alaska Game

Regulations or the latest GMU map for legal boundary descriptions.)

B. Management Objectives

The Tanana Hills Sheep Management Plan has been developed by the ADF&G for sheep populations in this area. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ibid.).

C. Management Considerations

Relatively easy access to portions of this area resulted in establishment of regulations designed to maintain aesthetic hunting conditions in the GMCUA. Use of motorized vehicles for transportation of hunters is prohibited.

Two proposed transportation corridors through this area and development of a nearby asbestos deposit could lead to increased use of the area and impact the sheep population. Proper placement and construction of the roads may minimize impacts to sheep in the area (ibid.).

D. Period of Use

The hunting season in the GMCUA is from 10 August through 20 September. Beginning in 1984, Dall rams with full curl or larger horns were legal. Consistent with the management objectives for this area, no motorized vehicles are allowed to transport hunters, gear, or game within the GMCUA from 5 August through 21 September.

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU and GMS they hunted; in 1967, they were required to report the specific area they hunted. Human use information reported here is obtained from ADF&G reports derived from returned hunter reports.

In 1984, only four hunters reported hunting in GMCUA. All four were successful and expended a total of 25 hunter-days of effort. Participation and harvest may be higher than reported, as some hunters do not return the required harvest reports.

XI. GMS 20E - (EXCEPT GMCUA) AND THAT PORTION OF GMS 20D NORTH OF THE ALASKA HIGHWAY

A. Boundaries

See the most recent Alaska Game Regulations or the latest GMU map for legal boundary descriptions.

B. Management Objectives

The Tanana Hills Sheep Management Plan developed by the ADF&G applies to this area also. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977). To meet this objective, the Board of Game in 1983 placed the remaining area of GMS 20E (exclusive of the GMCUA) and that portion of GMS 20D north of the Alaska Highway in a permit hunt classification for the 1984 hunting season. To further distribute harvest pressure, four permits are issued for each of three areas for a total of 12.

C. Management Considerations
Hunter use of this area has been increasing in recent years. Therefore, to maintain management objectives and protect the sheep population, permit hunt regulations were established.

D. Period of Use
The hunting season in this area begins 10 August and extends through 20 September. Dall rams with full curl horns or greater or with both horns broken are legal. (See the latest Alaska Game Regulations for current restrictions and limitations.)

E. Human Use Data
Hunters who receive a permit for this area must return the completed permit to the ADF&G regardless of their success. Human use information reported here is obtained from ADF&G reports derived from returned permit information. Table 18 presents harvest data for 1984.

Table 18. Sheep Harvest Information, GMSs 20E and 20D North of Alaska Highway, 1984

GMU	Harvest	No. of Hunters	No. of Hunter-Days
20D	1	1	10
20E	0	4	18
Total	1	5	28

Source: ADF&G 1979-85.

Because this area has received intensive harvest pressure, it was designated a permit hunt area by the Board of Game for the 1984 season. It is probable that this area will remain under permit hunt regulations. Therefore, human use information is presented only for 1984 to allow for future comparisons.

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.

Table 19 presents sheep harvest and hunter data for GMSs 20E and 20D north of the Alaska Highway for 1984. Only three areas within this region had reported hunting activities. Effort and participation were divided almost equally between the three, and only one sheep was reported harvested.

Table 19. Sheep Harvest and Hunter Data for GMSs 20E and 20D North of the Alaska Highway, 1984

Subunit	Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
D	03	10	1	1
Subunit total		10	1	1
E	02	8	2	0
E	08	10	2	0
Subunit total		18	4	0
Area total		28	5	1

Source: ADF&G 1979-85.

XII. GMU 24

A. Boundaries

GMU 24 encompasses the Koyukuk River drainage and its tributaries upstream from but not including the Dulbi River drainage. This area includes the mountainous regions on the south slope of the middle portion of the Brooks Range. (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 Southern Brooks Range Management Plan, which applies to this area, has a primary objective to provide the greatest sustained opportunity to hunt sheep under aesthetically pleasing conditions. A secondary objective is to provide an opportunity to be selective in hunting sheep (Bos 1980).

C. Management Considerations

In 1980, the Gates of the Arctic National Park and Preserve (GAAR) was created by ANILCA legislation. The majority of all sheep habitat within GMU 24 is included within the boundaries of this park/preserve. The only sheep habitat remaining available to general hunters is a narrow band located east of the trans-Alaska pipeline corridor and an area near Wild Lake on the southern border of the park/preserve.

Beginning in 1982, the Alaska Board of Game established that Alaska residents whose permanent residence is within Gates of the Arctic National Park and Preserve were allowed a special registration hunt to take sheep. In 1983, the game board complied with provisions of ANILCA and expanded subsistence hunting opportunities to all residents of the subsistence zone associated with GAAR. This zone, as defined by ANILCA, includes residents of Alatna, Allakaket, Ambler, Anaktuvuk, Bettles, Hughes, Kobuk, Nuiqsut, Shungnak, and Wiseman.

The limit for this hunt is three sheep of either sex, with a 50-sheep quota. The season is from 1 August to 30 April, with most of the harvest occurring in late winter. Airplanes are not allowed for transportation of hunters or meat.

Sheep population fluctuations could occur as a result of increased localized hunting from residents. The late-season hunt that allows hunters to take three sheep of either sex is considered a higher risk to sheep populations than the general early season harvest of mature rams (Heimer 1984). Areas of localized harvest during the late season should be identified, therefore, and populations in these areas surveyed annually (ibid.).

D. Period of Use

The general 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. As mentioned previously, in 1982 a special extended season for residents living within the GAAR was provided for by the Alaska Board of Game. This season runs 1 August through 30 April.

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU in which they hunted; in 1967, they were required to report the specific area within the GMU they hunted.

In 1980, the major portion of GMU 24 was placed within the Gates of the Arctic National Park and Preserve. Local subsistence hunters are the only persons allowed to legally hunt within the national park.

Table 20 presents Dall sheep harvest data for GMU 24 from 1980 through 1984. As can be seen in table 20, the number of hunters increased 38% from 1980 to 1981 (possibly as a result of land status changes in other parts of Alaska) and then remained relatively constant through 1984. The effort expressed in hunter-days was also relatively high in 1981. Harvest increased over 44% from 1980 to 1981 and then declined to a relatively constant rate through 1984.

F. Significance of Particular Use Areas

Beginning in 1983, the ADF&G introduced a new system for coding the hunters' harvest, the Uniform Coding System (UCS), designed to

Table 20. Reported Dall Sheep Harvest Information in GMU 24, 1980-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1980	15	34	---
1981	27	55	297
1982	19	51	239
1983	18	46	253
1984	14	56	235

Source: ADF&G 1979-85.

--- means no data were available.

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.
Data presented in table 21 indicate that one particular area in GMU 24, the Middle Fork of the Koyukuk River (15), received most of the hunting pressure during 1983 (ADF&G 1984).
The Middle Fork of the Koyukuk River had 160 of 253 (63%) total hunter-days, 28 of 46 (61%) hunters, and 9 of 18 (50%) sheep harvested.

XIII. GMS 25A

A. Boundaries

GMS 25A encompasses the mountainous regions of the south slope of the eastern Brooks Range from the Canadian border west to near the upper drainages of the Koyukuk River. (See the latest Alaska Game Regulations or the latest GMU map for the exact legal description.)

B. Management Objectives

In 1980, portions of GMS 25A were included within the Arctic National Wildlife Refuge. The USFWS is cooperating with the ADF&G in the development of a management plan for the refuge, and final decisions regarding management policy will be determined at a later date.

Table 21. Reported Dall Sheep Harvest and Permit Harvest and Hunter Data in GMU 24, 1983-84

Minor Tributary	No. of Hunter-Days	No. of Hunters	Harvest
15*	160	28	9
12	55	10	7
00	24	4	0
14	6	1	0
11	5	1	0
09	2	1	1
13	1	1	1
Unit total	253	46	18

Source: ADF&G 1979-85.

* Area of particular significance.

The ADF&G has developed the Southern Brooks Range Sheep Management Plan, which applies to this area. The Southern Brooks Range Sheep Management Plan has a primary objective to provide the greatest sustained opportunity to hunt sheep under aesthetically pleasing conditions. A secondary objective is to provide an opportunity to be selective in hunting sheep (Bos 1980).

C. Management Considerations

Local overharvest of sheep by residents of Arctic Village could prove to be a problem in the future. As yet, sheep populations appear to be able to withstand current harvest levels. Additional information is needed on the population and harvest levels.

D. Period of Use

The general hunting season has been from 10 August through 20 September. Dall sheep rams with 7/8 curl or larger horns have been legal since 1979. Hunting in portions of GMSs 25A and 26C, the former Arctic National Wildlife Refuge, was conducted on a lottery permit basis in 1980 and 1981. The hunts ran in conjunction with the general hunting season and were eliminated after 1981.

Beginning in 1981, a registration permit hunt was established by the Board of Game from 1 October through 30 April for portions of GMSs 26C and 25A. The limit is three sheep, with a total allowed harvest of 50.

E. Human Use Data

Beginning in 1962, hunters were required to return harvest reports specifying the GMU in which they hunted. Starting in 1967, they were required to report the specific area within the GMU they hunted.

As seen in table 22, harvest in GMS 25A increased considerably from 1980 to 1981 and then remained relatively stable during 1981-1984. The total number of hunters increased from 1980 to 1981 and increased again by 24% from 1981 to 1982, then declined in 1983 and 1984. Hunter-days are not available for 1980 and 1981. The total effort increased from 1982 to 1983 by 22% and then dropped by 46% in 1984. The reason for this decline is not clear. Harvest figures presented here do not include sheep harvested by lottery permit.

Table 23 presents 1980 and 1981 Dall sheep harvest information for lottery permit areas in GMS 25A.

F. Significance of Particular Use Areas

Beginning in 1983, the ADF&G introduced a new system for coding the hunters' 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.

Table 24 presents the reported 1983-1984 sheep harvest information from GMS 25A. As seen in table 24, three areas in GMS 25A received the most use during 1983-1984. These areas were the East Fork of the Chandalar River (05), the Middle Fork of the Chandalar River (03), and the upper Sheenjek River (13). The East Fork of the Chandalar River had the greatest total effort, 175 of 587 (30%) of the hunter-days, whereas the Middle Fork of the Chandalar River had the greatest number of hunters, 19 of 65 (29%). The upper Sheenjek River had the largest harvest, 10 of 32 (31%).

XIV. GMS 25C

A. Boundaries

This area includes portions of the White Mountains region of the Tanana-Yukon uplands. (See the most recent Alaska Game Regulations or the latest GMU map for legal boundary descriptions.)

B. Management Objectives

The White Mountains Sheep Management Plan developed by the ADF&G applies to portions of this area. The objective of this plan is to provide sustained opportunities to hunt sheep under aesthetically pleasing conditions (ADF&G 1977).

C. Management Considerations

Sheep distribution is limited to areas of scattered alpine habitat within this area. Sheep density is low; however, hunting pressure and harvest are increasing (Jennings 1984).

The most serious threat to sheep in this area is displacement and habitat loss associated with mining activity and other development

Table 22. Reported Dall Sheep Harvest Information in GMS 25A, 1981-84

Year	Harvest	No. of Hunters	No. of Hunter-Days
1980	19	35	---
1981	32	56	---
1982	38	74	457
1983	32	65	587
1984	32	56	314

Source: ADF&G 1979-85.

--- means no data were available.

Table 23. Reported Dall Sheep Harvest Information for Drawing Permits in GMS 25A, 1980, 1981

Year	Harvest	No. of Hunters	No. of Hunter-Days
1980	7	23	---
1981	16	27	---

Source: Heimer 1982, Watson 1983.

Table 24. Reported Dall Sheep Harvest and Permit Harvest and Hunter Data in GMS 25A, 1983-84

Minor Tributary	No. of Hunter-Days	No. of Hunters	Harvest
05*	175	10	7
03*	152	19	9
13*	125	18	10
04	56	7	3
07	36	4	1
00	17	3	0
08	15	2	0
15	11	2	2
Subunit total	587	65	32

Source: ADF&G 1979-85.

* Areas of particular significance.

(ibid.). Because of the limited habitat available, any range loss would seriously affect the sheep population.

D. Period of Use

Since 1955, the hunting season in this area has been from 10 August through 20 September (ADF&G 1977). Dall rams with 7/8 curl horns or larger have been legal since 1979.

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 25 presents Dall sheep harvest information for GMS 25C for 1983 and 1984. Data are presented by year and indicate total harvest, total hunters, and number of hunter-days.

The number of hunters and total effort increased in this area during 1984 by 41 and 25%, respectively.

This area is relatively close to Fairbanks and probably receives most of its use from that city. However, sheep populations are of low density in this GMS and will not support continuing increases in use.

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

Table 25. Dall Sheep Harvest Information, GMS 25C

Year	Harvest	No. of Hunters	No. of Hunter-Days
1983	0	10	62
1984	1	17	83

Source: ADF&G 1979-85.

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 presented in table 26 demonstrates that area 02 (Upper Beaver Creek) received the most hunter-use during 1984. Although no sheep were reported harvested from this area of GMS 25C, it had 12 of 17 total hunters (70%), who spent 53 of 83 (64%) total days in the field.

Table 26. Sheep Harvest and Hunter Data for GMS 25C, 1984

Minor Tributary	No. of Hunter-Days	No. of Hunters	No. of Successful Hunters
02*	53	12	
01	30	5	1
Subunit total	83	17	1

Source: ADF&G 1979-85.

* Area receiving most use by hunters.

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Human Use of Moose
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

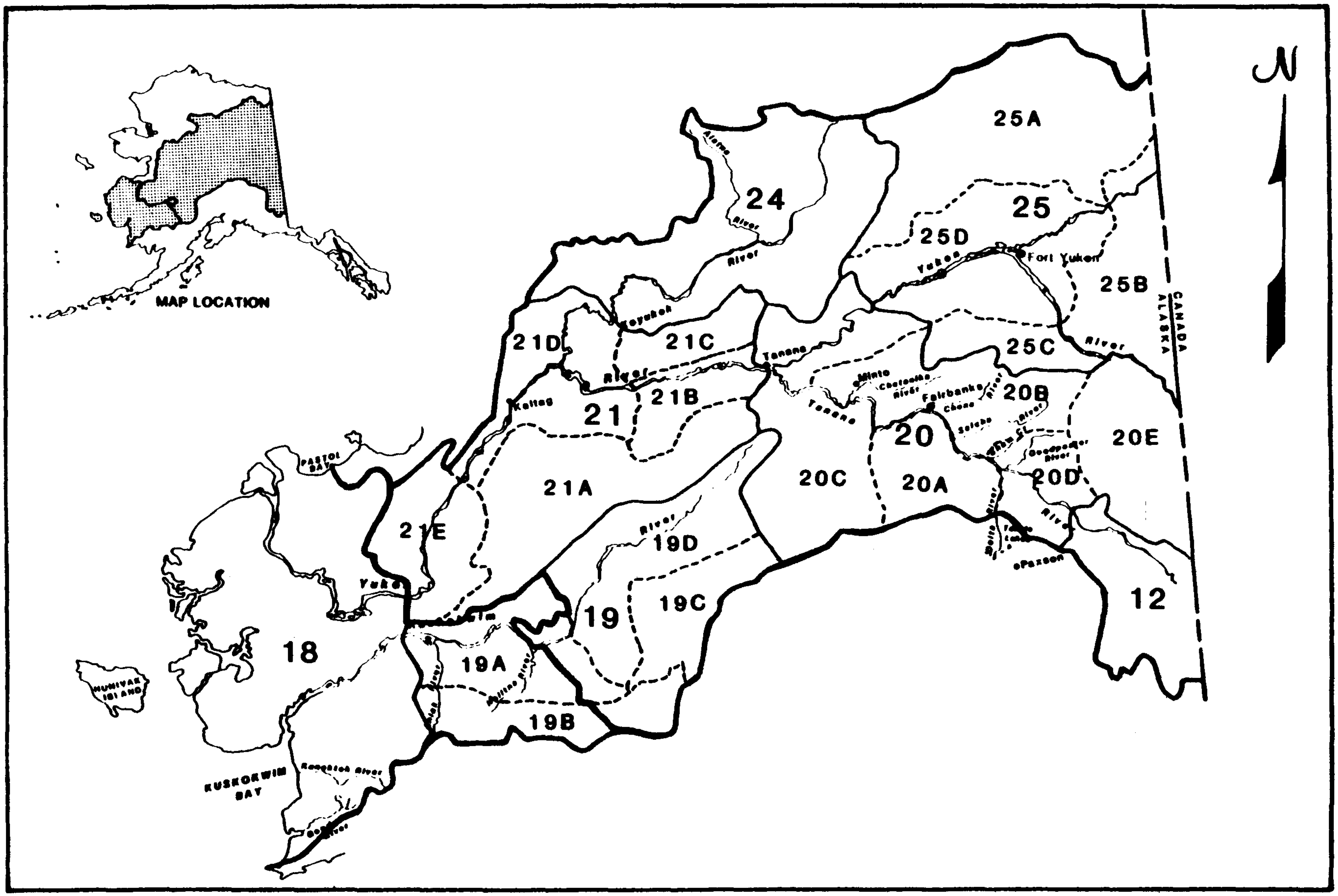
A. Introduction

Human use data in the following sections are presented by game management subunit (GMS), with the exception of Game Management Units (GMUs) 12 and 18, which have no subunits (see map 1). The data are presented for the regulatory years 1979-1980 through 1984-1985 and include the reported number of hunters and harvest and, where available, the estimated harvest. Beginning with the 1983-1984 hunting season, the Division of Game has used 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; the drainage of a minor tributary or island group; and the specific harvest unit (Uniform Code Unit [UCU]) within the minor tributary. Harvest and hunter data by minor tributary are displayed on 1:1,000,000-scale maps in the Atlas to the guide for the Western and Interior regions and on 1:250,000-scale reference maps in ADF&G offices. Minor tributary data will be presented for regulatory years 1983-1984 and 1984-1985 in the Significance of Particular Use Areas sections. The data are coded to minor tributaries because accuracy is currently greatly diminished at the UCU level. Although this information is more detailed than GMU or GMS data, it should be interpreted cautiously. When reported data are applied to large geographic areas, odd or erroneous data are somewhat buffered and may not significantly affect the data summaries. When applied to smaller geographic areas, however, unusual information can drastically influence data summaries.

Frequently, those minor tributary units that receive the highest use are near population centers and/or are associated with major access points. The UCS data presented in the Significance of Particular Use Areas sections should be used in conjunction with the human use maps and access maps.

B. Regional Summary of Hunting

On a regionwide basis (Western and Interior regions combined), the reported number of hunters and harvest has increased since 1979. During the 1984-1985 regulatory year, a total of 7,953 hunters reported hunting for 47,287 days and harvested 2,606 moose (ADF&G 1985). Substantial fluctuations in the reported harvest and the number of hunters afield have occurred prior to 1979 and both prior to and after 1979 on a GMU and/or GMS basis. There are numerous reasons for these fluctuations, including moose



Map 1. GMUs of the Western and Interior regions.

population increases and declines, regulatory restrictions and relaxations, weather conditions during the hunting seasons, error or inadequacies in reporting, and others.
Although improving, harvest ticket reporting remains less than adequate in much of the Western and Interior regions. Check stations have been set up in several locations in the Interior Region and generally result in much greater compliance with harvest ticket and registration permit reporting. These improvments, however, are generally restricted to a particular GMS or portion of a GMS. In all cases, the reported number of hunters and harvest should be considered a minimum.
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.

II. GMU 12

A. Boundaries

GMU 12 primarily consists of the Upper Tanana and White rivers. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to GMU 12: the Yukon-Tanana Moose Management Plan (ADF&G 1977). Its primary management objective is to provide the greatest sustained opportunity to participate in hunting moose; its secondary objective is to provide sustained opportunities for subsistence use of moose (State of Alaska 1984a).

C. Management Considerations

Predation appears to be the primary factor influencing the moose population in GMU 12. Studies conducted in adjacent areas indicate that the high rate of early calf mortality is caused by black and brown bears and wolves (Kelleyhouse 1985a). Browse studies conducted in the GMU indicate that, with the exception of the Tok, Little Tok, and upper Tetlin river drainages during years of deep snow, winter ranges are used only moderately or are grossly understocked (Kelleyhouse 1984a, 1985a). During March 1983, approximately 350 acres of old-age, riparian felt-leaf willow (<u>Salix alaxensis</u>) were crushed. Production was expected to increase five-fold within two years after crushing (Kelleyhouse 1985a). The Fortymile Fire Management Plan was implemented in May 1984 and is expected to result in the restoration of a near-natural fire regime over 60 to 80% of the unit. This restoration should eventually result in a habitat mosaic with a higher percentage of brush land and deciduous forest, conditions favorable to moose (ibid.).

D. Period of Use

Hunting seasons generally have been during the month of September and range in length from 10 to 30 days, depending upon where in the unit hunting takes place. (See the latest Alaska Game Regulations for the current hunting seasons and bag limits.)

E. Human Use Data

Table 1 presents hunter and harvest data in GMU 12 for regulatory years 1979-1980 through 1984-1985.

The apparent increase in the number of hunters reporting from the 1979-1980 season compared to the 1980-1981 season may not be a real increase, because reminder letters were not sent for the 1979-1980 hunting season, and it is likely that a number of hunters failed to return their permits. No explanations were found concerning subsequent increases and decreases in the number of hunters hunting and in harvest.

F. Significance of Particular Use Areas

Tables 2 and 3 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMU 12 but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

III. GMU 18

A. Boundaries

GMU 18 consists primarily of the Yukon-Kuskokwim delta. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to GMU 18: the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977). Its primary management objective is to provide sustained opportunities for subsistence use of moose, and its secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (State of Alaska 1984b).

C. Management Considerations

During most years, the out of season harvest of moose during winter and spring is one of the most serious management problems in GMU 18. The problem is aggravated by a lack of alternative game resources, a poorly developed cash economy, and an unusually high density of people and villages (Machida 1985). Although little is known about predation in GMU 18, it is probably not a significant source of moose mortality. Wolves are rare to nonexistent throughout most of the unit and, although brown bears are common in the Andreafsky and Kilbuck mountains, there is little evidence that bears are major predators of moose in the unit (Machida 1984). Low densities of moose make aerial surveys of limited value in most areas of the unit (Machida 1985).

Because of heavy hunting pressure throughout the year, occupation of many areas by moose appears to be quite transitory, and seasonal movements may be very different from those in other areas of the state (Machida 1984, 1985).

D. Period of Use

Recent moose hunting seasons in most of GMU 18 have been during the month of September and from mid November through December. In the northwestern portion of the unit, the season has been restricted to the first 20 days of September. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 4 presents moose harvest and hunter data in GMU 18 for regulatory years 1979-1980 through 1984-1985.

The apparent increase in harvest and hunters from the 1979-1980 hunting season to the 1980-1981 hunting season was primarily due to the circumstance that no reminder letters had been sent after the 1979-1980 hunting season and that harvest ticket reporting had been poor. Also, GMU 18 was without an area biologist during most of that regulatory year (Machida 1981). The increase in harvest and hunters reporting from the 1980-1981 season to the 1981-1982 hunting season is believed to be related to several factors. For one, local residents reported seeing more moose than they had previously, but because fall composition survey data were available for only one year, this observation could not be substantiated. Probably the most significant factor was an apparent increase in compliance with harvest ticket reporting, as a consequence of a concerted effort by department personnel to increase the public's awareness of their reporting responsibilities (Machida 1983).

The decrease in harvest from the 1981-1982 hunting season to the 1982-1983 season was likely the result of poor hunting conditions due to high water during September (Machida 1984). The reported harvest during the 1983-1984 hunting season was similar to that of the 1982-1983 season but still lower than that reported for the 1981-1982 season. Hunting conditions were good during the fall but extremely poor during November and December (Machida 1985).

Reports concerning the 1984-1985 harvest are not available at this time. Most of the reported harvest of moose is by local residents and generally accounts for over 80% of the harvest. Because much of the harvest by local residents is unreported, the actual percentage of moose harvested by local residents probably exceeds 90% (Machida, pers. comm.). Access is primarily by boat. Most of the successful hunters reporting aircraft as a means of transport tend to be nonlocal residents and generally ranges from 5 to 14% of the total successful hunters. As indicated earlier, compliance with harvest-ticket reporting is poor but improving (ibid.).

F. Significance of Particular Use Areas

Tables 5 and 6 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and

1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMU 18 but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

IV. GMU 19

A. Boundaries

GMU 19 consists of the middle and upper Kuskokwim drainage. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans pertain to GMU 19: the Yukon-Kuskokwim and the Farewell moose management plans (ADF&G 1977). The primary objective of the Yukon-Kuskokwim plan is to provide for the greatest sustained opportunity for subsistence use of moose, and the secondary objective is to provide for the greatest sustained opportunity to hunt moose. The primary management objective in the Farewell plan is to provide sustained opportunities to be selective in hunting moose, and the secondary objective is to provide sustained opportunities to hunt moose under aesthetically pleasing conditions (State of Alaska 1984c).

C. Management Considerations

Unreported harvest in GMU 19 is large; estimated harvests are usually double the reported harvest figures. The Bear Creek burn near Farewell is becoming excellent moose habitat. An ongoing study of moose movements will provide information on the movement patterns and use by moose of the Bear Creek burn (Pegau 1984).

D. Period of Use

Moose hunting seasons generally run through the month of September. Subunits 19A and portions of 19D also have early winter hunts, which, depending on the subunit or portion of a subunit, occur during November, December, January, and February. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Tables 7 through 11 present moose harvest and hunter data for GMU 19 in its entirety and for Subunits 19A through D for regulatory years 1979-1980 through 1984-1985.

The increases noted in all subunits from the 1979-1980 to the 1980-1981 hunting seasons are largely explained by the fact that reminder letters were not sent out after the 1979-1980 hunting season. The overall decline from the 1981-1982 hunting season to the 1982-1983 season was due in part to legislation enacted prior to the hunting season requiring all alien hunters to be accompanied by a guide (Pegau 1984). The overall increase from the 1982-1983 season to the 1983-1984 season was particularly apparent in Subunits 19A and D. Much of the increase was the result of GMU 18 residents traveling to GMU 19 to hunt moose. The number of alien hunters increased in 1984 to levels recorded prior to 1982, particularly in Subunit 19B (Pegau 1985).

F. Significance of Particular Use Areas

Tables 12 through 19 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in a subunit of GMU 19 but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. Table 20 lists the number of hunters who reported hunting in GMU 19 but who did not indicate in which subunit they hunted. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

V. GMU 20A

A. Boundaries

GMS 20A is composed of the Tanana flats and Central Alaska Range. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans pertain to GMS 20A: the Central Alaska Range and the Yukon-Tanana moose management plans (ADF&G 1977). Both plans share a primary management objective to provide the greatest sustained opportunity to participate in hunting moose. The secondary management objectives in the Central Alaska Range plan are to provide for sustained opportunities to hunt moose under aesthetically pleasing conditions and to be selective in hunting moose. The secondary objective in the Yukon-Tanana plan is to provide sustained opportunities for subsistence use of moose (Bos 1980, State of Alaska 1984c).

C. Management Considerations

The number of moose has been increasing in GMS 20A in recent years; however, the rate of increase may be declining. Increased predation because of a higher density of wolves is suspected to be responsible for reduced recruitment (Jennings 1985a). In the foothills portion of the subunit, the rate of increase is much lower, probably because of predation by both brown bears and wolves (ibid.). Because of plant succession and the lack of wildfires, especially in the Tanana flats, carrying capacity is generally declining in GMS 20A. In a number of locations within the subunit, preferred browse species are overmature or are being replaced by spruce or other nonbrowse species. Ultimately, habitat limitations will dictate the upper population limits attainable by moose in the subunit (Jennings 1984a).

D. Period of Use

Moose hunting seasons generally occur during the month of September and range in length from 20 to 30 days, depending upon the portion of the subunit in which hunting is occurring. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 21 presents moose harvest and hunter data in GMS 20B for regulatory years 1979-1980 through 1984-1985.

The increase in the number of hunters and harvest from the 1979-1980 hunting season to the 1980-1981 season is partially explained by the increased response to reminder letters. In addition, the 1980-1981 season was six days longer in the portion of the subunit between the Wood and Little Delta rivers than in the remainder of the subunit. Analysis of harvest ticket data suggests that the longer season did not result in a large increase in the number of hunters. It does appear, however, that hunters took advantage of the longer season to hunt later, when greater success was likely (Jennings 1981). The 1981-1982 hunting season was 10 days longer in the Wood and Little Delta rivers area than in the remainder of the subunit and accounted for one-third of the harvest. It did not, however, appear to attract a large increase in the number of hunters (Jennings 1983a). The increase in hunters and harvest during the 1982-1983 season is partially explained by the addition of a November season, the first since 1974. Overall, the moose harvest in Subunit 20A has increased yearly since 1978, as has the moose population (Jennings 1985a).

Generally, transportation patterns have been similar during recent years. Hunters using aircraft harvested more moose and had greater success than hunters using any other mode of transportation. Boat and off-road vehicle are the second and third most frequently reported means of access, respectively (ibid.).

F. Significance of Particular Use Areas

Tables 22 and 23 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20A but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

VI. GMS 20B

A. Boundaries

GMS 20B consists of the Fairbanks vicinity and portions of the central Tanana valley. See the latest GMU maps and boundary descriptions.

B. Management Objectives

The Yukon-Tanana Moose Management Plan applies to GMS 20B (ADF&G 1977). Its primary objective is to provide the greatest sustained opportunity to participate in hunting moose. Its secondary objective is to provide sustained opportunities for subsistence use of moose (Bos 1980, State of Alaska 1984c).

C. Management Considerations

Moose densities are low throughout most of GMS 20B; however, they appear to be increasing in areas where wolf control has been effective (Crain and Haggstrom 1985a). Browse utilization is light in the subunit, and habitat is presently not limiting the growth of the moose population. Unless enhancement of aging habitats occurs, however, browse species will decline in abundance; and productivity and high moose densities, such as have occurred in the past, will no longer be possible. A wildfire management plan has been implemented to improve habitat by restoring a near-natural fire regime in portions of the subunit. Changing land ownership and continued development will, however, preclude the use of wildfire for habitat improvement in many areas (ibid.).

D. Period of Use

Within GMS 20B are the Fairbanks and Minto flats management areas. In the Fairbanks Management Area, hunting for moose is by bow and arrow only, and recent hunting seasons have been during the month of September and the fourth week of November. In the Minto Flats Management Area, moose hunting is by permit only, and recent seasons have been during September and from mid January through February. The remainder of GMS 20B generally has had a September 1 through 20 season. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 24 presents moose harvest and hunter data in GMS 20B for regulatory years 1979-1980 through 1984-1985.

The increase in hunters and in harvest from the 1980-1981 hunting season to the 1981-1982 season can in part be attributed to the expansion of GMS 20B to include the Salcha and Tolovana river drainages (Crain and Haggstrom 1983b). The continued increases throughout the six-year period likely reflect the increasing human population in the Fairbanks area.

F. Significance of Particular Use Areas

Tables 25 and 26 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20B but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

VII. GMS 20C

A. Boundaries

GMS 20C consists of the Kantishna, Cosna, and Nenana river drainages. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan applies to GMS 20C: the Yukon-Tanana Moose Management Plan (ADF&G 1977, Bos 1980). The plan's primary objective is to provide the greatest sustained opportunity to participate in hunting moose. Its secondary objective is to provide sustained opportunities for subsistence use of moose (State of Alaska 1984c).

C. Management Considerations

The moose population in the Totatlanika and Nenana river drainages in eastern Subunit 20C has responded favorably to reductions of wolf density. Brown bears appear to be responsible for the majority of summer moose calf mortality (Crain and Haggstrom 1984b). Moose densities are below carrying capacity in GMS 20C. The human demand for moose is high, primarily because access is good. Controlling predation and human take are necessary in order to increase the moose population (ibid.). Yearling recruitment has been chronically poor in Denali National Park, and high natural mortality among bulls has produced a low bull:cow ratio. Because of this, the moose population is likely to continue to decline in the park (ibid.).

D. Period of Use

Moose hunting seasons generally occur during the first 20 days of September. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 27 presents moose harvest and hunter data in GMS 20C for regulatory years 1979-1980 through 1984-1985.

The decline in harvest and hunters from the 1980-1981 hunting season to the 1981-1982 season was the result of boundary changes, which reduced the size of GMS 20C (Crain and Haggstrom 1983b). No information was found explaining the decline in hunters and harvest during the 1982-1983 hunting season. The increase in harvest and hunters during the 1983-1984 hunting season is explained, in part, by an increased use of 3-wheelers within the subunit (Crain and Haggstrom 1985b). No information is available at this time to explain the subsequent decrease during the 1984-1985 hunting season.

F. Significance of Particular Use Areas

Tables 28 and 29 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20C but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

VIII. GMS 20D

A. Boundaries

GMS 20D consists of the southcentral Tanana valley. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans pertain to GMS 20D: the Yukon-Tanana and the Donelly-Clearwater moose management plans (ADF&G 1977, Bos 1980). The primary management objective of the Yukon-Tanana plan is to provide the greatest sustained opportunity to participate in hunting moose. Its secondary objective is to provide sustained opportunities for subsistence use of moose (State of Alaska 1984c). The primary objective of the Donelly-Clearwater plan is to provide sustained opportunities to view and photograph moose; its secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations

Currently, browse does not appear to be limiting the moose population in GMS 20D. The Jarvis Creek and Gerstle burns, however, appear to be past their best browse production. Habitat manipulation in the southern portion of the subunit may become necessary if the moose population continues to expand (Johnson 1985). There appears to be a relatively high loss of moose to both road kills and out of season harvest. It is likely that this mortality factor will become more important as the moose population expands (Johnson 1984). Data suggest that predation by wolves is keeping yearling recruitment low. Both black and brown bears almost certainly affect the moose calf survival rate (ibid.).

D. Period of Use

Moose hunting seasons generally occur during September and range in length from 15 to 20 days, depending upon what portion of the subunit is being hunted. (See the latest Alaska Game Regulations for current hunting season and bag limits.)

E. Human Use Data

Table 30 presents moose harvest and hunter data in GMS 20D for regulatory years 1979-1980 through 1984-1985.

F. Significance of Particular Use Areas

Tables 31 and 32 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20D but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

IX. GMS 20E

A. Boundaries

GMS 20E is composed of the Forty mile, Charley, and Ladue river drainages. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans apply to GMS 20E: the Yukon-Tanana and Charley River moose management plans (ADF&G 1977, Bos 1980). The primary management objective of the Yukon-Tanana plan is to provide the greatest sustained opportunity to participate in hunting moose, and the second objective is to provide sustained opportunities for subsistence use of moose. The Charley River plan has a primary management objective to provide sustained opportunities to hunt moose under aesthetically pleasing conditions (State of Alaska 1984d).

C. Management Considerations

It appears that most moose mortality is the result of predation by black and brown bears and wolves (Kelleyhouse 1984b). Research conducted within GMS 20E indicates that brown bears are a major predator of neonate moose. Because of this predation, the moose population continues to be composed of old, unproductive animals that exist at low densities (Kelleyhouse 1985b). An inspection of browse plants in the subunit indicated that there is less than 10% use by moose. Browse is therefore not a limiting factor affecting population growth. Implementation of the Fortymile Fire Management Plan will ensure a near-natural fire regime in much of the area and thus will result in a more heterogeneous habitat mosaic than currently exists (ibid.).

D. Period of Use

GMS 20E was partitioned off from GMS 20C prior to the the 1978-1979 regulatory year. There was no legal moose hunting season in the subunit until the 1982-1983 regulatory year, when a short 10-day season was established during September. A September 1-10 season has been held in the subunit until the 1985-1986 regulatory year, when September 5-25 and September 1-14 seasons were established in separate portions of the subunit. (See the latest Alaska Game Regulations for current hunting season and bag limits.)

E. Human Use Data

Table 33 presents moose harvest and hunter data in GMS 20E for regulatory years 1982-1983 through 1984-1985.

F. Significance of Particular Use Areas

Tables 34 and 35 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20E but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

X. GMS 20F

A. Boundaries

GMS 20F consists of the central Yukon, Hess Creek, and Tozitna river drainage. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to GMS 20F: the Yukon-Tanana Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide the greatest sustained opportunity to participate in hunting moose, and the secondary objective is to provide sustained opportunities for subsistence use of moose.

C. Management Considerations

Little is known about the moose population in GMS 20F. Habitat generally appears poor throughout the subunit but is probably not limiting population growth at the present time. Predation by wolves and brown bears may be limiting recruitment, but data are sparse (Jennings 1985b). Out of season harvest in Subunit 20F is believed to be substantial but as yet is unquantified (Jennings 1984b).

D. Period of Use

GMS 20F was partitioned off from GMS 20C prior to the 1981-1982 regulatory year. Since then, September 1-15 and November 1-10 seasons have been held in the subunit. (See the latest Alaska Game Regulations for current hunting season and bag limits.)

E. Human Use Data

Table 36 presents moose harvest and hunter data in GMS 20F for regulatory years 1981-82 through 1984-85.

Virtually all of the hunting in Subunit 20F is by state residents (Jennings 1985b).

F. Significance of Particular Use Areas

Tables 37 and 38 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 20F but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XI. GMS 21A

A. Boundaries

GMS 21A consists of the upper Nowitna, Iditarod, and upper Innoko drainage. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to Subunit 21(A): the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide sustained opportunities for subsistence use of moose; the secondary objective is provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations
Predation by wolves is the largest source of adult moose mortality in Subunit 21A. In the upper Innoko and upper Nowitna, wolves may also be responsible for the poor yearling recruitment (Osborne and Pegau 1985).

D. Period of Use
The recent moose hunting seasons have been September 5-30 and November 1-30. (See the latest Alaska Game Regulations for current hunting season and bag limits.)

E. Human Use Data
Table 39 presents moose harvest and hunter data in GMS 21A for regulatory years 1980-1981 through 1984-1985. GMU 21 was partitioned into GMSs prior to the 1980-1981 regulatory year.
Aircraft and boat are the first and second most frequently reported means of transportation by hunters. Most of the reported harvest form Subunit 21A occurs in the Innoko drainage. Most of the hunting occurs along the main river, where boat and aircraft access is easiest (Haggstrom and Osborne 1982).

F. Significance of Particular Use Areas
Tables 40 and 41 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 21A but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XII. GMS 21B

A. Boundaries
GMS 21B consists of the lower Nowitna River and the Yukon River between the Melozitna and Tozitna rivers. See the latest GMU maps and boundary descriptions.

B. Management Objectives
One moose management plan pertains to Subunit 21B: the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide sustained opportunities for subsistence use of moose; the secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations
Prior to 1980, available information indicated a declining moose population. In 1980, however, a survey using a stratified random sample technique produced an estimate two-to-three times above what was previously thought. A comparison of the estimated yearling recruitment with estimated mortality (both hunting and predation) suggested a stable population (Haggstrom and Osborne

1981b). Fall surveys conducted during 1983 indicated that in the Nowitna-Sulatana confluence, a slight decline in moose density had occurred.

Along the Yukon River, an increase was observed, and elsewhere in the subunit the population appeared stable (Osborne 1985a). Most hunting occurs from boats or float-equipped aircraft. Harvest is therefore concentrated near water courses, and most of the subunit is unhunted (Osborne 1984b).

D. Period of Use

Recent hunting seasons were September 5-30 in GMS 21B. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 42 presents moose harvest and hunter data derived from check station and registration permit reports primarily related to the Nowitna drainage. These data do not represent GMS 21B in its entirety, but they do reflect most of the use and are the most comparable data for the subunit. Subunit harvest data are presented when available.

The decrease in hunters and harvest in the Nowitna drainage from the 1979-1980 hunting season to the 1980-1981 season can be attributed to several factors. During the 1980-1981 season, aircraft were restricted in the registration permit area, fuel costs were higher, there was inclement weather, and there were changes in the permit-issuance procedures (Haggstrom and Osborne 1981b). During the 1981-1982 hunting season, aircraft restrictions were lifted, resulting in an increase in hunters and harvest (Osborne 1983b). The decline in harvest during the 1982-1983 hunting season was partially because of warm, rainy weather that delayed the rut, made hunting conditions unpleasant, and kept some bulls in the uplands (Osborne 1984b).

F. Significance of Particular Use Areas

Tables 43 and 44 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 21B but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XIII. GMS 21C

A. Boundaries

GMS 21C consists of the upper Dulbi River and the Melozitna River drainage above Grayling Creek. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to Subunit 21C: the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide sustained opportunities for subsistence use of moose; the secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations

Little is known about the moose population in Subunit 21C; trend areas have only recently been established. The moose population in the subunit is low, and natural mortality is keeping it stable (Osborne 1985b).

D. Period of Use

Recent moose hunting seasons in GMS 21C have run from September 5 to September 25. (See the latest Alaska Game Regulations for the current hunting season and bag limits.)

E. Human Use Data

Table 45 presents harvest and hunter data for regulatory years 1980-1981 through 1984-1985

Nearly all moose hunters in GMS 21C use aircraft as a means of transport. During the 1982-1983 and 1983-1984 hunting seasons, Fish and Wildlife Protection conducted extensive patrols in the area, enforcing the same-day-airborne regulation. Because of this, the harvest declined during those seasons (Osborne 1984c, 1985b).

F. Significance of Particular Use Areas

Tables 46 and 47 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 21C but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XIV. GMS 21D

A. Boundaries

GMS 21D consists of the middle Yukon River, from Eagle Island to Ruby, and the Koyukuk River below Dulbi Slough. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to Subunit 21D: the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide sustained opportunities for subsistence use of moose; the secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations

Natural mortality of moose within Subunit 21D is thought to be high. Good populations of brown bear exist in the uplands, black bears are abundant in the lowlands, and wolves are found throughout the subunit (Osborne 1984d).

D. Period of Use

Recent hunting seasons in GMS 21D have been from September 5 through 25 and from February 1 through 10. (See the latest Alaska Game Regulations for current hunting season and bag limits).

E. Human Use Data

Table 48 presents harvest and hunter data for regulatory years 1980-1981 through 1984-1985.

The increase in harvest from the 1980-1981 hunting season to the 1981-1982 season was in part related to a late season held in March and also apparently because of better compliance with harvest ticket reporting (Osborne 1983c). Subsequent increases in hunters and harvest appears to be related substantially to increased compliance with harvest ticket reporting (Osborne 1985c).

F. Significance of Particular Use Areas

Tables 49 and 50 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 21D but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XV. GMS 21E

A. Boundaries

GMS 21E includes the Yukon River drainage between the Paimiut-Kalskag Portage and Blackburn Creek and including the lower Innoko River downstream from the confluence of the Iditarod and Innoko rivers. See the latest GMU maps and boundary descriptions.

B. Management Objectives

One moose management plan pertains to Subunit 21E: the Yukon-Kuskokwim Moose Management Plan (ADF&G 1977, Bos 1980). The primary management objective is to provide sustained opportunities for subsistence use of moose; the secondary objective is to provide the greatest sustained opportunity to participate in hunting moose (Bos 1980).

C. Management Considerations

No data were available.

D. Period of Use

Recent hunting seasons in GMS 21E have been from September 5 through 25 and from February 1 through 10. (Previously season was November 1 through 30). (See the latest Alaska Game Regulations for current hunting season and bag limits.)

E. Human Use Data

Table 51 presents harvest and hunter data for regulatory years 1980-1981 through 1984-1985.

Unreported harvest appears to be substantial (four to five times the reported harvest) in Subunit 21E (Osborne 1984e, 1985d). Fluctuations in harvest and hunters may in part be related to compliance with harvest ticket requirements.

F. Significance of Particular Use Areas

Tables 52 and 53 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMS 21E but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XVI. GMU 24

A. Boundaries

GMU 24 consists of the Koyukuk River drainage north of and including Dulbi Slough. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans pertain to Unit 24: the Dietrich and Yukon-Tanana moose management plans (ADF&G 1977, Bos 1980). The primary management objective in the Dietrich plan is to provide sustained opportunities to hunt moose under aesthetically pleasing conditions; the secondary objective is to provide sustained opportunities to view and photograph moose (State of Alaska 1984e). The primary management objective for the Yukon-Tanana plan is provide the greatest sustained opportunity to participate in hunting moose; the secondary objective is to provide sustained opportunities for subsistence use of moose (Bos 1980).

C. Management Considerations

Since the Dalton Highway was opened for public use, harvest of moose along the highway has increased substantially (Osborne 1984f, 1985c). Moose trend count areas have only recently been established in much of Unit 24 and should aid in future management efforts (Osborne 1984f, 1985e).

D. Period of Use

There are four different sets of hunting seasons that currently apply to GMU 24. In one portion of the unit, there are September 5 through September 25, December 1 through 10, and a March 1 through 10 seasons. Another area has an August 25 through December 31 season, another an August 25 through September 25 and March 1 through 10 season, and a fourth area has an August 25 through September 25 season. (See the latest Alaska Game Regulations for current hunting seasons, bag limits, and area descriptions.)

E. Human Use Data

Table 54 presents harvest and hunter data for regulatory years 1980-1981 through 1984-1985.

Much of the fluctuations in harvest and hunter numbers can be attributed to variability in compliance with harvest ticket reporting requirements. Estimated harvests range from an additional 35 moose to more than double the reported harvest (Osborne 1983d, 1984f, 1985e).

F. Significance of Particular Use Areas

Tables 55 and 56 list the number of hunters, hunter-days, and harvest by minor tributary for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in GMU 24 but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

XVII. GMU 25

Although GMU 25 is divided into four subunits (A through D), survey and inventory reports are for GMU 25. Subunit distinctions will be noted where information is available.

A. Boundaries

GMU 25 consists of the Yukon Flats; Chandalar, Porcupine, and Black river drainages; and Birch and Beaver creeks. See the latest GMU maps and boundary descriptions.

B. Management Objectives

Two moose management plans pertain to Unit 25: the Dietrich and Yukon-Tanana moose management plans (ADF&G 1977, BOS 1980). The primary management in the Dietrich plan is to provide sustained opportunities to hunt moose under aesthetically pleasing conditions; the secondary objective is to provide sustained opportunities to view and photograph moose (State of Alaska 1984e). The primary management objective for the Yukon-Tanana plan is to provide the greatest sustained opportunity to participate in hunting moose; the secondary objective is to provide sustained opportunities for subsistence use of moose (Bos 1980).

C. Management Considerations

In western Subunit 25D, moose densities are critically low and will require significant management actions in order to increase the population (Nowlin 1985). Out of season harvest appears to be substantial throughout most of Unit 25 and is thought to be more than the total reported harvest (ibid.). Predation by wolves in portions of the unit is high. During one year in western Subunit 25D, wolves may have killed a minimum of 120 moose, or approximately 15% of the fall population. Most predation appears to occur during winter and consists primarily of calves and yearlings (ibid.). Movements of radio-collared moose in western Subunit 25D indicate that two distinct populations exist in the area (ibid.). (See the moose Distribution and Abundance narrative for further information of these two populations).

D. Period of Use

Currently, GMS 25A has a September 5 through 25 moose hunting season. GMS 25B is divided into two areas, one of which has a September 20 through 30 season and the other a September 5 through 25 and a December 1 through 15 season. GMS 25C has a September 5 through 15 season. GMS 25D is also divided into two areas, one of which has seasons of September 10 through 30, December 1 through 10, and February 18 through 28 by tier II permit only (formerly a drawing permit). The other portion of GMS 25A has seasons of September 10 through 20 and December 1 through 10. (See the latest Alaska Game Regulations for current hunting seasons, bag limits, and area descriptions.)

E. Human Use Data

Tables 57 through 61 present harvest and hunter data for Subunit 25 (A through D) and for Unit 25 in its entirety for regulatory years 1980-1981 through 1984-1985.

Much of the harvest in GMU 25 is not reported; estimated harvest is at least twice that of the reported harvest (Nowlin 1985). Year-to-year fluctuations may in part be due to changes in compliance with harvest ticket reporting. For instance, the increase in harvest and hunters from the 1982-1983 season to the 1983-1984 season was largely due to improved reporting in western Subunit 25D, where the hunt was changed to registration permit for the 1983-1983 season (ibid.).

F. Significance of Particular Use Areas

Tables 62 through 68 list the number of hunters, hunter-days, and harvest by minor tributary for GMSs 25 (A through D) for regulatory years 1983-1984 and 1984-1985. Note that minor tributary designation "00" represents hunters who reported hunting in a particular subunit in GMU 25 but who did not supply sufficient information on their harvest reports to be coded to a minor tributary. Table 69 lists the number of hunters who reported hunting in GMU 25 but who did not specify the subunit in which they hunted for regulatory years 1983-1984 and 1984-1985. (See the moose human use maps in the 1:250,000-scale Reference Maps, available in ADF&G offices, and the 1:1,000,000-scale Atlas to the Alaska Habitat Management Guide for the Western and Interior regions.)

Table 1. GMU 12 Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest	Estimated Harvest
1979-80	203	91*	110
1980-81	285	96**	115
1981-82	354	102***	125
1982-83	408	91****	125
1983-84	340	78****	100
1984-85	417	84	---

Source: Kelleyhouse 1980a, 1981a, 1983a, 1984a, 1985a.

--- means no data were available.

* Includes three road-killed moose, three poached, and six moose taken for funeral potlaches.

** Includes two road-killed moose and three poached moose.

*** Includes eight road-killed moose and three animals taken for funeral potlaches.

**** Includes five road-killed moose.

Table 2. GMU 12 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
06	670	98	26
04	626	86	9
08	519	85	14
07	219	21	7
00	173	24	3
09	148	25	9
10	90	13	5
Subunit total	2,445	352	73

Source: ADF&G 1984.

Table 3. GMU 12 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
06	786	119	30
00	665	65	7
08	580	87	9
04	446	73	13
09	243	31	9
07	174	22	11
10	83	16	5
05	11	2	0
01	2	2	0
Subunit total	2,990	417	84

Source: ADF&G 1985.

Table 4. GMU 18 Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest	Estimated Harvest
1979-80*	33	12	24-36
1980-81	145	48	---
1981-82	221	82**	150+
1982-83	220	58***	100-150
1983-84	236	63	125
1984-85	250	75	---

Source: Dinneford 1980; Machida 1981, 1983, 1984, 1985; ADF&G 1985.

--- means no data were available.

* Reminder letters were not sent out to nonreporting hunters for the 1979-80 hunting season, and GMU 18 was without an area biologist during most of the year.

** Includes four known poached moose.

*** Includes three known poached moose.

Table 5. GMU 18 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
02	551	91	30
03	206	32	9
14	178	18	3
16	169	25	8
12	111	19	5
15	102	19	2
01	60	7	3
00	38	6	0
06	38	6	1
05	23	3	0
13	16	4	2
17	7	1	0
11	3	1	0
18	3	1	0
04	2	2	0
Subunit total	1,507	235	63

Source: ADF&G 1984.

Table 6. GMU 18 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
02	688	98	48
12	393	56	4
15	187	23	4
14	152	14	0
03	127	22	6
00	86	9	3
16	66	13	4
04	26	3	2
13	19	4	2
01	18	4	1
05	10	1	0
06	10	1	1
07	6	2	0
Subunit total	1,788	250	75

Source: ADF&G 1985.

Table 7. GMS 19A Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81**	134	75
1981-82	199	78
1982-83	208	77
1983-84	281	102
1984-85	338	184

Source: Shepherd 1980; Burris 1981; Pegau 1983, 1984, 1985; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

** Harvest is based on boundary of GMS since 1981.

Table 8. GMS 19B Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81**	189	103
1981-82	170	78
1982-83	142	71
1983-84	200	110
1984-85	278	154

Source: Shepherd 1980; Burris 1981; Pegau 1983, 1984, 1985; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

** Harvest is based on boundary of GMS since 1981.

Table 9. GMS 19C Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81**	148	78
1981-82	147	86
1982-83	129	80
1983-84	137	102
1984-85	168	95

Source: Shepherd 1980; Burris 1981; Pegau 1983, 1984, 1985; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

** Harvest is based on boundary of GMS since 1981.

Table 10. GMS 19D Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81**	145	82
1981-82	185	104
1982-83	176	106
1983-84	215	120
1984-85	229	133

Source: Shepherd 1980; Burris 1981; Pegau 1983, 1984, 1985; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

** Harvest is based on boundary of GMS since 1981.

Table 11. GMU 19 Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters*	Reported Harvest*	Estimated Harvest
1979-80**	431	283	480-530
1980-81	689	369	550
1981-82	753	369	---
1982-83	687	335	600-700
1983-84	849	438	925-975
1984-85	1,026	571	---

Source: Shepherd 1980; Burris 1981; Pegau 1983, 1984, 1985; ADF&G 1985.

--- means no data were available.

* Includes hunters and harvest of those who reported hunting in GMU 19 but did not specify which subunit they hunted.

** Reminder letters were not sent to nonreporting harvest-ticket holders.

Table 12. GMS 19A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
01	363	47	12
03	357	54	10
09	262	41	23
04	191	36	13
14	178	23	10
00	133	20	6
12	97	14	7
13	78	14	8
02	40	6	0
08	19	6	3
10	14	4	4
11	12	3	2
06	10	1	0
15	8	4	3
05	3	1	1
Subunit total	1,765	274	102

Source: ADF&G 1984.

Table 13. GMS 19A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
01	427	52	23
03	353	48	13
00	331	44	18
09	313	45	29
04	303	53	34
12	159	23	19
14	145	16	8
06	96	9	6
13	96	12	7
11	67	9	8
02	45	8	5
10	37	7	5
15	36	5	4
05	9	2	0
07	6	1	1
08	5	4	4
Subunit total	2,428	338	184

Source: ADF&G 1985.

Table 14. GMS 19B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
11	385	53	28
14	285	40	18
00	213	33	15
13	155	21	9
12	129	15	12
03	112	8	7
04	60	7	2
02	44	8	8
10	34	6	5
05	32	3	3
06	15	1	1
07	7	1	1
09	6	2	2
08	5	2	2
Subunit total	1,482	200	113

Source: ADF&G 1984.

Table 15. GMS 19B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
11	476	65	28
14	421	58	34
13	355	45	18
00	200	33	21
12	180	20	13
01	66	8	5
07	40	5	5
04	38	9	6
02	32	6	5
08	32	3	2
06	25	2	2
03	17	4	4
05	15	4	4
09	10	1	1
10	10	2	2
Subunit total	1,917	265	150

Source: ADF&G 1985.

Table 16. GMS 19C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	239	37	25
03	70	11	9
11	69	12	10
13	68	10	7
14	64	9	8
06	61	11	8
10	42	9	8
02	41	6	6
08	34	5	2
01	31	4	2
00	30	5	4
12	28	5	5
04	21	4	4
09	20	3	0
07	11	3	3
16		10	1
Subunit total	839	135	101

Source: ADF&G 1984.

Table 17. GMS 19C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	259	42	30
00	150	23	7
11	143	23	12
14	113	12	7
03	86	13	7
01	61	10	5
06	49	6	4
13	34	7	3
02	31	4	3
09	31	4	0
04	28	6	5
07	27	6	4
12	26	5	3
08	10	3	1
10	8	2	2
16	5	2	2
Subunit total	1,061	168	95

Source: ADF&G 1985.

Table 18. GMS 19D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	711	99	48
10	155	26	10
11	148	14	7
21	133	17	14
01	96	11	8
02	84	6	5
00	58	11	7
22	53	5	2
04	49	5	5
07	44	2	2
06	35	4	3
16	30	2	1
12	25	4	
20	17	2	1
03	8	2	2
17	3	1	1
18	3	1	1
Subunit total	1,652	212	117

Source: ADF&G 1984.

Table 19. GMS 19D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	721	100	52
10	234	35	23
21	141	21	18
01	140	18	10
11	131	18	9
12	85	9	5
02	50	8	3
04	43	5	3
16	37	10	8
00	22	3	2
22	20	1	
17		14	1
Subunit total	1,638	229	133

Source: ADF&G 1985.

Table 20. Hunters Who Reported Hunting in GMU 19 but Did Not Specify Subunit, Regulatory Years 1983-84 and 1984-85

Regulatory Year	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
1983-84	145	24	5
1984-85	207	26	9

Source: ADF&G 1984, 1985.

Table 21. GMU 20A Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1979-80*	136	88
1980-81	423	138
1981-82	706	200
1982-83	810	238
1983-84	1,087	282
1984-85	1,208	391

Source: Jennings 1980, 1981, 1983a, 1984a, 1985a; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

Table 22. GMS 20A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	3,207	591	142
04	1,151	198	43
00	634	99	11
06	550	74	34
02	163	23	11
08	153	29	16
03	88	16	9
07	76	21	12
01	66	16	4
Subunit total	6,088	1,067	282

Source: ADF&G 1984.

Table 23. GMS 20A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
05	2,635	453	128
01	1,582	244	82
02	886	142	48
04	847	153	67
06	369	53	23
00	366	57	12
08	251	48	19
03	229	38	5
07	122	20	7
Subunit total	7,287	1,208	391

Source: ADF&G 1985.

Table 24. GMS 20B Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1979-80*	356	59
1980-81	665	86
1981-82	1,050	154
1982-83	1,420	158
1983-84	2,067	329
1984-85	2,258	332

Source: Haggstrom 1980a; Crain and Haggstrom 1981a, 1983a, 1984a, 1985a; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

Table 25. GMS 20B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	4,716	885	126
02	2,615	515	100
06	1,604	295	68
05	788	154	2
00	474	106	16
01	364	67	20
03	249	44	3
Subunit total	10,810	2,066	335

Source: ADF&G 1984.

Table 26. GMS 20B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	5,740	919	112
02	2,922	593	116
06	1,958	317	58
05	1,048	177	18
00	475	106	4
01	389	75	12
03	338	71	12
Subunit total	12,870	2,258	332

Source: ADF&G 1985.

Table 27. GMS 20C Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1979-80*	334	143
1980-81	947	247
1981-82	800	174
1982-83	531	108
1983-84	655	217
1984-85	300	110

Source: Haggstrom 1980b; Crain and Haggstrom 1981b, 1983b, 1984b, 1985b; ADF&G 1985.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

Table 28. GMS 20C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
06	1,757	301	100
08	888	162	48
05	487	88	43
00	248	50	5
01	98	19	9
07	84	17	6
03	66	10	1
04	27	8	5
02	8	2	0
Subunit total	3,663	657	217

Source: ADF&G 1984.

Table 29. GMS 20C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
06	698	121	42
05	602	110	53
00	161	27	2
01	140	26	9
04	46	9	3
03	37	7	1
Subunit total	1,684	300	110

Source: April 1985.

Table 30. GMS 20D Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1979-80*	215	19
1980-81	---	37
1981-82	---	102
1982-83	---	120
1983-84	542	105
1984-85	635	104

Source: Larson 1980; Johnson 1981, 1983, 1984, 1985; ADF&G 1985.

--- means no data were available.

* Reminder letters were not sent to nonreporting harvest-ticket holders.

Table 31. GMS 20D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
03	773	111	18
09	469	115	15
01	359	93	21
02	232	46	5
11	148	40	8
05	117	18	7
10	115	38	10
14	110	24	9
00	101	23	1
12	50	13	2
04	31	6	1
08	31	5	2
13	23	6	2
15	20	4	2
06	18	5	3
07	15	1	1
Subunit total	2,612	548	107

Source: ADF&G 1984.

Table 32. GMS 20D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
03	882	117	23
09	534	129	17
01	490	108	10
02	275	57	6
14	261	42	9
10	244	65	14
05	108	16	3
00	99	20	1
11	89	30	4
04	73	14	2
06	45	11	6
08	45	8	3
12	44	12	5
13	30	3	0
07	16	1	0
15	8	2	1
Subunit total	3,243	635	104

Source: ADF&G 1985.

Table 33. GMS 20E Reported Moose Harvest and Hunter Data for Regulatory Years 1982-83 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1982-83	113	19
1983-84	166	31
1984-85	154	29

Source: Kelleyhouse 1984b, 1985b; ADF&G 1985.

Table 34. GMS 20E Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
07	383	57	14
02	216	36	4
04	127	16	1
00	98	15	0
06	78	13	3
01	58	9	1
09	35	5	3
11	32	5	4
05	28	6	1
08	21	3	0
03	1	1	0
Subunit total	1,077	166	31

Source: ADF&G 1984.

Table 35. GMS 20E Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
07	289	52	8
02	108	18	1
04	105	16	4
09	92	16	3
06	89	18	6
00	84	13	0
11	42	6	4
08	34	7	1
03	20	2	0
01	18	3	1
05	13	3	1
Subunit total	894	154	29

Source: ADF&G 1985.

Table 36. GMS 20F Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1981-82	109	27
1982-83	76	17
1983-84	111	25
1984-85	100	15

Source: Jennings 1983b, 1984b, 1985b; ADF&G 1985.

Table 37. GMS 20F Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
03	285	38	5
02	226	40	8
06	70	19	6
00	34	6	1
01	18	7	4
05	5	1	1
Subunit total	638	111	25

Source: ADF&G 1984.

Table 38. GMS 21A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
03	214	43	5
02	107	20	0
06	96	21	6
01	38	5	3
00	26	8	1
05	24	2	0
04	2	1	0
Subunit total	507	100	15

Source: ADF&G 1985.

Table 39. GMS 21A Reported Moose Harvest and Hunter Data for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	---	83
1981-82	---	104
1982-83	---	102
1983-84	176	130
1984-85	190	136

Source: Haggstrom and Osborne 1981a; Osborne 1983a, 1984a; ADF&G 1984, 1985.

--- means no data were available.

Table 40. GMS 21A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
06	261	42	27
02	246	39	28
08	187	24	15
00	167	26	23
01	110	18	15
09	62	7	4
05	34	5	4
07	34	7	7
04	28	4	4
11	8	2	2
10	7	1	0
13	5	1	1
Subunit total	1,149	176	130

Source: ADF&G 1984.

Table 41. GMS 21A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
00	204	34	25
01	173	29	26
06	166	29	14
02	148	30	25
08	100	17	16
10	91	7	3
05	87	14	6
07	68	11	9
04	56	7	7
12	52	7	1
09	14	1	0
11	13	2	2
13	7	1	1
03	5	1	1
Subunit total	1,184	190	136

Source: ADF&G 1985.

Table 42. Reported Moose Harvest and Hunter Data for the Nowitna drainage in GMS 21B for Regulatory Years 1979-80 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest	GMS 21B Harvest
1979-80	201	61	---
1980-81	81	41	---
1981-82	138	55	73
1982-83	---	36	71
1983-84	---	45	77
1984-85	---	---	96

Source: Haggstrom and Osborne 1981b; Osborne 1983b, 1984b, 1985a; ADF&G 1984, 1985.

--- means no data were available.

Table 43. GMS 21B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	536	59	44
01	151	33	16
05	102	16	12
00	68	11	1
03	15	4	2
07	13	2	2
02	6	1	0
Subunit total	891	126	77

Source: ADF&G 1984.

Table 44. GMS 21B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	584	71	45
01	180	37	24
05	136	20	13
00	117	11	3
09	100	17	6
07	47	4	0
03	38	4	3
02	14	3	2
Subunit total	1,216	167	96

Source: ADF&G 1985.

Table 45. GMS 21C Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	---	21
1981-82	32	23
1982-83	25	17
1983-84	32	15
1984-85	30	18

Source: Osborne 1981a; ADF&G 1981, 1982, 1983, 1984, 1985.

--- means no data were available.

Table 46. GMS 21C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
01	114	23	12
00	28	3	0
02	28	6	3
Subunit total	170	32	15

Source: ADF&G 1984.

Table 47. GMS 21C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
01	116	26	17
00	25	2	0
02	17	2	1
Subunit total	158	30	18

Source: ADF&G 1985.

Table 48. GMS 21D Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	---	107
1981-82	219	174
1982-83	229	181
1983-84	287	186
1984-85	354	242

Source: Osborne 1981b; ADF&G 1982, 1983, 1984, 1985.

--- means no data were available.

Table 49. GMS 21D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
03	309	86	53
08	190	55	49
12	112	12	11
01	100	33	20
06	91	26	18
11	88	19	17
00	68	32	0
04	23	14	12
05	23	5	4
07	9	3	0
10	1	1	1
02	---	1	1
Subunit total	1,014	287	186

Source: ADF&G 1984.

--- means no data were available.

Table 50. GMS 21D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
08	513	107	99
03	307	64	48
06	156	29	16
01	115	29	20
11	110	24	13
12	88	16	14
00	71	52	1
04	62	14	12
05	17	4	4
13	12	13	13
02	---	2	2
Subunit total	1,451	354	242

Source: ADF&G 1985.

--- means no data were available.

Table 51. GMS 21E Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	---	95
1981-82	102	76
1982-83	102	67
1983-84	125	95
1984-85	160	133

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

--- means no data were available.

Table 52. GMS 21E Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
02	272	65	51
05	188	30	21
03	52	10	7
00	35	9	9
08	15	5	3
04	13	3	1
09	10	3	3
Subunit total	585	125	95

Source: ADF&G 1984.

Table 53. GMS 21E Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
02	323	63	57
05	190	51	47
09	68	11	8
00	55	11	5
03	55	15	10
08	25	5	3
04	11	2	1
07	3	1	1
06	2	1	1
Subunit total	732	160	133

Source: ADF&G 1985.

Table 54. GMU 24 Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	158	105
1981-82	180	110
1982-83	192	105
1983-84	199	112
1984-85	232	122

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

Table 55. GMU 24 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
11	309	37	18
15	222	33	14
07	131	19	9
09	125	19	15
01	105	26	22
08	104	24	10
12	74	14	7
00	42	8	0
05	20	4	4
03	13	3	3
02	11	4	4
10	9	1	1
13	9	3	2
06	7	1	0
04	2	2	2
14	2	1	1
Subunit total	1,185	199	112

Source: ADF&G 1984.

Table 56. GMU 24 Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
11	361	52	29
15	203	35	17
01	143	40	28
12	134	18	7
07	121	23	6
08	102	18	11
00	100	12	3
13	86	13	5
09	38	9	8
05	28	3	3
03	18	4	4
14	9	3	1
06	7	1	0
02	3	1	0
Subunit total	1,353	232	122

Source: ADF&G 1985.

Table 57. GMS 25A Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	41	16
1981-82	53	24
1982-83	26	10
1983-84	53	33
1984-85	51	34

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

Table 58. GMS 25B Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	19	9
1981-82	73	39
1982-83	39	25
1983-84	76	34
1984-85	87	39

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

Table 59. GMS 25C Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	47	35
1981-82	63	24
1982-83	127	23
1983-84	128	26
1984-85	100	25

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

Table 60. GMS 25D Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters	Reported Harvest
1980-81	9	4
1981-82	53	19
1982-83	50	16
1983-84	121	40
1984-85	134	41

Source: ADF&G 1981, 1982, 1983, 1984, 1985.

Table 61. GMU 25 Reported Moose Harvest and Hunter Data for Regulatory Years 1980-81 through 1984-85

Regulatory Year	Number of Hunters*	Reported Harvest*
1980-81	147	74
1981-82	301	114
1982-83	319	118
1983-84	389	137
1984-85	377	140

Source: Haggstrom and Nowlin 1981; Nowlin 1983; Nowlin 1984; ADF&G 1984, 1985.

* Includes hunters and harvest who reported hunting in GMU 25 but who did not specify which subunit they hunted.

Table 62. GMS 25A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
14	148	22	11
00	122	3	2
07	99	2	1
10	96	8	5
13	74	8	7
04	33	4	2
03	20	4	4
06	5	1	1
11	4	1	0
Subunit total	601	53	33

Source: ADF&G 1984.

Table 63. GMS 25A Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
14	108	13	6
13	71	9	8
00	60	8	5
03	32	5	3
10	30	6	5
04	24	6	4
02	12	1	0
01	5	1	1
15	3	2	2
Subunit total	345	51	34

Source: ADF&G 1985.

Table 64. GMS 25B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
07	201	28	13
00	112	19	2
08	36	7	5
02	29	7	5
01	19	3	2
04	18	3	1
05	10	5	4
06	9	2	0
03	6	2	2
Subunit total	440	76	34

Source: ADF&G 1984.

Table 65. GMS 25B Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
00	230	25	5
07	194	23	13
08	39	7	1
02	37	10	7
01	28	6	3
06	21	4	3
05	14	3	0
04	13	6	5
03	12	3	2
Subunit total	588	87	39

Source: ADF&G 1985.

Table 66. GMS 25C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	302	44	12
05	175	27	2
02	141	32	7
01	83	5	1
00	64	12	1
06	37	6	1
03	5	2	2
Subunit total	807	128	26

Source: ADF&G 1984.

Table 67. GMS 25C Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
04	141	31	10
02	140	29	12
05	88	23	1
00	32	8	2
01	27	4	0
06	15	3	0
03	5	2	0
Subunit total	448	100	25

Source: ADF&G 1985.

Table 68. GMS 25D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1983-84

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
00	359	44	4
01	160	25	11
11	98	19	5
16	61	10	6
09	46	8	4
15	32	7	4
06	20	3	3
14	12	3	2
04	10	1	0
02	2	1	1
Subunit total	800	121	40

Source: ADF&G 1985.

Table 69. GMS 25D Minor Tributary Human Use Data Ordered by Number of Hunter-Days, Regulatory Year 1984-85

Minor Tributary	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
01	321	54	16
09	116	22	7
11	76	15	7
15	52	12	3
06	37	3	1
00	34	7	1
14	17	6	2
07	14	5	1
16	13	2	0
02	9	3	1
10	9	3	1
08	4	1	0
12	3	1	1
Subunit total	705	134	41

Source: ADF&G 1985.

Table 70. Hunters Who Reported Hunting in GMU 25 but Who Did Not Specify the Subunit, Regulatory Years 1983-84 and 1984-85

Regulatory Year	Number of Hunter-Days	Number of Hunters	Number of Successful Hunters
1983-84	49	11	4
1984-85	38	5	1

Source: ADF&G 1984, 1985.

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Human Use of Furbearers
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

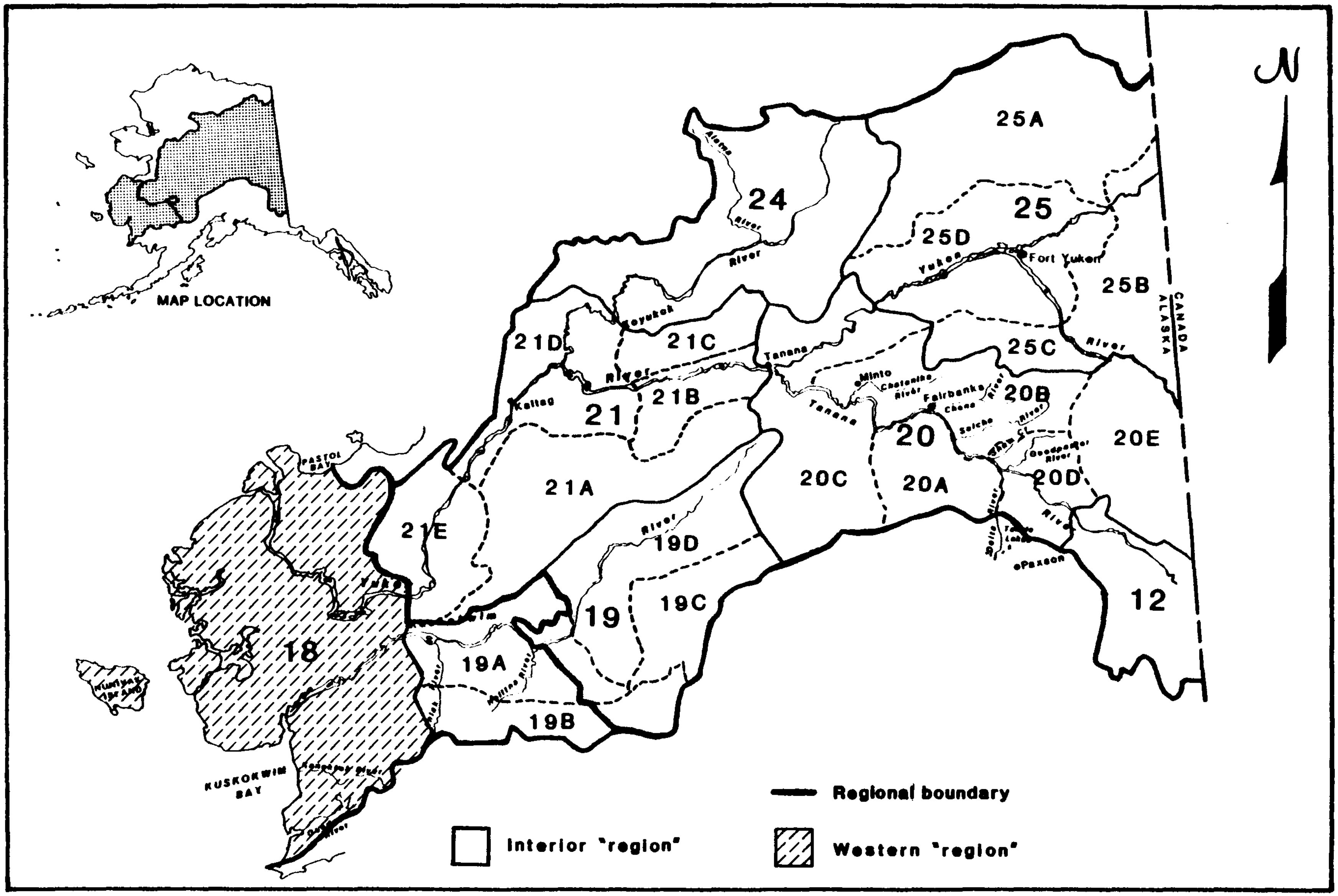
A. Introduction

Furbearers were an important factor in the exploration and settlement of Alaska, and they continue to be an important resource used by the people of the state. The value of Alaska's 1983-1984 furbearer harvest was estimated at $4.1 million (Melchior 1985a). In addition to being an important source of income to trappers from the sale of pelts, the trapping industry also generates income in communities from the purchases of snowmachines, gasoline, traps, and so forth; is an important source of recreation in winter, when other seasonal jobs and activities are limited; and is a highly valued "way of life" for some people. Moreover, nontrappers enjoy observing furbearers and their tracks.

Seventeen species of furbearers commonly occur in the Interior Region of Alaska. Beaver (*Castor canadensis*), land otter (*Lutra canadensis*), mink (*Mustela vison*), and muskrat (*Ondontra zibethica*) are the most prominent species in riparian and aquatic habitats. Wolverine (*Gulo gulo*), wolf (*Canis lupus*), lynx (*Lynx candensis*), coyote (*C. latrans*), red fox (*Vulpes vulpes*), and weasels (*M. erminea*, *M. nivalis*) occur in a wide variety of habitats. Marten (*M. americana*), red squirrels (*Tamiasciuris hudsonicus*), and flying squirrels (*Glaucomys sabrinus*) inhabit forested areas. Woodchucks (*Marmota monax*) occur in loess soils along river valleys and in dry lowlands, and hoary marmots (*M. caligata*) live at the bases of talus slopes. Arctic ground squirrels, or "parka" squirrels (*Spermophilus parryii*), inhabit primarily alpine and subalpine habitat (ADF&G 1976a).

In the Western Region of Alaska, the same four aquatic furbearers listed for the Interior Region are abundant in the flat, marshy expanses of the Yukon-Kuskokwim delta and are also present in riparian habitats throughout the region. Arctic fox (*Alopex lagopis*) is present and locally abundant along the coast, and red fox is common in both upland and lowland habitats. Marten, weasel, lynx, red and ground squirrels, and wolverine are common only in local upland areas, and wolf and coyote are uncommon (ibid.).

With increasing demands on the resource, we will need to know more about these furbearer populations and the effects of harvest on them. This report describes the human use of furbearers in the Interior and Western regions of Alaska, focusing on the regulatory years from 1974-1975 through 1984-1985. Information is presented by game management unit (GMU) and subunit (GMS) (map 1).



Map 1. Boundaries of the Western and Interior "regions" of Alaska and Game Management Units.

B. Regional Summary of Hunting and Trapping

1. Regional summary of human use information. The most common human use of furbearers is to harvest them for their pelts. Most pelts are sold, but some are also retained for domestic use. More than 30,000 people were licensed to trap in 1984, which is twice that reported in 1973. License sales reflect the intent to trap, however, and do not necessarily indicate the actual incidence of trapping. Snowmachines are the most common mode of transportation on traplines.

    a. Interior Region. The furbearer harvest in the Interior Region is the largest of any region in Alaska. Sealing documents provide the most accurate estimate of furbearer harvest for the five species that are sealed; documents from 1974-1975 to 1984-1985 were examined for beaver, wolf, and wolverine and from 1977-1978 to 1984-1985 for land otter and lynx. The Interior Region encompasses approximately 38% of the area of the state; however, 35 to 78% of the annual beaver, lynx, wolf, and wolverine pelts sealed in Alaska during the years indicated above were from this region. Only 9 to 13% of the annual number of land otter pelts sealed in Alaska were from Interior Alaska. Within the region, the annual number of pelts sealed has ranged from 2,265 to 6,762 for beaver, 146 to 288 for otter, 1,088 to 3,914 for lynx, 319 to 626 for wolf, and 258 to 474 for wolverine. Relative to the proportion of the Interior Region that each GMU represents, high harvests occurred in GMU 12 for wolverine, in GMU 19 for beaver, otter, and wolverine, in GMU 20 for wolf and wolverine, in GMU 21 for beaver and otter, and in GMUs 24 and 25 for lynx. Harvest data for furbearer species that are not required to be sealed are available from pelt export reports and fur acquisition reports; however, only the export reports from 1977-1978 to 1983-1984 were examined for this narrative. Annual numbers of muskrat and marten pelts exported from the Interior Region greatly exceeded the number of exported pelts from any other furbearer. More than 35,000 muskrat pelts were exported in 1977-1978, but since then the annual export has ranged from 3,230 to 15,469 pelts. Annual exports from the Interior Region also included the pelts of 8,756 to 16,029 marten, 1,134 to 4,096 mink, 858 to 2,375 red fox, and less than 800 each of arctic fox, squirrel, and weasel.

        Not all pelts harvested are exported from Alaska. The percentage of sealed pelts exported varied among years and among species, ranging from 33 to 80% for beaver, 57 to 99% for lynx, and 46 to 80% for otter during the 1977-1978 to 1983-1984 period.

b. Western Region. Although the Western Region covers only about 6% of the area of the state, it is among the most important areas for harvest of aquatic furbearers and arctic and red foxes. For the past 8 to 11 years, from 13 to 31% of beaver and land otter pelts sealed in Alaska were from this region; the average was 20%. The annual number of beaver pelts sealed has ranged from 981 to 2,502. Because many beaver pelts are used domestically, particularly when pelt prices are low as they have been for the past few years, the actual harvest is probably at least 30% higher than the number sealed (Machida, pers. comm.). For land otter, the range has been 222 to 686 pelts. As many as 258 trappers have submitted beaver pelts for sealing in one year. Mink and muskrat pelts are not sealed, but annual exports of pelts from the Western Region from 1977-1978 through 1983-1984 ranged from 637 to 10,013 for mink and from 533 to 31,391 for muskrat, averaging about 35% of the total statewide exports of these species. During the same time span, exports of pelts of the two other furbearer species for which the Western Region contributes a disproportionately large share of the statewide harvest, arctic and red fox, ranged from 47 to 922 and from 281 to 2,740, respectively. On the average, this was about 24% of the total statewide exports of fox pelts. Red fox, mink, and land otter pelts from the Western Region are known for their consistently high quality and value compared to those from other regions of the state. Harvest of each of the other furbearers in the Western Region contributes no more than 3% to statewide sealing or export figures. However, some furbearers are highly valued for local use and may be harvested but not sealed or exported. Examples of these are wolverine (for parka ruffs), beaver (for hats), and muskrat (for eating).

2. Managerial authority. Wildlife management in Alaska was formally established in 1925 when Congress created the Alaska Game Commission "to protect game animals, land furbearing animals, and birds in Alaska, and for other purposes" (ADF&G 1976b). Prior to 1925, protection of wildlife had been undertaken by the Departments of Treasury, Commerce, and Agriculture, and by the territorial governor. With the attainment of statehood in 1959, the Alaska Legislature established by statute a Department of Fish and Game, provided for a commissioner as the principal executive officer of the department, and created a Board of Fish and Game. Since statehood, the legislature has variously added to, amended, or repealed portions of the original state fish and game

statutes, reflecting the increased complexities of resource management (ibid.).

In 1975, the Board of Fisheries and Game was restructured into two seven-member boards, one for fisheries and one for game:

> . . . the Legislature has delegated broad regulatory authority to the Board of Game . . . the Legislature has the authority to affect that delegation at any time. For example, seasons and bag limits, normally set by the Board, could legally be established by the Legislature . . . .
>
> The primary functions of the Board of Game in conserving and developing the game resources of the state are the promulgation of regulations affecting use of wildlife and the establishment and conduct of advisory committees . . . . In addition, the Board of Game may adopt regulations upon the recommendation of the Department, by the majority vote of affected local advisory committees, or by written petition by interested residents of an area as regards the establishment of subsistence hunting areas, the control of transportation methods and means within subsistence hunting areas, and the establishment of open and closed seasons and areas to protect subsistence hunting . . . Advisory committees have the authority to declare emergency closures during established seasons under procedures established by the Board (ibid.).

Although the ADF&G has managerial authority over most game resources throughout the state, other agencies (e.g., the National Park Service) may restrict the use of resources on their land. They may not, however, implement less restrictive regulations than those set up by the Board of Game.

II. INTERIOR REGION (GMUS 12, 19, 20, 21, 24, AND 25)

A. Boundaries

The area discussed here as the Interior Region includes GMUs 12 and 20 (Tanana River drainage and that area drained by the Yukon River upstream from and including the Tozitna River drainage to and including the Hamlin Creek drainage, and by the tributaries draining into the south bank of the Yukon River upstream from and including the Charley River drainage to the Alaska-Canada boundary, and by the drainage of Ladue and Fortymile rivers); GMU 19 (Kuskokwim River drainage upstream from a straight line between Lower Kalskag and Paimiut); and GMUs 21 and 25 (Yukon River drainage upstream from a straight line between Lower Kalsag and Paimiut, except that portion included in GMU 20) (map 1). Although part of GMU 19 is within the Western Region, the furbearer data for all of GMU 19 are discussed with the Interior

Region because most harvest data are available by GMU and most of GMU 19 is in the Interior Region. (See section III. for data regarding the human use of furbearers in the rest of the Western Region.)

The total area of the Interior Region includes approximately 38% of Alaska. The regional boundary has not changed during the last 10 years; however, there was one change in the GMU boundaries that affects the annual harvest attributed to GMUs 20 and 25. In July 1981, a boundary change between GMU 20 and 25 resulted in approximately 6,700 mi^2 shifting from GMU 20 to GMU 25. Prior to this change, GMU 20 included the entire area draining into the south bank of the Yukon River upstream from and including the Tozitna River drainage.

B. Management Objectives

According to the Alaska Wildlife Management Plans Draft Proposal (ADF&G 1976a), the ADF&G's primary objective for managing furbearers is to provide a sustained opportunity for commercial use of furbearers. Secondary objectives are to provide 1) the greatest sustained opportunity to participate in hunting and trapping, 2) a sustained opportunity for subsistence use of furbearers, and 3) the opportunity to view and photograph furbearers (ibid.). Policies for statewide furbearer management are described in the Alaska Wildlife Management Plans - Species Management Policy (ADF&G 1980). These plans present statewide furbearer management policies and do not address specific regions of the state; local management problems are addressed by input to the Game Board via public comment, advisory committees, and agency personnel. The following summary of the 1980 policy statement is applicable to furbearer management throughout Alaska.

1. Species and habitat management policies. These policies for furbearers are to maintain an active department program to increase knowledge of the population status and the biological and ecological requirements of furbearers, including cooperating with and making recommendations for furbearer research conducted by other biologists in Alaska; to designate and protect critical habitat areas and advocate land management policies that recognize the role of wildfire in maintaining habitat diversity; to generally oppose transplants of furbearers but to consider approving transplants if substantial resource or public benefit can be shown; and to implement control of furbearers only after an investigation by department personnel has determined that a valid need exists.

   For wolves, two additional management policies exist: 1) to maintain suitable habitat for ungulates as an adequate prey base for wolves and to manage ungulate harvests by man by considering the requirements of both wolf and ungulate populations affected by human harvests to ensure the continued well-being of both, and 2) to manage wolf and prey populations and to regulate human harvest when the use of prey by wolves and by humans exceeds the capabilities of the prey population to sustain those uses. The wolf populations may be reduced when the department and the Board of Game determine it to be necessary.

2. Species use management policies. These policies for furbearers (except wolves) are to manage furbearers on the sustained yield principle for the benefit of the resource and the people of the state while also considering national and international interests; to manage furbearers in most areas of the state for the optimum sustained yield of economic benefits; to provide maximum opportunities for consumptive and nonconsumptive recreational use of furbearers; to encourage recreational observation and photography of furbearers through public information and education and to issue permits for capturing, holding, importing, and exporting furbearers only if suitable habitat or holding facilities are available to the permittee and if substained benefits consistent with the department's goals and policies can be demonstrated. The species use management policy for wolves was being revised at the time of this report and was not available. Check with ADF&G representatives for current information.

C. Management Considerations

Issues related to the management and human use of furbearers are identified in the Alaska Wildlife Management Plans - Species Management Policies (ibid.). Policies for responding to many of these issues are discussed in the management plans.

The land-related problems addressed in the Species Management Policies and pertaining to furbearer management in the Interior Region include the loss of habitat due to fire suppression, resource and human development, mining activities, and urbanization; the underharvesting of furbearer populations that have a significant economic potential not being realized; the overharvesting of beaver and wolverine and the potential overharvest of other furbearers; the loss of public trapping opportunity on private lands or federal lands with limited use status under terms of the Alaska Native Claims Settlement Act (ANCSA); the increased conflicts between trappers resulting from competition for areas (which also may result in higher trapping intensity on these areas); high market values for some furbearers (the average pelt value for lynx in 1983-1984 was $312), which may increase trapping intensity; accidental trapping of dogs near populated areas, which increases public antitrapping sentiment; potential transmission of diseases such as rabies and Ecinococcus from furbearers to humans; damage to property and water flow due to beaver activity; and the damage done to human property by red squirrels. In addition to these problems addressed in the Species Management Policies, concern has also been expressed about changes in habitat due to agricultural development and land disposals.

Other issues to be considered with respect to human use of furbearers include 1) public attitudes, 2) changes in furbearer populations, and 3) changes in furbearer harvest and harvest intensity:

1) Differing public attitudes regarding furbearer management have resulted in conflicts such as those between trappers and antitrappers (some trappers have reported traps stolen or intentionally tripped by people who oppose trapping in general or in that area) and those between people who want beaver locally protected because they value the viewing opportunity and people who want beaver removed because of damage to trees or property. Public attitudes toward the ADF&G's wolf predation control program also differ widely.
2) Furbearer populations fluctuate in response to changes in their environment, including such factors as habitat, weather and snow conditions, availability of shelter, and availability of food. For example, lynx populations cycle at 8 to 11-year intervals, partly because lynx reproduction declines when the abundance of their primary prey, snowshoe hares (Lepus americanus), declines (O'Connor 1984). Understanding this type of relationship can help biologists evaluate the potential influence of human use of lynx during different periods in the cycle.
3) Harvest levels and harvest intensity fluctuate in response to changes in pelt prices, conditions for trapping, numbers of trappers, and the size of the furbearer population. These factors are discussed in Section II.E.3. and should also be considered when assessing the human use of furbearers.

D. Period of Use and Bag Limits

Alaska furbearer trapping seasons and bag limits have remained relatively unchanged since statehood in 1959 (ibid.). Generally, trapping seasons are open from November through February or March, coinciding with the months when pelts are prime. Seasons for trapping beaver, muskrat, and land otter extend into April, May, or June. Although the open season for harvesting muskrats extends from September or November into June, most are taken during the last six weeks of the season (ibid.). There are no closed seasons for trapping squirrels (red, flying, ground, or parka) or marmots in the Interior Region. There are no bag limits for trapping any Interior furbearer species except beaver. Beaver bag limits range from 15 to 40 animals. A trapping license permits the licensee to trap or shoot furbearers.

In addition to trapping seasons, there are also open hunting seasons for coyote, red fox, lynx, raccoon, red squirrel, wolf, and wolverine. Hunting seasons for coyote, wolf, and wolverine are longer than the trapping seasons. Only one wolverine and two coyotes, red foxes, and lynx may be taken per year with a hunting license; there are no bag limits for hunting wolves. Wolf and wolverine are classified as both big game and furbearers; therefore, the Alaska hunting regulations apply if they are taken under a hunting license, and the Alaska trapping regulations apply if they are taken under a trapping license.

The seasons or types of use can vary with land status. Four national parks and/or preserves exist within the Interior Region: the Gates of the Arctic National Park and Preserve in the northern quarter of GMU 24, Denali National Park and Preserve in the southeastern tenth of GMU 20 and in a small portion of northeastern GMU 19, Wrangell-Saint Elias National Park and Preserve in the southern half of GMU 12, and the Yukon Charley Rivers National Preserve in small portions of northeastern GMU 20 and southeastern GMU 25 (see map 2). Sport hunting and commercial trapping are prohibited in national parks or monument lands; however, subsistence hunting and trapping has been allowed in these areas since December 1980. All hunting and trapping have been prohibited within the old boundaries of former Mt. McKinley National Park since its creation.

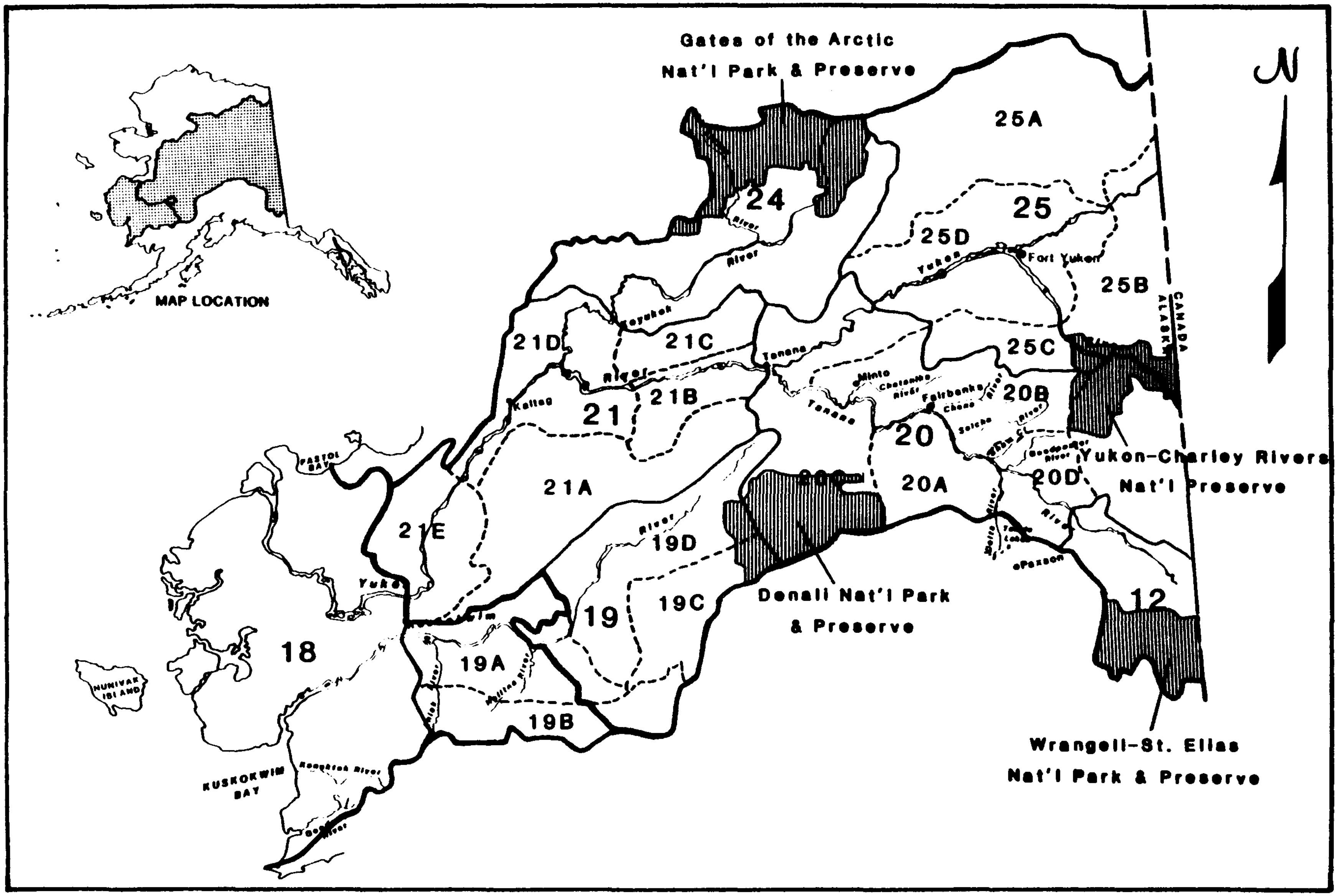
One major change in furbearer seasons has occurred in the last 10 years. The 1985-1986 trapping seasons for lynx were reduced in some Interior units (GMUs 12,20,25) from a four-to-four-and-one-half-month season (November 1 through March 15) to a two-or three-month season. This change was made to reduce the harvest during the low phase of the lynx population cycle.

E. Human Use Data

1. Types of uses. Commercial and domestic utilization are the most important uses of furbearers in much of Alaska. Most furs are sold, but some are retained for domestic use in parkas, hats, mukluks, or as trim for garments. Wolf, wolverine, marten, muskrat, and beaver are the species most used in the domestic manufacture of garments, but almost all species are used to some extent (ADF&G 1980). Most furs are sent to commercial tanneries for processing, even furs kept for domestic use. Beaver, muskrat, ground squirrel, and to a limited extent, lynx and red squirrel are also used as human or dog food. In addition, other parts of furbearers, such as beaver castor and fox urine, are used for scent lures, and many furbearer carcasses are used for trapping bait. The few furbearers taken by hunters are usually taken on an opportunistic basis in conjunction with hunts for other species. Wolves and wolverines are generally considered trophies by hunters (ibid.).

   Fur trapping can be a very important source of income for many people who need to supplement their income from other seasonal jobs because frequently there are very few jobs available in winter in rural areas.

   Recreational trapping and nonconsumptive use of furbearers occur also, usually near urban areas and along roads, trails, or rivers. Viewing and photography are usually limited to those furbearers whose habits provide opportunities for observation, such as beaver, muskrat, red squirrel, arctic



Map 2. Boundaries of the National Parks and Preserves within the Interior Region.

ground squirrel, and occasionally fox or marmots. Many people enjoy observing furbearer tracks in the snow, even though the furbearer itself is not often seen.

2. Estimates of harvest. Furbearer harvest data are available from sealing documents, export reports, and fur acquisition reports. Sealing documents provide the most accurate estimate of harvest; however, the pelts of only five species of furbearers (beaver, land otter, lynx, wolf, and wolverine) are required by law to be sealed. The pelts of muskrat, marten, mink, red fox, arctic fox, squirrel, and weasel are not required to be sealed. Export records plus fur acquisition reports give the best estimates of harvest data for these latter species. Furbearer export data from 1977-1978 through 1983-1984 were examined; however, fur acquisition data are not included in this report. The qualifications and limitations of using sealing and export records to estimate harvest are discussed in section II.E.3.

   a. Beaver. Since 1974-1975, 35 to 54% of the statewide harvest of beaver has been from the Interior Region; this region has sealed from 2,265 to 6,762 beaver pelts annually (table 1). Seventy-four to 93% of the annual Interior beaver harvest was from GMUs 19, 20, and 21 combined, even though only 61 to 63% of the Interior Region is in these three GMUs (table 2). During the last 10 years, two sharp peaks in the number of Interior beaver pelts sealed have occurred, one in 1976-1977 and one in 1979-1980.

   b. Land otter. The numbers of Interior land otter pelts sealed since 1977-1978 have not fluctuated as widely as those of beaver, ranging only from 146 to 288 pelts annually and accounting for 9 to 13% of the annual statewide land otter harvest (table 3). As with the beaver harvest, the Interior otter harvest was highest in GMUs 19, 20, and 21, with these three GMUs contributing 70 to 88% of the Interior's otter harvest. The GMU 24 otter harvest was also relatively high during some years and accounted for 19 to 20% of the Interior otter harvest in 1978-1979, 1980-1981, and 1981-1982.

   c. Lynx. Since 1977-1978, 54 to 78% of the annual lynx harvest in Alaska has been from the Interior Region; the numbers of pelts sealed have ranged from 1,088 to 3,914 (table 4). Peaks in harvest occurred in 1981-1982 and 1982-1983. GMU 25 has consistently contributed more to the Interior lynx harvest than any other GMU; 30 to 50% of the annual number of lynx sealed in the Interior were from this GMU alone. During a peak in 1982-1983, 1,564 lynx pelts from GMU 25 were sealed. GMUs 20 and 24 also contributed significantly to the Interior lynx harvest.

   d. Wolf. The number of Interior wolf pelts sealed has ranged from 319 to 626 since 1974-1975 and has comprised

44 to 54% of the annual statewide wolf harvest (table 5). The highest harvests occurred prior to 1977-1978. In all years except 1984-1985, most of the Interior wolf pelts sealed were from GMU 20. The number of wolf pelts sealed in the other five GMUs has remained relatively consistent; the variability in annual Interior harvest was due primarily to changes in the GMU 20 harvest.

e. Wolverine. The annual number of Interior wolverine pelts sealed has ranged from 258 to 474 since 1974-1975 and represents 36 to 51% of the statewide harvest (table 6). Variability in the annual numbers of Interior wolverine pelts sealed was usually due primarily to changes in the GMU 20 harvest; the annual numbers of wolverine pelts sealed in the other five GMUs were relatively constant. Peak Interior wolverine harvest occurred in 1976-1977 and 1982-1983.

f. Other furbearers. Export records were examined to evaluate the harvest of furbearers not required to be sealed. The numbers of muskrat and marten pelts exported from the Interior have far exceeded the numbers of exported pelts from any other furbearer species (table 7). A dramatic peak in muskrat pelt exports (more than 35,000) occurred in 1977-1978, but since then exports have ranged from 3,230 to 15,469 pelts annually. Annual marten pelt exports ranged from 8,756 to 16,029 pelts. Exports of mink and red fox pelts were less numerous, and their numbers also varied widely from year to year, ranging from 1,134 to 4,096 and from 858 to 2,375, respectively. A peak in the mink, red fox, and lynx exports occurred in 1981-1982. Less than 800 arctic fox, squirrel, land otter, and weasel pelts have been exported annually from Interior Alaska since 1977-1978.

3. Considerations when evaluating harvest data. Estimates of harvest vary, depending on the type of harvest data used. Sealing records provide the most reliable estimates of harvest because all pelts from the designated furbearers (beaver, land otter, lynx, wolf, and wolverine) are required to be sealed. However, several factors can influence the accuracy of estimates of harvest based on sealing documents, including variability in adherence to sealing requirements in different areas, pelts not being sealed the same year they were harvested, human errors in data entry, coding to the wrong area, and generalized statements about where the animal was harvested (e.g., Yukon River). Since 1984-1985, area biologists have been responsible for coding the certificates for their areas, and the number of miscodings should decline. Export data underestimate the furbearer harvest because not all pelts harvested are exported, furs are not always

exported during the same year they are harvested, and export reports are not always used when they should be. Until recently, the enforcement of this regulation has been lax. Estimating harvest for specific areas from export data can be misleading because until 1984-1985 only the address of the trapper/shipper was recorded on the export tag, not the location of the harvest. Fur dealers and trappers often obtain furs from areas far from their resident address. As with sealing records, data entry errors can also cause inaccuracies in reports of export data. Because of these underestimations, the best estimate of harvest for those furbearer species whose pelts are not required to be sealed is made by combining information from export reports with fur dealer acquisition reports.

The degree to which export data underestimate the harvest can be evaluated by examining the proportion of sealed pelts that were exported; however, only beaver, lynx, and land otter have both sealing and export data available. For these three species, between 33 and 99% of the number of pelts sealed were exported (table 8). The harvest of the furbearers not required to be sealed has been estimated by some biologists by multiplying their export numbers by a correction factor based on percentages such as those in table 8. However, because the percentages of sealed pelts exported varied among years and among species, these percentages can best be used to help provide a range of possible harvest levels for unsealed species, rather than to estimate what the actual harvest was. Annual and species variability in the relationship between number of pelts sealed versus exported is partly due to fluctuating market values, the incidence of domestic use for that species, and the number of trappers that adhered to sealing and export reporting requirements.

Variability in the number of furbearers harvested per GMU is expected partly because of the wide-ranging sizes of these GMUs (table 2). For instance, GMU 12 encompasses only approximately 4% of the Interior Region; thus, the proportion of the Interior harvest from GMU 12 is expected to be much lower than from the larger GMUs. Relative to the proportion of the Interior that each GMU represents, GMU 12 had high lynx, wolf, and wolverine harvests; GMU 19 had high beaver, otter, and wolverine harvests; GMU 20 had high beaver and wolf harvests; GMU 21 had high beaver and otter harvests; and GMUs 24 and 25 had high lynx harvests. However, the amount of land open to trapping should also be considered when evaluating these harvest statistics. For instance, since the Alaska National Interest Lands Conservation Act (ANILCA) was passed in 1980, approximately 25% of GMU 24 has been closed to commercial trapping.

It is important to remember that changes in furbearer harvest levels do not necessarily parallel changes in population size. Fluctuations in harvest levels may also result from changes in the accuracy of reporting data, changes in pelt prices, or changes in trapping conditions (i.e., weather, ice thickness, etc.). Biologists evaluating furbearer population levels must examine other information in addition to harvest data. One source of data on furbearer population trends is the ADF&G trapper questionnaire, which has been sent annually to selected Interior trappers since 1965.

4. Estimate of number of users. The human uses of furbearers includes both nonconsumptive use (viewing, photography) and consumptive use (hunting or trapping). Because of the generally secretive nature of most furbearers, nonconsumptive use of furbearers is less common than that of other more visible animals such as moose (*Alces alces*) and is very difficult to quantify. No estimates are available for the numbers of nonconsumptive users of the furbearer resource.

   The numbers of consumptive users of furbearer resource are also difficult to quantify. Data on the numbers of furbearer trappers are available from license sales, sealing documents, and export reports. Over 30,000 people were licensed to trap in 1984, double the number licensed to trap in 1973 (table 9). Trapping license sales, however, may not accurately portray the number of people actually trapping in a given winter. Overestimates of trapping pressure may occur if license sales are used because purchase of a license reflects the intent to trap, not the actual trapping activity. Because of the low cost of trapping licenses ($3 prior to 1985, $10 since 1985), many people bought licenses in case they had the opportunity to harvest a furbearer. Annual trapping license sales can also underestimate trapping pressure because a trapping license is valid from the date of purchase through September of the following year. For example, the number of people licensed to trap during the 1983-1984 season would be the sum of licenses sold from January 1983 through September 1984. In addition, no license is required of residents over 60 years of age or under 16 years of age. Eight furbearers can also be harvested with a hunting license (see section II.D.), but the number of people using the resource in this way is unknown.

   Regional information on numbers of licensed trappers is difficult to assess because a licensee is allowed to trap or hunt statewide. Regional information is available only by examining the sealing records for a specific region and counting the number of trappers responsible for that harvest. This type of data-sorting by computer should be available in the near future. Even this regional information, however, measures only the number of successful trappers, not the actual number of trappers.

5. Types of access. Snowmachines are the most commonly used mode of transport for trapping or hunting furbearers,

although aircraft are also used extensively. Snowmachines are the standard means of winter transportation in all bush communities and provide rapid and efficient coverage of large areas surrounding settlements. Snowmachines are used to maintain trapping lines as well as to pursue and shoot furbearers, especially red fox, wolf, and wolverine. Aircraft are useful for trapping in areas far from human habitation and are also used as an aid in locating and ground-shooting fox, wolf, and wolverine (ADF&G 1980).

Based on 66 responses to a 1982-1983 ADF&G trapper questionnaire, the percentages of the distribution of trapping effort by transportation mode within the Tanana basin were estimated as follows (ADNR 1984):

Airplane/walking	1.5
Airplane/dog team	3.0
Airplane/snowmachine	4.5
Vehicle/walking	6.1
Vehicle/dog team	1.5
Vehicle/snowmachine	53.0
Snowmachine only	27.0
Dog team only	1.5
Walking only	1.5

The Tanana basin encompasses about 14% of the Interior Region and includes the most populated and easily accessible areas; thus the proportion of trappers using vehicles would likely drop dramatically if questionnaires were examined from trappers from the entire Interior Region. Most of the Interior Region that is <u>not</u> included in TBAP is not accessible by vehicle and is probably trapped primarily by snowmachine and airplane.

F. Particular Use Areas

Throughout Alaska, the areas used most intensively for furbearer harvest are areas closest to human settlements, along easily accessible travel routes such as roads, trails, or rivers, and with high furbearer populations.

1. <u>GMU 12</u>. Nearly all of GMU 12 is heavily trapped, especially areas near the road system in the western portion of the unit (Grangaard, pers. comm.). Virtually all drainages are trapped, particularly in the vicinity of the Northway-Tetlin flats (Kelleyhouse, pers. comm.) Muskrat populations in these flats were high in 1985 and were heavily trapped. Beaver densities are moderate-to-low throughout most of the unit, with areas of high densities in the eastern portion of the Northway-Tetlin flats. Land otter populations are low and are trapped incidentally to trapping other furbearers. Most trappers trap primarily for marten and lynx; most of the lynx harvested in Unit 12 are caught in the low elevations of the Tanana valley. Little is known about wolverine

populations in the unit, but the harvest is well distributed. Although trappers set traps for foxes and wolves, very few are harvested (Grangaard, pers. comm.). Most wolves that are harvested are taken in the southern and eastern portions of the unit.

2. GMU 19. In GMU 19, the most important areas of furbearer human use are within 20 mi of the villages and within the drainages of the Holitna and Hoholitna rivers (Pegau, pers. comm.). The latter drainages support productive furbearer populations and intensive trapping and yield a good harvest of many species of furbearers. Red fox and otter are relatively abundant in these areas. Other important furbearer areas in GMU 19 include the Aniak River and the Kilbuck Mountains, the south and north forks of the Kuskokwim River, and the Takotna River, including the Nixon Fork.
Marten are the principal fur species for trappers in GMU 19 and provided more than 50% of the entire unit's fur income in 1982-1983 (Pegau 1984). Most marten trapping occurs near the villages. The upper Kuskokwim normally has 15-20 trappers who harvest more than 200 marten each per year. Beaver sign is abundant in most of the unit; houses and dams are especially common in GMSs 19A and 19D. Although beaver populations appear to be increasing throughout the unit, the number of beaver trappers remains low (ADF&G in press). Red fox are relatively abundant in GMU 19, especially in the flats near Nikolai and in the lower Holitna and Hoholitna rivers (Pegau 1984). Land otter sign is abundant and widespread in the unit, particularly in the flats near Nikolai and the lower Holitna and Aniak rivers; however, otter trapping is mostly incidental to beaver trapping. Areas of highest lynx numbers continue to be the upper south fork of the Kuskokwim near the Alaska Range and the Aniak River tributaries that drain the Kilbuck Mountains. The wolverine harvest is fairly well distributed throughout GMU 19, but most wolverine trapping efforts occur near the foothills of the Alaska Range. The upper Stony River is a popular area for landing and shooting wolves (Pegau, pers. comm.) and trapping wolverines (Pegau 1984).

3. GMU 20. Trapping intensity in GMU 20 is probably the highest of any unit in the Interior because of the large number of people residing there (75,000 in 1985 in the Fairbanks North Star Borough [FNSB 1986], which is only 15% of the GMU 20 area), the network of roads that reach into all of the six subunits, and the accessibility of much of the rest of the area by rivers and trails. In 1984, a broad overview of trapping intensity indicated that only about 3% of GMU 20 was not within 10 mi of a trapline (O'Connor and Stephenson, unpubl. data). The most intensively used areas are within approximately 5 mi of each side of each of the five highways (George Parks, Elliot, Steese, Dalton, and Richardson), the

Chena Hot Springs Road, Spur roads and trails, the Tanana and Yukon rivers, Tanana and Minto flats, and within approximately a 20-mi radius from the communities. Delta Junction is known for a high fox population, which may be due to the increase in rodent populations in agricultural areas (Melchior, pers. comm.).

3. GMUs 21 and 24. The Yukon and Koyukuk river lowlands are the most important furbearer areas in GMUs 21 and 24, in terms of both the most important trapping area and where the most people live (Osborne, pers. comm.). The Galena area of GMU 21 is known as exceptionally good marten country (Stephenson 1984). Within GMU 21 during 1983-1984, most beavers were harvested in GMS 21D, and 50% of these were from the extensive wetland area of the Kaiyuh flats (ADF&G in press). Land otter is trapped incidentally to beaver trapping in both units. Normally, 50% of the GMU 21 otter harvest is from GMS 21E (Osborne 1984). Mink are of minor interest to trappers in GMU 21, and muskrat populations and harvest are low in most of the unit. Coyotes are usually rare in this unit but have been relatively abundant during the last few years. The wolf harvest in GMU 21 is apparently influenced more by March weather conditions than by population size or fur prices because 75% of the wolves harvested are taken by landing and shooting when the weather is good (ADF&G in press). Lynx are abundant in the northeastern portion of GMU 24, but the areas of highest harvest fluctuate from the western section of the Brooks Range to the eastern section (Osborne 1984). Red fox are primarily trapped along the major rivers, and there continues to be a high fox density in the southern portion of GMU 24 (ibid.).

4. GMU 25. Further upstream on the Yukon River, the Porcupine River drainage (especially the Black River) and, to a lesser degree, the mouth of the Christian River are among the most productive furbearer areas in GMU 25 (Nowlin, pers. comm.). The lynx harvest in GMU 25 is the highest of any unit in Alaska, with the highest density of lynx in the Little Black River and Porcupine River drainages and the eastern portion of GMS 25D (ADF&G in press). In 1982-1983 and 1983-1984, more than 87% of the GMU 25 lynx harvest was from GMSs 25B and 25D.

   In the Yukon Flats, marten populations appear to be moderate and are one of the primary furbearers trapped, and fox populations appear to be abundant but are not harvested very intensively (Golden, pers. comm.). Land otter and wolverine densities are low in most of the unit, although in GMS 25D otter density is probably moderate because of higher-quality habitat in the extensive wetlands of the Yukon Flats. In 1983-1984, five of the seven otters harvested within GMU 25 were from GMS 25B, probably because of higher trapping pressure in that subunit. Most of the beaver harvested in GMU 25 are from GMSs 25B and 25D.

Wolves are abundant in most of the unit, except in the western portion of GMS 25D, where wolf densities are low. Most wolves harvested during the last few years were from GMSs 25A and 25B and the eastern portion of GMS 25D (ibid.).

III. WESTERN REGION (GMU 18)

A. Boundaries

The area discussed here as the Western Region includes GMU 18: the Yukon and Kuskokwim rivers downstream from a straight line between Paimiut and Lower Kalsag and into all streams flowing into the Bering Sea from Cape Newenham north to and including the Pastolik River drainage, also Nunivak, St. Matthew, and other adjacent islands (map 1). No national parks and/or preserves are located in GMU 18, but the area includes the Yukon Delta National Wildlife Refuge (NWR) and a portion of the Togiak NWR. The total area of GMU 18 is approximately 6% of Alaska.

B. Management Objectives

The current Alaska Wildlife Management Plans - Species Management Policies (ADF&G 1980) include one statewide plan for wolves and one for all other furbearers. Because regional plans are not included, species and habitat management policies and species use management policies for the Western Region are identical to those for the Interior Region discussed in section II.B. of this narrative.

C. Management Considerations

Management considerations discussed for wolves and other furbearers on a statewide basis in the Alaska Wildlife Management Plans - Species Management Policies (ibid.) and summarized in section II.C. of this narrative are applicable to the Western Region as well. In addition, there are other considerations of particular importance in the Western Region, many of which are concerned with beavers.

1. <u>Expansion of beaver range</u>. Since the 1978-1979 season, the expansion of beaver colonies downriver and into tundra areas, in some cases where they have not been seen for generations, has resulted in damming of streams from which blackfish (spp.) are traditionally harvested (Jonrowe 1980, Machida 1983). Illegal summer and fall shooting and netting of beaver is occurring in response to this impact of beavers on blackfish harvest. In 1981-1982 and 1982-1983, a special spring hunting season was opened but was not used because of limited access and interference with the spring waterfowl hunt and commercial fishing; fall shooting of beaver continues (Machida 1983, 1984). South of the Yukon River, the beaver season trapping has been extended from November through early June and the harvest limit removed in an attempt to solve this problem.

2. Local overharvest of beavers. Whole colonies of beavers are being trapped out near villages, while more distant areas are not trapped at all (Machida 1983, 1984).
3. Fur sealing. Compliance with sealing requirements for pelts of furbearers is low, especially for those used locally, including wolf, beaver, wolverine, and to a lesser degree land otter. The wolverine harvest, for example, is thought to be at least double the number sealed. Establishing fur sealers in villages without one, encouraging local fur buyers to comply with reporting requirements, and publicizing the importance of accurate harvest data for management purposes may improve the database on furbearer harvest (Machida 1983, 1984).
4. Illegal aerial hunting. Reports are occasionally received regarding the illegal hunting of wolves and foxes from aircraft. Wolves are uncommon in the Western Region and are rarely sought by air (Machida 1985), but the aerial hunting of foxes may be an important problem (Machida 1984).
5. Lack of furbearer population data. Except for beaver, which is censused by fall surveys of beaver caches, little is known about furbearer population status in the Western Region. If trapping intensity increases, population data may be needed for more intensive management. Land otter could be cencused by aircraft through observation of their distinctive tracks (Machida 1983, 1984).
6. Widespread natural mortality. Aquatic and riparian furbearers are subject to widespread, severe mortality from events such as flooding, glaciering, and freeze-down of lakes (ADF&G 1980). Trapping pressure on decimated populations usually decreases, thus facilitating recovery.
7. Introduction of furbearers to islands. Introduction of furbearers to islands for the purposes of fur farming or trapping has had disastrous effects on indigenous wildlife (e.g., nesting birds) (ibid.).

D. Period of Use and Bag Limits

Trapping seasons and bag limits have not changed substantially for most furbearer species since statehood in 1959 (ibid.). Open seasons coincide with the months when pelts are prime, generally from November through March. There are no bag limits for any furbearer other than beaver. Muskrats are usually taken right after breakup, in May and early June (Jonrowe 1980); the open season extends through June 10. Mink are usually trapped in November and early December, when the ice is thick enough for travel but not too thick for trapping (Jonrowe 1980, Dinneford 1982); the mink season closes in January. As beavers have become increasingly abundant in the Western Region, bag limits have been raised from 10 in 1976-1977 and have been removed entirely throughout GMU 18 for 1985-1986. Beaver open seasons in 1985-1986 run from 1 November through June 10. There is no closed season for squirrel trapping. Arctic and red foxes, lynx, squirrels, coyotes, wolves, and wolverines may be taken under general hunting regulations as well as under trapping regulations. Hunting seasons generally begin a month or two prior to trapping seasons and end at the same time. Only one wolverine, two arctic or red foxes, two lynx, two coyotes, and four wolves may be taken annually with a hunting license.

E. Human Use Data

1. Types of use. The most important use of furbearers in the Western Region is commercial and domestic harvest for pelts and, for some species, meat. Mink is the most important commercial furbearer, consistently commanding high prices because of large size, high quality, and uniformity of color (Machida 1984). Although most furs are sold, many are retained for domestic use in parkas, mukluks, or as garment trim, including pelts of species with very high local value (e.g., wolverine), pelts not in prime marketable condition, and pelts of species for which market values are very low (e.g., arctic fox in 1982-1983 [ibid.]). Wolf, wolverine, muskrat, red and ground squirrels, and small beaver pelts are usually used in domestic manufacture of garments in the Western Region (Shepherd 1974, 1976; Jonrowe 1980; Machida 1983, 1985). In many villages, pelts kept for domestic use are tanned locally (Machida, pers. comm.). Beavers are often harvested for meat as well as for pelts. Unlike in the Interior, where trappers normally attempt to catch only larger, more valuable beavers, the vast majority of beaver trappers in the Western Region use snares rather than making sets and attempt to take as many beavers as possible (Machida 1983, 1984). Mink and otter are used as human food in GMU 18 (Melchior, pers. comm.). Muskrat, red and ground squirrels, and lynx are also utilized as human or dog food (ADF&G 1980). Some furbearers (e.g., wolverine, wolf, and land otter) are not intentionally trapped but are usually taken incidentally to other hunting or trapping activities (Jonrowe 1980, Machida 1984). In the Western Region, nonconsumptive use of furbearers for viewing or photography is minimal. Fishermen and hunters may opportunistically observe beavers and red squirrels (ADF&G 1976b).

2. Estimates of harvest. Sealing certificates, export reports, and fur acquisition reports all provide data on harvest of furbearers. Since 1982, the GMU 18 trapper questionnaire has also provided some harvest information. Sealing provides the most accurate data, because all pelts taken are required by law to be sealed, regardless of use, but the only species whose pelts are sealed are beaver, land otter, lynx, wolf, and wolverine. Export reports and fur acquisition reports are available for the other furbearers as well as for beaver, land otter, and lynx, but these reports do not include information from pelts used domestically. Other

qualifications of these estimates of harvest are discussed in sections II.E.3. and III.E.3.

Harvests of furbearers from the Western Region vary greatly from year to year, depending on factors both within and external to the region. Prices being paid for pelts in the European market influence relative trapping effort on each furbearer species as well as use of the pelts for domestic or commercial purposes (Shepherd 1977). The availability of alternative sources of income is important, as are weather, snow, and ice conditions. The latter determine the difficulty of travel to and along traplines and the ability to locate and catch furbearers. The availability of furbearers is critical, because effort will not be spent on trapping unless a sufficient take is expected. Aquatic furbearers in particular are subject to periodic, regionwide die-offs from extreme weather conditions. Widespread flooding in the spring of 1971, for example, drastically reduced mink populations and harvest (Shepherd 1974), and lack of snow combined with unusually cold weather froze out and killed almost all muskrats in the late winter of 1983 (Machida 1984), drastically decreasing harvest.

a. Beaver. Since 1974-1975, 14 to 24% (averaging 20%) of the statewide harvest of beaver has been taken in the Western Region. This is substantially greater than the area of the state (6%) that the Western Region comprises. From 981 to 2,502 pelts have been sealed annually (table 10). Harvest levels increased dramatically as pelt prices rose from 1972-1973 to a peak in 1976-1977, accompanied by overharvest of furbearers in accessible drainages (Shepherd 1974, 1976, 1977; Ernest 1978). Then harvest levels declined as prices dropped and the difficulty of trapping beaver increased (Jonrowe 1979, 1980). A second peak in harvest occurred in 1980-1981, coincidentally, as was the 1976-1977 peak, with maximum harvests in the Interior Region.

b. Land otter. The number of land otter pelts from the Western Region sealed annually since 1977-1978 has varied threefold and accounted for 13 to 32% of the statewide harvest (table 11). The harvest of 686 pelts in 1978-1979 is particularly noteworthy, as is that of 1983-1984. The pelts are difficult to handle but are worth the effort when pelt prices are high (Shepherd 1975). Current prices (1985-1986) are low (Machida, pers. comm.). Because land otters are normally trapped incidentally during the fall mink and spring beaver seasons, harvest fluctuates with the effort expended on the latter two species.

c. Lynx. Harvest of lynx in the Western Region has been consistently low since 1977-1978, averaging 1.8% of the number sealed statewide and never exceeding 3.3% (79 pelts in 1978-1979) (table 12). Most pelts are sold because of high price, so the sealing records are quite accurate (Machida 1984). Lynx are intensively and easily trapped wherever concentrations occur, but in the Western Region lynx are only locally common.

d. Wolf and wolverine. The numbers of wolf (table 13) and wolverine (table 14) pelts sealed from the Western Region since 1974-1975 have contributed an average of only 0.2 and 1.2%, respectively, of the statewide sealing totals for those species. A maximum annual harvest of 5 wolves and 29 wolverines has been reported; typical numbers are 1 or 2 and 6 to 10, respectively. There has been no obvious pattern of changes in harvest over the years. Both of these species are highly valued for local use, and actual harvests are believed to be substantially greater than sealing records indicate (Machida 1984, 1985).

e. Other furbearers. Harvest data for the seven furbearers for which pelts are not sealed are available only from export records and fur acquisition reports. Data for the Western Region from 1977-1978 through 1983-1984 are presented in table 15. The numeric importance of mink and muskrat pelts to average statewide export totals, as well as to total numbers of pelts of all furbearer species exported from the Western Region, is obvious: 36% of statewide totals (range 9-53%) for mink and 32% for muskrat (range 5-55%). Peak export of mink pelts was 10,013 in 1981-1982, the highest number since 1959-1960. An increase of $10 per pelt and ideal trapping weather were probably responsible (Dinneford 1982). Muskrat exports peaked at 31,391 in 1980-1981, prior to the regionwide freezing-related dieoff in 1982-1983. Exports of arctic fox and red fox from the Western Region have contributed an average of 25 and 22%, respectively, to statewide exports, but peak numbers of pelts of arctic and red fox pelts exported (922 in 1980-1981 and 2,712 in 1978-1979 for arctic and red fox, respectively) have been much lower than for mink and muskrat. With the increasing market for long-haired furs, the deep red pelts characteristic of red foxes in the Western Region are highly prized in European markets and are commanding high prices, and hence high trapping effort is being devoted to these foxes. Average exports of weasel and marten are only 2 to 3% of statewide exports and never exceeded 1,000 pelts annually for marten and 100 for weasel. No squirrel pelts have been exported from the Western Region since 1977-1979.

Section II.E.3. discusses the underestimation of harvest due to the use of export rather than sealing data on a statewide basis. Comparative data for individual regions are unavailable.

3. Estimate of numbers of users. Two estimates of the number of consumptive users of furbearers in the Western Region are available. The number of trappers residing in the Western Region who submitted beaver pelts for sealing is listed for 1974-1975 through 1983-1984 in table 10. Numbers range from 258 in 1976-1977 to 111 in 1983-1984 and have declined noticeably since 1980-1981. The second estimate is that of the total number of trappers listed on dealer purchase and pelt export forms who resided in the Western Region. Beaver is included in the list of pelts reported, but wolf and wolverine are not. Dinneford (1981) compiled the figures for the 1979-1980 season and reported 812 trappers in 38 villages. The number of nonconsumptive users of furbearers in the Western Region is unknown but likely to be very low (see section III.E.1.). For a general discussion of the limited availability of regional data on numbers of users of furbearers and for statewide estimates, see section II.E.3. and II.E.4.
4. Types of access. Snowmachines are the primary means of transport for trapping or hunting furbearers in the Western Region of Alaska. They are used to reach beaver colonies during winter (Shepherd 1975) and to pursue and take fox and wolverine (Shepherd 1977, 1978; Jonrowe 1980). More foxes and wolverines are taken in this way than by any other method (Shepherd 1977). Snowmachines are also used to maintain traplines for other furbearer species. Exceptions are muskrat, taken by shooting from boats just after breakup, and beaver, taken during the extended open-water spring season south of the Yukon River. As in other areas of the state without road systems, aircraft are also useful for long-distance transport and for locating foxes and wolverines for ground shooting (ADF&G 1980). Very few trappers use aircraft, however. Trapper questionnaires for the Western Region have not included means of access.
5. Historical levels of use. Although numeric data on historical levels of consumptive use of furbearers in the Western Region do not exist, general trends in human use can be described. Despite increased furbearer harvests from 1978-1979 through 1982-1983, the take is still substantially less than the level of 20-30 years ago. Overtrapping is not a factor, because the only significant effects of current trapping intensity on furbearer density are in areas immediately adjacent to villages (Machida 1984). Changes in the social structure of villages and decreased dependence on trapping income are involved in the decrease in mink harvests. The peak harvest of 10,000 mink pelts during the

10-year period examined was far below the historic high of 40,000 for the Western Region in 1953-1954 (Dinneford 1981). Similar changes are associated with decreased beaver harvests. Historically, beavers were trapped commercially during winter, then hunted in May and June for pelts for local use and for meat, in summer for meat, and in the fall before freeze-up again for pelts for local use and for meat. During the last 15 years or so, the development of the commercial fishing industry has provided cash income and occupied village residents during the open-water season (Burris, pers. comm.). A resurgence of interest in trapping beavers occurred from 1973-1974 through 1976-1977, apparently to reinforce the concept of a subsistence lifestyle and to reestablish subsistence use patterns (Shepherd 1975), but has since decreased. As a result, beavers are abundant and are expanding their range into areas where they have not been observed for generations (Jonrowe 1979).

6. Considerations when evaluating harvest data. Limitations on the accuracy of furbearer harvest data are discussed in section II.E.6. Two additional considerations apply to the Western Region. First, some trappers count only larger beavers toward their limit and do not submit smaller beavers for sealing (Machida 1983). Second, when the land otter sealing program was begun, many trappers thought that an unstated limit was also involved and did not submit all of their pelts for sealing (Jonrowe 1979). Harvest data are believed to be fairly accurate for lynx and mink pelts in the Western Region, where most of the pelts harvested are sold (Machida 1984). For wolf, wolverine, and beaver pelts, however, local use and minimal compliance with sealing and fur trade reporting regulations is responsible for substantial underestimates of harvest (Machida 1984, 1985). For example, reports show that 10 wolf pelts were bought in 1979-1980, but none were sealed (Dinneford 1981).

F. Particular Use Areas

Throughout the Western Region, the majority of trappers utilize only the areas immediately adjacent to villages. Much of the furbearer habitat receives little or no trapping pressure. Trapping of lynx is the only exception. Lynx are intensively trapped wherever local high-density populations exist (Machida 1984). Trapping of many furbearer species occurs only in limited areas of the Western Region, where the density of the animals is sufficiently high. Land otters are usually harvested from coastal drainages with high-density populations, such as the Kashunuk, Black, and Johnson rivers, along Baird Inlet, and in the big lake country northwest and southwest of Nunapitchuk (Dinneford 1981, Machida 1984). Local high-density lynx populations exist along the Kuskokwim River from Akiak upriver and along the Bogus, Tuluksak, Kwethluk, and Kisaralik rivers (Machida 1984). Beavers are trapped heavily near villages. A large but relatively low-density beaver population along the Johnson River supports a heavy harvest from villages on the Kuskokwim River (Machida 1984). Wolves are generally taken in the eastern portion of the region, and wolverines are harvested along the northeast, southeast, and east boundaries of the region, including the Andreafski and Kilbuck mountains, with occasional animals taken on the Yukon-Kuskokwim delta (ibid.). Mink are harvested throughout the region, but trapping is concentrated in the same areas as for land otter. Likewise, muskrats are harvested throughout the region, with the highest take in the low-lying delta area between the Yukon and Kuskokwim rivers (ibid.). Arctic foxes are limited to the coastal fringes north of the Kuskokwim River and are commonly trapped on Nunivak and Nelson islands, Cape Romanzof, and the Yukon River delta (ibid.). Red foxes are widespread, with most of the harvest occurring on Nunivak Island and inland from 60 to 100 mi of the coast (Jonrowe 1979). Marten are taken usually where spruce stands occur, in the Kilbuck Mountains south and east of Bethel and on the north side of the Yukon River above St. Mary's (Dinneford 1982). Some are taken in mink traps on the tundra along the lower Yukon and Kuskokwim rivers (Shepherd 1978). Squirrels are taken only south of the Kuskokwim River, primarily in the lower Kanektok River basin (Jonrowe 1979) and in the upper Kwethluk drainage (Patten, pers. comm.). Weasels are harvested incidentally throughout the region (ADF&G 1976b).

Table 1. Number of Sealed Beaver Pelts from the Interior Region of Alaska, 1974-75 through 1984-85

GMU	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
12	5	5	35	29	11	156
19	1,188	806	1,668	1,338	636	1,640
20	685	812	1,281	1,080	607	1,955
21	753	618	1,794	848	719	1,890
24	295	52	579	129	108	630
25	281	105	247	258	184	491
Interior total	3,207	2,398	5,604	3,682	2,265	6,762
% of statewide	42.7	42.5	50.8	46.6	40.9	54.0
Statewide total	7,516	5,641	11,033	7,902	5,532	12,515

(continued)

Table 1 (continued).

GMU	1980-81	1981-82[a]	1982-83	1983-84	1984-85[b]
12	53	19	15	41	44
19	1,569	1,263	625	540	700
20	1,310	946	437	763	655
21	1,406	593	882	984	700
24	354	163	383	508	236
25	219	383	200	235	334
Interior total	4,911	3,367	2,542	3,071	2,669
% of statewide	40.9	40.1	36.0	42.9	35.0
Statewide total	12,002	8,400	7,056	7,160	7,625

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, June 1985.

a The boundary between GMUs 20 and 25 was changed in 1981 and resulted in an increase in the GMU 25 area and a decrease in the GMU 20 area.

b Preliminary data.

Table 2. Estimated Areas of Game Management Units (GMU) Within the Interior Region of Alaska

GMU	Estimated Area (mi^2)[a]	% of Interior Region
12[b]	10,040	4
19[b]	38,000	17
20[b]	53,886[c]	24
21	45,200	20
24[b]	27,940	12
25	53,619[c]	23
Interior total	228,685	
State of Alaska	591,004[d]	

a Areas were estimated by counting townships and fractions of townships on 1:250,000-scale maps.

b Portions of these GMUs are within national park or monument lands, which have been closed to sport hunting and commercial trapping but open to subsistence hunting and trapping since Dec. 1980. All hunting and trapping have been prohibited within the old boundaries of former Mt. McKinley National Park since its creation.

c Prior to July 1981, GMU 20 was estimated to be 60,600 mi^2, and GMU 25 was estimated to be 46,905 mi^2.

d U.S. Census Bureau (1983).

Table 3. Number of Sealed Land Otter Pelts from the Interior Region of Alaska, 1977-78 through 1984-85

GMU	1977-78	1978-79	1979-80	1980-81	1981-82[a]	1982-83	1983-84	1984-85[b]
12	5	10	12	6	4	6	4	2
19	105	58	66	55	86	69	62	66
20	58	51	76	36	33	23	47	20
21	67	30	60	86	55	32	103	70
24	43	39	54	47	11	13	28	19
25	2	8	20	10	10	3	7	11
Interior total	280	196	288	240	199	146	251	188
% of statewide	12.4	8.9	12.8	10.0	10.8	8.5	12.7	9.4
Statewide total	2,265	2,199	2,243	2,397	1,849	1,726	1,969	1,992

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, June 1985.

a The boundary between GMUs 20 and 25 was changed in 1981 and resulted in an increase in the GMU 25 area and a decrease in the GMU 20 area.

b Preliminary data.

Table 4. Number of Sealed Lynx Pelts from the Interior Region of Alaska, 1977-78 through 1984-85

GMU	1977-78	1978-79	1979-80	1980-81	1981-82[a]	1982-83	1983-84	1984-85
12	73	75(76)[b]	85(89)	139	214	224	150	82
19	98	150	215	271	283	147	55	32
20	390	346	376(404)	389	683	831	369	222
21	71	82	65	122	484	363	121	123
24	109	303	262	432	798	698	430	162
25	347(364)	415	712	1,216	1,452	1,564	1,092	617
Interior total	1,088(1,105)	1,371(1,372)	1,715(1,747)	2,569	3,914	3,828	2,217	1,238
% of statewide	54.0	56.7	62.6	77.8	74.6	67.3	70.4	73.4
Statewide total	2,014	2,416	2,737	3,301	5,243	5,686	3,148	1,686

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, June 1985.

a The boundary between GMUs 20 and 25 was changed in 1981 and resulted in an increase in the GMU 25 area and a decrease in the GMU 20 area.

b Figures in parenthesis indicate higher numbers given in ADF&G survey and inventory reports than from original sealing certificate files.

c Preliminary data.

Table 5. Number of Sealed Wolf Pelts from the Interior Region of Alaska, 1974-75 through 1984-85

GMU	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
12	44	40	39	34	35	35
19	57	84	69	53	81	44
20	356	335	197	185	145	85
21	38	74	120	47	86	82(85)[b]
24	65	44	58	58	100	51
25	57	49	104	45	37	74
Interior total	617	626	587	422	484	371(374)
% of statewide	50.1	50.2	52.6	46.0	53.1	54.6
Statewide total	1,232	1,246	1,115	917	906	679

(continued)

Table 5 (continued).

GMU	1980-81	1981-82[a]	1982-83	1983-84	1984-85
12	23	33	35	23	20
19	48	53	34	39	110
20	123	143	156	111	102
21	78	38	96	54	145
24	72	31	44	45	48
25	56	68	63	47	69
Interior total	400	366	428	319	494
% of statewide	53.0	53.5	51.9	43.6	48.4
Statewide total	754	684	824	731	1,021

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, June 1985.

a The boundary between GMUs 20 and 25 was changed in 1981 and resulted in an increase in the GMU 25 area and a decrease in the GMU 20 area.

b Figures in parenthesis indicate higher numbers given in ADF&G survey and inventory reports than from original sealing certificate files.

Table 6. Number of Sealed Wolverine Pelts from the Interior Region of Alaska, 1974-75 through 1984-85

GMU	1974-75	1975-76	1976-77	1977-78	1978-79
12	59	33	36	25(28)[b]	29(30)
19	43	62	74	75	59
20	122	144	157	118	96
21	34	32	83	58	54
24	22	20	42	39	43
25	64	66	82	87	50
Interior total	344	357	474	402(405)	331(332)
% of statewide	42.7	36.3	50.5	44.2	41.0
Statewide total	805	984	939	909	807

(continued)

Table 6 (continued).

GMU	1979-80	1980-81	1981-82[a]	1982-83	1983-84	1984-85[c]
12	22	24	11	34	21	19
19	62	53	70	65	58	60
20	59	75	55	77	56	63
21	38(40)	41	43	78	32	57
24	30	45	24	45	36	19
25	78	51	55	81	59	62
Interior total	289(291)	289	258	380	262	280
% of statewide	40.4	50.3	40.9	49.1	43.4	44.0
Statewide total	716	574	631	774	603	637

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, June 1985.

a The boundary between GMUs 20 and 25 was changed in 1981 and resulted in an increase in the GMU 25 area and a decrease in the GMU 20 area.

b Figures in parenthesis indicate higher numbers given in ADF&G survey and inventory reports than from original sealing certificate files.

c Preliminary data.

Table 7. Numbers of Raw Pelts Exported From the Interior Region of Alaska[a], 1977-78 through 1983-84

Species	Interior: Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[b]	Statewide Export[b]
Year 1977-78						
Beaver	1,846	349	12	2,207	40.7	5,417
Mink	1,391	605	0	1,996	18.1	11,030
Muskrat	30,987	4,118	1	35,110	73.8	47,564
Marten	11,747	2,824	5	14,576	58.3	24,995
Land otter	205	19	0	224	12.5	1,786
Arctic fox	232	27	1	260	18.7	1,388
Red fox[c]	801	198	0	999	15.8	6,334
Weasel	387	142	0	529	58.3	908
Lynx	475	138	6	619	35.6	1,738
Squirrel[d]	92	40	0	132	41.4	319
Year 1978-79						
Beaver	905	157	---	1,062	27.7	3,838
Mink	1,420	363	---	1,783	17.2	10,348
Muskrat	13,774	1,695	---	15,469	47.2	32,803
Marten	13,286	2,743	---	16,029	54.4	29,467
Land otter	93	24	---	117	7.3	1,595
Arctic fox	330	25	---	355	13.3	2,661
Red fox[c]	934	231	---	1,165	11.6	10,018
Weasel	183	149	---	332	49.3	673
Lynx	410	209	---	619	26.0	2,383
Squirrel[d]	47	520	---	567	72.7	780

(continued)

Table 7 (continued).

Species	Interior				% of Statewide Export[b]	Statewide Export[b]
	Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total		
Year 1979-80						
Beaver	3,745	444	10	4,199	41.7	10,070
Mink	758	373	3	1,134	15.2	7,459
Muskrat	3,523	3,726	30	7,279	17.4	41,814
Marten	7,839	3,991	44	11,874	45.6	26,042
Land otter	78	29	0	107	7.5	1,436
Arctic fox	46	48	5	99	10.2	970
Red fox[c]	828	253	5	1,086	11.4	9,499
Weasel	15	62	0	77	16.2	474
Lynx	312	279	0	591	32.3	1,829
Squirrel[d]	0	726	0	726	71.0	1,023
Year 1980-81						
Beaver	2,080	702	2	2,784	37.8	7,366
Mink	2,447	473	1	2,921	19.7	14,852
Muskrat	11,015	2,507	21	13,543	23.5	57,546
Marten	10,410	4,160	22	14,592	60.1	24,284
Land otter	156	31	1	188	13.2	1,425
Arctic fox	4	33	19	56	2.9	1,936
Red fox[c]	972	354	6	1,332	16.6	8,002
Weasel	24	50	0	74	32.5	228
Lynx	1,010	358	1	1,369	55.1	2,483
Squirrel[d]	8	225	0	233	37.6	619

(continued)

Table 7 (continued).

Species	Interior: Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[b]	Statewide Export[b]
Year 1981-82						
Beaver	1,286	576	83	1,945	32.6	5,961
Mink	3,625	470	1	4,096	21.6	18,922
Muskrat	6,065	1,059	0	7,124	39.3	18,147
Marten	10,347	4,186	6	14,539	57.6	25,251
Land otter	76	54	3	133	9.0	1,470
Arctic fox	7	112	5	124	8.4	1,478
Red fox[c]	1,721	640	14	2,375	23.0	10,309
Weasel	10	50	0	60	31.9	188
Lynx	1,445	516	2	1,963	49.3	3,984
Squirrel[d]	2	174	0	176	34.3	513
Year 1982-83						
Beaver	818	350	115	1,283	38.5	3,331
Mink	2,214	284	266	2,764	35.9	7,706
Muskrat	2,964	266	0	3,230	52.2	6,193
Marten	5,039	3,737	71	8,847	54.0	16,370
Land otter	39	63	2	104	12.0	869
Arctic fox	13	69	0	82	12.7	646
Red fox[c]	337	578	5	920	28.4	3,238
Weasel	79	36	0	115	47.9	240
Lynx	636	562	49	1,247	38.7	3,220
Squirrel[d]	5	6	0	11	5.5	201

(continued)

Table 7 (continued).

Species	Interior					
	Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[b]	Statewide Export[b]
Year 1983-84						
Beaver	328	336	40	704	29.8	2,362
Mink	3,176	226	14	3,416	37.9	9,024
Muskrat	6,675	1,053	13	7,741	77.9	9,936
Marten	4,455	4,266	35	8,756	64.4	13,594
Land otter	97	65	1	163	18.0	907
Arctic fox	37	2	1	40	7.0	574
Red fox[c]	429	415	14	858	28.8	2,980
Weasel	0	36	0	36	15.5	232
Lynx	424	303	2	729	37.9	1,925
Squirrel[d]	0	107	0	107	54.0	198

Source: Computer printouts from Statistics Section, ADF&G, Div. Game, Anchorage.

--- means no data were available.

a Includes GMUs 12, 19, 20, 21, and 24.

b Total of only the exports with GMU data available for them.

c Includes the cross, black, and silver color phases.

d Includes red, flying, and ground squirrels.

e Personal use data for 1978-1979 were not available from the computer printout.

Table 8. The Percentage of Sealed Beaver, Lynx, and Land Otter Pelts Exported from Alaska, 1977-78 to 1983-84

Year	Beaver	Lynx	Land Otter
1977-78	69%	86%	79%
1978-79	69%	99%	73%
1979-80	80%	67%	64%
1980-81	61%	75%	59%
1981-82	71%	76%	80%
1982-83	47%	57%	50%
1983-84	33%	61%	46%

Table 9. Number of Trapping Licenses Sold in Alaska, 1974-84

Calendar Year	Number of Licenses Sold					
	Resident-Trap	Resident-Trap/Hunt	Resident-Trap/Hunt/Fish	Non-Resident-Trap/Hunt	Resident 25¢-Trap/Hunt/Fish	Total Number Licensed to Trap
1974	890	1,109	6,239	24	6,256	14,518
1975	759	1,181	7,551	26	5,004	14,521
1976	1,210	1,328	9,606	37	5,281	17,462
1977	1,589	2,063	9,153	52	5,463	18,320
1978	1,480	1,947	9,141	67	6,887	19,522
1979	1,465	2,170	9,328	53	8,334	21,350
1980	1,526	2,378	9,953	61	9,498	23,416
1981	1,633	2,510	10,620	86	10,669	25,518
1982	1,430	2,534	11,983	70	11,882	27,899
1983	1,349	2,723	13,236	46	12,540	29,894
1984	1,155	2,301	13,620	67	13,176	30,319

Source: ADR 1974-84.

a No hunting or trapping license is required of an Alaska resident over 60 years of age; however, an identification card issued by the Alaska Department of Revenue is required. No trapping license is required of Alaskan residents under 16 years of age.

b Resident trapping licenses are valid from October 1 through the following September 30, inclusive. All other licenses, resident and nonresident, are valid from January 1 through December 31 of the year in which they were issued.

Table 10. Number of Sealed Beaver Pelts from the Western Region of Alaska (GMU 18) and Number of Trappers, 1974-75 through 1984-85

	Sealed Pelts			Trappers			Average Catch per Trapper	
Year	GMU 18	% of Statewide	Statewide Total	GMU 18	% of Statewide	Statewide Total	GMU 18	Statewide
1974-75	1,389	18.5	7,516	181	20.1	899	7.7	8.4
1975-76	1,350	23.9	5,641	180	23.4	770	7.5	7.3
1976-77	2,209	20.0	11,033	258	20.1	1,283	8.6	8.6
1977-78	1,695	21.5	7,902	178	19.5	914	9.5	8.6
1978-79	1,223	22.1	5,532	141	18.0	784	8.7	7.1
1979-80	2,067	16.5	12,515	173	10.7	1,615	11.9	7.7
1980-81	2,502	20.8	12,002	237	17.1	1,388	10.6	8.6
1981-82	1,794	21.3	8,400	172	17.3	997	10.4	8.4
1982-83	1,185	16.8	7,056	113	13.4	846	10.5	8.3
1983-84	981	13.7	7,152	111	13.1	846	8.8	8.4
1984-85[a]	1,506	19.7	7,638					

Sources: Summary sheet in Furbearer Program files at ADF&G, Fairbanks, and computer printouts from Statistics Section, ADF&G, Div. Game, Anchorage.

a Preliminary data.

Table 11. Number of Sealed Land Otter Pelts from the Western Region of Alaska (GMU 18), 1977-78 through 1984-85

Year	GMU 18	% of Statewide	Statewide Total
1977-78	506	22.3	2,265
1978-79	686	31.2	2,199
1979-80	343	15.3	2,243
1980-81	645	26.9	2,397
1981-82	385	20.8	1,849
1982-83	222	12.9	1,726
1983-84	618	31.4	1,969
1984-85[a]	431	21.6	1,993

Source: Summary sheet in Furbearer Program files at ADF&G, Fairbanks.

a Preliminary data.

Table 12. Number of Sealed Lynx Pelts from the Western Region of Alaska (GMU 18), 1977-78 through 1984-85

Year	GMU 18	% of Statewide	Statewide Total
1977-78	56	2.8	2,014
1978-79	79	3.3	2,416
1979-80	66	2.4	2,737
1980-81	55	1.7	3,301
1981-82	55	1.0	5,243
1982-83	67	1.2	5,689
1983-84	23	0.7	3,144
1984-85	23	1.4	1,687

Source: Summary sheet dated 11/18/85 in Furbearer Program files at ADF&G, Fairbanks.

a Preliminary data.

Table 13. Number of Sealed Wolf Pelts from the Western Region of Alaska (GMU 18), 1974-75 through 1984-85

Year	GMU 18	% of Statewide	Statewide Total
1974-75	4	0.3	1,232
1975-76	3	0.2	1,246
1976-77	2	0.2	1,115
1977-78	2	0.2	917
1978-79	1	0.1	906
1979-80	0	0	679
1980-81	1	0.1	754
1981-82	1	0.1	684
1982-83	5	0.6	824
1983-84	0	0	731
1984-85	3	0.3	1,028

Source: Summary sheet dated 11/18/85 in Furbearer Program files at ADF&G, Fairbanks.

Table 14. Number of Sealed Wolverine Pelts from the Western Region of Alaska (GMU 18), 1974-75 through 1984-85

Year	GMU 18	% of Statewide	Statewide Total
1974-75	5	0.6	805
1975-76	29	2.9	984
1976-77	1	0.1	939
1977-78	10	1.1	909
1978-79	8	1.0	807
1979-80	15	2.0	716
1980-81	10	1.7	574
1981-82	6	1.0	631
1982-83	11	1.4	774
1983-84	3	0.5	603
1984-85[a]	7	1.1	639

Source: Summary sheet dated 11/18/85 in Furbearer Program files at ADF&G, Fairbanks.

a Preliminary data.

Table 15. Number of Raw Pelts Exported from the Western Region of Alaska (GMU 18), 1977-78 through 1983-84

Species	Western					
	Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[a]	Statewide Export[a]
Year 1977-78						
Beaver	993	106	0	1,099	20.3	5,417
Mink	4,613	49	0	4,662	42.3	11,030
Muskrat	6,679	229	0	6,908	14.5	47,564
Marten	793	6	0	799	3.2	24,995
Land otter	429	14	0	443	24.8	1,786
Arctic fox	477	4	1	482	34.7	1,388
Red fox[b]	1,793	60	1	1,854	29.3	6,334
Weasel	95	3	0	98	10.8	908
Lynx	21	0	0	21	1.2	1,738
Squirrel[c]	0	0	0	0	0	317
Year 1978-79						
Beaver	1,032	10	0	1,042	27.1	3,838
Mink	3,584	37	0	3,621	35.0	10,348
Muskrat	8,480	353	0	8,833	26.9	32,803
Marten	756	27	0	783	2.7	29,467
Land otter	485	15	0	500	32.4	1,545
Arctic fox	487	6	0	493	18.5	2,661
Red fox[b]	2,635	77	0	2,712	27.1	10,018
Weasel	9	0	0	9	1.3	673
Lynx	106	4	0	110	4.6	2,383
Squirrel[c]	0	0	0	0	0	780

(continued)

Table 15 (continued).

Year 1979-80

Species	Western Fur Dealer Exports	Western Trapper Exports	Western Personal Use Exports	Western Total	% of Statewide Export[a]	Statewide Export[a]
Beaver	1,549	6	0	1,555	15.4	10,070
Mink	561	76	0	637	8.5	7,459
Muskrat	20,797	285	0	21,082	50.4	41,814
Marten	444	0	0	444	1.7	26,042
Land otter	218	3	0	221	15.4	1,436
Arctic fox	159	28	0	187	19.3	970
Red fox[b]	2,364	106	0	2,470	26.0	9,499
Weasel	4	0	0	4	0.8	474
Lynx	38	1	0	39	2.1	1,829
Squirrel[c]	0	0	0	0	0	1,023

Year 1980-81

Species	Western Fur Dealer Exports	Western Trapper Exports	Western Personal Use Exports	Western Total	% of Statewide Export[a]	Statewide Export[a]
Beaver	1,556	180	0	1,736	23.6	7,366
Mink	4,872	59	8	4,939	33.3	14,852
Muskrat	29,597	1,794	0	31,391	54.5	57,546
Marten	321	145	0	466	1.9	24,284
Land otter	371	15	0	386	27.1	1,425
Arctic fox	871	51	0	922	47.6	1,936
Red fox[b]	2,585	82	2	2,679	33.5	8,002
Weasel	6	0	0	6	2.6	228
Lynx	68	6	0	74	3.0	2,483
Squirrel[c]	0	0	0	0	0	619

(continued)

Table 15 (continued).

Year 1981-82

Species	Western					
	Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[a]	Statewide Export[a]
Beaver	1,872	8	0	1,880	31.5	5,961
Mink	9,892	121	0	10,013	52.9	18,922
Muskrat	7,864	336	0	8,200	45.2	18,147
Marten	948	2	0	950	3.8	25,251
Land otter	462	6	0	468	31.8	1,470
Arctic fox	475	8	1	484	32.7	1,478
Red fox[b]	2,017	130	1	2,148	20.8	10,309
Weasel	13	0	0	13	6.9	188
Lynx	94	0	0	94	2.4	3,984
Squirrel[c]	0	0	0	0	0	513

Year 1982-83

Species	Fur Dealer Exports	Trapper Exports	Personal Use Exports	Total	% of Statewide Export[a]	Statewide Export[a]
Beaver	601	66	2	669	20.1	3,331
Mink	2,852	155	0	3,007	39.0	7,706
Muskrat	1,642	151	0	1,793	29.0	6,193
Marten	392	0	0	392	2.4	16,370
Land otter	99	4	0	103	11.9	869
Arctic fox	65	8	3	76	11.8	646
Red fox[b]	326	13	0	339	10.5	3,238
Weasel	0	0	0	0	0	240
Lynx	27	0	0	27	0.8	3,220
Squirrel[c]	0	0	0	0	0	201

(continued)

Table 15 (continued).

Year 1983-84

Species	Western: Fur Dealer Exports	Western: Trapper Exports	Western: Personal Use Exports	Western: Total	% of Statewide Export[a]	Statewide Export[a]
Beaver	332	2	0	334	14.1	2,362
Mink	3,430	48	0	3,478	38.5	9,024
Muskrat	397	136	0	533	5.4	9,936
Marten	34	0	0	34	0.3	13,594
Land otter	207	17	0	224	24.7	907
Arctic fox	33	14	0	47	8.2	574
Red fox[b]	189	92	0	281	9.4	2,980
Weasel	0	0	0	0	0	232
Lynx	2	0	0	2	0.1	1,925
Squirrel[c]	0	0	0	0	0	198

Source: Computer printouts from Statistics Section, ADF&G, Div. Game, Anchorage.

a Statewide total from only the exports with GMU data available for them.

b Includes the cross, black, and silver color phase.

c Includes red, flying, parka, and ground squirrels.

Table 16. Estimated Prices Paid for Raw Pelts in the Western Region, 1977-78

Species	Pelt Size	Price Paid to Trappers
Beaver	Large	$20-25
Land otter	Large	45-55
Lynx	---	200-275
Mink	Large	35-45
Muskrat	Large	2-2.50
Arctic fox	---	25-45
Red fox	---	80-125
Marten	---	25-35

Source: Jonrowe 1979.

--- means no data were available.

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Commercial Harvest of Pacific Halibut
Western Region

I. POPULATION MANAGEMENT HISTORY

A. Introduction

The fishery for halibut conducted by Canadian and United States fishermen is regulated by the International Pacific Halibut Commission (IPHC). Regulation is by regulatory area established along the eastern Pacific coastline extending from California to the Bering Sea. The halibut regulatory area corresponding to the Western Region falls within Area 4E in the Bering Sea. Delineation of the regulatory areas for the Pacific Ocean including the Bering Sea are as follows (IPHC 1985):

- Area 2A includes all waters off the coasts of the states of California, Oregon, and Washington; Subarea 2A-1 includes all waters off the coast of Washington that are north of latitude 48°02'15"N, east of longitude 125°44'00", and west of longitude 123°42'30"W.
- Area 2B includes all waters off the coast of British Columbia.
- Area 2C includes all waters off the coast of Alaska that are east of a line running northwest one-quarter west (312°) from Cape Spencer Light (latitude 58°11'57"N, longitude 136°38'18"W), and south and east of a line running south one-quarter east (177°) from said light.
- Area 3A includes all waters between Area 2C and a line extending from the most northerly point on Cape Aklek (latitude 57°41'15"N, longitude 155°35'00"W) to Cape Ikolik (latitude 57°17'17"N, longitude 154°47'18"W), then southeast by east one-quarter east (121°);
- Area 3B includes all waters between Area 3A and a line extending southeast (135°) from Cape Lutke (latitude 54°29'00"N, longitude 164°20'00"W).
- Area 4A includes all waters in the Gulf of Alaska west of Area 3B and in the Bering Sea west of the closed area defined below and east of longitude 172°00'00"W and south of latitude 56°20'00"N. The closed area in which halibut fishing may not occur includes all waters in the Bering Sea that are east of a line from Cape Sarichef Light (latitude 54°36'00"N, longitude 164°55'42"W) to a point at latitude 56°20'00"N, longitude 168°30'00"W and south of a line from the latter point to Cape Newenham (latitude 58°39'00"N, longitude 162°10'25"W).
- Area 4B includes all waters in the Bering Sea and the Gulf of Alaska west of Area 4A and south of latitude 56°20'00"N.
- Area 4C includes all waters in the Bering Sea north of Area 4A and north of the closed area defined in Area 4A above that

are east of a line extending true northwest (315°) from a point at latitude 56°20'00"N, longitude 170°00'00"W, and west of longitude 168°00'00".

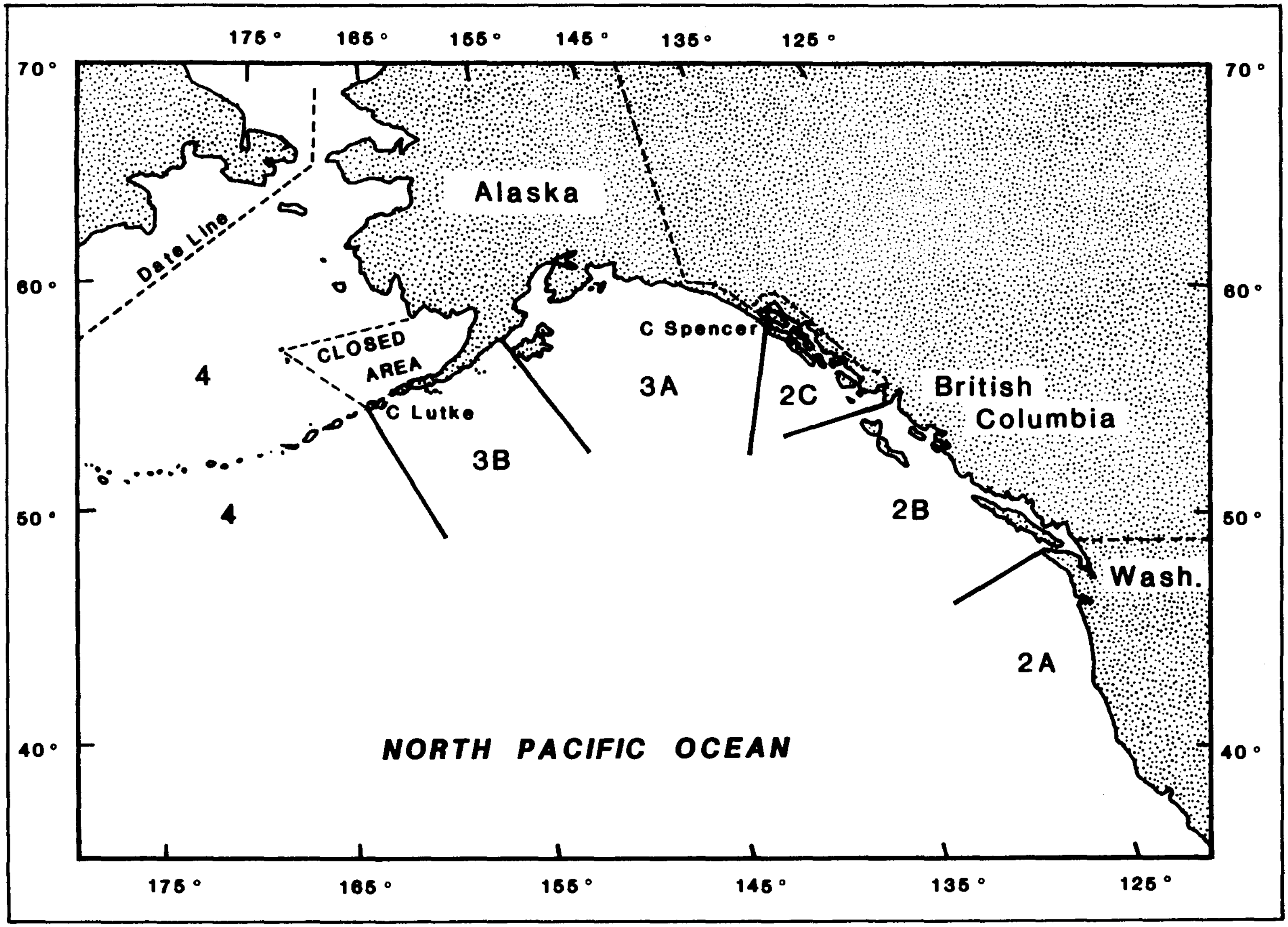
- ° Area 4D includes all waters in the Bering Sea north of Areas 4A and 4B and west of Area 4C.
- ° Area 4E includes all waters in the Bering Sea north of the closed area defined in Area 4A above, east of longitude 168°00'00"W, and south of latitude 65°34'00"N.

For the 1983 fishery, Regulatory Area 4 (Bering Sea) (map 1) was divided into four smaller sections of 4A, 4B, 4C, and 4D (map 2). Another regulatory area was added for the 1984 fishery when Area 4C was divided into two new sections, consisting of a smaller Area 4C and a new Area 4E (map 3). The following narrative will provide a general overview of the entire halibut fishery and will emphasize recent developments in the Bering Sea and Area 4E.

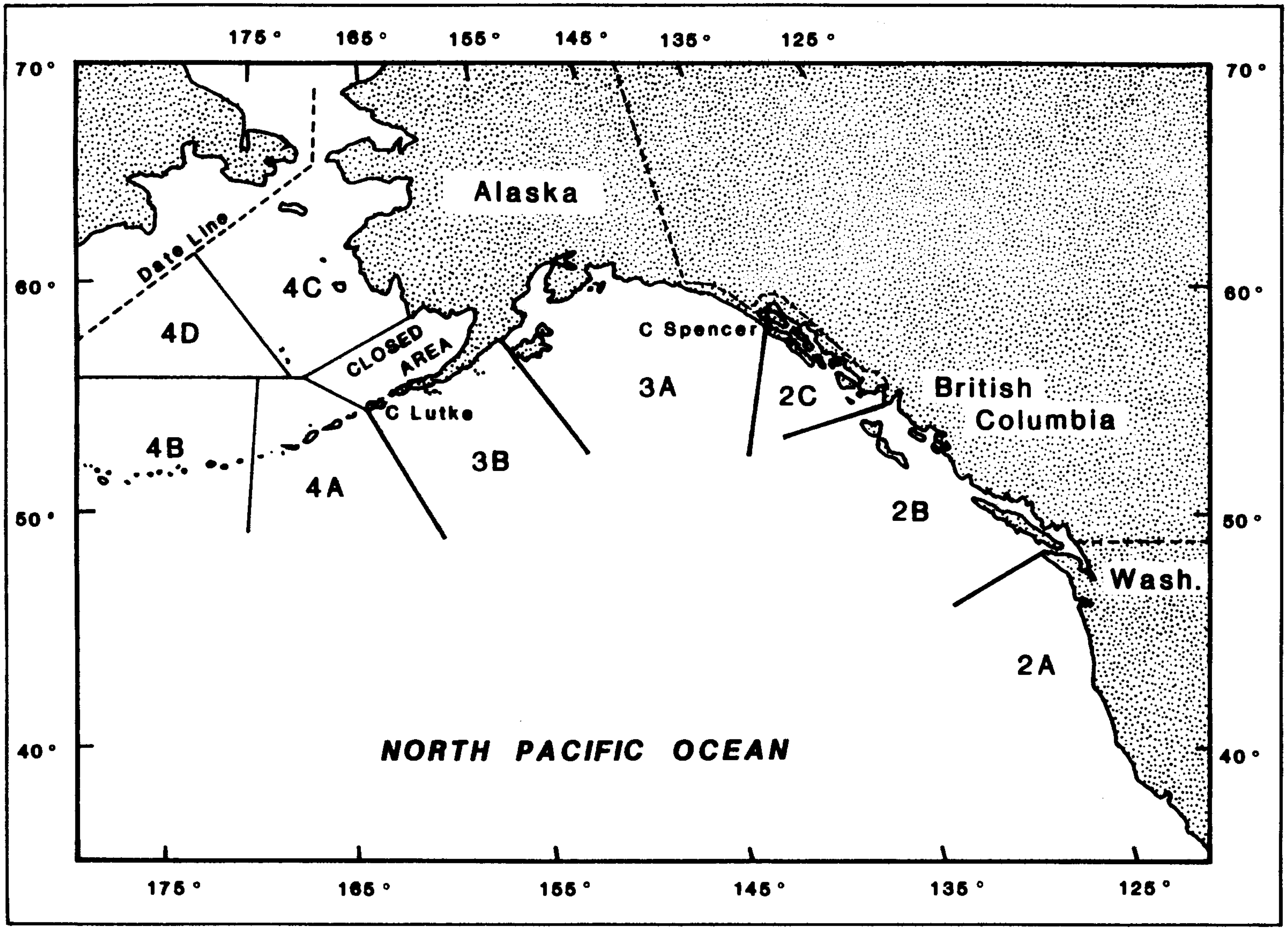
B. Management History and Reported Use

1. Managerial authority. The International Pacific Halibut Commission (IPHC), originally called the International Fisheries Commission, was established in 1923 by a convention between Canada and the United States (IPHC 1978b). The Halibut Commission 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 the incidental catch of halibut (Skud 1976, IPHC 1978b). 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 the incidental catch of halibut in other domestic fisheries, restrict gear type, and close halibut nursery areas to halibut fishing (ibid.).

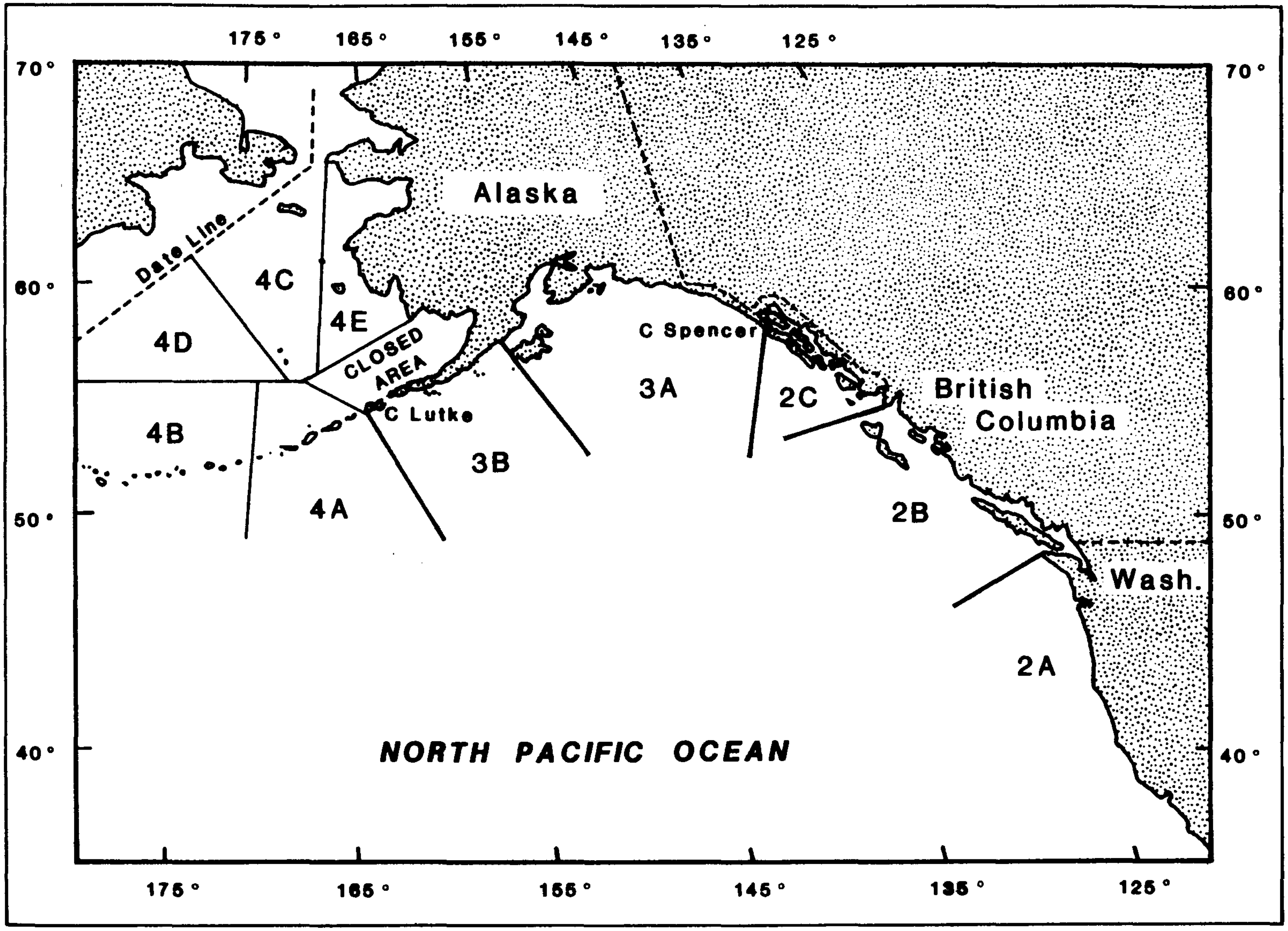
   Prior to 1977, restrictions on foreign fishing for halibut were achieved through separate agreements between the United States, Canada, and other foreign nations involved. Since the passage in 1976 of the Magnuson Fishery Conservation and Management Act (effective March 1, 1977), halibut has been a prohibited species that must be avoided by United States and foreign groundfish fleets within the 200-mi fishery conservation zone (NPFMC 1983). The North Pacific Fishery Management Council (NPFMC) has included in their Gulf of Alaska and Bering Sea/Aleutians groundfish management plans, time-area closures designed to minimize the incidental catch of halibut to allow halibut grounds to remain undisturbed for a short time before the beginning of the halibut season (ibid.). Foreign groundfish trawling in the Gulf of Alaska through 1985 has also been restricted to pelagic trawls during late winter and early spring by the NPFMC, in order to minimize the incidental catch of halibut.



Map 1. Regulatory areas for the Pacific halibut fishery, 1982 (IPHC 1982b).



Map 2. Regulatory areas for the Pacific halibut fishery, 1983 (IPHC 1983b).



Map 3. Regulatory areas for the Pacific halibut fishery, 1984 (IPHC 1984b).

2. Harvest summary:

a. North Pacific and Bering Sea harvests. The commercial fishery for halibut in the North Pacific Ocean began in 1888 when three sailing ships from New England fished off Cape Flattery, Washington. The fishery expanded across the Gulf of Alaska and as far west as Unimak Pass (NPFMC 1984). Fishing for halibut in the Bering Sea, however, did not occur until 1930. Development of the Bering Sea fishery was slow because of the area's distance from home ports, poor weather conditions, and the small size of the halibut stocks. In addition, fishing in the Gulf of Alaska was profitable, giving little reason for the fleet to consider major expansion of their operation into the Bering Sea area (Best 1981). A few boats fished the Bering Sea from 1930 through 1934. Fishing did not again occur until 1952. Catches averaged about 100 metric tons annually (ibid.).

To attract fishermen to the Bering Sea, the opening date of the season was scheduled one month earlier than for the Gulf of Alaska (ibid.). Harvest levels responded to this regulation change, reaching 3,321 metric tons (dressed weight) in 1962 (Best 1981, Myhre et al. 1977). Catches to this date, in the Bering Sea had been divided about equally between United States and Canadian vessels (Myhre et al. 1977). Because the International North Pacific Fishery Commission (INPFC) determined that halibut in the Bering Sea no longer qualified for abstention, Japan was allowed to enter the fishery in 1963 (Best 1981). During the same year, the INPFC established a three-nation catch limit of 5,000 metric tons (3,300 metric tons dressed weight), which was greatly above the maximum sustained yield of 2,268 metric tons (1,496 metric tons dressed weight) calculated by the IPHC for the same area consisting of waters between Unimak Pass and the Pribilof Islands) (ibid.). The harvest during the 1963 season peaked at about 3,690 metric tons (dressed weight). Japan withdrew from the fishery after 1964. Canadian interest in the Bering Sea fishery declined with the growth of their domestic herring fishery. Canadian participation in the Bering Sea ceased in 1979 (ibid.).

Despite these changes in fishing patterns and imposition of time and area regulations on the fishery, catches continued to decline, mainly because of large incidental catches of halibut in the foreign trawl fisheries and a subsequent reduction in the number of young halibut recruited into the fishery (IPHC 1978b). Catches from 1965 through 1974 averaged about 496 metric tons (dressed weight) annually, considerably less than the annual average catch of 1,549 metric tons harvested from 1955 through 1964 (Myhre et al. 1977).

There has been some recovery of halibut stocks in the eastern Bering Sea since the 1960's. Catches from 1975 through 1984 have continued to show a slight increase over the previous decade's harvest and have averaged about 375 metric tons (dressed weight) of halibut caught annually (table 1).

The Bering Sea catch comprised about 3% of the total North Pacific halibut catch from 1975 through 1984. During the same time period, the total halibut catch in the North Pacific Ocean averaged about 12,419 metric tons annually (table 1). About 70 to 75% of the total harvest of halibut has been taken from the Gulf of Alaska (Morris et al. 1983).

b. Small coastal Bering Sea commercial fisheries. Local residents along the eastern Bering Sea coast have caught halibut primarily for subsistence purposes. Participation in the commercial fishery was limited by few interested participating vessels, limited available gear, and limited access to commercial markets. Since the 1981 season, villagers from St. George Island, St. Paul Island, and Nelson Island have entered the commercial fishery for halibut. Because the small villages have no harbor facilities, these fishermen have used small vessels (less than five net tons). The fishery is a day fishery, with activity occurring within 12 mi of the communities (NPFMC 1984). Prior to entry of this local effort into the fishery, a maximum of six vessels had fished the area designated as 4C (as delineated prior to the 1984 change of boundaries [map 2]) (ibid.). These vessels were owned by fishermen who were not residing in local Bering Sea communities (ibid.).

In 1981, the St. Paul Island fishery for halibut began as a demonstration project. About 9 metric tons (dressed weight) of halibut were landed. By 1983, the fishery had expanded considerably, with 40 fishermen participating and about 27 metric tons (dressed weight) harvested (ibid.).

The fishery in the vicinity of St. George Island began in 1982, when 20 fishermen harvested 7 metric tons (dressed weight). The harvest increased to 44 metric tons (dressed weight) taken by 32 fishermen during the 1983 season (ibid.).

The Nelson Island halibut fishery is the only small local fishery found within the boundaries of the Western Region covered by this publication. The 1982 season marked the first commercial halibut harvest for the villages of Tununak and Toksook on Nelson Island.

Table 1. Commercial Harvest Data (In Metric Tons Dressed Weight) for Halibut Taken From the North Pacific Ocean and From the Bering Sea, 1975-84

		Fishing Season									
Area	Subarea	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Bering Sea[a]											
	4A	1	15	9	20	1	7	21	7	78	50
	4B	121	86	122	94	57	74	209	68	176	41
	4C	20	20	58	34	93	43	121	108	240	478
	4D	96	117	119	150	282	59	78	36	167	202
	4E[b]	---	---	---	---	---	---	---	---	---	---[c]
Bering Sea (Area 4) total		238	238	308	298	433	183	429	189	661	771
North Pacific total	2A through 4E	12,526	12,489	9,919	9,973	10,220	9,918	11,671	13,157	17,410	2,039

Source: Myhre et al. 1977; IPHC 1977, 1978a, 1979, 1981, 1982a, 1983a; Quinn, pers. comm.

--- means no data were available.

a Harvest data from subareas are not comparable from year to year because of changes in subarea boundaries.

b Area 4E as defined in IPHC (1984).

c Harvest for Area 4E not available at time of publication.

During the first year, 35 fishermen harvested about 3 metric tons (dressed weight). The 1983 season produced a slightly better catch of 7 metric tons (dressed weight) harvested by 42 fishermen (ibid.).

3. Gear types. The commercial fishery for halibut is restricted to hook and line gear (IPHC 1985). In the Bering Sea (Regulatory Area 4), harvest has primarily been taken by longline (IPHC 1984c). Many local villagers, however, have traditionally caught halibut by jigging with the line dropped from a wooden spool (Cullenberg 1984).
4. Period of use. In 1977, the IPHC adopted the split season wherein the fishing period was divided into a succession of opening and closures. The purpose of this management strategy was to regulate the length of the fishing period and to spread fishing mortality through time (IPHC 1978b). Fishing periods for Area 4 in the Bering Sea have usually occurred between the first of April to mid September (IPHC 1981, 1983a).
5. Significance of particular use areas. Traditional commercial halibut fishing grounds in the Bering Sea have been along the 200 m shelf edge and north of Unimak and Unalaska islands (Bakkala et al. 1976). A series of reference maps has been prepared for use with this report and may be found in the Map Atlas that accompanies this publication. The categories of mapped information include the commercial halibut harvest areas.

II. MANAGEMENT OBJECTIVES

The management goal of the IPHC is to maintain the stocks of halibut at levels that produce the optimum yield (IPHC 1978b). Until recently, however, stock abundance has been low, and the commission's efforts have been directed toward rebuilding the resource (Skud 1976). The IPHC is responsible for biological management and negotiation as an international treaty organization. The North Pacific Fisheries Management Council regulates harvest levels by allocations defined within IPHC harvest limits for Alaskan waters (Rigby, pers. comm.).
The NPFMC's objectives for halibut management (NPFMC 1983) 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 sustainable 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.

III. MANAGEMENT CONSIDERATIONS

A. Stock Assessment

Catch-per-unit-effort data obtained from the halibut fishery is the basis by which stock condition and abundance is assessed. Changes in the fishery in recent years have altered the relationship between catch and effort. Therefore, there is concern that data obtained in recent years is not comparable to the historical information, resulting in an inaccurate picture of stock status. Conditions affecting the catch-per-unit-effort data include the increasing use of more efficient snap-on gear by small vessels rather than the traditional fixed-hook or fixed-gangion gear, conversion to more efficient circle hooks, and the apparent differences in catchability in recent short fishing periods as compared to CPUE from longer fishing periods (IPHC 1984c). Results from recent studies indicate that a major adjustment is needed before recent CPUE data may be used for stock assessment purposes (ibid.).

B. Incidental Catches

The incidental harvest of halibut taken in fisheries directed at other species has been considerable. The incidental catch of halibut is composed principally of prerecruit fish (less than eight years of age). Removal of these fish reduces both the reproductive potential of the population and the size of future halibut year classes (McCaughran 1981).

Incidental catches increased rapidly during the 1960's and peaked at 12,700 metric tons during the 1965 season (NPFMC 1984). In the late 1960's and early 1970's, the incidental catch of halibut dropped to about 9,525 metric tons (IPHC 1984c).

Regulations intended to reduce the incidental harvest of halibut have apparently stopped the downhill trend in abundance; however, the incidental catch remains significant. In 1982, the incidental harvest of halibut in the Bering Sea totaled 6,214 metric tons, which is much larger than the 648 metric tons commercial harvest for the same year of (ibid.).

C. Moratorium

Since the 1970's, 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, 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 catch limits of halibut are removed in increasingly shorter periods of time (Anonymous 1983a, McCaughran 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 include 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 was dropped (Anonymous 1983c).

D. Nonlocal Participation

Participation in the Bering Sea halibut fishery by residents of coastal villages is recent. Local fishermen usually use smaller boats with less efficient gear than traditional nonlocal halibut operations. Since development of the local fisheries, larger boats have moved into the area and have taken most of the quota within a short period of time. The northwestern Bering Sea was made into a distinct regulatory area for the 1983 season to prevent this problem. In 1984, a new Area 4E was established, and since then catches have been taken entirely by local fishermen. However, the threat of potential limited entry and the need for a longer season in a halibut fishery resulted in an influx of larger vessels, regardless of the change (Cullenberg 1984, Anonymous 1983d). The potential for expansion of these fisheries will largely be influenced by the success of the NPFMC's efforts to discourage participation by larger, nonlocal boats.

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Commercial and Subsistence Use of Pacific Herring
Western Region

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Through the 1984 fishing season, the Western Region encompassed Herring Statistical Area W (map 1). This area, which is known as either the Kuskokwim Area or the Security Cove, Etolin Strait Area, has as its southern boundary a line extending west from Cape Newenham and as its northern boundary a line extending west from Dall Point. The western boundary for Statistical Area W is the International Dateline in the Bering Sea. The area is divided into the Security Cove, Goodnews, Nelson Island, and Nunivak districts (ADF&G 1985e). For the 1985 season, this Statistical Area W was changed to include only the Goodnews Bay Area. Security Cove became Statistical Area S, and Nelson-Nunivak became Area N (Francisco, pers. comm.).

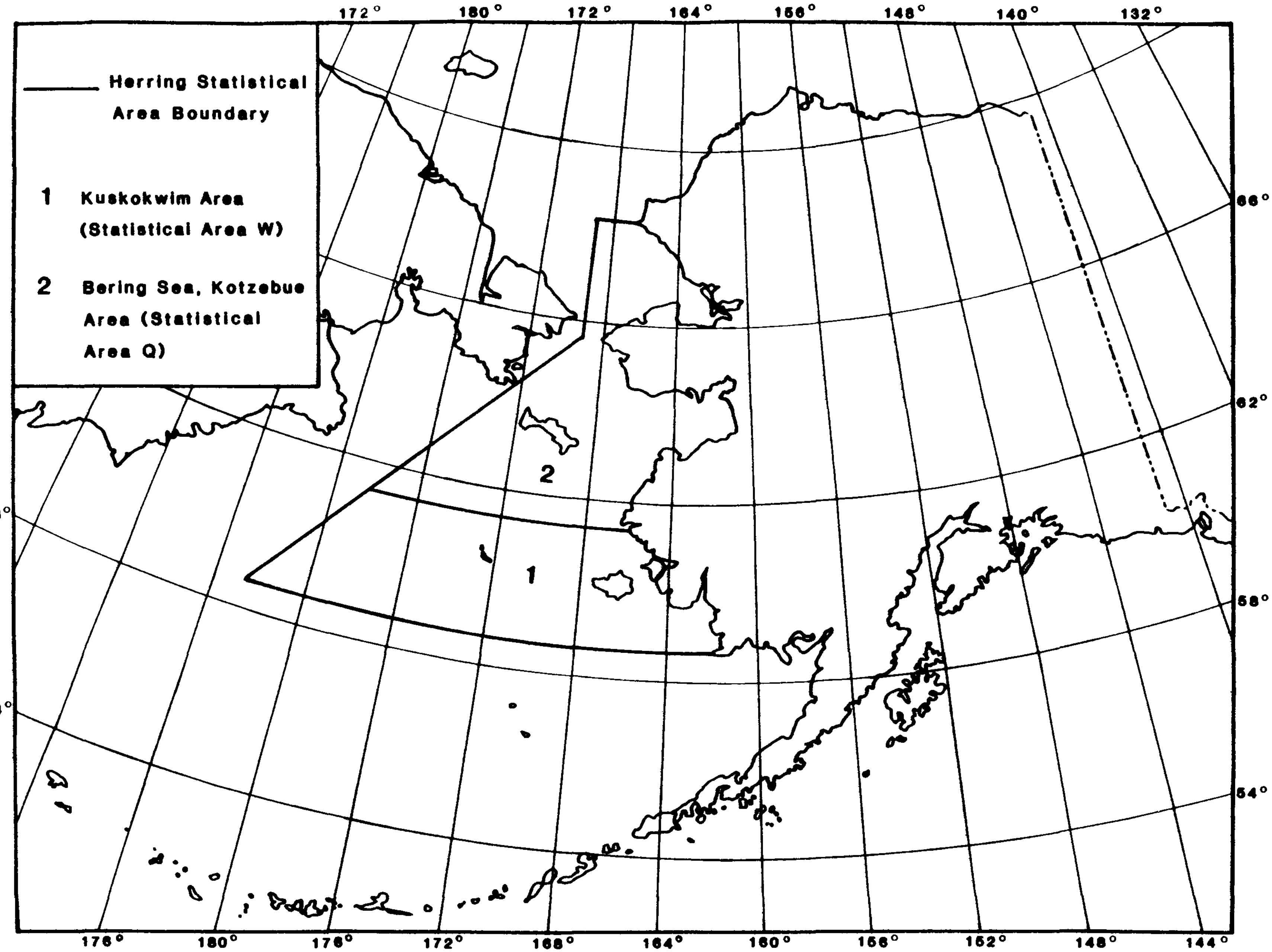
The Western Region also includes a portion of Statistical Area Q, or the Bering Sea, Kotzebue Area (map 1). Statistical Area Q has as its southern boundary a line extending west from Dall Point and as its northern boundary a line extending west from Point Hope. The western boundary of Statistical Area Q is the International Dateline in the Bering and Chukchi seas (ADF&G 1985e).

The narratives that follow present information on the Security Cove, Goodnews, Nelson Island, and Nunivak Island districts in Statistical Area W and the Cape Romanzof District in Statistical Area Q.

B. Summary of the Regional Fishery

1. Subsistence harvest summary. Human utilization of herring in the Western Region appears to have occurred at least 2,000 years ago (Hemming et al. 1978). Currently, villages located on the Yukon-Kuskokwim delta exhibit the greatest dependence upon herring for subsistence purposes in the State of Alaska (ibid.). Surveys performed since 1975 have provided estimates of subsistence harvest levels. These estimates, though minimal because not all families are surveyed, indicate a peak subsistence harvest of up to 102.5 metric tons taken during the 1979 fishery by 160 families (table 1).

2. Commercial harvest summary. The commercial herring fisheries established in the Western Region are relatively new, commencing in the late 1970's in the Security Cove and Goodnews Bay districts and in the 1980's in the other districts. Development of these fisheries, as with the other herring fisheries in the eastern Bering Sea, has been in response to the increased demand for sac roe by oriental markets. The herring fisheries established in the Western Region are smaller than the other Bering Sea fisheries.



Map 1. Herring statistical area boundaries (ADF&G 1985e).

Table 1. Subsistence Harvest of Pacific Herring in Metric Tons in the Western Region, 1975-84

Area	Fishing Season									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Nelson Island Harvest	80.8	61.2	74.0	78.5	85.0	88.9	58.0	75.4	85.0	[a]
No. fishing families	109	42	90	83	54	70	93	65	43	
Yukon-Kuskokwim delta Harvest	2.5	13.5	3.1	4.1	17.5	21.3	12.2	21.5	8.3	9.9
No. fishing families	34	49	39	29	106	80	45	64	37	46
Total subsistence harvest	83.3	74.7	77.1	82.6	102.5	110.2	70.2	96.9	93.3	---
Total number fishing families	143	91	129	112	160	150	138	129	80	---

Source: Lebida et al. 1984

--- means no data were available.

a Not surveyed.

Catches since 1978 have ranged from 259 metric tons taken during the 1978 season to a record harvest of 4,272 metric tons harvested in the 1985 fishery (table 2). During the 1985 season, Western Region fisheries accounted for about 14% of the commercial harvest of sac roe herring in fisheries extending from Togiak northward to Norton Sound (ADF&G 1985d; Whitmore, pers. comm.).

3. Gear types. In the Western Region, herring may be harvested commercially only with gill nets, usually of 2 1/2- to 2 3/4-inch mesh size. Maximum mesh size by regulation is 3 inches. Trawls also may be used during seasons established by emergency order (ADF&G 1985e).
4. Period of use. The period of harvest in all of the Western Region herring fisheries may vary from year to year and is dependent upon the time of arrival and the abundance of the fish that move into the respective fishing districts. By regulation, however, herring may be taken in periods established by emergency order from May 1 through June 30 (ADF&G 1985e).
5. Managerial authority and management considerations. Commercial fisheries for herring in coastal waters are managed by the State of Alaska.

   The management objective for commercial herring fisheries in Alaska is to maintain the resource at levels that will maintain maximum sustainable yield. The statewide management strategy is to harvest 0 to 20% of the herring biomass, with the upper end of the exploitation range applied to stocks in good condition. The lower end of the exploitation rate is applied to stocks exhibiting a trend toward decreasing abundance and poor recruitment (ADF&G 1985c). In all areas, difficulties arise in determining harvest levels when poor visibility, inclement weather, and a high incidence of other pelagic species inhibit aerial surveys, thus increasing the error in assessing abundance or biomass. The level of exploitation is different for each fishing district in the Western Region and is dependent upon the stock condition of the herring population in each area.

   Fluctuations in herring abundance are not well understood, causing difficulty in forecasting abundance and harvest levels. In addition, the relationship of these eastern Bering Sea herring populations and their migrational patterns to those of other spawning and overwintering concentrations of herring in the Bering Sea has not been fully defined. Herring from Togiak, Security Cove, Goodnews Bay, and to a lesser degree, Nelson Island are intercepted in a food/bait fishery in the Unalaska Island Area (Walker and Schnepf 1982, Rogers et al. 1983, Rogers and Schnepf 1985). The extent of interception must be evaluated to minimize the double harvest and overexploitation of Bering Sea spawning stocks.

Table 2. Commercial Harvest of Pacific Herring in Metric Tons and Effort in Numbers of Permits for the Western Region, by District and by Year, 1978-85

Fishing District	Fishing Season 1978	1979	1980	1981	1982	1983	1984	1985[a]
Security Cove								
Harvest	259	385	632	1,064	737	973	295	833
Effort	---	61	175	113	107	94	38	122
Goodnews Bay								
Harvest	0	82	406	596	441	395	605	800
Effort	0	41	165	175	84	84	130	69
Nelson Island								
Harvest	0	0	0	0	0	0	0	886
Effort	0	0	0	0	0	0	0	131
Nunivak Island								
Harvest	0	0	0	0	0	0	0	325
Effort	0	0	0	0	0	0	0	32
Cape Romanzof								
Harvest	0	0	554	653	596	740	1,075	1,428
Effort	0	0	69	111	75	63	66	75
Total regional harvest	259	467	1,592	2,313	1,774	2,108	1,975	4,272

Source: Lebida et al. 1984, Geiger 1985, Francisco 1985, Schultz 1985.

a Preliminary data.

Spawning activity for Bering Sea herring occurs earliest in the more southerly coastal areas and becomes progressively later with an increase in latitude. This staggered run timing makes it feasible for fishermen, particularly those with larger, more efficient boats, to harvest fish in more than one fishing district. Therefore, both to prevent overharvest of the smaller herring stocks and to protect the interest of the less efficient local fishermen, exclusive registration regulations were first imposed for the 1982 season.

Prior to the 1985 season, Cape Romanzof and Norton Sound were the only herring fisheries classified as exclusive use areas. Under this regulation, fishermen who commercially fished in an exclusive area could not fish in a nonexclusive or exclusive area from February 1 through June 30 (ADF&G 1984).

For the 1985 herring season, the Norton Sound District, Cape Romanzof District, the combined Nelson Island and Nunivak Island districts, and the Goodnews District are designated superexclusive registration areas, which dictates the following:

Any person participating in the commercial taking of herring as a Commercial Fisheries Entry Commission (CFEC) permit holder in a superexclusive use area at any time from February 1 through June 30 may not participate or have participated in the commercial taking of herring, either as a CFEC permit holder or as a crew member aboard a vessel used to take herring in another superexclusive or nonexclusive use area at any time from February 1 through June 30 of the same year (ADF&G 1985e).

Any person participating in the commercial taking of herring as a crew member aboard a vessel used to take herring in a superexclusive use area at any time from February 1 through June 30 may not participate or have participated in any commercial taking of herring as a CFEC permit holder in another superexclusive or nonexclusive use area at any time from February 1 through June 30 of that year (ibid.).

Any vessel used in the taking of herring in a superexclusive use area at any time from February 1 through June 30 may not be used or have been used in the taking of herring in another superexclusive or nonexclusive use area at any time from February 1 through June 30 of that year (ibid.).

Notwithstanding the provisions listed above, any person who participates in the taking of herring and any vessel used to take herring in the Goodnews Bay District may also participate in the taking of herring or be used to take herring in the Security Cove District (ibid.).

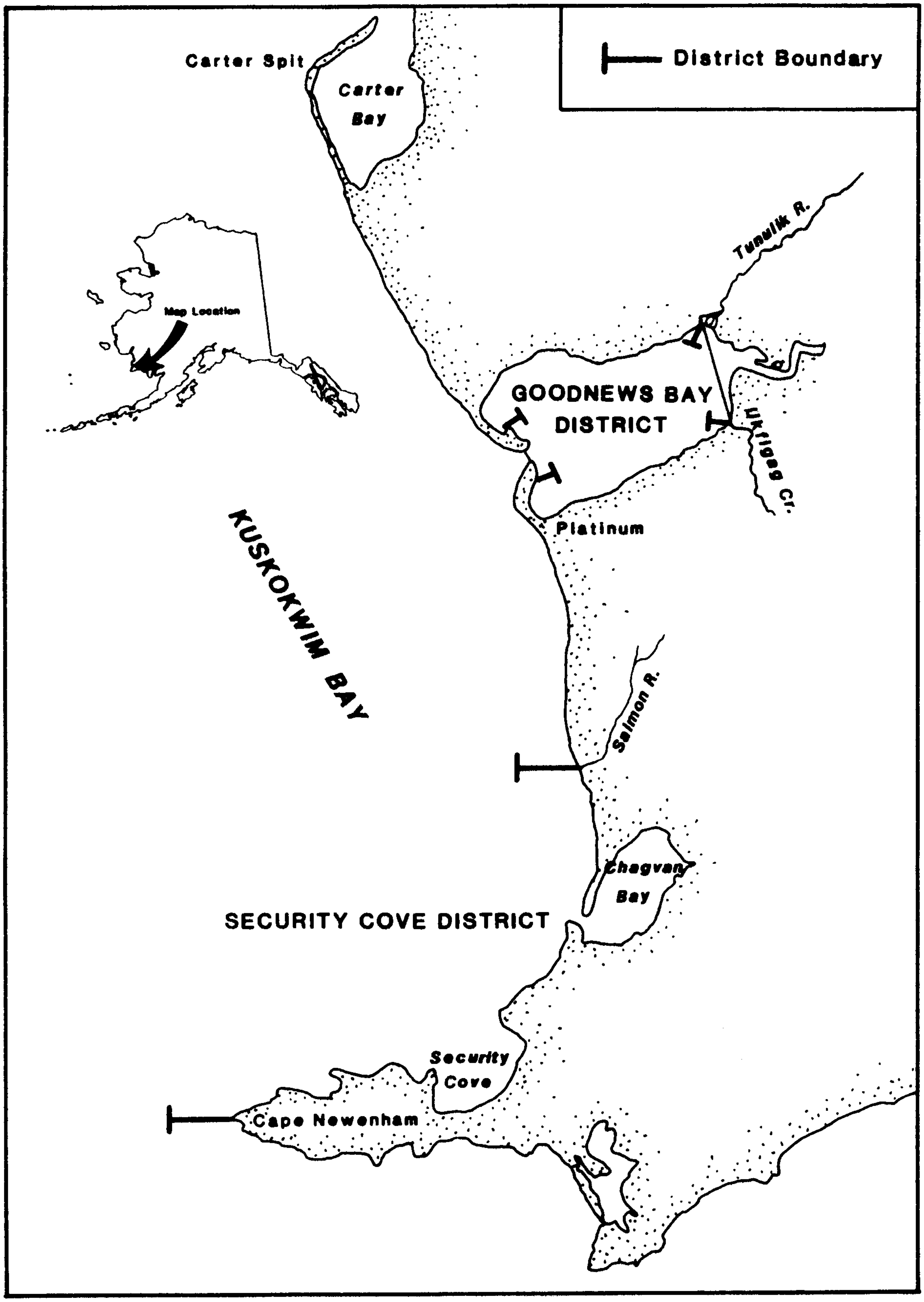
II. SECURITY COVE AND GOODNEWS BAY DISTRICTS

A. Boundaries

The Security Cove and Goodnews Bay districts are contained within Statistical Area W. The Security Cove District encompasses all waters between the latitude of Cape Newenham and the latitude of the Salmon River (58°52'N) (map 2). The Goodnews District consists of the portion of Goodnews Bay inside a line between ADF&G markers placed near the bay entrance and a line between ADF&G markers placed near the mouth of the Ufigag River and on the opposite shore near the mouth of the Tunulik River (ADF&G 1985e) (map 2).

B. Fishery Description and Reported Harvest

1. Subsistence harvest summary. The subsistence harvest of herring is very small and therefore is not monitored in the Security Cove and Goodnews Bay districts.
2. Commercial harvest summery:
   a. Security Cove District. The Security Cove District is one of two herring fishing districts in Kuskokwim Bay. First landings in the Security Cove fishery were reported in 1978, with a harvest of about 259 metric tons. The peak harvest of 1,064 metric tons was taken during the 1981 fishery by 113 fishermen. Thirty-eight fishermen, the lowest recorded number of participants, fished the 1984 season and took 295 metric tons, the smallest herring catch since 1978. A record effort of 175 permit holders harvested 632 metric tons during the 1980 season (table 2). The 1985 season produced a harvest of 833 metric tons taken by 122 permit holders. During the 1984 and 1985 seasons, the Security Cove fishery contributed about 15 and 19%, respectively, to the entire Western Region herring harvest.
   b. Goodnews Bay District. Interest in fishing the Goodnews Bay District did not occur until 1979, when 82 metric tons were harvested by 41 fishermen. Catches have increased gradually, reaching a record harvest of 800 metric tons taken by 69 fishermen during the 1985 fishery. The Goodnews Bay harvest accounted for 47 and 19% of the Western Region herring harvest during the respective years of 1984 and 1985 (table 2).
3. Harvest methods. By regulation, herring in the Security Cove and Goodnews Bay districts may be taken for commercial purposes only by gill net. Trawls are legal in seasons established by emergency order (ADF&G 1985e). No trawl seasons have been established (Francisco, pers. comm.).
4. Period of use. The arrival of herring in the Security Cove and Goodnews Bay districts usually occurs from early to mid May. Herring may be harvested commercially in periods established by emergeny order (ADF&G 1985c, 1985e).



Map 2. Security Cove and Goodnews Bay herring commercial fishing districts (ADF&G 1985c, 1985e).

C. Management Objectives and Consideration

Consistent with the Statewide Management Strategy for herring fisheries, the exploitation rate of herring in the Goodnews Bay and Security Cove districts has been based on estimated abundance and recruitment each season (ADF&G 1985c). Should inclement weather and water conditions prohibit satisfactory aerial surveys, as is often the case in the Goodnews Bay District, then stock abundance and condition will be assessed by using a combination of data from test and commercial catches, including catch rates, the percentage of roe recovery, the ratios of prespawners to postspawners, and the relative age class composition. Additional information to assess stock abundance would include spawn deposition observations and projections from the prior season's escapement estimates. If aerial survey biomass estimates were achieved for the Security Cove District but not for the Goodnews Bay District, abundance trends from Security Cove would be used in management of the Goodnews Bay herring fishery (ibid.).

D. Significance of Particular Use Areas

A series of reference maps has been prepared for use with this report and may be found in the Map Atlas that accompanies this publication. The category of mapped information includes the commercial herring harvest areas.

III. NELSON ISLAND AND NUNIVAK ISLAND DISTRICTS

A. Boundaries

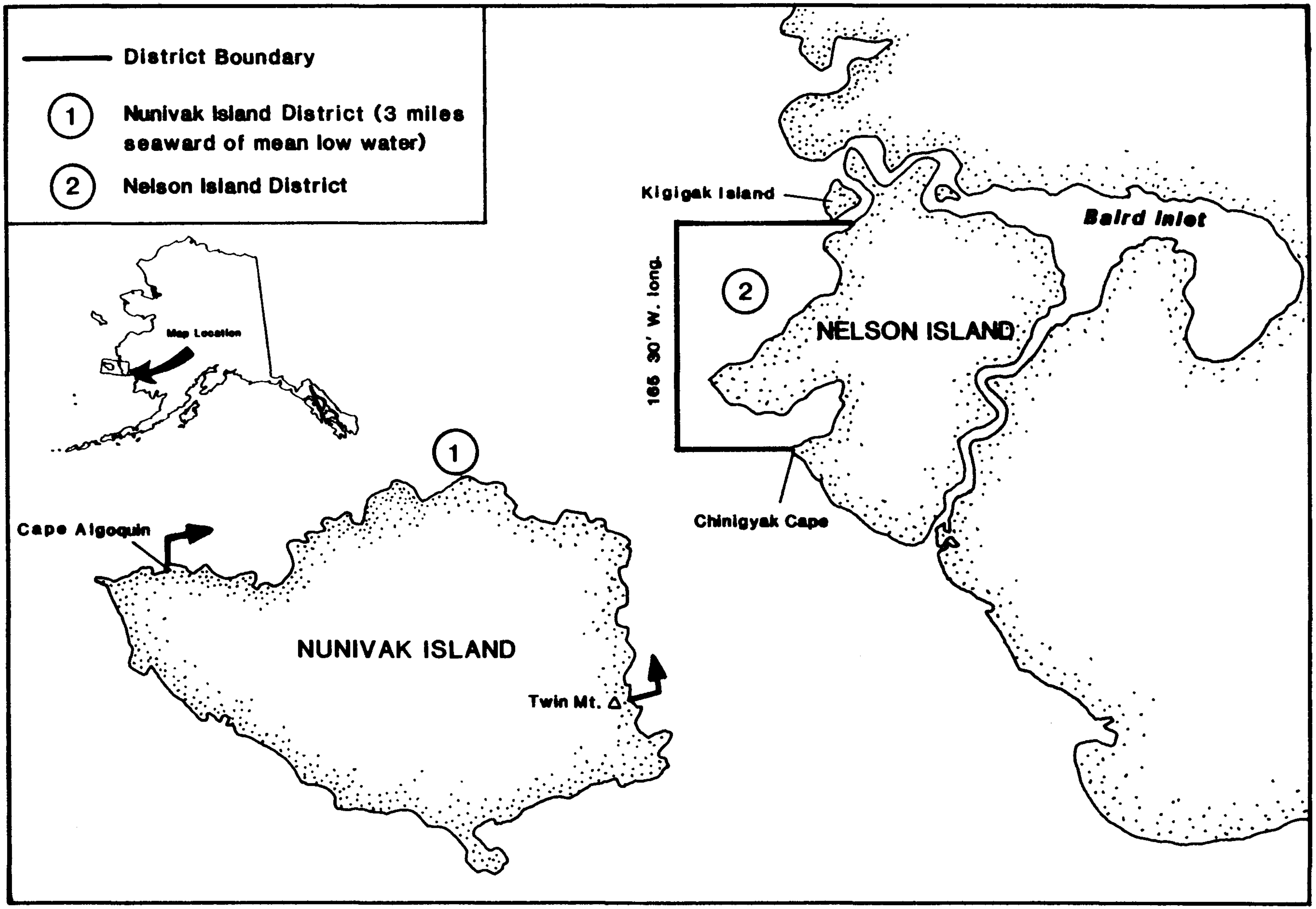
Within herring Statistical Area W, the Nunivak Island District consists of all water extending 3 mi seaward of mean low water along the northern and eastern sides of Nunivak Island from Cape Algonquin (60°13'33"N, 166°55'30"W) to Twin Mountains (60°02'N, 165°43'W) (ADF&G 1984e) (map 3).

The Nelson Island District consists of all waters north of the latitude of Chinigyak Cape (60°27'N), south of the latitude of the southernmost tip of Kigiyak Island (60°50'N), and east of 165°30'W (ibid.) (map 3).

B. Fishery Description and Reported Harvest

1. Subsistence harvest summary. About 75% of the annually surveyed subsistence harvest is taken from the Nelson Island area villages of Tununak, Toksook Bay, and Umkumuit (Nightmute) (Lebida et al. 1984). For areas surveyed between 1975 through 1984, the subsistence harvest has averaged about 76 metric tons annually. The largest harvest of 88.9 metric tons was taken by 70 families during the 1980 season (table 1). The greatest number of families participating in the fishery was documented in 1975, with 109 families harvesting 80.8 metric tons of herring (table 1). Though subsistence surveys are believed to reflect harvest trends, one must remember that documented catches represent minimum figures because all fishermen cannot be contacted.

2. Commercial harvest summary. The herring resource in the Nelson and Nunivak islands area has historically supported



Map 3. Nunivak Island and Nelson Island herring commercial fishing districts (ADF&G 1985e).

important subsistence herring fisheries (Hemming et al. 1978, ADF&G 1985b). With development of commercial fisheries in neighboring areas in 1978, the Nelson and Nunivak islands area was closed by emergency order. The Alaska Board of Fisheries closed the area by regulation the following year to protect the subsistence fishery occurring on stocks of unknown size. Increased knowledge regarding the herring resource in the area, assessment of the subsistence use, and growing public interest in a commercial fishery resulted in a provision of the Alaska Board of Fisheries to open the area to commercial fishing in 1985 (ADF&G 1985b).

a. Nunivak Island District. The commercial harvest of herring from the Nunivak Island District totaled 325 metric tons in 1985 (table 2). Of this total, about 97% of the catch was sold for sac roe extraction, with the remaining 3% processed for food and bait. Thirty-two permit holders participated in the fishery. It is estimated that 80% of the harvest was taken by local fishermen (Francisco 1985b). The Nunivak Island catch in 1985 contributed about 8% of the entire Western Region commercial herring catch.

b. Nelson Island District. About 886 metric tons of herring were taken in the Nelson Island commercial fishery in 1985, of which 99% of the total was sold for sac roe (Francisco 1985). Peak effort in the fishery totaled 131 permit holders (table 2). The fleet was dominated by local boats and accounted for about 60% of the total harvest (Francisco 1985). The Nelson Island fishery contributed about 21% of the total Western Region herring harvest during the 1985 season.

3. Harvest methods. Herring in the Nunivak Island and Nelson Island districts may be taken for commercial purposes only by gill net. Trawls may be used in seasons established by emergency order, though no such seasons have been established (ADF&G 1985d).

4. Period of use. The arrival of herring in the Nelson Island and Nunivak Island districts occurs from early May to early June, depending on ice conditions (ADF&G 1985b). Herring may be taken in periods established by emergency order from May 1 through June 30 (ADF&G 1985e).

C. Management Objectives and Consideration

In accordance with the Alaska Board of Fisheries policy statement in management of the Nelson Island District herring fishery, the rate of exploitation established for the Nelson Island and Nunivak Island districts is a range of 0 to 10% of the estimated biomass for each district (ADF&G 1985b). The exploitation rate is lower than the 0-20% rate of exploitation established for the rest of the State of Alaska, to protect subsistence utilization. Aerial surveys conducted to assess biomass levels are frequently hampered by weather, the presence of ice, and turbid water. Therefore, if it is not possible to determine herring abundance by aerial survey, stock abundance and condition may be assessed by using additional information, such as age class composition, commercial catch rate, percentage roe recovery, rates of pre-to-postspawners from test and commercial catches, spawn deposition observation, and the preseason projection (Francisco 1985b, ADF&G 1985b). Before a season within a district is opened, a minimum of 1,000 to 1,500 metric tons or significant spawning activity must be observed. The commercial fishery must be managed so that there is minimal conflict with the subsistence harvest of herring. This goal is achieved through delayed openings, periodic closures in-season, and special area closures during the season (Francisco, pers. comm.).

The policy statement of the management of the Nelson Island District fishery establishes the priority of subsistence use during the development of the commercial herring fishery in this area. Regulations necessary for the orderly development of the commercial herring fishery in the Nelson Island District do not in any way restrict the taking of herring or other fish for subsistence purposes. In addition, Section 5 AAC 01.020 of the commercial and subsistence fishing regulations provides that commercial fishermen may retain fish for their subsistence use or for the subsistence use of other persons.

To provide additional protection of the Nelson Island District subsistence herring fishery, the following guidelines are provided (ADF&G 1985e):

1. The commercial fishery will be allowed to take up to 10% of the available herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.
2. The commercial fishing season will be opened when a biomass of 1,000-1,500 metric tons or spawning activity is documented.
3. Periodic closures of the commercial fishery will be scheduled, during which time subsistence fishing will be the only activity allowed.
4. Several important subsistence use areas occur throughout the district, including waters north of Cape Vancouver, and specific areas may be closed to commercial fishing to ensure the adequacy of subsistence harvests.
5. The Alaska Department of Fish and Game will use all available means, including input from local residents, to ensure the adequacy of subsistence herring harvests during the commercial fishing season.

D. Significance of Particular Use Areas

A series of reference maps has been prepared for use with this report and may be found in the Map Atlas that accompanies this publication. The category of mapped information includes the commercial harvest areas.

IV. CAPE ROMANZOF DISTRICT

A. Boundaries

In the eastern Bering Sea, Statistical Area Q has as its southern boundary a line extending west from Dall Point, as its northern boundary a line extending west from Point Hope, and as its western boundary the International Date Line in the Bering and Chukchi seas (map 1). The Kotzebue, Port Clarence, Norton Sound, and Cape Romanzof districts for the commercial harvest of herring are within Statistical Area Q. Only the Cape Romanzof District is within the Western Region; it consists of all waters of Alaska between the latitude of Dall Point and 62°N (ADF&G 1985e) (map 4).

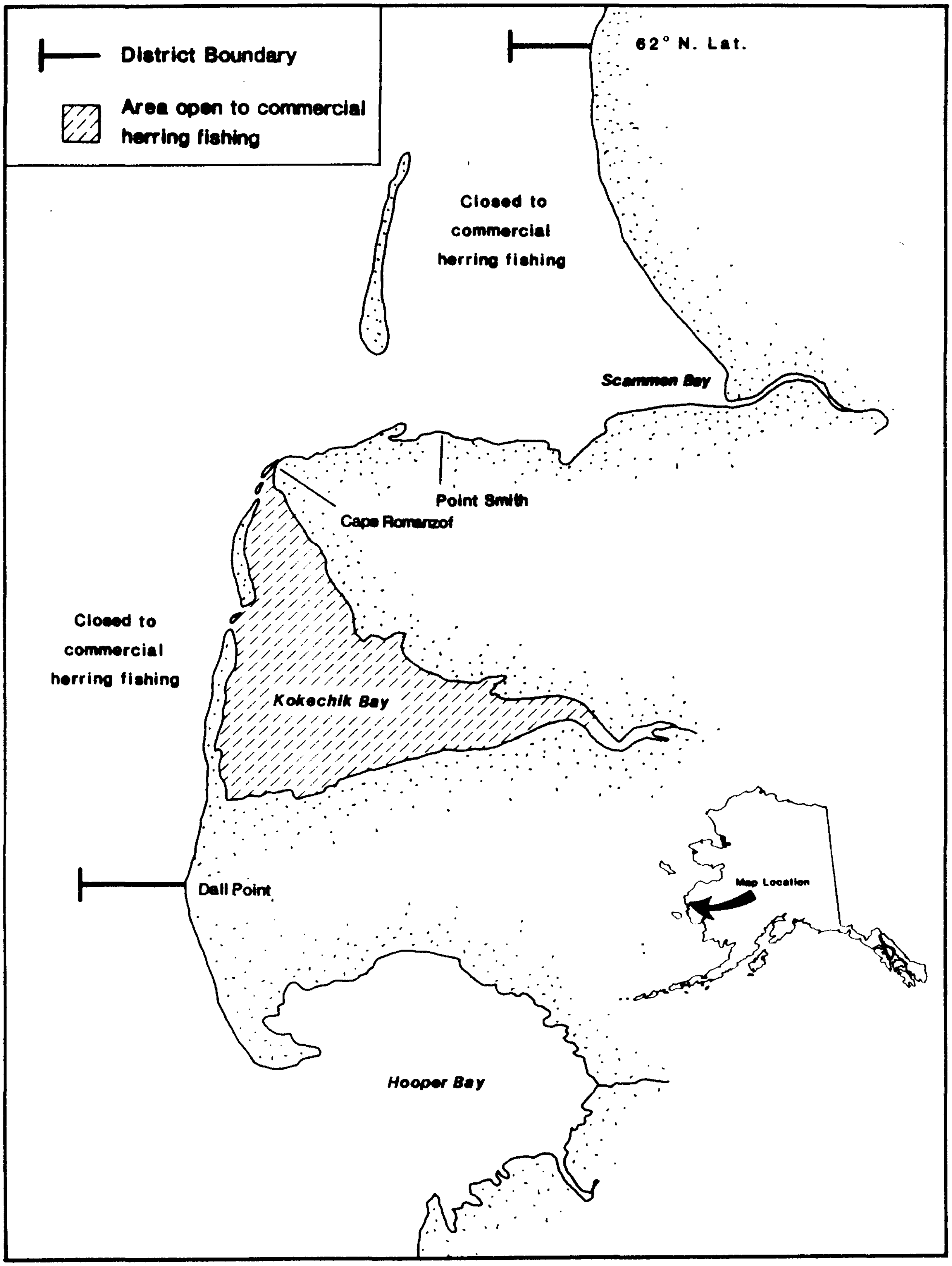
B. Fishery Description and Reported Harvest

1. Subsistence harvest summary. On the Yukon-Kuskokwim delta, the villages of Hooper Bay, Chevak, and Scammon Bay have a long tradition of subsistence use of herring and herring roe-on-kelp (Hemming et al. 1978). These villages have been surveyed annually since 1975. The results of the subsistence surveys are believed to accurately reflect harvest trends and reported catches represent minimum figures because all fishermen cannot be contacted (Lebida et al. 1984). Results for areas surveyed through the 1984 season indicate that an average of 11.4 metric tons have been harvested annually (table 1). A peak harvest of 21.5 metric tons was taken by 64 families in 1982. A maximum number of 106 families documented in the subsistence surveys harvested 17.5 metric tons of herring during the 1979 fishery (table 1).

2. Commercial harvest summary. The Cape Romanzof fishery is one of the more recently developed herring sac roe fisheries along the eastern Bering Sea coast. First landings were reported in 1980, when 69 permit holders harvested about 554 metric tons (table 2). Catches have since increased steadily, reaching a record harvest of 1,428 metric tons taken by 75 permit holders during the 1985 season (table 2). The fishery supported 111 fishermen during the 1980 season. Up to four buyers have purchased herring on the Cape Romanzof ground (Geiger 1985).

   Participation in this fishery has been dominated by residents from the local communities of Hooper bay, Chevak, and Scammon Bay (Lebida et al. 1984, Geiger 1985). Implementation of exclusive and superexclusive registration policies, beginning in 1982, has increased the success of these local fishermen in the fishery. During the 1980 season, local residents accounted for about 40% of the Cape Romanzof herring harvest (Regnart and Kingsbury 1980), and during the 1984 fishery, this percentage increased to 99.8% (Lebida et al. 1984). Approximately 94.1% of the herring caught during the 1985 fishery was taken by local fishermen (Geiger 1985).

   Harvest levels in the Cape Romanzof fishery during the 1984 and 1985 seasons exceeded catches of other Western Region herring catches (table 2). Cape Romanzof fishermen have



Map 4. Cape Romanzof commercial herring fishing district (ADF&G 1985e).

contributed 54% and 33% of the Western Region herring harvest during 1984 and 1985, respectively (table 2).

3. Harvest methods. Only gill nets are legal for the commercial harvest of herring in the Cape Romanzof District.
4. Period of use. Though somewhat variable from year to year, herring usually appear on the fishing grounds and spawn from mid May to mid June (ADF&G 1985a). By regulation, the duration of the fishing season extends from May 1 through June 30. Since 1982, however, commercial periods have been established by emergency order. The management policy for the Cape Romanzof fishery states that the fishery will open after test fish catches and observations regarding spawn deposition determine that harvestable quantities of herring are present (Lebida et al. 1984, ADF&G 1985a).

C. Management Objectives and Consideration

Turbid water conditions in the Cape Romanzof area prevent reliable estimation of herring abundance by aerial survey. Therefore, for purposes of stock assessment several types of data are used. These include the extent of spawn deposition, catch rate, age class composition, percentage roe recovery, and ratios of pre-to-postspawning herring taken in both test and commercial catch samples (ADF&G 1985a). Spawning occurs in the intertidal zone. Most of the intertidal spawning areas are located along the north shore of Kokechik Bay and, to a lesser extent, on the south shore of Scammon Bay. Unless a greater proportion of spawning activity occurs in Scammon Bay, fishing activity is restricted to Kokechik Bay (ADF&G 1985a).

The Cape Romanzof District is small, and, with the increase in fishing effort and gear efficiency, the allowable harvest can be taken within a short period of time. Therefore, to provide for management control, the season is regulated by emergency order.

Prior to 1985, a 350 metric ton guideline harvest level was established by the Alaska Board of Fisheries. However, since the inception of the fishery, this guideline harvest level has been exceeded each year. Because the published guideline harvest level did not adequately represent preseason harvest estimates, this published figure was repealed for the 1985 season (ADF&G 1984, 1985a,e).

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Commercial and Subsistence Harvest of Salmon
Western and Interior Regions

I. POPULATION MANAGEMENT HISTORY

A. Introduction

Two areas in the Western and Interior regions have been delineated for the management of commercial salmon fisheries, the Yukon and Kuskokwim management areas. Collectively, these management areas encompass the entire freshwater drainages of the Yukon and Kuskokwim rivers and coastal waters extending from the latitude of Cape Newenham north to the latitude of Canal Point Light. The two management areas are divided further into districts to facilitate salmon management. Information presented in sections II and III of this narrative is organized by management area.

B. Summary of Regional Fisheries

1. Harvest summary. Five species of Pacific salmon are harvested in the Western and Interior regions. Though all species may be present in commercial and subsistence catches, chum salmon *Oncorhynchus keta*), chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*) dominate the fisheries. The Yukon and Kuskokwim rivers chinook salmon, the Kuskokwim River coho salmon, and the Yukon River fall and summer chum salmon are highly prized species that are sold in a growing export market (Pope 1981). A significant portion of the salmon harvested in these management areas is for personal consumption, more than in any other area of Western or Arctic Alaska. Combined reported commercial and subsistence harvest of salmon between 1975 and 1984 has ranged from 1.9 million fish taken in 1976 to 3.3 million fish harvested in 1984 and averaged 2.7 million fish annually. About 23% of the 1984 catch was by the subsistence fishery.

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 Magnusen 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 the shore, creating the Fishery Conservation Zone (FCZ) from 3 to 200 nautical miles from shore. The North Pacific Fishery Management Council is responsible for managing fisheries in the FCZ and proposes management plans that 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 Yukon and Kuskokwim management areas under policy established by the Alaska Board of Fisheries.

3. Gear types. Primarily set and drift gill net gear are used to harvest salmon in the Western and Interior regions' subsistence and commercial fisheries. Fish wheels are also used to harvest salmon in the commercial and subsistence fisheries of the upper Yukon River (ADF&G 1985b).
4. Period of use. Timing of the commercial fishery depends upon timing of the salmon runs into the management areas. Fishing seasons and periods are established for each species by district within each of the management area.
5. Economic value. Information concerning the value of salmon within the western and interior regions is presented in the Economic Overview of Fish and Wildlife volume.

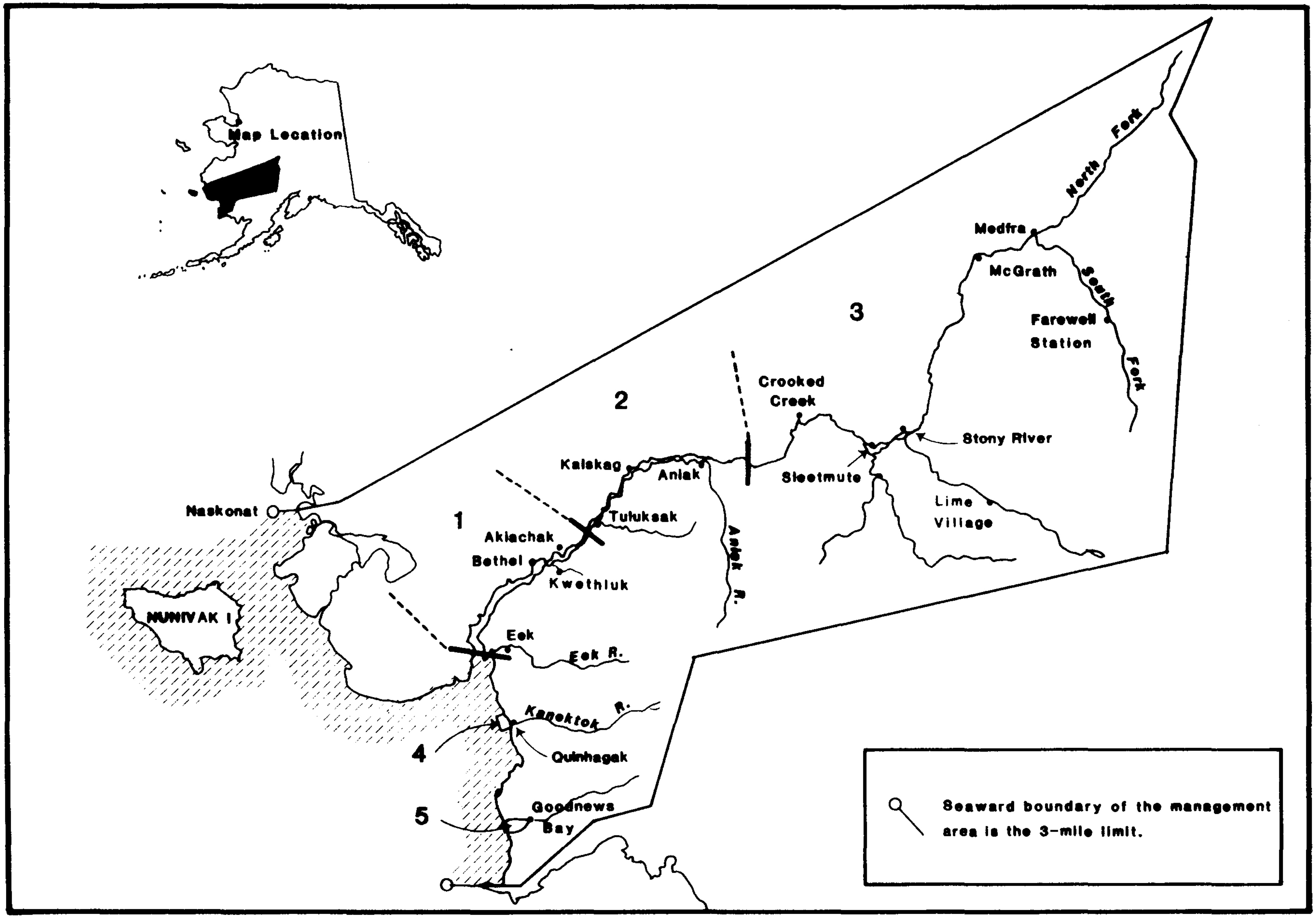
II. KUSKOKWIM MANAGEMENT AREA

A. Boundaries

The Kuskokwim Area consists of all Alaskan waters between the latitude of the westernmost point of the Naskonat Peninsula and the latitude of the southernmost tip of Cape Newenham, including the waters of Alaska surrounding Nunivak and St. Matthew islands (ADF&G 1985b).

The Kuskokwim Management Area is divided into five fishing districts (map 1). Three of these districts are located within the main stem of the Kuskokwim River. The remaining two districts are located in marine waters at the mouths of the Kanektok and Goodnews rivers. District descriptions are as follows:

1. District 1. District 1 consists of that portion of the Kuskokwim River upstream of a line from Apokak Slough (60°08'N, 162°12'W) to the southernmost tip of Eek Island to Popukamiut (60°04'N, 162°28'W) to a line between ADF&G regulatory markers at the upstream edge of the north mouth of Mishevik Slough.
2. District 2. District 2 consists of the Kuskokwim River drainage from an ADF&G regulatory marker placed at the upstream edge of the north mouth of Mishevik Slough upstream to the downstream edge of the mouth of the Kolmakoff River.
3. District 3. District 3 consists of the Kuskokwim River upstream of the upper boundary of District 2. Though subsistence fishing for salmon occurs in District 3, the commercial salmon fishery has been closed in the area since 1966.



Map 1. Salmon commercial fishing districts of the Kuskokwim Management Area (ADF&G 1984a).

Note: Not all communities located within the management area are shown.

4. District 4. District 4 consists of Kuskokwim Bay between ADF&G regulatory markers placed at the westernmost edge of the mouth of Oyak Creek and at the southermost edge of the mouth of the Arolik River.
5. District 5. District 5 consists of that portion of Goodnews Bay inside a line between ADF&G regulatory markers placed near the bay entrance and a line between ADF&G regulatory markers placed near the mouth of the Ufigag River and on the opposite shore near the mouth of the Tunulik River (ADF&G 1985b).

B. Fishery Description and Reported Use

Salmon in the Kuskokwim Area are harvested for both subsistence and commercial use. Combined catches of all species reached a peak of 1.7 million fish during the 1984 season (tables 1 and 2) During the past decade, the commercial fishery accounted for 76% of the total harvest of salmon, with the subsistence fishery contributing the remaining 24%.

1. All-species harvest:
   a. Commercial harvest summary. Five species of salmon are commercially harvested in the Kuskokwim Management Area. The fishery is dominated by chum salmon followed, in order of magnitude, by coho, chinook, sockeye, and pink salmon. The Kuskokwim Area commercial fishery is the oldest salmon fishery in the combined Arctic, Western, and Interior regions, with catches reported as early as 1913. For many years, small commercial mild-cure operations were conducted in or near the Kuskokwim Bay while the fishery in the Kuskokwim River remained undeveloped (ADF&G 1978a). A commercial fishery did develop in the 1930's near the McGrath area for the sale of dried salmon for dog food. This particular fishery, however, declined as the use of dog teams also declined in the Kuskokwim Area (ibid.). Overall, the commercial fishery prior to 1961 was small and poorly documented (ADF&G 1975). In the Bay area, the commercial harvest of salmon began in 1968. The fishery has been somewhat sporadic because of inconsistent processing capability and inclement weather (ADF&G 1984a). The market and resultant harvest levels, however, have stabilized during the past few years (ibid.).

      From 1960 through 1965, commercial salmon catches in the Kuskokwim Area averaged 52,014 fish annually, increasing to 219,970 fish per year from 1965 through 1975 (ADF&G 1979). During the past 10 years, the commercial harvest increased gradually from 384,196 fish in 1975 to a peak harvest of almost 1.5 million salmon in 1984, averaging about 818,879 salmon annually (table 1). During the this period, 74% of the total commercial salmon harvest has been taken from District 1, the lower Kuskokwim River. Districts 4, 5, and 2, respectively, accounted

Table 1. Commercial Harvest of Salmon (All Species) in Numbers of Fish for the Kuskokwim Area, by District and By Year, 1975-84

	Fishing Season									
District	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
1 (Lower Kuskokwim)	286,731	295,182	511,571	508,124	510,537	785,868	709,340	773,034	561,987	1,080,769
2 (Middle Kuskokwim)	3,704	5,022	23,926	6,131	10,495	21,182	16,918	35,525	13,867	49,847
3[b] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	58,001	109,048	77,546	111,869	103,787	173,873	142,879	166,616	112,348	253,242
5 (Goodnews Bay)	35,760	38,651	26,954	42,087	74,382	91,008	80,865	113,538	52,259	114,313
Area total	384,196	447,903	639,997	668,211	699,201	1,071,931	950,002	1,088,713	740,461	1,498,171

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Preliminary data.

b There is currently no commercial fishing in District 3.

for 16, 8, and 29% of the harvest during the same time period (table 1).

Although most of the commercial harvest is taken by drift gill nets, set gill nets are also used. Drift gill nets are fished in areas of the river that are relatively free of snags. Commercial set gill nets are fished in small eddies along the bank of the Kuskokwim River and larger eddies out in the main river (ADF&G 1983). Most of the salmon catch from the Kuskokwim Management Area is gutted, iced, and exported to be marketed as a fresh or frozen product. Currently, there are no operating canneries in the area (ADF&G 1984a).

b. Commercial fishing effort. Participation in the commercial salmon fishery has grown significantly since statehood as fishermen have been making the transition from subsistence to a cash economy (ibid.). The use of highly mobile nylon drift gill nets has improved the efficiency of the fleet. Improvement of processing and tendering facilities in the Kuskokwim area has also contributed to expansion of the fishery (ibid.).

In recent years, fishermen participation levels have risen in the lower Kuskokwim River (District 1) and Quinhagak (District 4), which have become the centers for most Kuskokwim Area fishermen. This is due to the close proximity to population centers and the liberal harvest goals associated with these fisheries. The District 2 (middle Kuskokwim River) and District 5 (Goodnews Bay) fisheries have remained fairly stable in terms of the number of fishermen working in these areas because of the relative remoteness and smaller allowable harvest levels associated with these fisheries (ADF&G 1984a).

Recent increases in fishing effort may appear to be somewhat of a contradiction, considering that the Limited Entry Commission issued 831 permits in 1976 to fishermen, based on points earned for past participation in the fishery. No other permits have been available since that time. Some families were eligible for more than one permit, and many elderly fishermen were eligible. Many of these fishermen, after having received a permit, did not immediately participate in the fishery. These inactive permits have since been transferred and/or sold to more aggressive fishermen. In 1984, 813 Kuskokwim area permits were renewed, and 774 permits were fished (Schultz, pers. comm.). Ninety-eight percent of all Kuskokwim entry permit holders are residents of the area (ADF&G 1984a).

c. Subsistence harvest summary. There are approximately 33 villages in the Kuskokwim Area, some of which are among the largest and some among the smallest in the state

(Haynes, pers. comm.). Most of the residents are Eskimos with varying dependency on fish and game resources for their livelihood. The Kuskokwim River fishery is also important to Athabaskan residents in the upper river area and to other rural residents living outside established communities and in McGrath (ibid.). Further discussion of the subsistence use of Kuskokwim River salmon is found in the final section of this volume. The subsistence salmon fishery is one of the most important in the state (ADF&G 1984a, 1985a) and based on reported harvest is second in size only to the Yukon Area fishery (tables 2 and 16).

The first record of any subsistence catches was in 1922; these were based on brief visits or on reports from local residents (Pennoyer et al. 1965). The annual survey of the Kuskokwim River subsistence fishery was initiated in 1960. In the early years, "smokehouse counts" were used to determine total utilization of subsistence-caught fish. Subsistence-catch calendars were distributed to fishermen prior to the fishing season in order to determine timing and run magnitude (ADF&G 1984a).

Traditional fishing methods and materials limited the size and scope of the early fishing. Spears, dip nets, fish traps, and willow- or caribou-strip gill nets were slowly supplanted by more efficient linen gill nets and then by nylon gill nets (ADF&G 1984a).

The majority of the subsistence salmon catch is comprised of chum salmon. Since statehood, however, improvements in fishing gear, notably the introduction of nylon gill net webbing, have probably increased the harvest and importance of chinook salmon. Estimated peak subsistence salmon harvest levels were reached during the 1930's coincidentally with the peak activity of the quasi-commercial McGrath fishery, but records indicate a continuing decline of this fishery into the 1940s. Few catch data are available for the 20-year period prior to statehood (ADF&G 1984a). Today the value of the subsistence fishery to local people remains as great as money realized from the commercial fishery (ibid.)

Reported subsistence harvest levels since 1975 have ranged from 175,698 salmon in 1978 to 301,488 salmon in 1982 (table 2). Catches between 1975 and 1984 averaged 255,994 fish annually. About 63% of the harvest during the same period was taken from District 1 (lower Kuskokwim Area). Districts 2, 3, 4, and 5 accounted for 22, 10, 3, and 1%, respectively, of the total subsistence harvest (table 2). In order of magnitude, the primary species harvested are chum, chinook, and coho

Table 2. Subsistence Harvest of Salmon (All Species) in Numbers of Fish in the Kuskokwim Management Area by District and by Year, 1975-84

District	Fishing Season									
	1975[a]	1976[a]	1977[a]	1978[a]	1979[a]	1980[a]	1981[a]	1982[a]	1983[a]	1984[a]
1 (Lower Kuskokwim)	161,293	186,780	169,211	107,461	147,274	186,084	154,511	203,205	105,066	140,351
2 (Middle Kuskokwim)	42,534	68,044	69,362	36,067	44,281	44,113	51,196	53,643	59,446	70,252
3 (Upper Kuskokwim)	20,131	26,885	26,960	23,402	50,008	32,026	28,678	32,510	7,900	19,736
4 (Quinhagak)	7,301	8,147	6,380	8,768	4,304	9,211	10,978	5,448	3,395	5,489
5 (Goodnews Bay)	b	1,629	1,612	b	1,646	6,835	6,209	6,682	2,589	2,002
Area total	231,259	291,485	273,525	175,698	247,513	278,269	251,572	301,488	176,396	237,830

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Data expanded from survey results.

b No survey preformed.

salmon. Subsistence catches of sockeye and pink salmon have been very small and have usually been included in the chum salmon harvest figures.

2. Chum salmon harvest. Chum salmon are the most abundant salmon species in the Kuskokwim Management Area. This species has comprised 48% of the combined subsistence and commercial salmon catch (all species) over the past 10 years. About 75% of the harvest for both fisheries combined is taken from the Kuskokwim River drainage (tables 3, 5).

   a. Commercial harvest summary. The commercial fishery for chum salmon prior to 1971 was very small. Catches primarily were incidental to the harvest of chinook and coho salmon (ADF&G 1984b). A directed commercial harvest for chum salmon was established in 1971. This was done because of an apparent reduction in subsistence use of this species, because of assurances that the spawning populations of chum salmon in the Kuskokwim River were of sufficient size to support the fishery, and because the biological data regarding length, age, sex, run timing, and run size obtained from sampling commercial chum salmon catches would be beneficial in future management of the run (ADF&G 1982).

      Commercial salmon catches have increased steadily since expansion of the fishery in 1971. From 1975 through 1984, chum salmon catches have ranged from 225,156 fish in 1975 to a record catch of 542,531 fish in 1982 and have averaged 348,410 salmon annually. About 488,715 chum salmon were harvested during the 1984 season. Fishing districts within the Kuskokwim River accounted for 86% of the harvest. About 83% of the catch came from District 1. Districts 4 and 5 accounted for 11 and 3% of the catch, respectively.

      Data compiled from the 1982 and 1983 commercial fisheries indicate that chum salmon are available on Kuskokwim River Districts 1 and 2 when the fishery opens during mid June. Catch levels peaked the last week of June or first week of July and diminished by mid August to the first of September (table 4).

      Timing of the chum salmon migration through the Kuskokwim Bay commercial fisheries is slightly later than the Kuskokwim River run. Chum salmon returning to Districts 4 and 5 for both years were present when the fishery opened in mid June. Harvest levels peaked the second week of July, with the catch diminishing by the second week of August (table 4). Chum salmon caught throughout the

Table 3. Commercial Harvest of Chum Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

	Fishing Season									
District	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
1 (Lower Kuskokwim)	181,786	176,727	232,681	247,219	258,516	450,616	410,542	259,254	267,936	396,133
2 (Middle Kuskokwim)	2,385	1,137	16,040	1,437	3,358	16,617	8,135	19,052	8,762	27,687
3[b] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	34,402	43,659	43,707	24,798	25,995	65,984	53,316	33,336	23,090	50,555
5 (Goodnews Bay)	6,583	10,354	6,531	8,590	9,298	9,314	13,642	13,829	6,766	14,340
Area total	225,156	231,877	298,959	282,044	297,167	542,531	485,635	325,471	306,554	488,715

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Preliminary data.

b There is currently no commercial fishery in District 3.

Table 4. Run Timing of Chum Salmon in the Kuskokwim Management Area Based on Commercial Harvest Data, by Fishing District, 1982-83

District	Year	Date a/ Entry	Date Peak Harvest	Date last Harvest Reported	Date of last Harvest Period
1	1982	June 14	June 28	Aug. 30	Aug. 30
(Lower Kuskokwim)	1983	June 13	June 30	Aug. 26	Aug. 26
2	1982	June 17	July 5	Aug. 19	Aug. 19
(Middle Kuskokwim)	1983	June 16	June 27	Aug. 11	Aug. 18
4	1982	June 17	July 7	Aug. 27	Aug. 30
(Quinhagak)	1983	June 13	July 7-8	Sept. 1	Sept. 8
5	1982	June 17	July 14	Aug. 13	Sept. 8
(Goodnews Bay)	1983	June 13	July 7-8	Aug. 19	Sept. 8

Source: Huttenum 1984, 1985.

a Starting date of each commercial opening.

Table 5. Subsistence Harvest of Chum Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

	Fishing Season									
District	1975[c]	1976[c]	1977[c]	1978[c]	1979[c]	1980[c]	1981[c]	1982[c]	1983[a,c]	1984[a,c]
1 (Lower Kuskokwim)	123,548	140,258	122,165	72,010	86,472	109,863	96,406	127,845	109,914	84,834
2 (Middle Kuskokwim)	34,704	58,537	53,413	26,319	34,424	29,216	36,522	39,225	84,393	56,916
3 (Upper Kuskokwim)	18,137	24,997	22,777	20,480	39,940	26,093	20,838	22,966	5,550	7,550
4 (Quinhagak)	4,040	5,930	4,186	6,243	1,130	1,992	2,737	2,186	776	890
5 (Goodnews Bay)	[b]	1,428	856	[b]	1,082	[b]	3,178	2,754	1,518	1,219
Area total	180,429	231,150	203,397	125,052	163,048	167,164	159,681	194,976	202,151	151,409

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Preliminary data.

b No survey.

c Data expanded from survey results.

Kuskokwim Management Area during 1982 and 1983 were primarily ages 4 and 5 fish (Huttenum 1984, 1985).

b. Subsistence harvest summary. Estimated peak subsistence harvest levels of chum salmon were attained during the 1930's, when they were used as food for dog teams used for freight hauling. Catches declined during the 1940's, and little data exist for the 20 years prior to statehood (ADF&G 1985a).

Since 1975, subsistence catches of chum salmon have ranged from the 125,052 recorded for the 1978 season to 231,150 taken during the 1976 fishery. Most of the harvest has consistently been from District 1 (table 5). Since 1975, District 1 has accounted for 60% of the subsistence harvest. Districts 2, 3, 4, and 5 have accounted for the remaining 26, 11, 2, and 1% of the harvest, respectively (table 5).

3. Coho salmon harvest. Coho salmon has comprised about 36% of the total harvest of salmon (all species) from 1975 through 1984. Combined commercial and subsistence harvest of coho salmon has ranged from 111,763 fish in 1975 to a record harvest of 845,307 fish taken during the 1984 season (tables 6 and 8).

a. Commercial harvest summary. About 40% of the commercial salmon harvest in the Kuskokwim Management Area has been comprised of coho salmon. Areawide, commercial catches in the last decade have shown a steady increase. Harvest levels have ranged from 111,763 fish in 1975 to a record harvest of 830,931 salmon taken during the 1984 season (table 6). Catches have averaged 329,673 coho salmon, annually. About 76% of the coho salmon harvest has been taken from District 1 in the Kuskokwim River. Districts 2, 4, and 5, respectively, contributed about 1, 13, and 9% of the coho salmon harvest between 1974 and 1984 (table 6).

The commercial harvest of coho salmon from the Kuskokwim River has ranged from a low of 5,000 fish in 1971 to a peak catch of 623,000 fish in 1984. The number of vessels participating in the fishery in the river has increased from 83 in 1971 to 651 during the 1984 fishery (ADF&G 1984b).

Data from the 1982 and 1983 fisheries indicate that entry of coho salmon into the fishing areas is somewhat later than for other salmon species. Coho salmon have entered the Kuskokwim River fishery in District 1 as early as July 8, peaking in mid August and continuing through the final harvest

Table 6. Commercial Harvest of Coho Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and Year, 1975-84

District	Fishing Season									
	1975	1976	1977	1978	1979	1980	1981	1982	1983[a]	1984[a]
1 (Lower Kuskokwim)	84,120	87,933	237,659	210,790	215,430	219,174	207,868	435,357	195,816	605,184[a]
2 (Middle Kuskokwim)		568	3,705	2,603	3,630	2,868	3,383	11,760	1,100	18,349[a]
3[b] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	10,096	13,777	9,028	20,114	47,525	62,610	47,587	73,651	32,442	135,482[a]
5 (Goodnews Bay)	17,547	9,852	13,335	13,764	42,098	43,256	19,749	46,683	19,660	71,176[a]
Area total	111,763	112,130	263,727	247,271	678,683	327,908	278,587	567,451	249,018	830,191[a]

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Preliminary data.

b There is currently no commercial fishery in District 3.

Table 7. Run Timing of Coho Salmon in the Kuskokwim Managegment Area Based on Commercial Harvest Data, by Fishing District, 1982-83

District	Year	Date of First Harvest Period	Date First Harvest Reported	Date of Peak Harvest	Date of Last Reported Harvest	Date of Last Harvest Period
1	1982	June 14	July 8	Aug. 12	Aug. 30	Aug. 30
(Lower Kuskokwim)	1983	June 13	Aug. 11	Aug. 11	Aug. 26	Aug. 26
2	1982	June 17	Aug. 9	Aug. 19	Aug. 19	Aug. 19
(Middle Kuskokwim)	1983	June 16	Aug. 11	Aug. 11	Aug. 11	Aug. 18
4	1982	June 17	July 12	Aug. 9	Aug. 30	Aug. 30
(Quinhagak)	1983	June 13	July 18	Sept. 19	Sept. 8	Sept. 8
5	1982	June 13	July 19	Aug. 27	Sept. 6	Sept. 8
(Goodnews Bay)	1983	June 17	July 27	Aug. 22	Sept. 8	Sept. 8

Source: Huttenum 1984, 1985.

period. Upriver in District 2, first catches have been reported in mid August, with peak harvest occurring the second and third weeks of August (table 7). Coho salmon entered District 4 during the second and third weeks of July, with peak catches occurring the second and third weeks of August. District 5 coho appeared the third and fourth weeks of July.

Until recently, commercial fishing effort declined after mid August, when fishermen focused their energy toward hunting game. The coho salmon fishery, however, because of the increased value received for the fish, has sustained a high level of fishing activity throughout the later portion of the season in recent years (ADF&G 1984b). Since 1979, the commercial coho salmon harvest has been more valuable than that of any other species (ibid.).

b. Subsistence harvest summary. Traditionally, few coho salmon were taken in the subsistence fishery because subsistence needs were usually met by the harvest of earlier migrating salmon species. Also, the wet weather occurring in later summer months when coho salmon have been available to the fishery makes it difficult to dry the fish for preservation (ibid.). More families, however, have been acquiring freezers for food storage. Implementation of this additional storage method for subsistence-caught coho salmon has been partially responsible for the increased subsistence harvest of coho salmon in the Kuskokwim area in recent years.

Catches reported from 1977 through 1984 indicate that about 8% of the subsistence salmon harvest has been comprised of coho salmon. About 87% of the reported catch over the same period has occurred in the Kuskokwim River districts (table 8). Districts 4 and 5 accounted for 8 and 4% of the harvest, respectively (table 8).

Subsistence catches are often underestimated because fishermen are still harvesting fish after the subsistence surveys are conducted. Between 1977 and 1984, reported catches ranged from 7,589 fish in 1983 to a peak harvest of 47,335 salmon harvested in 1980. About 15,116 coho salmon were reported taken in the 1984 season (table 8).

4. Chinook salmon harvest. The chinook salmon harvest comprises about 11% of the total removal of salmon in the Kuskokwim area subsistence and commercial fisheries. Combined catches from both user groups ranged from

Table 8. Subsistence Harvest of Coho Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

	Fishing Season									
District	1975[c]	1976[c]	1977[c]	1978[c]	1979[c]	1980[c]	1981[c]	1982[c]	1983[c]	1984[c]
1 (Lower Kuskokwim)	a	a	7,567	8,672	19,265	28,511	10,929	29,721	4,584	9,926[b]
2 (Middle Kuskokwim)	a	a	1,982	2,069	1,323	4,834	3,843	5,079	2,153	3,246[b]
3 (Upper Kuskokwim)	a	a	2,281	1,499	4,611	4,197	3,843	6,819	770	300[b]
4 (Quinhagak)	a	a	182	197	1,754	5,279	5,679	860	77	1,490[b]
5 (Goodnews Bay)	a	a	182	a	226	4,514	1,622	2,692	5	154[b]
Area total	a	a	12,703	12,437	27,179	47,335	27,251	45,171	7,589	15,116

Source: ADF&C 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Insufficient information.

b Preliminary data.

c Data expanded from survey results.

79,018 fish in 1975 to 165,600 salmon in 1983, averaging about 121,175 chinook salmon annually (tables 9 and 11). About 134,958 chinook salmon were harvested during the 1984 season.

a. <u>Commercial harvest summary</u>. Commercial exploitation of chinook salmon in the Kuskokwim Management Area has occurred only since statehood (ADF&G 1984a). The size of the commercial harvest has been more a function of predetermined harvest goals than of run magnitude (McBride and Wilcock 1983). Annual catches have gradually increased since 1975, reaching a peak harvest of 93,676 fish in 1983. Catches during the past 10 years averaged about 62,740 fish annually. About 74,014 chinook salmon were harvested commercially during the 1984 season (table 9).

   Most of the chinook salmon harvest taken during the past decade has occurred in Districts 1 (lower Kuskokwim) and 4 (Quinhagak), accounting for 55 and 32% of the catch, respectively. Catches in Districts 2 and 5 have been small, contributing about 4 and 9%, respectively, to the chinook salmon harvest. Fishing activity in Districts 1 and 2 occurs within the Kuskokwim River whereas fishing activity in Districts 4 and 5 is restricted to marine waters (ADF&G 1985a).

   The timing of the chinook salmon run is variable and dependent upon weather conditions (ADF&G 1985a). Harvest data for the 1982 and 1983 fishing seasons indicate the availability of chinook salmon to the District 1 fishery when the season opened the second week of June (table 10). Dates on which peak harvest occurred in District 1 were the third week of June in 1983 and in 1982 during the first fishing period (table 10). Final catches for District 2 in 1982 were reported August 19, the date of the last fishing period. In 1983, however, final catches of chinook salmon in District 2 were reported June 27, primarily because of new gear restrictions that were implemented to curb harvest of chinook salmon during directed harvest for other species.

   Chinook salmon during the same two seasons have appeared in District 4 commercial catches June 17 and June 13, with the opening of the salmon fishery. Peak catches in this fishery occurred the third week of June, yet chinook salmon were still present in the fishery the last week of August and first week of September.

Table 9. Commercial Harvest of Chinook Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

District	Fishing Season									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1 (Lower Kuskokwim)	20,816	27,418	31,659	43,553	36,053	34,184	42,392	45,449	30,343	29,947[a]
2 (Middle Kuskokwim)	1,319	3,317	4,171	2,088	2,913	1,697	5,271	2,785	2,831	1,796[a]
3[b] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	3,994	14,110	19,090	12,335	11,144	10,387	24,524	22,106	46,385	33,659[a]
5 (Goodnews Bay)	2,149	4,417	3,336	5,218	3,204	1,974	7,190	9,476	14,117	8,612[a]
Area total	28,278	49,262	58,256	63,194	53,314	48,242	79,377	79,816	93,676	74,014

Source: ADF&G 1975, 1976, 1977, 1978,b 1979, 1980, 1981, 1982, 19834a 1984.b

a Preliminary data.

b There is currently no commercial fishery in District 3.

Table 10. Run Timing of Chinook Salmon in the Kuskokwim Management Area Based on Commercial Harvest Data, by Fishing District, 1982-83

District	Year	Date a/ Entry	Date Peak Harvest	Date last Harvest Reported	Date of last Harvest Period
1	1982	June 14	June 21	Aug. 30	Aug. 30
(Lower Kuskokwim)	1983	June 13	June 13	Aug. 26	Aug. 26
2	1982	June 17	June 24	Aug. 19	Aug. 19
(Middle Kuskokwim)	1983	June 16	June 23	June 27	Aug. 18
4	1982	June 17	June 24	Aug. 27	Aug. 30
(Quinhagak)	1983	June 13	June 23	Sept. 5	Sept. 8
5	1982	June 17	July 5	Aug. 30	Sept. 8
(Goodnews Bay)	1983	June 13	June 27	Sept. 8	Sept. 8

Source: Huttenum 1984, 1985.

a Starting date of each commercial opening.

The timing of chinook salmon in District 5 was similar to other chinook salmon runs in the Kuskokwim Area for the 1982 and 1983 seasons. Chinook salmon were present in the fishery when the season opened the third and second weeks of June, peaked July 5 and June 27, respectively, and were present in the fishery through the first week of September (table 10).

b. Subsistence harvest summary. The subsistence harvests of chinook salmon in the Kuskokwim Management Area have been at least equal in magnitude and in some years have exceeded the commercial catches of chinook salmon (tables 9, 11). During the past decade, catches have ranged from 38,309 fish harvested during the 1978 season to a peak recorded harvest of 71,924 salmon in 1983. The fishery has averaged about 58,432 fish annually. About 60,944 chinook salmon were taken during the 1984 season (table 11).

The subsistence harvest of chinook salmon has comprised about 23% of the total subsistence harvest of salmon since 1974. As with the commercial fishery, most of the fish have been harvested in the Kuskokwim River, with District 1 contributing about 73% of the catch. Districts 4 and 5 contributed 4 and 1% of the area's recorded subsistence harvest during the same time period (table 11).

5. Pink salmon harvest:

a. Commercial harvest summary. The commercial harvest of pink salmon accounts for less than 2% of the total harvest of salmon in the Kuskokwim Management Area. Pink salmon runs in this area exhibit even-year run strength. From 1975 through 1984, catches in even years have ranged from 18,259 fish taken during the 1982 season to 61,968 pink salmon harvested during the 1978 season, averaging 35,000 per year (table 12). Odd-year catches have been very small, averaging 563 fish annually. The District 4 fishery has accounted for 73% of the area's pink salmon catch from 1975 through 1984. Districts 5 and 1 contributed about 20 and 6% of the harvest, respectively (table 12.)

Pink salmon appeared in the commercial catch in District 4 by the fourth week of June during the 1982 and 1983 seasons and peaked in mid July (table 13). During the 1982 season, pink salmon continued to appear in the commercial fishery until the end of August, and in 1983 pink salmon were

Table 11. Subsistence Harvest of Chinook Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

District	Fishing Season									
	1975[c]	1976[c]	1977[c]	1978[c]	1979[c]	1980[c]	1981[c]	1982[c]	1983[c]	1984[c]
1 (Lower Kuskokwim)	37,745	46,522	39,470	26,779	41,537	47,710	47,176	45,639	48,068	45,591[a]
2 (Middle Kuskokwim)	7,830	9,507	13,967	7,679	8,534	10,063	10,831	9,339	18,668	10,090[a]
3 (Upper Kuskokwim)	1,904	1,888	1,902	1,423	5,457	1,736	1,662	2,725	1,580	1,525[a]
4 (Quinhagak)	3,261	2,217	2,012	2,328	1,420	1,974	2,562	2,402	2,542	3,109[a]
5 (Goodnews Bay)	b	201	574	b	338	498	1,409	1,236	1,066	629[a]
Area total	50,740	60,335	57,925	38,209	57,286	61,981	63,640	61,341	71,924	60,944

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Preliminary data.

b Insufficient information.

c Data expanded from survey results.

Table 12. Commercial Harvest of Pink Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and by Year, 1975-84

District	Fishing Season									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1 (Lower Kuskokwim)	5	133	203	5,829	78	[a]	292	1,741	211	2,931[b]
2 (Middle Kuskokwim)	[a]	[a]	[a]	3	[a]	[a]	[a]	7	[a]	11[b]
3[c] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	540	31,412	202	47,033	295	21,671	160	11,838	168	16,249[b]
5 (Goodnews Bay)	418	8,453	29	9,103	201	7,832	11	4,673	[a]	4,711[b]
Area total	963	39,998	434	61,968	574	29,503	463	18,259	379	23,902

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1981, 1982, 1984a, 1984b.

a Insufficient information.

b Preliminary data.

c There is currently no commercial fishery in District 3.

Table 13. Run Timing of Pink Salmon in the Kuskokwim Area Based on Commercial Harvest Data, by Fishing District, 1982, 1983

District	Year	Date of First Harvest Period	Date Entry	Date Peak Harvest	Date Last Harvest Reported	Date of Last Harvest Period
1	1982	June 14	June 16	July 8	Aug. 30	Aug. 30
(Lower Kuskokwim)	1983	June 13	June 27	July 11	Aug. 26	Aug. 26
2	1982	June 17	July 5[a]	July 5	July 5	Aug. 19
(Middle Kuskokwim)	1983	b	b	b	b	b
4	1982	June 17	June 28	July 19	Aug. 27	Aug. 30
(Quinhagak)	1983	June 13	June 23	July 18	Aug. 5	Sept. 8
5	1982	June 17	July 9	July 14-19	Aug. 13	Sept. 8
(Goodnews Bay)	1983	b	b	b	b	b

Source: Huttenun 1984, 1985.

a Only reported harvest of pink salmon (seven fish) was recorded July 5.

b No recorded harvest.

taken only through the first week of August (table 13).

During the 1982 season, pink salmon appeared in District 5 commercial catches during the second week of July, with peak catches recorded between July 14 through July 19 and diminishing by August 13 (table 13).

Pink salmon are purchased as a bonus by area processors for very low prices. As a result, the catch does not reflect the true size of the run. Pink salmon in the commercial catch are often discarded when more valuable species are available (Francisco, pers. comm.).

b. Subsistence harvest summary. Few pink salmon are harvested in the subsistence fishery, and recorded catches have been combined with chum salmon harvest totals.

6. Sockeye salmon harvest:

a. Commercial harvest summary. The commercial harvest of sockeye salmon comprises 6.4% of the total commercial salmon harvest for the Kuskokwim Management Area. From 1975 through 1984, District 1 has accounted for 40% of the area's sockeye salmon harvest, followed in order of significance by District 5 (34%), District 4 (25%), and District 2 (1%). Recorded catches ranged from 13,734 fish during the 1978 season to 105,940 fish taken during the 1981 fishery (table 14).

Sockeye salmon is the target species for fishermen in District 5 during the month of July (ADF&G 1985a). Catches have ranged from a low of 3,712 fish during the 1977 season to a peak harvest of 40,273 sockeye salmon harvested during the 1981 fishery.

During the 1982 and 1983 seasons, sockeye salmon were available to the fishery when the season opened in mid June. Peak catches were reported at the end of June. In 1982, final catches were reported August 6, and in 1983, sockeye salmon were still present in the fishery during the final commercial opening (table 15). Harvest levels in District 4 during the 1982 and 1983 seasons peaked the first and second weeks of July, yet sockeye salmon were available to the fishery through the end of August and first week of September (table 15).

Within the Kuskokwim River (Districts 1 and 2), sockeye salmon have been harvested incidentally in fisheries targeting on other species. Historically, fishermen have not accurately identified

Table 14. Commercial Harvest of Sockeye Salmon in Numbers of Fish in the Kuskokwim Management Area, by District and Year, 1982-83

District	Fishing Season									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1 (Lower Kuskokwim)	4	2,971	9,369	733	460	[a]	48,246	31,233	67,681	46,574[b]
2 (Middle Kuskokwim)	[a]	[a]	10	[a]	594	[a]	129	1,921	1,174	2,004[b]
3[c] (Upper Kuskokwim)	0	0	0	0	0	0	0	0	0	0
4 (Quinhagak)	8,969	6,090	5,519	7,589	18,828	13,221	17,292	25,685	10,263	17,297[b]
5 (Goodnews Bay)	9,063	5,575	3,723	5,412	19,581	28,632	40,273	38,877	11,716	15,474[b]
Area total	18,036	14,636	18,621	13,734	39,463	41,853	105,940	97,716	90,834	81,349[b]

Source: ADF&G 1975, 1976, 1977, 1978b, 1979, 1980, 1981, 1982, 1984a, 1984b.

a Insufficient information.

b Preliminary data.

c There is currently no commercial fishery in District 3.

Table 15. Run Timing of Sockeye Salmon in the Kuskokwim Management Area Based on Commercial Harvest Data, by Fishing District, 1982-83

District	Year	Date Entry [a]	Date Peak Harvest	Date last Harvest Reported	Date of last Harvest Period
1	1982	June 14	June 28	Aug. 1	Aug. 30
(Lower Kuskokwim)	1983	June 13	July 30	Aug. 26	Aug. 26
2	1982	June 17	July 5	July 5	Aug. 19
(Middle Kuskokwim)	1983	June 16	June 27	Aug. 11	Aug. 18
4	1982	June 17	July 7	Aug. 25	Aug. 30
(Quinhagak)	1983	June 13	July 11	Sept. 8	Sept. 8
5	1982	June 17	June 30	Aug. 6	Sept. 8
(Goodnews Bay)	1983	June 13	June 27	Sept. 1	Sept. 1

Source: Huttenum 1984, 1985.

a Starting date of each commercial fishing opening.

sockeye and chum salmon in their commercial catches. Therefore, the true magnitude of the sockeye and chum salmon harvests have not been accurately reported. The 1981 catch was the first year in which a significant sockeye salmon run was documented (ADF&G 1985a). Because the ex-vessel value of sockeye salmon is greater than that of chum salmon, distinguishing between species is beneficial to the fisherman (ibid.).

b. Subsistence harvest summary. Fishermen have not distinguished between chum and sockeye salmon catches in the subsistence fishery. Therefore, the magnitude of the subsistence harvest of sockeye salmon in the Kuskokwim Area is unknown (ibid.).

C. Harvest Methods

1. Commercial fishery. Set and drift gill nets are the only legal gear for the commercial harvest of salmon in Districts 1, 2, 4, and 5 (ADF&G 1985b). Though no mesh size restrictions are imposed upon the fishery in Districts 1 and 2 prior to June 25, most nets are of 8½-inch stretched-mesh webbing. After June 25, a six-inch stretched-mesh size limitation is in effect, and most nets consist of 5¼-5½-inch stretched mesh. The gill net mesh size restriction minimizes the capture of chinook salmon, particularly the larger more fecund females (ADF&G 1984a). Set gill nets are primarily used for subsistence fishing, whereas commercial fishermen generally use drift gill nets. Generally speaking, boats used in the Kuskokwim River salmon fishery are long and narrow, with a high bow. Boats range from 16 to 32 ft in length. In recent years, more sophisticated vessels have entered the fishery, including jet boats and larger diesel powered vessels that are used to fish for herring along the coast (ibid.).

2. Subsistence fishery. Spears, dip nets, fish traps, and willow- or caribou-strip gill nets were traditional gear used for subsistence harvest of salmon. These methods have slowly been replaced by linen gill nets and even more recently by nylon gill nets. Since statehood, the introduction of nylon gill net webbing has increased the importance and harvest of chinook salmon particularly (ADF&G 1983). Gear currently legal for the subsistence harvest of salmon in the Kuskokwim area are gill nets, beach seines, and fish wheels. Spears are legal for subsistence harvest in the Holitna River drainage (ADF&G 1985b).

D. Period of Use

1. Kuskokwim River. Until June 26, commercial fishing periods are regulated by emergency order. This allows scheduling of the chinook salmon harvest throughout a greater portion of the run. This is necessary because of the intensive nature of the king salmon fishery (ADF&G 1984a). The fishery closes

by regulation in Districts 1 and 2 on September 1 (ADF&G 1985a).

Commercial fishing periods are most often limited to two six-hour periods each week during the June 26 to July 31 "chum salmon season." This helps offset the increased effort and efficiency of the fleet and distributes the allowable harvests over a greater portion of the salmon run.

Commercial fishing in District 1 is allowed only below Bethel (the lower 86 mi of the river) during the "chum salmon season." Only gill nets of six-inch stretch mesh or less can be used during this time. Restricting fishing to the lower portion of the district enhances fish quality, helps prevent excessive harvest and wastage, and allows subsistence demands to be met. The gill net mesh restriction minimizes the capture of chinook salmon, particularly the larger, more fecund females. Regulatory changes in 1985 limit mesh sizes to six inches or less at all times and allow for fishing in the entire length of District 1.

Subsistence fishing is prohibited for 24 hours before, during, and for 6 hours after each commercial fishing period in District 1 prior to June 25 and from August 1 to August 31. During the "chum salmon season" (June 26-July 31), only District 1, below Bethel, is open to commercial fishing, and the subsistence fishing prohibition in conjunction with commercial periods is limited to this area during this time. This regulation reduces the illegal sale of subsistence salmon and provides for a more even escapement distribution. It also reduces fish wastage because subsistence fishermen are required to check their gear at regular intervals throughout the commercial fishing season.

After July 31, commercial fishing periods are again regulated by emergency order. This allows fishing effort to be regulated according to the magnitude of the variable coho salmon run (ADF&G 1984a).

2. Kuskokwim Bay. Commercial fishing periods in Districts 4 and 5 of Kuskokwim Bay are usually 12-hour periods and are regulated by emergency order. The fishery is opened when a harvestable surplus of salmon has reached the fishing grounds. The fishery in Districts 4 and 5 closes by regulation on September 8.

E. Management Objectives

The main objective for management of Kuskokwim Area salmon fisheries is to manage the fisheries on a sustained yield basis in accordance with policies set forth by the Alaska Board of Fisheries (ibid.).

1. Commercial fishery. The area's commercial fishery has shown considerable expansion during the past 10 years as a result of increased participation by individual fishermen, improvements in fishing gear, and better tendering and processing capability. Harvest guidelines and gear restrictions have

been established to ensure maintenance of both adequate subsistence harvest levels and spawning escapement (ibid.).

2. Subsistence fishery. Subsistence has been designated by the legislature as having highest priority among beneficial uses of the fish and game resources. Except in areas where intensive commercial fisheries occur, the subsistence fishery is subject to very few restrictions in order to give preference to subsistence users.
3. Chum salmon:
   a. Kuskokwim River. Official guideline harvest levels have not been established for the commercial chum salmon fishery in the Kuskokwim River fishing districts. Historical data indicate that the commercial harvest of chum salmon should fall within the range of 200,000 to 400,000 salmon to ensure that both subsistence requirements and spawning escapements are met. The commercial harvest of chum salmon will not exceed 400,000 fish unless test-fishing indices, commercial catch per effort, and escapement levels indicate a larger than average salmon run, and subsistence catches have been adequate (ADF&G 1985a). Should the magnitude of the run be below expectation, both commercial and subsistence fishing times will be restricted (ibid.).
   b. Kuskokwim Bay. In District 4, fishing times and catches are dependent upon run strength and escapement as determined by comparison of current harvest level to historical catches and by in-season assessment of escapement counts and test-fishing indices (ibid.).
4. Coho salmon:
   a. Kuskokwim River. The range of commercial harvest for coho salmon in the Kuskokwim River is 150,000 to 200,000 fish. The guideline harvest level established by regulation for District 2 from August 1 through August 31 is 2,000 to 4,000 coho salmon (ibid.). These harvest levels were established to provide for adequate spawning escapements and to ensure subsistence utilization.
   b. Kuskokwim Bay. The coho salmon fishery in District 4 is regulated by scheduled fishing periods, unless in-season assessment of run strength indicates the run is above or below expectations. Fishing time or duration of the fishing period is manipulated by emergency order (ibid.).
5. Chinook salmon:
   a. Kuskokwim River. The Alaska Board of Fisheries established guideline harvest levels of 15,000 to 30,000 chinook salmon for District 1 and harvest levels of 2,000 to 4,000 chinook salmon for District 2. The fishery may be terminated before or after guideline harvest levels have been achieved, depending on in-season assessment of run strength. When test-fishing

indices and subsistence catch levels indicate a sustained run is in progress and when the upriver distribution of chinook salmon has reached Aniak, the fishing season in Districts 1 and 2 is opened to commercial fishing (ibid.).

b. Kuskokwim Bay. The commercial fishing season for Districts 4 and 5 opens in mid June, depending on the entry pattern of chinook salmon into the Kanektok and Goodnews rivers. Respective guideline harvest levels for Districts 4 and 5 are 15,000 and 5,000 chinook salmon (ibid.), unless assessment of in-season run strength through escapement enumeration or test-fishing indices indicate that the run is strong enough to support larger harvest levels (ibid).

6. Sockeye salmon:
   a. Kuskokwim River. A specific management strategy has not been identified for sockeye salmon in the Kuskokwim River.
   b. Kuskokwim Bay. Sockeye salmon are the target species in District 5 during the month of July. The fishery operates on scheduled fishing periods unless changed by emergency order because of a change in anticipated run strength (ADF&G 1984a, 1985a).

F. Management Considerations

1. Subsistence. The subsistence fishery for salmon in the Kuskokwim Management Area is one of the largest of its kind in the State of Alaska. Within all commercial fishing districts of the Kuskokwim Area, the majority of the fishermen usually take salmon for both commercial and subsistence purposes. Short subsistence fishing closures each week are used in Districts 1, 4, and 5 to discourage illegal commercial fishing under the guise of subsistence fishing and to provide for adequate spawning escapements. Substantially more subsistence fishing time is allowed compared to commercial fishing in all areas.
2. In-season management. Commercial fishing time is adjusted in-season in response to the magnitude of the run of the salmon species on which harvest effort is being directed. Guideline harvest levels have been established in many instances to ensure achievement of both required subsistence harvest and spawning escapements. Although escapement levels have been established for selected streams within the Kuskokwim Area, in many instances, the spawning streams are located considerable distances from the fishing grounds. Attaining timely escapement estimates, therefore, to make in-season management decisions is difficult. The use of test-fishing indices and migration timing information, however, has been helpful in overcoming this difficulty.
3. Species identification. Historically, separating sockeye salmon from chum salmon catches in the Kuskokwim River

fishery has not been of concern. The result is that the true magnitude of the sockeye salmon run is unknown. Since 1981, fishermen, processors, and the ADF&G have worked together to identify sockeye and chum salmon in the commercial harvest (ADF&G 1985a). Sockeye salmon have comprised 10 to 20% of the combined chum-sockeye salmon harvest since 1981. Prior to the 1981 season, the reported sockeye salmon harvest was less than 2% of the chum-sockeye salmon harvest (ibid.). The result of the effort to distinguish between the two species in the commercial harvest has caused the reported commercial sockeye salmon harvest to increase from 1% of the total commercial salmon harvest prior to 1981 to about 11% of the commercial harvest after 1981 (ibid.).

4. Interception of Western Alaska fish in other fisheries. Due to their extensive ocean travels, salmon of Western Alaska origin are intercepted in domestic and foreign fisheries operating in the waters of the North Pacific Ocean and Bering Sea.
   a. Domestic fisheries. Record chum salmon catches made in the South Peninsula commercial fishery totaled 1,015,000 in 1982 and 756,000 in 1983. In 1984, the catch dropped to 338,000 chum salmon, after the Board of Fisheries reduced the June fishing time allowed in this fishery. The chum salmon catch in this fishery is incidental to the harvesting of sockeye salmon bound primarily for Bristol Bay. Based on past tag recovery data and recent scale pattern studies, a large proportion of the chum salmon taken in this fishery are fish bound for other Western Alaska Areas, ranging from the northern Alaska Peninsula to Kotzebue, including the Kuskokwim and Yukon River drainages. The increasing chum salmon catch has created a major harvest allocation controversy among domestic fishermen (ADF&G 1985a).
   b. Foreign fisheries. A recent study (Rogers et al. 1984) indicated that an average of 141,000 chinook salmon of Western Alaska origin (including unknown numbers of Kuskokwim and Yukon area fish) have been intercepted yearly by the Japanese mothership and land-based gill net fisheries during the period 1975-1983. This study confirmed that substantial numbers of Western Alaska chinook salmon are intercepted in the Japanese land-based fishery located in the North Pacific Ocean waters. In 1980, a total of 438,000 Western Alaska chinook salmon were estimated to have been taken in these fisheries, which exceeded the domestic commercial catch in Western Alaska that year. High seas fisheries have captured an average of 26% of the estimated Western Alaska return during the 1965-1977 time frame and 14% since 1978. Although reported foreign catches have decreased in recent years, it is believed that high seas

fishing mortality in the form of gill net dropouts from the Japanese land-based gill net fishery (estimated to be 30% of the reported catch in one study) and under-reporting result in continued substantial losses of Western Alaska fish.

The expanding domestic and joint-venture trawl fleets in the North Pacific Ocean and Bering Sea waters are also known to take chinook and chum salmon and represent an additional potential threat to these same stocks. There is some question whether accurate monitoring of incidental salmon catches is occurring (ADF&G 1985a).

III. YUKON MANAGEMENT AREA

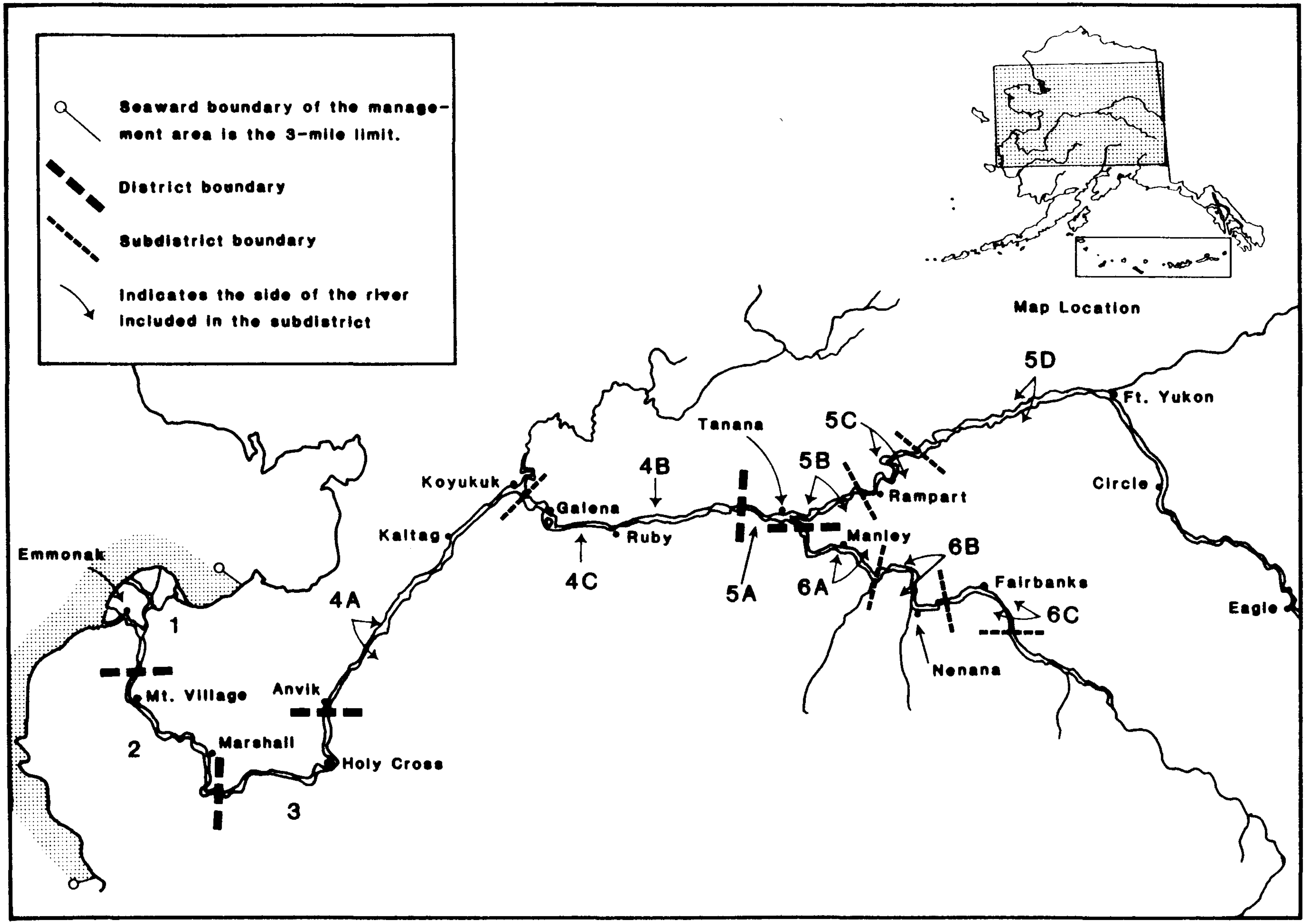
A. Boundaries

The Yukon Management Area includes all waters of the Yukon River and its tributary streams in Alaska and all coastal waters between the latitude of Canal Point light southward to the latitude of the westernmost tip of the Naskonat Peninsula (map 2). The river originates in British Columbia and flows over 2,300 mi to the Bering Sea (ADF&G 1984c). Within Alaska, the river is divided into six fishing districts. The districts are defined as follows:

1. <u>District 1</u>. District 1 consists of that portion of the Yukon River drainage from its terminus upstream to the northern edge of the mouth of the Anuk River and all waters of the Black River, including waters within one nautical mile of its terminus.
2. <u>District 2</u>. District 2 consists of that portion of the Yukon River drainage from the northern edge of the mouth of the Anuk River upstream to an ADF&G regulatory marker located at Toklik and includes the Anuk River drainage.
3. <u>District 3</u>. District 3 consists of the Yukon River from an ADF&G regulatory marker located at Toklik upstream to an ADF&G regulatory marker at the mouth of an unnamed slough three-forths of a mile downstream from Old Paradise Village.
4. <u>District 4</u>. District 4 consists of the Yukon River from an ADF&G regulatory marker at the mouth of an unnamed slough three-fourths of a mile downstream from Old Paradise Village upstream to the western edge of the mouth of Illinois Creek at Kallands.
5. <u>District 5</u>. District 5 consists of that portion of the Yukon River drainage (excluding the Tanana River drainage) from the western edge of the mouth of Illinois Creek to the United States-Canada border and includes the Illinois Creek drainage;
6. <u>District 6</u>. District 6 consists of the Tanana River drainage to its confluence with the Yukon River.

B. Fishery Description and Reported Use

Subsistence and commercial fisheries for salmon occur along the length of the Yukon River. Primary species of interest are chinook, chum, and coho salmon, alhough limited numbers of sockeye



Map 2. Salmon commercial fishing districts and subdistricts of the Yukon Management Area (ADF&G 1984c).

Note: Not all communities located within the management area are shown.

and pink salmon are present. Although commercial and subsistence fishing activity extends across the border into Canada, most of the harvest is taken in the Alaskan portion of the drainage. Combined reported subsistence and commercial all-species catches from 1975 through 1984 for both countries combined have ranged from 1.2 million fish taken in 1977 to about 2.1 million fish harvested during the 1981 season, averaging 1.6 million fish annually (tables 16 and 17).

1. <u>All-species harvest</u>. Commercial fisheries for salmon in the Yukon River drainage occur both in Alaska and in the Yukon Territory. Since 1975, the Alaska and Canada combined commercial harvest of all species ranged from 1.1 million fish taken in 1976 to 2.0 million salmon taken in 1981. Catches during this same time period averaged about 1.6 million salmon annually (table 17).

    a. <u>Alaskan commercial harvest summary</u>. The first commercial harvest of salmon in the Alaska portion of the Yukon River was reported in 1918 when Carlisle Packing Company operated a floating cannery at Andreafsky (St. Mary's). Relatively large catches of chinook, coho, and chum salmon were harvested during the first four years of the fishery (ADF&G 1984c). The emphasis upon the large upriver subsistence fishery resulted in closure of the commercial fishery occurring at the mouth of the river from 1925 through 1931 (ibid.). The commercial fishery targeting on chinook salmon resumed with less effort in 1932. Chinook salmon were the only species harvested on a sustained basis prior to 1959 (ibid.).

        Major interest in the commercial fishery on the Yukon River has developed since 1961. Until recently, virtually all commercially harvested salmon were taken from the delta region of the Yukon River. In recent years, upper river commercial fishing has increased, and as it has grown it has been necessary to restrict the catch in the lower river in order to allow enough salmon upriver for fishery and spawning needs (Pope 1981). This relatively recent development and expansion of the commercial salmon fisheries in Alaska has enabled many area residents to obtain cash income when other employment has been intermittent or nonexistent. Most of the commercial fishermen fishing in Alaska and the processing plant workers are resident Eskimo and Athabaskan Indians. During the early years of the fishery, salmon were marketed as either a canned or salted product. Currently, most of the catch is processed as a fresh/frozen product (YTC 1985).

        Commercial fishing activity is dispersed widely over 1,200 river miles in the main stems of the upper Yukon and lower Tanana rivers. The major commercial

Table 16. Subsistence Harvest of Salmon (All Species) in Numbers of Fish in the Yukon River Management Area by District and by Year, 1975-84

District	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984[a]
1	17,755	33,171	25,798	38,817	41,179	30,690	36,670	53,163	46,360	48,063
2	30,298	32,640	38,323	28,141	44,470	39,392	37,040	50,520	58,946	52,628
3	13,694	6,773	10,588	6,320	8,676	10,527	12,823	12,208	14,216	14,254
Lower Yukon subtotal	61,747	72,584	74,709	73,278	94,322	80,609	86,533	115,891	119,522	114,945
4	138,601	131,159	105,183	126,543	169,419	272,532	68,635	231,285	187,900	154,634
5	64,370	47,361	65,940	85,078	148,217	105,506	155,871	101,334	150,724	162,424
6	35,027	27,792	46,685	52,976	68,526	72,188	57,828	45,302	72,438	64,551
Upper Yukon subtotal	237,998	206,312	217,812	264,697	385,802	447,486	282,332	377,921	411,062	381,609
Total Alaskan catch	299,745	278,896	292,521	337,875	480,065	528,095	368,865	493,812	530,584	496,554
Canadian catch	21,100	5,725	11,296	9,116	17,200	27,764	16,737	13,047	9,125	12,445
Yukon drainage total	320,845	284,621	303,817	346,961	497,265	555,859	385,602	506,859	539,709	508,999

Source: ADF&G 1984c; YTC 1985; Geiger, pers. comm.

a Preliminary data.

Table 17. Commercial Harvest of Salmon (All Species) in Numbers of Fish in the Yukon River Management Area by District and by Year, 1975-84

District	Year									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	623,480[a]	445,537[a]	484,045	597,199[a]	565,723[a]	593,292	787,627	436,565	675,587	475,570
2	162,327[a]	137,008[a]	179,714	317,953	311,228	445,249	560,390	332,236	379,523	387,495
3	9,767	18,200	23,766	42,204	70,988	63,541	77,956	12,597	28,724	11,176
Lower Yukon subtotal	795,574	600,745	687,525	957,356	947,939	1,102,082	1,425,973	781,398	1,083,834	874,241
4	179,109	213,458	184,506	375,812	220,473	177,089	73,147	8,643	11,755	10,690
5	43,086	9,312	31,168	28,988	59,456	47,118	94,230	19,212	47,641	28,374
6	34,027	26,770	25,282	51,774	56,239	58,480	61,737	37,178	65,477	85,368
Upper Yukon subtotal	256,222	249,540	240,956	456,574	336,168	282,687	229,114	65,033	124,873	124,432
Total Alaskan catch	1,051,796	850,785	928,481	1,413,930	1,284,107	1,384,769	1,655,087	846,431	1,208,707	998,673
Canadian catch	5,500	4,500	8,710	6,331	15,259	18,500	23,853	19,952	39,017	32,817
Yukon drainage total	1,057,295	855,285	937,191	1,420,261	1,299,366	1,403,269	1,678,940	866,383	1,247,724	1,031,490

Source: ADF&G 1984c, YTC 1985.

a Catch figures include numbers of pink or sockeye salmon (less than 300 fish).

fisheries, however, occur within the lower 150 river miles. The lower Yukon River Districts 1, 2, and 3 when combined have accounted for 78% of the total commercial salmon harvest from 1975 through 1984. About 48% of the total catch is taken in District 1 alone (table 17).

b. Alaskan commercial fishing effort. Commercial fishing effort in the lower river increased sharply during the period 1961 through 1975, when the amount of set gill net gear doubled and drift gill net gear tripled. The number of fish wheels has also increased in recent years with development of the upper Yukon commercial fishery (ADF&G 1984c). In 1976, the salmon fishery became limited entry to stabilize the amount of fishing gear in the river. Currently, about 700 gill net permits (drift and set combined) are issued annually for the lower Yukon area (ibid.). In the upper Yukon, about 75 gill net (set gill nets only) and 170 fish wheel permits are issued annually (YTC 1985).

c. Canadian commercial harvest summary. Commercial fishing in the Canadian section of the Yukon River occurred as early as the late 1800's in association with the activity stimulated by the gold rush era at the turn of the century (ibid.). A fishery inspector was appointed in 1900 to monitor the fishery and issue licenses. By 1903, 17 commercial licenses had been sold, and 40 people were engaged in the fishing industry. Most of the effort took place near Dawson City. Commercial fishing activity declined after the 1920's, remaining at a relatively low level until a recent increased interest. The opening of a processing plant in Dawson in 1982 provided an additional marketing outlet and has been a major impetus for increased harvest levels. Currently, commercial fishing is permitted in the main stem of the Yukon River from the United States/Canada border to the confluence of Tatchun Creek, about 20 mi downstream from the village of Carmacks (with the exception of a closed area in the Dawson vicinity) and in the lower sections of the Stewart and Pelly rivers (ibid.). Most of the harvest is taken by set gill net. The harvest is marketed both for local consumption by residents and tourists and through the newly built processing plant. Fish sold to the plant are frozen and trucked to southern distributors (ibid.).

The Canadian commercial fishery has shown a steady increase in harvest levels during the past 10 years. Catches have ranged from 4,500 salmon in 1976 increasing to 39,017 salmon during the 1983 season. About 32,817 salmon were harvested in 1984. From 1975 through 1984, the Canadian harvest has contributed about 1% of the total salmon commercial catch for the entire Yukon River drainage (table 17).

d. Alaskan subsistence harvest summary. Chinook and chum salmon are the most important species taken for subsistence purposes. Based on the reported catch (tables 2 and 16), the subsistence salmon fishery occurring in the Alaskan portion of the Yukon River drainage is the largest fishery of its kind in Alaska. About 10,000 to 15,000 Native and fewer non-Native people reside in 45 small remote communities scattered throughout the drainage. Most of these people are dependent to varying degrees upon the fishery resource for their livelihood. Chinook salmon are almost exclusively used for human consumption whereas chum salmon are also fed to sled dogs (ibid.).

A household survey is performed annually to document subsistence catches. The survey involves either personal interviews of fishing families or catch questionnaires mailed to fishermen at the close of the season. During the 1984 season, one or more members of 1,064 fishing families operated about 790 gill net and 170 fish wheel units for subsistence harvest of salmon. Often, the same fishermen take salmon for both commercial and subsistence purposes while using the same units of gear (ibid.).

A decrease in the total subsistence harvest from the mid 1960's through the early 1980's has been attributed to replacement of dog teams by more mechanized means of travel (i.e., snow vehicles and airplanes). Because chinook salmon are primarily for human consumption, this decrease is primarily a reflection in chum salmon utilization.

Reported salmon catches in the subsistence fishery have averaged 410,200 fish annually between 1975 and 1984 and have ranged from 278,896 salmon taken in 1976 to 530,584 salmon harvested in 1983 (table 16). Between 1975 and 1984, 76% of the total Yukon drainage subsistence harvest was taken in the upper river districts (Districts 4, 5, and 6). Districts 4 and 5 alone accounted for 60% of the harvest. The lower river contributed above 20% of the harvest during the same time period (table 16).

e. Canadian subsistence harvest summary. Both an Indian food fishery and a non-Native subsistence fishery for salmon occur in the Canadian portion of the Yukon River drainage. Indian residents have traditionally relied heavily upon the harvest of Yukon River chinook and chum salmon for food. The food fishery on the Yukon River is the largest of its kind in the Yukon Territory and northern British Columbia, potentially supplying salmon to over 6,000 Native residents in the area for 12 different Indian bands. Fishing sites all scattered throughout the Canadian portion of the drainage, with primary effort focused around the communities of Burwash, Carmacks, Dawson, Johnsons' Crossing, Mayo, Minto, Old Crow, Pelly Crossing, Ross River, and Teslin. Most of the Indian food catch is dried, frozen, or served fresh for home consumption with small amounts, particularly of chum salmon, dried for dog food (YTC 1985).

Provisions for a small non-Native or domestic subsistence fishery have been made sporadically since 1899. Domestic licenses were eliminated in 1961 and reestablished in 1974. A rural frontier-type lifestyle characterizes participants in the fishery. Domestic fishing is permitted in the areas open to commercial fishing (i.e., downstream of Tatchun Creek and in the lower portion of the Pelly and Stewart rivers.) Fishing gear used in this fishery is similar to commercial gear fished in the area, primarily consisting of gill nets and, infrequently, fish wheels (ibid.).

The documented harvest of subsistence-caught salmon has fluctuated considerably between 1975 and 1984. Catches have ranged from 5,725 fish taken in 1976 to 27,764 fish harvested in 1980, averaging 16,210 fish annually (table 16).

2. Chum salmon harvest. Chum salmon are found throughout the Yukon River drainage. Two distinct runs of chum salmon enter the river. Summer chum salmon are the more abundant group, entering the river from early June through mid July (table 19). The less abundant fall chum salmon exhibit later run timing, from mid July through early September (table 20) (ADF&G 1984c). Commercial and subsistence fisheries targeting on chum salmon occur both in the Alaskan and the Canadian portions of the Yukon River. Combined catches for both the commercial and subsistence fisheries from both countries between 1974 and 1985 have ranged from 1,023,574 chum salmon harvested in 1977 to 1.8 million salmon taken in 1981 and have averaged 1.3 million fish annually (tables 18, 21).

   a. Alaskan commercial harvest summary. The chum salmon fishery has shown steady growth since statehood was achieved in 1959. Prior to the mid 1960's, summer chum salmon were used primarily for sled dog food. With increased use of snow machines, the need for sled dogs declined, and, subsequently, the subsistence harvest of summer chum salmon dropped.

   Therefore, in 1967 restrictions regarding commercial harvest of summer chum salmon were relaxed, as subsistence needs declined. The commercial harvest of summer

Table 18. Commercial Harvest of Chum Salmon in the Yukon River Management Area by District and by Year, 1975-84

District	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
					Year					
1	576,506	379,055	382,410	521,732	479,340	498,081	674,992	347,000	575,535	371,427
2	150,805	120,402	157,673	279,194	266,880	392,585	506,761	278,925	333,737	307,734
3	5,590	14,052	19,263	38,530	65,970	58,301	73,514	9,901	24,618	7,516
Lower Yukon subtotal	732,901	513,509	559,346	839,456	812,190	948,967	1,255,267	635,826	933,890	686,677
4	178,720	213,049	183,531	375,172	218,538	175,538	71,800	7,541	11,154	8,634
5	40,209	6,161	27,004	25,908	56,067	42,227	87,856	13,827	44,035	24,705
6	33,474	24,565	22,990	48,073	52,676	55,307	58,466	28,417	58,398	76,813
Upper Yukon subtotal	252,403	243,775	233,515	449,153	327,072	273,072	218,122	49,785	113,587	110,152
Total Alaskan catch	985,304	757,284	792,861	1,288,609	1,139,262	1,222,039	1,473,389	685,611	1,047,477	796,829
Canadian catch	2,500	1,000	3,990	3,356	9,084	9,000	15,260	11,312	25,990	22,932
Yukon drainage total	987,804	758,284	796,851	1,291,965	1,148,346	1,231,039	1,488,649	696,923	1,073,467	819,761

Source: ADF&G 1984c, YTC 1985.

Table 19. Run Timing of Summer Chum Salmon in the Yukon Management Area Based on Commercial Harvest Data, by Fishing District, 1982-84

District	Year	Date of First Harvest Period	Date First Harvest Reported	Date of Peak Harvest	Date of Last Reported Harvest	Date of Last Harvest Period
1	1982	June 14-15	June 14-15	July 8-10	July 15-17	Aug. 12-13
	1983	June 9-10	June 9-10	June 30-Jul 1	July 14-15	Aug. 11-12
	1984	June 18-19	June 18-19	June 25-26	July 12-13	Aug. 12-18
2	1982	June 16-17	June 16-17	July 4-5	July 21-22	Aug. 15-16
	1983	June 12-13	June 12-13	June 29-30	July 17-18	Aug. 14
	1984	June 20-21	June 20-21	July 1-2	July 18	Aug. 19
3	1982	June 28-29	June 28-29	July 1-2	July 5-6	Aug. 16-18
	1983	June 16-17	June 16-17	July 7-9	July 14-16	Aug. 15-16
	1984	June 28-29	June 28-29	June 28-29	July 2-3	Aug. 13-14
4	1982	June 20-22	June 20-22	July 11-13	Aug. 11-13	Sept. 9-10
	1983	June 15-17	June 15-17	June 29-Jul 1	Aug. 7-9	Aug. 14-16
	1984	June 15	June 20-22	June 8-10	Aug. 1-3	Sept. 5-9
5	1982	June 25-27	July 09-11	July 13-14	July 13-14	Aug. 1
	1983	June 24-26	July 01-03	July 22-24	July 26-28	Sept. 18-22
	1984	June 15-12	July 3-5	July 10-12	July 22-28	Sept. 7-11
6	1982	July 2-4	July 9-11	Aug. 2-4	Aug. 6-8	Sept. 17-19
	1983	June 27-29	July 4-6	July 29-31	Aug. 8-10	Sept. 19-20
	1984	June 15-17	July 6-8	July 23-25	Aug. 10-12	Sept. 16-17

Source: McBride et al. 1983, Buklis and Wilcock 1984, Buklis and Wilcock 1985.

a Starting date is the date of the first commercial opening.

Table 20. Run Timing of Fall Chum Salmon in the Yukon Management Based on Commercial Harvest Data, by Fishing District, 1982-84

District	Year	Date of First Harvest Period	Date First Harvest Reported	Date of Peak Harvest	Date of Last Reported Harvest	Date of Last Harvest Period
1	1982	June 14-15	July 15-17	July 22-23	Aug. 12-13	Aug. 12-13
	1983	June 9-10	July 18-19	Aug. 8-9	Aug. 11-12	Aug. 11-12
	1984	June 18-19	July 16-17	July 16-17	Aug. 16-17	Aug. 16-17
2	1982	June 16-17	July 18-19	Aug. 15-16	Aug. 15-16	Aug. 15-16
	1983	June 12-13	July 20-21	Aug. 14	Aug. 14	Aug. 14
	1984	June 20-21	July 18	Aug. 1	Aug. 19	Aug. 19
3	1982	June 28-29	July 26-28	Aug. 5-7	Aug. 16-18	Aug. 16-18
	1983	June 16-17	Aug. 1-2	Aug. 15-16	Aug. 15-16	Aug. 15-16
	1984	June 28-29	Aug. 2-3	Aug. 2-3	Aug. 13-12	Aug. 13-14
4	1982	June 20-22	Aug. 15-17	Sept. 1-3	Sept. 8-10	Sept. 8-10
	1983	June 16-17	Aug. 14-16	Aug. 28-30	Sept. 14-16	Sept. 14-16
	1984	June 15	Aug. 8-10	Aug. 15-17	Sept. 2-4	Sept. 5-7
5	1982	June 25-27	Sept. 4-5	Sept. 10-12	Sept. 14-15	Aug. 1
	1983	June 24-26	Aug. 30-Sept. 1	Sept. 2-4	Sept. 18-22	Sept. 18-22
	1984	June 24-26	Aug. 30-Sept. 1	Sept. 9-4	Sept. 2-4	Sept. 18-22
6	1982	July 2-4	Sept. 14-15	Sept. 17-19	Sept. 17-19	Sept. 17-19
	1983	June 27-29	Sept. 13-14	Sept. 16-17	Sept. 19-20	Sept. 19-20
	1984	June 15-17	Sept. 14-15	Sept. 14-15	Sept. 16-17	Sept. 16-17

Source: McBride et al. 1983, Buklis and Wilcock 1984, Buklis and Wilcock 1985.

a Starting date is the date of the first commercial opening.

Table 21. Subsistence Harvest of Chum Salmon in the Yukon River Management Area by District and by Year, 1975-84[d]

	Year									
District	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	17,258	31,816	22,596	32,429	35,116	25,213	30,619	39,660	36,507	43,439
2	28,923	29,774	32,319	23,579	39,070	30,917	29,724	38,182	43,809	45,456
3	8,804	3,953	7,666	2,195	5,401	5,653	8,312	8,174	8,389	9,899
Lower Yukon subtotal	54,985	65,543	62,581	58,203	79,584	61,783	68,655	86,016	88,705	98,794
4[ab]	134,652	126,684	95,929	120,849	161,895	252,610	61,954	223,256	174,200	146,984
5[c]	62,993	42,292	59,013	73,703	135,265	85,621	140,858	85,047	131,496	147,435
6	34,249	26,571	41,084	47,036	62,581	65,199	46,480	35,441	62,810	60,952
Upper Yukon subtotal	231,894	195,547	196,026	241,688	359,741	403,430	249,292	343,744	368,506	355,371
Total Alaskan catch	286,879	261,090	258,607	299,791	439,328	465,213	317,947	429,760	457,211	454,165
Canadian catch (includes Porcupine)	18,100	4,200	8,489	6,201	13,000	13,218	7,021	4,779	3,500	6,335
Yukon drainage total	304,979	265,290	267,095	306,001	452,328	478,431	324,968	434,539	460,711	460,500

Source: ADF&G 1984c; YTC 1985; Geiger pers. comm.

a Includes Innoko River harvest.

b Includes Koyukuk River harvest.

c Includes Porcupine (U.S. only) and Chandalar rivers harvests.

d Includes small numbers of coho and pink salmon.

chum salmon has increased sharply as a result of regulation changes, increased fishing effort, increased availability of tendering and processing facilities, higher prices paid to the fisherman, development of Japanese markets, and increased run strength in recent years (ADF&G 1984c).

The commercial fishery for fall chum salmon in the Yukon River is also recent, beginning in the early 1960's, with considerable expansion since 1969 in terms of harvest levels and corresponding increases in fishing effort and availability of processing facilities. Fall chum salmon are in demand because of their good quality, bright silvery appearance, large size, and high oil content (ibid.). Therefore, the fall run of chum salmon is the target species of the commercial fishery for Districts 5 and 6, whereas the summer run is of primary importance to District 4.

The Alaskan harvest of chum salmon in the Yukon River accounts for 99% of the entire drainage harvest. About 47% of the harvest since 1975 was caught in District 1. The combined lower river (Districts 1, 2, and 3) accounted for 77% of the total harvest during the same time period, with the upper river (Districts 4, 5, and 6) accounting for 22% of the total catch (table 18). Chum salmon comprise about 87% of the entire commercial harvest from the Yukon River. The Alaskan harvest since 1975 has ranged from 757,284 salmon in 1976 to almost 1.5 million chum salmon taken in 1981. During this 10-year period, catches have averaged about 939,184 fish annually (table 18).

b. Canadian commercial harvest summary. The commercial harvest of chum salmon in the Canadian portion of the Yukon River drainage has increased steadily since 1975. Catches have ranged from 1,000 salmon in 1976 to 25,990 in 1984 (table 18). Chum salmon comprise about 58% of the total Canadian commercial salmon harvest (tables 17 and 18).

c. Alaskan subsistence harvest summary. Chum salmon comprise about 86% of the total subsistence harvest for all salmon species. Subsistence catches of chum salmon seemed to decline from an average annual harvest of 399,001 fish taken from 1961 through 1965 to an average of 191,009 fish harvested between 1966 through 1973 (ADF&G 1984c). However, during the past 10 years, catches have increased considerably, averaging 366,999 fish annually (table 21). Because chum salmon have characteristically been used for dog food, the decline in subsistence use was attributed to replacement of sled dogs by snow machines. However, the more recent increase is explained by above average size runs, particularly for summer chum salmon, subsistence roe sales, and increasing numbers of recreational sled dog teams (ADF&G 1984c). About 79% of the subsistence harvest is taken in the upper river (Districts 4, 5, and 6). The Alaskan fishery accounts for 76% of the total subsistence harvest of chum salmon in the Yukon River drainage.

d. Canadian subsistence harvest summary. The subsistence fishery in the Canadian portion of the Yukon River drainage occurs primarily in the main stem of the Yukon River from Dawson to Carmacks. The Pelly, Stewart, and Porcupine (Old Crow) river drainages also support subsistence fisheries for chum salmon. The Canadian harvest is difficult to monitor and may be substantially greater than reported (Buklis and Barton 1984). The Canadian chum salmon harvest for subsistence purposes comprises about 60% of the entire Canadian subsistence catch for all salmon species and, based on the recent 10-year average, approximately 1% of the entire chum salmon subsistence harvest for the United States and Canada portions of the Yukon drainage, combined (table 21).

3. Chinook salmon harvest. Chinook salmon are taken in both the commercial and subsistence fisheries in the Yukon River drainage. Combined catches for the harvest in the United States and Canada have ranged from 82,883 chinook salmon taken in 1975 to 219,255 fish harvested in 1980. Catches have averaged 160,806 chinook salmon annually (tables 22, 24).

a. Alaskan commercial harvest summary. In the commercial fishery occurring prior to 1960, only chinook salmon were harvested on a sustained basis (ADF&G 1984c). Between 1918 and 1959, the commercial harvest averaged 30,000 fish annually (ADF&G 1984c). Under new regulations established by the ADF&G in 1961, the annual chinook salmon harvest averaged 104,371 fish from 1961 through 1970, decreasing to 75,989 fish annually from 1970 through 1984. The lowest recorded harvest since 1960 of 63,838 fish occurred in 1975, even though effort had increased substantially (ibid.).

Restrictions placed on the commercial fishing during the 1970's have resulted in improved run strength, thereby increasing commercial harvest levels. Run-timing information is presented in table 23. The record harvest of 158,018 chinook salmon was taken in 1981. Catches between 1975 and 1984 averaged 117,867 salmon annually (table 22). Most of the harvest occurs in a directed gill net fishery in the lower 200 mi of the river (McBride and Wilcock 1983). About 85% of the harvest was taken from the lower river (Districts 1, 2, and 3),

Table 22. Commercial Harvest of Chinook Salmon in the Yukon River Management Area by District and by Year, 1975-84

District	1975	1976	1977	1978	1979	1980	1981	1982[a]	1983	1984
1	44,585	62,410	69,115	59,006	75,007	90,382	99,506	74,450	95,457	74,671
2	11,315	16,556	16,722	32,924	41,498	50,004	45,781	39,132	43,229	36,697
3	4,177	4,148	3,965	2,916	5,018	5,240	4,023	2,609	4,106	3,039
Lower Yukon subtotal	60,077	83,114	90,602	94,846	121,523	145,626	149,310	116,191	142,792	114,407
4	389	409	985	608	1,989	1,521	1,347	1,087	601	961
5	2,872	3,151	4,162	3,079	3,389	4,891	6,374	5,385	3,606	3,669
6	500	1,102	1,008	635	772	1,947	987	981	911	867
Upper Yukon subtotal	3,761	4,662	6,155	4,322	6,150	8,359	8,708	7,453	5,118	5,497
Total Alaska catch	63,838	87,776	96,757	99,168	127,673	153,985	158,018	123,644	147,910	119,904
Canadian catch	3,000	3,500	4,720	2,975	6,175	9,500	8,593	8,640	13,027	9,885
Yukon drainage total	66,838	91,276	101,477	102,143	133,848	163,485	166,611	132,284	160,937	129,789

Source: ADF&G 1984c, YTC 1985.

a Catch figures include number of pink or red salmon (less than 300 fish).

Table 23. Run Timing of Chinook Salmon in the Yukon River Management Area Based on Commercial Harvest Data, by Fishing District, 1982-84

District	Year	Date of First Harvest Period [a]	Date First Harvest Reported	Date of Peak Harvest	Date of Last Reported Harvest	Date of Last Harvest Period
1	1982	June 14-15	June 14-15	June 21-22	Aug. 12-13	Aug. 12-13
	1983	June 9-10	June 9-10	June 9-10	Aug. 11-12	Aug. 11-12
	1984	June 18-19	June 18-19	June 21-22	Aug. 16-17	Aug. 17-18
2	1982	June 16-17	June 16-17	June 23-24	Aug. 15-16	Aug. 15-16
	1983	June 12-13	June 12-13	June 19-20	Aug. 14	Aug. 14
	1984	June 20-21	June 20-21	June 24-25	Aug. 19	Aug. 19
3	1982	June 28-29	June 28-29	June 28-29	June 29-31	Aug. 16-18
	1983	June 16-17	June 16-17	June 20-21	June 14-16	June 14-16
	1984	June 28-29	June 28-29	July 2-3	Aug. 6-7	Aug. 13-14
4	1982	June 20-22	June 23-25	July 11-13	July 25-27	Sept. 8-10
	1983	June 15-17	June 15-17	July 13-15	July 24-26	Sept. 14-16
	1984	June 15	June 24-26	July 1-3	July 22-24	Sept. 5-7
5	1982	June 25-27	June 25-27	July 7-9	Aug. 1	Aug. 1
	1983	June 24-26	June 24-26	July 12-14	July 29-31	Sept. 18-22
	1984	June 29-July 1	June 21-July 1	July 10-July 12	Aug. 5-7	Sept. 9-11
6	1982	July 2-4	July 2-4	July 19-21	Aug. 6-8	Sept. 17-19
	1983	June 27-29	June 27-29	July 18-20	Aug. 5-7	Sept. 19-20
	1984	June 15-16	July 7-8	July 9-11	Aug. 6-8	Sept. 16-17

Source: McBride et al. 1983; Buklis and Wilcock 1984; Buklis and Wilcock 1985; Geiger, pers. comm.

a Starting data is the date of the first commercial opening.

Table 24. Subsistence Harvest of Chinook Salmon in the Yukon River Management Area by District and by Year, 1975-84

District	Year									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	497	1,355	750	5,246	2,879	3,669	2,282	2,311	6,263	4,624
2	1,375	2,866	1,668	3,964	4,268	3,674	3,580	2,109	9,065	7,172
3	4,890	2,820	2,559	3,902	3,263	4,783	4,001	3,359	4,910	4,355
Lower Yukon subtotal	6,762	7,041	4,977	13,112	10,410	12,126	9,813	7,779	20,238	16,151
4	3,949	4,475	4,900	5,549	7,265	11,088	4,442	5,077	9,754	7,650
5	1,377	5,069	6,129	10,405	11,997	17,684	13,300	12,859	16,780	14,989
6	778	1,221	1,571	1,231	1,333	1,826	2,085	2,443	2,706	3,599
Upper Yukon subtotal	6,104	10,765	12,604	17,185	20,595	30,598	19,827	20,379	29,240	26,238
Total Alaskan catch	12,866	17,806	17,581	30,297	31,005	47,724	29,690	28,158	49,478	42,389
Canadian catch	3,000	1,525	2,807	2,906	4,200	13,046	9,216	8,268	5,625	6,610
Yukon drainage total	15,866	19,331	20,388	33,203	35,205	55,770	38,906	36,426	55,103	48,999

Source: ADF&G 1984c; YTC 1985; Geiger, pers comm.

--- means no data were available.

a Includes Porcupine River.

with 60% accounted for specifically by District 1. Since 1975, the chinook salmon catches comprised 11% of the entire commercial harvest. River morphology and regulations dictate exclusive use of set and drift gill nets in the lower Yukon Area (ibid.). Chinook salmon are of less importance to the commercial fisheries in the three upper river districts. The most intensive chinook salmon commercial fishery in the upper river had developed in the lower portion of District 5.

b. Canadian commercial harvest summary. Historical information regarding the Canadian commercial harvest of chinook salmon is limited. Catches, however, since 1975 have shown a substantial increase from 2,975 fish harvested during the 1978 season to a record harvest of 13,027 chinook salmon taken during the 1983 season. The 1984 harvest was slightly less at 9,885 fish (table 22). During the past 10 years, the fishery has averaged 7,000 fish per year and accounted for 4% of the Canadian commercial harvest of all species. This fishery contributed 6% of the Yukon drainage chinook salmon commercial harvest through the same period.

c. Alaskan subsistence harvest summary. Early subsistence catches of salmon in Alaska were primarily chum salmon. Whereas chum salmon have primarily been utilized as dog food, chinook salmon have mostly been harvested for human consumption (YTC 1985). Catches in the subsistence fishery have increased, particularly in the past five years, as a result of increased run strengths. Reported catches since 1975 have ranged from 12,866 fish harvested in 1975 to 49,478 fish harvested in 1983. About 42,389 chinook salmon were taken during the 1984 fishery (table 24). During the same period, about 64% of the chinook salmon harvest was taken in the upper Yukon districts. District 5 alone accounted for 36% of this total catch. The subsistence harvest of chinook salmon accounts for 7% of the total subsistence harvest (all species) from the entire Yukon River drainage.

d. Canadian subsistence harvest summary. Chinook salmon have been harvested in both the Indian food and domestic subsistence fisheries in the Canadian Yukon area. Little information is available regarding catch and effort levels in the domestic fishery before 1961. Chinook salmon catches in recent years have shown a steady increase, which resulted in a licensing requirement beginning in 1982.

Little information is also available regarding the early chinook salmon harvest in the Indian food fishery. However, catches have recently increased over levels experienced during the mid 1960's (ibid.). The largest chinook catches are taken in the main stem Yukon River near Carmacks and in the Pelly, Stewart, and Teslin rivers (ibid.).

The combined chinook salmon subsistence harvest taken in Canada has ranged from 1,525 fish harvested in 1976 to 13,046 salmon harvested during the 1980 season and has averaged 5,720 fish annually (table 24).

4. Coho salmon harvest. Coho salmon are harvested primarily in the commercial and subsistence fisheries in the Alaskan portion of the Yukon River drainage. The total coho salmon harvest is only 3% of the entire salmon harvest of all species. Combined catches for all coho salmon fisheries (for years when harvest was reported for both subsistence and commercial fisheries) have ranged from 26,959 coho salmon in 1979 to 131,376 coho salmon in 1984. Catches from 1977 through 1984 averaged 54,380 fish annually (tables 25 and 27).

    a. Alaskan commercial harvest summary. Coho salmon returns to the Yukon River are of lesser magnitude than fall chum salmon runs and are taken incidentally to the commercial fishery for fall chum salmon (ADF&G 1984c). Coho salmon run-timing information in the commercial fishery is presented in table 26. Commercial catches since 1975 have shown a substantial increase in magnitude. Harvest levels have ranged from 2,546 coho salmon harvested in 1975 to 81,940 coho salmon taken in 1984 (table 25). Catches averaged 25,477 fish annually during the same period. Coho salmon comprise about 2% of the total Alaskan commercial harvest. About 52% of the coho salmon catch during this time period was taken from District 1. The lower river districts (1, 2, and 3) combined accounted for 86% of the commercial catch, with the upper Yukon area comprising 14% of the harvest.

    b. Canadian commercial harvest summary. There is no documented harvest of coho salmon in the Canadian section of the Yukon River drainage.

    c. Alaskan subsistence harvest summary. Reported catches for the subsistence harvest of coho salmon have been available since only 1977. Most of the catch has been reported in the upper river districts. Catches have ranged from 7,787 fish taken in 1978 to 48,936 coho salmon harvested in 1984 and have averaged 23,500 salmon annually (table 27).

    d. Canadian subsistence harvest summary. The reported harvest of subsistence-caught coho salmon in the Canadian portion of the Yukon River has been minimal. Records show catches of 1,500, 500, and 500 fish, respectively, documented for 1980, 1981, and 1984 (table 27).

5. Other salmon species harvest. Sockeye salmon are uncommon in the Yukon River, with catches of only a few fish reported

Table 25. Commercial Harvest of Coho Salmon in the Yukon River Management Area by District and by Year, 1975-84

District	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
					Year					
1	2,288	4,046	31,720	16,460	11,369	4,829	13,129	15,115	4,595	29,472
2	200	17	5,319	5,835	2,850	2,660	7,844	14,179	2,552	43,064
3	0	0	538	758	0	0	419	87	0	621
Lower Yukon subtotal	2,488	4,081	37,577	23,053	14,219	7,489	21,396	29,381	7,152	73,157
4	0	0	0	32	155	30	0	15	0	1,095
5	5	0	2	1	0	0	0	0	0	0
6	53	1,103	1,284	3,066	2,791	1,226	2,284	7,780	6,168	7,688
Upper Yukon subtotal	58	1,103	1,286	3,099	2,946	1,256	2,284	7,795	6,168	8,783
Total Alaska catch	2,546	5,184	38,863	26,152	17,165	8,745	23,680	37,176	13,320	81,940
Canadian catch	0	0	0	0	0	0	0	0	0	0
Yukon drainage total	2,546	5,184	38,863	26,152	17,165	8,745	23,680	37,176	13,320	81,940

Source: ADF&G 1984c, YTC 1985.

Table 26. Run Timing of Coho Salmon in the Yukon Management Area Based on Commercial Harvest Data, by Fishing District, 1982-84

District	Year	Date of First Harvest Period a	Date First Harvest Reported	Date of Peak Harvest	Date of Last Reported Harvest	Date of Last Harvest Period
1	1982	June 14-15	July 12-13	Aug. 12-13	Aug. 12-13	Aug. 12-13
	1983	June 9-10	July 20-21	Aug. 11-12	Aug. 11-12	Aug. 11-12
	1984	June 18-19	July 16-17	Aug. 13-14	Aug. 16-17	Aug. 17-18
2	1982	June 16-17	July 25-26	Aug. 15-16	Aug. 15-16	Aug. 15-16
	1983	June 12-13	June 13-14	Aug. 14	Aug. 14	Aug. 14
	1984	June 20-21	Aug. 1	Aug. 19	Aug. 19	Aug. 19
3	1982	June 28-29	Aug. 17-18	Aug. 17-18	Aug. 17-18	Aug. 17-18
	1983	0	0	0	0	0
	1984	June 28-29	Aug. 6-7	Aug. 13-14	Aug. 13-14	Aug. 13-14
4	1982	June 20-22	Aug. 18-20	Aug. 26-28	Aug. 26-28	Sept. 8-10
	1983	0	0	0	0	0
	1984	June 15	Aug. 15-17	Aug. 29-31	Sept. 2-4	Sept. 5-7
5	1982	0	0	0	0	0
	1983	0	0	0	0	0
	1984	0	0	0	0	0
6	1982	July 2-4	Sept. 14-15	Sept. 17-19	Sept. 17-19	Sept. 17-19
	1983	June 27-29	Sept. 13-14	Sept. 13-14	Sept. 13-14	Sept. 19-20
	1984	June 15-17	Sept. 14-15	Sept. 16-17	Sept. 16-17	Sept. 16-17

Source: McBride et al. 1983, Buklis and Wilcock 1984, Buklis and Wilcock 1985.

a Starting date is the date of the first commercial opening.

Table 27. Subsistence Harvest of Coho Salmon in the Yukon River Management Area by District and by Year, 1975-84

District	Year									
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	---	---	2,452	1,142	3,184	1,808	3,769	11,192	3,590	6,095
2	---	---	4,336	598	1,132	4,801	3,736	10,229	6,072	7,066
3	---	---	363	223	12	91	510	675	917	656
Lower Yukon subtotal	---	---	7,151	1,963	4,328	6,700	8,015	22,096	10,579	13,817
4[ab]	---	---	4,354	145	295	7,734	2,239	2,952	3,946	2,867
5[c]	---	---	798	970	595	561	1,713	3,428	2,448	17,467
6	---	---	4,030	4,709	4,612	5,163	9,263	7,418	6,922	14,785
Upper Yukon subtotal	---	---	9,182	5,824	5,466	13,458	13,213	13,798	13,316	35,119
Total Alaskan catch			16,333	7,787	9,732	20,158	21,228	35,894	23,895	48,936
Canadian catch	---	---	---	---	---	1,500	500	---	---	500
Yukon drainage total	---	---	16,333	7,787	9,794	21,658	21,728	35,894	23,895	49,436

Source: ADF&G 1980, 1981, 1982b, 1983, 1984c; Geiger, pers. comm.

--- means no data were available.

a Includes Innoko River harvest.

b Includes Koyukuk River harvest.

c Includes Porcupine and Chandalar rivers harvests.

each year. Sockeye salmon have been reported taken in the main Yukon River upstream to Rampart (ibid.).

Pink salmon spawn in the lower portion of the Yukon River drainage, below the village of Grayling. Reported catches in the commercial and subsistence fisheries are small. Pink salmon have been caught in the main stem Yukon River upstream as far as Ruby (ibid.).

C. Harvest Methods

Both drift and set gill net are legal gear for the commercial harvest of salmon in Districts 1, 2, and 3 (lower river), except that after July 19, only set gill nets may be used at specified locations in District 1.

In Districts 4, 5, and 6 (upper river), only set gill nets and fish wheels may be used for the commercial harvest of salmon.

Subsistence harvest of salmon in Alaska may be taken by set or drift gill net, beach seine, or fish wheels (ADF&G 1985b).

Most fishermen operate small (16-20 ft) outboard powered skiffs. Net rollers and powered reels of any type are rarely used (YTC 1985).

In Canada, both set and drift gill nets and fish wheels are legal gear for commercial fishing (ibid.).

D. Period of Use

1. Commercial seasons. Commercial fishing seasons are specific to each district and, frequently, to subdistricts, as described below:

   a. Districts 1, 2, and 3. In these districts, the early season will open by emergency order between June 5 and June 15 and will close by emergency order between July 19 and July 25. The late season will open by emergency order between July 26 and August 1 and will close by emergency order August 31.

   b. Districts 4, 5, and 6. In these districts, the season is from June 15 through September 30. The early season is closed by emergency order, and subsequent seasons are opened and closed by emergency order.

      Subdistrict 4-A closes August 1.

      The commercial salmon fishing season is closed in Subdistrict 6-C during closures of the subsistence salmon fishing season in Subdistrict 6-F.

      Subdistrict 4-A, downstream from the mouth of Stink Creek, is open for commercial salmon fishing from June 15 through August 1.

      Subdistrict 4-A, upstream from the mouth of Stink Creek, is open from June 24 through August 1 (ADF&G 1985b).

2. Subsistence seasons. With the exceptions described below, salmon may be taken only during the open weekly fishing periods of the commercial salmon fishing season and may not be taken for 24 hours before the opening and 24 hours after the closure of the commercial salmon fishing season.

a. Districts 1, 2, and 3. The above regulations apply to these districts except that in Districts 1 and 2 through July 19 subsistence fishing periods will be established by emergency order every other weekend during commercial salmon fishing closures.

In District 1, except for the set-net-only locations described in 5 AAC 05.330(a)(1)--(8) and in District 2 after July 19, a 24-hour subsistence fishing period will be established by emergency order each weekend during the open commercial salmon fishing season.

b. District 4, excluding the Koyukuk and Innoko river drainages. The above regulations apply to this district, except that in Subdistrict 4-A from June 15 through August 1 salmon may be taken from 6:00 p.m. Sunday until 6:00 p.m. Tuesday and from 6:00 p.m. Wednesday until 6:00 p.m. Friday.

In Subdistricts 4-B and 4-C from June 15 through September 30 salmon may be taken from 6:00 p.m. Sunday until 6:00 p.m. Tuesday and from 6:00 p.m. Wednesday until 6:00 p.m. Friday.

c. District 5, excluding the Tozitna River drainage and excluding Subdistrict 5-B. The above regulations apply to this district.

d. District 6, excluding the Kantishna River drainage and that portion of the Tanana River drainage upstream of the mouth of the Salcha River. The above regulations apply to this district, except that in Subdistrict 6-B, from the downstream end of Crescent Island to 3 mi upstream of the mouth of the Totchaket Slough, salmon may be taken from 6:00 p.m. Friday until 6:00 p.m. Wednesday.

During any commercial salmon fishing season closure greater than five days in duration, salmon may not be taken during the following periods in the following districts:

- In District 4, excluding the Koyukuk and Innoko River drainages, salmon may not be taken from 6:00 p.m. Friday until 6:00 p.m. Sunday.
- In District 5, excluding the Tozitna River drainage and Subdistrict 5-B, salmon may not be taken from 6:00 p.m. Sunday until 6:00 p.m. Tuesday.
- In Subdistricts 6-A and 6-B, excluding the Kantishna River drainage and that portion of the Tanana River drainage upstream of the mouth of the Salcha River, salmon may not be taken from 6:00 p.m. Wednesday until 6:00 p.m. Friday.
- In Subdistrict 6-C and that portion of the Tanana River drainage upstream to the mouth of the Salcha River, salmon may not be taken following the closure of the commercial salmon fishing season from 6:00 p.m. Monday until 6:00 p.m. Friday.

Except as provided in 5 AAC 01.225 and except as may be provided by the terms of a subsistence fishing permit, there is no closed season on fish other than salmon (ADF&G 1985b).

E. Management Objectives

The following management objectives summary is taken verbatim from YTC (1985) and has only been reformatted for presentation in this narrative.

1. Alaska. The ADF&G, Division of Commercial Fisheries, is the harvest management authority responsible for regulating the Yukon River subsistence and commercial salmon fisheries in Alaska. The overall objective of the Yukon Area research and management program is to manage the various salmon runs for optimum sustained yield. The commercial fishery is regulated on the assumption that a harvestable salmon surplus is available after providing for spawning and subsistence utilization requirements.

   The various fisheries in Alaska are scattered over 1,400 river miles. As a result, allocation issues exist between various user groups. In order to satisfy both user group harvest allocations and conservation requirements, the commercial fishing area is divided into six districts and 10 subdistricts. Regulations may vary between districts and subdistricts. To illustrate the complexity of the regulations, there are 11 different weekly fishing schedules and 11 guideline harvest ranges in effect throughout the area.

   As a result of the difficulty in obtaining the necessary biological information, the mixed-stock and mixed-species fisheries, the increased effort and efficiency of the commercial fishery, the allocation issues, and the need to provide for subsistence, management of the Yukon River salmon runs must take a conservative approach.

   Commercial fishing time has been greatly restricted by regulation during the past 20-25 years for the purposes of conservation. The hours available for fishing in the lower Yukon (Districts 1 and 2 combined) during the June-early July chinook salmon fishery have decreased from an average of 711 hours during 1961-1970 to an average of only 210 hours during 1981-1984. Fishing time in the lower Yukon fall chum fishery during the last two years has been reduced by an even greater rate.

   Other regulations and strategies necessary for conservation have also been implemented, such as delayed season openings (to afford additional protection for early run stocks that are subject to intensive fishing effort), split fishing periods (to spread out the harvest over a greater portion of the run and to afford additional protection to smaller stocks), and mesh size restrictions (to allow optimal harvests of mixed species).

   Other restrictions imposed in recent years include conservative guideline harvest ranges or quotas and in-season fishing time reductions and season closures. Approximately 20 emergency orders are issued annually for in-seasons regulatory changes. In-season management relies heavily on the analysis of the comparative commercial and test fish catch data.

2. Canada. Management of anadromous Pacific salmon stocks in Canada is a federal responsibility of the Department of Fisheries and Oceans (DFO). Next to conservation concerns, the Indian Food Fishery receives the highest management priority by DFO. This fishery has relatively few restrictions, with little regulation of fishing time, effort, and location. Although "status" Indians and elders are eligible for "Indian food fish permits," the annual issuance of these permits has been inconsistent and slow to evolve. Permit distribution is not widespread. Therefore, one must be extremely cautious in associating total effort levels with numbers of permits issued. Catch statistics have been collected utilizing a variety of methods, including catch calendars, interviews, and counts of fish drying racks. In 1984, a comprehensive monitoring program was conducted in conjunction with several Indian bands. Seasonal staff members were hired in most of the major fishing villages to collect catch information on a regular basis.

   Management of the commercial fishery has been relatively low-key, with effort limitation constituting the major management tool. The maximum number of commercial licenses issued annually has been restricted to 45 since 1982 because of concerns regarding overexploitation. Prior to that time, significant growth had occurred and interest had escalated primarily because of the development of processing and marketing facilities in the early 1980's. A "Yukon River salmon license" is issued to Canadian citizens or landed immigrants, providing they possess a "personal commercial fishing license" and have previously fished in one of the previous three years. Each license is restricted to a maximum of four nets, the aggregate length of which cannot exceed 90 m. In most years, the commercial fishery has operated six days per week, although in recent years reduction in fishing time has been implemented in response to poor fish abundance. Now, fishing time in the Dawson area (the most concentrated fishing area) is open five days per week. Weekly fishery opening are monitored closely by a fishery officer and/or patrolman, who reside in the area during the fishing season.

   Management practices for the domestic fishery have been similar to those employed with the commercial fishery. License limitation was initiated in 1982, with the maximum number of licenses available set at 26. Eligibility requirements include possession of a "Yukon River salmon license" and a "domestic fishing license" as well as participation in the fishery in one of the previous three years. Domestic fishermen are currently restricted to one net, which cannot exceed 90 m in length (down from the 550 m permitted prior to 1950). Fishing areas are restricted by the same boundaries in force for the commercial fishery. Catch information is collected through interview by a fishery officer and/or patrolman and through the voluntary return of monthly catch diaries.

F. Management Considerations

The following management considerations summary is taken from YTC (1985) and has only been reformatted and stylistically modified for presentation in this narrative.

1. Habitat issues:

   a. Placer mining. Placer mining occurs in stream beds and banks throughout the Yukon River drainage in Alaska, Yukon Territory, and British Columbia. Recent expansion in the industry has resulted in water quality problems and degradation of salmon habitat in a number of Yukon River tributaries. In Alaska, this includes the Koyukuk and Tanana rivers. In Canadian portions of the drainage, placer mining occurs on tributaries to the main stem Yukon, Stewart, White, Pelly, Teslin, and Big Salmon rivers. Major concentrations of placer activities in Canada occur in the Dawson and Mayo areas. There are currently over 800 placer-mining operations in the Yukon River watershed.

      Placer mining impacts fisheries by discharging sediment and heavy metals into streams and by altering stream banks with heavy equipment. In the normal operation of removing placer deposits through excavation by heavy equipment, the natural conditions of the stream are altered by the stripping of vegetation and overburden adjacent to the stream, creation of stream diversions, and altering braided and meandering stream channels. High levels of suspended and settleable solids and heavy metals in the water may be carried many miles downstream from the actual placer operation. In addition, runoff from tailings piles and settling ponds may continue to discharge sediment into the stream long after mining has ceased.

      The effects of placer mining can be long-lasting, blocking fish migration and destroying or degrading spawning and rearing habitat. Extensive scientific literature and several ongoing studies in the Yukon River drainage indicate that suspended and settleable solids from placer mining can cause direct mortality to juvenile fish and eggs through suffocation, avoidance by fish of affected habitats, and loss of aquatic productivity because of less light penetration of turbid waters.

Highly turbid water (high levels of suspended sediment) discharged by placer mining has hindered the ADF&G's ability to assess some salmon escapements. Since 1982, the ADF&G has cancelled 14 aerial surveys on the Chena, Chatanika, Hogatza, and Bearpaw drainages because of the turbid water resulting from placer mining (YTC 1985).

b. Hydroelectric projects. Hydroelectric projects in the Yukon River drainage are currently nonexistent in Alaska and occur on a very small scale in Canada. However, future power demands in the area are difficult to project. A 1983 inventory of the potential hydroelectric development in the Yukon River drainage in Yukon Territory identified about 100 potential projects. Fisheries impacts from hydroelectric projects can include loss of riverine or lake habitat through flooding or the creation of a reservoir, blockage of fish migration, and flow alterations or changes in channel morphology. As a result, entire fish populations can be altered or eliminated.

Although there are no hydroelectric projects in the Alaska portion of the drainage, there is a flood control dam on the Chena River near Fairbanks that does not affect salmon migration.

An existing hydroelectric dam in Canada on the lower Mayo River prohibits chinook salmon access to upstream spawning grounds. A hydroelectric dam constructed on the main Yukon River at Whitehorse in 1957 provides adult salmon passage to upstream spawning areas by way of a fishway. However, studies by Canadian fisheries personnel have shown that substantial numbers of chinook salmon smolts are killed or injured as they pass downstream through the dam turbines.

Several sites in Canada are being considered for hydroelectric dams. In the Yukon River main stem, a major hydroelectric dam may be developed in the Five Finger Rapids Area. The development, if built, would block chinook salmon access to about half of the known spawning areas in the drainage. In the Pelly River subbasin, facilities may be developed at Granite Canyon, Ross Canyon, and Hoole Canyon. Chinook salmon runs would be blocked by all three dams, and fall chum salmon runs would be blocked by the Granite Canyon dam. While these projects are considered medium-to-large-scale, it is generally believed that small-scale hydro projects located on a number of tributaries would not create migration barriers for as many salmon stocks (ibid.).

c. Habitat protection. In Alaska, water quality is regulated by the Department of Environmental Conservation (DEC), and salmon habitat alteration is regulated by the Division of Habitat of the ADF&G. The DEC has created water quality standards that establish levels of discharge of pollutants designed to protect various uses on the streams. In general, enforcement efforts have not adequately curtailed water pollution problems caused by placer mining.

The Division of Habitat of the ADF&G has authority to regulate human activities that impair spawning, rearing, and migration of anadromous fish by diverting, obstructing, polluting, and changing the natural flow of water in a stream. The regulations require specific identification of anadromous waters as listed in the Catalog of Waters Important to the Spawning, Rearing or Migration of Anadromous Fish; therefore many unsurveyed streams that may contain anadromous fish are not protected. No reclamation of mined areas is currently required of the placer mining industry in Alaska.

In Canada, a new set of placer-mining guidelines has been drafted jointly by the Federal Department of Indian Affairs and Northern Development, DFO, and Environment Canada. The guidelines classify streams into five categories as evaluated by habitat quality, biological sensitivity, fisheries resource values, and past mining activities. The distinction between categories is based primarily on fish spawning behavior and the requirements for spawning and egg incubation. Water pollution effluent standards and placer-mining technology requirements are in the process of being established for each level of sensitivity. Requirements for development plans, stream diversions, and reclamation requirements are also being considered.

Alaska statutes provide for the creation of fish and game critical habitat areas, which are managed for maintenance of habitat elements crucial to the species in question. Uses of adjacent uplands and waters can be controlled to prevent or minimize habitat alteration. the ADF&G has nominated an area within the Toklat River (Tanana River system) that contains an important spawning population of fall chum salmon. Most Yukon River fall chum salmon spawn in only five or six known areas having the highest quality water and spawning gravel. Other important fall chum salmon spawning habitats should be identified for special recognition and control.

2. Marine harvest of Yukon River salmon. This section discusses the interception of Yukon River salmon in marine fisheries outside of the Yukon River fishery. Although exact numbers are unknown, Yukon River salmon are harvested in the following fisheries: Japanese mothership and land-based high seas salmon gill net fisheries. The Japanese mothership fishery operates

primarily in the Bering Sea, both within and outside the U. S. Fisheries Conservation Zone. The Japanese land-based fishery operates in the North Pacific Ocean south of the mothership fleet area of operation.

The combined harvest of all salmon species by these two fleets historically was in the 40-60 million catch range prior to renegotiation of the International North Pacific Fisheries convention and harvest limit reductions in the Japan/USSR salmon agreement. The recent renegotiation of the International North Pacific Fisheries convention between Canada, Japan, and the United States in 1978 resulted in time and area restrictions. The Japanese mothership fishery had to pull back 10 degrees of longitude to the west and incurred additional time and area restrictions. The land-based fishery likewise pulled back 10 degrees to the west (to 175° E).

These restrictions have resulted in a substantial reduction in interceptions of North American salmon, especially sockeye salmon of Bristol Bay origin. Interceptions of chinook, coho, and chum salmon were also reduced. These two gill net fisheries now catch 20-25 million salmon annually, the majority of which are of Asian origin (mostly USSR). The Japanese pay a fee to the Soviet Union to fish Asian salmon on the high seas, but the Soviets do not allow them to fish within their fisheries conservation zone.

Although the renegotiation did reduce interceptions of some North American salmon stocks, it was understood that Western Alaska chinook salmon continued to be very vulnerable to harvest in the mothership fishery. After discussions with fishermen from Western Alaska, the Japanese undertook voluntary measures to limit their chinook harvest in the mothership fleet to 110,000 fish per year from 1981 through 1983 and 100,000 fish per year from 1984 through 1986. This was done to prevent peak catches of the size that occurred in 1980, when 704,000 chinook were taken, of which over half were of Western Alaskan and Canadian Yukon origin. There were problems with ensuring that the agreement was being enforced, particularly in regards to discard of chinook from catcher boats fishing outside of the U. S. Fisheries Conservation Zone. Discarded fish would still be lost to inshore harvest but would not count against the Japanese quota. "Dropouts" from high seas gill nets (estimated to be 30% of the reported catch in one study) constitute another factor that may result in catches substantially larger than reported. Also, these fish are being taken as immatures weighing an average of about 6 lb, compared to an inshore average weight as adults of 20 lb or more.

Information from a study recently contracted by the ADF&G to the Fisheries Research Institute (FRI), University of Washington, showed that substantial numbers of chinook salmon in both the land-based and mothership fleets were of Alaska origin and, surprisingly, that a large proportion were from central Alaska, as well as from Western Alaska (including the Canadian Yukon). The origin of chinook salmon in the land-based fishery was largely unknown prior to the study. This new information indicates that an average of 188,000 and 149,000 Western Alaska chinook (including the Canadian Yukon) have been annually harvested during 1964-1977 and 1978-1983, respectively. Since 1981 (excluding 1984, when this study was terminated), the estimated annual harvest of Western Alaska chinook has been between 75,000 and 86,000 fish.

The study did not attempt to estimate the numbers of chinook salmon intercepted from each major stock (Yukon, Kuskokwim, Bristol Bay), but it did indicate that Yukon River chinook salmon were the "overwhelmingly predominant Western Alaska stock" in the Bering Sea catches.

The United States and Canada have consistently maintained that directed high seas salmon fisheries should be eliminated for a variety of reasons: stocks are fully utilized in coastal areas; stocks are broadly mixed on the high seas, making management for conservation difficult; and significant wastage occurs in high seas salmon fisheries because of the harvest of immature fish and the dropout from high seas gill nets (YTC 1985).

b. <u>Foreign, joint-venture and United States groundfish trawl fisheries</u>. Foreign and joint-venture fisheries operating in the Bering Sea-Aleutians area captured 23,000 to 122,000 salmon annually during 1977-1984. These fisheries operating in the Gulf of Alaska captured 7,000 to 36,000 salmon annually during 1977-1984. These data are based on reports from United States observers placed upon foreign trawlers and processing ships. The joint ventures represent United States trawlers selling catches at sea to foreign processors. For all foreign and joint-venture trawl fisheries, United States federal regulations designate salmon a prohibited species, and any salmon caught must be returned to sea. The majority of salmon taken have been chinook salmon, but the percentage of chum salmon has increased in recent years' catches. Some United States trawlers deliver their catches to United States processors, but there is little information on the numbers or species composition of these catches. Studies by the FRI on stock origins of chinook salmon taken in the foreign groundfish fishery indicate that Western Alaska stock (including the Canadian Yukon) was taken predominantly (ibid.).

c. Other fisheries. Stock identification studies have indicated the presence of Yukon River salmon in at least two nearshore salmon net fisheries operating in Alaska waters. These are the Unimak-Shumagin islands purse seine and gill net fishery in June and set gill net fisheries in southern Norton Sound.

The June Unimak-Shumagin islands fishery harvests sockeye salmon primarily of Bristol Bay origin and also incidentally takes chum salmon bound for several terminal fisheries, including those in Western Alaska. The numbers of chum salmon taken in the fishery are partially dependent on management of the more abundant sockeye salmon runs. Recent stock identification studies have shown that the contribution of Western Alaska (including the Canadian Yukon) chum salmon in the Unimak-Shumagin islands fishery during 1983 ranged from 39 to 99% in the various time/area strata. Both Yukon River summer and fall chum salmon are taken, but the exact numbers harvested annually are not known. Annual chum salmon catches in this fishery averaged 277,000 during 1970-1979. Catches began increasing sharply after 1979, with record catches of 1,015,000 in 1982 and 756,000 in 1983. The catch in 1984 was 338,000. Coincidentally with poorer-than-anticipated chum salmon returns to some western Alaska fisheries in 1982, several proposals to reduce the chum salmon harvest in this fishery were made to the Alaska Board of Fisheries. These proposals were rejected, in part because of the lack of accurate stock composition information.

Previous tag and recovery studies indicate that some Yukon River chinook and chum salmon are intercepted in commercial salmon fisheries operating in southern Norton Sound, located about 150 mi northwest of the Yukon River mouth. Exact numbers taken are unknown but are probably small because the commercial harvests where known interceptions occurred averaged only 5,500 chinook and 95,000 chum salmon during the last five years.

There is no information to indicate that Yukon River salmon occur in waters open to trolling. Trolling is prohibited in the Northern Gulf of Alaska and the Bering Sea (ibid.).

3. River management and mixed stocks and species. Generally, fisheries that harvest mixed stocks and/or species complicate fisheries management and usually result in a reduced ability to optimize the yield of all components of the fishery. The cause for conservation

concern generally increases in relation to the degree of mixture in the fishery. The Yukon River fisheries harvest mixed stocks usually several weeks and hundreds of miles from their spawning grounds. Salmon entering the mouth may be exposed to harvest for up to 50 days in the main stem Yukon River. As a result, some tributary populations may be under- or overharvested in relation to their actual abundance. It is currently not possible to manage most stocks in the lower river fisheries separately, and there is concern that small spawning populations may be reduced to very low levels.

Management of chinook and summer chum salmon runs is complicated because both species exhibit similar run timing. The harvest of the more abundant summer chum salmon in the lower river is greatly dependent on the regulations and management strategies employed toward the more intensively managed chinook salmon fishery. During the early portion of the season, fishermen may use unrestricted mesh size gill nets; however, the majority of the gear operated consists of large-mesh gill nets (8½ in), which are selective for chinook salmon. Later in the season the use of only 6-inch or smaller mesh gill nets, as announced by emergency order, redirects the fishery towards the summer chum salmon run while providing increased protection of large chinook salmon, especially fecund females.

Management of the lower Yukon fall chum salmon fishery is also complicated by the concurrent run timing of coho salmon. In most years, the commercial fishery is closed by mid August for conservation of fall chum salmon, which precludes optimizing the harvest of coho salmon.

4. Fall chum salmon depressed stocks. In recent years (since 1980), commercial and subsistence fall chum salmon catches have increased sharply while escapements have substantially declined. Because of increased effort and efficiency of the fishery and problems in accurately assessing run strength in-season, there is a likelihood for overharvest. A conservative management strategy is required to allow for greater escapements and to reduce the risk of overharvesting anticipated weaker returns. Commercial harvests should at least be held to the lower half of the guideline harvest range unless a large return is apparent and a harvestable surplus of fish is known to exist. In anticipation of a very weak return of fall chum salmon from poor escapements of the 1982 brood year, more stringent harvest restrictions will be required in 1986 (YTC 1985).

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Commercial Harvest of King Crab
Arctic and Western Regions

I. POPULATION MANAGEMENT HISTORY

A. Introduction

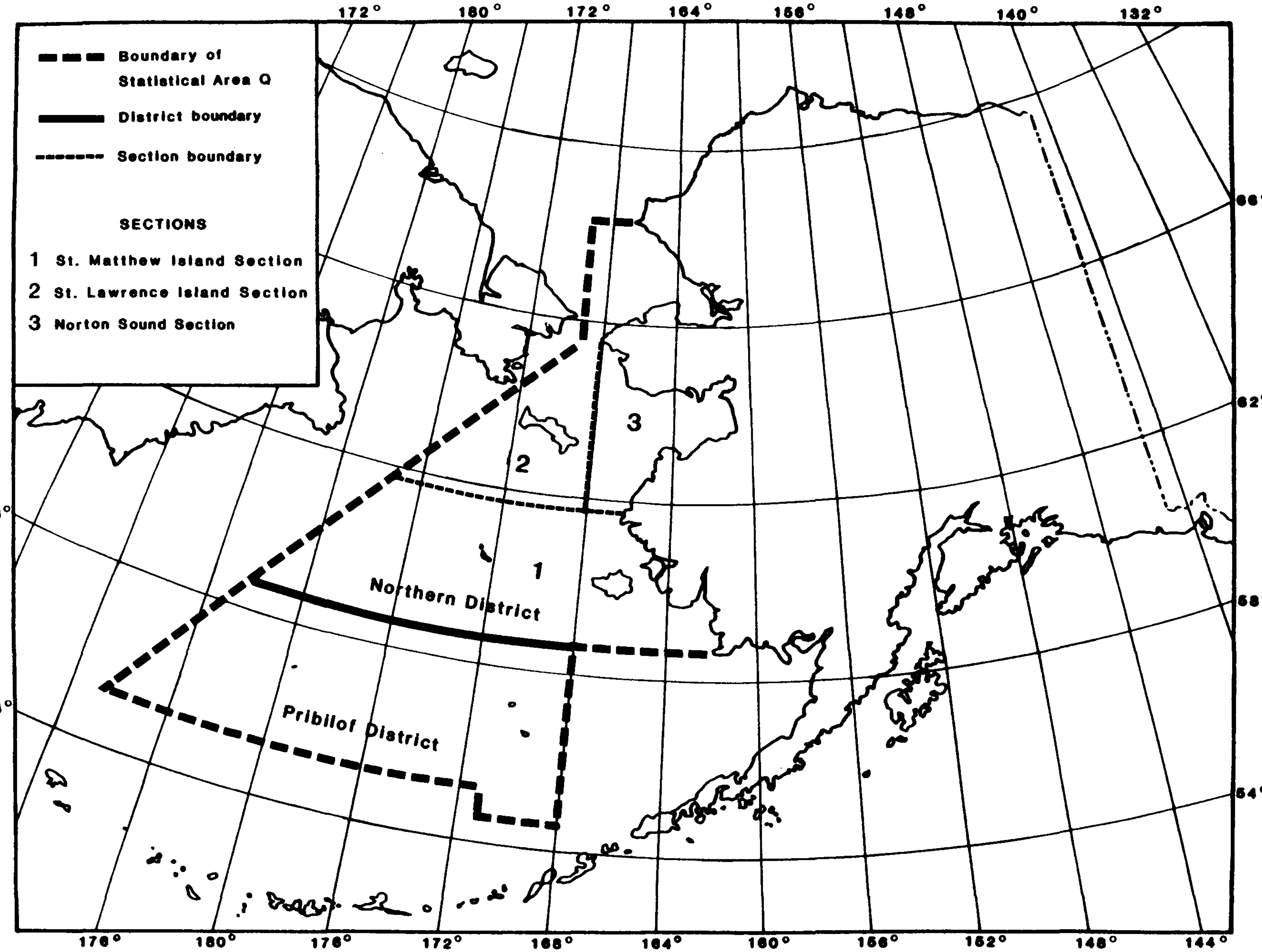
The Bering Sea Statistical Area (Statistical Area Q) for king crab includes waters of the Bering and Chukchi seas north of Cape Sarichef (54°36'N) and east of the United States-Russian convention line of 1867 (see map 1). Its northern boundary is the latitude of Point Hope (68°21'N). The area is separated into two fishing districts: the Pribilof and Northern districts. The Northern District contains the waters of Statistical Area Q north of the latitude of Cape Newenham (38°39'N) and is divided into the St. Matthew Island, St. Lawrence Island, and Norton Sound sections (ADF&G 1984a). The Norton Sound and St. Lawrence Island sections are located within the Arctic Region. The St. Matthew Island Section occurs in the Western Region. In this narrative, information will be presented for the Norton Sound Section and combined for the St. Matthew and St. Lawrence islands sections.

B. Summary of Fishery

1. Harvest summary. Currently, three species of king crabs are of commercial interest. Red king crab (*Paralithodes camtshatica*) has been the more abundant and most widely distributed species in the Bristol Bay Registration area. Blue king crab has been the most abundant and widely distributed species in the Pribilof and Northern districts (Griffin, pers. comm.). Red king crab has been targeted by the commercial fishery. With declines in red king crab populations, interest and harvest effort for blue king crab (*P. platypus*) and brown king crab (*Lithodes aequispina*) have intensified.

The commercial harvest of king crab in the eastern Bering Sea was initiated by the Japanese in 1930. During the first year, approximately one million red king crabs were caught with tangle nets in the area north of the Alaska Peninsula by a fleet of 12 small catcher boats (Bakkala et al. 1976). Fishing did not occur in 1931, but each year from 1932 through 1939 one or two Japanese factory ships operated in the area. During this eight-year period, some 7.6 million crabs were taken from the Bering Sea (Miyahara 1954). The Japanese discontinued fishing after the 1939 season.

The United States conducted exploratory fishing and processing studies on the king crab resource in 1940 and 1941. Ignorance of Japanese canning techniques, an import-dominated market, and a healthy salmon fishery that left little incentive for winter fishing (Gray et al. 1965) were



Map 1. King crab fishing districts and sections of Statistical Area Q (ADF&G 1984).

factors partly responsible for the late entry of American fishermen and processors into the king crab fishery.

In March of 1948, the factory ship Pacific Explorer left Seattle with a fleet of 10 fishing vessels to fish for both groundfish and king crab; king crab was the target species. This fleet used otter trawls and tangle nets to catch a total of 387,250 crabs. The success of these exploratory fishing ventures resulted in development of a small United States trawl fishery for king crab in the Bering Sea (NPFMC 1980).

Between 1949 and 1952, commercial operations by United States fishermen in the eastern Bering Sea yielded 4,250 metric tons of crab (Otto 1981). Domestic trawlers continued to fish for crabs until after the 1957 season, when development of a successful pot fishery for king crab south of the Alaska Peninsula attracted domestic crab fishermen from the eastern Bering Sea. In 1959, no domestic catch was reported from the Bering Sea (NPFMC 1980).

Japan reentered the eastern Bering Sea king crab fishery in 1953 with a catch of 1.3 million crabs weighing approximately 5,100 metric tons. Japanese landings, however, were less than 4,500 metric tons through the remainder of the 1950's (Otto 1981).

The USSR entered the fishery in 1959 with a catch of 620,000 crabs weighing about 1,000 metric tons (ibid.). The combined catch of these two countries peaked in 1964 when about 9 million crabs were harvested (Bakkala et al. 1976).

Domestic fishermen increased their effort for king crab in the Bering Sea in 1970 as stocks in the Gulf of Alaska became heavily exploited. In the late 1960's and early 1970's, the domestic harvest of red king crab increased, but the total catch by all countries declined to less than one-half the peak years of 1962-1964. The reduced foreign catch was partly a result of declining stocks and partly a result of agreements that limited harvest size and fishing gear (ibid.). In 1971, the Soviets ceased fishing for king crab in the area, and by 1975, after four years of very low catches, the Japanese ceased operation. The king crab fishery of the eastern Bering Sea has been a domestic effort since the mid 1970's.

The Bering Sea fishery for king crab has traditionally taken the harvest from Bering Sea and Bristol Bay waters along the Alaska Peninsula from Cape Sarichef to Port Heiden. In 1973, however, fishing for blue king crab began in the Pribilof District. By 1977, exploratory fisheries developed for red king crab in the Norton Sound District and for blue king crab near the St. Lawrence and St. Matthew islands (ADF&G 1981).

Currently, all three species of king crabs are harvested in the Northern District. Combined catches since 1977 have ranged from about 2.3 million pounds harvested the first year of the fishery to 10.1 million pounds taken during the 1983 season. About 4.2 million pounds were harvested in 1984 (tables 1 and 3). During the 1984 season, about 48% of the entire king crab harvest in Bering Sea waters (Statistical Area Q) was taken in the Northern District (see map 1) (ADF&G 1985).

2. Managerial authority. Prior to statehood, Alaskan king crab fisheries were managed by the United States Bureau of Fisheries. In 1959, management was transferred to the State of Alaska. By 1960, the king crab fleet had expanded into offshore areas beyond the state's 3-mi jurisdictional boundary. With enactment of the Fishery Conservation Zone (FCZ) from 3 to 200 nautical miles from shore and by pending memorandum of agreement between the State of Alaska and the federal government, the management of the Bristol Bay, Adak, Dutch Harbor, Bering Sea, and Aleutian Islands king crab statistical areas is by a joint statement of principles between the Alaska Board of Fisheries and the National Marine Fisheries Service.

3. Harvest methods and 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 the State of Alaska. By law, the fishing season may therefore occur from August through mid January. Seasons differ by management area as environmental and biological concerns may be considered (e.g., recovery rate, migrational patterns, weather conditions, etc.).

   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 total yield from each year class. Fishing gear is restricted to pots and ring nets to protect nonlegal crabs because high mortality rates can occur with other gear types (e.g., tangle nets, trawls).

C. Management Objectives and Considerations

The resource is managed to achieve optimum yield of king crab stocks in the FCZ and to promote full utilization of the resource by the domestic fishery (NPFMC 1980). The current management framework 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 1) relate to maximizing the reproductive potential of the resource, 2) consider the competitive advantages among vessels of different sizes, 3) attempt to prevent conflicts with other fisheries, 4) promote even distribution of the fishing fleet, and 5) monitor catch and catch rate in particular areas (ibid.). Management objectives are similar in all king crab statistical areas, and guideline harvest levels are set at a specified

Table 1. Commercial Harvest in Thousands of Pounds and Effort for King Crab Fisheries in the Norton Sound Section of the Northern District of the Bering Sea, 1977-84

Fishing Section	Fishery and Species	1977	1978	1979	1980	1981	1982	1983	1984
		Year							
Norton Sound	Summer red catch	520	2,100	2,900	1,200	1,400	230	370	390
	Effort[a]	7	8	34	9	36	11	23	8
	Winter red catch[c]	0	27	[d]	0.66[d]	0	[e]	1.51[e]	2.4
	Effort[b]		37	1	1	0	1	5	8
	Management area total catch	520	2,127	2,900	1,200.66	1,400	230	371.51	392.4

Source: Schwarz and Lean 1985.

a Number of vessels.

b Number of fishermen.

c Winter catch, reported as number of crabs; therefore numbers multiplied by 2.8 lb per crab, the average crab weight during the 1984 summer fishery.

d Harvest combined for 1979 and 1980 to protect confidentiality.

e Harvest combined for 1982 and 1983 to protect confidentiality.

percentage dependent upon the estimated abundance of recruit and postrecruit overall population levels. Size limits in these northern areas are smaller because of slower growth rates and smaller crabs (ADF&G 1983a; Otto, pers. comm.). Regulations used to address these objectives in state waters differ by area (NPFMC 1980).

A major problem in determining harvestable population levels of king crab is the length of time (7-9 years) between egg hatching and recruitment of crabs on the fishing grounds. This problem, coupled with the inability to age crabs, has resulted in poor understanding of the causes and rates of mortality during this growth period. Therefore long-term projections of stock status based on fishery performance alone is not possible.

To prevent overexploitation of given crab populations, superexclusive, exclusive, and nonexclusive registration areas have been established. A vessel or gear registered for a superexclusive registration area may not be used to take king crab in any other registration area during that registration year. A vessel or gear registered for an exclusive registration area may not be used to take king crab in any superexclusive registration area or any other exclusive registration area during that registration year. A vessel or gear registered for one or both of the nonexclusive areas may also be registered for one exclusive registration area but may not be used to take king crab in more than one exclusive registration area or in any superexclusive registration area during that registration year (ADF&G 1983b). Statistical Area Q is a nonexclusive registration area.

II. NORTON SOUND SECTION

A. Boundaries

The Norton Sound Section is comprised of waters east of 168° west longitude and north of the latitude of Cape Romanzof (61°49'N) and south of the latitude of Cape Prince of Wales (65°36'N) (see map 1) (ADF&G 1984a).

B. Fishery Description and Reported Harvest

1. Harvest summary. The only shellfish fishery in Norton Sound is for red king crab (*Paralithodes camtshatica*). Blue king crab (*P. platypus*) and Tanner crab (*Chionoecetes opilio*) also occur in the region but are seldom caught by commercial or subsistence fishermen (ADF&G 1983a). The commercial harvest of king crab in Norton Sound is relatively new.

   Two separate fisheries actually occur in the area. The summer fishery was first conducted as an exploratory fishery, as designated by the Alaska Board of Fisheries in 1977 (Powell et al. 1983). Catches have ranged from 230,000 lb taken by 11 vessels during the 1982 season to a peak harvest of 2.9 million pounds taken in 1979 by 34 vessels. Peak participation of 36 vessels was evident during the 1981 fishery (table 1). Though catches have fluctuated, the crab catch per pot has declined from a high of 64 in 1978 to 6 in

1982 as a result of declining crab abundance (ADF&G 1983a). However, by 1983 recruitment into the legal male population began to increase. The 1984 harvest of about 390,000 lb of crabs was below the season's guideline harvest level of 400,000 lb (Schwarz and Lean 1985).

The second fishery for king crab in Norton Sound occurs during the winter months. This fishery is small and is conducted primarily by residents of Nome using pots, ring nets, and hand lines set through holes or leads in the ice (Otto 1981). Peak effort of 37 fishermen and harvest of 27,000 lb occurred during 1978, the first year of the fishery. Catches dramatically decreased thereafter. About 2,400 lb were taken by eight fishermen during the 1984 fishery (table 1).

The subsistence fishery for king crab in Norton Sound has also traditionally occurred during the winter, with the nearshore ice packs serving as a convenient platform for gaining access to the fishing grounds and operating fishing gear. Most of the effort has occurred in the Nome area from Sledge Island to Cape Nome, concentrating within 2 to 3 mi of shore. Access to the grounds in this area is by foot or snowmachine. Participants are both Native and non-Native fishermen of varying incomes and lifestyles (Regnart 1978). The fishery occurs from December to May. Harvest levels recorded since the 1977-1978 season show catches, based on permits issued and returned, that exceed those of the winter commercial harvest, producing up to 35,000 lb (during the 1977-1978 fishery) and averaging 14,500 lb per year (5,200 crabs) (table 2).

1. Commercial gear type and size limits. In the Norton Sound Section of the Northern District, legal gear for harvesting king crab is pots. The minimum size limit is the smallest in the state for red king crab. The size limit is 4 3/4 inches carapace width (CW), and for blue king crabs it is 5 1/2 inches CW (ADF&G 1984a).
2. Period of use. Harvest in the Norton Sound summer commercial fishery must occur in the summer prior to sea ice formation. As a result, most of the commercial harvest has occurred in July and August (Powell et al. 1983). By regulation, male red king crab and blue king crab may be taken or possessed from 12:00 noon, August 1, through 12:00 noon, September 3 (summer season), and from January 1 through April 30 (winter season) (ADF&G 1984a).

C. Management Objectives and Considerations

Norton Sound crab production is relatively small compared to the rest of the eastern Bering Sea. The smaller crabs of Norton Sound frequently may be more costly to harvest than in other Bering Sea areas and bring a lower price per pound to fishermen (Powell et al. 1983). The fishery is the newest and northernmost Alaskan red king crab fishery. The nearest onshore processing facilities are

Table 2. Subsistence Harvest in Number of Pounds of Red King Crab in Norton Sound and Effort in Number of Fishermen from 1978 through 1984

	Year						
	1978	1979	1980	1981	1982	1983	1984[a]
Harvest[b]	35,016	627	596	1,008	3,606	29,209	31,416
Effort	149	38	9	23	54	85	143

Source: ADF&G 1984b, Schwarz and Lean 1985.

a Figures reflect the number of crabs removed and kept.

b Figures are number of crabs as reported, multiplied by 2.8 lb, the average weight per crab harvested in the 1984 summer fishery.

located in Dutch Harbor and Akutan in the Aleutian Islands. The catch (from the summer fishery) is currently processed entirely by floating processor ships and catcher/processor vessels operating during the season in the Norton Sound area (ibid.). The significance of the Norton Sound fishery is the necessity to ensure the development of a "new" commercial fishery that will not impact the long-established subsistence fishery. The emotional impact of the local populace upon seeing commercial utilization of crab stocks off their shores by modern crab vessels with home ports from as far away as Seattle has been considerable (ibid.).
The size or abundance of the legal male population is derived from pot and trawl surveys performed periodically in the Norton Sound area. A harvest strategy was adopted by the Board of Fisheries in 1983 (5AAC 34.915) that set the optimum yield in Norton Sound at 50% of the normal exploitation rate as determined in 5AAC 34.080, to provide protection to a long-established subsistence fishery. Under harvest strategy guidelines specified in 5AAC 34.080, the status of the male king crab population in Norton Sound is depressed, with a stable abundance of prerecruits and a moderate level of postrecruitment. The appropriate level of exploitation is 30% under these conditions but is reduced to 15% for the summer fishery, translating to a guideline harvest level of about 400,000 lb for the 1984 season (Schwarz and Lean 1985). As with other areas in the State of Alaska, information regarding king crab is limited to male king crabs. Information regarding female crabs is scarce. The reason for low recruitment, which has caused the decline in population levels, though currently under investigation, is equally obscure.

III. ST. MATTHEWS AND ST. LAWRENCE ISLAND SECTIONS

A. Boundaries

The St. Matthew Island section of the Northern District consists of all waters north of the latitude of Cape Newenham (58°39'N) and south of the latitude of Cape Romanzof (61°49'N) (map 1). The St. Lawrence Island Section consists of all remaining waters of the Northern District, excluding the Norton Sound Section (ADF&G 1985). Because most of the fishing activity occurring in this portion of the Bering Sea is within the Norton Sound District, information for these two fishing sections is combined in the following narrative.

B. Fishery Description and Reported Harvest

Blue, brown, and red king crabs have been harvested in the Northern District. Small subsistence fisheries for blue king crab occur around St. Lawrence, Little Diomede, and Nunivak islands. The commercial fishery in this offshore area of the Bering Sea began in 1977, concentrating upon blue king crab near St. Matthew Island. The fishery produced 1.2 million pounds during the first season, increasing to about 2.0 million pounds during the 1978 fishery. Catches decreased the following two years to less than 220,000 lb because of low participation in the fishery (ADF&G

1983a). Both catch and effort increased steadily beginning in 1981 and reached a peak harvest of almost 9.5 million pounds during the 1983 season taken by the peak effort of about 164 vessels (table 2). Both catch and effort decreased during the 1984 fishery, with about 3.8 million pounds harvested by 90 vessels. The decreased harvest resulted from an apparent decline in stock abundance and the resultant decreased guideline harvest level from 9.5 million pounds during the 1983 season to 2.0 to 4.0 million pounds for the 1984 fishery (ADF&G 1985).

Although the blue king crab fishery has primarily taken place near St. Matthew Island, about 13 fishermen also reported harvest of about 52,000 lb in the St. Lawrence Island Section during the 1983 season (table 3). It is believed, however, that 16,000 lb of this harvest were taken from the St. Matthew Section (Griffin, pers. comm.). Although the St. Lawrence Island Section was open during the 1984 season and two or three vessels were present, no landings were reported (ADF&G 1985).

Red king crab stocks outside the Norton Sound Section are widely and sparsely distributed. As a result, the red king crab fishery outside the Norton Sound Section has historically been incidental to the blue king crab fishery at St. Matthew Island (ibid.). Catches have remained below 130,000 lb (tables 1 and 3). No red king crab harvest was reported during the 1984 fishery (table 3).

The only reported harvest of brown king crab in the Northern District occurred during the 1983 season, when 22 vessels took 193,500 lb. Although the fishery was also opened the following year and is presently open year-round by permit, no effort nor landings have since been reported (ADF&G 1985; Griffin, pers. comm.). This species has not been encountered in trawl surveys performed by NMFS in the Bering Sea at depths less than 128 mm. Although apparently not consistently sought by domestic fishermen, brown king crabs are the most frequently occurring king crab incidentally caught in eastern Bering Sea Japanese and Soviet trawl fisheries (Otto 1981).

1. Gear type. King crab in the St. Lawrence and St. Matthew islands areas may be taken only by pots for commercial purposes. King crabs taken by means other than pots must be immediately returned to the fishery (ibid.).
2. Period of use and size limits. In the St. Matthew Island Section, male king crabs 4 3/4 inches and male blue king crabs 5 1/2 inches or greater in shell width may be taken or possessed from 12:00 noon September 1 through September 22 (ADF&G 1984a). Male brown king crabs 5 1/2 inches or greater in width of shell may be taken or possessed from January 1 through December 31 under conditions of a permit issued by the commissioner (ibid.).

   In the St. Lawrence Island Section, male king crabs 4 3/4 inches and male blue king crabs 5 1/2 inches or greater in width of shell may be taken or possessed from 12:00 noon August 1 through September 3 (ibid.). Male brown king crabs

Table 3. Commercial Harvest in Thousands of Pounds and Effort in Number of Vessels for King Crab Fisheries of the St. Matthew and St. Lawrence Islands Sections of the Northern District, 1977-84

King Crab Species		Fishing Section	1977	1978	1979	1980	1981	1982	1983	1984
			Fishing Season							
Blue	Catch	St. Matthew Is.	1,202.1	1,984.3	210.9	219.8	4,627.8	8,844.8	9,454.3	3,764.6
		St. Lawrence Is.	0	0	0	0	0	0	52.6	0
	Total		1,202.1	1,984.3	210.9	219.8	4,627.8	8,844.8	9,506.9	3,764.6
	Effort	St. Matthew Is.	10[b]	22[b]	18[b]	2[b]	31[b]	96[b]	164[b]	90[b]
		St. Lawrence Is.	0	0	0	0	0	0	13	0
Brown	Catch		0	0	0	0	0	0	193.5[c]	0
	Effort		0	0	0	0	0	0	22	0
Red	Catch[a]		543.0	2,007.9	3,024.2	353.7	64.0	3.7	1.6	0
	Effort[b]		-	-	-	-	-	-	-	-
Combined section and species catch			1,745.1	3,992.2	3,235.1	573.5	4,691.8	8,848.5	9,702.0	3,764.6

Source: ADF&G 1983a, 1985.

a Harvest is incidental to the targeted blue king crab. Catches from 1977 through 1979 include the Norton Sound Section. Data from 1980 through 1984 is for the St. Matthew Section only.

b Because harvest is incidental, effort is by the same vessels reporting blue king crab catches in St. Matthew Section.

c Catch reported from southern portion of St. Matthew Section.

5 1/2 inches or greater in width of shell may be taken or possessed from January 1 through December 31 under conditions of a permit issued by the commissioner (ibid.).

C. Management Objectives and Considerations

Three stocks of blue king crab have been identified in the Bering Sea: Herendeen Bay, the Pribilof Island, and the northern Bering Sea blue king crab. The northern Bering Sea blue king crab refers primarily to the population in the St. Matthew Island area. Each stock is managed independently of the other. Trawl surveys performed by the NMFS occur annually to obtain population estimates and other biological data for king crab stocks in the Bering Sea. Guideline harvest levels are developed from this information. The ADF&G recommends regulatory changes, monitors the fishery, and issues closure announcements commensurate with the overall objectives for managing king crab.

The occurrence of red king crab in the St. Matthew/St. Lawrence islands sections is comparatively sparse. Although seasons and size limits have been established, the harvest is incidental to the blue king crab harvest. Abundance estimates and guideline harvest levels have not been set, as the harvest is totally dependent on the parameters established for the blue king crab fishery.

Catches for the brown king crab fishery have been reported for only one year. Season and size limits have been established for this fishery. Research surveys are not performed on this species in this area. Therefore, distribution, abundance, and basic biological information is not available.

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Sport Use of Freshwater Resident and Anadromous Fish Species
Western and Interior Regions

I. MANAGEMENT HISTORY

A. 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, Division of Sport Fish, 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).

B. 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 (Mills 1985). 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.

Recreational fisheries have grown tremendously since statehood and now play a significant role in total fisheries management (Mills 1985). Alaska statewide sportfishing regulations now address access to and development near recreational fisheries. Bag limits and legal 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.

II. ALASKA STATEWIDE SPORTFISHING HARVEST MONITORING

A. 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 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 regulation, management, and allocation of multiple use fisheries is a statewide database 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). Western and Interior regional harvest areas and boundaries used in the postal survey are delineated on map 1.

B Application of Data

Detailed tabulations of annual effort and harvest by region, area, fishery, and species for 1977 through 1984 may be found in Mills (1979-1985). Summary tables of annual (1977-1984) Interior and Western regions sportfishing effort and harvest data 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 3 include effort directed toward species not addressed in detail 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 may be underestimated if evaluated on the basis of these tables alone.

It is also important to understand that sport harvest estimates from the statewide postal survey for fisheries that attract relatively few anglers may not be as precise as estimates for those that attract a large number of anglers. This is true for many fisheries within the Interior and Western regions that may be important within the region but attract only a small percentage of total statewide sportfishing effort.

III. REGIONAL HARVEST SUMMARY

A. Harvest Methods

Sportfishing for salmon, char, lake trout, rainbow trout, and sheefish in streams and lakes in the Interior and Western regions is permitted by hook and line only. Northern pike may be taken by spear. In lakes, northern pike, burbot, and whitefish may be taken by spear by persons who are completely submerged. In the Tanana River drainage (excluding waters between Paxson and Cantwell south of the Denali Highway) spears may be used to take pike and burbot during specified months of the fall and winter. Also in the Tanana drainage, spears and bow and arrow may be used to take whitefish during specified months of the fall and early winter (ADF&G 1985a). Readers should refer to the latest sportfishing regulations summary or 5 AAC 75.001 through 5 AAC 75.995 for details of gear restrictions.

B. Angler Effort

In 1984, sport anglers spent approximately 165,500 angler-days fishing in the Interior and Western regions. This was 8.9% of the total statewide sportfishing effort in 1984 (Mills 1985) and is consistent with the percentage of effort expended in the Interior and Western regions in prior years. From 1977 through 1984, an annual average of 9.5% of the total angler-days fished in Alaska were expended in the Interior and Western regions (ibid.). Most of the fishing effort in the Interior and Western regions is concentrated in the Fairbanks Area.

C. Harvest Data

Arctic grayling, landlocked salmon, rainbow trout, and northern pike provide the largest sport fish harvests in the Interior and Western regions, with the harvest of grayling far surpassing harvest of other species. In 1977 through 1984, annual sport harvest of grayling in the Interior and Western regions averaged approximately 89,100 fish. Landlocked salmon are harvested from stocked lakes in the Fairbanks Area and contribute the second largest average catch in the Interior and Western regions. Annual sport harvest of landlocked salmon averaged 31,900 fish from 1977 through 1984. A large harvest of rainbow trout is also taken from the Interior and Western regions. From 1977 through 1979, this harvest averaged only 6,200 fish, but with increased stocking in the Fairbanks Area the harvest increased to an annual average of 26,200 fish from 1980 through 1984. Northern Pike, whitefish, char, lake trout, burbot, sheefish, and all five species of Pacific salmon are also harvested by sport anglers in the Interior and Western regions. In the following sections, sport harvest information for all species will be presented for each sport fish postal survey area in the Interior and Western regions (map 1).

D. Harvest Survey Areas

1. Lower Yukon-Kuskokwim Area:

a. Boundaries. The Lower Yukon-Kuskokwim Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all drainages of the Yukon River south of Kaltag to the Bering Sea; the Kukokwim River watershed; all waters flowing into Kukokwim Bay; and adjacent salt water and islands. This area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed (ADF&G 1985b).

b. Major watersheds and significant fisheries. Local residents along with fishermen from throughout the world participate in sport fisheries in the Lower Yukon-Kuskokwim Area. Sport fishermen in this area harvest all five species of Pacific salmon, arctic grayling, northern pike, char, rainbow trout, whitefish, burbot, sheefish, and lake trout (tables 1-13). Rainbow trout is probably the most important sport fish in the Kuskokwim Bay area, and many anglers fishing in Kuskokwim Bay rivers come specifically for rainbow trout (Alt 1977). Many anglers fishing for rainbow trout in the Kanektok and other Kuskokwim Bay streams practice catch and release (Snellgrove 1985, Dlugokenski et al. 1983). Harvest statistics, therefore, underestimate the importance to the sport fishery of the rainbow trout in these rivers. Excellent fishing is also available for chinook, chum, pink, and sockeye salmon from late June to mid July and for coho salmon in August (Alt 1977).

The Kanektok River is considered one of the premier sportfishing salmonid streams on the North American continent, and the Goodnews River ranks only slightly below (USFWS 1985a). Use of these rivers has increased dramatically over the last decade. The number of fishing guides operating eclusively in the area has increased, and some Bristol Bay area guide services have also expanded their operations to include the Kanektok and Goodnews rivers (ibid.). Part of the increase in interest may have resulted from the establishment of the Togiak National Wildlife Refuge in the early 1980's (ibid.). The area of the refuge includes the Goodnews, Arolik, and Kanektok rivers. Guides in the Togiak National Wildlife Refuge operate for 10 to 16 weeks during the summer and fall (ibid.).

In 1984, the largest single use of the Kanektok River was by unguided fly-in groups. An estimated 700 unguided fly-in groups visited the river in 1984, primarily residents of Bethel who fished in the lower stretch of the river near Quinhagak (ibid.) Qanirtuug, Inc., the local Native corporation, owns the land along the lower Kanektok River and charges a fee to recreational users of the area (Snellgrove 1985). In 1984, 12 principal guides were also using the Kanektok River, and there were five established camps used by guides on the river (USFWS 1985a). The number of guided float groups and guided fly-in groups using the river increased from 8 and 6, respectively, in 1980 to 37 and 22 in 1983 (ibid.). The average guided float group size in 1984 was eight people. The average fly-in group size was five people. ADF&G estimates for angler-days spent on the Kanektok increased from 1,517 in 1983 to 6,881 in 1984 (table 14). Alt (1977) noted that the best rainbow trout fishing in the Kanektok River was in the area from river mile 12 to river mile 33. In 1984, the harvest of rainbow trout from the Kanektok was estimated to be 312 fish, but many more than this were probably caught and released. The chinook salmon in the Kanektok River are among the largest in the state and 30 to 40 lb fish are common (ibid.). Chinook salmon harvest from the Kanektok River in 1984 was estimated to be 922 fish, down from the estimated 1983 harvest of 1,511 (table 3). Lake trout fishing is good in the lakes of the upper Kanektok drainage (ibid.). Kagati Lake is an important sportfishing lake mainly because of its close proximity to Bethel (ibid.). The outlet of the lake is a popular sportfishing site for fly-in fishermen, as well as being the starting point for fishermen floating the Kanektok River (Dlugokenski et al. 1983).

Recreational use on the three forks of the Goodnews River has also increased. In 1984, USFWS estimated that 31 guided fishing groups and 53 unguided groups used the Goodnews River (USFWS 1985a). Guided motorboat use, with an average group size of 12 people, was the predominant use of the river (ibid.). In 1984, five principal guides were using the three forks of the Goodnews River, and there were three guide camps on the river. The USFWS describes use levels on the Goodnews River as high on the main fork and moderate on the middle fork (ibid.). The Goodnews River supports a good run of large sockeye salmon, with many fish over 10 lb. Sport harvest of sockeye salmon from the Goodnews River, however, is low, with an estimate of only 14 fish harvested in 1983 (table 1). In 1984, too few responses were received from fishermen on the Goodnews River for any use or harvest estimates to be generated by the Statewide Postal Harvest Survey.

In 1977, Alt noted that none of the lakes of the Goodnews River system received heavy sportfishing pressure, though a small number of float plane pilots from Bethel and Dillingham fished on Canyon and Goodnews lakes (Alt 1977).

Sportfishing use of the Arolik River is low at this time but is increasing (ibid.). Alt (1977) noted that the Arolik did not support large populations of rainbow trout or grayling and that most effort came from local Bethel and Dillingham residents.

Some sportfishing also takes place on tributaries of the Kuskokwim River. Large numbers of pike are caught in the main Kuskokwim by residents of lower Kuskokwim villages (Alt 1977). A sport fishery for pike occurs in the area near Bethel (ibid.). Pike are taken both through the ice in the winter and on hook and line during the open water season (ibid.). Because of their small size and lack of fight, pike generally rank below rainbow trout, grayling, salmon, and char as desirable sport species (ibid.).

Sportfishing pressure on the Eek River is low and comes mainly from residents of the village of Eek (ibid.).

The Kwethluk River recieves the heaviest fishing pressure of the lower Kuskokwim streams. Rainbow trout is the main sport species, but char, grayling, and coho salmon are also sought by sport fishermen (ibid.).

The Kasigluk River receives sportfishing pressure from residents of Bethel, Kwethluk, and possibly Akiak and Akiachak (ibid.). Rainbow trout, which are found above river mile 30, are generally the target species for sport fishermen in the Kasigluk, though anglers also harvest grayling, northern pike, char, and coho salmon (ibid.).

The Kisaralik River is an important sportfishing stream, attracting fishermen mainly from Bethel and villages upstream. The most important sport species in the Kisaralik River are rainbow trout, grayling, char, and coho salmon (ibid.). Most fishing on the Kisaralik takes place between river miles 20 and 40 (ibid.).

The Tuluksak River receives light sportfishing pressure, mainly by residents of the village of Tuluksak (ibid.). Northern pike, grayling, and arctic char are the most important sport species (ibid.).

Local residents fish with rod and reel for non-salmon fish species and for salmon in the Oskawalik and Aniak rivers (Charnley 1982). Chuathbaluk and Sleetmute residents fish with rod and reel for sheefish, rainbow trout, char, grayling, and northern pike (Charnley 1984). This is a traditional harvest focused on gathering of food for human and animal consumption, but the use of rod and reel during open water months places this harvest under sportfishing regulations.

The Holitna River and other tributaries between Sleetmute and McGrath are sites of a sheefish and chinook salmon sport harvest. This harvest is participated in by anglers with local guides, anglers with guides from the Bristol Bay area, and area and nonarea fishermen (Alt 1984). Guided fishermen account for the bulk of the harvest (Alt 1981a). The sheefish harvest takes place during late June and early July. Feeding sheefish leave the Holitna River by late July; thus the fishery lasts only about one month (Alt 1984). In 1983, Alt (1984) estimated the sheefish sport harvest during the week following July 4 to be about 100 fish . Effort directed toward sheefish has recently declined as sportfishing preference is now for chinook salmon (Alt 1981a).

Residents of the village of Stony River harvest grayling with rod and reel during the summer at the mouths of small streams (Kari 1985).

Farther up the Kuskokwim River, residents of Nikolai and McGrath use rod and reel to harvest chinook salmon from the Pitka Fork of the Kuskokwim River (Stokes 1982). Harvest is conducted with rod and reel because it is the most effective legal means to harvest salmon in clearwater areas (ibid.). Most chinook salmon harvest takes place at the confluence of the north and south forks of the Salmon River, near the confluence of the Salmon River with the Pitka Fork, and in the vicinity of the mouth of the Middle Fork (ibid.). In 1982, the Salmon River harvest was approximately 527 chinook salmon, though some of these were taken with set nets rather than rod and reel (ibid.). Use of the Salmon River fishery by McGrath-based fishermen has occured since the late 1970's and is concentrated around the Fourth of July weekend (ibid.).

In the South Fork of the Kuskokwim River, residents of Nikolai use rod and reel to catch chinook salmon at the mouth of the Little Tonzona River (ibid.). In 1982, approximately 281 chinook were taken by local residents from the South Fork of the Kuskokwim. The major part of this catch was taken from the Little Tonzona River, primarily with rod and reel (ibid.).

Residents of Telida, on the Swift Fork of the Kuskowim, take some coho salmon with rod and reel along with their set net harvest near the confluence of Highpower Creek and the Swift Fork (ibid.).

Some sportfishing occurs on tributaries of the lower Yukon River, usually by residents of the area.

The Andreafsky River, near the mouth of the Yukon River, is an important sportfishing stream (Alt 1981b). Most of the effort is confined to the lower 25 mi of the river because boat travel in the summer is limited by low water conditions (ibid.). In 1980, Alt noted that an air taxi operator maintained a camp at river mile 42 and flew a few anglers into this camp each year (ibid.). A few groups are also flown into gravel bars near the headwaters of the Andreafsky to float the river (ibid.). Char, grayling, pike, and chinook, chum, pink, and coho salmon are the important species on the Andreafsky (ibid.).

The Innoko River is used by a small number of recreational fishermen who harvest salmon, sheefish, northern pike, and grayling (Alt 1983). Sheefish are available to sport fishermen in areas upstream of Shageluk Village to the Iditarod River (Alt 1982). The sport harvest of sheefish by Holy Cross, Shageluk, and Grayling residents, however, is very low (ibid.). In 1981, Alt noted that anglers from McGrath occasionally catch sheefish on hook and line near Folger Creek on the upper Innoko River (ibid.).

A guide operating a lodge at Cripple Landing on the Innoko features sheefish fishing along with pike and grayling (Alt 1983). Some recreational fishermen float the Innoko between Ophir and Cripple (ibid.). Chinook, chum, and coho salmon have spawning migrations up the Innoko, and a few Innoko River salmon are taken by sport fishermen in the Folger Creek, Beaver Creek, and Ophir areas (ibid.). Alt (1983) estimated the Innoko River sport harvest of salmon to be less than 50 per year.

The Bonasila River receives light sportfishing pressure, mainly from local residents. Local residents sport fish in the lower 10 mi of the Anvik River for pike, sheefish, and salmon (Alt 1980). In 1979, Alt noted a small guiding operation on the Anvik River in the area 4.5 mi above the Yellow River confluence (ibid.). The Khotol River, which enters the Yukon River below Kaltag, contains numerous pike that provide a light recreational harvest for Kaltag residents (ibid.).

c. <u>Management considerations</u>. In the lower Kuskokwim River and Kuskokwim Bay area, rainbow trout are probably the most sought after sport fish. Population levels of rainbow trout, however, are probably not high (Alt 1977). Rainbow trout in this area have a late age at maturity, and the spawning population is made up of only three or four age classes (ibid.). These trout may be caught in the sport fishery three or four years before they reach spawning age (ibid.). In streams that flow into Kuskokwim Bay, all segments of the rainbow trout population are vulnerable to fishing pressure during the summer months (ibid.). These fish are also vulnerable during winter months because of their concentrations in holes in lower reaches of the streams (ibid.).

Lake trout in lakes at the headwaters of Kuskokwim Bay streams may also be vulnerable to overharvest. These lake trout populations contain few young fish under 380 mm, with most fish belonging to age classes 9 through 13 (ibid.). An increased harvest of these older fish might disrupt population structure (ibid.).

Some guides and recreational users in the area have expressed concern that increased use of the Kanektok River may lead to a decline in the fish populations and the quality of the sportfishing experience on that river (Dulugokenski et al. 1983, USFWS 1985a). New catch limits were recently adopted by the Alaska Board of Fisheries for sport harvest of rainbow trout and chinook salmon in the Bristol Bay Area, which includes the Kanektok, Arolik, and Goodnews drainages. The rainbow trout catch limit was reduced in 1985 to two fish per day and and two fish in possession (ADF&G 1985a). The chinook salmon catch limit was reduced to five per day, five in possession (ibid.).

The recent increase in nonlocal recreational use of the Kanektok River has lead to a perception by local subsistence users that recreational users may compete with their use of the river (USFWS 1985a). The increased use of fish and game by nonlocal users is perceived as a threat to the local villager's way of life (ibid.). One problem already identified by local residents is the trespass of refuge vistors on lands owned by the local Native corporation (ibid.). The Native corporation holds title to lands above mean high tide line on the lower Kanektok River.

The USFWS in their draft Togiak National Wildlife Refuge Comprehensive Conservation Plan Environmental Impact Statement and Wilderness Review has proposed to eliminate the use of motors on recreational boats in the Kanektok River wilderness area (ibid.). As a further step to protect wilderness values of the Kanektok and Goodnews rivers the USFWS proposed to freeze the number of sportfishing guides on each river at 1984 levels (ibid.). In order to distribute users along the rivers, reduce conflicts with local users, reduce impacts to fish and wildlife habitat, and ensure opportunities for more than one group to camp at desired spots, the USFWS also proposed to limit the length of time river recreational users can stay at one location (ibid.). These management proposals will not be adopted until affected local, state, and federal government agencies, industry, local interests, conservation groups, and other interested parties and individuals have a chance to review and comment on the proposed plan (ibid.).

The potential for an additional management problem in the Lower Yukon-Kuskokwim Area exists because many subsistence resource users harvest fish for food using hook and line. The use of hook and line, except in the form of jigging gear operated through holes in the ice, is not technically defined as a legal subsistence harvest method (ADF&G 1985c), but in some areas it is the most efficient way for local users to harvest fish for food (Stokes 1982).

2. South Slope Brooks Range Area:

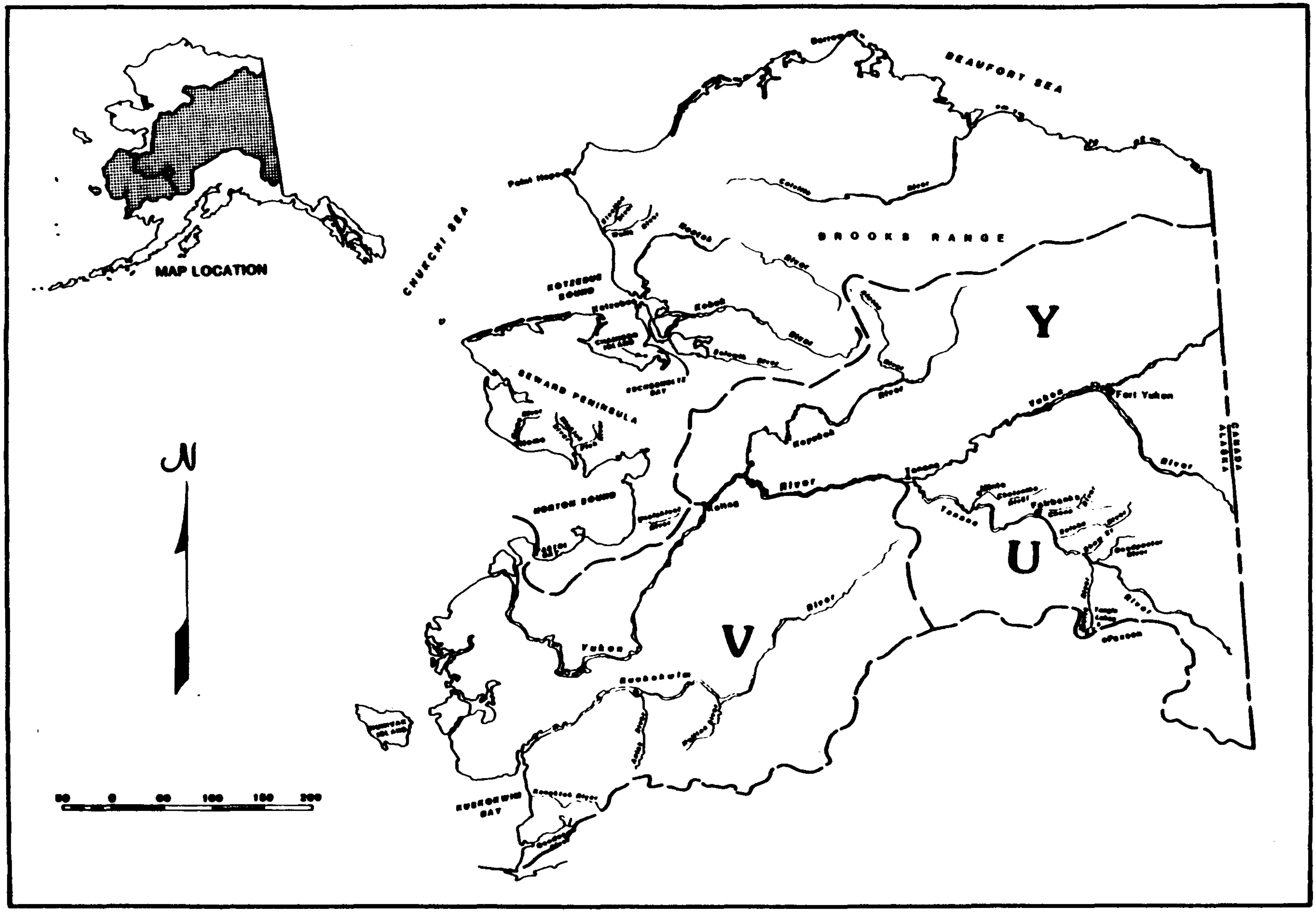
   a. Boundaries. The South Slope Brooks Range Postal Survey Area (map 1) includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna river drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border (ADF&G 1985b).

   b. Major watersheds and significant fisheries. Small sport harvests of chum salmon, char, lake trout, burbot, and sheefish are taken from the South Slope Brooks Range Area (tables 15-19). Grayling and northern pike contribute the largest harvests in this area (tables 20 and 21), with most grayling taken from streams accessible from the Haul Road (Dalton Highway) and most pike taken from streams away from the Haul Road corridor. Grayling harvest increased from 1,032 fish in 1977 to 6,072 fish in 1979 and has averaged 5,479 fish anually from 1979 through 1984. Pike harvest increased from an average of 465 fish annually from 1977 through 1983 to 2,570 fish in 1984.

      Effort in the South Slope Brooks Range Area has averaged 4,450 angler-days anually from 1977 through 1982 (table 22). In 1984, 5,121 angler-days of effort were expended in the South Slope Brooks Range Area, which was 3.1% of the total effort expended in the Western and Interior regions that year.

      Most sportfishing effort in the South Slope area takes place in lakes and streams accessible from the Haul Road, near the mouths of Yukon River tributaries, and at remote lakes and streams that are accessible by boat or small plane.

      The Nulato River, a Yukon River tributary downstream from the Koyukuk River, is an important sportfishing stream for Nulato residents (Alt 1980). Char are the most important sport fish species in the Nulato (ibid.). Sportfishing effort is heaviest on the lower 0.5 mi of the Nulato because travel further upstream by propeller boat is difficult except during high water (ibid.).



Map 1. Western and Interior regions sport fish survey areas (Area V: Lower Yukon-Kuskokwim; Area U: Fairbanks; Area Y: South Slope Brooks Range).

The Melozitna River receives a moderate amount of sportfishing effort from residents of Fairbanks, Ruby, and Galena (Alt 1981a). Sheefish is the main sport species in the Melozitna, though a few char, grayling, northern pike, and chum salmon are also harvested (Alt 1981a, USDI 1982). Sheefish harvest generally occurs from late June through mid July (Alt 1979). Most fishing takes place in the lower 1 mi of the river, though there is also some sportfishing pressure at a lodge on Hotsprings Creek, and a few people float the river (Alt 1984, USDI 1982). Grayling are the most important species for sport anglers in the Melozi Hot Springs area, and a few are also taken from the Melozitna River mouth upstream to Grayling Creek (Alt 1984). Anglers also fish for char in the Grayling Creek area, but difficult access keeps this effort low (ibid.). In the fall, moose hunters probably harvest a few pike in the upper Melozitna (USDI 1982).

Sheefish are harvested by sport fishermen in the Nowitna River (Alt 1973, 1979). Sheefish can be taken from the Nowitna in July through mid September (Alt 1973). The Nowitna is fished by many moose hunters in August (ibid.). Some sportfishing also occurs in the lower 1 mi of the Tozitna River, with most effort on this Yukon River tributary directed toward northern pike and sheefish (Alt 1984). Some sport harvest also occurs at the mouths of Hess Creek and the Dall River, Yukon River tributaries upstream from Rampart (Alt 1979).

Residents of Bettles, Evansville, Alatna, and Allakaket fish for grayling with hook and line along the Koyukuk River. Most grayling harvest takes place where small tributary streams enter the Koyukuk River and along the Koyukuk itself as it flows by the communities (Marcotte and Haynes 1985). In 1981 and 1982, Evansville and Bettles residents harvested grayling with hook and line in the John River from its mouth to above its confluence with Timber Creek, from the Koyukuk River around Bettles and Evansville, and from the mouth of Jane Creek (ibid.). Bettles and Evansville residents also harvested "trout" (species not identified, but probably lake trout) with hook and line from Iniakuk Lake (ibid.). Residents of Allakaket and Alatna harvested grayling with hook and line from the lower half of Henshaw Creek (ibid.).

Residents of upper Yukon and Porcupine river communities also use hook and line to harvest grayling during the summer and fall. Residents of Arctic Village on the East Fork of the Chandalar River harvest grayling and lake trout with hook and line in the Chandalar River and on adjacent creeks and lakes during the summer

(Caulfield 1983). Residents of Chalkyitsik on the Black River sometimes take grayling with hook and line in conjunction with hunting activity along the Black River and its tributaries (ibid.). Residents of Fort Yukon on the Yukon River near its confluence with the Porcupine River also harvest grayling with hook and line (ibid.). Harvests of fish using hook and line by residents of small South Slope area communities is often part of their subsistence-based food-gathering activities; however the use of hook and line places this harvest under sportfishing regulations.

Road access to the South Slope area is provided by the Dalton Highway (Haul Road). The Dalton Highway was built in 1974 by the Alyeska Pipeline Service Company to serve contruction of the Trans-Alaska Pipeline. In May of 1974, the ADF&G closed to sportfishing a strip within 5 mi of each side of the Trans-Alaska Pipeline alignment. This closure was enacted because of the unknown impacts of construction camps and the lack of biological information on affected fish populations (Bendock 1980). In 1979, this closure was rescinded by the Alaska Board of Fisheries, opening the Dalton Highway corridor to sportfishing for all species except sheefish and salmon (ibid.). Until 1981, access to the Dalton Highway was limited to permitted commercial users, which limited sportfishing opportunities primarily to truckers and employees of the Alyeska Pipeline Service Company and the Alaska Department of Transportation. In June of 1981, the highway was opened to the general public from the Yukon River to Disaster Creek, approximately 150 mi north of the Yukon River (Bendock 1982).

Between the Yukon River and Atigun Pass, the Dalton Highway crosses many streams and small tributaries of the Koyukuk River. The Koyukuk River supports a diverse community of fish, includeing salmon, sheefish, and northern pike, but the streams and tributaries accessible by foot from the Dalton Highway are limited in sportfishing potential principally to arctic grayling (Bendock 1980). Lakes on the south side of the Brooks Range along the Dalton Highway also contain grayling (ibid.). These lakes, such as Olsons and Grayling lakes, are warm, shallow, and highly productive during the open water season (ibid.). The most popular sportfishing locations south of Atigun Pass are Prospect Creek, Jim River, and Grayling Lake (Bendock and Burr 1984).

A limited creel census in 1979 based on 73 angler interviews obtained along the Dalton Highway from June through August found a catch per effort of 3.0 fish per hour in South Slope streams and 5.3 fish per hour in South Slope lakes (ibid.). Grayling were the only species harvested. These data, however, are biased because many unsuccessful trips were not reported (ibid.). Despite excellent sportfishing opportunities, effort along the Dalton Highway remains light. Some of the factors contributing to low fishing activity on the Dalton Highway may be 1) poor weather conditions, 2) rough road conditions 3) poorly situated and infrequent camping facilities, 4) placer-mining activities creating turbid water throughout the summer, and 5) the long distance and travel time required from the nearest towns and villages (Bendock 1982).

Lakes outside the Haul Road corridor that are accessible by hiking or by air and receive some sportfishing effort include Sithylemenkat Lake in the Kanuti River drainage, Iniakuk and Helpmejack lakes in the Alatna River drainage, Wild Lake at the headwaters of the Wild River, tributary to the Middle Fork of the Koyukuk River, Big (Bob Johnson) and Twin lakes in the Bettles River drainage, Chandalar and Squaw lakes on the North Fork of the Chandalar River, and Old John Lake in the Sheenjek River drainage (Pearse 1978, Kramer 1976).

c. Management considerations. Access to the South Slope Brooks Range Area is limited, and sportfishing effort in the area is light. Access is probably the most important factor affecting sportfishing in the South Slope area. Few people have the means neccessary to reach sportfishing areas. Sportfishing effort is, therefore, probably not heavy enough at this time to seriously impact fish populations.

3. Fairbanks Area:

a. Boundaries. The Fairbanks Sport Fish Postal Survey Area includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile river drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage (ADF&G 1985b).

b. Major watersheds and significant fisheries. Grayling, landlocked salmon, and rainbow trout contribute the largest harvests in the Fairbanks Area (tables 23, 24, and 25). The grayling harvest has contributed an annual average of 53% of the total sport harvest of fish from the Fairbanks Area from 1977 through 1984, and the Fairbanks Area grayling harvest is the largest in the state (Mills 1985). Large sport harvests (over 1,000 fish annually) of northern pike, whitefish, burbot, and lake trout are also taken from the Fairbanks Area each year, with lesser harvests of char, sheefish, and chinook, chum, and coho salmon (tables 26-34).

Effort in the Fairbanks Area has averaged 125,760 angler-days annually from 1977 through 1984 (table 35), with an increase from 99,919 angler-days in 1977 to a peak of 150,530 angler days in 1982. In 1984, sportfishing effort in the Fairbanks Area contributed 88% of the total sportfishing effort in the Western and Interior regions and 8% of the total statewide sportfishing effort (Mills 1985).

In the following narrative, major sport harvests from the Fairbanks Area will be described, working roughly from west to east up the Tanana River drainage. Many locations that receive only a small amount of sportfishing effort each year will not be discussed here. These locations, however, may be important to a local community or may offer a unique or valuable fishing experience for those who do use the site. More detailed information on sportfishing at specific sites in the Fairbanks Area can be found in the annual Federal Aid in Fish Restoration reports, Jobs G-III-G, G-III-H, G-III-I, G-III-K, and R-I-A.

The Minto flats area in the Tolovana and Chatanika river drainages is an excellent sportfishing area for northern pike. Access to Minto flats is by boat, float plane, or by road. In 1970, a road was constructed that linked the village of New Minto to Fairbanks, providing increased access to the area (Cheney 1971). Guided fishing trips are available in the area. In early summer (June), best fishing is in sloughs and shallow backwater areas (Kramer and Hallberg 1982). In mid-to-late summer, the best fishing is at the confluences of the main rivers and in the lakes (ibid.). An excellent fly-in pike fishery is available at Minto Lakes. A creel census in 1971 found that the Minto Lakes area attracted the greatest amount of effort, especially later in the summer (7/17-8/17), when fishing pressure declined in other areas (Cheney 1972). Fishing success in the Minto flats area is affected by water level. During periods of low water, the pike are concentrated in deep holes at the confluences of rivers and sloughs and are more vulnerable to harvest. When waters are high, the pike are more dispersed, and harvest declines (Cheney 1971, Hallberg 1983). Estimates from the statewide harvest study show that the harvest of pike from Minto flats has declined from a peak of 3,615 fish in 1977 to 1,960 in 1984 (table 26).

The Chatanika River, which flows through Minto flats, also supports fisheries for whitefish and grayling. Whitefish are captured in a spear fishery that was initiated in the Tanana drainage in 1970. Whitefish are taken at night in the fall as they travel up the Chatanika River to spawn. The whitefish harvest is centered around the area of the Eliott Highway bridge. Species taken in this fishery are least cisco, humpback whitefish, and round whitefish. From 1972-1974 and 1976-1980, least cisco contributed an average of 56% of each year's harvest, humpback whitefish an average of 37%, and round whitefish 7%. In 1978, some fishermen reported that they were selectively harvesting humpback whitefish (Kramer 1979).

Water levels affect the efficiency of the spear-fishing harvest. Low water makes boat travel difficult and may keep the fish from migrating upstream (Kramer 1977, 1978); however, low water may also concentrate the fish and make them more vulnerable to wading spear fishermen (Kramer 1979). Since 1979, muddy water caused by placer mining upstream has made spearfishing very difficult until the water clears in late September (Kramer 1980, 1981; Hallberg 1984). In 1981, the river never cleared, and whitefish harvest was negligible (Kramer and Hallberg 1982).

Grayling are also harvested from the Chatanika River. This fishery occurs along the Steese Highway from 31 mi to about 80 mi on the road. There are numerous access points, but the most important is the state campground at mile 40 (Kramer 1975). A survey in 1974 found that anglers on the Chatanika released 55% of the grayling they caught. Local residents made up 57% of the anglers contacted; 19% were military personnel; and 24% were tourists (ibid.).

The Chena River, which enters the Tanana River just below the city of Fairbanks, supports the largest sport fishey in the Interior and Western regions (table 35). The Chena Hot Springs Road, which parallels the Chena River from mile 26 to its terminus at mile 60, crosses the upper Chena River seven times, providing easy access for fishermen. The availability of the upper Chena River for one-day road access trips from Fairbanks is a major reason for the high use of the area (Holmes 1981). Recent campsite construction in the upper Chena River area by the Alaska Department of Natural Resources, Division of Parks, has increased access to the river and furthered recreational use (Holmes 1985). The upper Chena River provides varied fishing experiences for anglers. Many anglers fish near the bridges that cross the river, but for those anglers seeking more privacy there are many less crowded areas that can be reached by side roads (Holmes 1981). Short hikes up or downstream from the bridges will give an angler more solitude and often provide better fishing as well. It is also possible for anglers to float between the bridges with rafts or canoes to find better fishing (ibid.).

The Chena River contains many species of fish, but grayling is the principal species of recreational importance. The Chena River supports the largest grayling fishery in the state (Mills 1985). The upper Chena River grayling fishery takes place throughout the summer, from breakup in May until cold weather arrives in September. Higher catch rates tend to occur early and late in the season, reflecting grayling migrations through the fishery (Holmes 1984); however, weather strongly affects angler effort and rate of harvest. Poor weather and high water due to rain often reduce catch rates, and in 1983, silty water due to placer mining on the East Fork reduced catch rates in parts of July and August (ibid.). Angler effort and harvest in the month of May (the time of the major upstream migration of grayling) is enhanced in years with low water levels. In favorable years the highest use of the Chena River all summer may occur on Memorial Day weekend (Holmes 1981). The May grayling harvest tends to include a larger proportion of larger, mature fish than harvests during other months and must be carefully monitored (Hallberg 1982; Holmes 1983, 1984). During other months, ages 3 and 4 fish normally make up the bulk of the grayling harvest. Because of the dependence of this fishery on only two age classes of fish, a single weak year class can have a major effect on harvest levels (Holmes 1983). Annual harvest of grayling from the upper Chena River as estimated by the Statewide Harvest Survey has averaged 13,060 fish (table 23). More detailed harvest and effort information can be found in Federal Aid in Fish Restoration Job R-I reports, which contain results of the on-site creel census conducted on the upper Chena River each year.

A grayling fishery also takes place on Badger Slough, a 16-mi-long spring-fed tributary that flows into the Chena River at river mile 21. Warm springs in Badger Slough cause parts of it to become ice-free as early as the middle of April (Hallberg 1978), allowing for an extensive early season grayling fishery. The bulk of fishing effort occurs during the grayling spawning runs in May (Holmes 1983).

Chena Lake, located approximately 18 mi south of Fairbanks on the Army Corps of Engineers Chena River Flood Control Project, is a new lake, made from a group of central borrow pits during construction of the flood control project (Kramer and Hallberg 1982). Rainbow trout and landlocked coho salmon were stocked in Chena

Lake for the first time in 1982. The Corps of Engineers closed access to the project until all construction activities were completed in spring 1984 (Hallberg 1984). In 1984, a large harvest of rainbow trout and landlocked salmon was taken from Chena Lake, and it recieved 11,000 angler-days of effort (table 35). Effort expended on the upper Chena River declined in 1984, possibly because Chena Lake relieved some of the fishing pressure usually exerted on the upper Chena (Holmes 1985).

The Salcha River, which enters the Tanana River upstream from the Chena River, also provides a harvest of grayling, along with a small harvest of chinook and chum salmon. The chinook salmon harvest takes place from late June through late July. Annual harvest of chinook salmon from the Salcha River in 1977 through 1984 averaged 520 fish, along with 215 chum salmon (tables 32 and 33). Angler effort in this fishery is concentrated from the Richardson Highway brige to the Salcha River's confluence with the Tanana River (Doxey 1984). A boat charter service operates in the lower river, and many anglers use their own boats (ibid.). Jacks (precoious males) comprise a large portion of the harvest in this fishery (ibid.).

Harding Lake is located 45 mi southeast of Fairbanks along the Richardson Highway. The lake's fish community includes indigenous northern pike, burbot, and least cisco. Harding Lake also contains a small naturally reproducing population of lake trout that were stocked in the lake in 1939, 1963, and 1965 as adults and in 1967 as fingerlings. Landlocked coho salmon have also been stocked in Harding Lake intermitently from 1968 to 1981, and in 1982 and 1984 the lake was stocked with sheefish. The contribution of stocking to the harvest from this lake, however, has thus far been negligible. The natural populations of pike and burbot remain the basis of a light intensity sport fishery on the lake. The fishery for burbot begins immediately after freeze-up. Burbot apparently move into shoal areas of the lake and are harvested readily on set lines in these areas until mid December, when fishing slows down (Doxey 1981). Small numbers of burbot continue to be taken throughout the rest of the year. A summer set line fishery for burbot in Harding Lake takes place from late May to late June (Doxey 1984).

Birch Lake, 56 mi southeast of Fairbanks on the Richardson Highway, has been stocked with both rainbow trout and landlocked salmon over the years. Harvest of these stocked fish takes place during summer and via an ice fishery in the winter. The U.S. Air Force maintains a recreation camp on Birch Lake, and heavy summer use of this camp contributes significantly to angler pressure on the lake. About half the shoreline is privately owned, but there is a state parking and boat-launching area on the eastern shoreline and a turnout and parking area on the south end of the lake. In the winter, fishermen can generally drive an automobile onto Birch Lake, starting in December. Fishermen then may either fish in the open, using their cars for shelter, or may use an ice-fishing shanty (Doxey 1981). Shanties must be registered with the ADF&G, and in the winter of 1982-1983, 30 shanties were in use on Birch Lake (Doxey 1984). Harvest of rainbow trout from Birch Lake has averaged 17,600 fish annually from 1980 through 1984 (table 25), and landlocked salmon harvest has averaged 30,150 fish (table 24). Harvest of these species fluctuates a great deal in Birch Lake, depending upon the availability of fish for stocking.

Quartz Lake is a 1,500-acre lake located near the Richardson Highway approximately 16 mi north of Delta Junction. This lake is stocked regularly with landlocked coho salmon and rainbow trout. Quartz Lake has recieved an average of 12,400 angler-days of effort annually from 1977 through 1984 (table 35). Harvest of rainbow trout and landlocked salmon varies, depending upon the availability of fish for stocking. Landlocked salmon provide most of the harvest (table 24); however, some anglers fish selectively for rainbow trout (Peckham 1979). Rainbow trout harvest increased in 1981 and 1982 as a result of 1979 and 1980 plants of Swanson River strain rainbow trout (Peckham 1983). During the summer, anglers at Birch Lake fish both from shore and in boats; however, shore anglers account for only a very small percentage of the effort and harvest (Peckham 1981). On-site creel censuses are conducted on Quartz Lake in both summer and winter. Results of these creel censuses, which contain information on harvest rate and timing, can be found in Federal Aid in Fish Restoration reports for Job G-III-I.

A popular sport fishery for grayling is supported by the Delta Clearwater River. The Delta Clearwater is popular with fishermen and recreationists because of its road access, state campground, aesthetics, and good fishing for grayling (Ridder 1984). Public access is available at the State of Alaska Clearwater Campground at mi 8 of the river, which includes a boat-launching ramp. Downstream access is also provided via Clearwater Lake, where the U.S. Army has a launching facility. The two access points provide a popular float trip for canoists and kayakers (Ridder 1982). The middle section of the

Delta Clearwater is readily accessible to shore anglers, but in 1983 67% of anglers interviewed on the Delta Clearwater were fishing from boats (Ridder 1984). The majority of anglers, whether they use a boat or go on foot, fish within 3 mi of the main access points at mi 8 of the river (Ridder 1981). In 1983, interviewed boat anglers had a catch rate of 0.81 grayling caught and kept per hour, and interviewed shore anglers had a catch rate of 0.46 grayling per hour (Ridder 1984). The Delta Clearwater was stocked with grayling in 1974, 1975, 1976, 1983, and 1984. Stocked grayling make a significant contribution to the harvest. In 1980, stocked grayling from four age classes, 1975 through 1978, were responsible for 31% of the grayling examined during the on-site creel census (Ridder 1981). In 1981 and 1982, these pond-reared grayling made up approximately 23 and 24% of the creel sample, respectively (Ridder 1982, 1983). However, the percentage contribution of pond-reared grayling dropped by about one-half in 1983. The reasons for this sudden decline are not known but may be related to difficulties in identifying pond-reared fish as they grow older, differential mortality of pond-reared and wild grayling, increased straying of pond-reared fish from their stocking site, or additional recruitment of wild fish (Ridder 1984).

The Delta Clearwater also supports a growing fishery for fall-run coho salmon (Ridder 1981). In 1984, the harvest of coho salmon from the Delta Clearwater was estimated to be 571 fish (table 34). Also in this area, the Goodpaster River, the Richardson Clearwater River, and Shaw Creek provide additional grayling fishing. The Richardson Clearwater is accessible only by boat or float plane, and angling is predominantly by area residents, although use by anglers from outside the immediate area increased in 1982 (Ridder 1983, 1984). The Shaw Creek fishery takes place in the spring and focuses predominantly on prespawning grayling that concentrate at the mouth of the creek prior to breakup (Ridder 1982). Highway construction in 1976 rerouted the mouth of the creek, and the fishery was curtailed until 1981, when late breakup of Shaw Creek and changing river channels again allowed grayling to concentrate at the mouth (ibid.). This is a roadside fishery, with a 1983 angler composition of 55% residents, 33% military personnel and dependents, and 12% of unknown classification (Ridder 1984).

The Delta River flows from the Tangle Lakes to the Tanana River near Delta Junction. The river offers a high quality recreational experience, where floating (by canoe, kayak, or rafts) in combination with excellent grayling fishing can be enjoyed in an area of high scenic appeal (Peckham 1984). The Alaska National Interest Lands Conservation Act of 1980 established the upper Delta River, Tangle Lakes, and Tangle River as a component of the National Wild and Scenic River System, to be administered by the Bureau of Land Management (ibid.). The Tangle Lakes and Tangle River portion of the system is classified as "scenic," and the 20-mi stretch between the lakes and the Richardson Highway is designated "wild" (ibid.). Recreational users generally float the river from Tangle Lakes Campground at Mile 21 on the Denali Highway to just below Phelan Creek at Mile 212 on the Richardson Highway, a distance of approximately 28 mi (Peckham 1984, USDI n.d.). The Tangle Lakes Campground has a boat launch as well as camping facilities. Air boats and boats with jet units are also used for upstream access. The BLM estimated in 1982 that nearly 2,200 user-days were expended floating the Delta River (with any portion of a day spent on the river counted as one whole user-day). Approximately 120 user-days were also expended on the Delta River by people using mortorized boats to go upriver from mile 212 (USDI 1975-1982). The average length of a float trip is about three days (USDI 1975-1982, Peckham 1984). Downstream from its confluence with Eureka Creek the Delta River becomes glacial and offers little fishing potential (Carlton 1976; Kramer, pers. comm.).

A boat launch is also located in Tangle River Campground at mile 22 of the Denali Highway. This launch provides access to the upper Tangle Lakes and Tangle River. The majority of fishing in Tangle Lakes is for grayling, but good lake trout fishing is available in late winter and early spring (USDI n.d.).

Fielding Lake, in the Delta River drainage, provides a harvest of lake trout, burbot, and grayling (Peckham 1984). Harvest occurs during both winter and summer months. Set lines are used to harvest burbot through the ice in winter and are attached to floats to harvest burbot in summer (ibid.). Grayling are harvested by anglers at the outlet stream near the lake's public campground and by anglers with boats (Peckham 1983).

George Lake, which drains into the Tanana River about 40 mi east of Delta Junction, supports a popular fishery for northern pike. George Lake is accessible only by boat or float plane in summer or snowmachine or ATV in winter. Most anglers launch their boats at George Lake Lodge near mile 1385 of the Alaska Highway, while a few launch at a landing about 15 mi downstream on the Tanana River (Peckham 1981). Until 1980, the owner of George

Lake Lodge also transported anglers to the lake (ibid.). Fishing pressure is heaviest on George Lake from breakup around the first of June until mid July. In 1983, a limited summer creel census resulted in an estimate of 0.38 pike caught and kept per hour, with a mean length of 546 mm.

In the upper Tanana River drainage, most fishing is done by local residents. Four Mile Lake, near Tok, has been stocked with sheefish and rainbow trout. Sheefish in this lake are naturally reproducing but have not supported a large sport fishery. Four Mile Lake is primarily used by anglers from the vicinity of Tok (Peckham 1983).

In the Tetlin National Wildlife Refuge, fishing takes place primarily in road-accessible lakes and streams or fly-in lakes (USFWS 1985b). Fishing guide service is available in Tok, but demand for these services is low (ibid.).

c. Management considerations. Fairbanks area fisheries support the recreational needs of a rapidly growing population. Although the Fairbanks Area is large, the network of roads in the area is limited and provides access to only a fraction of potential fishing sites. Because of this, fishing pressure tends to concentrate on a few readily accessible and productive fisheries. These popular fisheries must be carefully monitored to ensure that quality fishing opportunities continue to be available to the public and that the integrity of fish populations is maintained. Grayling harvest from the Chena River is particularly sensitive because harvest relies on only two age classes of fish. Two successive years of poor recruitment could seriously reduce the harvest in this fishery.

As the population grows and recreational demands for fishing opportunities increase, so do other demands and stresses on the resource. Placer mining activities in the Fairbanks Area have caused siltation of some clearwater streams and reduced fishing opportunities. The Chatanika River spear fishery for whitefish and the grayling fishery on the East Fork of the Chena River have both been affected by placer mining siltation (Kramer 1980, 1981, Hallberg 1984, Holmes 1984). In the Delta area, runoff from recent agricultural development may be affecting the water quality of the Delta Clearwater River (Ridder 1983). Land allocations and development may also reduce fishing opportunities in the Fairbanks Area by blocking access to existing or potential fisheries.

Table 1. Lower Yukon-Kuskokwim Area Sockeye Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	143
Goodnews R.	---	---	---	---	---	---	14	---
Other streams	---	---	---	---	---	---	206	156
Lakes	---	---	---	---	---	---	41	0
Total	69	85	126	112	117	430	261	299

Source: Mills 1979-85.

--- means no data were available.

Table 2. Lower Yukon-Kuskokwim Area Coho Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	367	1,895
Goodnews R.	---	---	---	---	---	---	168	---
Other streams	---	---	---	---	---	---	1,427	1,728
Lakes	---	---	---	---	---	---	0	0
Total	430	566	537	2,014	583	2,923	1,962	3,623

Source: Mills 1979-85.

--- means no data were available.

Table 3. Lower Yukon-Kuskokwim Area Chinook Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	26
Kanektok R.	---	---	---	---	---	---	1,511	922
Goodnews R.	---	---	---	---	---	---	31	---
Other streams	---	---	---	---	---	---	420	273
Lakes	---	---	---	---	---	---	0	0
Total	177	629	400	878	1,020	1,121	1,962	1,221

Source: Mills 1979-85.

--- means no data were available.

Table 4. Lower Yukon-Kuskokwim Area Pink Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	210	195
Goodnews R.	---	---	---	---	---	---	168	---
Other streams	---	---	---	---	---	---	42	156
Lakes	---	---	---	---	---	---	0	0
Total	114	929	0	112	17	472	420	351

Source: Mills 1979-85.

--- means no data were available.

Table 5. Lower Yukon-Kuskokwim Area Chum Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	315	376
Goodnews R.	---	---	---	---	---	---	10	---
Other streams	---	---	---	---	---	---	922	520
Lakes	---	---	---	---	---	---	0	0
Total	241	1,034	482	603	1,113	2,096	1,247	896

Source: Mills 1979-85.

--- means no data were available.

Table 6. Lower Yukon-Kuskokwim Area Rainbow Trout Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	640	312
Goodnews R.	---	---	---	---	---	---	52	---
Other streams	---	---	---	---	---	---	934	1,104
Lakes	---	---	---	---	---	---	157	26
Total	223	362	401	835	982	796	1,783	1,442

Source: Mills 1979-85.

--- means no data were available.

Table 7. Lower Yukon-Kuskokwim Area Char Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	1,406	1,116
Goodnews R.	---	---	---	---	---	---	147	---
Other streams	---	---	---	---	---	---	3,041	702
Lakes	---	---	---	---	---	---	125	65
Total	1,689	1,944	1,854	1,300	1,668	3,375	4,719	1,883

Source: Mills 1979-85.

--- means no data were available.

Table 8. Lower Yukon-Kuskokwim Area Lake Trout Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	117
Goodnews R.	---	---	---	---	---	---	0	---
Other streams	---	---	---	---	---	---	0	78
Lakes	---	---	---	---	---	---	419	467
Total	124	172	218	267	117	503	419	662

Source: Mills 1979-85.

--- means no data were available.

Table 9. Lower Yukon-Kuskokwim Area Arctic Grayling Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	231	169
Goodnews R.	---	---	---	---	---	---	178	---
Other streams	---	---	---	---	---	---	8,550	2,013
Lakes	---	---	---	---	---	---	136	52
Total	4,090	5,053	7,466	9,127	6,553	8,499	9,095	2,234

Source: Mills 1979-85.

--- means no data were available.

Table 10. Lower Yukon-Kuskokwim Area Northern Pike Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	0
Goodnews R.	---	---	---	---	---	---	0	---
Other streams	---	---	---	---	---	---	5,769	1,442
Lakes	---	---	---	---	---	---	650	78
Total	1,652	2,667	2,800	4,339	3,433	6,257	6,419	1,520

Source: Mills 1979-85.

--- means no data were available.

Table 11. Lower Yukon-Kuskokwim Area Whitefish Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	13
Goodnews R.	---	---	---	---	---	---	0	---
Other streams	---	---	---	---	---	---	2,349	65
Lakes	---	---	---	---	---	---	881	0
Total	221	772	419	284	367	1,394	3,230	78

Source: Mills 1979-85.

--- means no data were available.

Table 12. Lower Yukon-Kuskokwim Area Burbot Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	0
Goodnews R.	---	---	---	---	---	---	0	---
Other streams	---	---	---	---	---	---	472	0
Lakes	---	---	---	---	---	---	0	0
Total	226	362	91	646	554	1,771	472	0

Source: Mills 1979-85.

--- means no data were available.

Table 13. Lower Yukon-Kuskokwim Area Sheefish Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Salt water	---	---	---	---	---	---	---	0
Kanektok R.	---	---	---	---	---	---	0	0
Goodnews R.	---	---	---	---	---	---	0	---
Other streams	---	---	---	---	---	---	838	481
Lakes	---	---	---	---	---	---	63	0
Total	294	479	427	568	559	765	901	481

Source: Mills 1979-85.

--- means no data were available.

Table 14. Lower Yukon-Kuskokwim Area Sportfishing Effort Expressed as Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the Lower Yukon-Kuskokwim Area Each Year

	1977		1978		1979		1980		1981		1982		1983		1984	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Salt water	---	---	---	---	---	---	---	---	---	---	---	---	---	---	122	0.8
Kanektok R.	---	---	---	---	---	---	---	---	---	---	---	---	1,517	9.2	6,881	47.1
Goodnews R.	---	---	---	---	---	---	---	---	---	---	---	---	742	4.5	---	---
Other streams	---	---	---	---	---	---	---	---	---	---	---	---	13,274	80.3	6,776	46.4
Lakes	---	---	---	---	---	---	---	---	---	---	---	---	995	6.0	818	5.6
Total	7,337	100.0	8,616	100.0	11,331	100.0	11,209	100.0	10,605	100.0	16,162	100.0	16,528	100.0	14,597	99.2

Source: Mills 1979-85.

--- 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 15. South Slope Brooks Range Area Chum Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	0
Streams[a]	---	---	---	---	---	---	297	0
Lakes	---	---	---	---	---	---	0	0
Total	7	0	0	0	11	21	297	0

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 16. South Slope Brooks Range Area Char Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	0
Streams[a]	---	---	---	---	---	---	594	143
Lakes	---	---	---	---	---	---	0	0
Total	11	0	45	60	162	178	594	143

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 17. South Slope Brooks Range Area Lake Trout Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	0
Streams[a]	---	---	---	---	---	---	0	0
Lakes	---	---	---	---	---	---	148	39
Total	496	307	173	362	313	723	148	39

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 18. South Slope Brooks Range Area Burbot Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	0
Streams[a]	---	---	---	---	---	---	0	52
Lakes	---	---	---	---	---	---	0	0
Total	0	0	0	0	97	31	0	52

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 19. South Slope Brooks Range Area Sheefish Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	0
Streams[a]	---	---	---	---	---	---	186	78
Lakes	---	---	---	---	---	---	0	0
Total	139	72	127	34	324	167	186	78

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 20. South Slope Brooks Range Area Arctic Grayling Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	3,285
Streams[a]	---	---	---	---	---	---	6,070	1,688
Lakes	---	---	---	---	---	---	111	766
Total	1,032	2,106	6,072	6,079	3,985	4,821	6,181	5,739

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 21. South Slope Brooks Range Area Northern Pike Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Haul Road streams[a]	---	---	---	---	---	---	---	143
Streams[a]	---	---	---	---	---	---	0	2,388
Lakes	---	---	---	---	---	---	130	39
Total	215	470	227	715	983	514	130	2,570

Source: Mills 1979-85.

--- means no data were available.

a Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 22. South Slope Brooks Range Area Sportfishing Effort Expressed as Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the South Slope Brooks Range Area Each Year

Location	1977 No.	1977 %	1978 No.	1978 %	1979 No.	1979 %	1980 No.	1980 %	1981 No.	1981 %	1982 No.	1982 %	1983 No.	1983 %	1984 No.	1984 %
Haul Road streams	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1,811	35.4
Streams	---	---	---	---	---	---	---	---	---	---	---	---	5,966	86.2	2,404	46.9
Lakes	---	---	---	---	---	---	---	---	---	---	---	---	955	13.8	906	17.7
Total	2,156	100.0	2,714	100.0	3,407	100.0	3,612	100.0	4,483	100.0	7,182	100.0	6,921	100.0	5,121	100.0

Source: Mills 1979-85.

--- 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 Haul Road streams were not reported separately from all other streams in 1977 through 1983.

Table 23. Fairbanks Area Arctic Grayling Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	21,723	33,330	---	---	---	---	---	---
Upper Chena R.[b]	---	---	11,664	16,588	13,735	12,907	10,835	12,630
Lower Chena R.[c]	---	---	11,290	18,520	10,814	11,117	7,894	13,850
Badger Slough[d]	---	---	5,023	6,717	2,999	5,294	3,137	3,920
Chatanika R.	6,737	9,284	6,121	5,143	3,808	6,445	9,766	4,180
Salcha R.	6,387	9,067	5,980	5,351	3,983	6,843	9,640	13,305
Delta Clearwater R.	6,118	7,657	6,492	5,680	7,362	4,779	6,546	4,193
Richardson Clearwater R.	---	---	---	---	1,562	1,729	2,822	---
Goodpaster R.	---	---	---	---	---	---	3,021	1,194
Piledriver Slough	---	---	---	---	---	---	5,822	3,751
Shaw Creek	---	---	---	---	---	---	---	2,570
Tanana R.	---	---	---	---	---	---	---	1,012
Other streams	---	---	---	---	---	---	20,744	12,647
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	27	9	17	6	0	0	65
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	1,913	3,044	2,035	935
Minto Flats	243	189	145	104	76	170	262	299
Tangle Lakes	---	5,786	3,466	5,522	6,858	9,590	7,794	4,829
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	2,045	4,246
Others	16,585	17,935	20,053	16,508	22,172	19,835	---	---
Total	57,793	83,275	70,243	80,150	75,288	81,753	92,363	83,626

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 24. Fairbanks Area Land Locked Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	0	0	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	59	0
Lower Chena R.[c]	---	---	0	0	0	0	0	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	0	0	0	0	0	0	0	0
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	262	0
Birch L.	5,697	6,354	132	0	2,549	6,275	8,686	6,049
Quartz L.	0	14,892	34,787	23,316	50,965	35,380	24,042	17,069
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	21	0
Chena L.	---	---	---	---	---	---	---	5,036
Harding L.	---	---	---	---	---	---	---	65
Other lakes	---	---	---	---	---	---	1,185	1,026
Others	1,454	1,166	1,154	2,417	3,780	1,719	---	---
Total	7,151	22,412	36,073	25,733	57,294	43,374	34,255	29,245

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 25. Fairbanks Area Rainbow Trout Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	0	0	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	0
Lower Chena R.[c]	---	---	0	0	0	0	0	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	0	0	0	0	0	0	0	0
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	8	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	41	0
Birch L.	1,850	5,126	4,190	18,727	21,622	18,385	16,963	12,123
Quartz L.	2,634	512	273	129	1,869	5,003	1,574	5,491
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	12,032
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	2,086	4,376
Others	1,508	768	723	728	1,080	2,790	---	---
Total	5,992	6,406	5,186	19,584	24,571	26,186	20,664	34,022

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 26. Fairbanks Area Northern Pike Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	871	452	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	286
Lower Chena R.[c]	---	---	437	458	277	314	392	415
Badger Slough[d]	---	---	0	0	56	63	388	363
Chatanika R.	121	407	71	458	28	305	713	389
Salcha R.	0	0	0	0	0	0	0	234
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	65
Piledriver Slough	---	---	---	---	---	---	31	52
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	65
Other streams	---	---	---	---	---	---	1,037	1,597
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	52	0
George L.	1,227	1,392	2,018	1,395	2,236	1,635	1,322	1,700
Volkmar L.	---	---	---	---	648	777	430	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	3,615	3,300	3,209	3,909	2,009	1,886	1,825	1,960
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	766
Other lakes	---	---	---	---	---	---	4,035	1,715
Others	3,511	2,287	2,240	3,232	4,687	4,842	---	---
Total	9,345	7,838	7,975	9,452	9,941	9,822	10,225	9,607

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 27. Fairbanks Area Whitefish Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	538	187	---	---	---	---	---	---
Upper Chena R.[b]	---	---	40	54	129	21	202	260
Lower Chena R.[c]	---	---	309	882	345	210	422	519
Badger Slough[d]	---	---	273	96	209	231	440	104
Chatanika R.	1,635	6,013	3,021	3,340	3,185	6,640	5,895	9,268
Salcha R.	45	137	44	17	56	94	94	117
Delta Clearwater R.	28	0	53	0	203	94	262	325
Richardson Clearwater R.	---	---	---	---	22	31	84	---
Goodpaster R.	---	---	---	---	---	---	0	65
Piledriver Slough	---	---	---	---	---	---	10	350
Shaw Creek	---	---	---	---	---	---	---	182
Tanana R.	---	---	---	---	---	---	---	52
Other streams	---	---	---	---	---	---	566	182
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	12	0	9	0	0	0	0	65
Volkmar L.	---	---	---	---	0	21	21	---
Fielding L.	---	---	---	---	11	31	0	0
Minto Flats	31	62	91	138	0	10	0	13
Tangle Lakes	---	137	31	574	97	73	315	78
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	0	78
Others	1,089	37	1,288	857	616	1,187	---	---
Total	3,378	6,573	5,159	5,958	4,873	8,643	8,311	11,658

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 28. Fairbanks Area Burbot Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	642	389	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	532
Lower Chena R.[c]	---	---	807	1,127	1,188	1,436	1,034	597
Badger Slough[d]	---	---	0	0	129	21	21	104
Chatanika R.	34	18	9	50	5	42	21	13
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	29	0	0	0	13
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	221
Piledriver Slough	---	---	---	---	---	---	84	0
Shaw Creek	---	---	---	---	---	---	---	415
Tanana R.	---	---	---	---	---	---	---	1,921
Other streams	---	---	---	---	---	---	3,146	935
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	5	0	64	0	68	31	105	143
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	249	365	367	0
Minto Flats	37	72	45	9	32	21	0	39
Tangle Lakes	---	72	88	229	194	105	84	39
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	428
Other lakes	---	---	---	---	---	---	178	156
Others	829	832	966	1,285	2,257	1,866	---	---
Total	1,547	1,383	1,979	2,729	4,122	3,887	5,040	5,556

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 29. Fairbanks Area Lake Trout Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	0	0	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	0
Lower Chena R.[c]	---	---	0	0	0	0	0	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	0	0	0	0	0	0	0	0
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	188	546
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	295	346	294	169
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	416	428	603	864	1,079	2,088	636
Chena. L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	367	753
Others	1,471	187	518	661	562	1,679	---	---
Total	1,471	603	946	1,264	1,721	3,104	2,937	2,104

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 30. Fairbanks Area Char Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	0	0	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	0
Lower Chena R.[c]	---	---	0	0	0	0	0	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	0	0	0	0	0	0	0	0
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	293	350
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	0	0
Others	877	524	364	524	572	482	---	---
Total	877	524	364	524	572	482	293	350

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 31. Fairbanks Area Sheefish Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	37	18	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	13
Lower Chena R.[c]	---	---	26	21	50	10	0	117
Badger Slough[d]	---	---	0	0	0	0	0	26
Chatanika R.	14	54	26	25	0	31	94	143
Salcha R.	0	0	0	0	0	0	0	0
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	13
Other streams	---	---	---	---	---	---	0	13
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	68	90	182	25	11	10	63	0
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	0	13
Others	39	72	45	25	32	76	---	---
Total	158	234	279	96	93	127	157	338

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 32. Fairbanks Area Chinook Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	29	23	---	---	---	---	---	---
Upper Chena R.[b]	---	---	10	0	0	0	0	0
Lower Chena R.[c]	---	---	0	0	39	31	31	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	9	35	29	37	5	136	147	78
Salcha R.	62	105	476	904	719	817	808	260
Delta Clearwater R.	0	0	0	0	0	0	0	0
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana River	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	10	0
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	52	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	0	0
Others	0	0	0	0		0	---	---
Total	100	163	515	941	763	984	1,048	338

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 33. Fairbanks Area Chum Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	43	20	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	39
Lower Chena R.[c]	---	---	9	21	0	0	10	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	34	20	0	104	0	68	136	78
Salcha R.	27	59	146	196	368	441	273	208
Delta Clearwater R.	19	59	0	25	0	21	63	182
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	157	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	0
Other streams	---	---	---	---	---	---	10	78
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	55	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	0	0
Others	177	0	9	137	227	168	---	---
Total	300	158	219	483	595	698	649	585

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 34. Fairbanks Area Coho Salmon Sport Harvest, 1977-84

Location	1977	1978	1979	1980	1981	1982	1983	1984
Chena R., Badger Sl.[a]	0	0	---	---	---	---	---	---
Upper Chena R.[b]	---	---	0	0	0	0	0	0
Lower Chena R.[c]	---	---	0	0	0	0	0	0
Badger Slough[d]	---	---	0	0	0	0	0	0
Chatanika R.	0	0	0	0	0	0	0	13
Salcha R.	0	0	0	0	0	0	0	26
Delta Clearwater R.	31	126	0	25	45	21	63	571
Richardson Clearwater R.	---	---	---	---	0	0	0	---
Goodpaster R.	---	---	---	---	---	---	0	0
Piledriver Slough	---	---	---	---	---	---	0	0
Shaw Creek	---	---	---	---	---	---	---	0
Tanana R.	---	---	---	---	---	---	---	26
Other streams	---	---	---	---	---	---	0	26
Birch L.	0	0	0	0	0	0	0	0
Quartz L.	0	0	0	0	0	0	0	0
George L.	0	0	0	0	0	0	0	0
Volkmar L.	---	---	---	---	0	0	0	---
Fielding L.	---	---	---	---	0	0	0	0
Minto Flats	0	0	0	0	0	0	0	0
Tangle Lakes	---	0	0	0	0	0	0	0
Chena L.	---	---	---	---	---	---	---	0
Harding L.	---	---	---	---	---	---	---	0
Other lakes	---	---	---	---	---	---	84	169
Others	63	13	25	42	0	31	---	---
Total	94	139	25	67	45	52	147	831

Source: Mills 1979-85.

--- means no data were available.

a All Chena River locations were reported together in 1977-78.

b The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

c The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

d All parts of Badger Slough (sometimes called Chena Slough).

Table 35. Fairbanks Area Sportfishing Effort Expressed as Angler-Days[a] and as a Percentage of the Total Sportfishing Effort in the Fairbanks Area Each Year

	1977		1978		1979		1980		1981		1982		1983		1984	
Location	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Chena R., Badger Sl.[b]	30,002	30.0	38,341	32.1	---	---	---	---	---	---	---	---	---	---	---	---
Upper Chena R.[c]	---	---	---	---	8,016	8.1	10,734	8.2	10,740	9.3	15,166	10.1	16,725	11.5	11,741	8.1
Lower Chena R.[d]	---	---	---	---	9,430	9.6	13,850	10.5	11,763	10.2	18,818	12.5	17,568	12.1	20,556	14.1
Badger Slough[e]	---	---	---	---	4,692	4.8	6,070	4.6	4,250	3.7	6,551	4.4	6,609	4.5	7,926	5.4
Chatanika R.	9,925	9.9	10,835	9.1	4,853	4.9	5,576	4.2	4,691	4.1	9,417	6.3	10,757	7.4	8,605	5.9
Salcha R.	8,167	8.2	9,715	8.1	14,788	15.0	8,858	6.7	8,090	7.0	14,126	9.4	11,802	8.1	8,449	5.8
Delta Clearwater R.	6,881	6.9	7,210	6.0	8,398	8.5	4,240	3.2	4,673	4.1	4,231	2.8	5,867	4.0	5,139	3.5
Richardson Clearwater R.	---	---	---	---	---	---	---	---	916	0.8	1,365	0.9	1,349	0.9	---	---
Goodpaster R.	---	---	---	---	---	---	---	---	---	---	---	---	1,989	1.4	766	0.5
Piledriver Slough	---	---	---	---	---	---	---	---	---	---	---	---	4,148	2.9	4,651	3.2
Shaw Creek	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2,195	1.5
Tanana R.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2,195	1.5
Other Streams	---	---	---	---	---	---	---	---	---	---	---	---	19,054	13.1	10,904	7.5
Birch L.	8,118	8.1	8,982	7.5	7,804	7.9	17,036	13.0	14,233	12.4	16,677	11.1	15,882	10.9	13,170	9.0
Quartz L.	6,317	6.3	6,845	5.7	10,150	10.3	13,994	10.6	19,599	17.0	18,254	12.1	14,162	9.7	15,922	10.9
George L.	854	0.9	1,271	1.1	903	0.9	1,057	0.8	1,351	1.2	989	0.7	860	0.6	1,254	0.9
Volkmar L.	---	---	---	---	---	---	---	---	458	0.4	546	0.4	270	0.2	---	---
Fielding L.	---	---	---	---	---	---	---	---	1,369	1.2	2,764	1.8	1,737	1.2	871	0.6
Minto Flats	3,886	3.9	3,640	3.0	2,709	2.7	2,727	2.1	2,045	1.8	1,791	1.2	1,281	0.9	1,829	1.3
Tangle Lakes	---	---	7,711	6.5	5,864	6.0	8,168	6.2	5,530	4.8	9,502	6.3	5,513	3.8	3,954	2.7
Chena L.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	11,044	7.6
Harding L.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1,707	1.2
Other Lakes	---	---	---	---	---	---	---	---	---	---	---	---	9,813	6.7	12,874	8.8
Others	15,769	25.8	24,814	20.8	20,907	21.2	39,184	29.8	25,391	22.1	30,333	20.2	---	---	---	---
Total	99,919	100.0	119,364	100.0	98,514	100.0	131,494	100.0	115,099	100.0	150,530	100.0	145,386	100.0	145,752	100.0

Source: Mills 1979-85.

--- 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 All Chena River locations were reported together in 1977-78.

c The Chena River and tributaries accessed from the Chena Hot Springs Road beyond 25 Mile on the road.

d The Chena River and tributaries from the mouth upstream to 25 Mile Chena Hot Springs Road.

e All parts of Badger Slough (sometimes called Chena Slough).

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Subsistence and Other Local Uses of Resources in Western Alaska

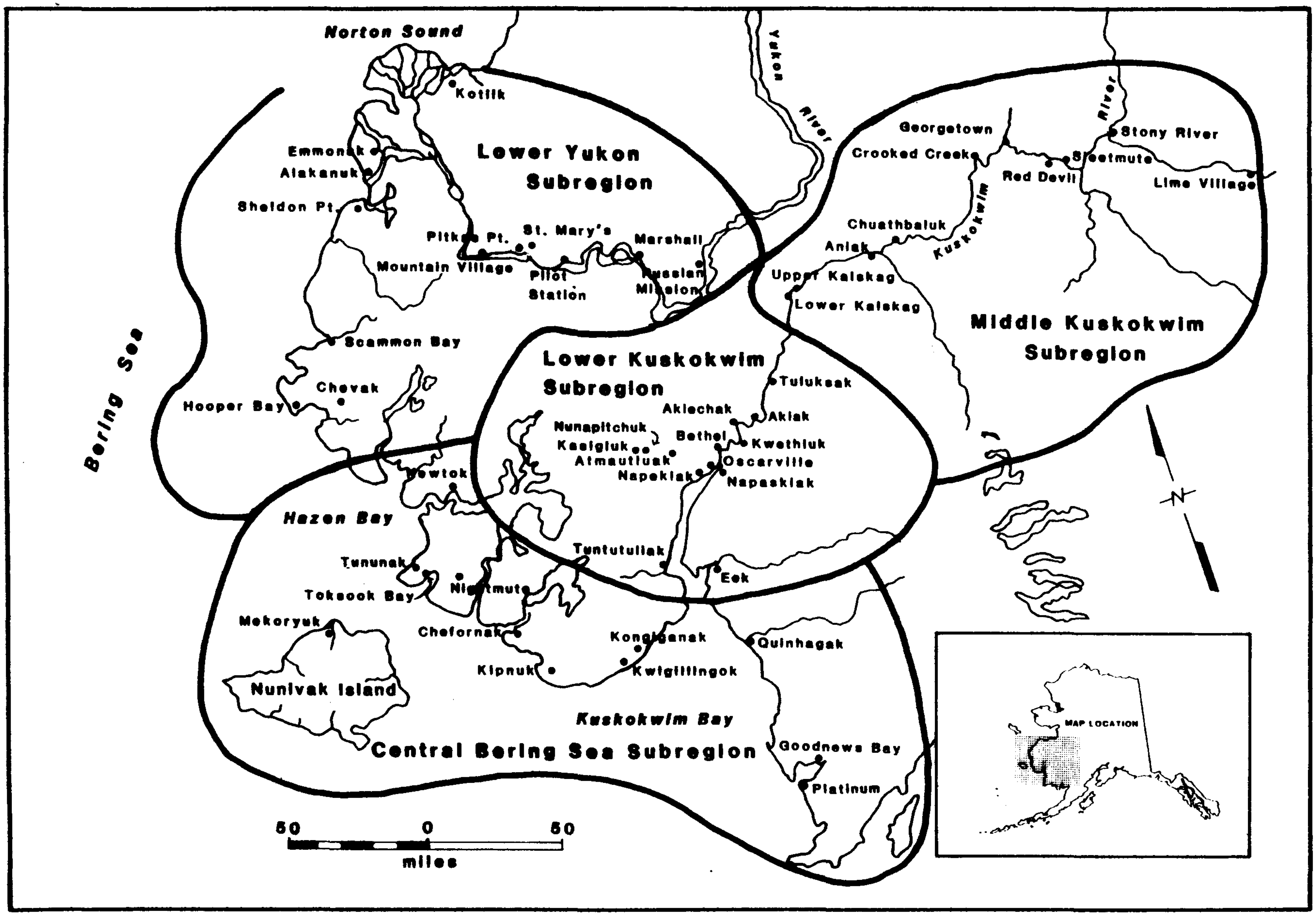
This narrative presents data on the subsistence use of fish and wildlife by residents of the Western Region (map 1). Most of the region's population is located in the 47 communities recognized in the 1980 census (table 1). A small number of people also reside at the Sparrevohn Air Force Station near Lime Village and in the currently unincorporated communities of Andreafsky and Georgetown. Although virtually all of the area's population lives in these named places, a small number of people live at camps, homesteads and remote parcels, mines, and other locations throughout the general use area. Data are drawn primarily from limited ethnographic literature available for Yup'ik people in Western Alaska; Division of Subsistence files and technical reports; interviews with area Division of Subsistence staff and other experts; planning documents and reports produced by local, state, and federal government agencies; and reports by the Association of Village Council Presidents, the region's main Native nonprofit corporation, and by Nunam Kitlutsisti, the regional Native organization most concerned with land use. The reader should consult references listed for this narrative for more detailed information on subsistence uses of fish and game in this region.

Contemporary baseline research on subsistence harvest and use has yet to be completed in all areas and communities of the Western Region (see Haynes and Andrews 1985 for a listing of Division of Subsistence research and reports). Particular data gaps exist for longitudinal estimates of the quantities of fish and wildlife used in each community in the region, distribution and exchange of fish and wildlife products, and subsistence-cash relationships. In addition, subsistence systems are known to change through time with changes in the distribution and abundance of harvested species, harvesting technology, food needs, and other factors. For all of these reasons, this narrative should be regularly updated to include the most current information available.

I. LOCATION AND ENVIRONMENT

A. Major Geographic Features

The region comprises the broad delta formed by the Kuskokwim and Yukon rivers and the surrounding mountain drainages. It includes the land and water area defined by the Calista Corporation regional boundaries and other adjacent areas beyond these boundaries regularly used by area residents (map 1). These boundaries largely coincide with the area north of Cape Newenham, in which Yup'ik Eskimos are the predominant cultural group. In addition to land, rivers, and mountain drainages, the region includes the marine waters and sea ice of Kuskokwim Bay, the central Bering Sea, and Norton Sound within about 100 mi of land



Map 1. Western Alaska subregions and communities (Haynes and Andrews 1985).

from Cape Newenham to just south of Unalakleet. Hunting for sea mammals commonly takes place on the ice itself, from the edge of shore-fast ice, in leads that open in pack ice, and in open ocean waters of the Bering Sea.

The Kuskokwim and Yukon rivers are the largest river systems in the region. The main subsistence use of the riverine environments formed by these rivers takes place downstream of the junction of the Swift River with the Kuskokwim River. The extensive delta areas at the mouths of these rivers and the flat tundra lake areas between these rivers and surrounding their lower tributaries form the dominant topographic characteristic of the region. In addition to these rivers and their tributaries, the Goodnews, Kanektok, Nuvavulnuk, and other rivers support salmon runs that are important parts of area subsistence systems.

The waterways of the region are used extensively for traditional subsistence harvests and for transportation. In many parts of the region, interconnected lakes and small rivers permit safe water transportation between communities that are not connected by riverine transportation routes. After freeze-up, the flat tundra and tundra lake terrain present few topographic obstacles to intercommunity travel by snowmachine or dog sled.

The Akhlun and Kilbuck mountains in the south, the Kuskokwim Mountains in the east, and the Andreafsky Mountains and the Nulato Hills in the north comprise most of the high ground in the region and are areas regularly hunted or traversed for subsistence harvesting by region residents. Nunivak and Nelson islands, located in the central Bering Sea, are the largest islands in the region and support subsistence communities focused on marine resources.

B. Management Units

Most of the land area intensively used for subsistence harvest of fish and game lies within Game Management Unit (GMU) 18 and Game Management Subunits (GMSs) 19A and 22A. Customary and traditional subsistence use of fish and game by residents of the region is also known to occur in portions of GMSs 17A, 17B, 19B, 19C, 19D, 21A, and 21E, and may occur in other as yet undocumented areas as well.

Although some regionwide subsistence use area mapping has been done (Patterson 1974), comprehensive mapping of subsistence use areas in all of the communities of the region has yet to be undertaken. Subsistence resource use mapping has been accomplished by the Division of Subsistence, using standard mapping methodologies, in Chuathbaluk, Hooper Bay, Kipnuk, Kwigillingok, Nunapitchuk, Russian Mission, Sleetmute, Stony River, Tununak, and Tuluksak (see the accompanying subsistence use area maps and the discussion below). More limited mapped data are available for Lime Village (Kari 1983), for lower Yukon communities (Wolfe 1979, 1981), and for other communities (Calista 1985).

C. Climate and Vegetation

1. Climate. The region lies within a subarctic climatic zone characterized by cold winters, cool summers, and little precipitation. Temperatures normally range between -3°F and 62°F, with extremes of around -44°F and 80°F. Precipitation averages about 20 inches per year and includes about 50 inches of snow (Burch 1984b). The temperature of coastal areas is moderated by the Bering Sea. The climate of Lime Village and communities further up the Kuskokwim resembles that of Interior Alaska.

   Because subsistence harvest activities usually depend on some form of transport, freeze-up and breakup mark the most important seasonal climatic changes with the region. Rivers and lakes generally are ice-free for from five to six months of the year. Major land or water travel does not take place during breakup and freeze-up because of unsafe ice and water conditions. The sea is generally ice-free from May to September, although some sea ice may persist in Norton Sound. The extent of pack ice south of Kuskokwim Bay is variable from year to year. Residents of coastal and island communities regularly hunt seals from shore-fast ice and in leads; walruses are hunted along the retreating edge of pack ice in late spring.

   Climatic variability exerts a strong influence on subsistence activities. The timing of breakup and freeze-up, the presence or absence of leads in sea ice accessible from shore, variable snow conditions, as well as periods of extreme cold winds and severe weather, determine what subsistence activities can be undertaken. These climatic conditions are not the same from year to year; the seasonal round of subsistence harvest activities (figs. 1-20) reflect this variability (see Truett et al. 1983; Truett and Raynolds 1983).

2. Vegetation. Most of the region is treeless tundra with a ground cover that includes lichens, mosses, short grasses and sedges, and dwarf shrubs. Numerous species of berries and other edible plants are harvested from this vegetative zone (see tables 6-12 for a listing of species known to be used.)

   Although shrub willows, cottonwoods, and alders are found along rivers and creeks in the lower Kuskokwim drainage, spruce forest extends downriver only about as far as Tuluksak. Upriver from Kalskag, the forest area widens.

Aniak and other upriver communities are located in comparatively dense forests of primarily black spruce, with some birch. A similar situation exists in the Yukon drainage, where true forest extends only about at far as Russian Mission. In the lower river areas, people have traditionally depended on driftwood and fallen trees carried downriver from forested areas during breakup as a source of wood for fuel, construction, and crafts.

II. HISTORY AND PATTERNS OF HUMAN ACTIVITY

A. Original Habitation of the Region

Dumond (1984a, 1984b) summarizes the prehistory and archaeological record of human habitation in the area now inhabited by Yup'ik Eskimos. The area was probably inhabited from at least 10,000 years ago to about 7,000 years ago by people of the Paleo-Arctic Tradition. From about 7,000 years ago to about 4,000 years ago people of the Northern Archaic Tradition lived in the area. This tradition was followed by the Arctic Small Tool Tradition, 4,000 to 3,000 years ago, and by the Norton Tradition, from 3,000 to 1,000 years ago. The Thule Tradition began in about A.D. 1000 and continued until contact with European and American explorers and traders occurred in the 1800's.

The earliest occupation sites in the archaeological record are found slightly outside the region: to the north at Cape Denbigh in Norton Sound, to the southeast in the Naknek River drainage, and to the south at Ugashik on the Alaska Peninsula. Norton Traditional sites are found on Nunivak Island, and Thule Tradition sites have been documented on Nunivak Island and near Hooper Bay.

The archaeological record documents the lengthy human habitation of the area and, more importantly, the cultural roots of the region's contemporary Yup'ik inhabitants. The cultural ancestors of present-day Western Region Yup'ik Eskimos were living in and utilizing the subsistence resources of the region since about A.D. 1000.

The earliest modern records and reports concerning the people of the Western Region were written by explorers, traders, and missionaries post-1840. Zagoskin's account (1967), based on data gathered in 1842-1844, and Nelson's account (1983), based on 1877-1881 data, present some of the best data available for the early contact period. Nelson's book describes the material culture collections he obtained while living in the region from 1877 to 1881. Table 3 presents a listing of early ethnographic documents concerning Yup'ik peoples.

The written record of the early historic period in the Western Region is very thin when compared to published reports of early contact with many other Alaska Natives. Although Russian fur trading produced many early records for Kodiak Island and for southeast Alaska, and commercial whaling produced records for northwest Alaska peoples, no comparable attention was paid to the central Yup'ik area. This lack of early information on the area's population, social organization, and subsistence system is particularly problematic because major changes in the area may have occurred following the smallpox epidemic of 1837 to 1839. Burch (1984b) feels that many important features of the general cultural context were significantly changed as a result of the social disruption and decline in population attendant upon this epidemic. Intersocial warfare ceased abruptly at this time, and changes in the organization of the area into societies may have taken place as well. Social organization of the Yup'ik cultural area before the epidemic may have resembled that described for northwest Alaska in the early nineteenth century (Burch 1978).

Because significant changes occurred in the Yup'ik cultural area before good description was undertaken, problems arise in determining the number and location of traditional societies. Several researchers have attempted to reconstruct the precontact distribution from the limited historical record and through interview data (Dall 1970b, 1977; Fienup-Riordan 1984; Pratt 1984; Shinkwin and Pete 1984a). Shinkwin and Pete (1984) examined historical sources and interviewed elders from communities throughout the region regarding societal groupings. Their data and analysis tentatively list 23 named groups inhabiting what is now the Western Region (table 4). These named groups represent the 19 historical and extant Yup'ik Eskimo regional groups or societies of the Western Region. The named societies and their approximate geographical location are presented in map 2.

Pre-1840, each society was generally endogamous and represented a unit in war. Although alliances, trading, and feasting might occur between societies, these bonds were not nearly as strong as those within a given society (Shinkwin and Pete 1984b). The societal groupings were also important with respect to social organization and subsistence. Intrasocietal kinship and social relationships generally were stronger than intersocietal ones. To some extent members of a society followed similar subsistence strategies within relatively distinct ecological niches and utilized common territories for subsistence harvests.

B. Early Contact Period

Local trade, in which fish and game products were traded between societies in the region or with Eskimo and Indian groups outside the region appears to have been a regular feature of indigenous subsistence systems in the Yukon-Kuskokwim delta area. More long-distance trade began to take place in the last half of the eighteenth century subsequent to Russian movement into eastern

Siberia. Trade flowed from the Siberian Chukchee area to the main Yup'ik area through King Island, Stuart Island, and other middlemen. This trade involved the exchange of Alaskan furs, which, after passing through many middlemen, often were destined to reach the Chinese or European market in exchange for Siberian reindeer skins, iron, tobacco, tea, and limited manufactured items. This trade probably increased in magnitude during the early Russian period (Black 1984, Wolfe 1979).

The Yup'ik cultural area, including the Yukon-Kuskokwim delta, began to be explored by Russians in the early 1800's. Korsakovskiy sighted the mouth of the Kuskokwim in 1819 and established a small post, called Aleksandrovskiy, in Bristol Bay in that same year. Vasilii Khromchenko and Adolph K. Etolin led a Russian-America Company expedition to survey the coast between Cape Newenham and Norton Bay beginning in 1821 and contacted Eskimo subsistence all along this coast. Ivan Ya. Vasilev and Fedor Kolomakov explored parts of the interior of the area between 1829 and 1832, and Kolomakov established a post at Kolomakov Redoubt in 1832 in the middle Kuskokwim. These explorations and the establishment of posts served to involve the Kuskokwim area in Russian fur trading.

Mikhailovskiy Redoubt, later known as St. Michael, was established in 1833 opposite Stuart Island in Norton Sound. This opened the way for Russian penetration of the Yukon the following year. The Yukon River drainage and much of the Kuskokwim and Koyukuk drainages were later explored by Lt. Lavrentii Zagoskin from 1842 to 1844 (VanStone 1984a, Zagoskin 1967).

Trade expanded during the years of active Russian presence in the area from 1833 to 1867. It is important to note, however, that the changes in Yup'ik material culture due to trade were relatively minor. Except for the introduction of some firearms after 1850, some metal implements, and caribou skins for clothing, little change took place.

Subsistence patterns also were not changed significantly, possibly because the returns from trapping were not that substantial under the Russian system. Most trapping during this time period was integrated into existing seasonal rounds of harvest activity, and trapping effort did not increase markedly. In particular, aggressive winter trapping for beaver, land otter, and other furbearers was not common (Wolfe 1979).

After the purchase of Alaska in 1867, the fur trade changed dramatically. Fur prices increased significantly, and the introduction of steamship freight service brought many more goods into the region at a reduced cost. These and other factors may have influenced people of the Yukon-Kuskokwim delta area to incorporate a winter trapping season into the seasonal round, changing a slack season into a season of active harvesting.

Abrupt change, at least in commerce, took place on the Yukon River with the discovery of gold nearby on the Forty Mile River in 1886 and with the Klondike strike in 1897. At one time, over 100 river steamers were plying Yukon waters (Wolfe 1979).

III. POPULATION

Estimates for the population of the region at the time of contact are fragmentary because they are based on limited contact with people living along the coast or exploration routes (Oswalt 1967, 1980). The earliest estimates for many groups were made in 1880 census work, after numerous epidemics and severe social disruption had drastically lowered population size. After closely examining the data available for the Yukon River Yup'ik population, Wolfe (1979) estimates that the society's population was about 1,781 at the time of contact with the Russian subsistence in 1833, about 1,449 in 1880, about 2,096 in 1960, and about 2,722 in 1972. These estimates are roughly in line with population fluctuations documented for other Alaskan Eskimo groups (see Burch 1978).

Eskimo groups usually suffered severe declines in population following contact with Russian subsistence and Euro-Americans because of the introduction of European diseases into virgin populations and because of social disorganization. The severity of one of these epidemics is described by Nelson (1983); Wolfe (1982a) analyzes the effect of measles and influenza epidemics in western Alaska in 1900. Tuberculosis was a major area health problem through the 1950's. The area population only recently has begun to recover from the population decline experienced over the past 150 years. As a very rough estimate, the current regional population is probably about what it was at the time of contact (Haynes and Andrews 1985, pers. comm.; Wolfe 1985).

The centralization of the regional population into permanent year-round communities has been a major demographic change in the region. This change was progressive during the 1850-to-1950 period. At the time of contact, Native societies occupied distinct territories, but extended family group units moved between multiple camps and villages within the societal territory. The succession of camps followed the seasonal round of subsistence harvest activities. Some camps, spring fishing and muskrat trapping camps, for example, might consist of single harvesting units. Summer fishing camps might include a small number of related extended families. Winter locations usually had larger concentrations of people with more permanent dwellings and men's community houses. Some permanent communities were established around early trading posts and administrative centers, which themselves were often located at important Native settlement sites. The establishment of churches and schools further encouraged population concentration.

Table 5 presents recent population data for Western Region communities based on United States decennial censuses. The region's population has increased almost 70% over the 1960-to-1980 time period and, because the population is very young, is likely to experience a similar rate of growth in coming years. Very little of this growth has been the result of migration into the region. The exception is Bethel, which has become an important regional center and tripled in size over this time period, primarily by immigration of persons coming from within and outside the Western Region. Bethel was a much smaller community, with a 1950 population of 651 and a 1939 population of 376, only slightly larger than other important Western Region communities in those years (Rollins 1978). In most communities, almost all of the permanently resident population consists predominantly of Yup'ik Eskimos. Non-Natives present include school teachers and spouses of persons born in the area. Bethel and Aniak, which functions as a regional center for central Kuskokwim communities, contain the only large concentrations of non-Natives in this part of the region. Mountain Village and St. Mary's, located on the Yukon River, have significant non-Native populations as well.

A number of the region's communities have grown quite large for subsistence-based communities. Eight communities, excluding Bethel, had populations approaching 500 persons in the 1980 census.

The region's population history has great relevance to the subsistence harvest and use of natural resources. Although the region's population is presently increasing, the overall quantities of fish and wildlife resources used for subsistence and the pressure put on these resources may continue to be less than that of the precontact period.

As discussed above, the present area population is probably close to the population at time of contact. Given equal food needs from subsistence harvests, about the same overall quantity of fish and wildlife need to be harvested now as in 1800 to feed the human population.

The recent replacement of working dog teams with snowmachines has dramatically reduced the need to harvest and process large quantities of salmon, seal, and other wild resources for dog food. In studies done in Kivalina, a northwest Alaska community, the overall amount and composition of subsistence harvest required to maintain dog teams were estimated to be about the same as that needed to maintain the human population in 1965 to 1966 (Burch 1985).

Good transportation systems and the availability of alternate food resources are related factors relevant to subsistence demand. In the precontact era, a localized food shortage potentially meant famine and starvation (Oswalt 1967, Nelson 1983). Given this potentially fatal outcome, successful subsistence harvesting strategies called for, among other things, the maintenance of a buffer stock of subsistence foods as insurance against possible harvest failure. This buffer stock was essential to survival but might not be consumed either as human or dog food in a typical year. Good transportation systems mean that subsistence foods can more easily move from areas of abundance to areas of scarcity, and alternate food resources have eliminated the possibility of famine. These factors may act to reduce the magnitude of subsistence harvests by lessening the need to keep a sizable stock of insurance food on hand.

IV. REGIONAL ECONOMY

The communities of the region have been found to have mixed, subsistence-based economies. The economies of Western Region communities include a "mix" of subsistence harvest and use of fish and game with cash-generating economic activities.

In approximate order of importance, the cash-generating economic activities within the region include employment by local, state, and federal government agencies, related employment in social service occupations, commercial fishing for salmon in the Yukon and Kuskokwim rivers and for herring and halibut in coastal areas, and employment in sales and services. Trapping provides income to some area residents, although prices for most furs are currently depressed (Wolfe 1984b). There is very limited employment generated by a private business sector, which is essentially nonexistent in most villages.

Employment outside the region accounts for an important share of earned income for certain villages, whose residents periodically leave the area for work in urban Alaska. Some of this labor migration is on a temporary or seasonal basis; some regional residents work on fire-fighting crews in summer months. Some residents of Kuskokwim Bay and the lower Kuskokwim River communities participate in the Bristol Bay commercial salmon fishery. Other area residents spend long periods of time away from the Western Region and may return when they have achieved enough financial security to allow them to come back to home communities. Most typically, however, area residents living outside the region return periodically during the year to participate in local seasonal subsistence harvests.

Table 2 presents income data for Western Region communities for 1978, 1981, and 1982 based on federal income tax returns. Although the general economic condition of these communities has improved in the past decade, income levels remain exceedingly low. The average taxable income per return for Chuathbaluk in 1982 was only 24% that of the Alaska average; the average taxable income for most of the region's communities was less than 50% that of Anchorage in 1982.

Cash-generating activities are very limited in the region, and the cost of living is extremely high. Food-basket data for Bethel indicate that costs of purchased food are about 165% that of Anchorage prices (Stetson 1981-1985). Food prices in village stores are significantly higher than in Bethel and probably run about 200% of Anchorage prices for the limited stock available. Gasoline costs as much as $3.00 per gallon in 1985 in outlying communities (Pete, pers. comm.). Some of the discrepancy between the cash needs of regional residents and earned income is compensated for by subsidies and grants administered through state and federal programs, such as energy and rent assistance; often these are administered by the Association of Village Council Presidents, the region's largest nonprofit corporation.

The economies of Western Region communities continue to be subsistence-based in that subsistence harvest and use of fish and wildlife are the most consistent economic activities that take place during the year and because regional residents continue to rely on local fish and wildlife resources for most of the protein and fat they consume (Durrenberger 1984). Division of Subsistence research throughout the state has identified eight characteristics of mixed, subsistence-based economies (Wolfe et al. 1984). Intensive research has described some aspects of the mixed subsistence-based economies in several Western Region communities (Andrews and Peterson 1983; Charnley 1983; Fienup-Riordan 1983a, 1983b; Stickney 1985; Wolfe 1979, 1981; Wolfe et al. 1984). These characteristics, which apply to Western Region communities, are as follows (Wolfe et al. 1984):

1. Community-wide seasonal round of fishing and hunting activities for subsistence use: subsistence harvest and use varies seasonally with the biological distribution and abundance of fish and game species (figs. 1-20) (Mauss and Beuchat 1979).

2. Large diet breadth relative to fish and wildlife species available: a large proportion of available food species is utilized (figs. 1-20).

3. High overall harvest and use level: resources harvested make a significant contribution to the support of individual households and of the community as a whole. Fish and wildlife supply most of the meat, fish, and fowl used on a household and community basis.

4. Noncommercial distribution and exchange networks: harvested fish and wildlife are distributed between households and between communities.

5. Traditional systems of land tenure and use rights: customary law defines access to resource harvest areas and sites, such as traplines, fish camp sites, set net sites, and community hunting areas, and regulates the resource harvest activities by members of the local social group.

6. Time allocation: a significant amount of time is spent harvesting and processing subsistence fish and wildlife.

7. Complementary cash and subsistence activities: cash income is used to purchase supplies needed for subsistence hunting and fishing; commercial fishing boats and gear may be used for subsistence. Subsistence harvest and use commonly compensate for uncertain cash income and difficult logistics for imported food.

8. Domestic mode of production: the organization of subsistence production is primarily around extended kinship groups and alliances, which differs markedly from the organization of production for a market (Sahlins 1972).

V. TRANSPORTATION

A. Transportation to and from the Region

The major means of personal travel to and from the region are by air. Aniak, Bethel, and sometimes St. Mary's have been connected by regularly scheduled jet flights to Anchorage in most recent years. Both scheduled and charter bush flights serving other communities in the region operate from these regional flight centers.

Frequent travel by snowmachine across the regional boundaries to neighboring villages takes place during months when there is adequate snow cover, particularly in March and April, when days are long and weather generally less severe.

Most fuel, building material, vehicles, food staples, and other items are transported into the region in the summer months, when barge service to coastal communities and to communities in the Yukon-Kuskokwim drainages is possible. Ice is generally present in the Bering Sea well into May, and freeze-up of sea routes can occur as early as the end of September. The Kuskokwim and Yukon rivers are generally ice-free from mid May through mid October. This means that there is a relatively tight window when barge shipments can reach distribution points in the Western Region.

Many of the region's communities, particularly the delta and upper Kuskokwim communities, cannot be reached by ocean-going vessels or barges. Freight shipments for these communities need to be broken down after arriving in the region and sent on smaller vessels. This extra handling of shipments adds to the already high cost of freight entering the region.

During other months of the year, any goods coming into the region must arrive by air freight. This includes all fresh foodstuffs and parts, equipment, and supplies that are not stocked in Bethel or the smaller regional centers.

B. Transportation within the Region

Surface travel between communities in the region is by snowmachine from freeze-up to breakup when there is snow cover and by skiff or boat in months when there is open water. A minimally equipped household needs to have at least one snowmachine and sled for use during frozen months and at least one skiff or boat with an outboard motor for water travel. More adequately equipped or larger families usually have more than one operating snowmachine and more than one outboard motor. Because these pieces of equipment receive heavy use, frequent repair and replacement are necessary. Purchase and maintenance costs of these essential vehicles are major components in household budgets.

Dog teams continue to be maintained by some regional residents who use them for racing and for local transportation. Prior to the introduction of snowmachines in the mid 1960's, virtually all households maintained working dog teams for winter travel and transport. Scheduled small-plane flights and air taxi charters have become increasingly common means of intercommunity personal travel within the region. Given the high cost of fuel and maintenance of personal vehicles, air travel may be the most economical mode of travel between many communities.

Large quantities of goods, fuel oil and gasoline, foodstuffs, and equipment are transported within the region by small barge during the open-water months and by air during most of the year. Small barges or small freighters are able to make summer deliveries to all of the region's communities. Air freight and the postal service are used during winter months.

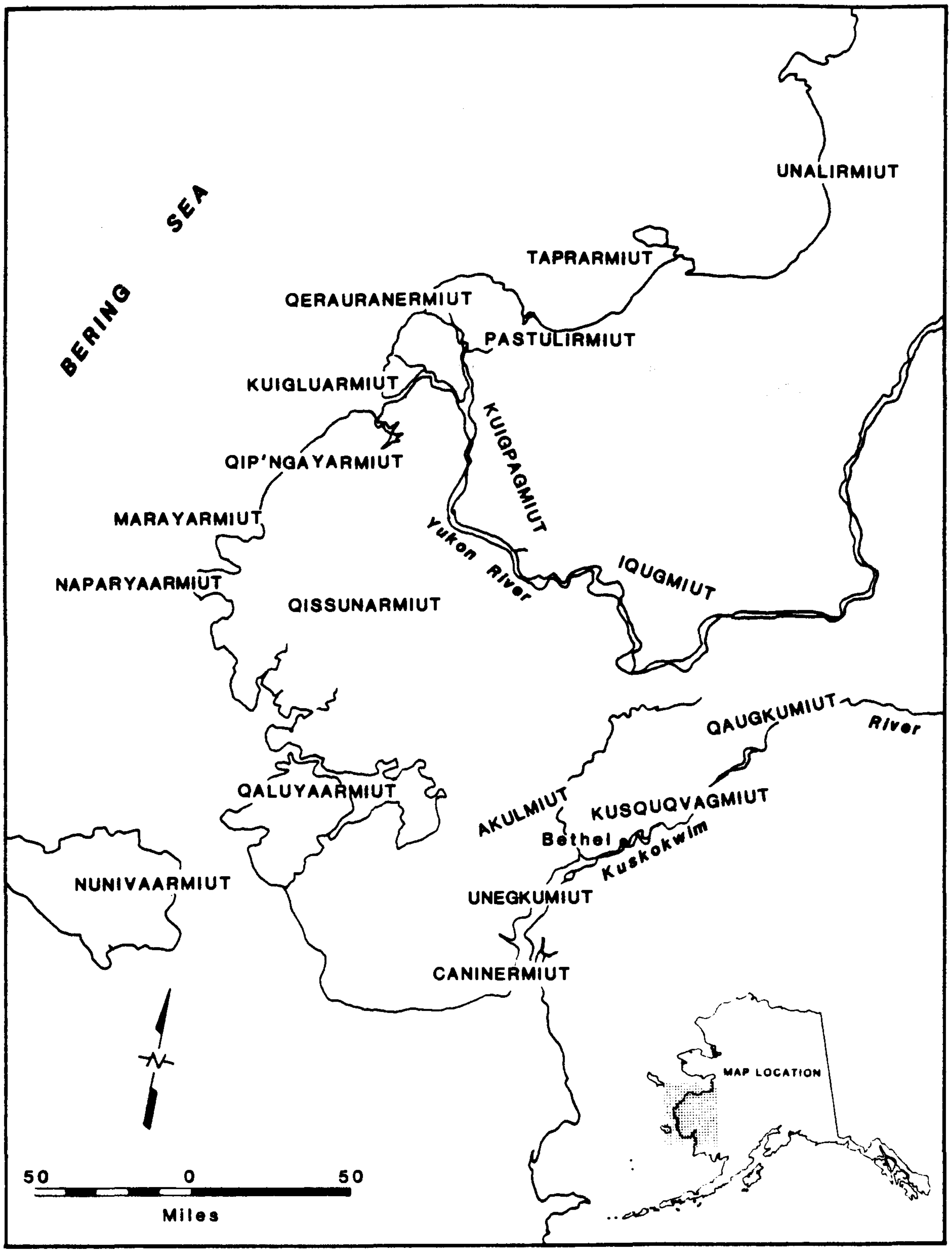
Snowmachines, skiffs, and boats are used by regional residents to transport personal goods from Bethel and the smaller regional centers to home communities and to transport supplies to camps and other subsistence harvest or processing sites.

VI. USE OF FISH AND GAME AND OTHER NATURAL RESOURCES

A. Historic Patterns of Resource Use

Descriptions of patterns of subsistence use in the Western Region for the early part of the nineteenth century are based on reconstructions from historical records and reports and on the oral tradition of contemporary subsistence harvesters. Burch (1984b) has listed most of the important early historical accounts (table 3). Based on Division of Subsistence research in the area, we know that contemporary subsistence patterns vary greatly within the Western Region; consequently, it would be desirable to have good descriptions for each of the 18 or so societies that were present at time of contact (see map 2). Unfortunately, this research has been done for only a limited number of areas within the region.

Lantis (1946, 1984), Oswalt (1963b, 1966, 1967), and VanStone (1984b, 1984c) present limited descriptions of early subsistence patterns for Nunivak Island, the lower Kuskokwim River, and the general Central Yup'ik cultural areas, respectively. Wolfe (1979) provides the most comprehensive reconstruction of early contact



Map 2. Contemporary (1983) central Yup'ik Eskimo Societies (Shinkwin and Pete 1984b).

subsistence patterns for the Iqugmiut and Pastulirimiut, two Yup'ik societies living on the lower Yukon River (see map 2). The description below is drawn from Wolfe's work and is representative of two types of subsistence systems on the lower Yukon River. It should be noted, however, that these are only two examples. Although members of all societies in the region depended totally on subsistence harvest of fish and game at the time of contact, the seasonal round of activities, species harvested, and movement from camp to camp varied significantly from society to society.

1. Iqugmiut subsistence. The Iqugmiut lived inland, with winter villages situated along the Yukon River. The present community of Russian Mission is located in the heart of the territory used by Iqugmiut (see map 1). In the early 1800's, the Iqugmiut used four main camps during the year as bases for subsistence harvests (see table 5). Iqugmiut relied most heavily on fish for subsistence. Fish was eaten dipped in seal or belukha oil obtained through trade or oil rendered from burbot and lamprey livers. Other species harvested included beaver, migratory birds, caribou, land otter, mink and other furbearers, ptarmigan and other small game, and the occasional seal or belukha that came up the Yukon River.

   In summer, Iqugmiut established fish camps along channels of the Yukon River. Camps were set up at good fishing locations and were probably composed of extended family units. Sheefish, whitefish, and smelt were the first species harvested at fish camps. Sheefish and whitefish were taken with drift nets made of willow fiber or sinew. Smelt were taken with dip nets.

   Chinook salmon were harvested during the major run in early to middle June and were taken with drift nets made from seal skin, dip nets, and sometimes with leisters and leister-type arrows. When water conditions permitted, fish traps were used for chinook and other salmon species.

   Successive large runs of chum and coho salmon were fished from late June to September. These species, which probably constituted the bulk of the summer fish catch, were taken with fish traps set into weirs. Basket traps constructed of spruce splints and fish fences were employed. In deeper water where traps could not be used, set nets made from willow or seal skin were placed in river eddies.

   The bulk of the summer salmon harvest was dried for later consumption and trade. Using smoke as part of the preservation process was possibly borrowed from the Russian subsistence in the late 1800's. Dried fish were traded, usually in fall, with coastal people for seal and belukha meat and oil, caribou and reindeer skins, and other fish and wildlife products not available locally.

In September and October and, depending on the timing of freeze-up, sometimes into November, Iqugmiut families lived at trail camps along the tundra rivers to the south of the Yukon River. Here they set basket traps and small-mesh nets to intercept the migration of small whitefish and blackfish. These fish were frozen or air dried for later use. Some caribou were taken at this time of year, usually with snares and less frequently with spears and arrows. A variety of baited and tossing snares were used for hares, ground squirrel, muskrat, wolf, wolverine, and, less frequently, for lynx and fox. Mink and land otter were taken in modified blackfish traps, shot with arrows, or run down and clubbed.

From about November to about mid March Iqugmiut returned to their winter villages along the Yukon River. This season was one of relative leisure and the time of year when group ceremonies frequently took place. In early November in some years, thousands of lampreys were caught in fish traps. In early winter, fish traps were also used for burbot, pike, and whitefish. Nets set under the ice for migrating sheefish were also employed. Beavers were sometimes caught with nets set near their dams or hunted. Ptarmigan and hare were also hunted in mid winter. Fish traps were sometimes set in the ice again in late February when food supplies were low.

In March or April, Iqugmiut families left the winter village for spring camps on the tundra, where they remained until late May or the beginning of June. Caribou hunting and the use of traps in streams for blackfish, whitefish, muskrat, and land otter were important spring harvesting activities. Migratory waterfowl were harvested, often in great numbers, using bird spears, bows and arrows, and bolas. Molting birds were taken in community drives using fishing nets for capture. At spring camp, men dried willow thread and prepared fish nets for the coming salmon season.

2. Pastulirimiut subsistence. The Pastulirimiut lived around the north mouth of the Yukon River in the area where the Yukon enters Pastol Bay. The present community of Pastolik is located in the heart of the territory used by Pastulirimiut (see map 1). In the early 1800's, the Pastulirimiut used five main camps during the year as bases for subsistence harvests (see table 5).

   Similarly to the Iqugmiut, the Pastulirimiut moved to fish camps in early June to be closer to salmon harvesting sites. The main Pastulirimiut fish camps stretched along the seacoast near the mouth of the Pastolik River. Smelt were the first fish to appear and were harvested with dip nets. Chinook salmon fishing took place in early June, followed by fishing for successive runs of chum and coho salmon. Most salmon were caught with short set nets in shallow Pastol Bay.

Nets were picked using kayaks. As with the Iqugmiut, the smaller salmon species comprised the bulk of the fish harvest, most of which was dried for winter use. Ringed and bearded seals were taken in early summer with large-mesh nets in Pastol Bay.

In mid July or early August, the Pastulirimiut moved to the winter village to drive belukha whales with kayaks in the shallows at the mouth of the Pastolik River. Harvested whales were butchered at the winter village and the fat boiled into oil for domestic consumption and for trade. Bird eggs were collected in early summer from nesting areas near winter communities, and, later on, molting birds were harvested by driving them into enclosures with boats or hand-held nets.

During September and October, prior to freeze-up, ringed, spotted, and bearded seals were hunted from kayaks along the coast or in the Yukon River estuaries. Seals were also taken with nets in Pastol Bay. In September, small-mesh nets and fish traps were set in streams near the winter villages for blackfish, burbot, and whitefish. Burbot were also seined during this season. Caribou were taken with snares or hunted with bow and arrow. Fall camps were established for only a few weeks during late August or September in berry-picking areas around the smaller rivers. Several moves were made as local berry patches were exhausted. Net fishing for blackfish and whitefish and trap fishing for burbot also took place at this time. As with the Iqugmiut, migratory birds were harvested with bows and arrows, bird spears, and bolas and stored for winter use. Before freeze-up, some men traveled upriver to trade seal and caribou skins and sea mammal oil.

Most Pastulirimiut returned to their winter villages by late October and remained there until late April. Gill nets for whitefish and traps for burbot and blackfish were set under the ice of streams, near winter villages. In early winter, jigging for burbot, saffron cod, northern pike, sheefish, and whitefish was productive. Fish nets and traps were tended until mid December. Late winter was not a very productive subsistence season. Some hare and ptarmigan were snared around the winter villages, and beaver, caribou, wolverine, and wolf were occasionally taken during this time. Bearded and ringed seals were hunted from kayaks and at the edge of sea ice intermittently from February to early May, if supplies of seal meat and oil became low.

During May, many Pastulirimiut families established spring camps along Apoon Pass near the present community of Hamilton. The Pastulirimiut called these "muskrat camps" because spring muskrat were taken in traps or hunted on the tundra rivers and lakes. Hunting migratory waterfowl, beginning in late April, was another primary purpose of spring camps, which were located near flyways. Some seals were also taken at this time.

3. Inqugmiut and Pastulirimiut subsistence harvest levels. Although no measurement of actual subsistence harvest of either society took place in the early 1800's, rough estimates of total harvest can be made. Based on what is known about contemporary subsistence harvests (see below), Iqugmiut and Pastulirimiut probably harvested somewhere between 1,000 and 1,500 lb food weight of subsistence foods per capita per year for human consumption. The amount of subsistence harvest needed to support working dog teams was probably about the same as that needed for human consumption.

B. Contemporary Patterns of Resource Use

Numerous studies including data relevant to subsistence use of fish and game by the Central Yup'ik of the Western Region have been conducted in the last 40 years. Burch (1984b) has listed most of the important social science research that has been completed (table 6). These sources should be consulted to gain an in-depth understanding of the Central Yup'ik area. Much of the earlier ethnographic work done in the Western Region has come from an academic tradition and has not been aimed directly at policy questions. Lantis (1947), Oswalt (1963a, 1966, 1967), and VanStone (1967) are examples of this orientation. Studies by Fienup-Riordan (1982, 1983a) and Wolfe (1981) were done as part of research on potential sociocultural impacts from oil and gas exploration and development that may take place within the region or in the adjacent continental shelf. Most of the recent research most relevant to subsistence has been done by the Division of Subsistence over the past five years.

Coverage of subsistence use in Western Region communities is not complete, however, despite the work completed in recent years. Comprehensive studies of subsistence have been completed for the 12 communities of Chuathbaluk and Sleetmute (Charnley 1984), Hooper Bay and Kwigillingok (Stickney 1985), Lime Village (Kari 1983), Stony River (Kari 1985), Alakanuk, Emmonak, Kotlik, Mountain Village, and Sheldon Point (Wolfe 1979, 1981), and Alakanuk, Sheldon Point, and Scammon Bay (Fienup-Riordan 1983a). Research is nearing completion for the communities of Nunapitchuk and Russian Mission and is underway at Kipnuk and Tununak (Andrews, pers. comm.). No thorough subsistence research has taken place in the other 35 communities in the Western Region, although short-term studies have been conducted in Goodnews Bay and Quinhagak (Wolfe et al. 1984). Some limited data for other communities are available in planning documents as well (Haynes and Andrews 1985) and under preparation by the Yukon Delta

National Wildlife Refuge planning team. In addition, a land use mapping project is scheduled for Aniak, Crooked Creek, and Red Devil in the spring of 1986 (Haynes, pers. comm.).

Comprehensive baseline mapped data depicting the territory used for subsistence harvest by individual Western Region communities are available for the following 11 communities: Chuathbaluk, Hooper Bay, Kipnuk, Kwigillinok, Nunapitchuk, Platinum, Russian Mission, Sleetmut, Stony River, Tuluksak, and Tununak. These mapped data depict the extensiveness of contemporary subsistence harvest areas by species harvested. The Reference Map Atlas that accompanies this volume contains standard reference maps using these data. Comprehensive subsistence mapping has not been done in the other 36 communities in the region. Limited mapped data are available for Alakanuk, Emmonak, Kotlik, Mountain Village, Scammon Bay, Sheldon Point, and Stebbins (Fienup-Riordan 1982, 1983a, 1983b, 1984; Wolfe 1979, 1981) and for Lime Village (Kari 1983); other mapped data for Western Region communities are on file with Calista, the regional corporation formed under the Alaska Native Claims Settlement Act.

1. <u>Species harvested and used</u>. 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. The range of species harvested by individual communities appears to include virtually all the edible species present within the territory used by that community. The following tables are presented to provide an indication of the range of species that have been used for food, clothing, shelter, and craft material within the region in the contemporary period. Table 7 presents a listing of the fish and wildlife resources most commonly harvested for subsistence in the Western Region, based on continuing Division of Subsistence research (Haynes and Andrews 1985).

   Tables 8 and 9 present lists of selected fish and wildlife species used by Hooper Bay and Kwigillingok residents based on Stickney's research (1985); table 10 presents lists of species used by residents of Stebbins and the Yukon delta area based on Wolfe's research (1979, 1981). Tables 11 and 12 present data on use of plant species for Hooper Bay and Kwigillinogok, again based on Stickney's research in those communities (1985). All five of these tables include Yup'ik terms for the commonly harvested species.

   Although the species most commonly used for subsistence are listed in these tables, there are doubtlessly other species for which use exists but for which neither species presence nor use has been documented. These would include additional bird species, primarily Asian and Pacific migratory birds that occasionally appear in Western Alaska, and also additional fish and intertidal species (Wolfe, pers. comm.)

2. Seasonal round of resource use. Figures 1 through 20 present seasonal round data for 23 communities in the Western Region and for the lower Yukon area. Although seasonal round data are not available for other communities in the region, seasonal rounds for these communities are believed to be similar to those of nearby communities.

   Seasonal round data for Alakanuk, Sheldon Point, Scammon Bay (fig. 1), for Kotlik (fig. 8), and for lower Yukon River (fig. 12) are representative of coastal, tundra, and lower riverine subsistence adaptations in the lower Yukon subregion (see map 1). The seasonal rounds for these communities focus on use of four species of salmon, several nonsalmon fish species, bearded, ringed, and spotted seal, belukha, walrus, and tundra and riverine furbearers. Waterfowl hunting has traditionally been an important spring harvesting activity. In general, large land mammals do not figure prominently in the seasonal harvesting activities of these communities.

   Data for Marshall (fig. 13) and Russian Mission (fig. 17) depict seasonal rounds of two riverine communities further up the Yukon River in the lower Yukon subregion (see map 1). In these communities, salmon, whitefish, pike, blackfish, and other lake and river fish species comprise an important part of the subsistence seasonal round. Fall and early winter moose harvest, late winter caribou harvest, and lengthy opportunistic harvest periods for black and brown bear affirm the importance of large mammals in these subsistence systems. Tundra, riverine, and upland furbearer species are harvested. Sea mammal products are obtained more by customary trade and exchange with members of coastal communities than by harvest by community members.

   Seasonal round data by Atmautlauk (fig. 2), Bethel (fig. 3), Nunapitchuk (fig. 15), and Tuluksak (fig. 19) are representative of tundra and riverine subsistence adaptations in the lower Kuskokwim subregion (see map 1). Communities in this subregion show greatest dependence on fish resources. Harvest of five species of salmon, blackfish, burbot, pike, sheefish, and whitefish account for the major fishing effort. Waterfowl harvest is an important activity especially in spring and in late summer and early fall months. Members of these communities incorporate hunting for seals and belukha in Kuskokwim Bay and for caribou, moose, and black and brown bear at upriver locations in their seasonal round of harvest activities. These communities are located at some distance from productive harvest sites for both sea and land mammals, however, and harvest effort and success are not as high as for communities more proximate to concentrations of these wildlife resources.

Data for Chuathbaluk and Sleetmute (fig. 4), Lime Village (fig. 10), Lower Kalskag (fig. 11), and Stony River (fig. 18) depict seasonal rounds for central Kuskokwim River subregion communities (see map 1). Relative to communities in other areas of the Western Region, these communities show greater seasonal use of caribou, moose, and black and brown bear. Fish species continue to be important to these upriver communities, although salmonid runs are smaller and fish quality not as good as at downriver interception points. Upland and forest furbearers and small game species predominate. Sea oil and some other marine mammal products reach these communities through traditional trading networks.

Seasonal round data for Hooper Bay (fig. 6), Goodnews Bay (fig. 5), Kipnuk (fig. 7), Kwigillingok (fig. 9) Newtok (fig. 14), Quinhagak (fig. 16), and Tununak (fig. 20) are representative of coastal communities in the central Bering Sea subregion (see map 1). The data for these communities show sea mammal harvesting activity in all months except December and January, when short days and cold temperatures limit harvesting activity, and in mid summer, when subsistence fishing for salmon and other species takes place. Subsistence harvest of herring, which occurs during the May and June herring runs, is a focal activity for many communities in this subregion, particularly for Nelson Island communities. Coastal and tundra furbearers are trapped in months when fur is in prime condition. Residents of Mekoryuk and of Nelson Island communities also harvest small numbers of muskox for subsistence use. Because most of these communities are distant from other large game populations, harvest of large land mammals is limited. Unlike other communities in this grouping, Goodnews Bay and Quinhagak incorporate freshwater fishing for char and trout species and hunting for brown bear and other big game species and for squirrels and other small game species in their seasonal rounds.

3. <u>Subsistence harvest levels and reported use</u>. Available harvest level data are of two types: comprehensive data covering most, if not all, species used in study communities and data collected to monitor harvest of particular species or species groups. Wolfe's study of six Yukon River delta communities (1979, 1981) and his work in Quinhagak (Wolfe et al. 1984), Fienup-Riordan's study (1983a) of three similar communities, Andrews community study of Nunapitchuk (pers. comm.), and Pete's ongoing baseline work in Tununak and Russian Mission (pers. comm.) have been major research efforts and provide the most comprehensive and reliable harvest data for the region. Additional harvest level data

covering all resources harvested in Western Region communities was collected by Nunam Kitlutsisti in 1976 (1983) as part of land use planning. Other harvest level data will become available as Division of Subsistence studies in Kipnuk, Tuluksak, Tununak, and other communities are completed.

Pennoyer's et al. summary (1965) of available information presents subsistence salmon harvest data for the Yukon and Kuskokwim rivers during the 1918 to 1961 time period. Data for subsequent years are found in annual management reports for the Yukon and Kuskokwim areas. Pete (1984) reports subsistence herring harvest levels for Nelson Island communities based on her field research in 1984. In recent years, annual subsistence salmon harvest levels have been monitored through use of subsistence calendars, which are filled out by harvesting households in each community (Jonrowe 1980; Stickney 1980, 1981). Commercial and subsistence salmon and herring harvest figures are discussed in the species narratives elsewhere in this volume.

Data on harvest levels of caribou, moose, muskox, and other game based on license and harvest ticket reporting and of furbearers, black bear, and brown bear based on tagging are presented in other sections of this guide. Data from these sources measures minimum subsistence levels only, however, because of limited historic participation in licensing and reporting by Western Region residents.

Limited data concerning the harvest of migratory birds by the Yukon Kuskokwim delta area communities were collected by Klein for April 1964 through February 1965 (1966). More extensive estimation of this harvest has been done by Copp and Smith (1981) for the years 1980 and 1981. More accurate data can be expected from studies currently in progress for the wildlife refuge area (Haynes, pers. comm.; also see Kelso et al. 1985 and Wolfe 1984a on management concerns).

Comprehensive data recording harvest level by species are available for seven Western Region communities. Table 13 presents data for the communities of Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins for the 1980-1981 harvesting cycle. Table 14 presents similar data for Alakanuk, Scammon Bay, and Sheldon Point for the 1981-1982 harvesting cycle. Differences in overall harvest levels and harvest composition between the two tables are probably due to a combination of yearly variation in actual subsistence harvests and different survey methods employed by researchers. Harvest levels of marine mammals and of king salmon are much lower in table 14 than in table 13 for Alakanuk and Sheldon Point.

Per capita harvest in these communities ranges from about 500 lb per person to about 1,400 lb per person. Numerous species contribute to the total subsistence harvests in all communities. Although fish species account for most of the total harvest in each of these communities, species composition of harvest varies significantly. Of fish species, chum and coho salmon are harvested in largest quantities in all communities. Alakanuk and Sheldon Point show high harvest levels of blackfish. Sheefish and herring account for a large portion of fish harvested in Sheldon Point and Stebbins, respectively.

Table 15 presents harvest level data by resource category for the communities of Aniak, Chevak, Emmonak, Goodnews Bay, Kotlik, Kwethluk, Mountain Village, Napaskiak, and Tununak for 1976; note that the data in this table were not collected according to standard Division of Subsistence methodologies. Table 16 presents recent data from Division of Subsistence studies for Quinhagak, Nunapitchuk, and Russian Mission. The table 15 data show particularly high harvest levels for fish for all communities except Aniak, with 12,219 lb of fish reported for Mountain Village. Reported household subsistence harvest levels of all species range from 3,157 lb to 14,391 lb in Aniak; per capita data are not available for these communities. As with data presented in tables 13 and 14, harvest levels of land mammals and sea mammals tend to be complementary. That is, communities that harvest large quantities of marine mammals usually do not harvest similarly large quantities of land mammals.

The table 16 data, based on continuing Division of Subsistence research, records household harvests ranging from 3,654 lb in Russian Mission to 4,600 lb in Nunapitchuk. As in other Western Region communities, fish account for most of the subsistence harvest by weight, although game species account for a large portion of harvest in Quinhagak and Russian Mission.

4. Subsistence harvest composition. Table 17 presents harvest composition data by resource category for the Western Region communities of Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins for the 1980-1981 harvesting cycle. Table 18 presents similar data for Aniak, Chevak, Emmonak, Goodnews, Kotlik, Kwethluk, Mountain Village, Napaskiak, and Tununak for 1976. In all of these communities, fish accounts for most of the reported subsistence harvest by weight, ranging from about 58% of total harvest for Kotlik in 1980-1981 to almost 85% of total harvest for Mountain Village in 1976. Even communities located far inland show high dependency on fish resources as opposed to game resources.

The subsistence harvest proportion of land mammals varies from a low of less than 2% in Chevak in 1976 and Stebbins in 1980-1981 to a high of over 15% in Mountain Village in 1980-1981 and in Aniak in 1976. The proportion of sea mammals in the total harvest was above 15% for Alakanuk, Emmonak, Kotlik, and Sheldon Point for 1980-1981; in Stebbins in that harvesting year, almost 31% of the total harvest consisted made up of sea mammals. The inland communities of Aniak, Kwethluk, Napaskiak, and Mountain Village had sea mammal subsistence harvest proportions of less than 3% in both data sets.

Birds account for a relatively smaller proportion of total subsistence harvest, with a range of 2.2% for Mountain Village in 1980-1981 to 9.5% for Aniak in 1976 data.

Composition of subsistence harvests varies significantly throughout the Western Region. Community location and access to fish and game populations are important determinants of subsistence harvest composition in the region. Figures 21 to 30 graphically present harvest composition data for the communities of Alakanuk, Emmonak, Kotlik, Mountain Village, Nunapitchuk, Quinhagak, Russian Mission, Scammon Bay, Sheldon Point, and Stebbins. These figures are based on selected harvest data presented in tables 13 through 16. Those communities represented are ones where data were collected using standard Division of Subsistence methodologies.

5. Participation in harvest. Table 19 presents household harvest participation data for the communities of Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins for the 1980-1981 harvest cycle. In this context, participation in harvest measures the proportion of households in each community that actually harvested each species listed. High rates of participation in harvest obtain for many of the species listed, particularly for salmon in almost all communities, for birds in all communities, and for seals in coastal communities.

Low rates of participation in harvest are indicative of two different situations. Low rates occur for species that are infrequently harvested in a given community -- for instance, blackfish in Mountain Village or whitefish in Stebbins. Low rates also occur for specialized hunting and trapping activities. Successful belukha hunting, for example, is an activity pursued by a few expert hunters, who share the harvest within the community. With current fur prices and a lessened need for fur for clothing and handicraft, trapping for beaver and mink has become a more specialized activity. A much higher rate of participation in muskrat harvesting occurs because muskrat hunting and trapping continues to be a common spring activity for adolescent boys.

Low participation in harvest, however, does not necessarily mean that few households in a community use the resource. Because of extensive distribution and exchange of subsistence fish and game resources both within a given community and between communities, households commonly use significant quantities of resources that have been harvested by others (Wolfe 1981, Wolfe et al. 1984). Intracommunity distribution and exchange generally functions to distribute locally obtained resources to all community members, including those who are unable to fish or hunt for themselves, particularly to the elderly, the infirm, and to households with incomplete work forces. Moose and salmon distribution and exchange patterns have been extensively described for middle Kuskokwim communities (Charnley 1983, 1984). Intercommunity distribution and exchange patterns serve to distribute specific subsistence products from places where they are abundant to places where they are scarce. Seal oil, for example, is traded and exchanged from coastal communities to inland communities along both the Yukon and Kuskokwim rivers (Wolfe 1981). Whitefish and moose are distributed from harvesting communities to coastal communities (Hensel, pers. comm.).

Table 1. Western Region Population, 1960-80

Community	1960	1970	1980
Akiachuk	229	312	480
Akiak	187	187	184
Alakanuk	278	414	522
Aniak	308	205	341
Atmautlauk	44	98	219
Bethel	1,258	2,416	3,576
Chefornak	133	146	230
Chevak	315	387	466
Chuathbaluk[a]	---	100	105
Crooked Creek	92	59	108
Eek	200	186	228
Emmonak	358	439	567
Goodnews Bay	154	218	168
Hooper Bay	460	490	627
Kasigluk (Aklomiut)[b]	346	526	641
Kipnuk	221	325	375
Kongigiganak	---	190	239
Kotlik	57	228	293
Kwethluk	325	408	454
Lime Village	32	25	48
Kwigillingok	334	148	354
Lower Kalskag	122	183	246
Marshall (Fortuna Ledge)	166	176	262
Mekoryuk	242	249	160
Mountain Village	300	419	583
Napakiak	190	259	262
Napaskiak	154	188	244
Newtok	129	114	131
Nightmute	237	127	119
Nunapitchuk[b]	327	---	---
Oscarville	51	41	56
Pilot Station	219	290	325
Pitka's Point	28	70	88
Platinium	43	57	55
Quinhagak	228	340	412
Red Devil	152	81	39
Russian Mission	102	147	169
Scammon Bay	115	166	250
Sheldon Point	110	125	103
Sleetmute	122	109	107
Stony River	---	---	26
St. Mary's/Andreafsky	225	384	382
Toksook Bay	178	257	333
Tuluksak	137	195	236
Tuntutuliak	144	158	216
Tununak	183	274	298
Upper Kalskag	147	122	129
Total population	9,382	12,038	15,456

Source: ADL 1984, Haynes and Andrews 1985.

--- means no data were available.

a No one was living in Chuathbaluk in 1960.

b In 1970 and 1980, Kasigluk and Nunapitchuk were combined under the name of their joint municipality, Akolmiut.

Table 2. Western Region Average Taxable Income, 1978, 1981, 1982

Community	Average Taxable Income ($)			Percentage of All Alaska Taxable Income (%)		
	1978	1981	1982	1978	1981	1982
Akiachuk	$4,016	$8,253	$8,782	25%	39%	41%
Akiak	4,224	7,787	7,606	26	37	35
Alakanuk	7,725	10,277	12,195	47	49	56
Aniak	5,488	18,317	16,169	34	87	75
Atmautlauk	6,698	9,881	7,199	41	47	33
Bethel	14,250	18,225	19,796	88	86	92
Chefornak	5,025	6,732	6,596	31	32	31
Chevak	5,707	7,715	7,746	35	37	36
Chuathbaluk	6,211	7,349	5,109	38	35	24
Crooked Creek	5,988	9,361	14,450	37	44	67
Eek	4,999	9,413	8,979	31	45	42
Emmonak	7,870	12,350	12,975	48	58	60
Goodnews Bay	4,351	8,043	7,531	27	38	35
Hooper Bay	5,307	7,179	8,856	33	34	41
Kasigluk (Aklomiut)	4,910	10,969	8,958	30	52	41
Kipnuk	4,746	7,262	5,917	29	34	27
Kongigiganak	6,333	9,025	9,009	39	43	42
Kotlik	5,604	9,159	10,035	34	43	46
Kwethluk	4,698	6,099	7,117	29	29	33
Lime Village[c]	---	---	---			
Kwigillingok	4,592	7,117	8,040	28	34	37
Lower Kalskag	4,470	8,081	10,290	27	38	48
Marshall (Fortuna Ledge)	8,911	9,126	10,405	55	43	48
Mekoryuk	6,396	8,515	9,800	39	40	45
Mountain Village	9,532	11,624	13,362	59	55	62
Napakiak	5,529	6,175	8,892	34	29	41
Napaskiak	4,238	8,523	9,822	26	40	45
Newtok	4,178	6,600	6,097	26	31	28
Nightmute	4,387	6,908	7,564	27	33	35
Nunapitchuk	5,055	8,137	7,103	31	39	33
Oscarville[a]						
Pilot Station	4,871	7,396	8,233	30	35	38
Pitka's Point[b]	6,616	7,774		41	37	
Platinium	9,143	10,894	11,626	56	52	54
Quinhagak	5,040	5,490	7,626	31	26	35
Red Devil[d]	13,411	10,020		82	47	
Russian Mission	4,696	10,269	13,217	29	49	61
Scammon Bay	4,774	10,004	9,827	29	47	45
Sheldon Point	6,261	12,955	15,032	38	61	70
Sleetmute	5,500	11,323	9,918	34	54	46
Stony River	3,700	7,376	9,389	23	35	43
St. Mary's/Andreafsky	7,951	10,716	11,973	49	51	55
Toksook Bay	6,541	11,070	8,019	40	52	37
Tuluksak	5,058	8,534	8,612	31	40	40
Tuntutuliak	5,119	6,138	8,433	31	29	39
Tununak	4,575	8,018	6,942	28	38	32
Upper Kalskag	5,715	8,024	6,934	35	38	32
Mean income	6,009	9,116	9,366	37	43	43
Anchorage	18,255	23,043	23,590	112	109	109
Fairbanks	17,901	23,476	24,178	110	111	112
Juneau	17,446	22,725	22,968	107	108	106
Alaska	16,274	21,127	21,624			

Source: ADR 1985.

--- means no data were available.

Note: Income data based on federal tax returns sorted by mailing addresses.

a Included with Bethel, all years.

b Included with Marshall, 1982 only.

c Included with Sleetmute.

d Included with Sleetmute, 1982 only.

Table 3. Chronological Summary of Early Ethnographic Research in the Central Yup'ik Area

Principal Field Experience	Name	Region	Publication Dates
1842-44	Lavrentiv Zagoskin	Norton Sound, Lower Yukon	(see Michael, ed. 1967)
1866-68	Wm. Healy Dall	Norton Sound, Lower Yukon	1870a, 1870b, 1877, 1884
1866-68	Frederick Whymper	Norton Sound, Lower Yukon	1868a, 1868b, 1889
1877-81	E.W. Nelson	Norton Sound, Lower Yukon	1899
1880	Ivan Petroff	Southwest Alaska generally	1884
1881-83	J.A. Jacobsen	Norton Sound, Lower Yukon	1884
1890	W.C. Greenfield	Lower Yukon, Kuskokwim and Nushagak	1893
1905, 1907	G.B. Gordon	Nunivak Island, Norton Sd., Kuskokwim	1906-07, 1917
1911-12	E.W. Hawkes	Norton Sound	1913, 1914
1926	Ales Hrdlicka	Norton Sound	1930
1927	Edward S. Curtis	Nunivak Island	1930
1936-37	Hans Himmelheber	Nunivak Island, Lower Kuskokwim River	1938, 1951
1930's	Clark M. Garber	West Alaska generally	1934, 1935, 1947
1935-49	George A. Dale	West Alaska generally	1953

Source: Burch 1984b.

Table 4. Tentative List of Some Groupings of Modern Central Yup'ik Villages

Regional Group	Location of Group	Source of Identification
	Kuskokwim River Areas	
Qaugkumiut	"Upriver People" - Tuluksak upriver	1, 2
Kusquqvagmit	"Kuskokwim River people", Napakiak to Tuluksak	1, 2
Kusquqvagmiut	All Kuskokwim River Yup'iks	4-6
Unegkumiut	"Downriver People" - Tuntutuliak to Napakiak	1,2
Akulmiut	"People inthe Middle" - Nunapitchuk, Kasigluk, Atmautluak	1-6
Caninermiut	"Lower Coast People" - Eek, Quinhagak	1, 2
Caninermiut	Kongiganak, Kwigillingok, Kipnuk, Chefornak**	3, 4
Cenarmiut	"Coastal People" - Eek Quinhagak	3, 4
Cenarmiut	Kongiganak, Kwigillingok, Kipnuk, Chefornak**	1, 2
	West Coast Areas	
Nunivaarmiut	People of Nunivak Island	1-6
Qaluyaarmiut	People of Nelson Island (including Kavalivigmiut)	1-6
Naparyaarmiut***	People of Hooper Bay	1-6
Qissanarmiut***	People of Qissunaq-Chevak	1-6
Maravarmiut	People of Scammon Bay	4, 5
Qip'ngayarmiut	People of Black River area	4, 5
	Yukon River Areas and Norton Sound	
Kuigpagmiut	People of the Yukon River	1-4
Kuigpagmiut	Lower Yukon River populations	5, 6
Iqugmiut	"People of the End" - Middle Yukon River populations	5, 6
Kuigluarmiut	"South Mouth" Yukon River populations	5
Qerauranermiut	"Middle Mouth" Yukon River populations	5
Pastulirmiut	People of the Pastol River area (Kotlik)	4-6
Taprarmiut	People of Tapraq (Stebbins)	4-6
Unalirmiut	Norton Sound Yup'ik populations (derivation unclear; may be altered Inupiaq term)	6

Source: Shinkwin and Pete 1984b.

* Exclusive of Bristol Bay, Nashagak River, Lake Iliamna areas.

** Most respondents placed Chefornak here, but the classification requires more research.

*** Some west coast respondents view these two large groups as one because marriage ties them together; earlier they were distinct groups (Woodbury 1984), and members today view them as separate (Shinkwin and Pete 1984a).

**** People from 1) Kuskokwim River villages, 2) Akulmiut, 3) Eek, 4) West Coast (Hooper Bay, Nunivak Island, Nelson Island), 6) Norton Sound.

Table 5. Iqugmiut and Pastulirmiut Seasonal Subsistence Moves and Residence Locations, ca. 1833

Months	Iqugmiut	Pastulirmiut
January	Winter village	Winter village
	Winter village	Winter village
February	Winter village	Winter village
	Winter village	Winter village
March	Winter village	Winter village
	Spring camp	Winter village
April	Spring camp	Winter village
	Spring camp	Spring camp
May	Spring camp	Spring camp
	Spring camp/summer camp	Spring camp
June	Summer camp	Summer camp
	Summer camp	Summer camp
July	Summer camp	Summer camp/winter village
	Summer camp	Winter village
August	Summer camp	Winter village
	Summer camp	Winter village/fall camp
September	Winter village	Fall camp/winter village
	Winter village	Winter village
October	Winter village	Winter village
	Winter village	Winter village
November	Winter village	Winter village
	Winter village	Winter village
December	Winter village	Winter village
	Winter village	Winter village

Source: Wolfe 1979.

Table 6. Summary of Recent Ethnographic and Linguistic Research in the Central Yup'ik Area

Main Subject	Authors Publication Dates
Art	Ray (1980, 1981)
Community study	Correll (1972), Oswalt (1963b), Oswalt and VanStone (1963), VanStone and Oswalt (1960)
Culture change	Collier (1973)
Dance	Ager (1975-76), Johnson (1978a)
Ethnobotany	Ager and Ager (1980), Oswalt (1957)
Ethnoarchaeology	Oswalt and VanStone (1967), VanStone (1970a, 1970b, 1972)
Ethnohistory	Oswalt (1963a, 1980), Oswalt, ed. (1960), Pratt (1984), Sarafian and VanStone (1972), Rav, ed. (1966), VanStone (1959, 1967, 1968, 1971, 1973)
Forklore	Ager (1979-80), Sonne (1978, 1980), Tennant and Bitar, eds. (1981), Woodbury (1984)
Games	Ager (1976)
General works	Meyer (1977), Oswalt (1965, 1966), Wolfe (1981)
Health, medicine	Fortuine (1966), Lantis (1959), Mason (1972, 1974, 1975), Wolfe (1982)
Lanugage	Hammerich (1955), Jacobson (1984), Miyoka (1980), Mivaoka and Mather (1979), Reed et al. (1977)
Learning	Harrison (1981)
Material culture	Oswalt (1972)
Politics	Lantis (1972)
Regional studies	Fienup-Riordan (1982), Kresge et al. (1974), Tussing and Arnold (1973)
Religion	VanStone (1980)
Social organization	Fienup-Riordan (1983b), Lantis (1946)
Subsistence	Charnley (1984), Fienup-Riordan (1983a), Klein (1966), Maddox (1975), Nowak (1982), 1984), Stickney (1985), Wolfe (1979), Wolfe and Ellanna (1983), Wolfe and Pete (1984), Wolfe et al. (1984)

Source: Burch 1984.

Table 7. Major Categories of Fish, Wildlife, and Marine Mammals Used by Communities in Western Alaska

Fish and Shellfish
- Arctic char
- Bering cisco
- Blackfish
- Burbot
- Capelin
- Chinook salmon
- Chum salmon
- Clams
- Coho salmon
- Dolly Varden
- Flounder
- Grayling
- Lamprey
- Mussel
- Ninespine stickleback
- Northern pike
- Pacific cod
- Pacific halibut
- Pacific herring
- Pink salmon
- Saffron cod
- Sculpin
- Sheefish
- Smelt
- Sockeye salmon
- Sole
- Sucker
- Trout
- Whitefish

Birds
- Sandhill crane
- Ducks
- Geese
- Grouse
- Ptarmigan
- Snowy owl
- Swan

Small Mammals
- Arctic white fox
- Beaver
- Hare
- Land otter
- Lynx
- Marmot
- Mink
- Muskrat
- Porcupine
- Red fox
- Squirrel
- Wolf
- Wolverine

Large mammals
- Black bear
- Brown bear
- Caribou
- Moose
- Musk ox

Marine Mammals
- Bearded seal
- Belukha whale
- Grey whale
- Ringed seal
- Sea lion
- Spotten seal
- Walrus

Source: Haynes and Andrews 1985.

Table 8. Fish and Wildlife Resources Used by Hooper Bay[a] Residents

Common English Name	Scientific Name	Local Name
Herring	Clupea harengus pallasi	Iqalluarpaq
Chinook salmon	Oncorhynchus tshawytscha	Taryaqvaq
Chum salmon	Oncorhynchus keta	Qavlunaq
Pink salmon	Oncorhynchus gorbuscha	Cuqpeq
Coho salmon	Oncorhynchus kisutch	Uqurliq
Starry flounder	Platichthys stellatus	Uuraruq
Tomcod	Microgadus proximux	Iqalluaq or Citegtaq
Smelt	Osmerus eperlanus	Naqecuat
Sculpin	Megalocottus platycephalus laticeps	Kayurlugaq
Bering cisco	Coregonus laurettae	Naptaq
Least cisco	Coregonus sardinella	Qassayagaq or Neq'yagaq
Humpback whitefish	Coregonus pidschian	Qaurtuq
Pike	Esox lucius	Cukvak
Blackfish	Dallia pectoralis	Can'giiq
Ninespine stickleback	Pungitius pungitius	Quarruuk
Sheefish	Stenodus leucichthys nelma	Ciiq
Burbot (lush)	Lota lota	Maniq'naq
Soft-shelled clam	Mya arenaria	Uiluq
Cockle	Clinocardium nuttalli	Taavtaaq
Bearded seal	Erignathus barbatus	Maklak Maklagak (subadult)
Ringed seal	Phoca hispida	Nayiq
Spotted seal	Phoca vitulina largha	Issuriq
Walrus	Odobendus rosmarus	Kaugpak or Asveq
Sea lion	Eumetopias jabatus	Uginaq
Belukha	Delphinapteras leucas	Cetuaq
Mink	Mustela vision	Imarmiutaq
Land otter	Lutra canadensis	Cinkaq
Red fox	Vulpes vulpes	Kaviaq
Arctic fox	Alopex lagopus	Qunguiq
Muskrat	Ondatra zibethicus	Kanaklaq
Beaver	Castor canadensis	Palaqtaq
Snowshoe hare	Lepus americanus	Maqaruaq
Tundra hare	Lepus othus	Qayaqeggliq
Yellow-billed loon	Gavia adamsii	Tuullek

(continued)

Table 8 (continued).

Common English Name	Scientific Name	Local Name
Arctic loon	Gavia arctica	Tunucillek
Red-throated loon	Gavia stellata	Qaqatacik
Red-necked grebe	Podiceps grisegena	Aarayuli
Sooty shearwater	Puffinus griseus	Ukuik
Double-crested cormorant	Phalacrocorax auritus	Uyalek or Uyalegiak
Tundra swan	Cygnus colombianus	Qugyuk
Canada goose	Branta canadensis	Nangi'lagiq or Tuutangayak
Brant	Branta bernicla	Neqlernaq
Emperor goose	Chen canagica	Nacaullek
Greater white-fronted goose	Anser albifrons	Neqleq
Snow goose	Chen caerulescens	Kanguq
Mallard	Anas platyrhynchos	Yuukarpak
Pintail	Anas acuta	Yuukaq
Green-winged teal	Anas crecca	Tengesqaaraq
Blue-winged teal	Anas discors	Qatkeggliq
Northern shoveler	Anas clypeata	Cug'erpak
Greater scaup	Aythua marila	Kepalek
Oldsquaw	Clangula hyemalis	Aarrangiiraq
Common eider	Somateria mollissima	Aangikvak or Angucaluq
King eider	Somateria spectabilis	Metraq
Spectacled eider	Somateria fischeri	Qaugeq
Black scoter	Melanitta nigra	Kukumyaraq
Red-breasted merganser	Mergus serrator	Payiq
Peregrine falcon	Falco peregrinus	Eskaviaq
Willow ptarmigan	Lagopus lagopus	Aqeygiq
Rock ptarmigan	Lagopus mutus	Elciayuli
Sandhill crane	Grus canadensis	Qucillgaq
Semi-palmated plover	Charadrius semipalmatus	Uyarr'uyaq
Black-bellied plover	Pluvialis squatarola	Tuigak
Bar-tailed godwit	Limosa lapponica	Uliyarneq
Greater yellowlegs	Tringa melanoleuca	Tuntusukangaliyak
Black turnstone	Arenaria melanocephala	Cilmak
Red-necked phalarope	Phalaropus lobatus	Teleqcaaraq
Red phalarope	Phalaropus fulicaria	Augtuaraq
Common snipe	Gallinago gallinago	Kukukuaq
Western sandpiper	Calidris mauri	Iiyuraaraq

(continued)

Table 8 (continued).

Common English Name	Scientific Name	Local Name
Dunlin	Calidris alpina	Curemraq
Parasitic jaeger	Stercorarius parasiticus	Cungarrlugaq
Glaucous gull	Larus hyperboreus	Naruyaq
Glaucous-winged gull	Larus glaucescens	Naruyaq
Sabine's gull	Larus philadelphia	Nacallngaraq
Arctic tern	Sterna paradisaea	Teqiyaraq
Thick-billed murre	Uria lomvia	Alpaq
Snowy owl	Nyctea scandiaca	Anipaq
Short-eared owl	Asio flammeus	Anipausugaq
Downy woodpecker	Picoides pubescens	Pugugtuyuli

Source: Stickney 1985.

a This table is based on partial data; both additional species and additional names for species may be used by Hooper Bay residents.

Table 9. Selected Fish and Wildlife Resources Used by Kwigillingok[a] Residents

Common English Name	Scientific Name	Local Name
Herring	Clupea Harengus pallasi	Iqalluarpak
Chinook salmon	Oncorhynchus tsawytscha	Taryaqvak
Chum salmon	Oncorhynchus keta	Kangitneq
Sockeye salmon	Oncorhynchus nerka	Sayak
Coho salmon	Oncorhynchus kisutch	Qakiiyaq
Tomcod	Microgadus proximus	Ceturrnaq
Boreal smelt	Osmerus eperlanus	Qusuuq
Sculpin	Megalocottus platycephalus laticeps	Nertuliiq
Bering cisco	Coregonus laurettae	Imarppinraq
Yellow-fin sole	Limanda aspera	Naternaq
Ninespine stickleback	Pungitius pungitius	Quarruuk
Blackfish	Dallia pectoralis	Can'giiq
Soft-shelled clam	Mya arenaria	Uiluq
Cockle	Clinocardium nuttalli	Taavtaaq
Bearded seal	Erignathus barbatus	Maklassuk Maklak (large male) Amirkaq (sub-adult)
Ringed seal	Phoca hispida	Nayiq
Spotted seal	Phoca vitulina largha	Issuriq
Walrus	Odobendus rosmarus	Asveq
Belukha	Delphinapterus leucas	Cetuaq
Mink	Mustela vision	Imarmiutaq
Land otter	Lutra canadensis	Cuignilnguq
Red fox	Vulpes vulpes	Kaviaq
Arctic fox	Alopex lagopus	Uliiq
Muskrat	Ondatra zibethicus	Kanaqlak or Tevyuliq
Beaver	Castor canadensis	Paluqtaq
Snowshoe hare	Lepus americanus	Maqaruaq
Arctic hare	Lepus othus	Qayuqeggli
Yellow-billed loon	Gavia adamsii	Tuullek
Arctic loon	Gavia arctica	Tunutellek
Red-throated loon	Gavia stellata	Qaqaq
Red-necked grebe	Podiceps grisegena	Qaleqcuuk
Horned grebe	Podiceps auritus	Tusairnaq
Double-crested cormorant	Phalacrocorax auritus	Uyalek
Whistling swan	Olor columbianus	Qugyuk

(continued)

Table 9 (continued).

Common English Name	Scientific Name	Local Name
Canada goose	Branta canadensis	Tutangayak
Brant	Brant bernicla	Neqlernaq
Emperor goose	Chena cangica	Nacaullek
White-fronted goose	Anser albifrons	Neqleq
Snow goose	Chen caerulescens	Kanguq
Mallard	Anas platyrhynchos	Curcurpaq
Pintail	Anas acuta	Uqsuqaq
Green-winged teal	Anas crecca	Tengesqar
Blue-winged teal	Anas discors	Qatgelli
Northern shoveler	Anas clypeata	Suggerpak
Canvasback	Aythya valisineria	Kepalek
Greater scaup	Aythya marila	Kepalek
Oldsqaw	Clangula hyemalis	Aarraangiik
Steller's eider	Polysticta stelleri	Anarnisakaq
Common eider	Somateria mollissima	Metraq
King eider	Somateria spectabilis	Qengallek
Spectacled eider	Somateria fisheri	Kaureq
Surf scoter	Melanitta perspicillata	Ekacakayak or Cingayak
Black scoter	Melanitta nigra	Kukumiyar
Red-breasted merganser	Mergus serrator	Paiyiiq
Bald Eagle	Haliaeetus leucocephalus	Metervik
Willow ptarmigan	Lagopus lagopus	Qangqiiq
Sandhill crane	Grus canadensis	Qucillgaq
Semipalmated plover	Charadrius semipalmatus	Uyarr'uyaq
Black-bellied plover (winter plumage)	Pluvialis squatarola	Tuuyiik
Long-billed dowitcher	Limnodromus scolopaceus	Pugtatnguartalek
Marbled godwit	Limosa lapponica	Tevatevaaq or Civikaq
Whimbrel	Numenius phaeopus	Tevatevaat
Greater yellowlegs	Tringa melanoleuca	Tuntusikaq
Black turnstone	Arenaria melanocephala	Qiurracetaaq
Red-necked phalarope	Phalaropus lobatus	Imaqcaar
Red phalarope	Phalaropus fulicarius	Ayungnaar
Common snipe	Gallinago gallinago	Kukukaq
Pectoral sandpiper	Calidris melanotos	Iisuayaar
Western sandpiper	Calidris mauri	Isuayaa
Dunlin	Caladris alpina	Ceremraq
Parasitic jaeger	Stercorarius parasiticus	Yungaq
Long-tailed jaeger	Stercorarius longicaudus	Enacallngar

(continued)

Table 9 (continued).

Common English Name	Scientific Name	Local Name
Glaucous gull	Larus hyperboreus	Narusvak
Arctic tern	Sterna paradisaea	Teqiiyar
Thick-billed murre	Uria lomvia	Alpaq
Pigeon guillemot	Cepphus columba	Eciguraq
Snowy owl	Nyctea scandiaca	Anipaq
Short-eared owl	Asio flammeus	Keneqpatak
Downy woodpecker	Picoides pubescens	Puugtuyuli
Tree swallow	Iridoprocne bicolor	Cungakcuarnaq
Common raven	Corvus corax	Tulukaruk
Black-capped chickadee	Parus atricapillus	Cekpiipiir
American robin	Turdus migratorius	Elagayuli
Water pipit	Anthus spinoletta	Cetaar
Yellow warbler	Dendroica petechia	Cungakcuarnaq
Rusty blackbird	Euphagus carolinus	Cuqculi
Common redpoll	Carduelis flammea	Uqviicartaq
Snow bunting	Plectrophenax nivalis	Kanguruaq
Lapland longspur	Calcarius lapponicus	Tekcitaq

Source: Stickney 1985.

a This table is based on partial data; both additional species and additional names for species may be used by Kwigillinok residents.

Table 10. Selected Fish and Wildlife Resources Used by Stebbins and Yukon Delta Residents[a]

Common English Name	Scientific Name	Local Name
Arctic grayling	Thymallus arcticus	Chulukbowuk
		Tuluqpak
Arctic lamprey	Lampetra japonica	Ngumugiyuq
		Ngumugazug
Alaska whitefish	Coregonus nelsoni	Chinekłiq
Lake whitefish	Coregonus clupeaformis	Nuqiya (small ones)
		Nuqłiq
Belukha (white whale)	Delphinapterus leucas	St'oaq (or Istoaq)
		Munduq - belukha epidermis
Bering cisco	Coregonus laurettae	Imuqbinruq (small whitefish)
Blackfish	Dallia pectoralis	Ima'ngaq
		Chun'geq
Broad whitefish	Coregonus nasus	Kaurtuq
		Nuqiyak (small)
		Kaurkiachalguq (small)
Burbot	Lota lota	Maniginuk (lush)
Dolly Varden	Salvelinus malma	Egathluqbiaq
Duck (generic)		Ootga
Least cisco	Coregonus sardinella	Etuleaq
Northern pike	Esox lucius	Qusulik
		Chuqfuk
		K'shuliq
Pacific herring	Clupea harengus	Egauthluk'biq
		Eqauthloauk'buq
		Kaultuk (herring eggs on kelp)
Round whitefish	Prosopium cylindraceum	Kassiaq
		Nuqiyaq
Saffron cod	Eleginusgracilis	Egauthluk
		Egauthloaug
Chum (dog) salmon	Oncorhynchus keta	Kanyetnuq
		Kamiknuk
		Nulkbiq
		Oqoqłiq (fall chum)
		Okokliq (fall chum)

(continued)

Table 10 (continued).

Common English Name	Scientific Name	Local Name
Coho (silver) salmon	Oncorhynchus kisutch	Kaukiuq Oqokliq Kugge'yuk
Chinook (king) salmon	Oncorhynchus tshawytscha	Dogiuqfug Chiuktuk Chaqilukfuk
Pink (humpback) salmon	Oncorhynchus gorbuscha	Chulqbuq Juqbuq Humpies
Salmon, salmon eggs, fermented		Imlauq
Salmon, color turned or hook nosed		Daliyuk
Salmon, easy drying		Kaukezuk
Sandhill crane	Grus canadensis	Ngutraq
Sculpin		
Slimy sculpin	Cotta cognatus	Kiyokobauq
Coastrange sculpin	Cottus aleuticus	Kanaufbuk
Prickly sculpin	Cottus asper	Bullheads Devil fish Irish lords
Seal		
Bearded seal	Erignathus barbatus	Mukluk - generic term Alemeguk - adults Oogeruk - adults (Stebbins) Muklasuq - small mukluk Ammirtaq - less than a year old Angiyoktiq - adolescent
Ring seal	Pusa hispida	Niyiq
Spotted seal	Phoca vitulina	Ezo'riq
Sheefish	Stenodus leucichthys	Cheliq Cheuq
Smelt		
Pond smelt	Hypomesus olidus	Kozout
Rainbow smelt	Osmerus mordax dentex	Chiqaulik Kozioq Chevokoliq

(continued)

Table 10 (continued).

Common English Name	Scientific Name	Local Name
Snowshoe hare	Lupus americanus	Makaquq
Starry flounder	Platichthys stellatus	Nautakanuk
		Nat'honuk
Swan (generic)		Nguguyuq
Threespine stickleback	Gasterosteus aculeatus	Koahulq
		Needlefish
Trout (generic)	Salmo sp.	Chuluqpauq
		Egauthlukbuq
Willow ptarmigan	Lagopus lagopus	Akazereaq

Source: Wolfe 1981; Pete, pers. comm.

a This table is based on partial data; both additional species and additional names for species may be used by residents of Stebbins or Yukon delta communities.

Table 11. Selected Ethnobotany for Hooper Bay[a]

Name	Harvest Period	Parts Used	Usage	Storage
Kapuukaraq (Ranunculus Pallasii) pallas buttercup	Late April-June (gathered from margins of ponds)	Young shoots	Cooked and eaten with seal oil made into akutaq	Some people freeze after the plant has been cooked
Allmaruaq (Caltha palustris) cowslip	June (before they flower)	Stems and leaves	Boiled with seal oil and eaten	Some people freeze the plant after cooking it or as is
Ikiituk (Angelica lucida) wild celery	Mid-late July	Stalk	Stalk is peeled and eaten raw; occasionally put on top of wood for smoking fish	None
Aatunaq (Rumex arcticus) sourdock	August	Leaves	Boiled and eaten; put into barrel after cooked, crowberries added to make akutaq	Boiled and stored in barrels in a cool place, can last a whole year; past: used to line pits where salmonberries were buried; after freeze-up, both plants and berries were retrieved
Tayaruq (Hippuris vulgaris) goose grass	Late October- early November (gather after freeze-up)	Stalks	Boiled and mixed with fish eggs (esp. tomcods) or "mousefoods" to make soup	Stored in a sack as is
Ayuq (Ledum palustre) Labrador tea	Throughout the snow-free months; peak time is right after the snow melts	Stems and leaves	Added to store-bought tea or used alone	Dried
Agevit (Rubus chamaemorus) "salmonberry" cloudberry	Late July- mid August	Berry	Made into akutaq with crisco and other berries or tomcod livers; eaten with sugar and seal oil (akumaarrluk)	Freeze; pack into barrels and store in a cool place; past: buried in pits lined with sourdock
Puyurniq (Rubus articus) nagoonberry (berries are not numerous)	Late July-mid August (only picked when available, usually only get enough for immediate consumption)	Berry	Made into akutaq with salmonberries	None

(continued)

Table 11 (continued).

Name	Harvest Period	Parts Used	Usage	Storage
Kavlakuaq (*Empetrum nigrum*) "*blackberry*" crowberry	Late August-September	Berry	Made into *akutaq* with other berries or sourdock; past: used as dye	Freeze; put in sacks and store in ponds until after freeze-up; put in barrels with lingon-berries
Tumagliq (*Vaccinium vitis-idaea*) lowbush cranberry lingonberry	Mid September-October late April-early May	Berry	Used in *akutaq*, occasionally used as dye; made into jam; past: used as medicine for teething babies	Freeze; put in barrels with blackberries
Taperrnaq (probably *Elymus arenaria mollis*) basketgrass lyme grass	Mid September-early November	Stem (pick plants without spikelets)	Used to make basketry items; part of stichery in sealgut raincoats	Dry in mats
Anget (*Poa* spp.)	Mid September-October	Stem	Used as insulation in boots	Store as bundles in store houses
Utngungssaaq (*Equisetum silvaticum E. arvense*) part of "mousefoods"	Mid September-mid October	Root	Cook in soup with tomcod or other fish eggs; make into *akutaq* but with no berries added	Can freeze as is or put in sacks after washing to be stored outside
Iitaq (*Eriophorum aqustifolium*) cottongrass roots are a component of "mousefoods"	August-mid October	Base of stem roots	Base of stems eaten by themselves or boiled and cut up made into *akutaq* without sugar; roots are used similarly to other "mousefoods"	Roots are frozen; past: stems buried in pits similarly be berries
Almaruaq (*Epilobium anqustifolium*) fireweed (roots are a component of "mousefoods"	Mid September-mid October	Roots	Used similarly to other "mousefoods"	Frozen

(continued)

Table 11 (continued).

Name	Harvest Period	Parts Used	Usage	Storage
Caiggluk (Artemesia tilesii) stinkweed	Mid August-September	Stems and leaves	Boiled to make a medicinal extract and juice; leaves discarded (some sources say use of this plant is recent within the past decade)	Dried as is; juice is stored in cool spot
Cangqullektaq (Cornus suecica and C. canadensis x suecica) bunchberry	August	Berry	Picked and eaten immediately as a snack	None
Curaq (Vaccinium uliginosum) blueberry	August (these berries are not numerous in area)	Berry	Used in akutaq	Frozen
Uskuraaleq (Oxycoccus microcarpus) bog cranberry	Mid September-October late April-early May	Berry	Can be used similar similar to lingonberries (not often picked since these berries are small and are slow to pick)	Similiar to lingonberries
Ceturnaq (Dryopteris dilatata) fern	This plant used in the distant past			
Angukaq (Polygonum alaskanum) wild rhubarb (only grows in the Askinuk Mountains)	July-August	Leaves	Eaten similarly to sourdocks (aatunaq)	Boil and put in barrel
Quunaraat (Oxyria digyna) sourgrass (not common in this area)	Picked when they are encountered	Leaves	Picked and eaten immediately	None
Itgaraalek (Ligusticum hultenii) wild celery	Mid May-early June	Stems and leaves	Boiled and eaten	None

Source: Stickney 1985.

a This table is based on partial data; other uses of listed plants and use of additional species of plants by Hooper Bay residents may occur.

Table 12. Selected Ethnobotany for Kwigillingok[a]

Name	Harvest Period	Parts Used	Usage	Storage
Kapuukaraar (Ranunculus Pallasii) pallas buttercup	Late April-early May (from the margin of ponds before flowers develop); mid September- mid October	Shoots	Cooked in soup; eaten alone or with seal oil after boiled	Freeze
Iliituk (Angelica lucida) wild celery	May-early June ("before salmon")	Stalk	Stalk is peeled (raw) and eaten with seal oil	None
Kaagpak (Senecio congestus) wild celery	June	Stalk	Stalk is peeled and cut up to make a "salad" or eaten with seal oil	None
Allngiguag (Caltha palustris) cowslip	June	Stems and leaves	Cooked in water with with seal oil; added and eaten alone or with seal oil	Freeze as is; put in jars; after cooking and freeze jars
Ayuq (Ledum palustre) Labrador tea	May-October	Leaves and stems	Boiled alone for tea or added to store-bought tea; plant burned and aroma inhaled as medicine for chronic headaches and other ailments; plant used as poultice for sores and applying directly or after the plant is cooked in water	Kept in cold place (porch, freezer, refrigerator); plant crumbles when dried
Qaugciq (Rumex articus) sourdock	July	Leaves	Used in akutaq with berries or salmon eggs (Makaq); eaten raw with seal oil	Cook and store in container for short time; past: cook and put in barrel to be buried in the ground, barrel retrieved after freeze-up; past: put in with salmonberries (when this was done, this plant was picked in August after the berries)

(continued)

Table 12 (continued).

Name	Harvest Period	Parts Used	Usage	Storage
Caiggluk (*Artemesia Tilesii*) stinkweed	June-August	Stems and flowers	Medicinal; dried and mashed to make poultice for cuts; the dried plant is also used in steambaths by slapping sore joints; boiled to make medicinal juice	Dried
Naunraq (*Rubus chamaemorus*) "salmonberry" cloudberry	Late July-mid August	Berry	Used to make *akutaq* with crisco and other berries or tomcod livers; past: used as medicine for dry throats	Frozen
Puyuraaq (*Rubus articus*)	Late July-mid August	Berry	Used with salmonberries in *akutaq* (these berreis are hard to find in large quantities)	Frozen
Tan'gerpak (*Empetrum nigrum*) crowberry	Late August-September	Berry	Used alone or with salmonberries to make *akutaq*	Frozen; past: stored in sack or barrel in pond until after freeze-up
Tumagliq (*Vaccinuum vitis-idaea*) lowbush cranberry; lingonberry	Mid September-October late April-early May	Berry	Used with other berries to make *akutaq*; past: berry juice used as medicine for snow blindness	Frozen; kept in cool storehouse
Kaulak (*Arctostaphylos alpina*) bearberry	September-October late April-early May	Berry	Eaten immediately; occasionally used for jam; some people pick them in the spring and use in *akutaq*	Not stored except as jam
Utngungssaraat (*Equisetum silvaticum* and *E. arvense*) horsetails; "mousefoods"	Mid September-October	Roots	Cooked in soup or eaten alone; eaten raw; made into *akutaq*	Frozen

Table 12 (continued).

Name	Harvest Period	Parts Used	Usage	Storage
Anlleq = root Iitaq = base of stem Kelugkaq = upper stalk (Eriophorum angustifolium) cottongrass	Mid July-mid September	Whole plant	Roots used as are other "mousefoods", see above; base of stalk may be peeled, put in water, and eaten after dinner; may also be used in akutaq; the rest of stalk is used for fish ropes	The roots are frozen
Neg'asek (species unknown) another component of "mousefoods"	Mid September-October	Roots	Roots used as are other "mousefoods"; these taste similar to potatoes	Frozen
Taperrnat (Elymus arenaria mollis) lyme grass; "basketgrass"	Late August-October	Stalk (use plants without spike-lets-local term "female plants")	Used to make basketry items; as stichery in seal-gut raincoats	Dried in mat form
Canget (Poa spp.) "boot grass"	Mid September-October	Stalk	They are picked after they are dead; used as insulation in boots; past: used as mats on beds	Kept in bundles in storehouses
Tayarut (Hippuris vulgaris) goose grass "wild onion"	Late October-early November (freeze-up)	Stalk	Cooked and added to seal or bird broth with fish eggs and livers added (Eskimo soup); also made into akutaq with fish eggs of any kind	Stored in bag outside on tundra all winter
Cetuuguat (Dryopteris dilatata) fern	Mid to late May	Fiddleheads roots are found in mouse caches	None	
Cenggullektat (Cornus suecica and C. canadensis x suecica bunchberry	Mid August-mid September	Berry	Picked and eaten immediately as snack	None

(continued)

Table 12 (continued).

Name	Harvest Period	Parts Used	Usage	Storage
Uingiaraat (*Oxycoccus microcarpus*) bog cranberry	Mid September-October late April-early May	Berry	Picked and eaten immediately	None
Qaltaruaq (*Petasites frigidus*) colts foot	Mid September-October	Leaf	Use leaf ash with tobacco	Dried when the plants are "old"; burned in a can
Tarnaq (*Heracleum lanatum*) cow parsnip (plant grows upriver from the village, not around the village)	Probably June	Stalk	Peeled and eaten immediately	None
Angkaq (*Polygonum alaskanum*) wild rhubarb (plant grows upriver from the village, not around the village)	June	Leaves	Made into *akutaq* like *qaugciq*	

Source: Stickney 1985.

a This table is based on partial data; other uses of listed plants and use of additional species of plants by Kwigillinok residents may occur.

Table 13. Subsistence Harvest Levels in Pounds per Household, Six Western Region Communities, June 1980 through May 1981[a]

Resource	Alakanuk	Emmonak	Kotlik	Mountain Village	Sheldon Point	Stebbins
Fish						
Bering cisco	164	147	171	38	103	63
Blackfish	998	215	142	347	1,386	0
Burbot	56	47	19	88	20	0
Cod, saffron	68	36	41	0	181	247
Herring	0	0	0	0	0	1,113
Northern pike	67	82	7	367	240	0
Salmon, chinook	480	359	301	385	1,543	1,272
Salmon, chum and coho	824	659	667	982	3,159	1,190
Sheefish	353	321	460	395	943	19
Smelt	23	0	30	0	6	0
Whitefish, broad	122	66	145	834	48	9
Other fish	0	0	0	63	4	1
Sea mammals						
Belukha	233	233	150	0	350	700
Sea lion	13	0	0	0	0	0
Seal, bearded	280	54	339	70	490	420
Seal, ringed	188	85	134	7	335	296
Seal, spotted	107	53	79	46	289	56
Walrus	33	0	0	0	0	560
Land mammals						
Bear, black	0	0	0	13	0	0
Beaver	28	6	27	26	20	0
Caribou	0	0	29	0	67	0
Hare, arctic and snowshoe	108	51	108	82	46	45
Land otter	4	0	5	4	10	0
Mink	17	2	30	4	27	0
Moose	273	179	204	402	238	60
Muskrat	35	19	74	170	37	4
Birds						
Cranes*	38	11	37	7	32	70
Ducks*	42	35	33	18	40	74
Geese*	145	67	144	30	111	152
Ptarmigan*	51	11	27	28	29	11
Swans*	72	21	26	14	30	13
Total fish	3,155	1,932	1,983	3,499	7,633	3,914
Total sea mammals	854	425	702	123	1,464	2,032
Total land mammals	465	257	477	701	445	109
Total birds	348	145	267	97	242	320
Total harvest	4,822	2,759	3,429	4,420	9,784	6,375
Harvest per capita	733	612	510	822	1,397	1,006

Source: Wolfe 1981.

a Harvest is expressed in pounds of dressed weight. Data are based on 88 sampled households. Subsistence harvest quantity and composition vary from year to year. Additional species may be harvested by community residents.

* Species not identified.

Table 14. Subsistence Harvest Levels in Pounds per Household, Alakanuk, Sheldon Point, and Scammon Bay, June 1981 through May 1982[a]

Resource	Alakanuk	Scammon Bay	Sheldon Point
Fish			
Bering cisco	118	219	142
Blackfish	209	364	1,161
Burbot	90	281	56
Cod, saffron	87	250	258
Herring	0	162	0
Northern pike	48	157	192
Salmon, chinook	87	572	790
Salmon, chum and coho	502	1,530	2,332
Sheefish	461	0	791
Smelt*	6	11	11
Whitefish, broad	7	66	5
Sea mammals			
Belukha	0	289	150
Seal, bearded	28	57	20
Seal, ringed	28	198	46
Seal, spotted	18	110	4
Land mammals			
Beaver	7	31	19
Hare, arctic	22	41	41
Hare, snowshoe	65	91	88
Land otter	9	13	5
Mink	18	36	37
Moose	153	0	204
Muskrat	23	40	28
Birds			
Cranes*	38	65	80
Ducks*	28	55	45
Geese*	55	119	102
Ptarmigan*	30	38	46
Swans*	28		
Plants			
Berries	24	32	41
Greens	49	73	83
Total fish	1,724	3,909	5,823
Total sea mammals	74	654	220
Total land mammals	297	252	422
Total birds	179	349	365
Total plants	73	105	124
Total harvest	2,347	5,269	6,954
Harvest per capita	499	781	1,093

Source: Fienup-Riordan 1983a.

a Because of numerous inconsistencies in the originally published data, some questions exist concerning the validity and relability of the data presented in this table. Data have been included because harvest level studies have been limited in the Western Region, and better data for these communities and years do not exist.

* Signifies that species is not specified.

Notes: Harvest is expressed in pounds of dressed weight.
Subsistence harvest quantity and composition vary from year to year.
Additional species may be harvested by community residents.

Table 15. Subsistence Harvest Levels in Pounds per Household, Nine Western Region Communities, 1976

Area/community	Fish	Land Mammals	Sea Mammals	Birds	Vegetation	Total
Yukon River						
Emmonak	8,013	504	1,089	552	781	10,939
Kotlik	10,810	440	922	562	737	13,471
Mt. Village	12,219	1,156	52	567	397	14,391
Kuskokwim River						
Aniak	2,065	759	0	301	32	3,157
Kwethluk	5,660	846	0	580	312	7,398
Napaskiak	5,988	688	24	560	458	7,718
Middle Bering Sea						
Chevak	8,536	168	1,107	695	471	10,977
Goodnews	7,532	556	796	540	485	9,909
Tununak	7,537	192	1,016	630	423	9,798

Source: Nunam Kitlutsisti 1983.

Note: This table presents one year's data only. Subsistence harvest level may vary from year to year.

Table 16. Subsistence Harvest Levels in Pounds per Household and per Capita, Three Western Regio Communities, ca. 1985

Community	Households Surveyed	Households Size	Harvest Composition (Lb per Capita): Harvest Fish	Game	Marine Mammals	Other	Total Harvest Per Capita	Total Harvest per Household
Quinhagak	12	4.8	491	113	128	24	756	3,629
Nunapitchuk	15	6.6	562	41	11	82	697	4,600
Russian Mission	22	6.1	503	96	0	0	599	3,654

Source: Unpubl. data; Andrews, pers. comm.; Pete, pers. comm; Wolfe 1985.

Notes: Harvest is expressed in pounds of dressed weight.
Subsistence harvest quantity and composition vary from year to year.

Table 17. Subsistence Harvest Composition, Six Western Region Communities, June 1980 through May 1981

	Alakanuk	Emmonak	Kotlik	Mountain Village	Sheldon Point	Stebbins
Total fish	65.0%	70.0%	57.8%	79.2%	78.0%	61.4%
Total sea mammals	17.6	15.4	20.5	2.8	15.0	31.9
Total land mammals	9.6	9.3	13.9	15.9	4.5	1.7
Total birds	7.2	5.3	7.8	2.2	2.5	5.0
Total harvest*	99.4	100.0	100.0	100.0	100.0	100.0

Source: Wolfe 1981.

Notes: Data are based on 88 sampled households. Subsistence composition may vary from year to year.

* Due to rounding figures, totals are not always 100%.

Table 18. Subsistence Harvest Compositions, Nine Western Region Communities, 1976

Area/community	Fish	Land Mammals	Sea Mammals	Birds	Vegetation	Total
Yukon River						
Emmonak	73.3%	4.6%	10.0%	5.0%	7.1%	100.0%
Kotlik	80.2	3.3	6.8	4.2	5.5	100.0
Mt. Village	84.9	8.0	0.4	3.9	2.8	100.0
Kuskokwim River						
Aniak	65.4	24.0	0.0	9.5	1.0	100.0
Kwethluk	76.5	11.4	0.0	7.8	4.2	100.0
Napaskiak	77.6	8.9	0.3	7.3	5.9	100.0
Middle Bering Sea						
Chevak	77.8	1.5	10.1	6.3	4.3	100.0
Goodnews	76.0	5.6	8.0	5.4	4.9	100.0
Tununak	76.9	2.0	10.4	6.4	4.3	100.0

Source: Nunam Kitlutsisti 1983.

Note: This table presents one year's data only. Subsistence composition may vary from year to year.

Table 19. Household Participation in Subsistence Harvesting of Selected Species, Six Western Region Communities, June 1980 through May 1981

	Alakanuk	Emmonak	Kotlik	Mountain Village	Sheldon Point	Stebbins
Fish						
Bering cisco	86%	83%	100%	31%	67%	75%
Blackfish	71	56	43	63	83	0
Burbot	52	28	50	69	50	0
Cod, saffron	43	28	43	0	67	92
Herring	0	0	0	0	0	83
Lamprey*	0	0	0	69.2	0	0
Northern pike	43	56	36	94	83	0
Salmon*	100	72	86	94	100	75
Sheefish	62	61	79	69	83	33
Smelt*	43	0	14	0	33	0
Whitefish, broad*	53	44	50	81	67	8
Sea Mammals						
Belukha whale	24	22	14	0	33	42
Sea lion	10	0	0	0	0	0
Seal*	71	50	100	56	100	100
Walrus	6	0	0	0	0	42
Land mammals						
Beaver	29	22	29	38	17	0
Caribou	0	0	7	0	17	0
Hare, arctic and snowshoe	86	78	93	75	100	50
Land otter	33	11	29	25	33	0
Mink	67	22	36	38	50	0
Moose	29	17	21	50	33	8
Muskrat	71	61	71	69	100	42
Birds						
Cranes*	71	44	86	31	67	83
Ducks*	86	89	86	81	100	83
Geese*	86	89	93	88	83	92
Ptarmigan*	81	56	93	81	83	58
Swans*	67	28	50	38	83	33

Source: Wolfe 1981.

* Indicates that species is not specified.

Notes: Numbers indicate percentage of households successfully harvesting each species. Data are based on 88 sampled households. Households and community participation in a particular harvest vary from year to year.

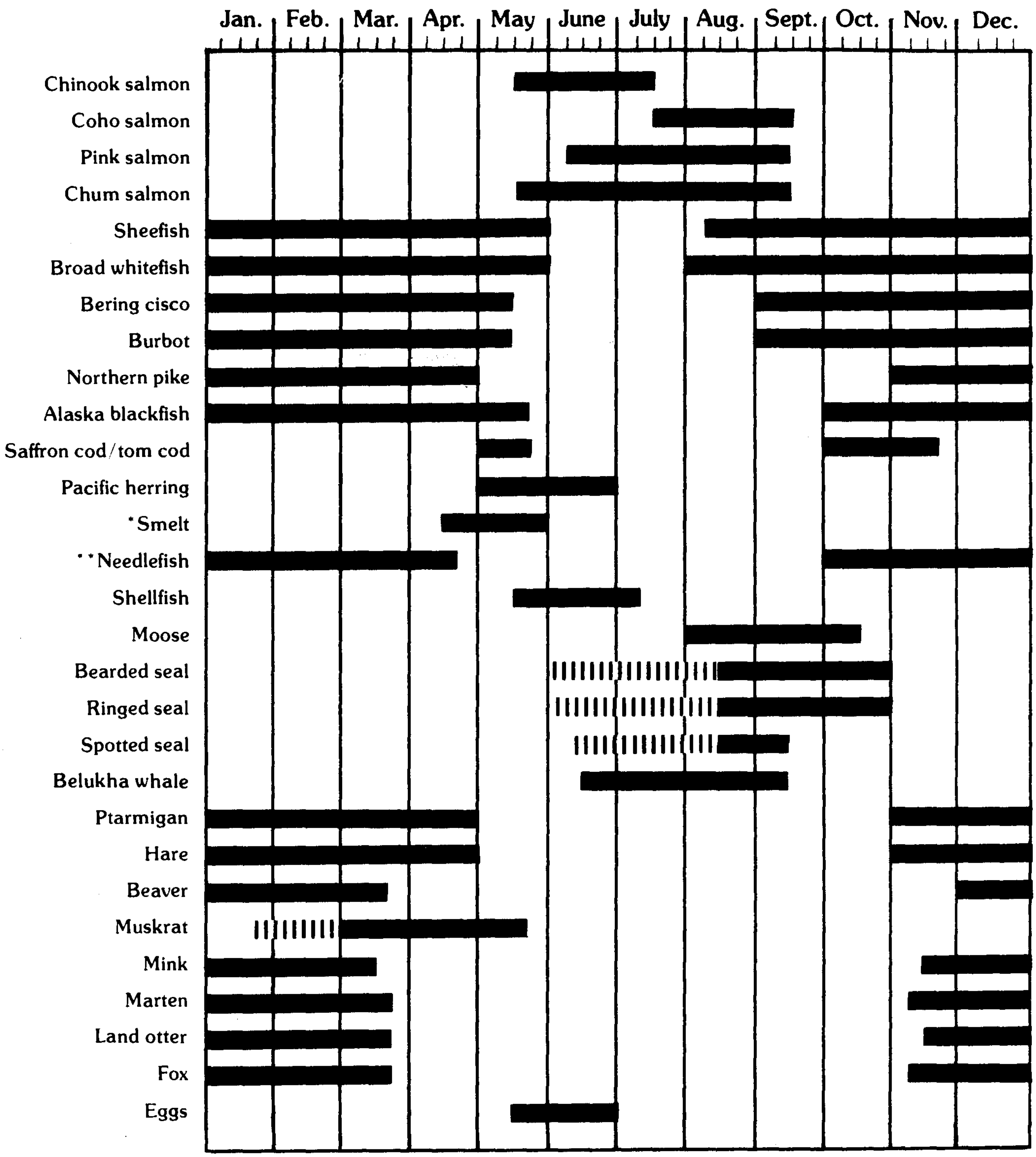


Figure 1. Annual round of subsistence harvest activities by residents of Alakanuk, Sheldon Point, and Scammon Bay, 1983 (Fienup-Riordan 1983a) (continued).

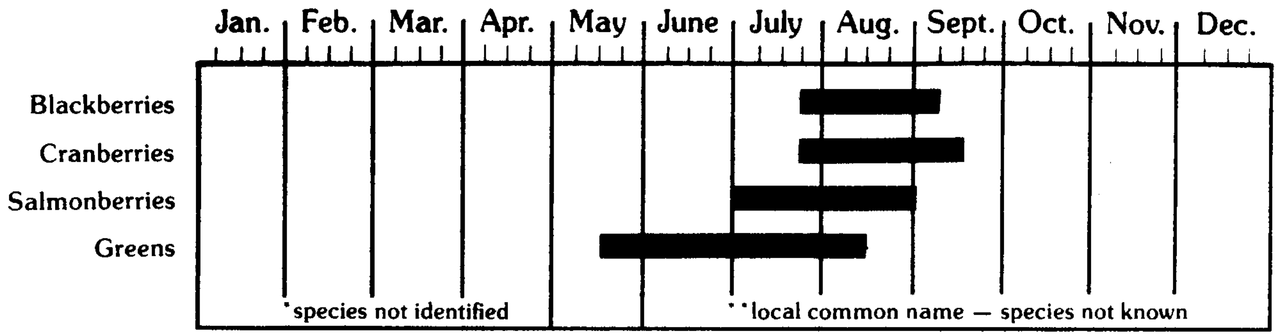


Figure 1 (continued). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Note: This figure is based on partial data; additional species and harvest periods may be used by Alakanuk, Sheldon Point, and Scammon Bay residents.

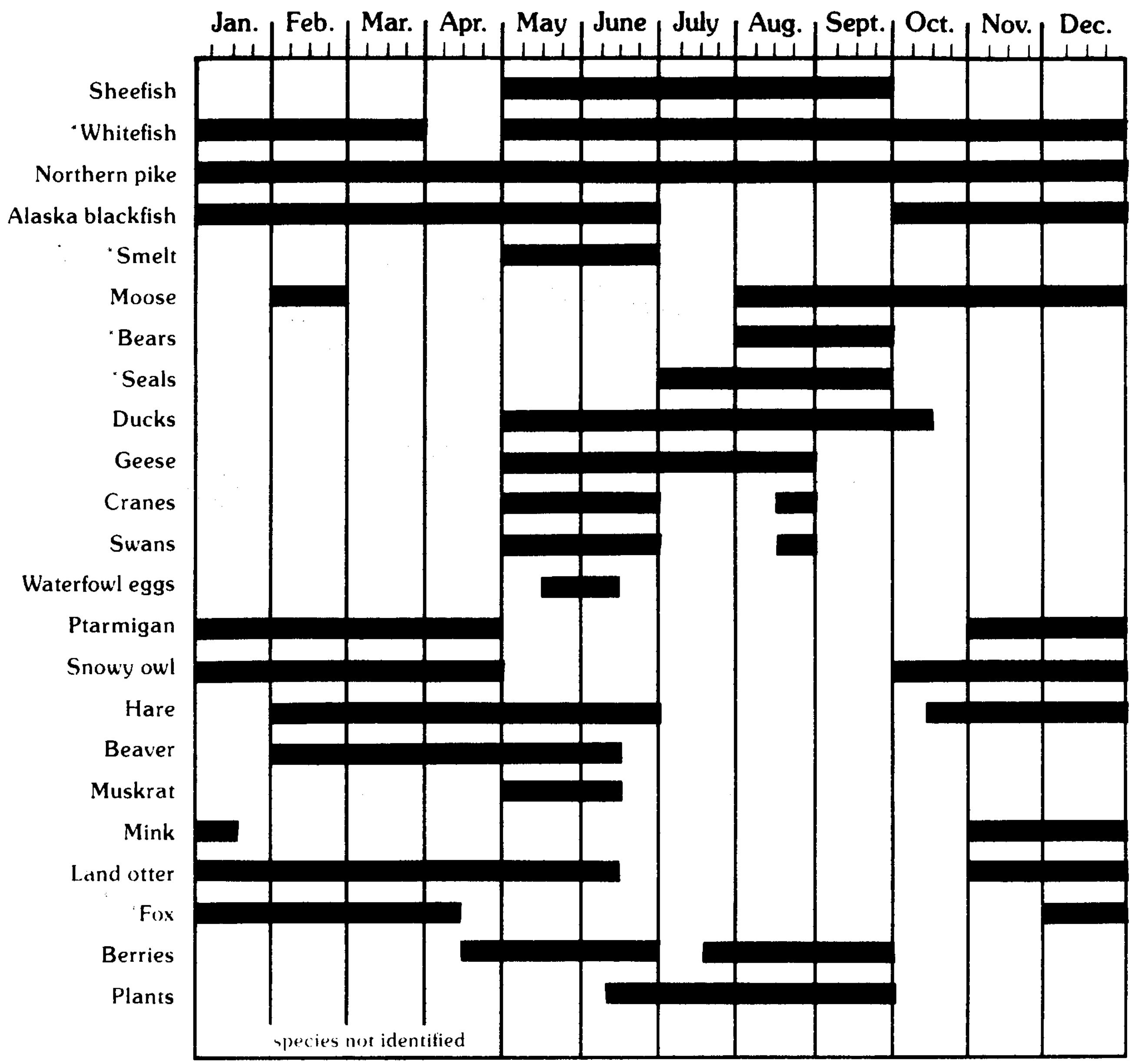


Figure 2. Annual round of subsistence harvest activities by residents of Atmautluak, 1983 (Nunam Kitlutsisti 1983).

Note: This figure is based on partial data; additional species and harvest periods may be used by Atmautluak residents.

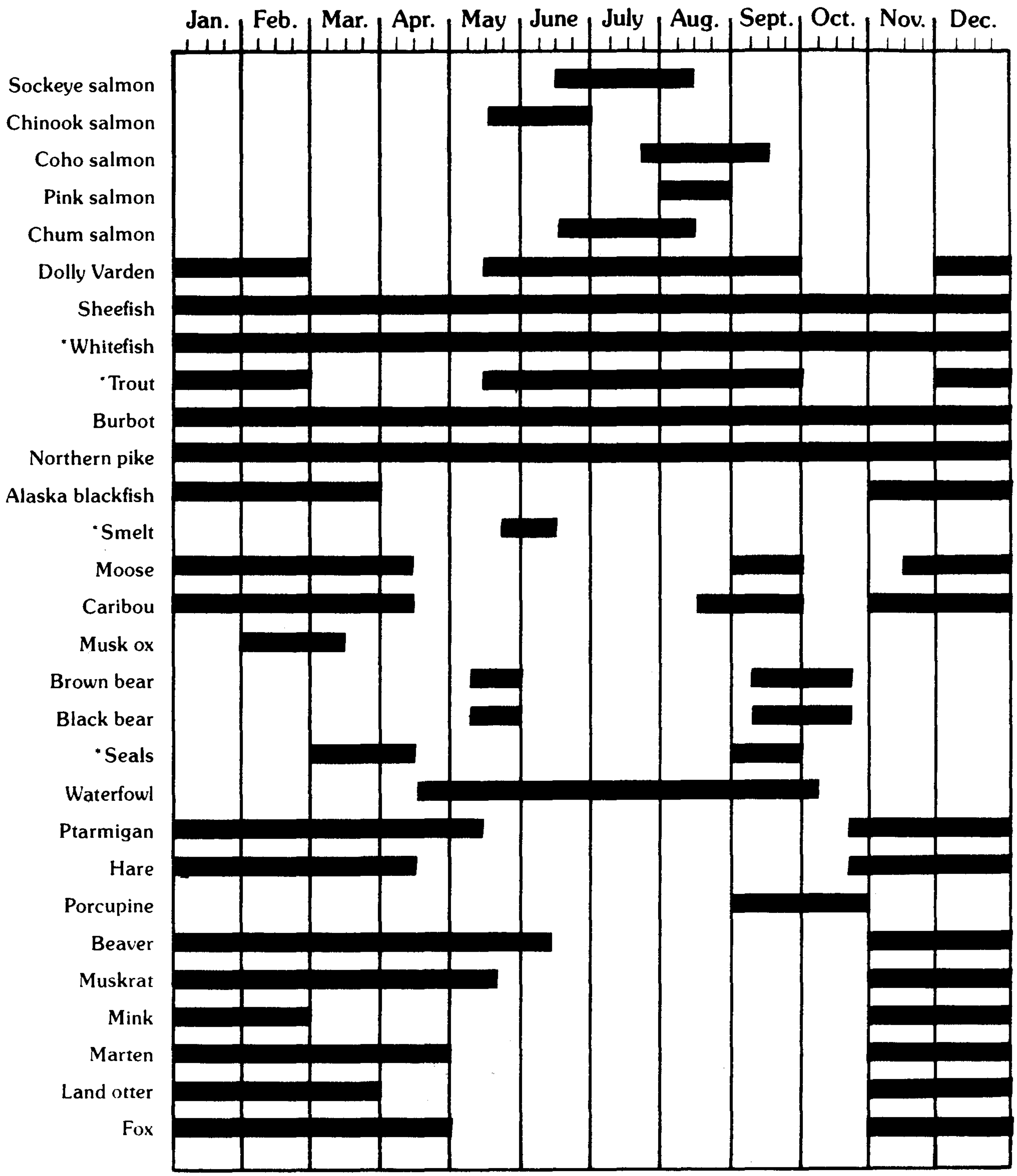


Figure 3. Annual round of subsistence harvest activities by residents of Bethel, 1985 (Pete, pers. comm.) (continued).

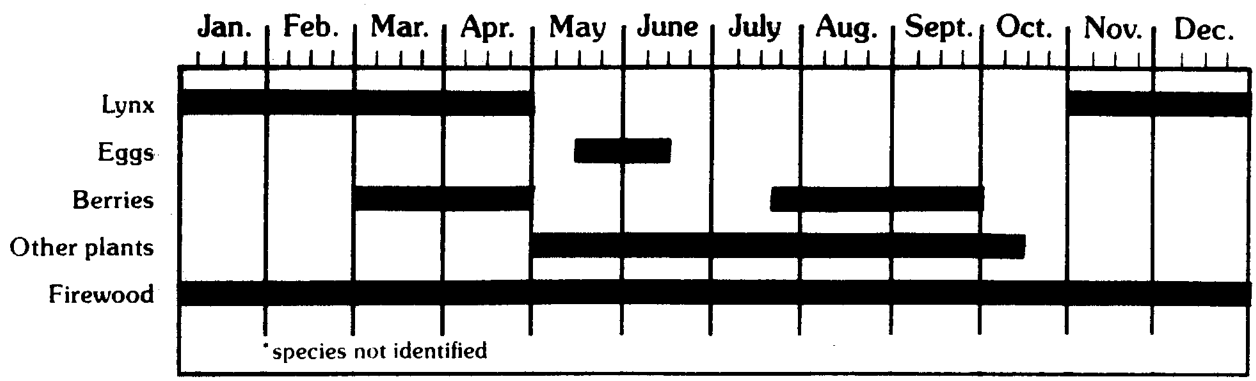


Figure 3 (continued).

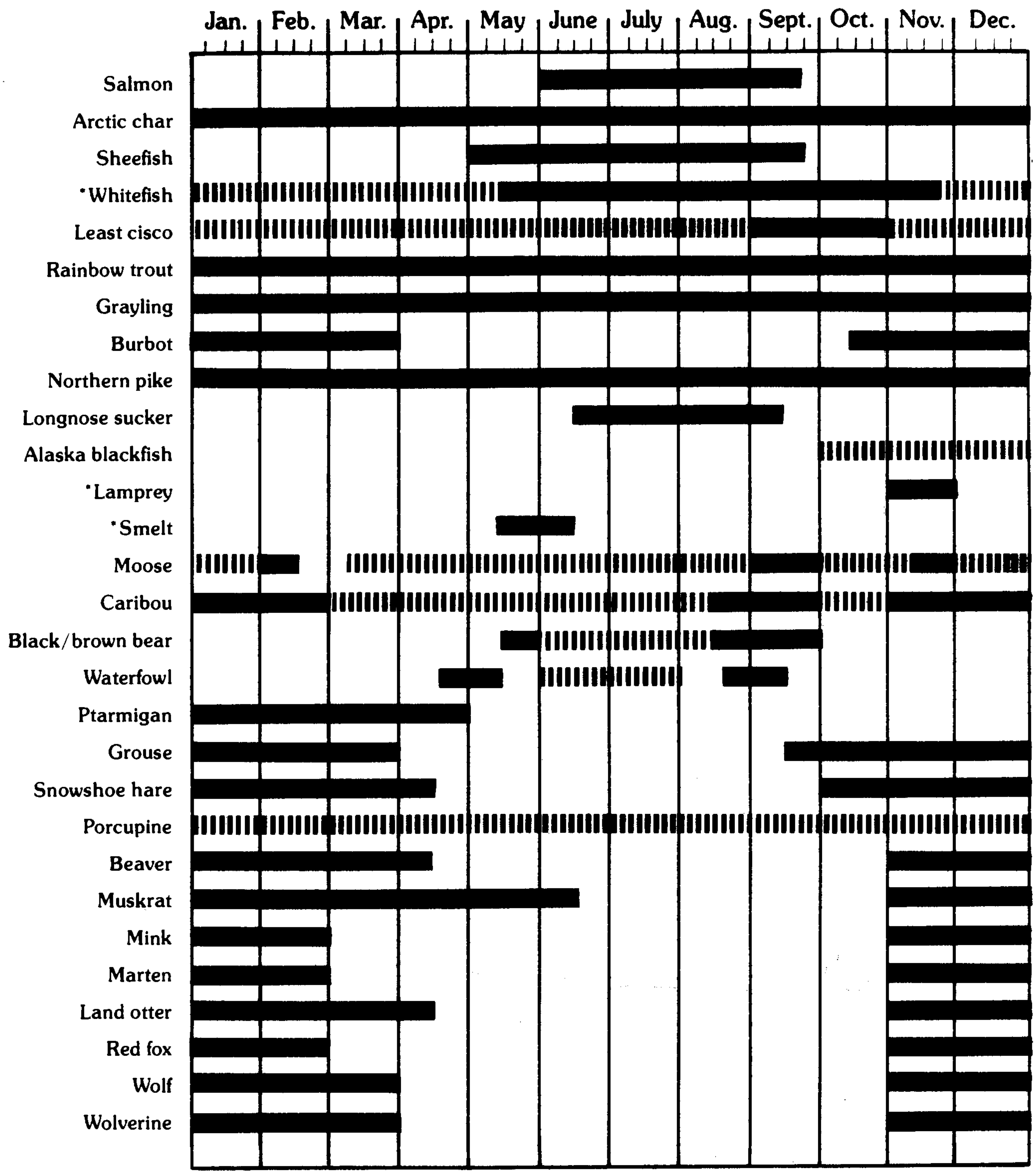


Figure 4. Annual round of subsistence harvest activities by residents of Chuathbaluk and Sleetmute, June 1982 - May 1983 (Charnley 1984) (continued).

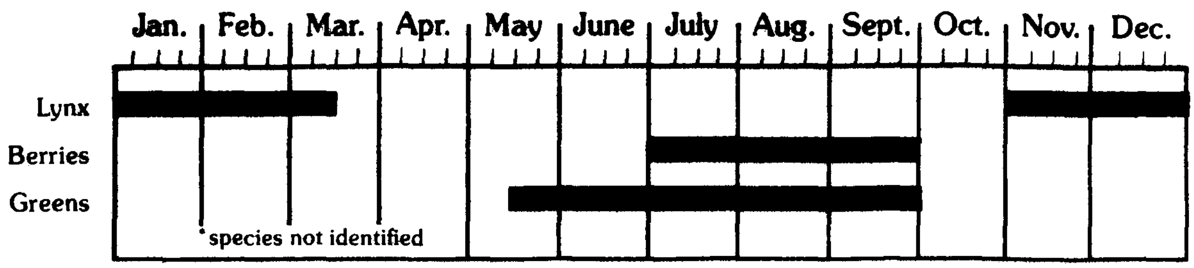


Figure 4 (continued). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

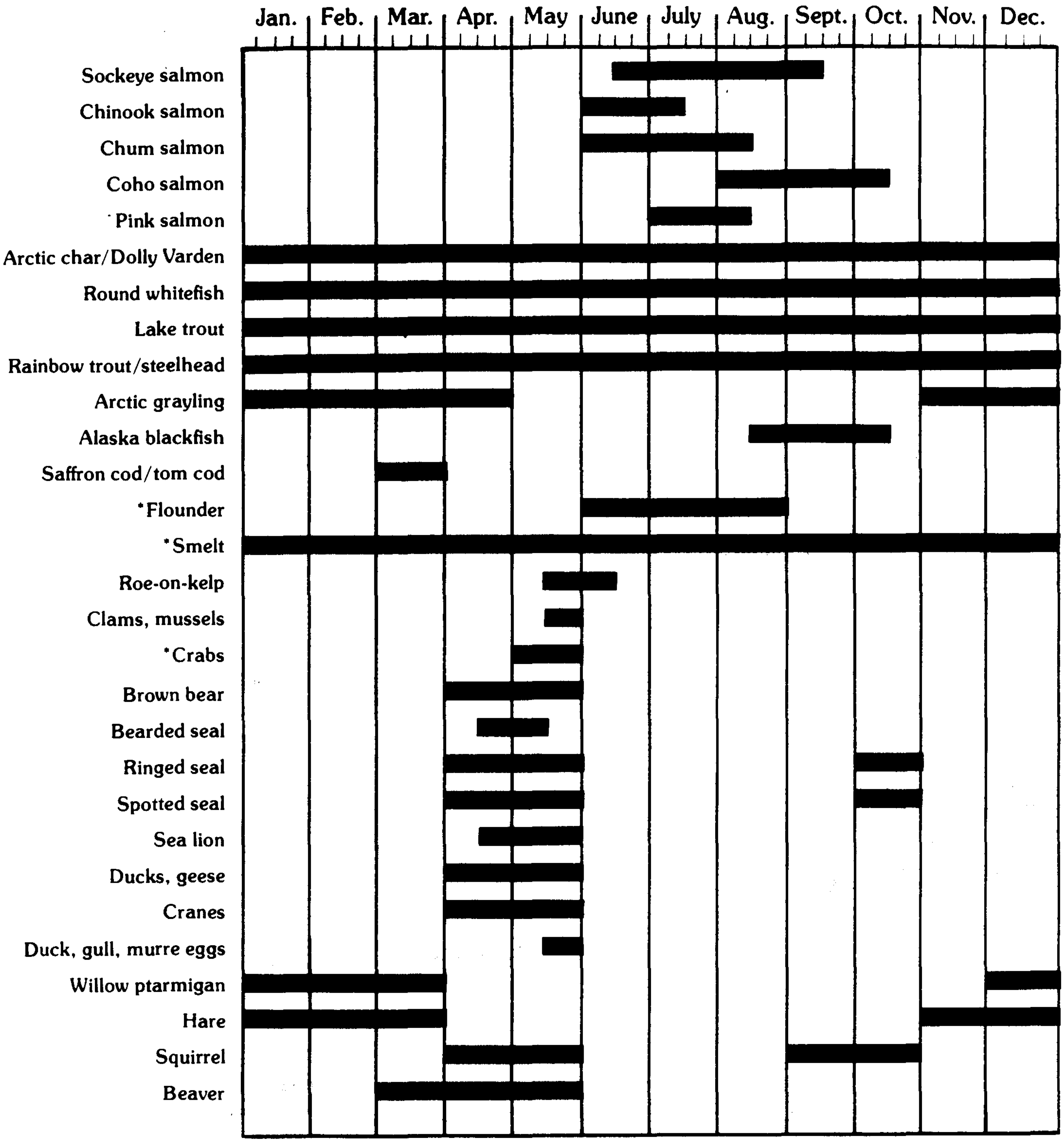


Figure 5. Annual round of subsistence harvest activities by residents of Goodnews Bay, 1983 (Wolfe et al. 1984) (continued).

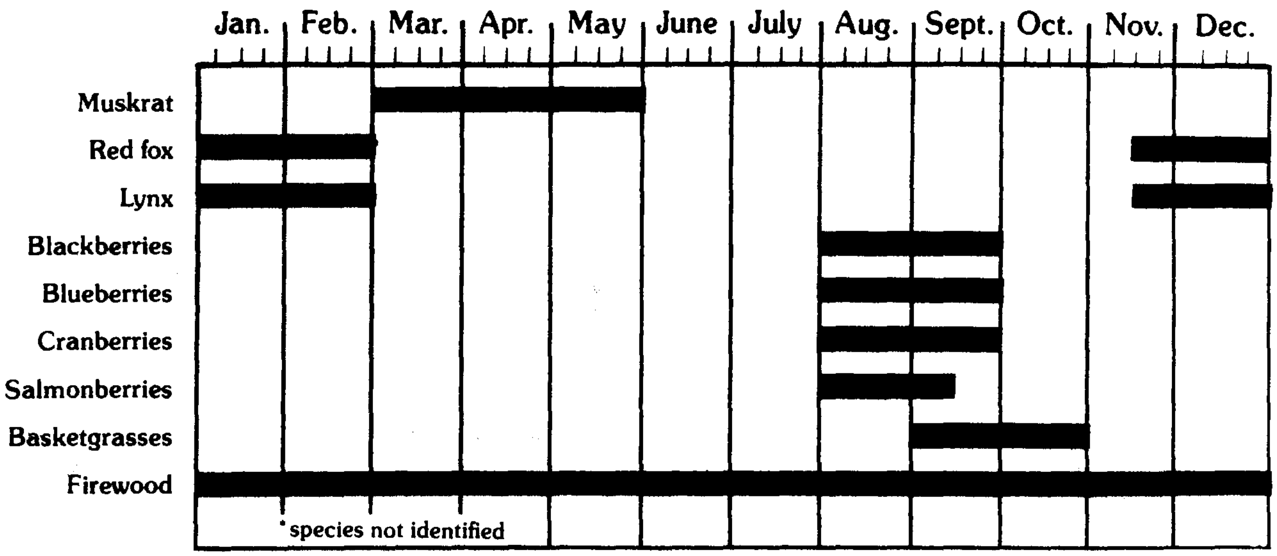


Figure 5 (continued). Note: This figure is based on partial data; additional species and harvest periods may be used by Goodnews Bay residents.

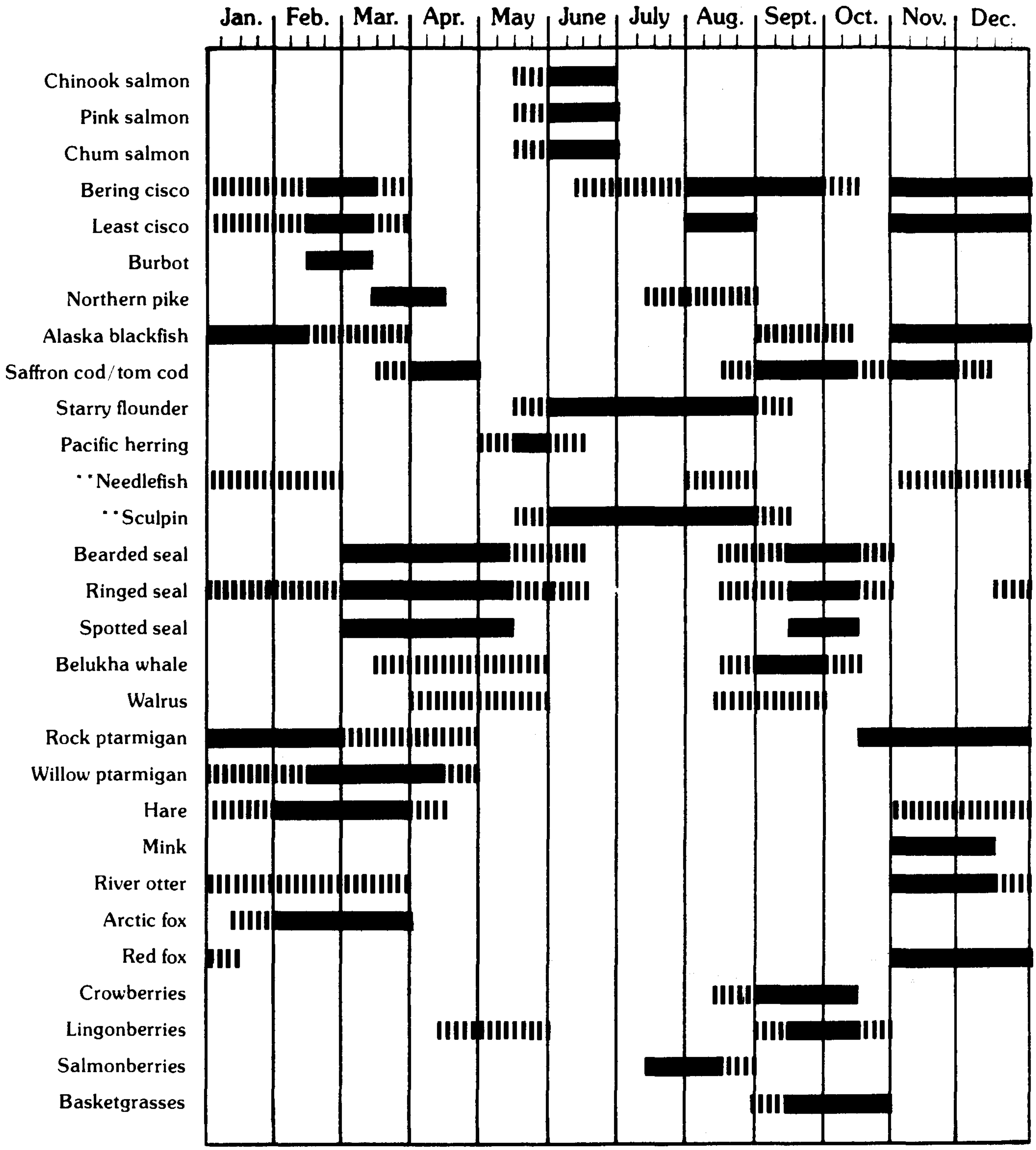


Figure 6. Annual round of subsistence harvest activities by residents of Hooper Bay (Stickney 1985) (continued).

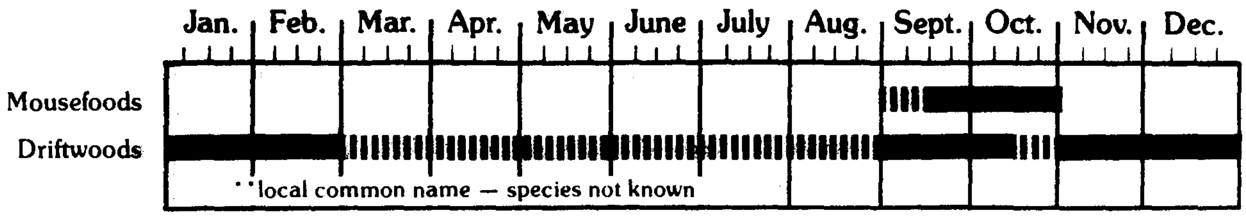


Figure 6 (continued). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

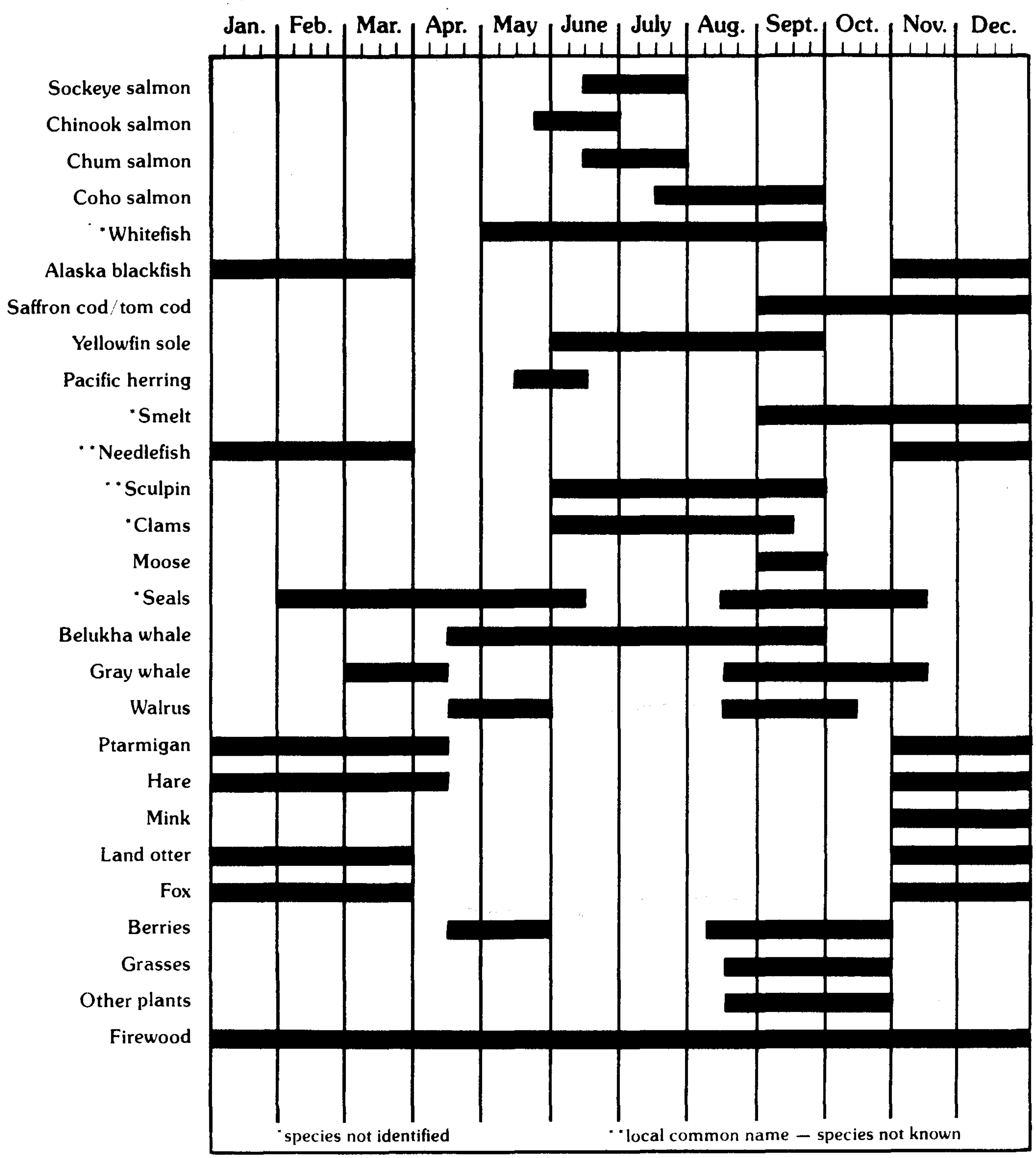


Figure 7. Annual round of subsistence harvest activities by residents of Kipnuk, 1985 (Pete, pers. comm.).

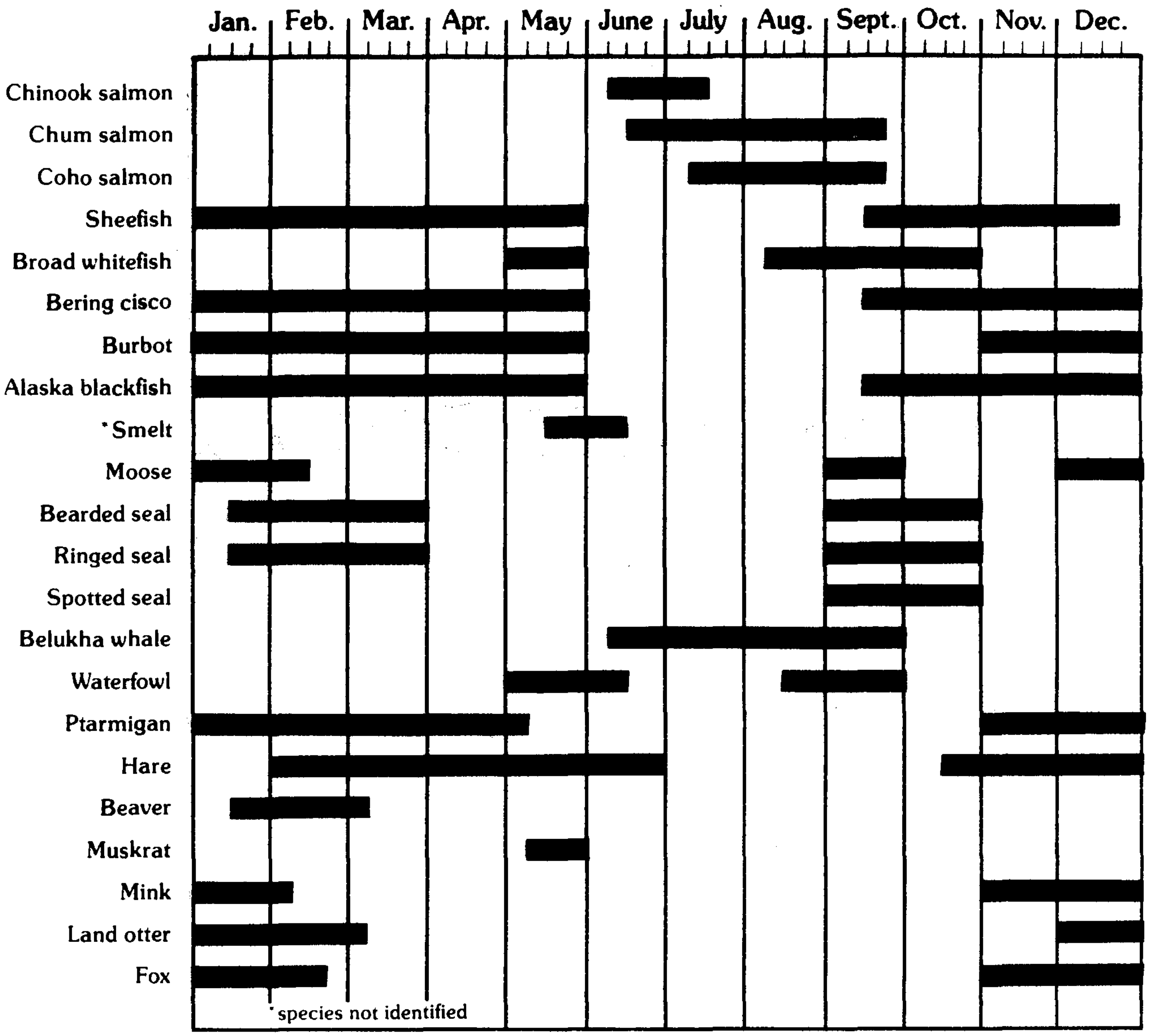


Figure 8. Annual round of subsistence harvest activities by residents of Kotlik, 1976 to 1977 (Wolfe 1985).

Note: This figure is based on partial data; additional species and harvest periods may be used by Kotlik residents.

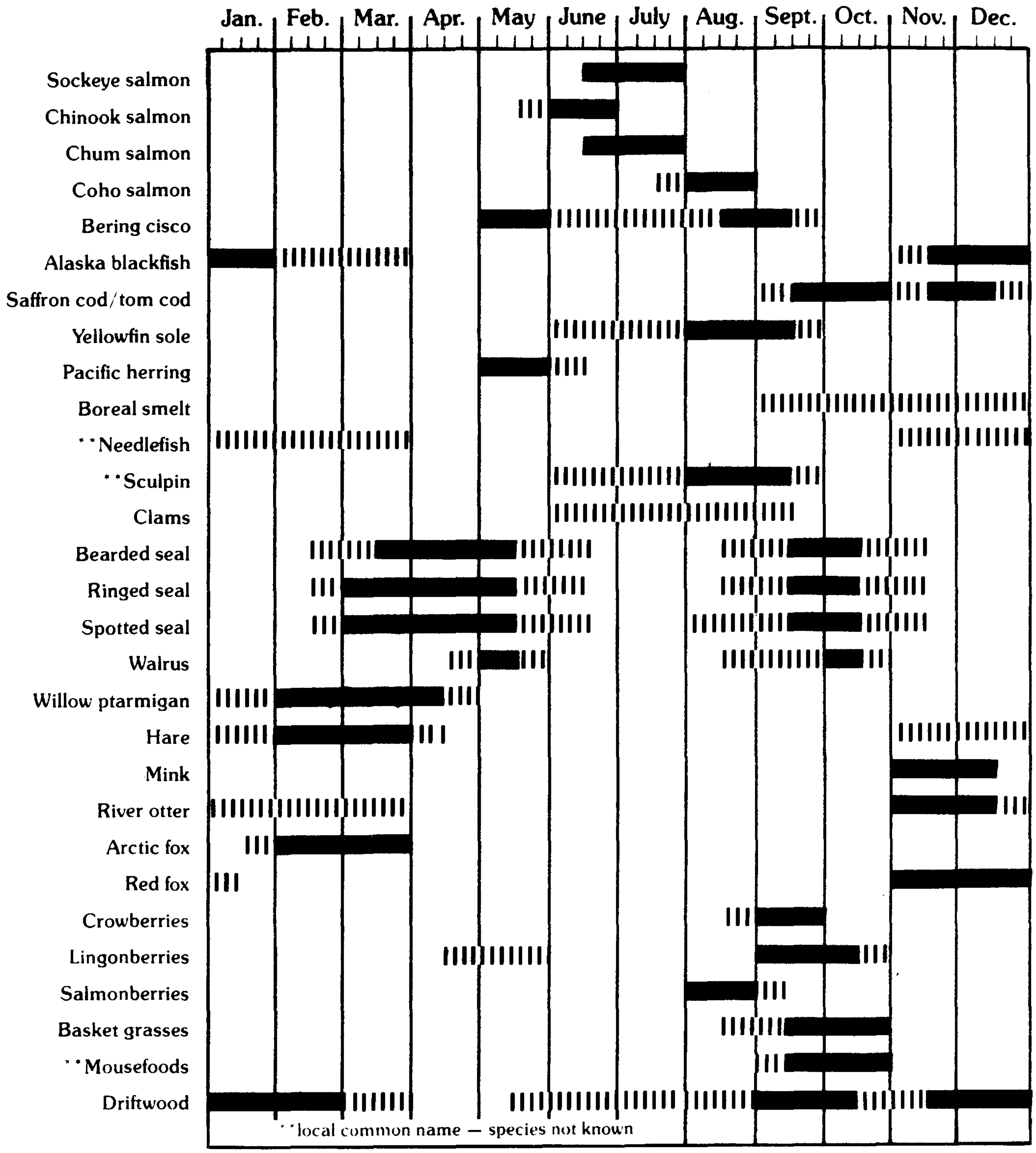


Figure 9. Annual round of subsistence harvest activities by residents of Kwigillingok (Stickney 1985). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

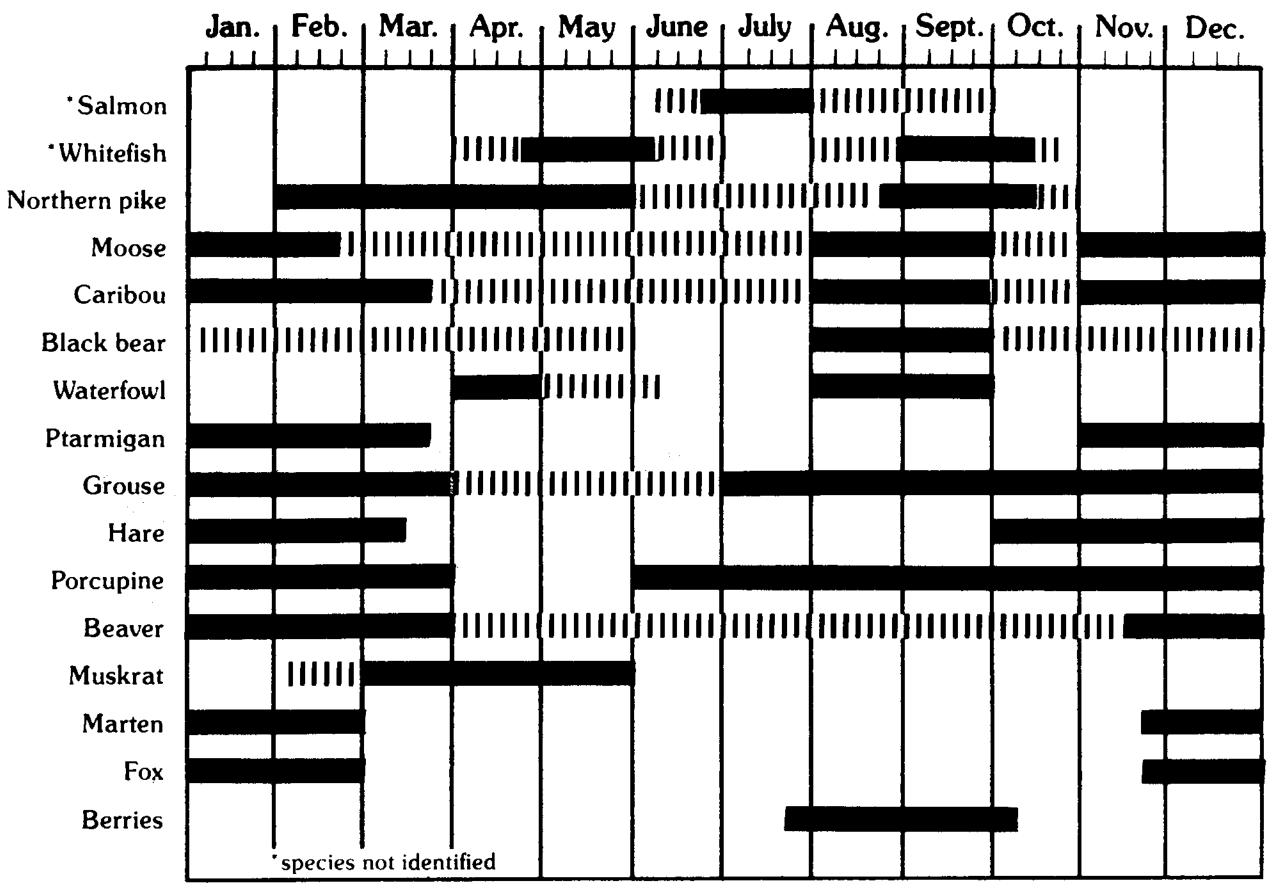


Figure 10. Annual round of subsistence harvest activities by residents of Lime Village, 1976 to 1983 (Kari 1983). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Note: This figure is based on partial data; additional species and harvest periods may be used by Lime Village residents.

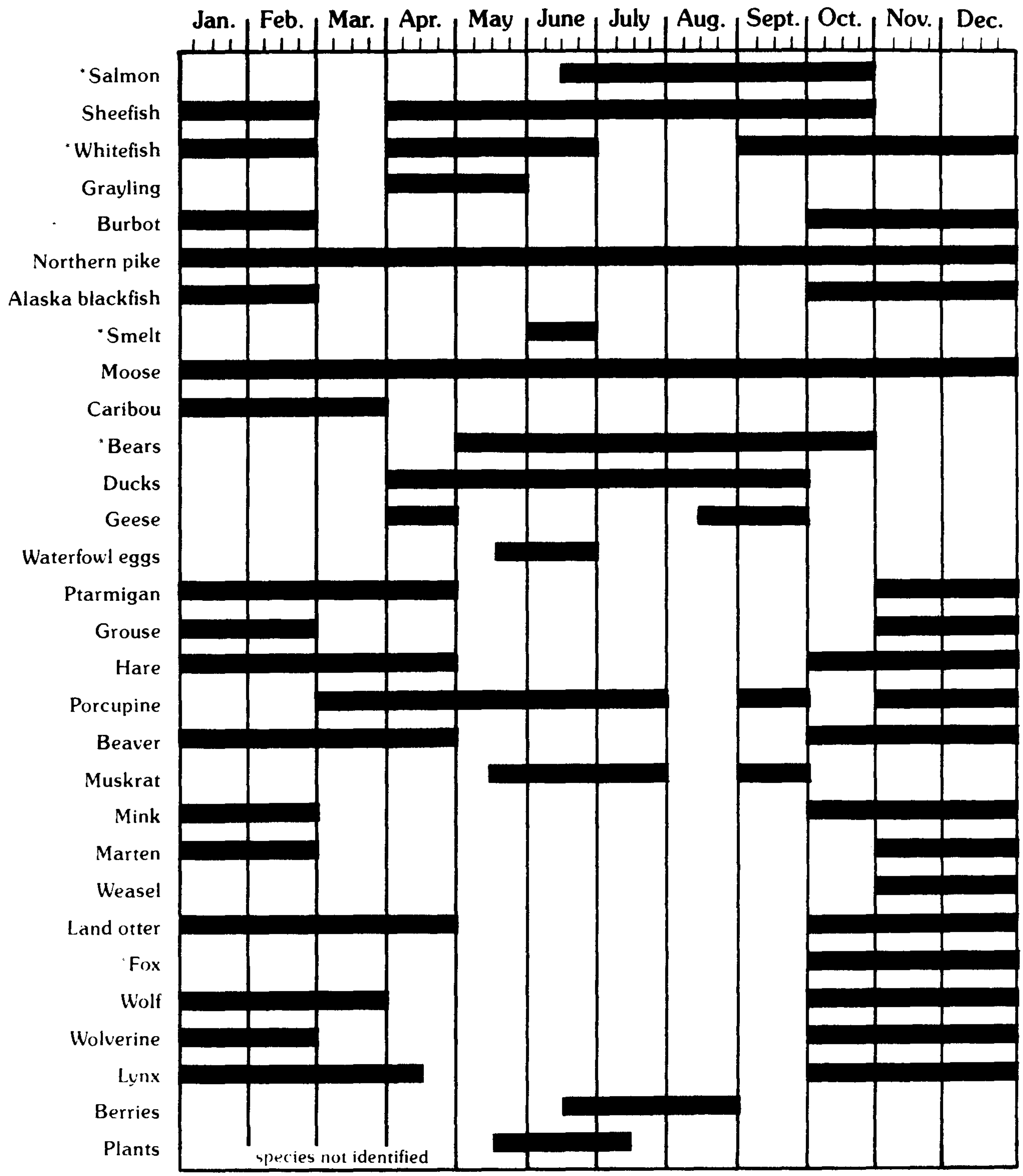


Figure 11. Annual round of subsistence harvest activities by residents of Lower Kalskag, 1983 (Nunam Kitlutsisti 1983).

Note: This figure is based on partial data; additional species and harvest periods may be used by Lower Kalskag residents.

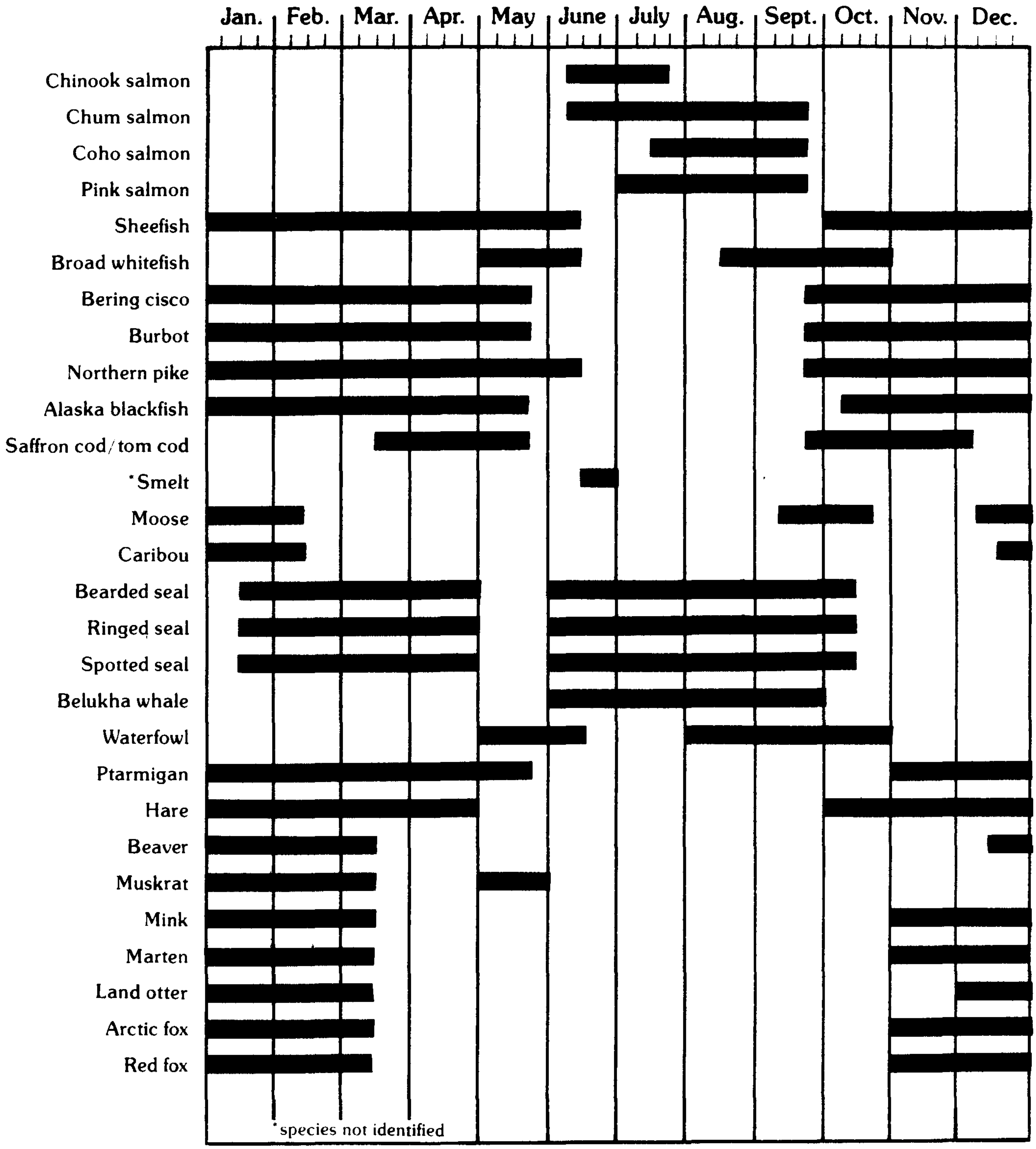


Figure 12. Annual round of subsistence harvest activities by residents of Lower Yukon River (Wolfe and Pete 1984).

Note: This figure is based on partial data; additional species and harvest periods may be used by residents of Lower Yukon River communities.

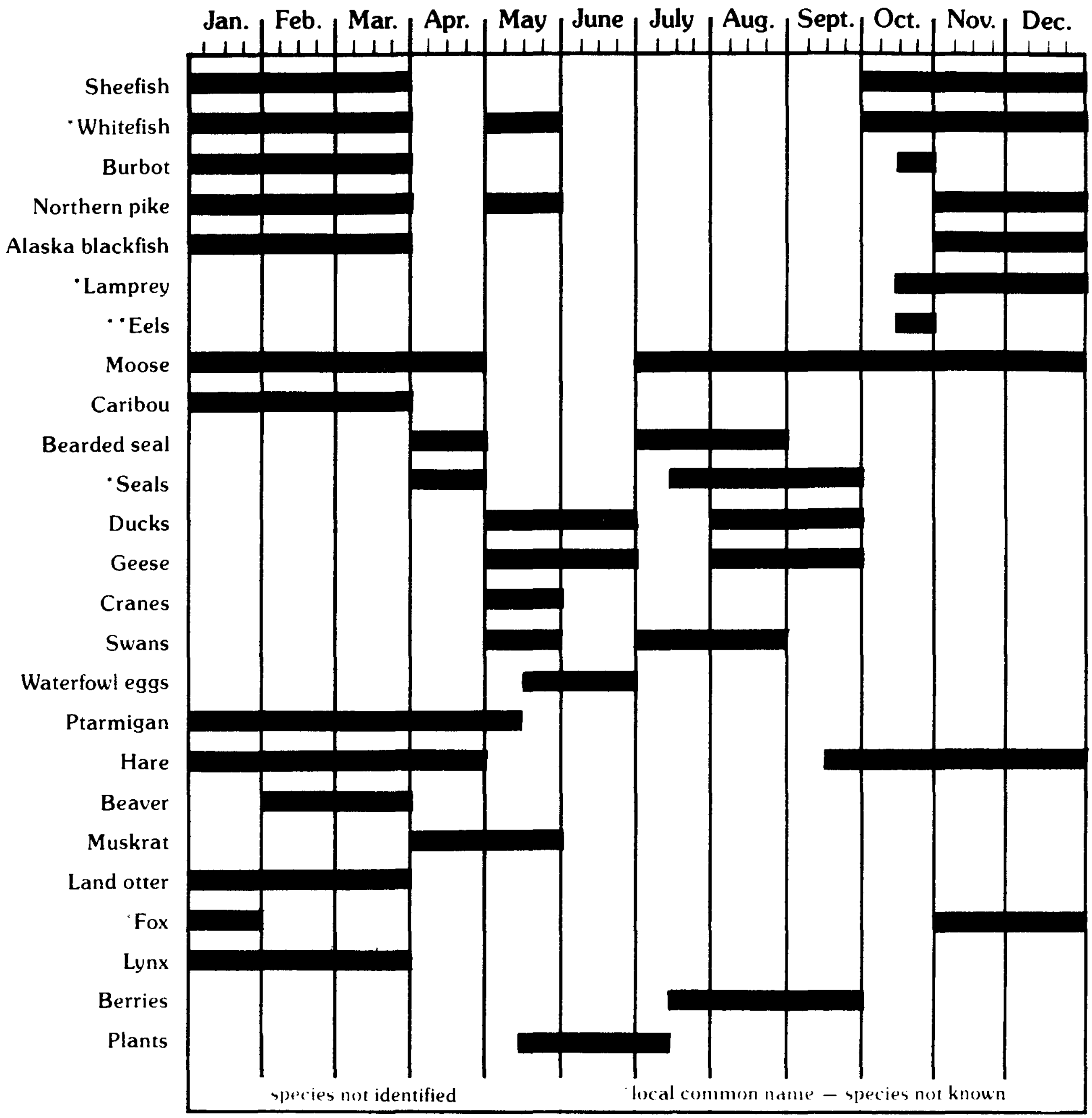


Figure 13. Annual round of subsistence harvest activities by residents of Marshall, 1983 (Nunam Kitlutsisti 1983).

Note: This figure is based on partial data; additional species and harvest periods may be used by Marshall residents.

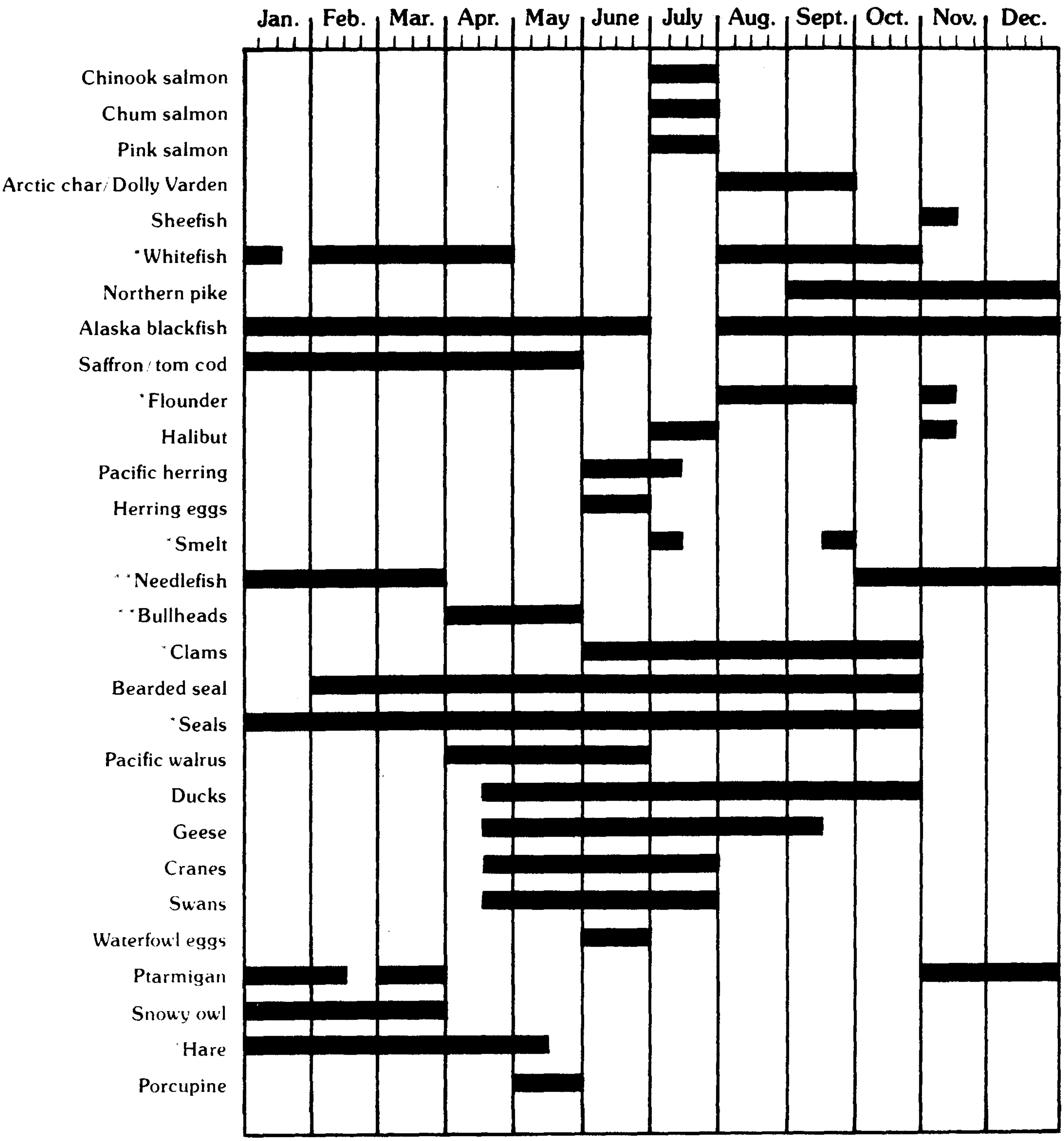


Figure 14. Annual round of subsistence harvest activities by residents of Newtok, 1983 (Nunam Kitlutsisti 1983) (continued).

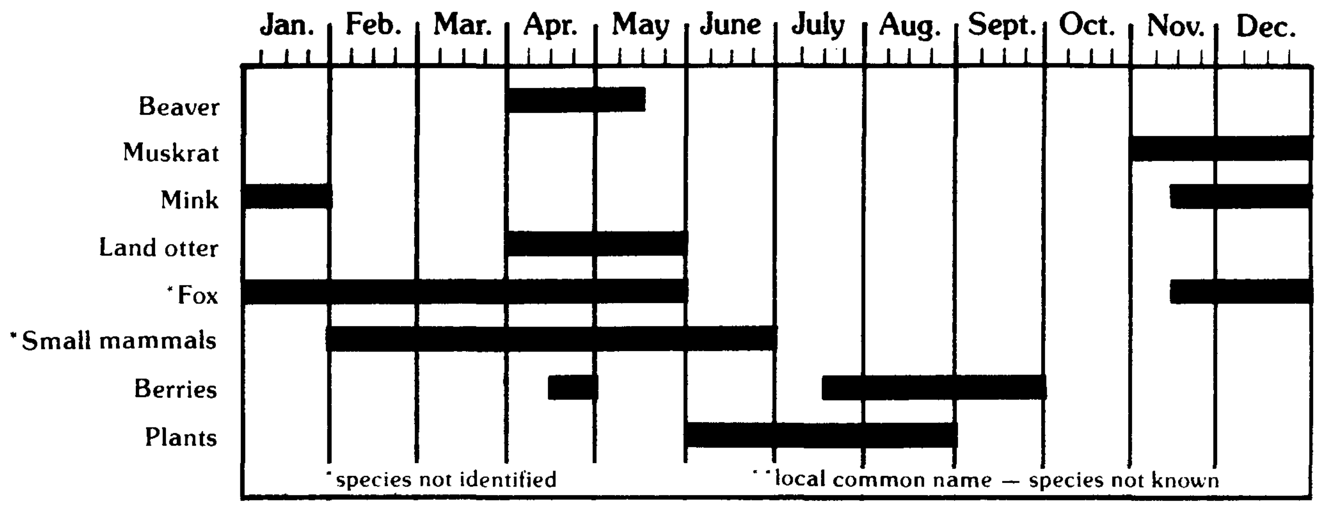


Figure 14 (continued). Note: This figure is based on partial data; additional species and harvest periods may be used by Newtok residents.

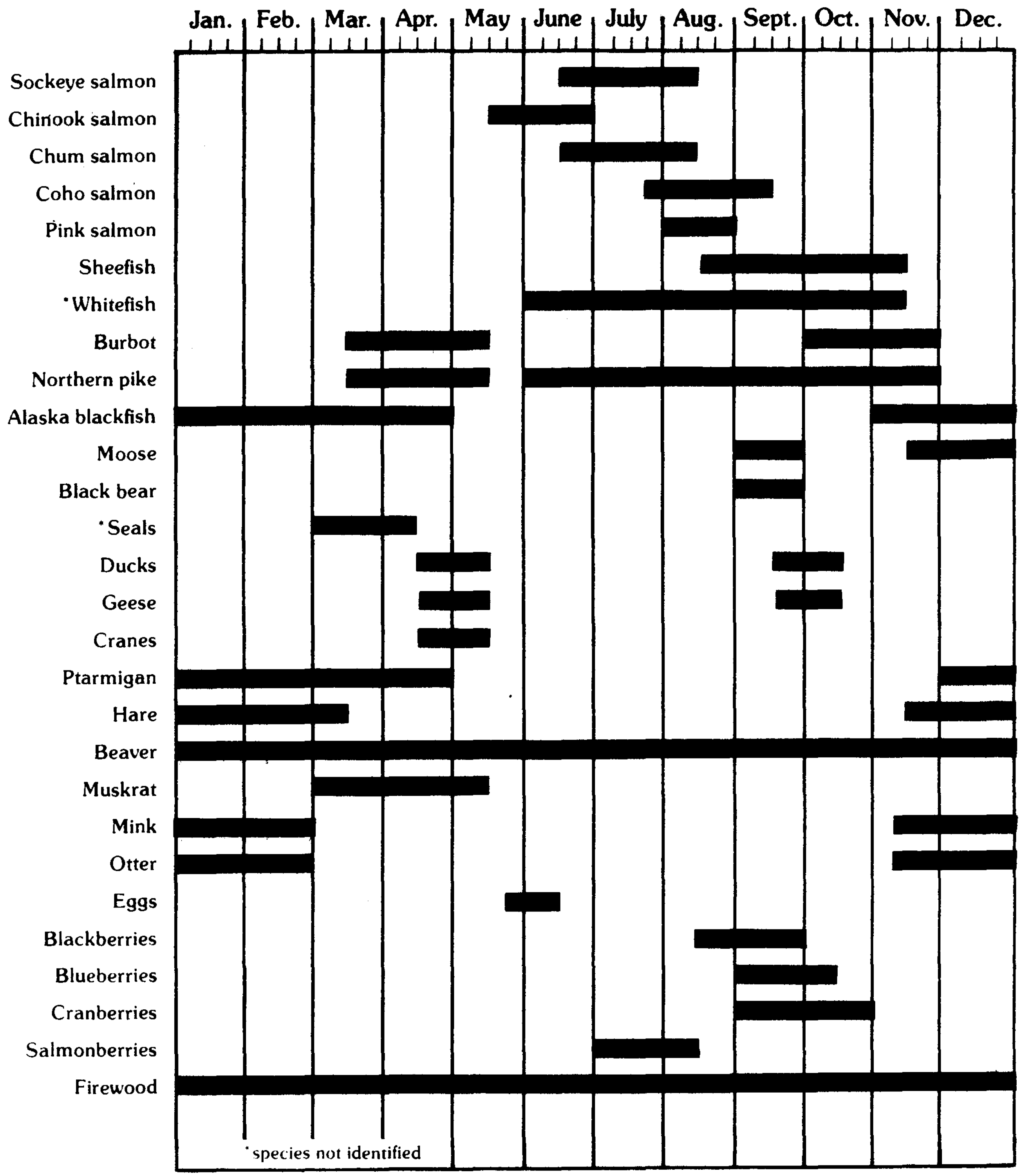


Figure 15. Annual round of subsistence harvest activities by residents of Nunapitchuk, 1983 (Andrews, pers. comm.).

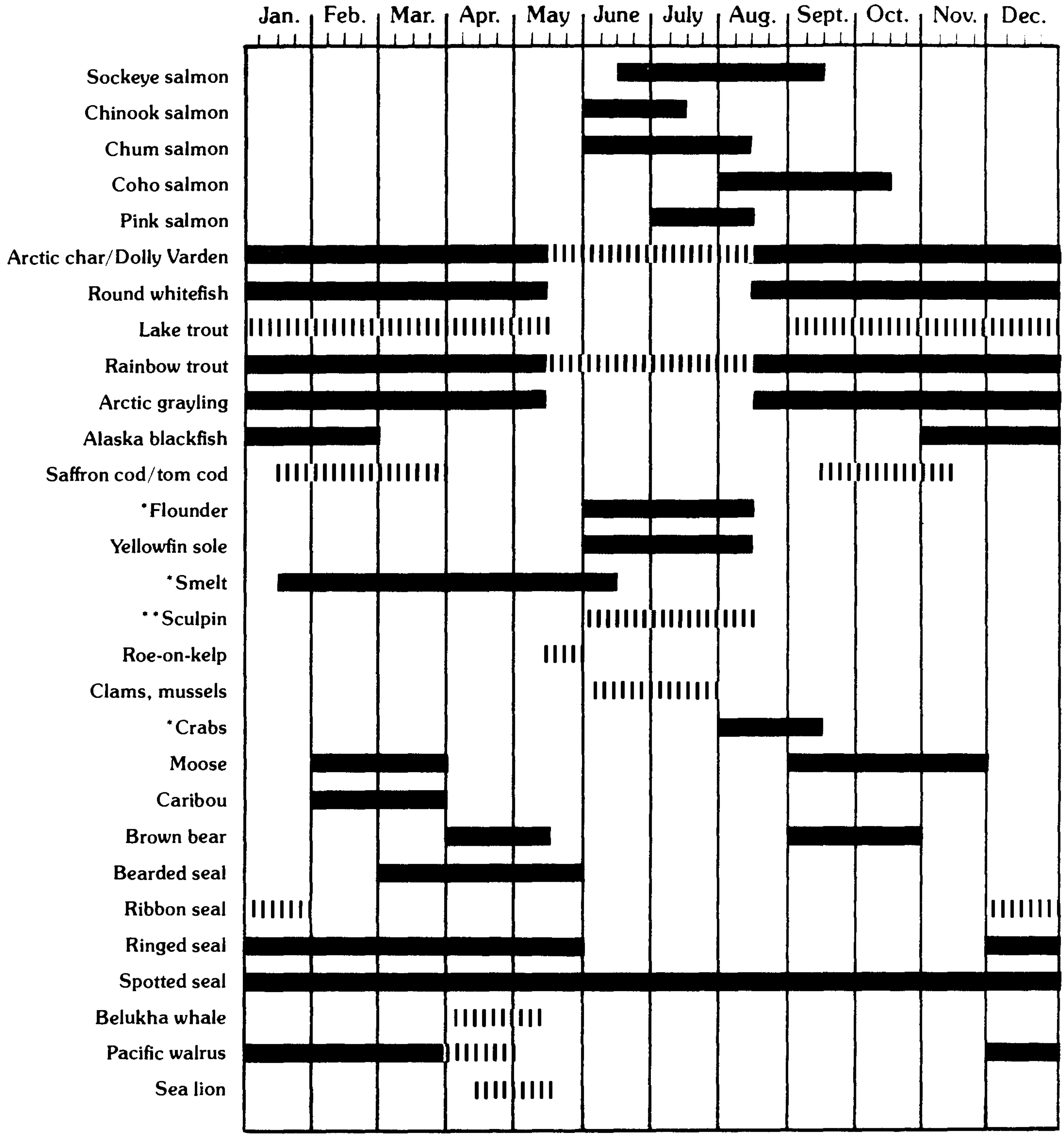


Figure 16. Annual round of subsistence harvest activities by residents of Quinhagak, 1983 (Wolfe 1984) (continued).

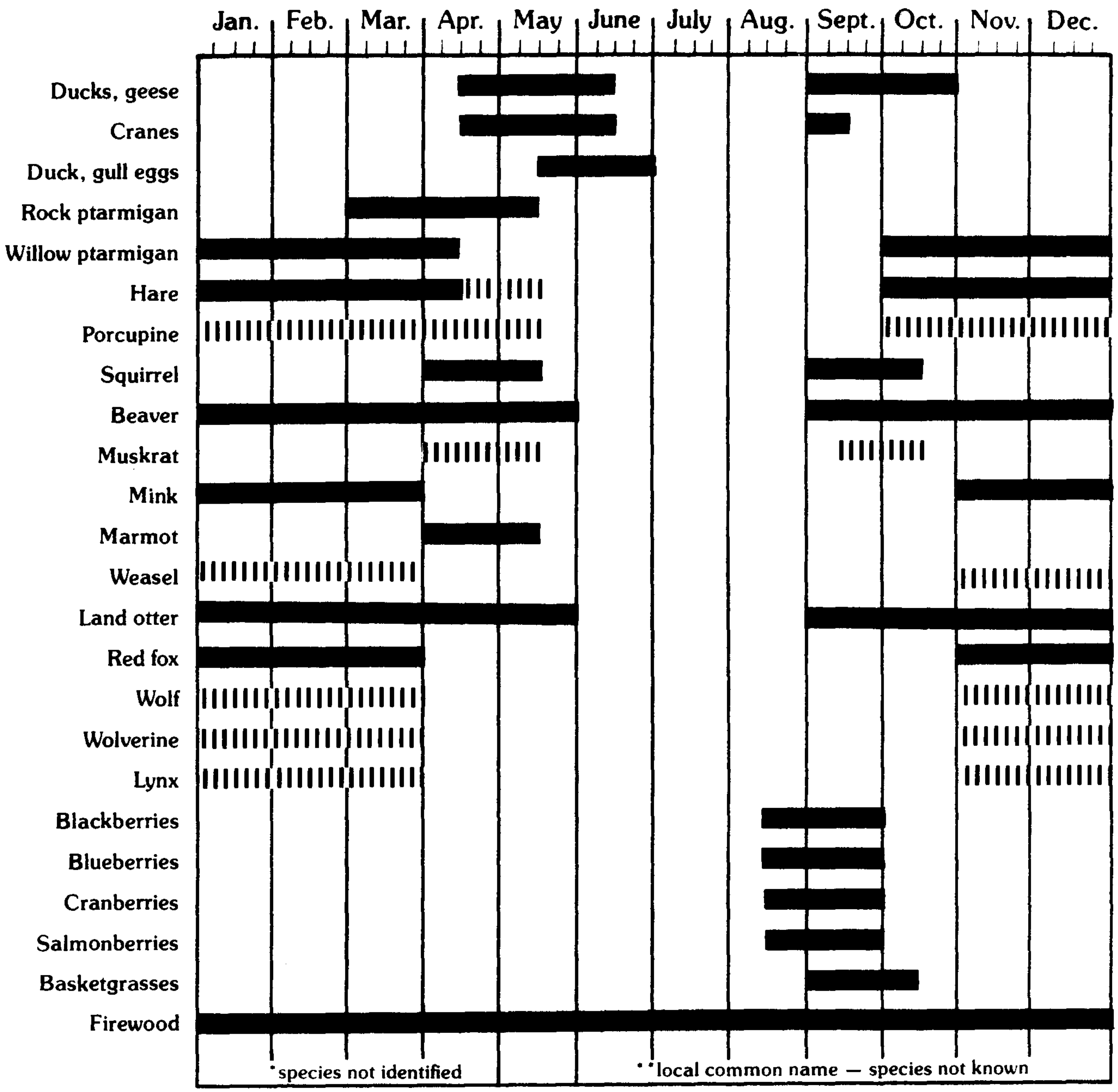


Figure 16 (continued). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

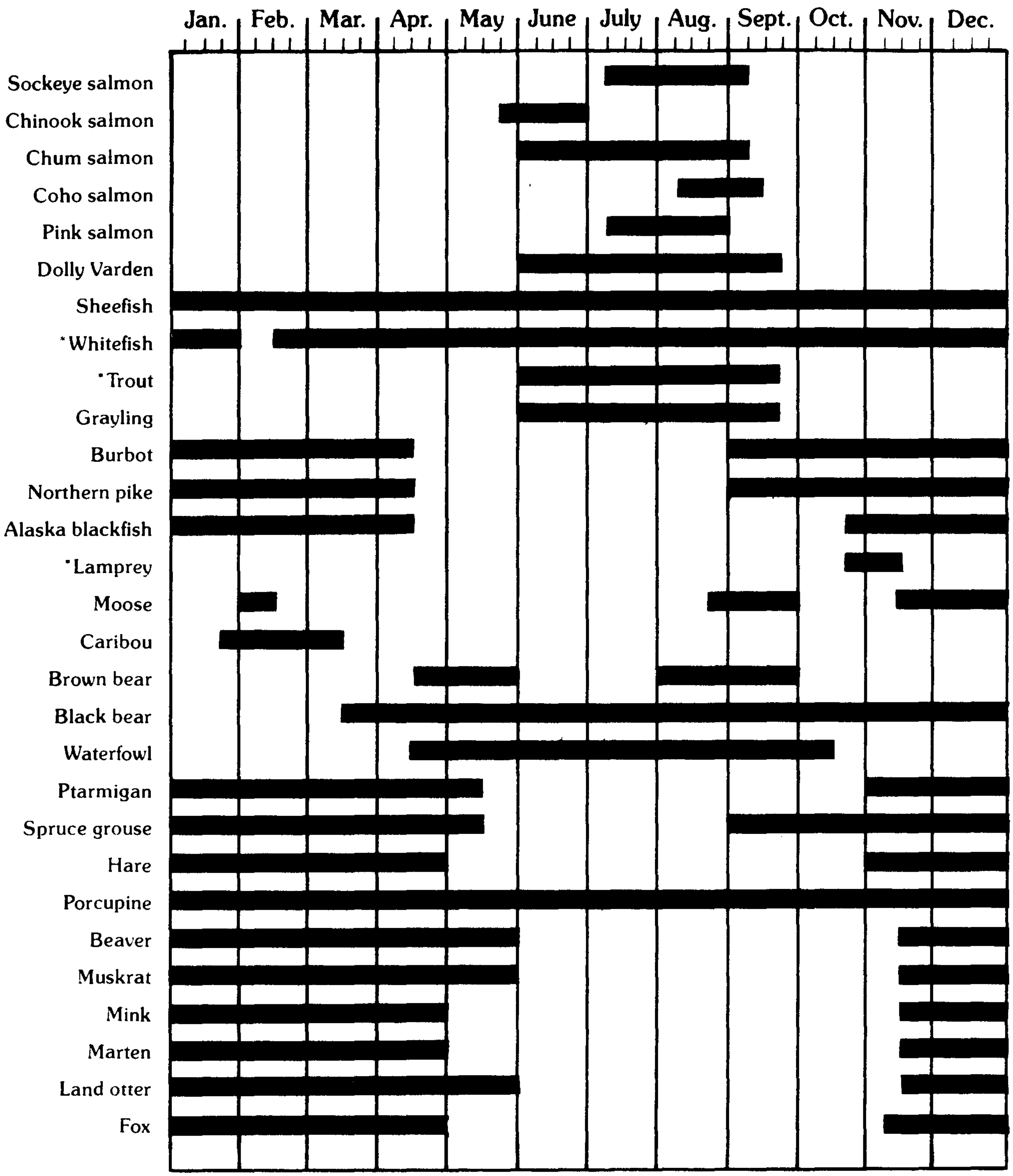


Figure 17. Annual round of subsistence harvest activities by residents of Russian Mission, 1984 (Pete, pers. comm.) (continued).

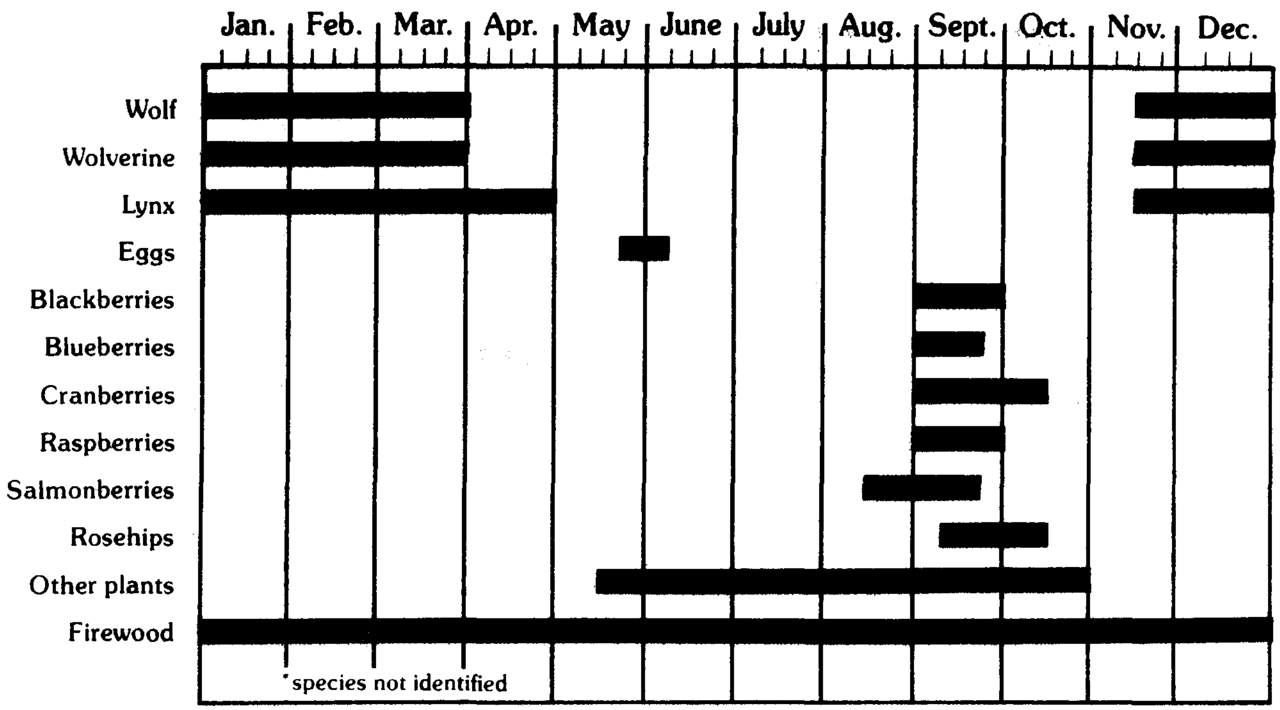


Figure 17 (continued).

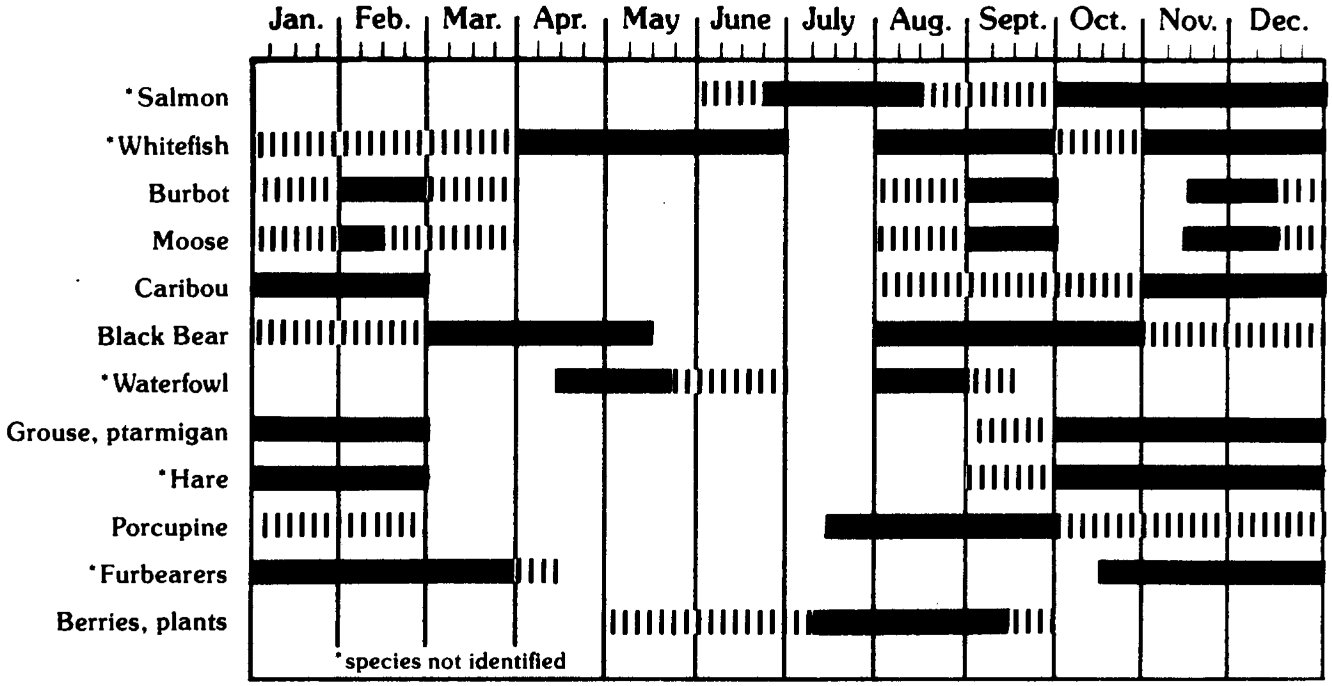


Figure 18. Annual round of subsistence harvest activities by residents of Stony River, 1980-1984 (Kari 1985). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Note: This figure is based on partial data; additional species and harvest periods may be used by Stony River residents.

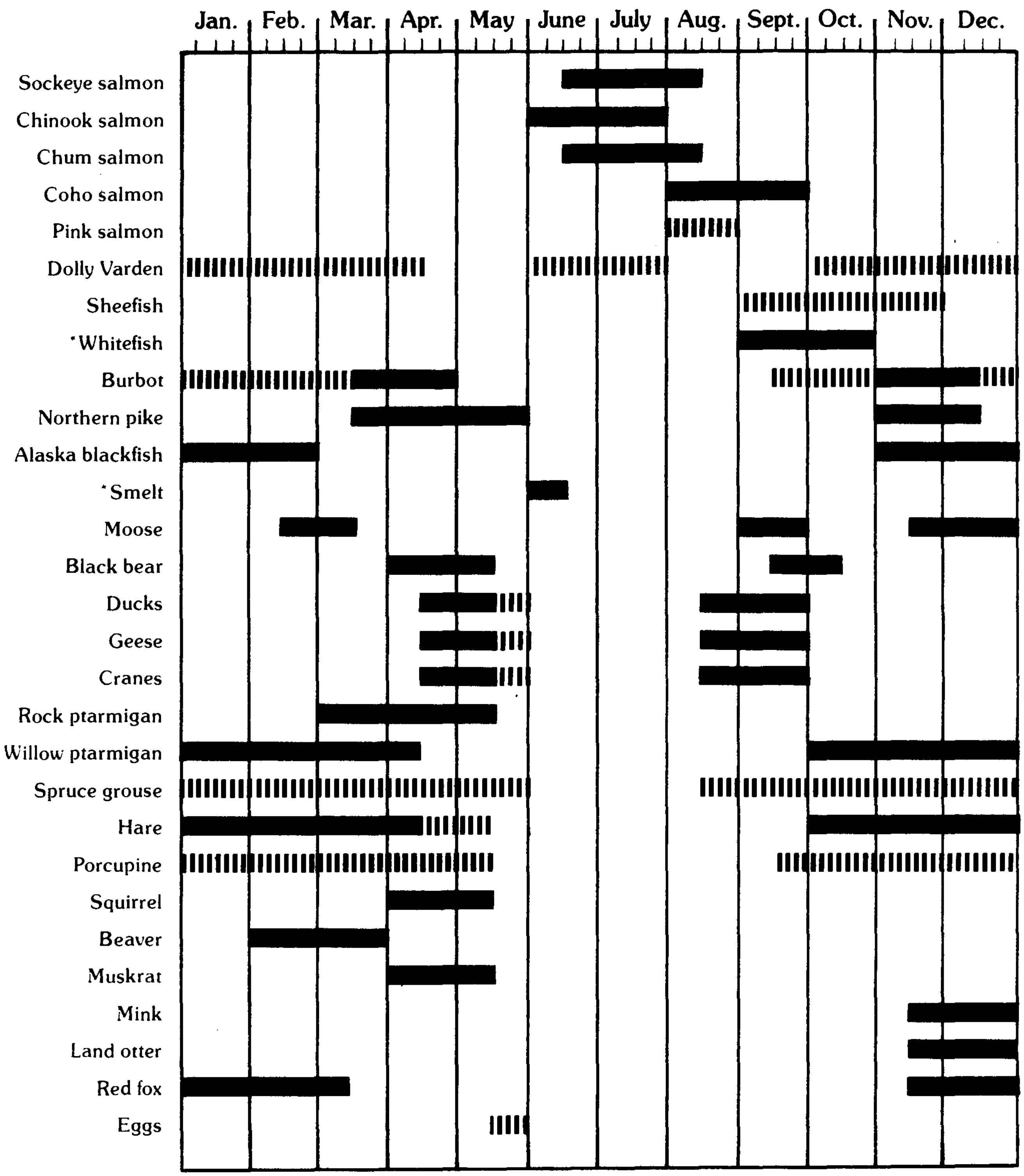


Figure 19. Annual round of subsistence harvest activities by residents of Tuluksak, 1980-1983 (Andrews and Peterson 1983) (continued).

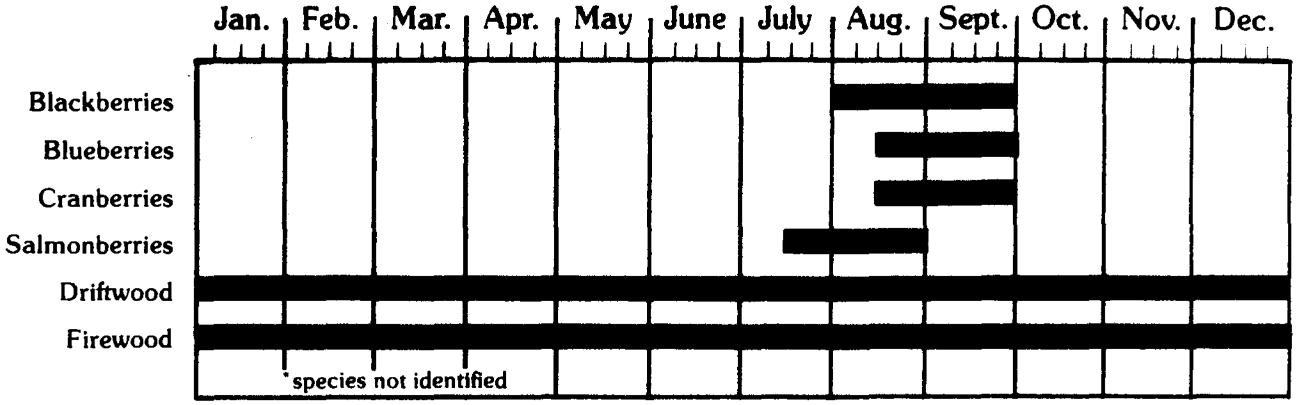


Figure 19 (continued). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

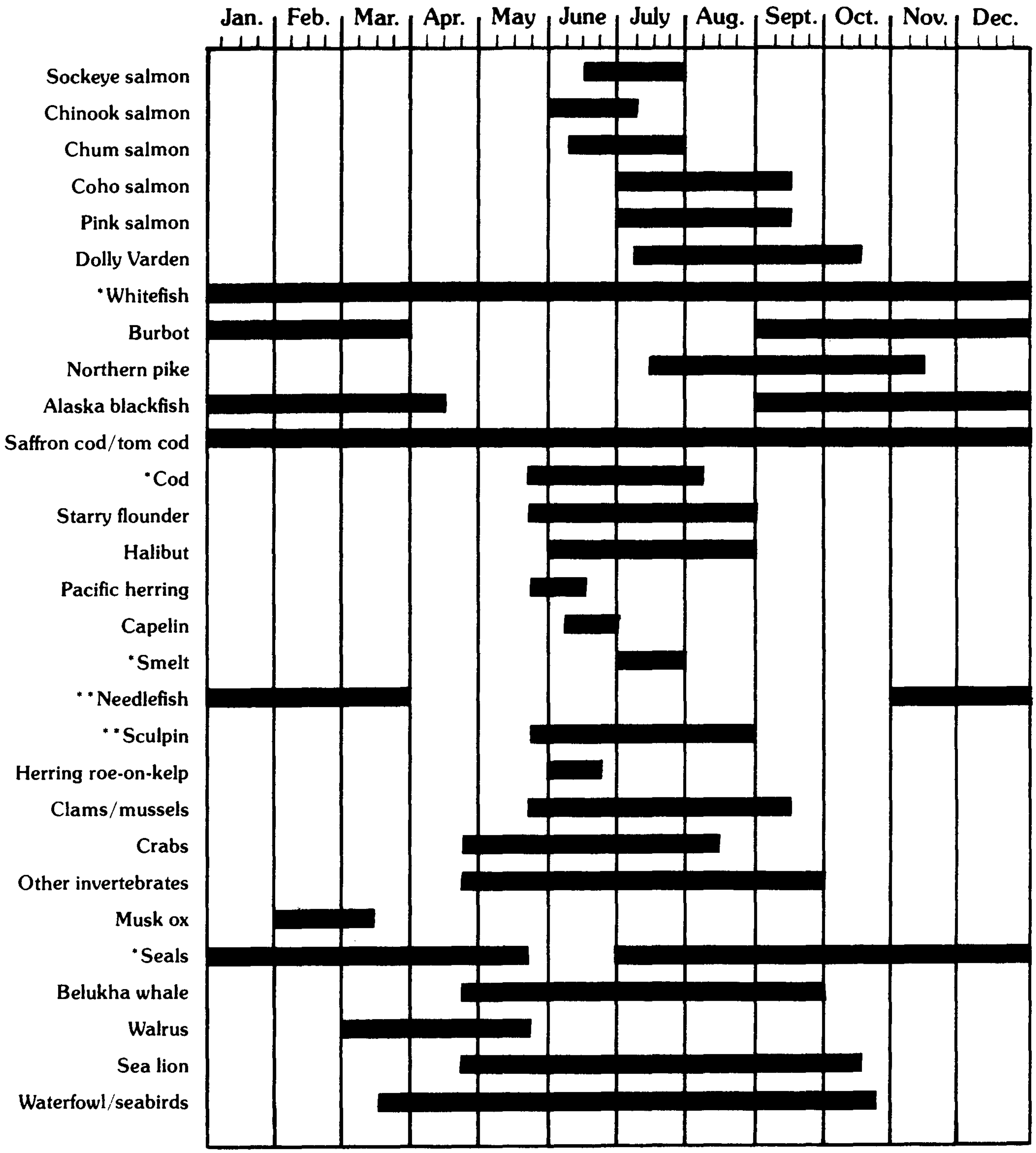


Figure 20. Annual round of subsistence harvest activities by residents of Tununak, 1985 (Pete, pers. comm.) (continued).

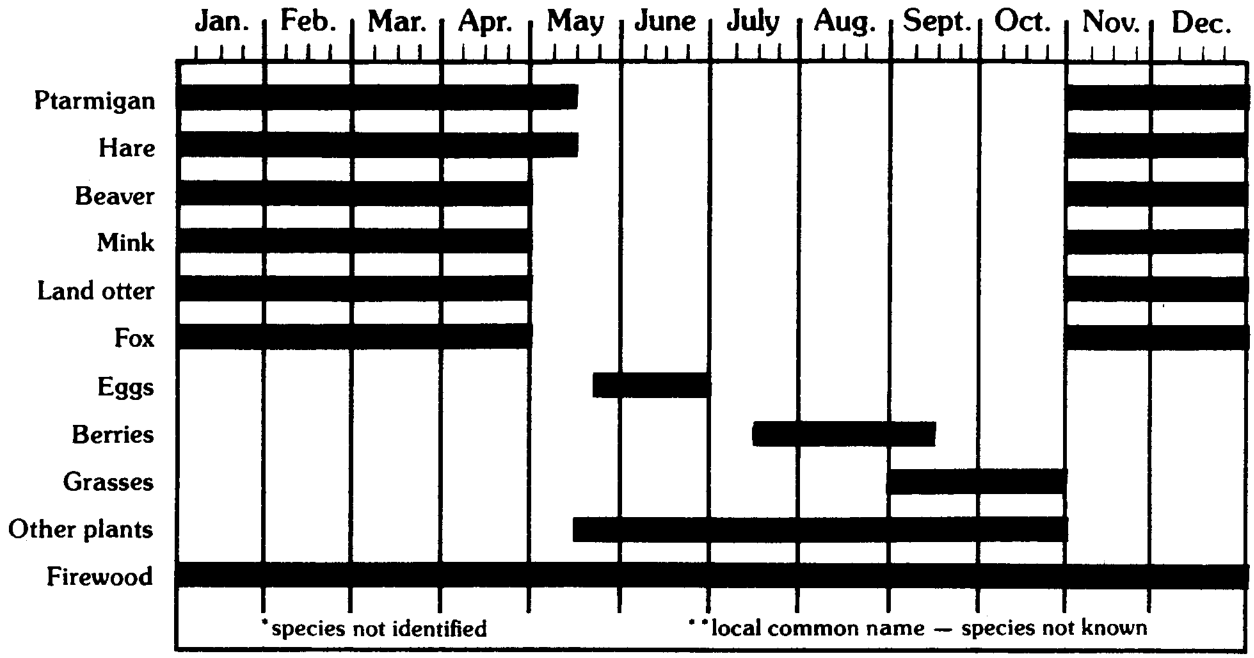


Figure 20 (continued).

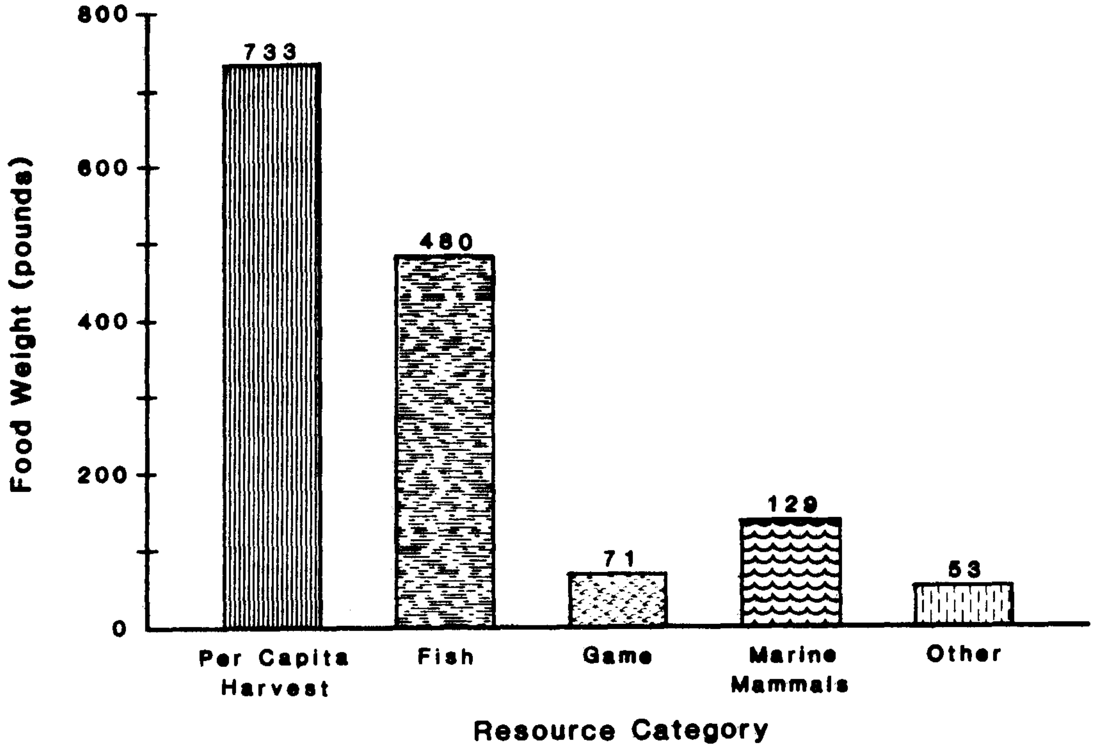


Figure 21. Composition of per capita subsistence harvest for Alakanuk (Wolfe 1984b).

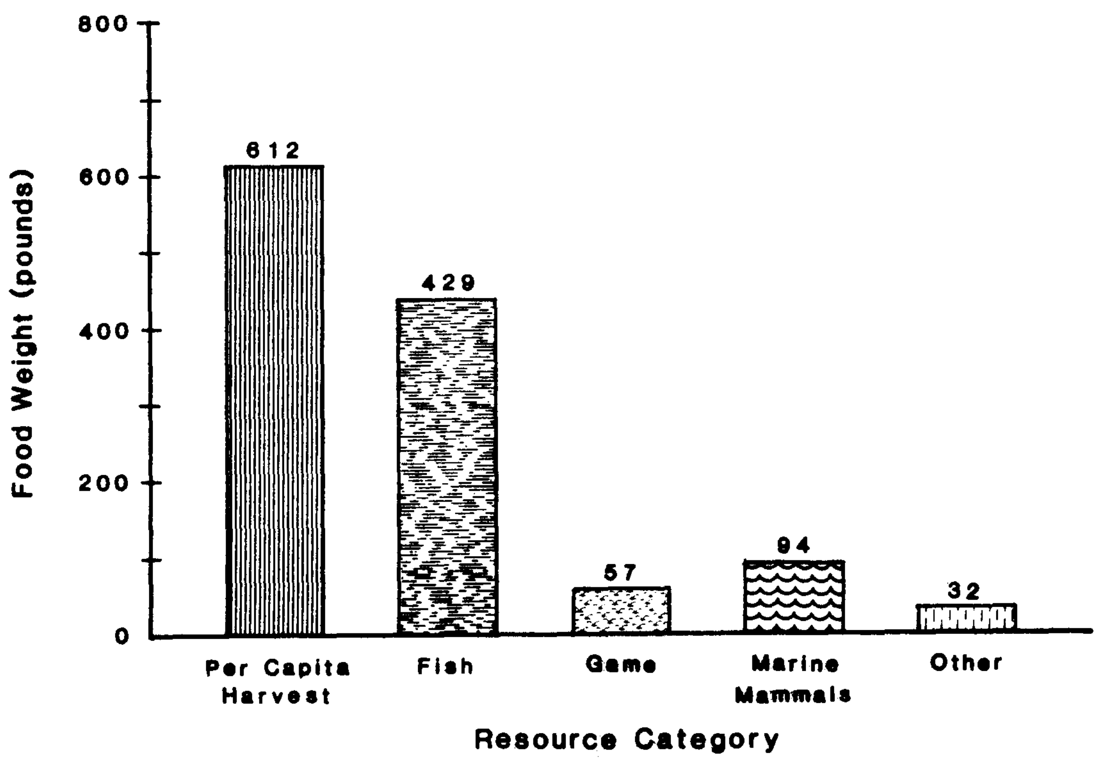


Figure 22. Composition of per capita subsistence harvest for Emmonak (Wolfe 1984b).

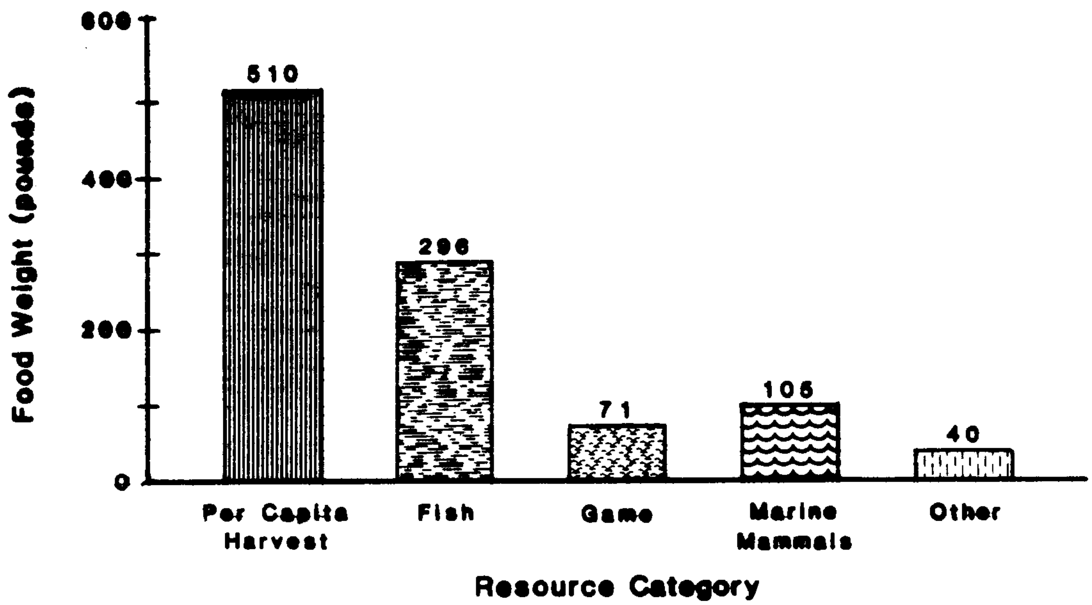


Figure 23. Composition of per capita subsistence harvest for Kotlik (Wolfe 1984b).

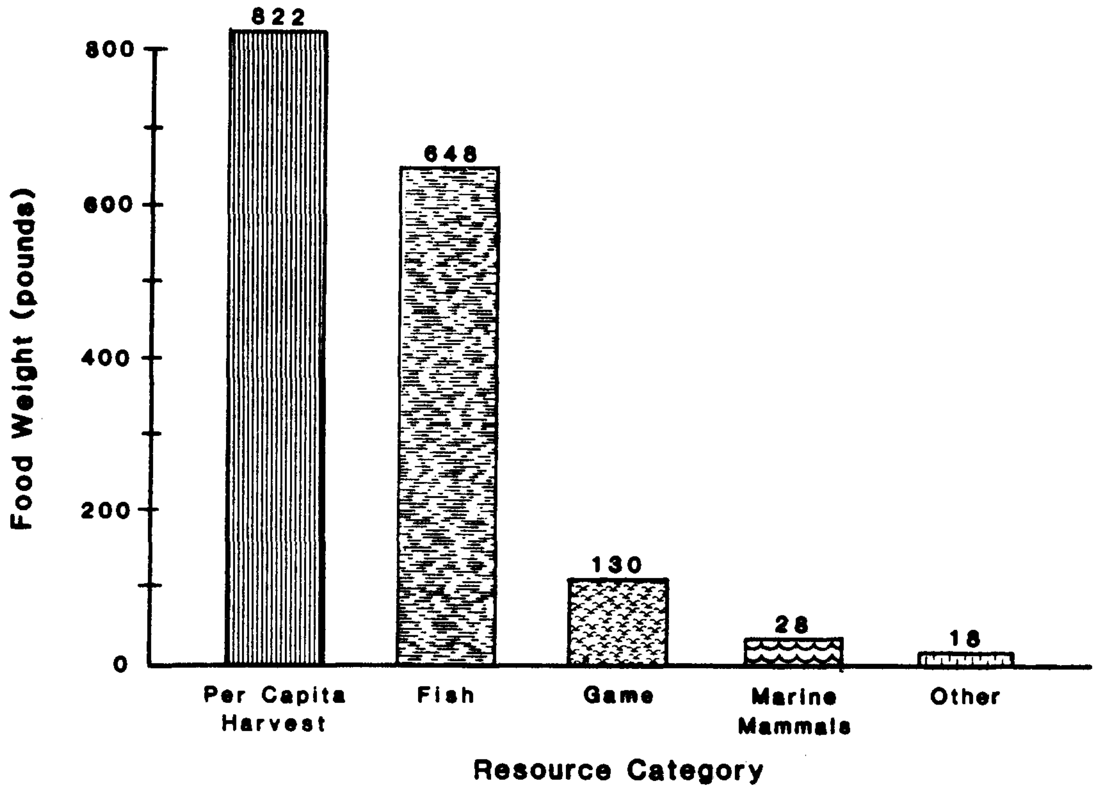


Figure 24. Composition of per capita subsistence harvest for Mt. Village (Wolfe 1984b).

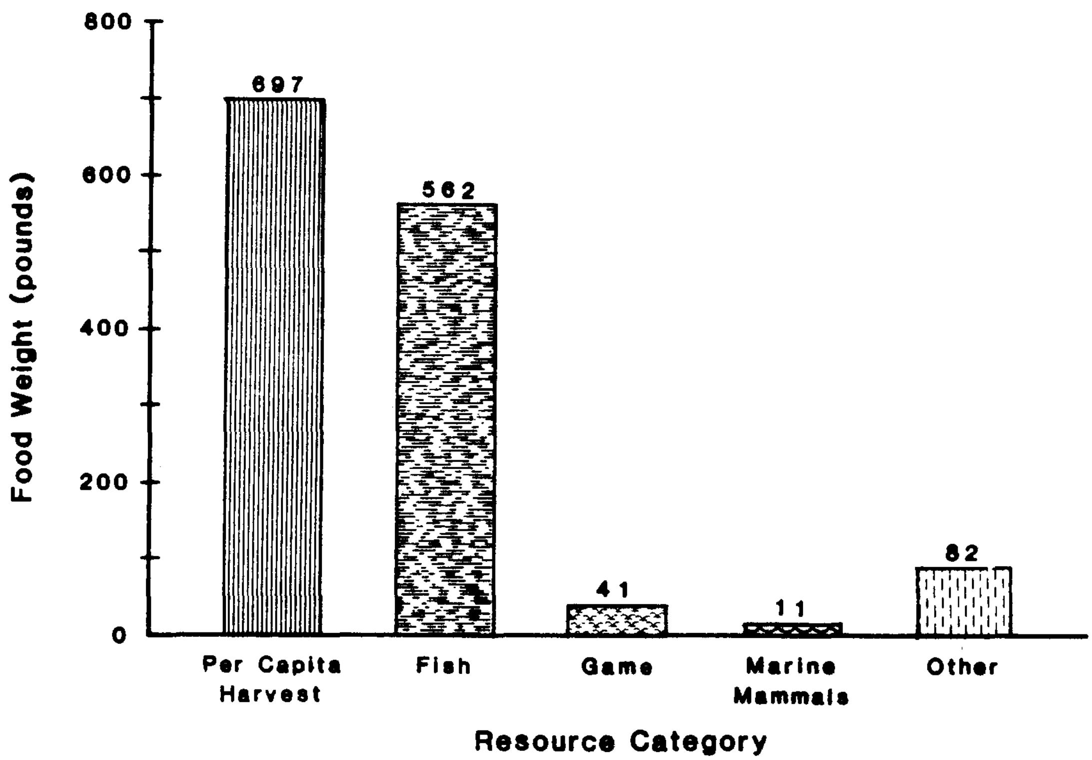


Figure 25. Composition of per capita subsistence harvest for Nunapitchuk (Andrews, pers. comm.).

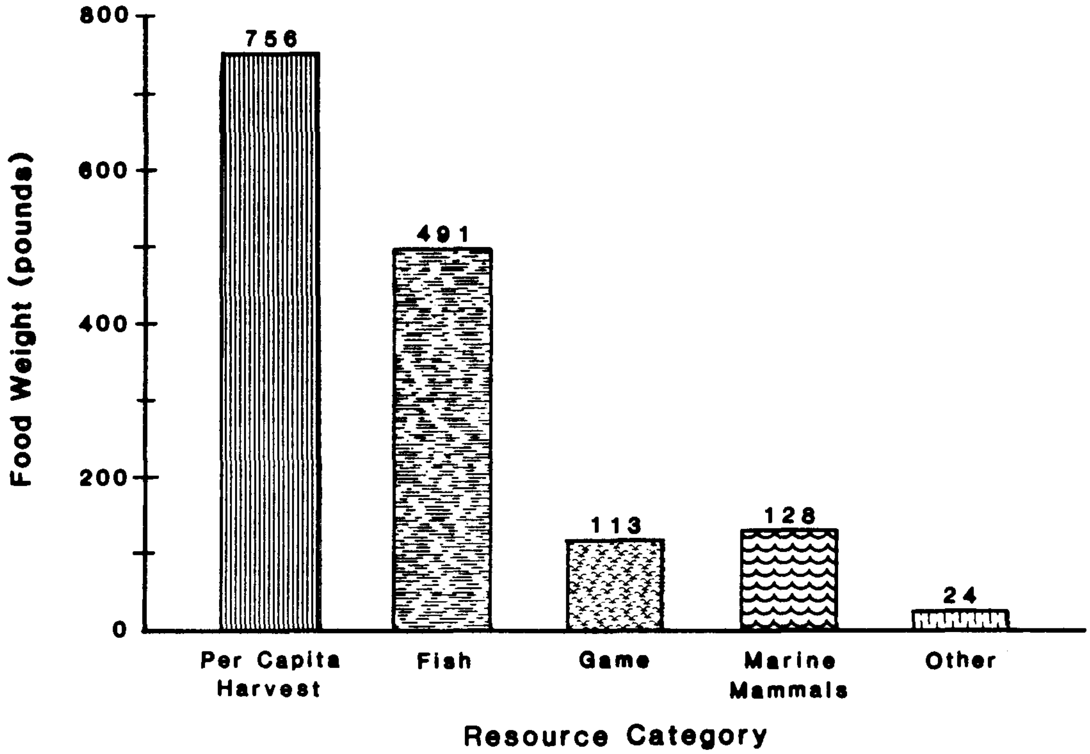


Figure 26. Composition of per capita subsistence harvest for Quinhagak (Wolfe et al. 1984).

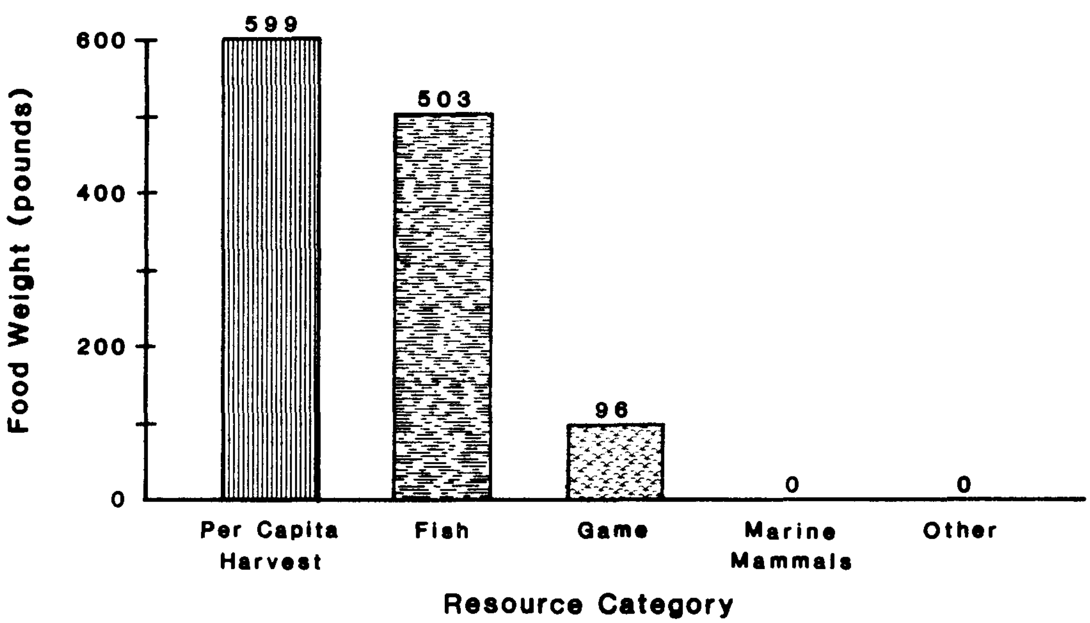


Figure 27. Composition of per capita subsistence harvest for Russian Mission (Pete, pers. comm.).

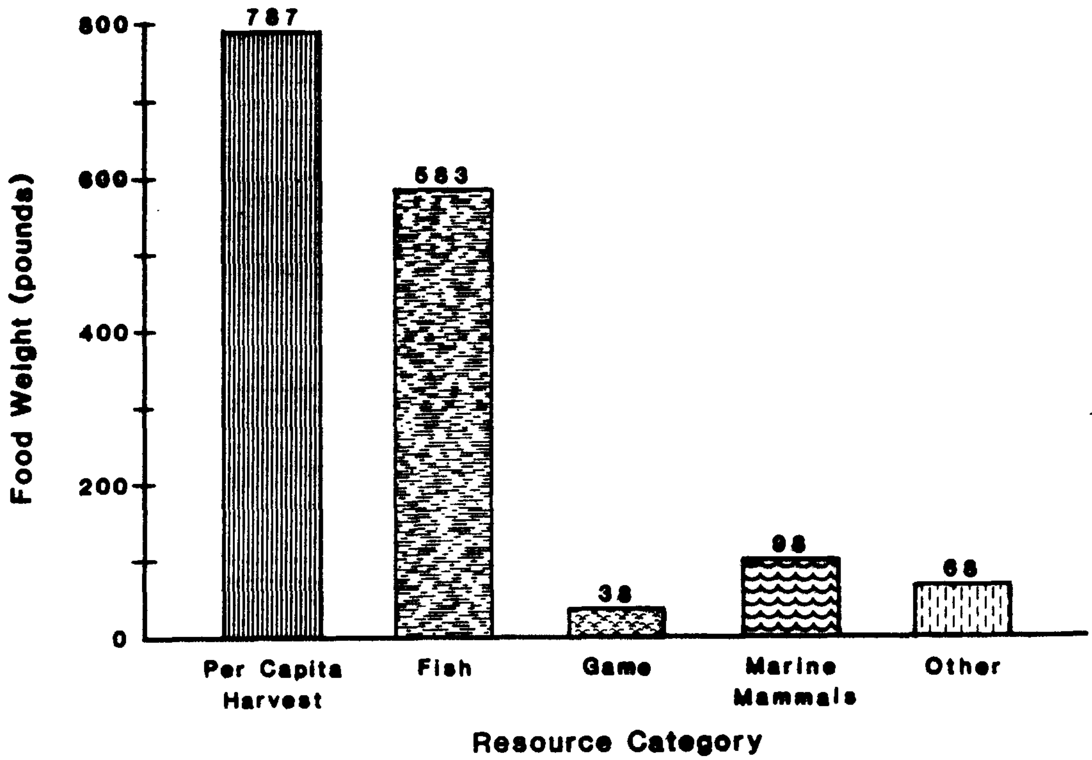


Figure 28. Composition of per capita subsistence harvest for Scammon Bay (Fienup-Riordan 1983a).

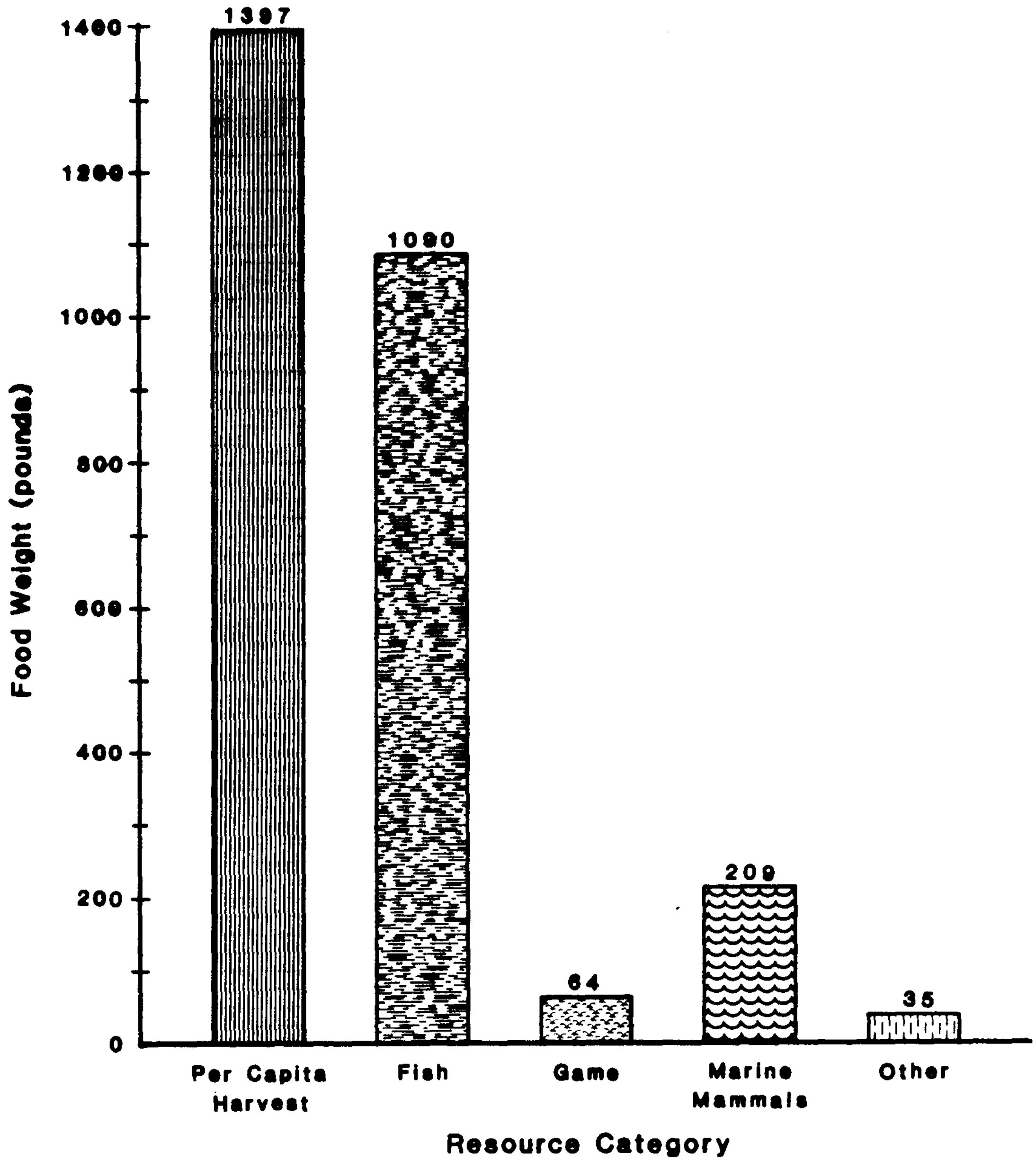


Figure 29. Composition of per capita subsistence harvest for Sheldon Point (Wolfe 1984b).

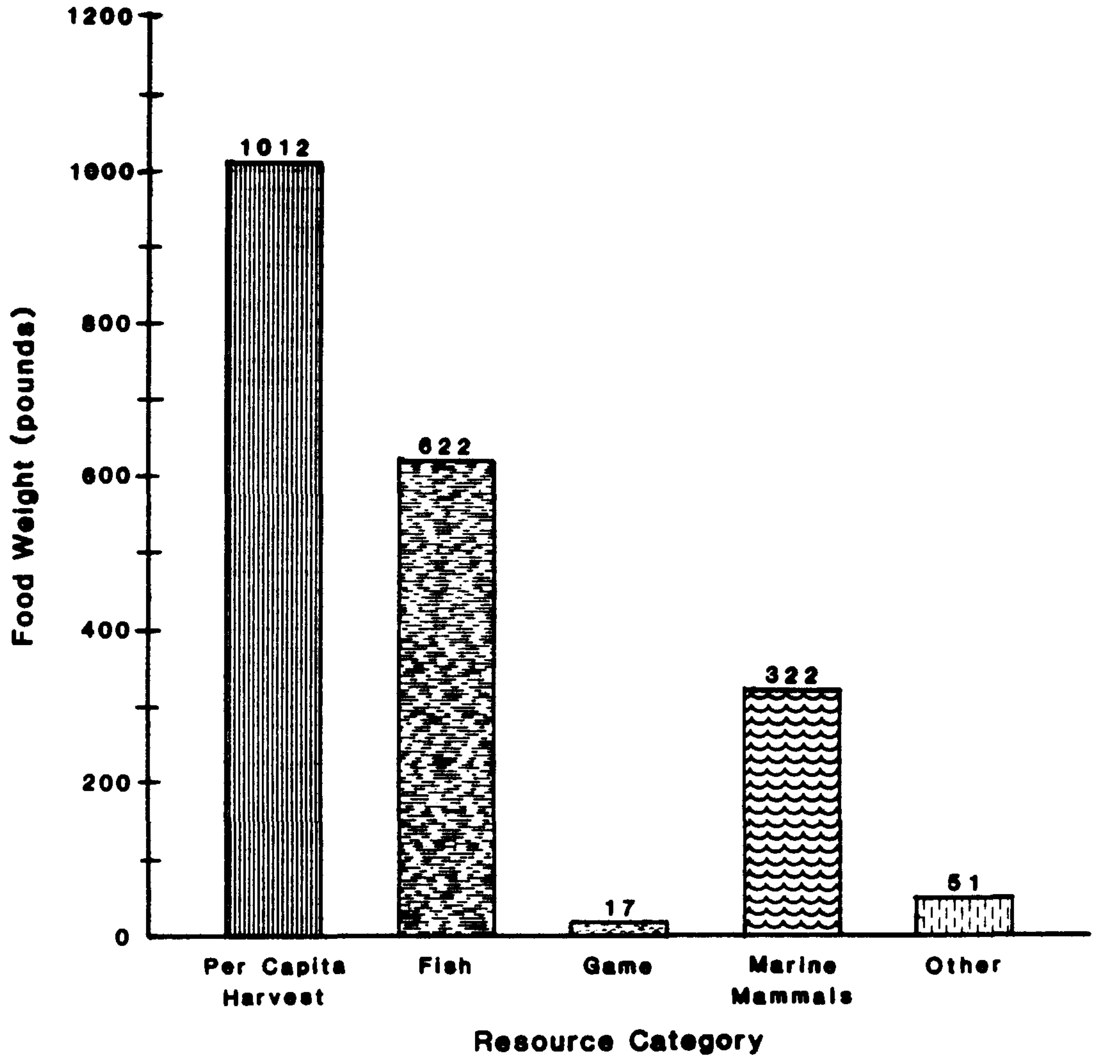


Figure 30. Composition of per capita subsistence harvest for Stebbins (Wolfe 1984b).

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Subsistence and Other Local Uses of Resources in Interior Alaska

I. LOCATION AND ENVIRONMENT

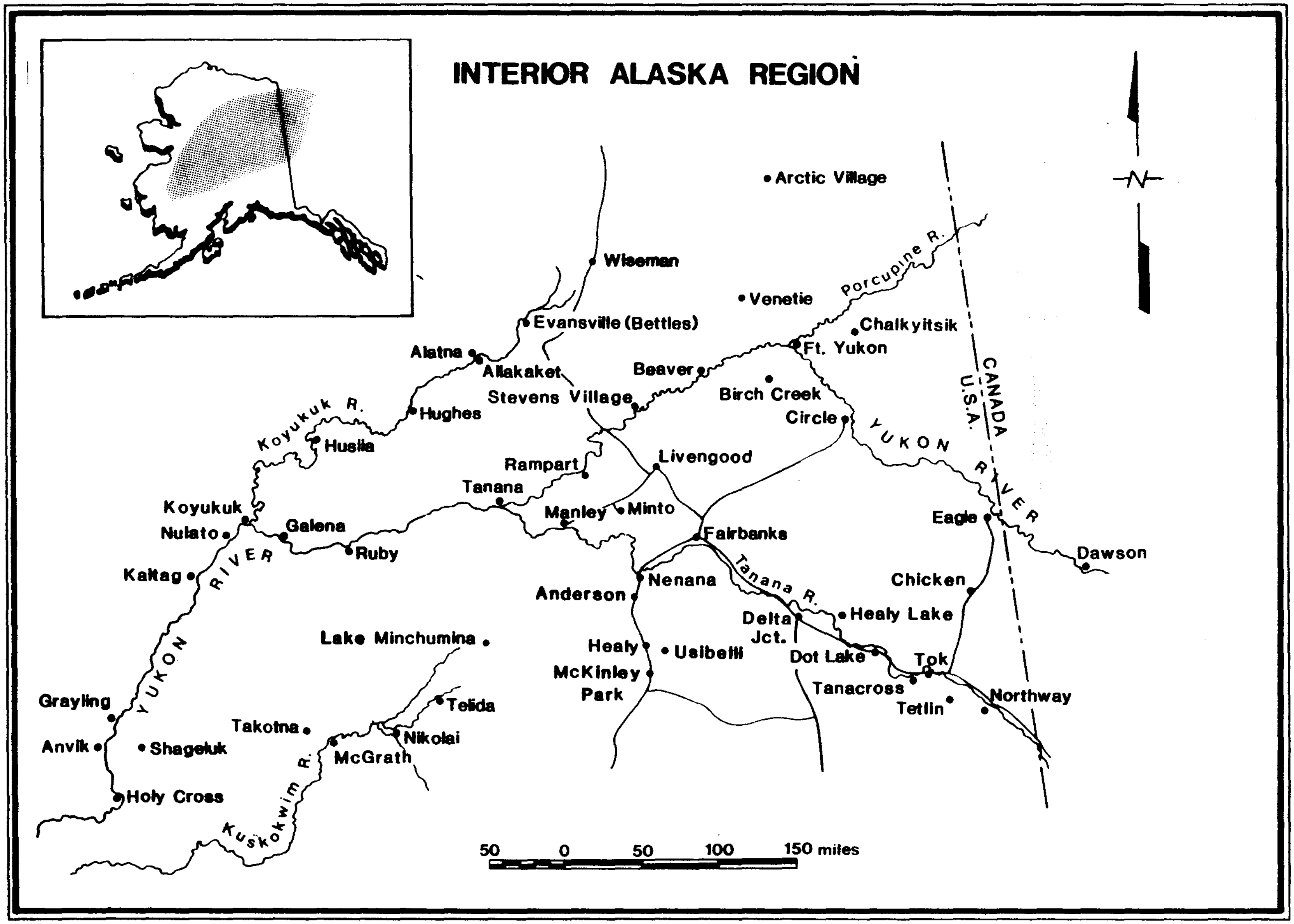
The vast Interior Region of Alaska comprises some 200,000 mi² bounded by the Brooks Range in the north, the Alaska Range in the south, the Alaska-Canada border in the east, and the Nulato Hills in the west. This region forms the major Alaskan portion of the Yukon River watershed from the community of Holy Cross to the Alaska-Canada border. Prominent Yukon River tributaries, such as the Innoko, Koyukuk, Porcupine, and Tanana rivers, also lie within the Interior Region and constitute major river systems in their own right. The upper Kuskokwim river drains the southwest portion of the region. More than 40 communities are located in the Interior Region, ranging in size from villages of less than 100 residents to Fairbanks, the second largest city in the state. Map 1 illustrates the boundaries and communities of the Interior Region.

Interior Alaska represents the westernmost extension of subarctic North America. Vegetation in the Yukon Valley is typical of the mixed conifer-hardwood boreal forest and consists largely of white spruce (*Picea glauca*) and paper birch (*Betula papyrifera*) stands interspersed with open stands of black spruce (*Picea mariana*) and treeless bogs in low-lying areas and low and tall shrublands and a variety of tundra in the foothills and at higher elevations.

Balsam poplar (*Populus balsamifera*) and black cottonwood (*Populus trichocarpa*) are common in floodplain areas along meandering streams (Viereck and Little 1972).

The climate of Interior Alaska is classified as continental, characterized by a wide variation in annual temperature extremes, with precipitation generally less than 15 inches annually. Summer temperatures frequently reach 90°F, and winter temperatures of -50° to -60°F are not uncommon. There is a frost-free period of about 100 days from late May through August. Boat travel on navigable rivers is precluded by ice for seven months of the year. Snow-cover duration exceeds 200 days per year, and the maximum snow depth averages 20 to 30 inches over most of the region (Gardner 1981, Selkregg 1976).

Game Management Units(GMUs) 12, 20, 21, 24, and 25 and Game Management Subunit (GMS) 19D fall within the Interior Region. The diverse habitats of this large area of Alaska host a variety of wildlife species as both residents and seasonal migrants. Table 1 lists fish and wildlife resources commonly utilized by residents of communities in



Map 1. The Interior Region.

Interior Alaska today. Moose, caribou, several furbearer species, migratory waterfowl, salmon, whitefish, and northern pike are particularly important from a human-use standpoint (Haynes 1985). Caribou from the Porcupine, Fortymile, and Delta caribou herds account for a majority of the caribou harvested in the region. Several small, localized herds provide more limited hunting opportunities at other Interior Alaska locations. Wildlife resources are not evenly distributed throughout the region but occur in areas of preferred habitat, often in local, seasonal, or cyclic concentrations.

II. HISTORY AND PATTERNS OF HUMAN ACTIVITY

A chronology of human activity and cultural changes in the Interior Region is useful in understanding the past and present socioeconomic role of wild resources. This section begins with a brief discussion of the original habitation of the Interior and the protohistoric Athabaskan settlement and subsistence pattern that was intrinsically tied to wild resource use. The historic period in the Interior generally encompasses the nineteenth and twentieth centuries. This time span has been variously divided into eras by researchers, depending upon the orientation of their work. Within the context of this narrative, three historic periods will be discussed: 1) the contact, fur trade, and mission period, 1830-1885; 2) the gold rush and territorial period, 1885-1950; and 3) the period since 1950.

A. Original Habitation

The archaeological record suggests that ancestors of Alaska's Native population arrived via the Bering land bridge prior to the end of the last ice-age some 10,000 years ago. It is theorized that some of these early inhabitants occupied Alaska's coast, with subsequent populations, the ancestors of present-day Eskimos, spreading east across the arctic coast of North America. Another group entered Alaska's interior, their descendants spreading eastward through the Yukon Territory and British Columbia, reaching what is now Washington State around 6500 B.C. These were the ancestors of the Athabaskan Indians (Selkregg 1976). Relatively little is known about these ancient hunters of the interior. Their nomadic lifestyle and the tendancy over the millennia for habitation sites to be eroded by rivers or covered with forest growth has made archaeological discoveries from this chapter in Alaska's prehistory rare (ibid.).

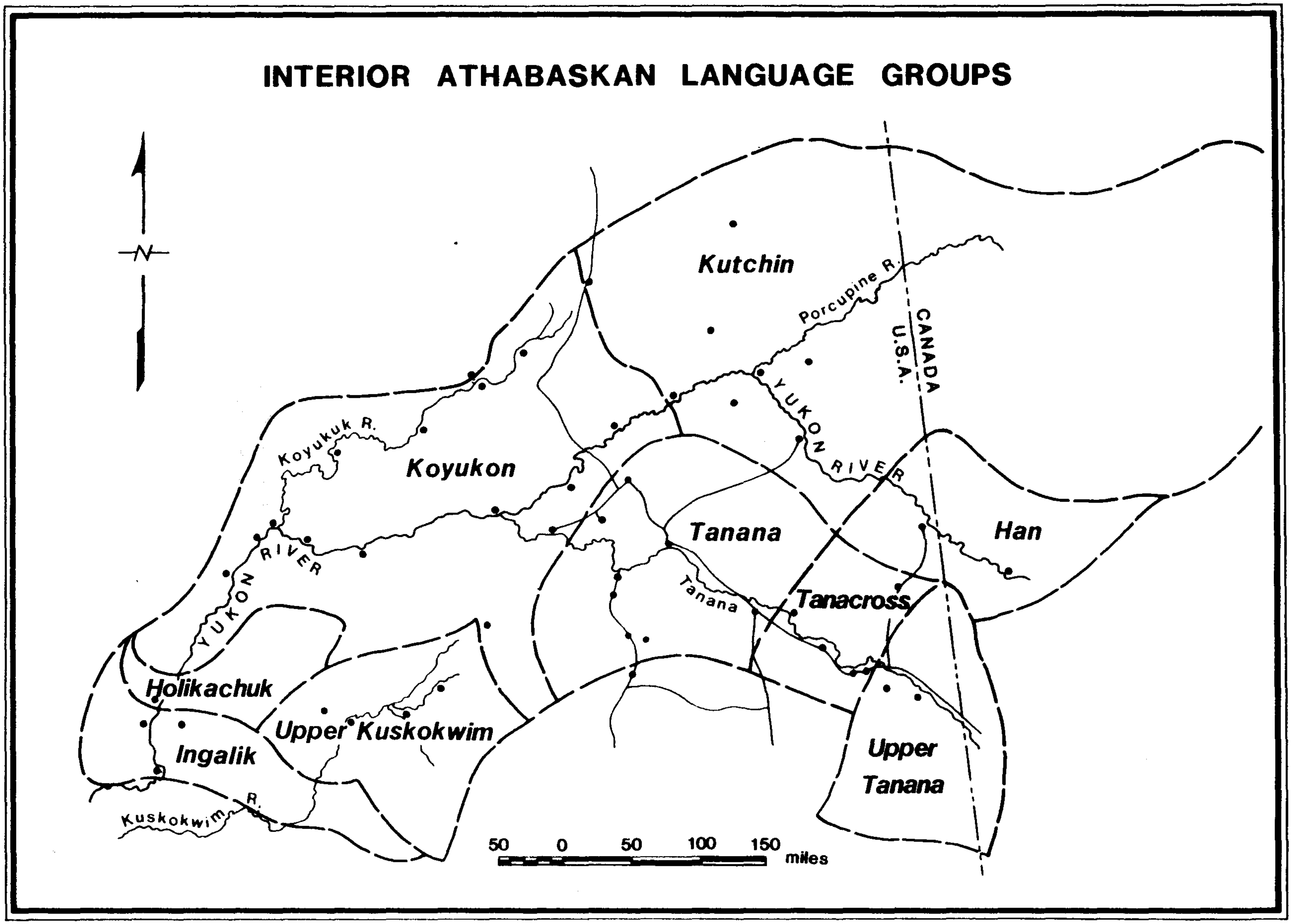
Linguistic evidence points to the emergence of three major groups of Athabaskans around 3,000 years ago. One of these groups, the northern Athabaskans, occupied interior and southcentral Alaska and the interior of western Canada (VanStone 1974). Among Northern Athabaskans, further diversification resulted in the formation of additional subgroups by about 1400 A.D. Nine linguistic subgroups of northern Athabaskans are recognized in Interior Alaska today. These are the Han, Holikachuk, Ingalik, Koyukon, Kutchin, Tanacross, Tanana, Upper Kuskokwim, and Upper Tanana (Krauss 1982). Map 2 shows the geographic distribution of these subgroups.

B. Protohistoric Settlement and Subsistence Patterns, to 1800

The protohistoric subsistence pattern of interior Athabaskans typically involved a dependence on summer fishing and gathering activities and spring and fall caribou hunting (Hosley 1981b). This general pattern was variously altered to produce a subsistence strategy that could best exploit local resources. In the areas of the interior where salmon were predictably abundant seasonally, salmon played a more pronounced role in the annual cycle, thereby allowing subsistence activities to be carried out from a centralized location for perhaps half the year. Among groups inhabiting headwater areas of the interior and along the divide between the Pacific and arctic drainages, big game such as caribou, moose, black and brown bear, and Dall sheep tended to be more important. This greater dependence on big game demanded a more nomadic existence (VanStone 1974).

The population density of interior Athabaskans tended to be lower than that of coastal Eskimo populations, with Athabaskans living in generally smaller and more widely dispersed groups (Hosley 1981a). The primary economic unit was the family or household. Several families combined to form the local group, and several local groups constituted a band. Among highly nomadic groups in pursuit of big game, band size usually was restricted to fewer than 100 individuals. Among bands relying heavily on salmon, the local abundance of that resource allowed band size to reach perhaps 200 (VanStone 1974). Each family, local group, and band exploited a well-defined territory that encompassed seasonal camps for hunting, fishing, and gathering. Where group participation was required or beneficial, such as in caribou hunting and salmon fishing and processing, the activities frequently became a cooperative effort among various local groups or bands. The combined territories of linguistically-related bands defined the extent of the language groups depicted in map 2. Dialect differences occurred within groups. Along the Tanana River, for example, where four language groups are shown, language actually varied slightly between each band over a continuum from the upper to lower reaches of the river (McKennan 1981).

Dwellings generally reflected the degree of band mobility. The more sedentary salmon fishers, such as the Ingalik, built semisubterranean structures consisting of a pole framework erected over a shallow excavation and covered with earth and sod (VanStone



Map 2. Athabaskan language groups in the Interior Region (Krauss 1982).

1974). The more nomadic game hunters, such as the Upper Tanana, built dwellings that were necessarily less permanent. Their winter dwellings generally consisted of a pole framework covered with skins to form a dome-shaped lodge. As many as 20 moose hides might be needed to cover one structure. Summer dwellings were simple lean-to structures covered with bark and moss (ibid.)

The seasonal round of fish and wildlife harvesting by interior Athabaskans varied. Subsistence strategies differed among bands, local groups, and even families as members sought the most efficient means of exploiting local resources. Common themes in the annual cycles of most interior Athabaskans included the movement to spring, summer, fall, and winter camps. These camps fell within the defined territory of the local group or band and were favorably situated to harvest locally available resources at that season. Winter subsistence activities commonly included small game hunting and fishing through the ice on lakes and streams for whitefish, burbot, and blackfish. Fox, wolf, wolverine, and marten were harvested for their fur by using a variety of snares and deadfalls (Osgood 1940). Most garments, however, were made from the hides or furs of animals that could also be used as food such as moose, sheep, caribou, bear, hare, lynx, and beaver (VanStone 1974, Caulfield 1983b). Moose and isolated bands of caribou were tracked and harvested in deep snow, and bears, primarily black bears, were hunted in dens (Nelson 1973). Winter was also a time for visiting, trade, and ceremonies (Selkregg 1976).

Prior to breakup, a movement to spring camp took place. In areas where caribou were common, spring camps were situated to harvest caribou during their spring migration northward. As breakup progressed, waterfowl, muskrat, and beaver were harvested. Among groups heavily dependent on salmon, the move to summer fish camps took place shortly after breakup. Weirs, basket traps, dip nets, and set nets were used to harvest the various summer salmon runs. Short hunting trips and most gathering activities also took place in the vicinity of fish camps. In late summer, as salmon runs diminished, hunting efforts for moose, caribou, and Dall sheep increased (Clark 1981, Snow 1981, VanStone 1974).

Among groups whose territory did not include good salmon streams, summer camps were more commonly located in upland areas, where caribou, moose, Dall sheep, and bear were harvested. Prior to freeze-up, some families moved to fall camps along rivers to fish for whitefish and salmon. Among most interior Athabaskan groups, the fall caribou hunt was a critically important source of meat and hides. Fall camps were generally situated near a caribou fence constructed along caribou migration routes. Cooperative hunting efforts among bands at these locations provided the bulk of the winter food supply for some groups (Hosley 1981b, McKennan 1981).

The above description highlights major subsistence resources associated with local subsistence strategies. It is important to realize that as hunters and gatherers in a relatively harsh climate, survival commonly depended upon their ability to know and utilize alternative plant and animal resources when conditions warranted (Hosley 1981a, Slobodin 1981). Trade was also important. Trade networks that linked neighboring bands extended to Eskimo groups in Siberia and east to Indian groups in Canada (Hosley 1981a). Trade served to alleviate local shortages of specific commodities and to promote the spread of new ideas and technology (ibid.).

C. The Contact, Fur Trade, and Mission Period, 1830-1885

Interior Athabaskans were among the last Native peoples of North America to have direct contact with Europeans. Western goods, however, such as tobacco, tea, utensils, and manufactured clothing found their way into the interior well in advance of direct contact through neighboring Indian and Eskimo intermediaries. Separated by distance and geography from the late-eighteenth and nineteenth century Russian presence and European explorations along Alaska's coast and from the Hudson Bay Company traders converging from the east, some interior Athabaskan groups did not experience direct contact until the 1880's (Helm et al. 1975).

The Yukon River provided the avenue for trade and exploration that brought initial contact and the permanent presence of non-Natives to Interior Alaska. During the late 1830's, Russian explorers based out of the newly established settlement of St. Michael ascended the lower Yukon River and founded trading posts at Russian Mission in 1837 and at Nulato in 1838. By the early 1840's, Russian traders had also ascended the Kuskokwim River and established a regular trade relationship with Upper Kuskokwim Athabaskans in the vicinity of Vinasale below the present-day community of McGrath (Hosley 1981c).

From the east, Hudson Bay Company traders reached the Yukon River via the MacKenzie, Peel, and Porcupine rivers during the 1840s, establishing their farthest-west outpost at Fort Yukon in 1847. In 1863, a trader navigated the Yukon River between Nulato and Fort Yukon, linking the Yukon posts for the first time (Loyens 1966).

Whereas the trade goods reaching the interior prior to contact represented conveniences and occasionally served to elevate the status of individuals as local leaders, they did not significantly alter Athabaskan social or economic systems (Hosley 1981b). The establishment of resident, non-Native representatives of the fur trade at the Nulato and Fort Yukon posts sparked the development of a new dual economy. With increased and direct access to western goods, flour, tea, sugar, tobacco, and western clothing gradually became regarded as necessities among Athabaskans. Commercial trapping began to be emphasized in the annual cycle to obtain furs for trade. The new mercantile relationship between trades and trappers was further encouraged through the practice of extending credit, paid in trade goods, toward future fur sales (ibid.).

With the purchase of Alaska by the United States in 1867, transportation to the Yukon River posts improved. In 1869, an Alaska Commercial Company sternwheeler made the first mechanized ascent of the Yukon River to Fort Yukon and assumed American operations of the post there. The Yukon River fur trade flourished as several new American trading enterprises competed and steamship travel improved the provisioning of ports and the transport of fur (Selkregg 1976). During the 1870's and 1880's, through the opening and closing of various posts, the focus of trading activities shifted between posts at Anvik, Nulato, Tanana, Fort Yukon, and Belle Isle (near present-day Eagle) (ibid.). Government exploration of the newly acquired territory also occurred in the 1880's. The U.S. Army expedition of Lt. Schwatka down the Yukon River in 1883 and Lt. Allen's 1885 journey through the Copper, Tanana, Yukon, and Koyukuk river valleys provided the first detailed observations of interior Alaska's people and landscape.

Concurrent with the fur trade, missionary activity was an additional source of direct contact with Euroamericans. Russian Orthodox missionaries had baptized significant numbers of Upper Kuskokwim Athabaskans as early as 1838 (Hosley 1981b). Lower and Middle Yukon River Eskimos and Athabaskans were visited by Russian missionaries operating out of St. Michael, Nulato, and Russian Mission prior to 1850 (Loyens 1966). From the Canadian side, Roman Catholic and Anglican missionaries visited the Kutchin during the 1860's establishing an Anglican mission at Fort Yukon in 1862. Despite this scattered presence of missionaries prior to the United States purchase of Alaska and more frequent visits by Catholic and Episcopal missionaries in the 1870's and 1880's, the acceptance of Christianity among interior Athabaskans was not widespread prior to the 1890's.

Along with a slightly altered seasonal round to accommodate a greater trapping effort, this period brought other changes in resource harvest. Firearms became increasingly available to interior Athabaskans after 1850 through the Fort Yukon post and trade with Kotzebue Sound Eskimos (Clark 1981). Firearms had become common between Nulato and Fort Yukon by 1867 and prevalent throughout the Yukon valley by 1883 (Whymper 1869, Schwatka 1900). The increased use of firearms allowed caribou hunting patterns to be more individualistic compared with the cooperative caribou drives of the local group or band used traditionally (Hosley 1981b). Moose, which had been difficult to harvest using traditional methods such as bow and arrow, were more easily taken with firearms and thus became an increasingly important food resource (Hosley 1981a, Whymper 1869).

An improvement in winter transportation developed in association with the growing emphasis on trapping. The use of dogs to pull sleds was borrowed from neighboring Eskimo cultures and increasingly adopted by interior Athabaskans after 1860 (Hosley 1981b). This did not represent a major cultural modification since basket- and toboggan-type sleds were traditional items of Athabaskan material culture, and dogs had been used for hunting and as pack animals (Osgood 1936, 1940). The use of small dog teams for winter transportation led to a gradual increase in the dog population of the interior. Bales of dried fish entered the economy as a standard of trade, as longer, more intense periods of summer salmon fishing were required to supply the growing demand for dog food (Hosley 1981b, McKennan 1981).

In summary, changes occurring between 1830 and 1885 included a developing dependence on items of nonlocal manufacture, such as western clothing, foodstuffs, firearms, and ammunition. The annual round was slightly altered to place a greater emphasis on winter trapping, and the growing use of dog teams resulted in a more intense summer salmon fishing effort. The introduction of firearms promoted a more individualistic hunting pattern and an increased utilization of moose.

It should be noted that these changes were gradual and not exclusive of other cultural patterns. Despite the possession of firearms and steel traps, for example, dead-fall traps were preferred among Athabaskans, and the bow and arrow remained in use until well after 1900 (VanStone 1974, Hosley 1981b). Whereas western clothing was quickly adopted as preferred summer attire, traditional hide and fur garments were retained for winter use (ibid.). And although tastes were acquired for flour, sugar, and tea, subsistence in 1885 was still attained through a seasonal round of activity that remained generally unchanged from earlier times.

D. The Gold Rush and Territorial Period, 1885-1950

Mineral exploration in Alaska increased under United States territorial policies that encouraged resource extraction. In 1886, gold was discovered along a tributary of the Fortymile River, focusing mineral exploration in areas along the Alaska-Canada border. A gold strike on Birch Creek in 1893 led to the establishment of Circle City and rapid in-migration, settlement, and development of the Circle mining district. Circle remained the center of upper Yukon River settlement and mining until the famed Klondike gold discovery in 1897. The stampede that followed and the boom town development of Dawson and the Klondike had repercussions throughout the whole interior. By 1900, new towns had been established and old settlements given renewed importance. More than 100 steamships were operating along the Yukon River (Cantwell 1904).

For interior Athabaskans, the late nineteenth and early twentieth centuries was a time of accelerated cultural change. Unlike the fur trade and missionary period, which was characterized by a relatively scattered presence of non-Natives and the active participation of Athabaskans in a mercantile fur economy, the goldrush and territorial period introduced mineral development, which caused a shift toward nonrenewable, capital-intensive resource extraction that did not require the participation of Alaska Natives (VanStone 1974). The slow change in material and social culture begun during the fur trade was rapidly accelerated as introduced epidemic diseases and alcohol decimated traditional groups. Wage labor joined trapping as another form of employment. Many Athabaskans were attracted to mining settlements by job opportunities, where they worked as wood cutters, guides, freighters, and market hunters (ibid.). Material culture underwent a transformation, such as the abandonment of traditional dwellings for log cabins and canvas tents and the adoption of the fish wheel, introduced around 1910 (Clark 1981). The efficiency of the fish wheel, coupled with an extraordinarily high demand for dog food by in-migrants, placed new emphasis on salmon fishing as a source of income for many Athabaskans. Due to these forces, traditional patterns of seasonal moves and settlement began to be replaced by a more sedentary, dual pattern of winter villages and summer fish camps (Hosley 1981a).

The shock of the gold rush was short-lived, though its effects were more permanent. By 1910, mineral exploration in interior Alaska was in decline, and by 1915 the gold rush had ended. In its wake were dozens of small communities connected by a network of sled trails and roadhouses. Territorial status was granted to Alaska in 1912. With this new status came new powers of government and plans for development. School systems, roads, and municipal governments were established. Fur farming and trapping were major enterprise into the 1930's. Following World War I, mining returned as a significant industry to the interior, with large mining companies using dredges and new mechanized equipment to rework old claims in many mining districts. In 1921, a college was built near Fairbanks. In 1923, the Alaska Railroad was completed from Seward to Nenana and Fairbanks, providing a new transportation route to the interior. Aviation, based in Fairbanks, was quickly replacing the dog team for mail, freight, and passenger service to remote communities. Fairbanks continued to develop as a regional center for the interior during the 1940s, when World War II spurred construction of military bases, airports, and the Alaska Highway and ushered in the modern era (Selkregg 1976).

E. The Period Since 1950

The post World War II era is marked by legal and political milestones, economic growth, capital improvements, and resource development. In the context of this narrative, several of these events need to be highlighted as ones that have helped shape contemporary lifestyles in Interior Alaska.

Alaska gained statehood in 1959. State selection of lands as provided for under the Statehood Act and the major oil discovery on Alaska's North Slope in 1968 accelerated the Native land claims process. In 1971, the Alaska Native Claims Settlement Act (ANCSA) was passed to address the land claims issue. Through the creation of Regional Native Corporations such as Doyon Ltd. in the interior, Alaska Natives emerged from ANCSA as a new political force and major land owner in Alaska.

Development of the Prudhoe Bay oil field and construction of the Trans-Alaska Pipeline in the 1970's focused national attention on Alaska's resources, initiated a new era of scientific study on the arctic and subarctic environment, and provided a major source of revenues to the state. Fairbanks was favorably situated to become the major staging area for the unprecedented level of construction activity associated with the pipeline project and for air shipments to Prudhoe Bay. The pipeline boom diminished with the completion of the project in 1977. Economic and demographic spin-offs from the pipeline era and the petroleum industry are still being felt. Employment created by the state spending of oil revenues on capital improvement in urban and rural areas is now the major economic base in the state. The development of support industries and a growing state-federal infrastructure in urban centers such as Fairbanks caused rapid population growth through in-migration from the continental United States (Dixon 1978).

In smaller communities, the subsistence way of life responded to the developments described above with increasing ties to the cash economy. Snowmachines, for example, were introduced in Alaska in the early 1960's. Despite their relatively high cost, the acceptance of the snowmachine as a replacement for dog teams was swift. Incorporation of this technological innovation increased the capitalization costs of hunting and trapping but decreased labor costs (Frances 1969). Time spent at wage employment in order to afford a snowmachine and gasoline to run it could be largely offset by the increased mobility it afforded and the liberation from the year-round care and feeding of a dog team. The decline in dog teams in turn affected salmon fishing effort, as less fish were needed for dog food. During the early 1970's, this fishing effort was, in some cases, redirected toward involvement in the commercial salmon fishery that was then developing along the Yukon River and provided another source of seasonal income for local residents.

III. POPULATION

Although estimates are difficult, aboriginal population levels have been reconstructed from historic source materials, cultural-ecological influence, and archeological evidence. Hosley (1981b) estimates that between 4,000 and 6,000 Natives occupied the Interior Region at the time of contact (ca. 1850). The Native population in the contact era, however, already had undergone substantial decline from the diseases that preceded and accompanied contact. The aboriginal population of the Kutchin (Canadian and Alaskan) circa 1750, for example, is estimated at around 5,400 (Krech 1978). Following successive epidemics of disease over the next century, that population was reduced to around 900 by 1862 (ibid.). Other Athabaskan groups probably were similarly reduced by famine and disease. A smallpox epidemic, which killed 25-50% of the Native population in southwest and southcentral Alaska in the 1830's reached Nulato in 1839. Scarlet fever devastated the upper Yukon River population around 1863, annihilating entire Native settlements (Michael 1967, Helm et al. 1975, Tanana Chiefs Conference 1983). Based on combined estimates from VanStone (1974) and Krech (1978), the late nineteenth century Native population of the Interior Region was probably between 4,500 and 5,000.

The decades of the gold rush era between 1890 and 1910 were a time of large demographic changes in interior Alaska. Unfortunately, questionable census data from that period do not accurately portray the population. The 1890 census reports 3,912 inhabitants in the "Yukon district" (Rollins 1978). This figure seems particularly low considering the estimate of 4,500-5,000 offered above and considering that the boundaries of that district included the Eskimo-occupied Yukon River delta and a portion of Norton Sound. The 1900 census, taken at the height of the gold rush era, was probably reasonably accurate in terms of total numbers of inhabitants, but the huge influx of transient prospectors and the rapid establishment and abandonment of mining settlements made the listing of village and community populations difficult. As a result, population figures for only 27 "selected" settlements north of the Alaska Range are offered in the 1900 census, and no distinction is made between Eskimo and Athabaskan populations (ibid.).

Whereas the total population of Alaska doubled between 1890 and 1900 (ibid.), the Alaska Native population continued to decline between 1880 and 1910 (Helm et al. 1975). Epidemics of influenza and measles concentrated in western Alaska in 1900 reached the middle Yukon River to a point above Rampart, killing many Natives (Wolfe 1982). Tuberculosis, pneumonia, and influenza remained major Native health problems in Alaska throughout the first half of the twentieth century as late as 1960 (Haynes 1970). With the availability of improved medical facilities after 1910, however, the population of Alaskan Athabaskans began to rise, increasing 25% between 1910 and 1930 (Helm et al. 1975). Census data in 1910 show the establishment of many contemporary communities and the emergence of Fairbanks as a major population center. Table 2 gives population information for selected Interior Alaska communities from 1890 to 1980.

The Fairbanks North Star Borough comprises the region's largest population concentration of population and the second largest urban area in Alaska. Roughly one-third of the borough's 75,000 inhabitants live within the city of Fairbanks, with the remainder residing in the road-connected suburban areas and surrounding communities (Fairbanks North Star Borough 1985b). In contrast to the rural Interior Region, which remains predominantly Native Athabaskan outside road-connected areas (table 2), the population of the Fairbanks North Star Borough is 94% non-Native (ibid.). Table 3 gives population figures for borough communities from 1960 to 1980.

IV. REGIONAL ECONOMY

Readers are referred to the Economic Overview of Fish and Wildlife volume of this series for details on the economy of the Interior Region. An overview of some general economic characteristics of Interior Region communties is offered here as background to the discussion of contemporary subsistence and other local use of wildlife resources presented in section VII.

The economy of the Fairbanks North Star Borough should perhaps be examined apart from the rest of the region. In 1984, an estimated 26,900 people were engaged in nonagricultural wage and salary employment in the borough (Fairbanks North Star Borough 1985). Reflecting the role of Fairbanks as a regional center for government and services, 33% of these jobs were in government, 21% in trade, 19% in services, 10% in transportation, communications, and utilities and 10% were in construction (ibid.) Within this relatively large urban area, harvesting fish and game are popular recreational and sport activities but do not represent a central component of the Fairbanks economy or of the household domestic economy of the majority of Fairbanks families (Caulfield 1983b, Wolfe 1983, Wolfe and Walker 1985).

The high level of participation in year-round wage employment within the borough and nearby road-connected communities stands in contrast to the role of wage employment in the remainder of the Interior Region. Communities outside the borough and especially those outside the road system are generally characterized as having a mixed economy involving varying levels of wage employment combined with resource harvest activities (Caulfield 1983a, Marcotte and Haynes 1985, Martin 1983). In these small, often remote communities, wage opportunities typically are few, and available jobs are generally seasonal or part-time. Household incomes commonly are correspondingly lower or less secure. Average taxable income levels for Interior Alaska communities are presented in table 4.

The economies of many Interior Region communities exhibit the characteristics of mixed, subsistence-based economies. These characteristics include 1) a mixed economy composed of mutually supportive market and subsistence sectors; 2) a domestic mode of production, where capital, land, and labor are controlled by kinship-based production units; 3) an established seasonal round of production activities; 4) networks of sharing, distribution, and exchange of food and materials; 5) traditional systems of land use and occupancy; and 6) complex systems of beliefs, knowledge, and values associated with wild resource uses passed between generations as the cultural and oral traditions of a social group (Wolfe 1983).

V. TRANSPORTATION

The Tanana valley portion of the Interior has a varied transportation network, including roads, railroads, air carrier routes, and river barge lines. Within the Tanana valley, the Elliott, Parks, Richardson, Steese, and Taylor highways provide a relatively extensive road system. The Steese and Taylor highways terminate at the Yukon River communities of Circle and Eagle, respectively. The Dalton Highway to Prudhoe Bay joins the Elliott Highway at Livengood and provides the only bridge-crossing of the Yukon River in Alaska. The Richardson Highway joins the Alaska-Canada (Alcan) Highway at Delta Junction. The Alcan is a major overland access route into Alaska. In 1984, 137,864 vehicles entered Alaska via the Alcan border crossing (Fairbanks North Star Borough 1985a). Fairbanks and Nenana serve as transportation hubs in the Interior Region, being connected by highway to the continental United States and by both rail and highway to tidewater ports in Southcentral Alaska.

Fairbanks is the major air terminal in Interior Alaska. Fairbanks International Airport recorded almost 16,000 aircraft landings in 1984 (ibid.). The upper Kuskokwim River area receives the majority of its freight and passenger service by air from Anchorage. River barges from Bethel also serve McGrath (Stokes 1985). Outside the road-connected area of the Interior Region, most villages are served by river barge service from Nenana and commuter airlines from Fairbanks.

Interior residents utilize a wide variety of individual transportation methods to access hunting and fishing areas. Common modes include shallow-draft river boats, snowmachines, four-wheel drive and all-terrain vehicles, and single-engine aircraft equipped with wheels, skis, or floats. Some areas are also accessed by horseback and on foot.

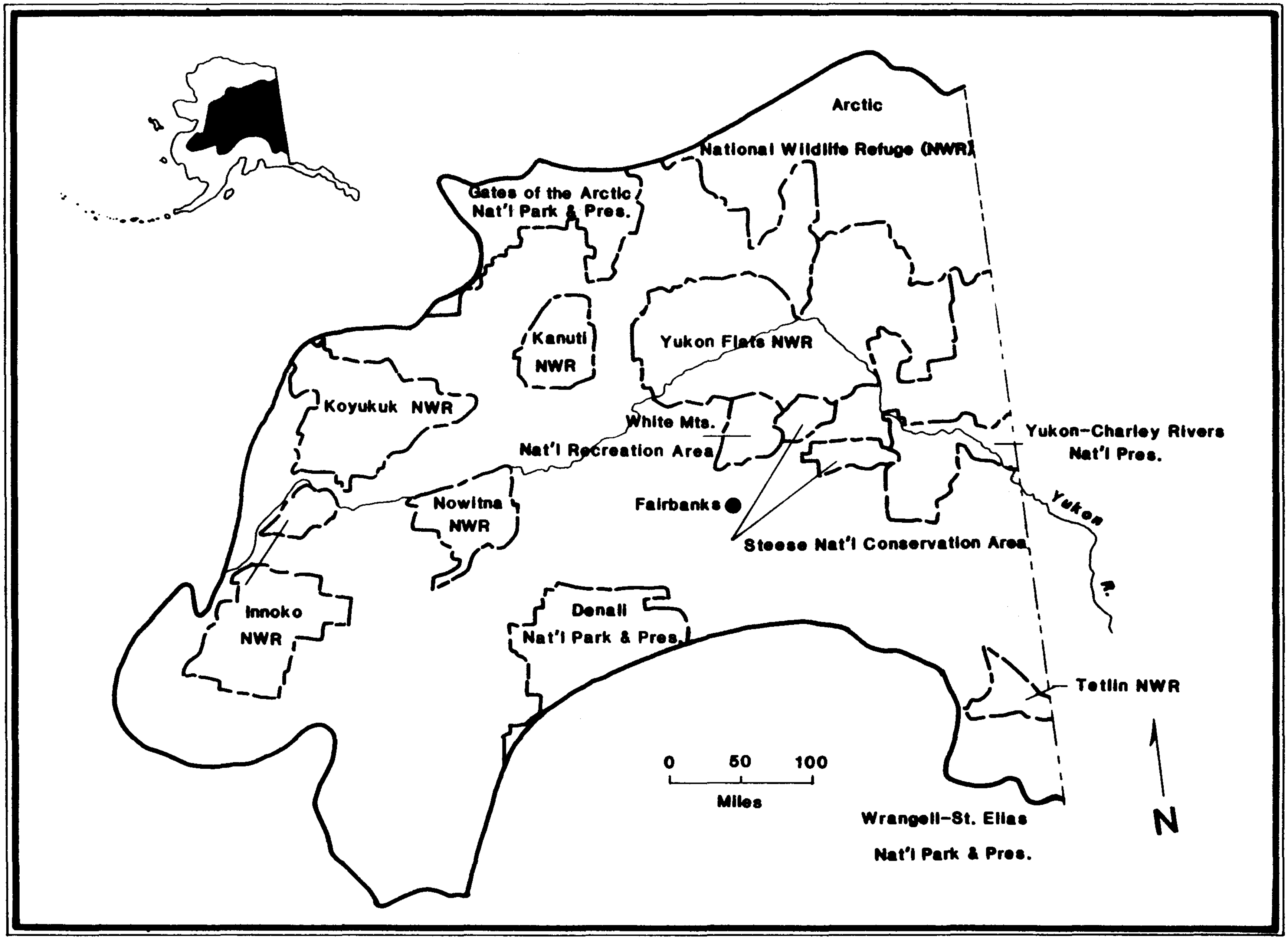
VI. LAND STATUS

Current land status in the Interior Region has been shaped by passage of ANCSA in 1971 and by the 1980 Alaska National Interest Lands Conservation Act (ANILCA). Most of the region is divided between federal, state, and Native corporation holdings. A small portion is in private ownership. Actual acreages are difficult to determine as many state and Native selections have yet to be conveyed by the federal government.

The federal government emerged from ANILCA as the largest land holder in the Interior Region, with 12 new or expanded conservation units falling within the boundaries of the Interior. These conservation units are shown on map 3. Other federal lands include large holdings by the Bureau of Land Management and over 2 million acres of military reserve land concentrated near Delta Junction and Fairbanks (Selkregg 1976). State lands are concentrated within and south of the North Star Borough, with additional large tracts located south of Ruby and along the southern foothills of the Brooks Range. State lands also include submerged lands beneath navigable waters (ibid.). Native land selections are concentrated in the vicinity of villages, with notably large tracts near Eagle, Tetlin, and Venetie (ibid.). Other private land holdings are concentrated in and near communities along the road system but extend into remote areas in the form of homesteads, mining claims, and Native allotments.

VII. CONTEMPORARY SUBSISTENCE USE OF WILD RESOURCES

This section summarizes subsistence hunting, fishing, trapping, and gathering activities in the Interior Region. For each of these activities, available harvest data by community are combined with generalized descriptions of harvest techniques, gear types, transportation methods, resource utilization, preservation and preparation, and distribution and exchange systems. Figures depicting the seasonal round of subsistence activities in selected Interior Region communities are presented in appendix 1. The bulk of this information is derived from the ADF&G, Division of Subsistence, technical paper series. Readers are referred to references cited throughout this section for details on subsistence activities in specific communities and are encouraged to contact the Division of Subsistence for new and updated data produced as part of its ongoing research program. Readers are also directed to the reference map series accompanying this volume,



Map 3. Federal Conservation Units in the Interior Region (USFWS 1985).

where subsistence land use maps for 18 Interior Region communities are presented.

The following discussion generalizes about subsistence activities in the predominantly rural areas of the Interior lying outside the Fairbanks North Star Borough. Resource use patterns within the urban and suburban areas of the greater Fairbanks area are considered in a separate section at the end of this narrative. Discussions of harvest activities that are not currently permitted under present regulations do not constitute endorsement of such activities by the Department of Fish and Game.

A. Hunting

1. Moose. Throughout the Interior Region, moose is regarded as one of the most important sources of wild meat. Community studies show that a high percentage of households participate regularly in moose hunting. Among the upper Tanana River communities of Tanacross, Tetlin, Northway, and Tok, for example, between 73 and 95% of surveyed households reported hunting for moose during a 12-month period in 1983-1984 (Haynes et al. 1984). In Nenana, 95% of surveyed households reported participating in moose hunting during a 12-month period in 1981-1982, a higher participation rate than for any other resource harvest activity in that community (Shinkwin and Case 1984). On the upper Koyukuk River, 77% of surveyed Allakaket-Alatna households and 79% of surveyed Hughes households reported hunting for moose in 1984 (Marcotte and Haynes 1985).

   Moose hunting takes place primarily in September but may continue through fall and winter into March in some locations. Boats are commonly used for fall moose hunts along major rivers, sloughs, and nearby lakes (Sumida and Alexander 1985). Boats are generally 16 to 20 ft in length, made of wood or aluminum, and powered by outboard motors of 18 to 75 hp (Sumida and Alexander 1985, Marcotte and Haynes 1985). Hunting parties typically consist of two to four related individuals. The amount of hunting effort is highly variable among parties. In Stevens Village, for example, hunters spent a total of from 1 to 21 days hunting moose in 1984-1985 and used between 15 and 165 gallons of gas (Sumida and Alexander 1985). Most moose hunters from communities on the upper Koyukuk River traveled a one-way distance of between 20 and 60 mi to hunt moose (Marcotte and Haynes 1985).

   In the winter, snowmachines are commonly used to access moose hunting areas, and the stalking and tracking of moose is done on foot with snowshoes. Moose are also taken opportunistically in conjunction with winter trapping activities

(Sumida and Alexander 1985). Dog teams and airplanes occasionally are used by residents of some Interior communities to access moose hunting areas (Marcotte and Haynes 1985).

General harvest levels for select communities are presented in table 5. Limited moose populations in some areas of the Interior have resulted in establishment of controlled use areas, relatively restricted seasons, or permit hunts. Controlled use areas on the upper Kuskokwim and middle Koyukuk rivers, for example, currently prohibit the use of aircraft for hunting moose or transporting hunters. Moose hunting and harvests in two registration permit areas have been very closely monitored. Permit and moose harvest data for the Minto Flats Management Area and the western Game Management Subunit 25D near Beaver, Birch Creek, and Stevens Village are presented in tables 6 and 7.

Harvested moose are generally very thoroughly utilized. Moose meat is eaten fresh or is frozen or canned for future use. In some locations, moose meat is also preserved by drying (Caulfield 1983a, Stokes 1985). Hunters report eating the heart, liver, head meat, lower lip, nose, chin, brains, intestine, tongue, kidneys, stomach, and lungs (Martin 1983, Caulfield 1983a). Moose hides occasionally are tanned and used for making clothing or handicrafts. Moose meat is commonly shared between hunting partners and members of extended families and often distributed widely throughout an entire community (Caulfield 1983a).

2. Caribou. Caribou have historically been regarded as an economic mainstay for many inhabitants of the Interior. As such, caribou occupy a special place in the culture of many Interior Athabaskans. Continuing oral traditions and customary laws regarding hunting behavior and the care and distribution of caribou meat reflect the cultural importance of caribou, particularly among Kutchin Athabaskans (ibid.). The role of caribou as a major food source, however, has diminished over much of the Interior during the last several decades.

   Declining caribou populations and shifting migration patterns among some herds have resulted in reduced access or restricted hunting seasons, making it difficult for residents in many communities to obtain caribou meat (Martin 1983). Only 5 of 74 households in four upper Koyukuk river communities reported participating in caribou hunting in 1982 (Marcotte and Haynes 1985). Residents of Shageluk and Holy Cross report that although there is a continuing interest in caribou hunting, caribou are infrequently harvested because of the long distances involved in traveling to good caribou hunting areas (Stokes 1984). No surveyed Nenana households reported hunting caribou during a 12-month period in 1981-1982 (Shinkwin and Case 1984). Nenana hunters cited the expense of transportation, nonlocal competition, and hunting seasons that conflict with moose hunting and salmon fishing as reasons for recent low participation in caribou hunting (ibid.). Significant numbers of caribou have not been harvested in the vicinity of Stevens Village, Beaver, or Birch Creek since the 1940's (Caulfield 1983a, Sumida and Alexander 1985).

Caribou are more reliably hunted in portions of the eastern Interior along the upper Tanana and upper Yukon rivers. In the upper Yukon over the past several decades, caribou from the Porcupine Caribou Herd have been most accessible to hunters in Arctic Village and Venetie (Caulfield 1983a). Some Fort Yukon residents travel by boat long distances up the Porcupine River to harvest caribou in the fall. Caribou often are available in the vicinity of Arctic Village and Venetie throughout the winter and spring, and snowmachines are commonly used to access caribou hunting areas. In 1981-82, movements of the Porcupine Caribou Herd made them accessible to hunters in communities such as Eagle and Chalkyitsik. The harvest of Porcupine caribou by residents of upper Yukon communities during the period July 1981 to June 1982 is summarized in table 8.

Among the upper Tanana River communities of Tanacross, Tetlin, Northway, and Tok, between 10 and 56% of surveyed households reported hunting caribou during a 12-month period in 1983-84 (Haynes et al. 1984). Caribou hunting efforts for those communities were concentrated along the Taylor Highway during the fall and winter (ibid.). Caribou from the Nelchina and Mentasta herds have occasionally wintered near Tetlin and Northway in recent years, after having been relatively inaccessible to these communities since the 1940's. A limited number of hunting permits for these caribou were issued to Northway residents in early 1985. Some Dot Lake residents hunt caribou by permit in the vicinity of the Macomb Plateau, accessing hunting areas on foot in the fall or by snowmachine in the winter (Martin 1983).

Harvested caribou, like moose, are thoroughly utilized. The meat is prepared fresh, frozen, or dried. Caribou head meat, internal organs, hooves, and bone marrow are used in a variety of traditional dishes (Caulfield 1983a, Martin 1983). Caribou hides are used as sleeping pads and for making clothing and handicrafts (ibid.). Caribou meat is commonly shared among families and communities. Caulfield (1983a) notes that Arctic Village commonly provides caribou meat for other upper Yukon River area communities and that residents of other communities may provide ammunition and gas for Arctic Village hunters in return for shares of caribou meat. Caribou meat frequently is provided to elderly people unable to hunt for themselves (Caulfield 1983a, Martin 1983).

3. Bear. Brown bears are not a major food resource in Interior Alaska. Nuisance brown bears that threaten life or property may be shot and the meat and hide utilized, but brown bears are only occasionally pursued by hunters for food. Elaborate cultural traditions surrounding the perceived spiritual power of bears govern the killing, treatment, and consumption of both black and brown bears by some Athabskans (Nelson et al. 1982). This aspect is discussed in more detail below. Regulations permit the harvest of only one brown bear every four years. In many areas of the Interior, encounters with brown bears are relatively rare.

   Black bears are more widely utilized than brown bears throughout the Interior. Black bears are typically hunted in conjunction with other hunting, fishing, or gathering activities, when they pose a threat to property, or when other meat is not available (Bishop 1978, Stokes 1985). Caulfield (1977, 1983) reported that black bears are harvested in all upper Yukon River communities except Arctic Village, where they rarely occur.

   On the upper Koyukuk River, between 25 and 53% of surveyed households in Bettles, Evansville, Alatna, Allakaket, and Hughes reported participating in black bear hunting in 1982 (Marcotte and Haynes 1985). In Nenana, 9% of surveyed households reported harvesting black bears, which was the only large game animal harvested besides moose during the 12-month study period (Shinkwin and Case 1984). Between 13 and 31% of surveyed households in four upper Tanana River communities reported harvesting black bear during a 12-month period in 1983-1984 (Haynes et al. 1984).

   Black bears are harvested in May at or near den sites and more commonly in late summer or early fall in conjunction with moose hunting, fishing, or berry picking (Marcotte and Haynes 1985, Stokes 1984). Some winter den hunting is also reported in the upper Yukon and upper Koyukuk River area (Caulfield 1983a, Nelson 1983). Bear meat is eaten fresh or preserved for later use by freezing, smoking, or curing in a brine solution (Caulfield 1983a, Martin 1983, Shinkwin and Case 1984). Black bear meat is commonly served at community feasts and potlatches. Fat black bears are preferred for human consumption (Caulfield 1983a). Bear fat is sometimes rendered into oil, but the entrails of black bears are not generally eaten (Martin 1983). The hides of black bears are tanned for local use and sale. Spring bear hide is considered best for mittens, boots, and moccasins (ibid.).

Among traditional Athabaskans, black and brown bears are regarded as spiritually powerful animals (Nelson 1983, Caulfield 1983a). In discussing contemporary bear hunting practices among Koyukon Athabaskans, Nelson et al. (1982) noted that "when carried out by culturally prescribed methods, the killing, treatment, and consumption of a bear is literally a religious act." Cultural prescriptions surrounding the eating of bear meat by women exist in some communities today (Caulfield 1983a, Nelson 1983, Stickney 1981). On the upper Koyukuk River, the harvest of a black bear is frequently marked by the observance of a bear party, or kitlakka, which involves a ritual sharing of the animal. At least three bear parties occurred in Allakaket and Hughes in 1983 (Marcotte and Haynes 1985).

Among Koyukuk River communities, 40 black bears were taken by Huslia residents in 1983 (Marcotte, in preparation). Five black bears and one brown bear were reported harvested in Bettles-Evansville in 1983 (Marcotte and Haynes 1985). Allakaket-Alatna residents harvested 21 black bears in 1982, and Hughes residents took 15 (ibid.).

4. Dall sheep. The relative inaccessibility of Dall sheep, increasingly restrictive harvest regulations, and the amount of effort required to harvest a relatively small quantity of meat are associated with reduced local harvests of Dall sheep today. Nevertheless, sheep meat remains a preferred or culturally important wild food in some Interior communities, and sheep hunting is included in the contemporary seasonal round of subsistence activities in near-mountain communities of the upper Koyukuk, Kuskokwim, Tanana, and Yukon rivers.

   Among upper Yukon River area communities, sheep hunting is carried out most frequently by Arctic Village hunters (Caulfield 1983a). Residents of Eagle and the Yukon River between Eagle and Circle also occasionally harvest sheep in the nearby Glacier Peak and Charley River areas (Caulfield 1977). Arctic Village hunters access sheep hunting areas on foot in late August and early September or by snowmachine in November, when hunters may travel more than 100 mi for a single sheep (Caulfield 1983a). Considerable prestige is associated with a successful sheep hunt. Sheep meat is particularly prized by Arctic Village elders and is often served at Christmas potlatches. In recent years, the annual harvest of sheep by Arctic Village hunters has averaged fewer than 10 animals (ibid.).

In the upper Koyukuk area, hunters from Allakaket/Alatna and Bettles/Evansville reported traveling from 130 to 200 mi (one-way) by riverboat to harvest Dall sheep in the fall (Marcotte and Haynes 1985). In 1982, two sheep were harvested by one household in Bettles/Evansville, and five sheep were harvested by four households in Allakaket/Alatna (ibid.).

In the upper Tanana River area, some Dot Lake residents reportedly participate in fall sheep hunting, accessing nearly all sheep hunting areas on foot (Martin 1983). Sheep are also taken by Tok residents in the fall using aircraft, boats, and all-terrain vehicles to reach hunting areas.

In the upper Kuskokwim communities of Nikolai and Telida, sheep are occasionally taken in conjunction with trapping activities in the Alaska Range foothills, but most sheep meat entering those communities is meat from nonlocal hunters left with local guides (Stokes 1985). Some McGrath residents use aircraft to access sheep hunting areas in the fall (ibid.).

5. Waterfowl and other small game. The contribution that small game harvests make to the diet and economy of Interior households should not be underestimated. A variety of ducks, geese, several species of grouse, and snowshoe hare are generally available throughout the Interior and are a widely used and highly valued source of wild food. Ptarmigan, porcupine, and arctic ground squirrel are less universally used but important in some locations and to some households.

   Small game hunting is often carried out in conjunction with other hunting, fishing, and gathering activities or conducted in areas within walking distance of communities. Whereas big game hunting is typically an adult male activity, small game is pursued by young and old hunters alike and by both men and women. For these reasons, levels of participation in small game hunting, particularly for waterfowl and hare, frequently are high. For example, 82% of surveyed Nenana households harvested hare, 73% harvested grouse or ptarmigan, and 77% harvested waterfowl during a recent study year (Shinkwin and Case 1984). Similarly high household participation rates in small game hunting are reported in upper Tanana River communities. Eighty percent of surveyed households in Tanacross, for example, reported hunting hare, and 85% of survey households in Tetlin reported hunting ducks (Haynes et al. 1985). Table 9 gives harvest levels and household participation rates for small game hunting in upper Koyukuk River communities. These data show a mean harvest of nearly 27 ducks and 12 geese per household in Hughes, indicating that small game can make significant contributions to food supplies.

The waterfowl species most often harvested in the Interior include the Canada and white-fronted goose, mallard, pintail, oldsquaw, common goldeneye, American wigeon, green-winged teal, scaup, and white-winged scoter (Caulfield 1983a, Marcotte and Haynes 1985). Stokes (1985) reports that some hunters consciously avoid hunting some species of waterfowl known collectively as "fish ducks."

Waterfowl hunting occurs in some areas in May, when ducks and geese are highly valued as a source of fresh meat and variety to the local diet. Peak waterfowl harvesting usually occurs in September, frequently in conjunction with fall moose hunting or on trips to lake and wetland areas specifically for waterfowl. Shotguns are universally used in waterfowl hunting. Natural or constructed blinds are sometimes used at traditionally productive hunting locations. Following freeze-up of lakes in the late fall, waterfowl hunting is concentrated along rivers and sloughs. Waterfowl are often eaten fresh, particularly in the spring, and are prepared by roasting or used in soup. Larger fall harvests of birds may be frozen whole. The heads, hearts, livers, gizzards, and intestines of waterfowl are also sometimes eaten roasted or in soup (Stokes 1985, Shinkwin and Case 1984).

Snowshow hares are shot or snared throughout the year but are less commonly harvested during the summer months. Snare lines are commonly set for hares within walking distance of communities and checked daily in the fall and winter. "Rabbit drives," whereby a hunter walks through a willow thicket driving hares towards fellow hunters, take place in August and September in some locations (Caulfield 1983a, Stokes 1985). Hares are prepared fresh or preserved by freezing. Hares are also used as trap bait or dog food, and their fur is occasionally used for boot and mitten liners (ibid.).

Ruffed, spruce, and sharp-tailed grouse and willow and rock ptarmigan are variously distributed across the Interior. These birds frequently are harvested when encountered. Grouse are particularly sought in the late fall and early winter. Ptarmigan are locally abundant near Arctic Village, where they constitute an important spring food resource (Caulfield 1983a).

Porcupines are highly prized by some hunters for their meat and fat. Quills are sometimes used in making handicrafts. Porcupines occasionally are shot but more frequently clubbed. They are commonly regarded as an emergency food source that can be easily obtained without the use of firearms. Harvested porcupines are frequently eaten in the field or at community potlatch celebrations. Although porcupines reportedly are used in many Interior communities, harvest figures are rarely given. Stokes (1985) estimates that 20-40 porcupines are harvested annually by one upper Kuskokwim River community.

Arctic ground squirrels are an additional small game resource utilized by residents of Arctic Village and Venetie and to a lesser extent in Fort Yukon, Birch Creek, and Chalkyitsik (Caulfield 1983a). Ground squirrels are shot, snared, or trapped in late April or May. Their meat is especially valued by older people for its perceived medicinal value (ibid.).

B. Fishing

1. Salmon. For most Interior Region communities, salmon are an important food source. A high percentage of households participate in salmon fishing activities. Salmon also represent a significant income source for some Interior households through commercial fishing activities on the Yukon and Tanana rivers. Commercial and subsistence harvest figures are discussed in the species narrative elsewhere in this volume. Chinook, chum, and coho salmon are the primary species available to Interior Region communities along the Yukon, Koyukuk, Tanana, and Kuskokwim rivers. Salmon do not ascend the upper Tanana River in harvestable quantities. Residents of upper Tanana River communities traditionally obtain salmon from the Copper River, where, in addition to the above-mentioned species, sockeye and pink salmon are also harvested (Haynes et al. 1984).

   Salmon runs vary in size, timing, and location across the Interior. Chinook salmon are the first to arrive in mid to late June or early July, followed by "summer" chums in late July and August and "fall" chums and cohos from August until freeze-up. Fishers frequently make no distinction between fall chum and coho, referring to the fall run as simply "silvers" or "fall" chums.

   Set gill nets and fish wheels are most commonly used to harvest salmon. A drift gill net season has also been established for a portion of the Yukon River near Nulato and Kaltag (Huntington 1981, Marcotte 1982). Due to clear water conditions on some upper Kuskokwim River area salmon streams, rod and reel are the most effective and most widely used means of harvesting chinook salmon in those locations (Stokes 1982). Fish wheels are rarely used on the Koyukuk River, where water conditions and local traditions favor the use of set nets

(Marcotte, pers. comm.). This is in contrast to the Copper River salmon fishery participated in by some upper Tanana River residents, where, for subsistence purposes, fish wheels predominate (Haynes et al. 1984).

Salmon fishing and processing is usually a group activity performed by related individuals. Past use generally establishes a family's claim to a particular fish camp, net, or wheel site. Where salmon fishing is productive at or near the community, fishing sites are generally located close to the community. In Nenana, for example, salmon fishing locations were concentrated within seven river miles of the community (Shinkwin and Case 1984). Among those communities where salmon fishing is relatively local, the use of fish camps has diminished recently in favor of staying in town, checking nets or wheels during short day trips, and bringing harvested fish home for processing (Marcotte and Haynes 1985).

Individual household salmon harvests may vary from year to year, depending on wage employment opportunities, water level, strength of salmon runs, and weather conditions for drying fish. The extent of reliance on salmon is largely a function of proximity to salmon runs and local traditions and preferences. Some communities in headwater locations such as Arctic Village, Bettles, and Telida are notably less involved in salmon fishing than communities more favorably situated for harvesting salmon. Even where salmon are not locally abundant, however, some salmon is generally obtained either through trade or long trips to reach salmon fishing locations. Some Nikolai residents, for example, travel 160 mi by boat to reach chinook salmon fishing locations, where they may stay for up to a month (Stokes 1982). Some residents of Chalkyitsik and Venetie relocate to Fort Yukon during the salmon season to participate in the more productive fishery there (Caulfield 1983a). Some Dot Lake residents travel up to 250 mi by road to fish for salmon with relatives in the Copper River basin (Martin 1983).

Recent subsistence salmon harvest data for Interior Region communities located on the Yukon River and its tributaries are presented in tables 10 through 12. In addition to these harvests, harvest of salmon occurs in Bettles/Evansville, where, for example, 9 chinook and 532 summer chum were harvested in 1982 (Marcotte and Haynes 1985). Annual subsistence salmon harvest data for the upper Kuskokwim communities of McGrath, Takotna, Nikolai, and Telida for the years 1979-1984 are presented in table 13. Most of the salmon harvested by residents of upper Tanana River communities are taken in the Copper River basin. Six of 15 surveyed households in Tanacross fished for salmon, harvesting a total of 270 Copper River salmon in 1984. Three of 20 surveyed Tetlin households harvested a total of 105 Copper River salmon in 1983. In Northway, 5 of 15 households surveyed reported fishing for salmon in the Copper River, taking a total of 397 salmon. In 1984, 77% of all Tok residents holding Copper River subsistence salmon fishing permits reported a harvest of 2,077 salmon (Haynes et al. 1984).

Chinook salmon are favored for human consumption. Depending upon the area, chinook are prepared as smoked strips, filets, and canned products. Some residents also can chinook salmon. Heads of chinook salmon are often dried and used in soup. Chum and coho salmon are used both for human consumption and for dog food, depending on the quality of harvested fish, individual preference, and the condition of fish after processing. Chum and coho salmon are usually gutted, split, filets scored with diagonal cuts, and hung to air dry on large outdoor racks. Household and community freezers are also used to preserve fish at some locations. Salmon eggs are often dried for human consumption of dog food. Fish entrails are used as dog food or fertilizer (Caulfield 1983a, Martin 1983, Marcotte and Haynes 1985).

Harvested salmon are frequently shared and exchanged among households and communities. Twenty-three percent of Allakaket households and 47% of Hughes households harvesting chinook salmon in 1982 gave some of their harvest to other households (Marcotte and Haynes 1985). Haynes et al. (1984) found that among surveyed Tanacross households harvesting salmon, between 10 and 40% of the household catch was distributed to other residents in the community. In Tetlin, although only 15% of surveyed households fished for salmon, 70% of surveyed households reported receiving salmon (ibid.). In the upper Yukon and Porcupine River areas, Fort Yukon serves as the supplier of salmon to neighboring communities that have poorer access to salmon runs (Caulfield 1983a). Some households in Arctic Village, for example, exchange caribou meat for salmon with relatives or friends in Fort Yukon (ibid.)

The importance of salmon as a wild food source is reflected in its almost universal use throughout the region, the extent to which salmon are shared through kinship, community, and intracommunity distribution and exchange networks, and the amount of effort some residents expend to obtain it.

2. Nonsalmon fish. Apart from salmon, a variety of other fish species are harvested by Interior residents. Arctic grayling, burbot, northern pike, sheefish, suckers, and whitefish are utilized throughout most of the Interior. Alaska blackfish, Dolly Varden, lake trout, and lamprey are harvested in some locations. Of the nonsalmon species, the harvest of whitefish is the most substantial in most communities and will be detailed separately below. Smaller quantities of the other species are taken and viewed as a welcome but often minor addition to the diet.

   a. Whitefish. Although several species of whitefish and cisco are harvested in the Interior, there is generally no distinction made between them among fishers, and they are collectively referred to simply as whitefish. Whitefish are taken by a wide variety of methods. They are frequently caught incidentally to summer salmon fishing activities, although in some locations the number of incidentally caught whitefish may exceed the number of salmon caught in a fishing period (Stokes 1985). Whitefish are the major fish species harvested in the upper Tanana River communities of Tanacross, Tetlin, and Northway (Haynes, pers. comm.). In the early spring and late fall, small-mesh gill nets are set for whitefish in rivers, sloughs, and lakes. Fishcamps complete with cabins and fish-drying racks may be located at or near reliably good whitefish fishing areas (Martin 1983). In the fall, gill nets are placed under the ice into December, when this technique is hampered by thick ice. Dip nets are used through holes in the ice to harvest whitefish, northern pike, and sheefish on the lower Middle Yukon and on the Innoko River near Shageluk (Stokes 1984). Residents from several nearby communities participate in this fishery, and the catch is widely distributed throughout the participating communities (ibid.). Along the upper Koyukuk River, seine nets are used to harvest whitefish in the fall (Marcotte and Haynes 1985).

      Whitefish are most commonly preserved by drying. Some are also smoked, canned, or frozen (Martin 1983). Whitefish eggs are also dried or frozen for later consumption. Whitefish stomachs are occasionally rendered into oil, and livers, heads, and eyes are sometimes cooked and eaten (ibid.). Although whitefish are primarily caught for human consumption, some are also used as dog food.

b. Other fish. Although salmon and whitefish are the major target species, fishing activities also produce sheefish, burbot, northern pike, arctic grayling, and sucker. Whereas large catches of the target species are typically preserved for later use, small catches of the incidental species are generally eaten fresh.

In the summer and fall, arctic grayling, northern pike, and sheefish are caught in lakes and sloughs by rod and reel. During the winter, arctic grayling and burbot are commonly "jigged" through holes in river or lake ice. Wood and wire basket traps are set under the river ice for burbot in some locations and yield incidental catches of whitefish and longnose sucker (Stokes 1985). In some areas, longnose suckers are valued as dog food and are occasionally harvested for that purpose by use of small-mesh nets or traps in the late spring (ibid.). In some locations, set hooks are used under lake and river ice for burbot, pike, and lake trout (Caulfield 1983a). On the lower Middle Yukon River near Holy Cross, a fall lamprey run is harvested in November through holes in the ice by use of dip nets (Stokes 1984). The harvest of Alaska blackfish in basket traps set under the ice was more common historically than today, although blackfish are still trapped in some communities (ibid.). Sheefish are harvested in fairly large numbers by residents of the Koyukuk River using beach seines. In Huslia in 1982, for example, the per household harvest of sheefish (pounds) was greater than for any other fish species besides salmon (table 15).

Harvest data by community for fish other than salmon are generally unavailable. Several recent subsistence studies have reported fish harvests by species, and these data are presented in tables 14-16. Table 14 indicates community participation in fishing and harvest data for nonsalmon species in Bettles/Evansville and Allakaket/Alatna and Hughes during 1982. Table 15 details the harvest of nonsalmon fish resources in Huslia 1983a. Table 16 indicates the percentage of surveyed households in Tanacross, Tetlin, Northway, and Tok that participated in fishing for listed species.

C. Trapping

Trapping is addressed in a separate narrative section found elsewhere in this volume. As an important part of the seasonal round of harvest activities, however, a brief discussion of trapping is warranted here. Readers are referred to the trapping section for further discussion of trapping activities and furbearer harvest figures.

The Yukon River drainage harbors some of the most productive furbearer habitat in Alaska. Historically and today, trapping has been and remains a primary winter activity for many Interior residents. Stokes (1984, 1985) reports that at least one member of most households in communities along the upper Kuskokwim River and lower-middle Yukon River participates in trapping. Similarly, high participation rates are reported for other communities throughout the Interior Region.

Trapping activities commence in November and continue into April for some species. Commonly harvested furbearers include beaver, red fox, lynx, marten, mink, muskrat, land otter, wolf, and wolverine. Marten is perhaps the most commonly trapped species across the region. Target species vary from area to area, from year to year, and among individual trappers. Marten, beaver, lynx, and red fox were found to be the most commonly trapped species by upper Koyukuk River trappers in 1982-1983 (Marcotte and Haynes 1985). A survey of Middle Yukon River trappers using the Innoko National Wildlife Refuge (northern portion) indicated that marten, beaver, and mink comprised 96% of the furbearer harvest for that area in 1981-1982 (Robert 1984). Steel traps and snares are universally used to harvest most furbearers. Wolf, wolverine, and muskrat are often shot rather than trapped.

Traplines vary in length from less than a mile to lines that are 75 or 80 mi long (Caulfield 1983a, Robert 1984, Stokes 1985). Among 40 trappers using the northern Innoko National Wildlife Refuge during the 1982-1983 season, the average trapline length was 20 mi (Robert 1984). As with fishing sites, there are customary rules regarding the use or ownership of traplines. Trapping areas generally are recognized as belonging to an individual, based on consistent use of an area over time, and trapping rights to an area are often passed between family members (ibid.). Snowmachines are commonly used to check traplines. A few trappers use dog teams; others fly into their trapping areas and work their line on foot, using skis or snowshoes.

Incomes from trapping are highly variable, depending upon effort, targeted species, and fluctuating fur prices. One trapper from Allakaket commented in 1983 that by working hard a trapper might gross $4,000 and net $2,000 in a season (Marcotte and Haynes 1985). Costs associated with trapping include depreciation and upkeep on snowmachines and camping gear, fuel, and the cost of new traps and snares. Robert (1984) found that among trappers using the northern Innoko Refuge, the cost of snowmachine fuel ranged from $200 to $1,100 per trapper during the 1981-1982 season.

Although furbearers are harvested primarily for the cash value of their pelts, some pelts are often retained for local use in making hats, mitts, parka ruffs, and handicrafts. In addition, the meat from beaver, lynx, and muskrat is prized as high-quality food for both humans and dogs. Beaver carcasses are often sold or traded as dog food and sometimes command a higher price than the pelt. Aside from providing a source of income, food, and furs for local use, the traditional land use skills associated with trapping make it a valued cultural activity for many Interior residents.

D. Gathering

Plant resources provide an important source of food, fuel, and raw materials to Interior residents. Table 17 indicates the wood, plant, and berry resources commonly gathered in the Interior Region and how they are utilized.

Wood is a major source of fuel for home heating across much of the Interior, and firewood cutting is an activity that proceeds year-round. White spruce is the preferred firewood in most locations. White spruce is also used in log cabin construction and making lumber. Small spruce poles are used in the construction of fish wheels, tent frames, and fish racks (Caulfield 1983a, Stokes 1985). Birch is occasionally used as firewood and is the preferred wood for making snowshoes and sleds. Cottonwood, poplar, and alder are used to smoke meat and fish.

Berries generally represent the most significant harvest of wild edible plant products. Berries are picked throughout the summer and fall, usually in areas close to villages or fish camps. Some households report traveling 30 to 50 mi to reach especially productive berry areas (Martin 1983, Stokes 1985). Berry trips are typically day or half-day trips, and women and children are frequently the most active berry pickers (ibid.). Berries are eaten fresh, frozen whole, cooked into a variety of products, or variously mixed with lard, sugar, and fish to make Indian ice cream.

Harvest data for wood and berry resources in several upper Koyukuk River communities is presented in table 18.

E. Local Use of Wild Resources in the Fairbanks Area

Relatively abundant employment opportunities and greater participation in the dominant cash economy within the urban and suburban areas surrounding Fairbanks influence the resource use patterns of area residents. The industrial-capital economic system operating there has, for the most part, relegated fish and game harvests to a level where they can no longer be considered central to the local economy. Although participation in some harvest activities may be high and may, for many residents, represent cherished spare-time pursuits, they are typically scheduled as a temporary break from wage employment and are therefore distinguished from subsistence activities as being primarily recreational in nature.

Particular subgroups within the Fairbanks area undoubtedly exhibit patterns of resource use that differ from the predominant recreational pattern. A small segment of the Fairbanks area population, for example, engages in fishing and hunting for commercial purposes as commercial fishers or commercial guides. A small number also participate in subsistence salmon fisheries near the Yukon River bridge and the Tanana River near Fairbanks (Subdistrict Y-6C). In 1984, 308 permits were issued for the Y-6C fishery, and salmon harvests totaled 8,632 fish (71 permittees did not fish or fished unsuccessfully, and 25 did not report) (ADF&G 1984b). A survey of the 1980 participants in this fishery revealed that virtually all were residents of the Fairbanks North Star Borough and that the large majority were significantly involved in the wage economy and had moderate-to-high income levels (Caulfield 1981). Furthermore, almost 60% of the respondents indicated that half or more of their household's meat and fish was obtained through subsistence activities (ibid.). Although this sample can not be considered representative of all Fairbanks area residents, it does serve to demonstrate that there are subpopulations and enclaves within the urban population for which fish and game resources represent significant economic value.

As another example, some portion of the 3,000 or so Alaska Natives residing in the Fairbanks North Star Borough (2,987 according to 1980 census) 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 relatives and friends in rural villages to relatives and friends in Fairbanks to satisfy personal and cultural needs. The precise characteristics of this rural-to-urban flow of wild resources has yet to be studied.

And finally, the Western "outdoorsman" traditions of certain Fairbanks area residents, traced as personal family history from the continental United States, undoubtedly contain special vlaues placed on wild resources and their use. These traditions are commonly passed on between members of outdoor and sportsmen clubs and other voluntary associations within the urban setting.

At this time, resource use surveys that have been administered in rural communities to gather subsistence information have not been applied to the state's urban areas. The above discussion points out that it would be a mistake to view resource use patterns in the greater Fairbanks area as a simple homogeneous pattern of recreational use. Characteristics of the various resource use patterns of urban subgroups hopefully will be examined in future research. Readers are directed to additional narratives on sport and commercial fishing and the Human Use sections of individual species found elsewhere in this volume for more information regarding some of those use patterns.

APPENDIX 1. Seasonal Round of Harvest Activities

Figures 1-7 depict the annual round of subsistence activities in several Interior communities and areas. Seasonal round data have not been collected for all Interior Region communities. Whereas small differences in the timing of activities and the relative importance of certain species can be found among most communities, these seasonal round figures present a general view of harvest activities that probably can be extrapolated to include neighboring communities. Marcotte and Haynes (1985), for example, found the seasonal rounds of five upper Koyukuk River communities to be very similar. Figure 6 upper Koyukuk River presents a generalized seasonal round for the area. Seasonal round information for upper Tanana River several communities has been similarly combined in figure 7.

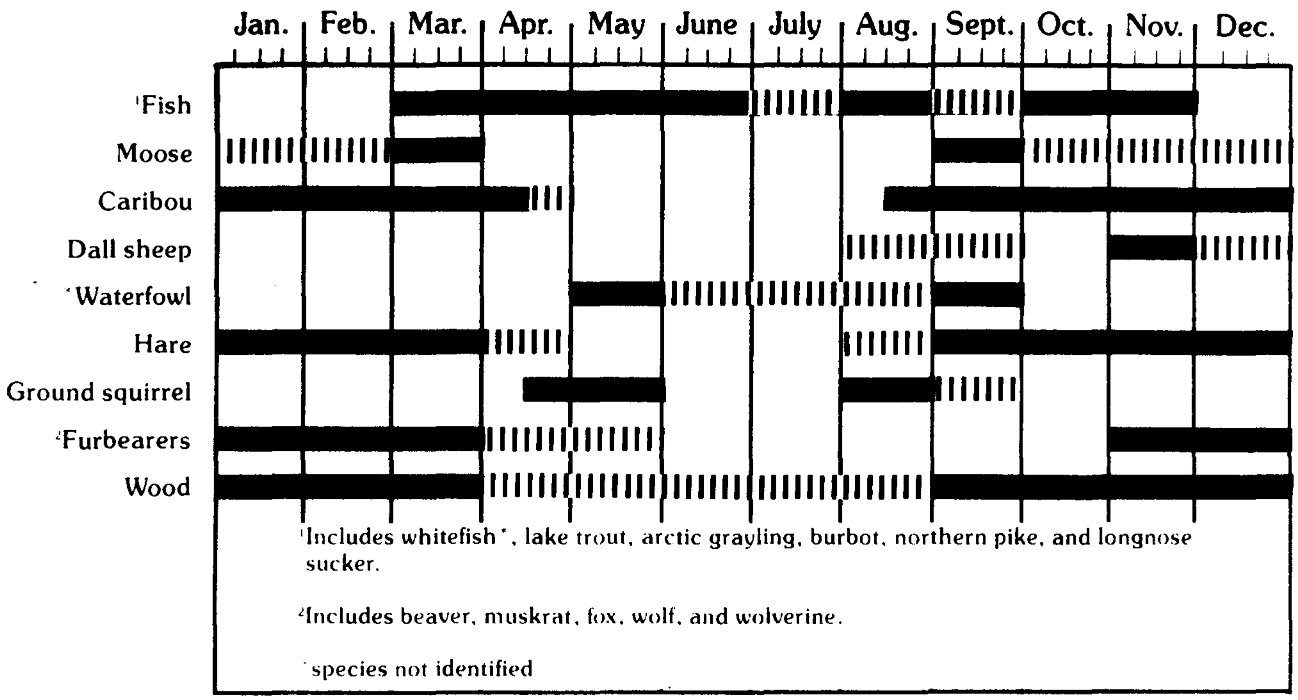


Figure 1. Annual round of subsistence harvest activities by residents of Arctic Village, circa 1970-1982 (Caulfield 1983). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

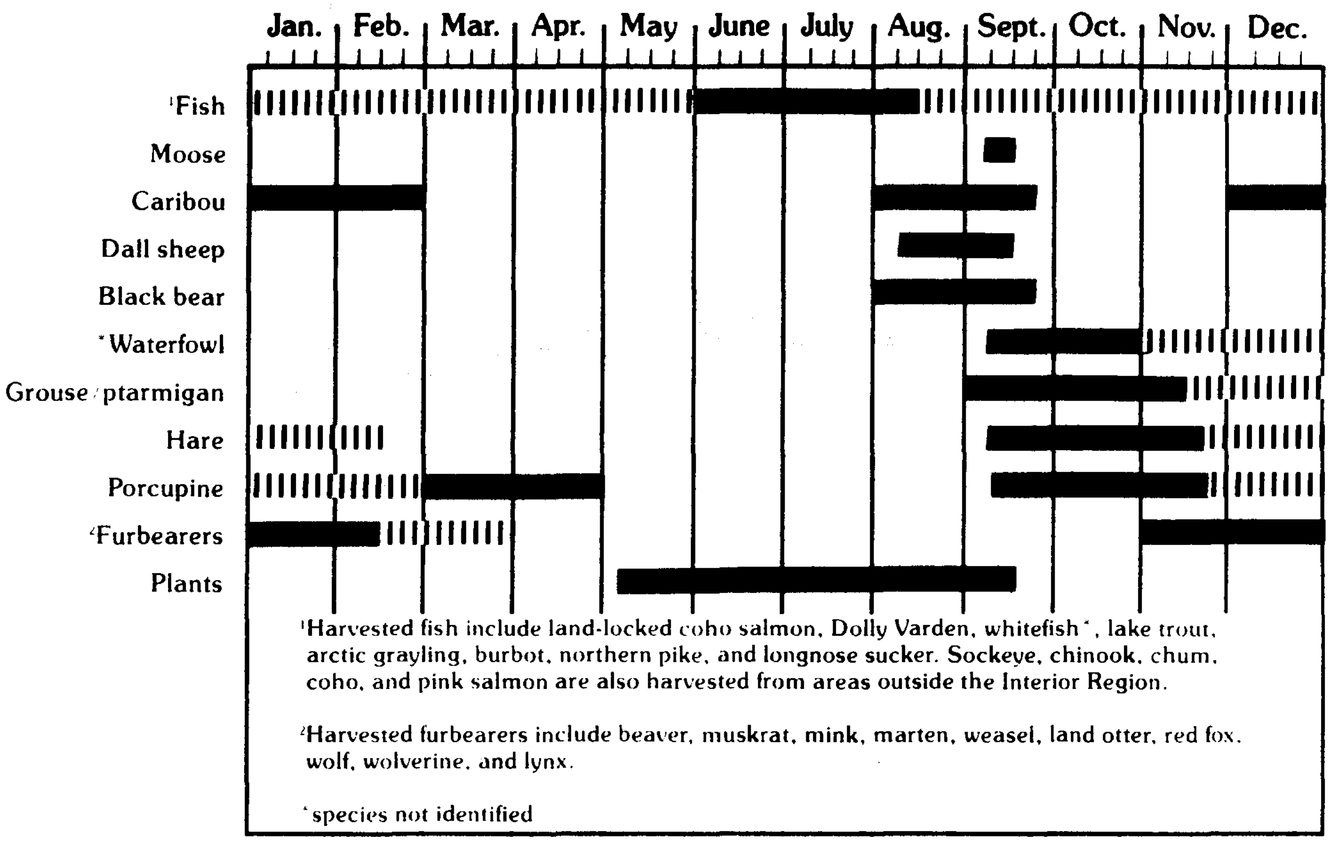


Figure 2. Annual round of subsistence harvest activities by residents of Dot Lake, 1980-1982 (Martin 1983). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

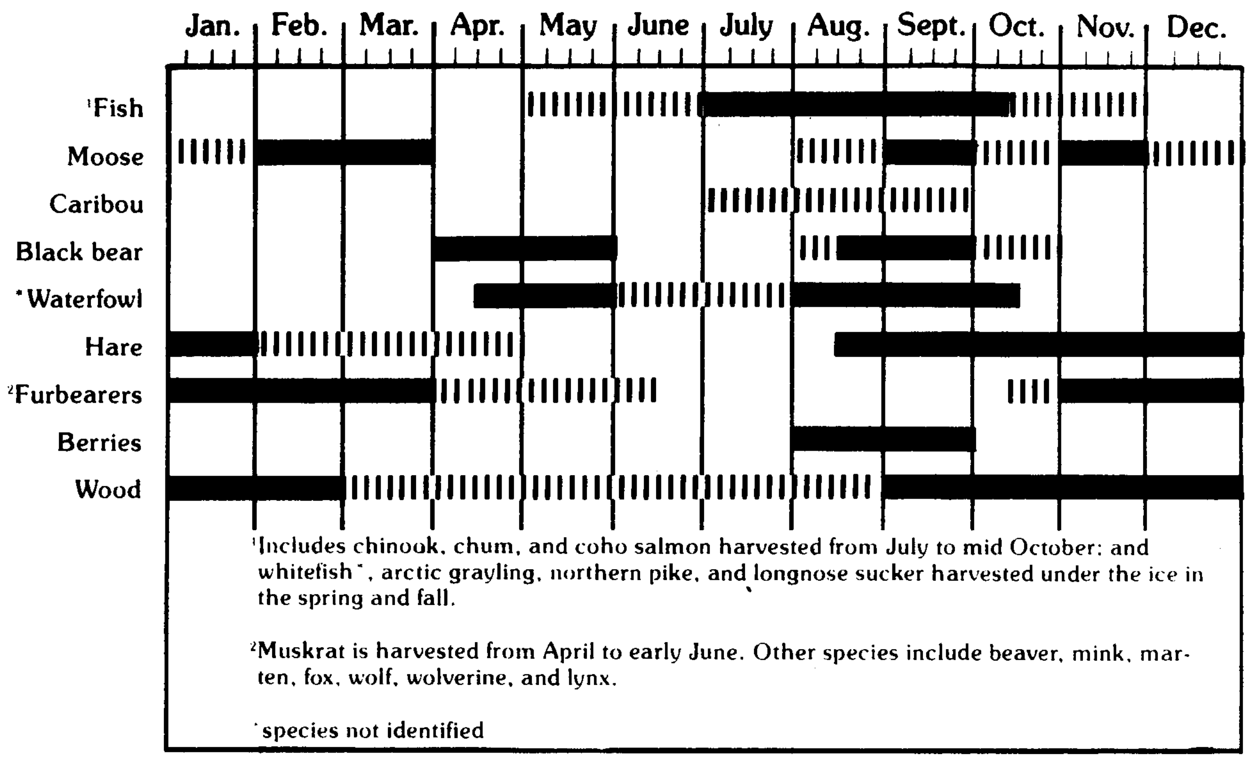


Figure 3. Annual round of subsistence harvest activities by residents of Fort Yukon, circa 1970-1982 (Caulfield 1983). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

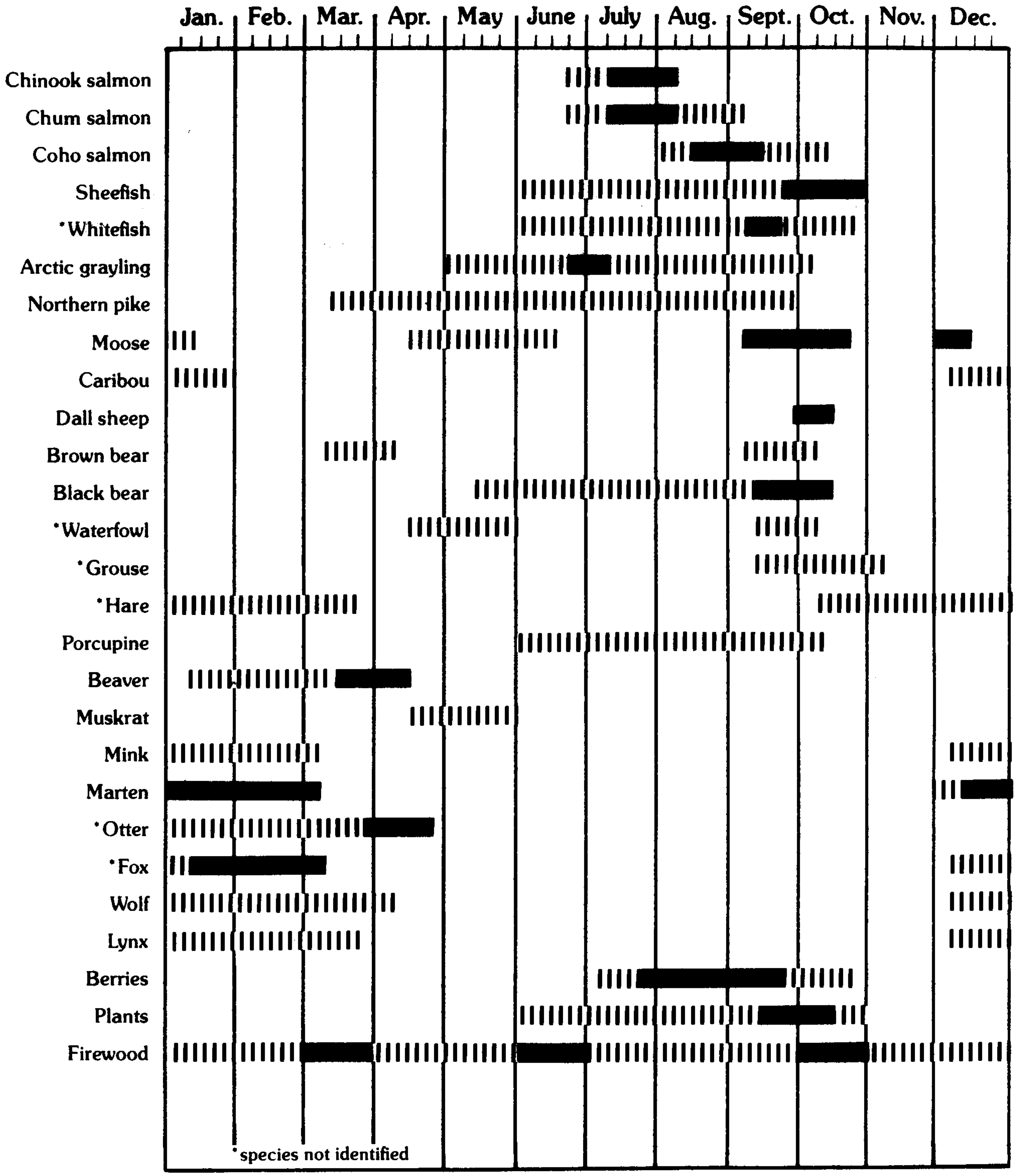


Figure 4. Annual round of subsistence harvest activities by residents of McGrath, 1983 (Stokes 1985). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

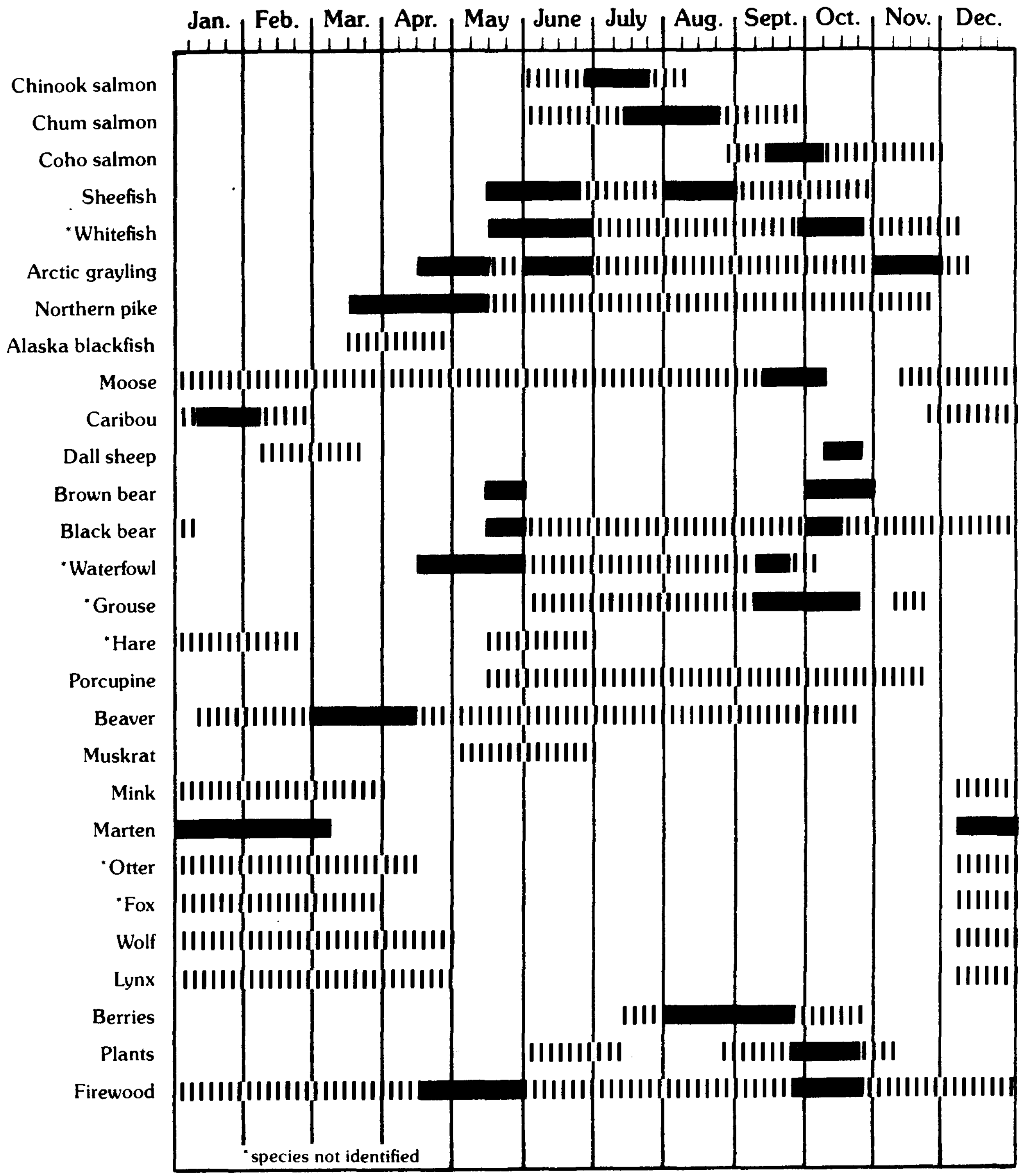


Figure 5. Annual round of subsistence harvest activities by residents of Nikolai, 1983 (Stokes 1985). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

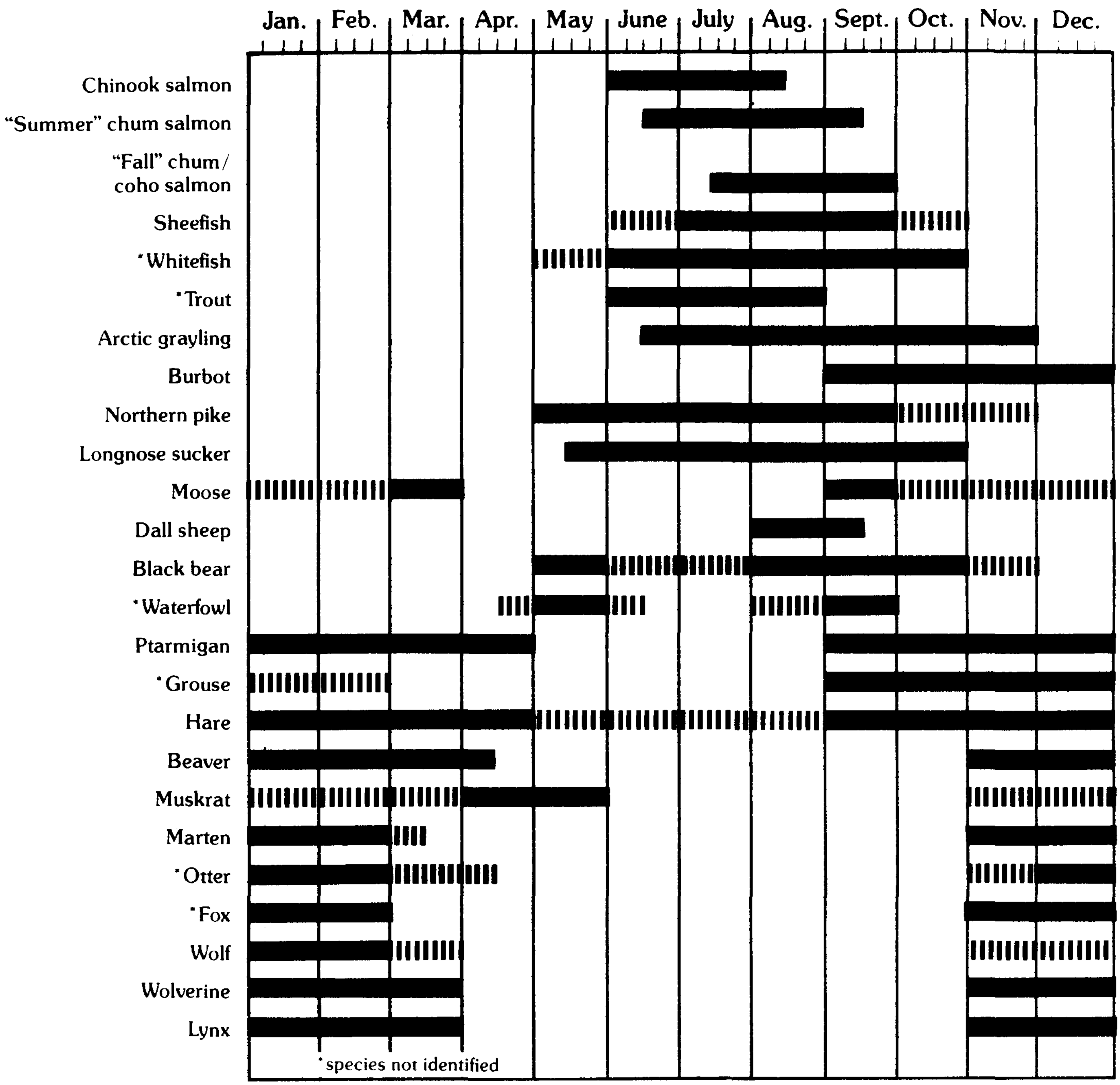


Figure 6. Annual round of subsistence harvest activities by residents of the Upper Koyukuk River communities of Bettles/Evansville, Alatna, Allakaket, and Hughes, 1982-1983 (Marcotte and Haynes 1985). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Note: Harvest of caribou and brown bear during this time period was insufficient to depict pattern.

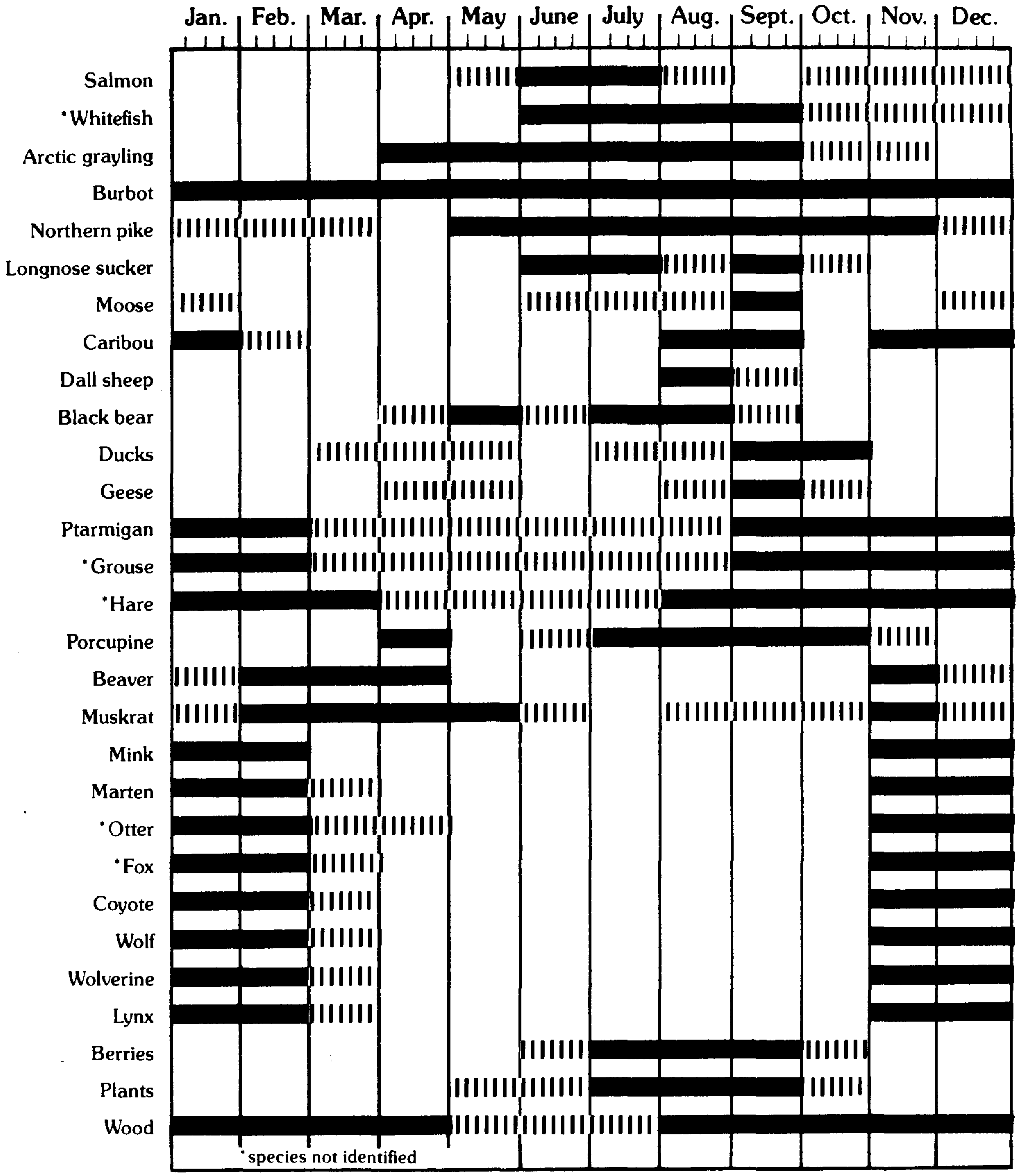


Figure 7. Annual round of subsistence harvest activities by residents of the Upper Tanana River communities of Northway, Tanacross, Tetlin, and Tok, 1983-1984 (Case, in press; Haynes et al. 1984). Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Note: Based on a sample of residents in each community. Not all resources were harvested in all communities during the study year.

Table 1. Major Fish and Wildlife Resources Utilized by Residents of Communities in Interior Alaska

Big Game

Black bear (*Ursus americanus*)
Brown bear (*Ursus arctos*)
Caribou (*Rangifer tarandus*)
Dall sheep (*Ovis dalli*)
Moose (*Alces alces*)

Wildfowl

Ducks (various)
Geese (various)
Grouse (various)
Ptarmigan (*Lagopus* sp.)

Small Game and Furbearers

Arctic ground squirrel (*Citellus undulatus*)
Beaver (*Castor canadensis*)
Ermine (*Mustela erminea*)
Lynx (*Lynx canadensis*)
Marten (*Martes americana*)
Mink (*Mustela vison*)
Muskrat (*Ondontra zebethica*)
Porcupine (*Erithizon dorsatum*)
Red fox (*Vulpes fulva*)
River otter (*Lutra canadensis*)
Snowshoe hare (*Lepus americanus*)
Wolf (*Canis lupus*)
Wolverine (*Gulo luscus*)

Fish

Alaska blackfish (*Dallia pectoralis*)
Arctic char (*Salvalinus alpinus*)
Broad whitefish (*Coregonus nasus*)
Burbot (*Lota lota*)
Chinook salmon (*Oncorhynchus tshawytscha*)
Chum salmon (*Oncorhynchus keta*)
Coho salmon (*Oncorhynchus kisutch*)
Dolly Varden (*Salvelinus malma*)
Arctic grayling (*Thymallus arcticus*)
Humpback whitefish (*Coregonus pidschian*)
Lake Trout (*Salvalinus namaycush*)
Least cisco (*Coregonus sardinella*)
Longnose sucker (*Catostomus catostomus*)
Northern pike (*Esox luscius*)
Round Whitefish (*Prosopium cylindraceum*)
Sheefish (*Stenodus leucichthys*)
Sockeye salmon (*Oncorhynchus nerka*)*

Source: Adapted from Haynes 1985, Nelson et al. 1982.

* Obtained from outside the Interior Region.

Table 2. Population Figures 1890-1980 and 1980 Ethnic Composition for Interior Alaska Communities

Community	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	Percentage Native Population 1980
Alatna				32	131	28	31	--	--	30	97%
Allakaket				85		105	79	115	174	163	97%
Anderson								200	362	517	3%
Anvik	191	--	151	140	79	110	99	120	83	114	80%
Arctic Village			40	--	40	24	53	110	85	111	88%
Beaver					103	88	101	101	101	66	98%
Bettles/ Evansville					23	10	47	77	57	94	29%
Big Delta								50	--	245	--
Birch Creek						32	--	32	--	32	97%
Central							41	28	26	36	--
Chalkytsik								57	130	100	96%
Chicken					20	41	34	--	--	35	--
Circle		242	144	96	50	98	83	41	54	81	74%
Delta Junction							155	250	703	945	3%
Dot Lake								56	42	67	57%
Eagle City		383	178	98	54	73	55	92	36	110	35%
Eagle Village			--	60	78	63	--	--	40	54	--
Fairbanks			3541	1155	2101	3455	5771	13311	14771	22645	7%
Fort Yukon		156	321	319	304	274	446	701	448	619	46%
Galena					67	44	176	261	302	765	74%
Grayling									139	209	61%
Healy					36	46	102	67	79	334	--
Healy Lake					16	77	--	--	--	33	88%
Holy Cross					337	226	157	256	199	241	92%
Hughes				45	--	32	49	69	85	73	97%
Huslia							65	168	--	188	95%
Kaltag			141	89	137	140	121	165	206	247	96%
Koyukuk			121	124	143	106	79	128	124	98	93%
Lake Minchumina							60	--	--	--	--
Livengood				131	22	153	40	--	--	--	--

(continued)

Table 2 (continued)

Community	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	Percentage Native Population 1980
Manley Hot Springs			101	29	45	39	29	72	34	61	20%
McGrath				90	112	138	175	241	279	355	46%
McKinley Park					49	11	59	--	--	32	--
Minto				58	--	135	152	161	168	153	92%
Nenana City			190	634	291	231	242	285	362	470	46%
Nenana Village				172	--	86	--	--	--	--	--
Nikolai							88	85	112	91	90%
Northway							196	196	40	112	91%
Nulato	118	291	230	258	204	113	176	283	308	350	94%
Rampart		211	119	121	103	106	94	49	36	50	94%
Ruby				128	132	138	132	157	145	197	92%
Shageluk				130	88	92	100	155	--	131	92%
Stevens Village			100	103	48	54	84	102	74	96	64%
Takotna					65	70	42	40	--	48	--
Tanacross				101	80	135	137	102	84	117	86%
Tanana City	120	186	298	213	185	170	228	349	120	388	79%
Tanana Village			114	99	96	75	--	--	--	--	--
Telida								14	--	33	97%
Tetlin						66	73	122	114	107	97%
Tok							104	129	214	589	--
Usibelli							28	30	102	53	--
Venetie						86	81	107	112	132	98%
Wiseman					58	53	--	--	--	--	--

Sources: Rollins 1978, USDC 1981, Tanana Chiefs Conference 1983.

--- means no data were available.

Table 3. Population Data for Fairbanks North Star Borough Communities 1960-80

	1960	1970	1980	1985*
Fairbanks North Star Borough	--	45,864	53,983	75,079
Big Horn	--	--	360	--
College	1,755	3,434	4,043	--
Eielson AFB	--	6,149	5,232	--
Ester	81	264	149	--
Fairbanks (city)	13,311	14,771	22,645	27,099
Fox	--	--	123	--
Harding Lake	--	--	38	--
Moose Creek	--	--	510	--
Murphy Dome	--	--	72	--
North Pole (city)	358	265	760	1,640
Salcha	--	--	319	--
Two Rivers	--	--	359	--

Source: USDC 1981, Fairbanks North Star Borough 1985b.

* 1985 data are listed by fire service district, with the exception of Fairbanks and North Pole.

--- means no data were available.

Table 4. Average Taxable Income for Interior Region Communities, 1978-82*

Community	Average Taxable Income (Dollars) 1978	1981	1982
Allakaket	$ 3,883	$ 6,626	$ 6,008
Anvik	5,488	7,703	8,490
Arctic Village	2,935	6,470	6,658
Beaver	4,225	6,753	7,856
Bettles/Evansville	12,958	17,103	17,742
Central	9,158	11,915	11,656
Chalkyitsic	7,562	4,655	7,253
Chicken	15,237	19,469	14,618
Circle	12,507	9,401	16,876
College	16,229	21,115	21,613
Delta Junction	16,880	19,911	20,673
Dot Lake	11,135	9,894	12,444
Eagle	5,327	7,988	10,576
Eielson AFB	9,612	11,743	12,801
Ester	17,174	22,487	22,698
Fairbanks	17,901	23,476	24,178
Fort Yukon	11,149	12,260	14,152
Fort Wainwright	8,402	10,676	12,262
Galena	14,643	18,533	21,467
Grayling	9,641	8,449	9,787
Healy	21,847	29,243	28,907
Holy Cross	8,432	9,655	10,853
Hughes	6,012	5,311	5,687
Huslia	10,221	6,199	7,356
Kaltag	8,154	7,306	8,070
Koyukuk	5,405	4,375	5,694
Lake Minchumina	---	13,075	13,528
Manley	8,389	14,270	14,076
McGrath	12,315	18,049	16,927
McKinley Park	10,975	16,408	16,538
Minto	6,562	6,566	7,415
Nenana	15,225	19,201	19,517
Nikolai	6,164	5,870	6,915
North Pole	17,026	21,560	22,197
Northway	10,791	10,549	13,304
Nulato	6,820	9,563	12,270
Rampart	6,007	10,816	7,620
Ruby	6,868	10,880	16,397
Shageluk	5,376	4,984	13,241
Stevens Village	4,938	5,736	6,555
Tanacross	4,335	6,519	6,898
Tanana	11,824	13,413	13,943
Tok	13,482	16,095	18,334
Usibelli	31,065	46,418	51,483
Venetie	4,700	4,568	5,387

Source: ADR 1985. --- means no data were available.

* Based on federal income tax returns sorted by mailing address.

Table 5. Moose Harvest Estimates for Selected Interior Region Locations

Community or Area	Estimated No. of Moose Harvested	Time Period	Source
Eagle, Eagle Village, and Yukon River residents between Eagle and Circle	26-32	1976	Caulfield 1977
Arctic Village, Beaver, Birch Creek, Chalkyitsik, Circle, Fort Yukon, Stevens Village, Venetie	300-500 200-250	1976 6/81-5/82	ISER 1978 Caulfield 1983a
Bettles-Evansville	10	1982	Marcotte/Haynes 1985
Allakaket-Alatna	28	1982	Marcotte/Haynes 1985
Hughes	33	1982	Marcotte/Haynes 1985
Huslia	84	1983	Marcotte, pers. comm.
McGrath	40-50 45-55 50-60 65-75	1979-80 1980-81 1981-82 1983-84	Stokes 1985 Stokes 1985 Stokes 1985 Stokes 1985
Takotna	15-20	Ann. avg.	Stokes 1985
Nikolai and Telida	50-70	Ann. avg.	Stokes 1985

Table 6. Minto Flats Management Area, Permit and Harvest Summary for Moose, 1979-85

Regulatory Year	Number Permits Allocated Fbks.	Minto	Nenana	Number Permits Issued Fbks.	Minto	Nenana	Reported Harvest Fbks.	Minto	Nenana	Non Res.	Unknown
1979-80	---	---	---	113	65[a]	10	4	2	0		
1980-81	25	50	25	25	28	25	2	0	0		3
1981-82	25	50	25	25	34	25	5	2	0		
1982-83	25	50	25	25	41	25	4	2	0	1	
1983-84	25	50	25	25	50	25	8	7	1		
1984-85 fall	10	30	10	10	29	10	4	6	1		
winter		50			30			1			

Source: Andrews and Napoleon 1985.

[a] 48 permittees listed Minto as their residence.

--- means no data were available.

Table 7. Moose Harvest Summary of the GMS 25D Permit Hunt, 1983-84 and 1984-85

Community	Number of Permits 1983-84	Reported Harvest* 1983-84	Number of Permits 1984-85	Total Harvest** 1984-85
Birch Creek	10	2	10	3
Beaver	25	7	25	12
Stevens Village	25	4	25	10
Totals	60	13	60	25

Source: Sumida and Alexander 1985.

* Based on returned permit reports only.

** Based on postseason interviews.

Table 8. Estimated Harvest of Porcupine Caribou by Residents of Upper Yukon Communities, July 1981 to June 1982

Community	Estimated Harvest of Porcupine Caribou
Arctic Village	300-400
Chalkyitsik	60-70
Eagle	200-300
Fort Yukon	15-20
Venetie	50-75

Source: Caulfield 1983a.

Table 9. Participation in Saml1 Game Hunting and Harvest Levels of Small Game Among Surveyed Households in Communities on the Upper Koyukuk River, 1982

	Bettles/Evansville			Allakaket/Alatna			Hughes		
Resource	% Hsld. Part.	Mean Hsld. Hvst.	Total Hvst.*	% Hsld. Part.	Mean Hsld. Hvst.	Total Hvst.*	% Hsld. Part.	Mean Hsld. Hvst.	Total Hvst.*
Hare	35	11.6	231	80	23.4	818	89	16.7	318
Ducks	15	1.8	36	80	24.5	858	79	26.6	505
Geese	10	.6	12	77	11.3	395	74	12.0	228
Grouse	10	.4	7	37	2.3	81	68	6.3	120
Ptarmigan	25	1.0	20	46	4.4	154	53	4.2	79

Source: Marcotte and Haynes 1985.

* Total harvest of surveyed households.

Table 10. Subsistence Harvests of Chinook Salmon by Interior Region Communities Located on the Yukon River and Yukon River Tributaries, 1977-84

	1977	1978	1979	1980	1981	1982	1983	1984
Yukon River								
Holy Cross	1,920	2,404	1,787	3,123	2,312	1,731	2,276	2,456
Anvik	67	180	261	161	191	354	744	576
Grayling	149	292	391	3,664	222	294	951	879
Kaltag	216	127	435	694	179	344	652	487
Nulato	1,531	1,354	1,245	2,297	1,117	811	1,135	966
Koyukuk	752	518	495	699	541	493	966	1,099
Galena	1,155	945	1,591	1,205	570	735	1,477	1,226
Ruby	735	1,539	2,221	1,736	964	1,168	2,346	1,107
Tanana	858	1,851	1,604	5,711	2,517	2,230	5,547	2,682
Rampart	1,194	987	1,820	1,169	488	887	1,070	876
Stevens Village	775	1,845	1,295	2,612	1,292	1,810	2,531	2,177
Fbks. Camp*	467	1,333	899	1,350	1,095	1,935	2,672	2,499
Beaver	299	558	394	506	552	250	220	553
Fort Yukon	1,061	2,642	1,922	2,527	2,794	1,894	1,887	3,608
Venetie	---	14	---	160	52	20	22	51
Circle	304	212	1,175	769	728	969	648	545
Eagle	1,171	963	2,888	2,880	3,782	2,864	2,183	1,998
Tanana River								
Manley	752	298	269	410	367	386	990	282
Minto	---	---	---	354	344	411	275	440
Nenana	742	807	800	771	974	1,195	966	2,556
Fairbanks	81	126	264	291	400	451	475	321
Koyukuk River								
Huslia	50	132	146	154	61	125	459	169
Hughes	72	216	180	226	402	479	318	856
Alatna	1	7	2	20	0	6	6	2
Allakaket	172	239	236	197	185	268	700	373

Source: ADF&G 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984b.
Note: See individual annual management reports for qualifications.

* Fairbanks fishers operating in the Yukon River bridge area.
--- Means no data were available.

Table 11. Subsistence Harvest of Summer Chum Salmon by Interior Region Communities Located on the Yukon River and Yukon River Tributaries 1977-84

	1977	1978	1979	1980	1981	1982	1983	1984
Yukon River								
Holy Cross	5,041	850	2,033	2,614	2,301	4,421	3,033	5,124
Anvik	23,394	15,883	12,714	28,051	26,588	27,087	20,592	22,433
Grayling	16,275	18,365	18,418	29,894	15,836	47,006	22,958	28,060
Kaltag	15,043	18,127	22,928	53,470	28,121	37,125	27,674	1,800
Nulato	9,444	8,589	6,054	29,657	7,534	19,740	11,130	232
Koyukuk	2,752	4,857	5,570	14,416	11,788	18,149	14,440	5,215
Galena	3,226	8,930	4,218	13,102	15,089	20,434	5,789	19,480
Ruby	2,204	11,568	8,305	15,084	5,542	7,539	8,804	4,282
Tanana	8,915	9,297	5,964	5,109	7,873	3,214	5,552	10,620
Rampart	6,327	1,135	15,300	109	1,946	0	3,698	7,650
Stevens Village	1,257	1,766	16	520	2,576	666	5,051	5,952
Fbks. Camp	1,568	6,055	1,202	1,227	4,501	2,056	2,194	4,065
Beaver	694	102	34	263	146	534	100	167
Fort Yukon	6,390	2,471	749	1,291	8,149	1,434	7,142	3,032
Venetie	0	0	0	0	0	0	0	0
Circle	1	39	433	48	2,009	0	73	0
Eagle	888	163	180	27	108	1,887	133	49
Tanana River								
Manley	3,615	3,601	1,939	564	2,972	971	7,245	1,260
Minto	---	---	---	450	367	808	7,414	5,042
Nenana	2,716	5,440	1,880	4,945	4,369	3,972	6,779	13,962
Fairbanks	118	2,729	2,384	3,749	3,239	2,708	2,276	3,177
Koyukuk River								
Huslia	2,949	8,556	19,805	15,063	12,550	6,809	18,588	12,550
Hughes	4,081	6,387	11,664	10,545	6,196	8,409	1,905	14,744
Alatna	210	672	58	300	293	410	325	205
Allakaket	3,540	8,125	7,421	9,134	7,534	7,277	3,840	3,964

Source: ADF&G 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984b.
Note: See individual annual management reports for qualifications.

* Fairbanks fishers operating in the Yukon River Bridge area.
--- means no data were available.

Table 12. Subsistence Harvests of Fall Chum and Coho Salmon by Communities Located on the Yukon River and Yukon River Tributaries, 1977-84

	1977	1978	1979	1980	1981	1982	1983	1984
Yukon River								
Holy Cross	363	89	1,441	2,159	2,452	1,548	2,467	1,373
Anvik	453	138	2,236	3,375	2,552	4,146	1,152	760
Grayling	827	459	2,212	2,414	1,062	3,986	5,122	2,047
Kaltag	1,545	1,164	8,496	3,869	2,431	874	2,833	1,330
Nulato	2,621	477	5,282	1,405	761	293	3,159	1,675
Koyukuk	1,194	411	4,563	3,029	842	1,542	1,160	1,760
Galena	2,301	3,015	2,597	3,597	3,475	2,511	5,018	7,722
Ruby	2,145	3,141	8,426	5,933	8,730	7,529	13,441	10,136
Tanana	10,875	13,386	33,254	33,152	32,193	34,730	43,942	59,588
Rampart	3,729	1,636	9,710	5,992	5,539	5,495	5,674	4,515
Stevens Village	1,102	4,959	4,125	3,414	8,451	7,415	3,502	5,077
Fbks. Camp*	999	3,680	7,070	6,524	7,533	9,292	12,943	13,174
Beaver	22	1,615	1,792	195	735	1,878	6,004	0
Fort Yukon	7,240	19,109	21,517	6,537	16,213	2,051	3,978	7,558
Venetie	1,660	2,606	3,943	2,730	6,400	850	7,800	4,345
Circle	202	820	3,108	1,737	5,219	290	3,687	3,107
Eagle	6,544	4,864	26,868	16,740	30,997	13,255	20,021	18,536
Tanana River								
Manley	12,576	11,893	20,274	9,107	13,142	5,281	12,750	3,762
Minto	---	---	---	9,680	3,449	5,068	6,489	4,825
Nenana	21,451	22,185	31,645	32,604	13,532	12,112	16,037	23,790
Fairbanks	607	1,188	4,459	4,100	5,770	4,521	3,830	5,134
Koyukuk River								
Huslia	804	100	1,950	1,737	265	119	4,003	6,318
Hughes	775	175	1,201	2,910	653	1,231	327	1,680
Alatna	0	9	46	70	11	28	111	35
Allakaket	146	1,708	1,084	3,070	1,430	1,012	1,829	556

Source: ADF&G 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984b.
Note: See individual annual management reports for qualifications.

* Fairbanks area fishers operating in the Yukon River Bridge area.
--- means no data were available.

Table 13. Subsistence Salmon Harvests by Residents of Upper Kuskokwim River Communities, 1979-84

	1979		1980		1981		1982		1983		1984	
	Chinook	Chum/ Coho	Chinook	Chum/ Coho	Chinook	Chum/ Coho	Chinook	Chum/ Coho	Chinook	Chum/ Coho	Chinook	Chum/ Coho
McGrath	581	5389	---	---	---	---	---	---	830	3200	730	2450
Takotna	65	---	---	---	---	---	---	---	--	---	---	---
Nikolai	60	2711	---	---	500	3750	778	5338	750	2900	795	5300
Telida	---	---	---	---	---	200	4	200	---	120	---	100

Sources: ADF&G 1984a, Stokes 1985.

--- means no data were available.

Table 14. Participation and Harvest of Nonsalmon Fish Resources by Surveyed Households of Upper Koyukuk River Communities in 1982

	Bettles/Evansville			Allakaket/Alatna			Hughes		
	% Hsld. Partic.	Mean Hsld. Hvst.	Total Harvest*	% Hsld. Partic.	Mean Hsld. Hvst.	Total Harvest*	% Hsld. Partic.	Mean Hsld. Hvst.	Total Harvest*
Burbot	0	0	0	9	1.7	58	11	3.2	60
Arctic grayling	70	24.6	491	54	46.8	1,639	84	72.4	1,376
Northern pike	15	0.7	13	40	11.5	401	53	11.1	211
Sheefish	20	10.6	212	69	70.0	2,451	79	16.8	320
Longnose sucker	0	0	0	37	13.7	480	32	2.6	49
Lake trout	15	3.1	61	0	0	0	0	0	0
Whitefish	10	10.5	210	71	138.8	4,858	74	112.4	2,135

Source: Marcotte and Haynes 1985.

* Total harvest for surveyed households.

Table 15. Harvest of Nonsalmon Fish Resources by Residents of Huslia, 1983

Resource	Total Number Harvested	Total Harvest (lb)	Per/Household Harvest (n=56) (lb)	Per/Capita Harvest (n=168) (lb)
Sheefish	873	6,111	109.1	32.3
Whitefish*	4,650	4,185	74.7	22.1
Northern pike	1,947	5,452	97.4	28.8
Arctic grayling	17	12	.2	.1
Longnose sucker	272	286	5.1	1.5
Burbot	205	492	8.8	2.6
Alaska blackfish	---	600	10.7	3.2

Source: Marcotte in preparation. --- means no data were available.

* Species not identified.

Table 16. Percent of Surveyed Households in Upper Tanana River Comunities who Participated in Fishing for Listed Species during a 12-month Period

	Tanacross N=15	Tetlin N=20	Northway N=15	Tok N=64
Time Period	9/83-8/84	6/83-5/84	6/83-5/84	10/83-9/84
Whitefish*	80%	85%	87%	20%
Arctic grayling	13	65	67	63
Burbot	7	70	67	29
Northern pike	47	85	80	33
Longnose sucker	33	40	40	3
Trout	0	0	7	19

Source: Haynes et al. 1984.

* Species not identified.

Table 17. Plant Resources Commonly Utilized by Interior Residents

Common Name	Scientific Name	Use
Wood:		
White spruce	Picea glauca	Firewood, logs, lumber, tent frames, fish wheels, fish racks
Birch	Betula papyrifera	Firewood, snowshoes, sleds, bark for baskets, sap for syrup
Poplar	Populus tremuloides	
Alder	Alnus crispa	Wood for smoking meat/fish
Diamond willow	Salix bebbiana	Crafts
Plants:		
Indian potato	Hedysarum alpinum	Eaten cooked or raw
Wild rhubarb	Polyganum alaskanum	Used in salads or cooked
Lambsquarter	Chenopodium album	Cooked like spinach
Strawberry spinach	Chenopodium capitatum	Cooked like spinach
Fireweed	Epilobium spp.	Used in salads and for medicinal purposes
Labrador tea	Ledum spp.	Tea
Chamomile	Tripleurospermum spp.	Tea
Birch fungus	Phellinus tremulae	Ashes mixed with snuff or tobacco
Mushrooms	Eight species	Fresh or cooked
Berries:		
Blueberry	Vaccinium uliginosum	
Lowbush cranberry	Vaccinium vitis idaea	Berries are eaten fresh, frozen whole, used in jellies, jams, pies, sauces, relishes, and syrups, or used in Indian icecream
Highbush cranberry	Viburnum edule	
Raspberry	Rubus idaeus	
Blackberry	Empetrum nigrum	
Bearberry	Arctostaphylos alpina	
Cloudberry	Rubus chamaemorus	
Rosehips	Rosa acicularis	

Sources: Caulfield 1983a, Martin 1983, Stokes 1985.

Table 18. Berry and Firewood Harvests for Surveyed Households in Upper Koyukuk River Communities, 1981

	% of Households Participating	Mean Household Harvest	Total Harvest*
Bettles/Evansville:			
Berries	80	4.7 gallons	92.4 gallons
Firewood	55	4.5 cords	89 cords
Allakaket/Alatna:			
Berries	77	7.2 gallons	251.5 gallons
Firewood	97	7.8 cords	274 cords
Hughes:			
Berries	84	6.1 gallons	115 gallons
Firewood	79	5.7 cords	107.5 cords

Source: Marcotte and Haynes 1985.

* Total harvest for surveyed households.

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Appendices

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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. <u>To provide for Subsistence Use of Wildlife by Alaskan Residents Dependent on Wildlife for Sustenance</u>.

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.