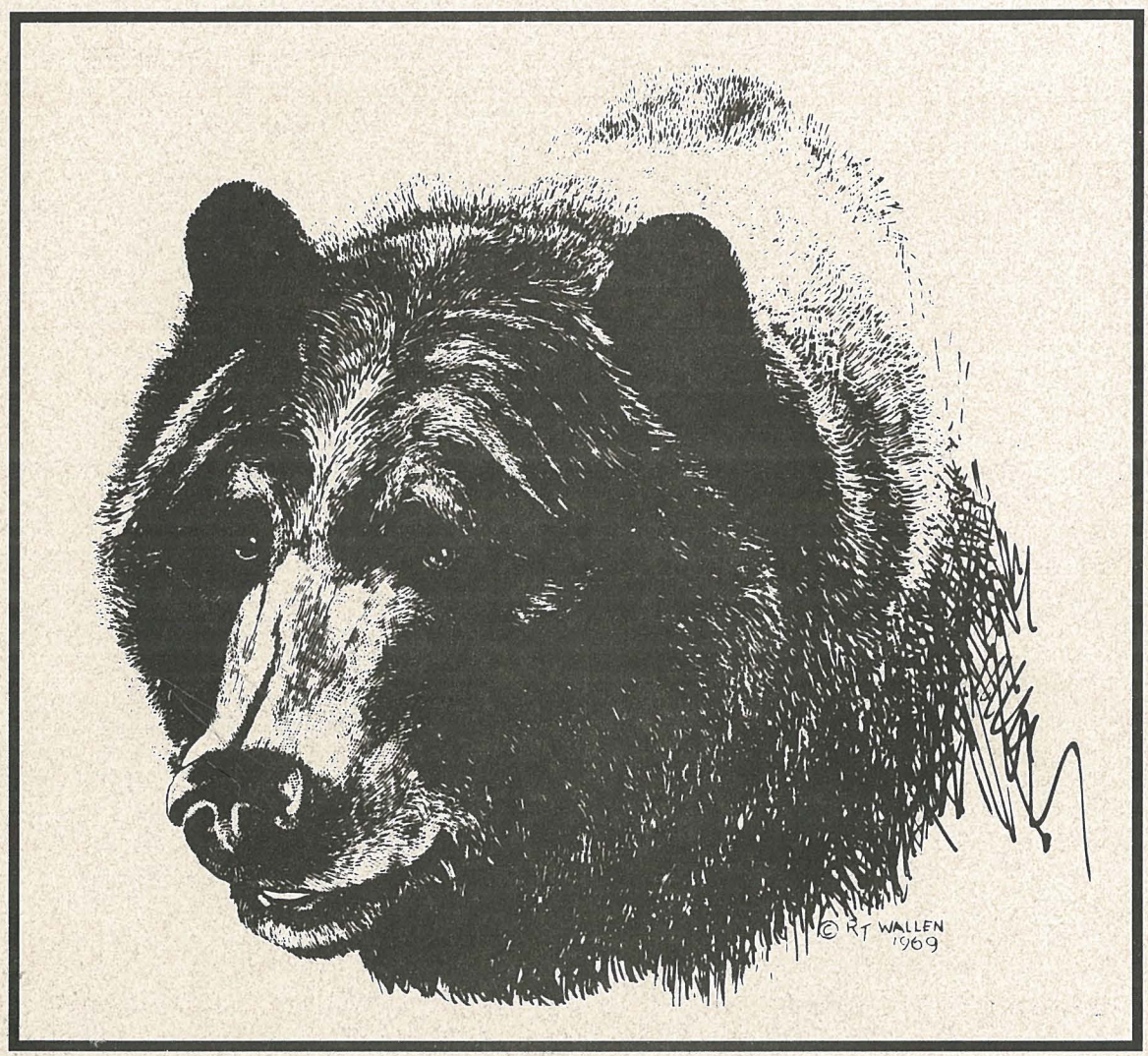
Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Management Report of
Survey-Inventory Activities
1 July 1990 - 30 June 1992

BROWN BEAR

Susan M. Abbott, Editor



Projects W-23-4 and W-23-5
Study 4.0
December 1993

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LOCATION

Game Management Unit: 1 (18,300 mi^2)

Geographical Description: Southeast Alaska mainland from Dixon Entrance to Cape Fairweather, and islands east of Clarence Strait from Dixon Entrance to Caamano Point, and all islands in Stephens Passage and Lynn Canal north of Taku Inlet.

BACKGROUND

Although brown bears occur throughout the islands and mainland of Southeast Alaska, they are only known to coexist with black bears on mainland portions of the panhandle. Extensive research of brown bear habitat use, movement patterns, and densities has been conducted on the islands in Unit 4; however, no research has been conducted on black or brown bears inhabiting Southeast Alaska's mainland. Anecdotal hunter information, occasional staff observations, and mandatory sealing data have provided most of the information used to assess and manage mainland brown bear populations.

Before the 1968-69 season, hunters were allowed to harvest one brown bear annually from any part of Alaska during 1 September - 10 June. Although the season remained unchanged during the 1968-69 season, the regulation changed so that hunters have since been restricted to one bear every four regulatory years. Beginning in 1969-70, the bear season was split into fall and spring segments; 1 September - 30 November, and 1 April - 10 June. Beginning with the 1971-72 season, a single, nine-month season was reinstated from 1 September - 10 June. In 1979-80 the season again changed, this time to 15 September - 31 May. The current season, which was first implemented in fall 1989, once again incorporates a fall and spring split from 15 September - 31 December, and 15 March - 31 May. Fall 1989 also marked the first season in which registration permits were required by Unit 1 brown bear hunters. Previously, hunters were only required to obtain a license and metal-locking tag before hunting. Brown bear sealing requirements have been in effect in Alaska since 1961.

MANAGEMENT DIRECTION

Management Objectives

Management objectives for Unit 1 brown bear are to: 1) maintain an average age of harvested males of no less than 6.5 years with a male:female harvest ratio of at least 3:2 and 2) reduce the number of bears killed because of garbage habituation.

METHODS

We collected brown bear harvest data through registration permit reports and a mandatory sealing program. We recored date and location of kill, sex, and skull measurements at the time of sealing. We sent premolar teeth extracted from skulls to the Anchorage Alaska Department of Fish and Game (ADF&G) office for age determination.

RESULTS AND DISCUSSION

Population Status, Trend, and Composition

Quantitative population data are not available for brown bears in Unit 1. However, based on anecdotal hunter reports, department staff observations, and sealing records, we believe the population remained stable during this report period.

Mortality

Harvest:

Season and Bag Limit:	Resident and nonresident hunters:
15 Sept. - 31 Dec. 15 Mar. - 31 May	One bear every four regulatory years by registration permit only.

Board of Game Actions and Emergency Orders: As reported previously (McCarthy 1991), the Alaska Board of Game implemented a registration permit requirement in 1989 for brown bear hunting in Unit 1. This was done to provide staff with timely harvest data which could be used to evaluate the need for early season closures. To date, no emergency closures have been necessary.

Hunter Harvest: Harvest from each of the Unit 1 subunits during 1990-92 was similar to that reported during the previous five seasons (Table 1). The unitwide harvest of 27 and 26 brown bears during 1990-91 and 1991-92, respectively, were the second and third highest reported during the past seven seasons. As in the past, Subunit 1D accounted for nearly half the bears harvested from the unit.

Four brown bears were killed in defense of life and property (DLP) during fall 1990, and two more were killed during fall 1991 (Table 2). All four of the 1990-91 and one of two 1991-92 DLPs were killed in Subunit 1D. The other 1991-92 DLP was killed on the Unuk River in Subunit 1A by a moose hunter who was reportedly charged without provocation by a young boar. The four DLP kills reported for Subunit 1D came from Klukwan in northern Southeast. Three of the four kills were made after fish scraps attracted bears to

human-inhabited areas. The fourth bear was found dead at the Klukwan garbage dump and no details about the incident were available.

We estimate unreported kills to be 10% of the reported harvest, although this is considered a conservative estimate (McCarthy 1991) (Table 2). We derived the total estimated harvests by adding the reported harvest, DLP kills, and estimated unreported/illegal kills. Estimates for the past two seasons are among the highest three in the past seven seasons.

Harvest of males has consistently been above our management objective of 60% (Table 2). During the past two seasons males constituted 64-79% of the annual harvest. Harvests are skewed towards males during spring seasons. As noted by McCarthy (1991), this may be partly because it is illegal to harvest females accompanied by cubs, and females with cubs tend to be more secretive than other bears. As sows with second year cubs separate at the end of spring season, they become legal to hunters. The proportion of females in the harvest is expected to increase during fall.

Mean skull sizes and ages of harvested males remained essentially unchanged during the past two seasons and are similar to what has been noted during the past 7 seasons (Table 3). Mean skull sizes of harvested females declined to a 7-season low in 1990-91 before returning to a level similar to the past 7-season mean. The average age of harvested females declined from 7.4 in 1989-90 to 5.2 in 1990-91, and subsequently increased to a 5-year high of 7.9 in 1991-92.

Permit Hunts: Registration permits were first implemented in Unit 1 during fall 1989 (Table 4). Although compliance with the registration permits was low during the first season, compliance in subsequent seasons has been excellent. The low compliance during the first season was due to hunter ignorance about the permits rather than intentional hunter disregard.

All 1990-91 permittees reported hunting. Of the 126 people who hunted, about 21% were successful (Table 4). In 1991-92, nearly half of the 324 people who obtained permits did not hunt. Of the 169 hunters, about 14% successfully harvested bears.

Hunter Residency and Success: During the past two seasons, Unit 1 residents have taken nearly two-thirds of the unit's brown bear harvest. This is an increase from the previous five seasons (Table 5). Nonresidents accounted for one-fourth of the unit's bear harvest during the past two seasons. This is higher than noted during 1985-88, but about the same as during 1988-90. Nonresident harvest is limited in part to numbers of available guides. It is uncertain what affect the state's newly-developed guide/outfitter regulations will have on nonresident brown bear harvest. Nonlocal Alaska residents harvested substantially fewer bears during the past two seasons than they did during the previous five seasons.

Harvest Chronology: During the past seven seasons, the annual harvest has split approximately 50:50 between fall and spring seasons (Table 6). During 1990-91, however, nearly two-thirds of the harvest occurred during fall.

Similar to black bear harvests, most brown bears harvested from Unit 1 were taken during May (Table 7). September has consistently been the month with the second highest annual harvest and has accounted for most of the fall-harvested bears. The 1990-91 harvest was evenly split between September, October, and May, however, the long-term trend was observed during the 1991-92 season.

Transport Methods: As in the past, most Unit 1 brown bear hunters accessed hunting areas using boats (Table 8). Only 8% of successful Unit 1 hunters used airplanes and off-road vehicles (ORV).

Habitat Assessment

Timber harvest and mineral exploration and development pose the most serious threats to brown bear habitat. Although this has been especially true in Subunits 1B and 1C, future timber harvest scheduled to occur on the Cleveland Peninsula in Subunit 1A will similarly impact brown bear habitat. Bear-human interactions and conflicts resulting from increased access and development activities continue as concerns. Bears killed in DLP incidents are an ever-present possibility where bears become attracted and accustomed to garbage dumps created by newly-established logging and mining camps.

CONCLUSIONS AND RECOMMENDATIONS

Despite a dismal compliance rate in its first year, the registration permit system subsequently provided complete and useful information about brown bear hunter effort and success in Unit 1. The 3:2 male-to-female harvest ratio was achieved during each of the past two seasons and six of the past seven seasons. Similarly, ages of harvested males have consistently averaged above the objective of 6.5 years.

Four DLP kills were reported during 1990-91. This is the highest number of DLP kills since 1985-86 when four were similarly reported. At least three of the kills were made after bears were attracted to fish scraps near Klukwan. The objective of reducing garbage-related DLPs was not met during this report period.

Based on harvest data, incidental observations, and reports by the public and our staff, we consider the Unit 1 brown bear population stable. We see no reason to modify seasons or bag limits at this time.

LITERATURE CITED

McCarthy, T.M. 1991. Brown bear survey-inventory management report. Pages 1-11 *in* S.M. Abbott, ed. Alaska Dep. Fish and Game, Div. Wildl. Cons. Fed. Aid in Wildl. Rest. Proj. W-23-3 and W-23-4, Study 4.0. Juneau. 271pp.

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Table 1. Unit 1 brown bear harvest by subunit[a], 1985-92.

	Subunit								
	1A		1B		1C		1D		
Year	Harvest	% of Total	Harvest	% of Total	Harvest	% of Total	Harvest	% of Total	Total Harvest
1985-86	1	(4)	7	(30)	6	(26)	9	(39)	23
1986-87	2	(13)	2	(13)	5	(33)	6	(40)	15
1987-88	8	(24)	4	(12)	3	(9)	18	(55)	33
1988-89	4	(25)	2	(12)	3	(19)	7	(44)	16
1989-90	4	(20)	4	(20)	1	(5)	11	(55)	20
1990-91	5	(19)	5	(18)	4	(15)	13	(48)	27
1991-92	4	(15)	6	(24)	4	(15)	12	(46)	26
Totals	28	(18)	30	(19)	26	(16)	76	(47)	160

[a] Does not include bears killed in defense of life or property, research mortalities, or other human-caused accidental mortalities.

Table 2. Unit 1 brown bear harvest, 1985-1992.

Regulatory Year	Reported							Estimated kill				
	Hunter kill				Non-hunting kill[a]			Unreported Illegal[b]	Total estimated kill			
	M (%)	F (%)	Unk.	Total	M	F	Unk.		M (%)	F (%)	Unk.	Total
Fall 1985	(30)	(70)	1	11	3	0	0	1	(46)	(54)	2	15
Spring 1986	(82)	(18)	1	12	1	0	0	1	(83)	(17)	2	14
Total	(57)	(43)	2	23	4	0	0	2	(64)	(36)	4	29
Fall 1986	(40)	(60)	0	10	0	0	0	1	(40)	(60)	1	11
Spring 1987	(80)	(20)	0	5	0	0	0	1	(80)	(20)	1	6
Total	(53)	(47)	0	15	0	0	0	2	(53)	(47)	2	17
Fall 1987	(73)	(27)	2	17	0	0	0	2	(73)	(27)	4	19
Spring 1988	(53)	(47)	1	16	1	0	0	1	(56)	(44)	2	18
Total	(63)	(37)	3	33	1	0	0	3	(67)	(33)	6	37
Fall 1988	(60)	(40)	0	5	1	1	0	1	(67)	(33)	1	8
Spring 1989	(82)	(18)	0	11	0	0	0	1	(82)	(18)	1	12
Total	(75)	(25)	0	16	1	1	0	2	(72)	(28)	2	20

Table 2 (Continued)

Regulatory Year	Reported: Hunter kill M (%)	F (%)	Unk.	Total	Reported: Non-hunting kill[a] M	F	Unk.	Estimated kill: Unreported Illegal[b]	Total estimated kill M (%)	F (%)	Unk.	Total
Fall 1989[c]	(67)	(33)	1	10	0	0	0	1	(67)	(33)	2	11
Spring 1990	(80)	(20)	0	10	0	1	0	1	(73)	(27)	1	12
Total	(74)	(26)	1	20	0	1	0	2	(70)	(30)	3	23
Fall 1990	(72)	(28)	0	18	1	1	2	2	(75)	(25)	2	24
Spring 1991	(100)	(0)	0	9	0	0	0	1	(100)	(0)	1	10
Total	(81)	(19)	0	27	1	1	2	3	(79)	(21)	3	34
Fall 1991	(50)	(50)	0	12	1	1	0	1	(50)	(50)	0	15
Spring 1992	(78)	(22)	0	14	0	0	0	1	(78)	(22)	0	15
Total	(65)	(35)	0	26	1	1	0	2	(64)	(36)	0	30

[a] Includes DLP kills, research mortalities, and other known human-caused accidental mortalities.
[b] Estimated to be 10% of reported kill (McCarthy 1991).
[c] First season registration permits required for hunting brown bear.

Table 3. Age and skull sizes of brown bears harvested in Unit 1, 1985-1992.

	Mean Skull Size[a]				Mean Age[b]			
	Male	n	Female	n	Male	n	Female	n
1985-86	22.3	12	20.5	8	9.1	11	6.5	8
1986-87	23.2	7	20.7	7	9.4	7	10.2	7
1987-88	21.4	18	20.6	11	5.5	17	7.7	7
1988-89	22.7	12	19.4	4	8.4	11	5.2	3
1989-90	21.2	14	20.6	5	6.7	13	7.4	5
1990-91	21.5	22	18.7	5	7.9	20	5.2	5
1991-92	21.6	13	20.4	8	7.4	14	7.9	6

[a] Skull sizes equal length plus zygomatic width.
[b] Determined through analyses of extracted premolar teeth.

Table 4. Unit 1 brown bear registration permit data, 1989-92.

Season/ Hunt No.	Year	Permits issued	Percent did not hunt	Percent Unsuccessful Hunters	Percent successful hunters	Bear Harvest			
						Males (%)	Females (%)	Unk.	Total
(Fall)									
278F	1989[a]	44	(0)	(95.5)	(4.5)	(50)	(50)	0	2
278F	1990	67	(0)	(73.1)	(26.9)	(72)	(28)	0	18
272F	1991	182	(46.7)	(47.8)	(5.5)	(50)	(50)	0	12
272F	1992	149	(45.6)	(37.6)	(16.8)	(56)	(44)	0	25
(Spring)									
278S	1990	60	(0)	(88.3)	(11.7)	(71)	(29)	0	7
278S	1991	59	(0)	(86.4)	(13.6)	(100)	(0)	0	9
272S	1992[b]	142	(49.3)	(40.8)	(9.9)	(79)	(21)	0	14
Totals	1989-90	104	(0)	(91.4)	(8.6)	(67)	(33)	0	9[c]
	1990-91	126	(0)	(79.4)	(20.6)	(81)	(19)	0	27
	1991-92	324	(47.8)	(44.8)	(7.4)	(65)	(35)	0	26

[a] First season permits required for hunting brown bear.
[b] One hunter did not return permit.
[c] Only 45% of the successful hunters obtained registration permits.

Table 5. Residency of successful brown bear hunters, Unit 1, 1985-1992.

Regulatory Year	Local resident[a] (%)	Nonlocal resident (%)	Nonresident (%)	Unknown	Total successful hunters
1985-86	(61)	(26)	(13)	0	23
1986-87	(60)	(27)	(13)	0	15
1987-88	(58)	(27)	(12)	3	33
1988-89	(56)	(19)	(25)	0	16
1989-90[b]	(45)	(25)	(30)	0	20
1990-91	(63)	(7)	(26)	1	27
1991-92	(65)	(4)	(23)	2	26

[a] Local residents are those hunters who reside in Unit 1.
[b] Before 1989-90, all harvest data was obtained solely from sealing records.

Table 6. Seasonal chronology of brown bear harvest, Unit 1, 1985-1992.

Year	Fall		Spring	
	Harvest	Percent of Total	Harvest	Percent of Total
1985-86	12	(52)	11	(48)
1986-87	5	(33)	10	(67)
1987-88	16	(48)	17	(52)
1988-89	11	(69)	5	(31)
1989-90	10	(50)	10	(50)
1990-91	18	(67)	9	(33)
1991-92	12	(46)	14	(54)
Totals	84	(53)	76	(47)

Table 7. Monthly Unit 1 brown bear harvest chronology, 1985-1992.

Regulatory Year	Harvest Periods							n
	September	October	November	March	April	May	June	
1985-86	6	4	1	0	0	12	0	23
1986-87	6	2	2	0	1	4	0	15
1987-88	9	4	4	0	0	15	1	33
1988-89	2	2	1	0	0	10	1	16
1989-90	2	7	1	0	0	10	0	20
1990-91	9	8	1	0	1	8	0	27
1991-92	8	2	2	1	0	13	0	26
Totals	42	29	12	1	2	72	2	160

Table 8. Successful brown bear hunter transport methods, Unit 1, 1985-1992.

Regulatory Year	Percent of harvest						n
	Airplane	Boat	Walk	ORV	Highway vehicle	Other/ unknown	
1985-86	(4)	(61)	(4)	(9)	(13)	(9)	23
1986-87	(7)	(53)	(0)	(13)	(27)	(0)	15
1987-88	(12)	(52)	(9)	(12)	(6)	(9)	33
1988-89	(6)	(63)	(6)	(6)	(13)	(6)	16
1989-90	(10)	(70)	(5)	(5)	(5)	(5)	20
1990-91	(15)	(52)	(7)	(15)	(4)	(7)	27
1991-92	(8)	(62)	(0)	(8)	(3)	(19)	26

LOCATION

Game Management Unit: 4 (5,820 mi^2)

Geographical Description: Admiralty, Baranof, Chichagof, and adjacent islands

BACKGROUND

Brown bears are common on the five largest islands in Unit 4: Admiralty, Baranof, Chichagof, Kruzof, Yakobi, and Catherine. They are frequently found on smaller islands. Most of Admiralty Island was designated a National Monument in the Alaska National Interest Lands Conservation Act (ANILCA), partly because of public interest in Admiralty Island's brown bear population.

Registration permits were first required for hunting brown bears in the Northeast Chichagof Controlled Use Area (NECCUA) beginning in spring 1988. We initiated the unitwide permit requirement in fall 1989 in response to court-mandated guide deregulation. It was feared elimination of exclusive guiding areas would result in excessive bear harvest.

Brown bear viewing is also important in Southeast Alaska. Four areas in Unit 4 are closed to bear hunting to provide viewing opportunities. These include: Seymour Canal Closed Area on eastern Admiralty Island, which encompasses the Stan Price Wildlife Sanctuary; Salt Lake and Mitchell Bay Closed Areas on southwest Admiralty Island; and Port Althorp Closed Area on northwest Chichagof Island.

Federal assumption of subsistence management under the terms of ANILCA included authority to manage brown bears on federal lands in Unit 4. Dual management will create a difference in regulations on state-controlled and federal lands when the U.S. Fish and Wildlife Service (USFWS) and the U.S. Forest Service (USFS) promulgate regulations.

MANAGEMENT DIRECTION

Management Objectives

Management objectives for Unit 4 brown bears are to: 1) maintain the average age of harvested males at no less than 6.5 years, 2) maintain the male/female harvest ratio at no less than 3:2, and 3) reduce the loss of bears killed in DLP incidents.

METHODS

Registration permits were issued at ADF&G offices for Unit 4 brown bear seasons. Hunters presented the head and hide of their brown bear to a representative of the Division of Wildlife Conservation (DWC) for sealing. Fish and Wildlife Protection (FWP) troopers, biologists, and DWC staff throughout the state sealed bears taken in Unit 4. Sealers measured the skull, extracted a premolar, determined sex (evidence of sex was required to be left on the hide), and noted pertinent data. Cementum annuli of teeth were counted at a commercial laboratory.

Project personnel attempted to reduce DLP incidents through education and cooperation with community authorities and other agencies.

Project personnel entered bear permit and harvest information into a computer data storage and retrieval program. Information included personal data on the hunter, hunt location, days hunted, date of kill, transport means, bear sex, and skull length and width. Staff called delinquent permittees and sent reminder letters and certified letters to improve reporting compliance.

Division staff contacted visitors at Stan Price Wildlife Sanctuary (Pack Creek) from late June through August to discuss bear behavior and management, promote public safety, prevent DLP loss of habituated bears, and explain Pack Creek Cooperative Management Area regulations.

Bear management areas were delineated to provide a reference for management and estimate minimum and maximum brown bear numbers (Figure 1).

RESULTS AND DISCUSSION

Population Status and Trend

Brown bear populations in most of Unit 4 are considered stable (Young 1990). Analysis of harvest data in newly delineated Brown Bear Management Areas (BBMAs) indicates potential for overharvest. Bear numbers in the controlled use area on Chichagof Island merit special attention. Road building increases human access to salmon streams, bays, and estuaries resulting in high bear harvest (Young 1989, 1990; Titus and Beier 1992).

Population Size: In 1932 a population of 900 bears (0.6 bears/mi^2) was estimated on Admiralty Island using track counts (Dufresne and Williams 1932). Holbrook (1938, 1939) did track counts and estimated 940 bears (0.5 bears/mi^2) on Chichagof Island and 445 bears (0.3 bears/mi^2) on Baranof Island.

Schoen and Beier (1990) used aerial surveys of marked bears to estimate 1.0 bear/mi^2 in their study area on Admiralty Island. Titus and Beier (1992) proposed 250 bears as a preliminary estimate in the 400 mi^2 NECCUA study area on Chichagof Island; but after using mark-recapture techniques, Titus (pers. comm.) estimated about 350 bears in the study area.

Bear densities were estimated for BBMAs by area staff's personal knowledge of the area, the input of researchers (L. Beier and K. Titus, pers. comm.), and a habitat suitability model (Schoen *et al.* 1993). We used the lowest of three figures as a minimum estimate and the highest as a maximum estimate to provide a population range. We believe these estimates are as close as possible for areas where censuses have not been conducted.

Following are my estimates for BBMAs in Unit 4 in 1991-92: Admiralty Island, 1,250-1,980 bears; Baranof Island (including Catherine Island), 660-1,180 bears; Chichagof Island (including Yakobi Island), 1,250-1,800 bears; and Kruzof Island, 80-130 bears. The total estimate for Unit 4 ranged from 3,240 to 5,080 bears. The secretive nature of brown bears, dense vegetation, paucity of census data, and lack of validation of the habitat model all make population estimates difficult.

Population Composition: Hunters and guides were encouraged to take male bears, but many other factors combined to bias reporting in favor of males: 1) regulations protect sows accompanied by cubs; 2) most hunters prefer large bears; 3) males are more common on beaches in early spring; and 4) sealers fail to correctly identify the sex of harvested bears. Hunters tend to tell sealers that bears are male and may be taken at their word; evidence of sex is now required and will improve accuracy of identification.

In Unit 4 the 1990-91 legal harvest was 75% males (n=98), 25% females (n=33) and one bear of unknown sex. The 1991-92 legal harvest was 66% males (n=82), 34% females (n=42) and one of unknown sex (Table 1).

The mean age of sport-killed females was 7.7 years (n=32) in 1990-91; males averaged 9.6 years (n=95). The mean age of sport-killed females was 7.1 years (n=37) in 1991-92 and males averaged 8.9 years (n=77).

Mortality

Harvest:

Season and Bag Limit:	Resident and Nonresident Hunters:
Chichagof Island south and west of a line which follows the crest of the island from Rock Point (58° N. lat., 136°	15 Sept. - 31 Dec. 15 Mar. - 31 May

21' W. long.) to Rodgers Point (57° 35' N. lat., 135° 33' W. long.), including Yakobi and other adjacent islands; Baranof Island south and west of a line which follows the crest of the island from Nismeni Point (57° 34' N. lat., 135° 25' W. long.), to the entrance of Gut Bay (56° 44' N. lat., 134° 38' W. long.), including the drainages into Gut Bay and including Kruzof and other adjacent islands One bear every four regulatory years by registration permit only.	
That portion in the Northeast Chichagof Controlled Use Area One bear every four regulatory years by registration permit only.	15 Mar. - 20 May
Remainder of Unit 4 One bear every four regulatory years by registration permit only.	15 Sept. - 31 Dec. 15 Mar. - 20 May

Human-induced Mortality: During fall 1990, hunters killed 33 brown bears in Unit 4; they took 99 bears in spring 1991 for a total 1990-91 take of 132 compared with 123 killed in 1989-90. During fall 1991, hunters took 42 bears in Unit 4 and they killed 83 in spring 1992 for a total 1991-92 take of 125.

The total take by island in 1990-91 was: 2 (2%) from Kruzof, 48 (36%) from Admiralty, 21 (16%) from Baranof, and 61 (46%) from Chichagof. During 1991-92 the take by island was: 1 (1%) from Kruzof, 49 (39%) from Admiralty, 32 (26%) from Baranof, and 43 (34%) from Chichagof.

During 1990-91, Admiralty Island (1,660 mi^2) had a harvest rate of 1 bear/35 mi^2, while on Chichagof Island (2,100 mi^2) the average kill was 1 bear/34 mi^2. Baranof Island (1,600 mi^2) had a kill of 1 bear/76 mi^2. During 1991-92, Admiralty Island hunters took 1 bear/34 mi^2, while on Chichagof Island the average kill was 1 bear/49 mi^2 and Baranof Island hunters killed 1 bear/50 mi^2.

The average male skull measurement for Unit 4 was 22.7 inches for males (n=96) in 1990-91 compared with 22.5 inches (n=80) for the 1991-92 harvest. Skulls are measured because decreasing male skull sizes may indicate effects of selective harvest of large bears. Miller and Miller (1990) cautioned that age and sex data derived from harvest is difficult to interpret, but stated that these data can sometimes indicate trends.

Board of Game Actions and Emergency Orders: The Mitchell Bay Closed Area on southwest Admiralty Island was created by board action in 1991 (ADF&G 1992).

An area west of Port Frederick on Chichagof Island was included in the federal controlled use area by the Federal Subsistence Board in 1992. This area had been subject to harvest that appeared to exceed the desired average kill and merited additional protection.

Hunter Residency and Success: Unit 4 includes three permit areas: Areas 278 (inside drainages), 279 (outside drainages), and 277 (Northeast Chichagof Controlled Use Area). In 1990-91, 35 permit holders hunted and 14 (40%) were successful in Hunt Area 277, where there was only a spring season. Sixty eight permit holders hunted in Permit Area 278 and 27 (40%) were successful. In Area 279, 291 permit holders hunted, and 91 (31%) were successful (Table 2).

During 1991-92, in Hunt Area 277, 35 hunted and 6 (17%) were successful. In Area 278 in 1991-92, 83 permit holders hunted, and 21 (25%) were successful. In 1991-92, 266 permit holders hunted in Permit Area 279 and 97 (37%) were successful (Table 2).

During fall 1990, 86 residents hunted 391 days, while 44 nonresidents hunted 247 days. During spring 1991, 154 residents hunted a total of 752 days and 83 nonresidents hunted 387 days. During fall 1991, 90 residents hunted 376 days and 44 nonresidents reported hunting 376 days. In spring 1992, 149 residents hunted 652 days and 101 nonresidents hunted 588 days (Table 6).

Harvest Chronology: The major harvest occurs shortly after bears leave their dens in spring and travel to beaches to feed on grasses and sedges. During 1990-91 hunters took 99 bears in spring and 33 during fall season. The period 11-20 May experienced the highest harvest during which 44% (n=58) of the annual kill occurred. During 1991-92 hunters killed 83 bears in spring and 42 in the fall season. The 10-day period 11-20 May again experienced the highest harvest in which 34% (n=43) of the annual kill took place.

The Unit 4 harvest chronology has been fairly consistent for the past 5 years (Table 4). Johnson (1980) stated that the optimum hunting period was 20 May through 10 June, which coincided with high availability and prime fur condition. That period is currently closed to hunting in the eastern two-thirds of the unit.

The relative number of females killed during fall and spring seasons differed considerably each year. The percentage of females in fall 1990 was 39% and 20% in spring 1991. In fall 1991, 63% were females as compared to 19% in spring 1992.

Transport: During 1990-91 motor vehicle users took no bears; but in 1991-92, hunters using motor vehicles killed three bears (Table 2). Aircraft were used in the taking of 18 bears in 1990-91 as compared to 11 bears in 1991-92. During 1990-91, boats were used by 111 (84%) of the successful brown bear hunters in Unit 4. In 1991-92, boats were used by 109 (87%) of the successful Unit 4 brown bear hunters (Table 2).

Restrictions in NECCUA: Restrictive regulations include a prohibition on hunting bears with the use of motorized land vehicles and elimination of the fall hunting season (Young 1990, ADF&G 1992).

Other Mortality: We attempted to reduce DLP incidents by educating the public and cooperating with other agencies. Village police stations and public safety offices in Unit 4 were written regarding bear habituation problems and how to deal with them. We met with representatives of the Alaska Department of Environmental Conservation (DEC), city officials in Angoon, and USFS personnel to discuss landfills attracting bears. We provided literature and advice on bear aversion to Port Armstrong fish hatchery workers and USFS archaeologists and fisheries biologists. We talked on bear safety to college students and summer workers. We distributed a leaflet on avoiding bear problems. Brown bear research staff gave talks on bear safety to Green's Creek Mine personnel on Admiralty Island.

Despite our efforts, 10 bears were killed in DLP incidents during 1991-92 and 7 bears were killed in DLP incidents in 1990-91 (Table 1). Highly publicized bear attacks in other parts of the state may have been partly responsible for DLP kills. The number of calls about bear problems increase after a publicized bear attack.

Distribution and Movements: Researchers are monitoring radio-collared bears within the NECCUA to determine movements. The relationship of the Hoonah landfill to bear movement is being investigated and will be detailed in future reports.

Schoen and Beier (1983) found that on Admiralty Island telemetered males (n=6) had home range sizes of 115 km^2 (SD=75 km^2), while females had mean home range sizes of 24 km^2 (SD=16 km^2). In an earlier study, Wood (1976) found little movement of brown bears from Hood Bay on Admiralty Island. Eight of 10 tagged bears were taken by hunters in the same drainage where tagged.

CONCLUSIONS AND RECOMMENDATIONS

Management objectives for age structure were met both regulatory years. The average age of harvested males in fall 1991 was 6.4 years, which failed to meet the 6.5-year minimum objective. This was because of a higher percentage of females and small males being killed in fall. Average skull sizes were smaller during fall hunting seasons.

The objective for sex ratios was met during both regulatory years, but the number of males per female was lower in fall. The male/female harvest ratio was 1.2:2 in fall 1991, which was well below the annual objective of 3:2. The ratio was 3:2 in fall 1990, and in spring 1991 and spring 1992 the ratio was an 8:2 male to female ratio.

The third objective was to reduce the loss of bears due to garbage habituation. Highly publicized bear attacks during the report period may have decreased human tolerance for bear encounters. The division should continue to work with USFS and DEC to address landfill attraction problems in logging camps and communities. The division should also cooperate with Habitat Division to use permit review authority to bring camps and communities into compliance with the interagency joint policy statement (Young 1989).

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Figure 1. Map of Unit 4 brown bear management areas.

Table 1. Unit 4 brown bear harvest, 1987-1992.

Regulatory Year	Reported: Hunter kill M	F	(%F)	Unk.	Total	Non-hunting kill[a] M	F	Unk.	Total	Total reported
1987										
Fall 87	22	16	42	1						
Spring 88	58	8	12	6						
Total	80	24	23	7	111	3	3	3	9	120
1988										
Fall 88	25	18	42	2						
Spring 89	40	17	30	1						
Total	65	35	35	3	103	7	6	0	13	116
1989[b]										
Fall 89	18	12	40	1						
Spring 90	73	17	19	0						
Total	91	29	24	1	121	1	3	0	4	125
1990										
Fall 90	20	13	39	0						
Spring 91	78	20	20	1						
Total	98	33	25	1	132	3	1	2	6	138
1991										
Fall 91	15	25	63	1						
Spring 92	67	16	19	0						
Total	82	41	33	1	124	6	5	0	11	135

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

[b] Permit hunt harvest is included.

Table 2. Unit 4 brown bear harvest data by permit hunt, 1987/88-1991/92.

Hunt No. /Season	Regulatory year	Permits issued[a]	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	M (%)[b]	F (%)[b]	Unk.	(%)[c]	Total harvest
NECCUA										
F/S	1987/88					6 (54)	5 (46)	2	(15)	13
F	1988/89					4 (57)	2 (29)	1	(14)	7
S	1988/89	38	18 (47)	18 (90)	2 (10)	2(100)	0 (0)	0	(0)	2
S	1989/90	66	44 (67)	19 (91)	2 (9)	1 (50)	1 (50)	0	(0)	2
S	1990/91	72	37 (51)	21 (60)	14 (40)	12 (86)	2 (14)	0	(0)	14
S	1991/92	92	57 (62)	29 (83)	6 (17)	3 (50)	3 (50)	0	(0)	6
Outside Drainages										
F/S	1987/88					8 (44)	10 (56)	0	(0)	18
F/S	1988/89					10 (59)	7 (41)	1	(6)	18
F	1989/90	164		16 (70)	7 (30)	6 (86)	1 (14)	0	(0)	7
S	1989/90	105		31 (80)	8 (20)	7 (88)	1 (12)	0	(0)	8
F	1990/91	221		29 (83)	6 (17)	3 (50)	3 (50)	0	(0)	6
S	1990/91	353		12 (38)	20 (62)	15 (75)	5 (25)	0	(0)	20
F	1991/92	268		28 (78)	8 (22)	2 (25)	6 (75)	0	(0)	8
S	1991/92	284		34 (72)	13 (28)	9 (69)	4 (31)	0	(0)	13
Inside Drainages										
F/S	1987/88					66 (88)	9 (12)	5	(6)	80
F/S	1988/89					49 (65)	26 (35)	1	(1)	76
F	1989/90	181		48 (68)	23 (32)	12 (52)	11 (48)	1	(1)	24
S	1989/90	241		95 (54)	80 (46)	65 (81)	15 (19)	0	(0)	80
F	1990/91	279		68 (72)	27 (28)	17 (63)	10 (37)	0	(0)	27
S	1990/91	353		105 (62)	65 (38)	51 (80)	13 (20)	1	(2)	65
F	1991/92	268		65 (66)	33 (34)	13 (41)	19 (59)	1	(<1)	33
S	1991/92	284		104 (62)	64 (38)	55 (86)	9 (14)	0	(0)	64

[a] Number of permits issued from 1990/91 to present are identical for 278 and 279 because a single permit was valid for both areas.

[b] Percentages based on known-sex bears.

[c] Percentages based on total bears.

Table 3. Unit 4 brown bear successful hunter residency, 1987-1992.

Regulatory year	Local[a] resident (%)	Nonlocal resident (%)	Nonresident (%)	Total successful hunters
1987/88	15 (14)	49 (44)	47 (42)	111
1988/89	17 (16)	38 (37)	48 (47)	103
1989/90	15 (12)	40 (33)	66 (55)	121
1990/91	17 (13)	41 (31)	74 (56)	132
1991/92	22 (18)	31 (25)	71 (57)	124

[a] Resident of Unit 4.

Table 4. Unit 4 brown bear harvest chronology by time period, 1987/88-1991/92[a].

Regulatory year	Harvest period: September 9/11-9/20	September 9/21-9/30	October 10/1-10/10	October 10/11-10/20	October 10/21-10/31	November 11/1-11/10	November 11/11-11/20	November 11/21-11/31	December 12/1-12/10	December 12/11-12/20	December 12/21-12/31
1987/88	8	12	5	6	5	3	0	0	0	0	0
1988/89	19	14	5	0	5	1	0	0	0	0	1
1989/90	14	7	7	1	2	0	0	0	0	0	0
1990/91	18	5	5	3	0	2	0	0	0	0	0
1991/92	13	14	6	1	3	1	1	1	1	0	0

Regulatory year	Harvest period: April 4/1-4/10	April 4/11-4/20	April 4/21-4/30	May 5/1-5/10	May 5/11-5/20	May 5/21-5/31	n
1987/88	0	0	0	20	45	7	111
1988/89	0	0	2	11	37	8	103
1989/90	1	0	3	26	55	5	121
1990/91	1	1	6	22	58	11	132
1991/92	0	0	6	26	43	8	124

[a] Includes all hunts.

Table 5. Unit 4 brown bear harvest by transport method, 1987-1992.

Regulatory year	Harvest									
	Airplane	Logging road; vehicle	Boat	3- or 4-wheeler	Walked	ORV	Highway vehicle	Unknown	Logging road; walking	Access unknown
1987/88	15	6	85						1	4
1988/89	5	5	86							7
1989/90[a]	15		106							
1990/91[b]	17		111		2		2			
1991/92[b]	11		108			1	2	2		

[a] Permit hunt included.

[b] Registration permit data and sealing certificate data often differ. Registration permit data used.

Table 6. Hunting effort by residency in Unit 4, fall 1990-spring 1992.

Hunt	Season	No. resident hunters	No. nonresident hunters	Total hunters	Days hunted by residents	Days hunted by nonresidents	No. days hunted	No. bears killed	Days effort per deer
277 (NECCUA)									
	Fall 1990	--	--	--	--	--	--	--	--
	Spring 1991	19	16	35	69	72	141	14	10
	Fall 1991	--	--	--	--	--	--	--	--
	Spring 1992	21	14	35	77	95	172	6	29
278 (outside drainages)									
	Fall 1990	32	4	36	99	19	118	7	17
	Spring 1991	19	13	32	63	59	122	20	6
	Fall 1991	33	3	36	103	18	121	8	15
	Spring 1992	23	24	47	62	140	202	13	16
279 (inside drainages)									
	Fall 1990	54	40	94	292	228	520	27	19
	Spring 1991	116	54	170	620	256	876	65	14
	Fall 1991	57	41	98	273	262	535	33	16
	Spring 1992	105	63	168	513	353	866	64	14
Unit 4 Totals	Fall 1990	86	44	130	391	247	638	34	19
	Spring 1991	154	83	237	752	387	1,139	99	12
	Fall 1991	90	44	134	376	280	656	41	16
	Spring 1992	149	101	250	652	588	1,240	83	15

LOCATION

Game Management Unit: 5 (6,200 mi^2)

Geographical Description: Cape Fairweather to Icy Bay, eastern Gulf of Alaska Coast

BACKGROUND

Brown bears probably first occurred on the Yakutat and Malaspina Forelands following the retreat of ice some 300 to 500 years ago. Like many other wildlife species, brown bears accessed the eastern Gulf of Alaska coast by moving from interior Alaska/Canada via the Alsek/Tatsenshini corridor.

Since 1961, when brown bears were first sealed in Alaska, 676 sport-killed bears have been sealed from Unit 5 (583 from Subunit 5A and 93 from Subunit 5B). Sixty-four percent of these bears were males, and 60% were taken by nonresident hunters. An additional 55 nonsport bears were taken in this same period.

A 1988 Superior Court decision which deregulated the guide industry has encouraged an increase in guide activity in some units. From 1980 through 1988, an annual average of 20 guided nonresident brown bear hunters hunted in Unit 5. Since 1988 the average number of guided nonresidents has climbed to 28.

MANAGEMENT DIRECTION

Management Objectives

Brown bear population objectives identified by staff include the maintenance of a male:female harvest ratio of no less than 3:2 and an average age of harvested males of no less than 6.5 years. We intend to establish long-term objectives in a regional strategic brown bear management plan.

METHODS

Department and Fish and Game and Division of Fish and Wildlife Protection staff gathered most data from sealing brown bear hides. State hunting regulations require that brown bears must be sealed within 30 days of harvest. Staff members measure the skull, extract a rudimentary pre-molar tooth for age determination, and determine the bear's sex. We obtain additional information from hunters such as location of harvest, transportation

method, number of days hunted, guide information, etc. Other information collected includes incidental observations of bear dens noted during aerial surveys for mountain goats and anecdotal information from hunters.

RESULTS AND DISCUSSION

Population Status and Trend

Population information is not available for brown bears in Unit 5. Data gathered from sealing certificates, incidental observations, and hunter interviews suggest that the population is probably stable. However, in 1991 the average male skull size was the second lowest and the number of bears killed was the highest for the 1986-91 period.

Mortality

Season and Bag Limit:		Resident and Nonresident Hunters:
Unit 5	Sept. 1-May 31	One bear every four regulatory years

Harvest

Human-induced Mortality: Brown bear harvests in Unit 5 have increased the last two decades. Average annual kill from 1971-80 was 21 bears, with a range of 13-28, while the 1981-90 mean harvest was 30 animals, ranging from 23-33 bears. The mean age for male bears in the harvest has increased as well: ages during the 1971-80 period averaged 5.8 years while the 1981-90 average was 7.0 years. Mean male skull dimensions also increased, with average measurements of 20.1 inches and 22.6 inches for the two periods. In 1991 harvest rose to 41 bears, with the average age (6.0 years) and average skull size (21.9 inches) decreasing to below the previous 10-year averages.

The 1990 harvest was comprised of 25 male, 8 female, and 2 bears of unknown sex composed the 1990 harvest, which included 2 non-sport kills. Guided hunter effort remained high. The female portion of the total kill was 23% in 1990. Average male skull size was identical with the mean for the 6-year period from 1986 through 1991.

During the 1991 season, hunters took 33 males and 8 females, 2 of which were non-sport kills. Females made up 20% of the harvest. Male skull size was the second lowest of the 1986-91 period and the mean age of males decreased to 6.0 years, the lowest value for the 6-year period.

Hunter Residency and Success: From 1984 to 1988, the number and percent of brown bears taken in Unit 5 by nonresident hunters was consistent, ranging from 19 to 23 bears (mean=21), which represents 66-77% of the total take (mean=70%). In 1989, nonresidents

(including one nonresident alien) took 20 of 33 bears in the sport harvest. In 1990 nonresidents harvested 85% of the brown bears sealed in Unit 5, and in 1991 this percentage decreased slightly to 82%.

Harvest Chronology: From 1981-90, the number of bears taken in spring averaged 44% of the annual total. In 1990, 17 of 33 kills (52%) took place in spring. In 1991, spring season accounted for 17 of the 39 sport kills (44%).

Transport Methods: Transportation types used in 1990 included aircraft (79%), boats (15%), and highway vehicles and foot (3% each). In 1991, aircraft were used in 56% of the successful brown bear hunts, while the use of boats increased to 23%. Off road vehicles were involved in 10% of the kills. Hunts on foot and by other methods accounted for the remaining 10%.

CONCLUSIONS AND RECOMMENDATIONS

Management objectives for brown bears in Unit 5 were met during the report period. The mean age of male bears was 8.3 and 6.0 years for 1990 and 1991, respectively, compared to the objective of 6.5 years. The male:female harvest ratio exceeded the desired 3:2 ratio in both years.

The 1990 Unit 5 brown bear harvest of 35 equalled the second highest level within the 1986-91 period (6-year mean=32). The 1991 harvest of 41 bears was the highest recorded during the period. The two seasons were tied for the lowest number of females harvested during the 6-year period, and showed the smallest average female skull sizes.

The trend of increasing harvests and the potential for increasing or sustained high levels of guiding activity may necessitate a more conservative approach to Unit 5 brown bear harvest in the near future.

Yakutat residents view black and brown bears as pests rather than valuable resources. The Yakutat dump has attracted bears for many years. This continues to be a problem. We should emphasize the importance of properly managing garbage to local residents.

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Table 1. Unit 5 brown bear harvest, age, and skull sizes.

Days/Kill	Harvest				Mean Age			Mean Skull Size		Average	
Year	MM	FF	Unk	Total	MM	FF	Total	MM	FF	MM	FF
1986	19	10	0	29	7.6	5.6	6.9	23.4	20.5	4.0	7.0
1987	21	14	0	35	7.0	6.8	6.9	22.8	20.9	4.4	4.8
1988	15	14	0	29	5.4	4.2	4.8	21.4	20.7	3.6	3.5
1989	15	10	0	25	6.4	3.8	5.4	23.2	19.7	4.0	3.1
1990	25	8	2	35	8.3	4.9	7.4	22.3	23.0	5.0	4.0
1991	33	8	0	41	6.0	5.4	5.9	21.9	22.4	5.4	4.3
Mean	21.3	10.7	0	32.3	6.8	5.1	6.2	22.5	21.2	4.4	4.5

LOCATION

Game Management Unit: 6 (10,140 mi^2)

Geographical Description: Prince William Sound and North Gulf of Alaska Coast

BACKGROUND

Brown bears are found in most of Unit 6, with the exception of Middleton Island and all islands in western Prince William Sound (PWS). Brown bear distribution in PWS appears unchanged from that observed by Heller (1910).

Hinchinbrook Island probably has the highest bear density in Unit 6 (0.36-0.90 bears/mi^2). The lowest bear density is on the mainland in western PWS (>0.05 bears/mi^2). Density over most of the rest of the unit is probably intermediate between these extremes (0.10-0.30 bears/mi^2). Based on these densities, I estimate the population is 493-1,003 bears.

Harvest was monitored through mandatory sealing which began in 1961. Total annual take increased substantially in the late 1980s and has continued at a relatively high level. Average annual kill during regulatory years 1961-1986 was 32 bears (range = 14-63). Since 1987, the average yearly harvest was 52 bears (range = 44-60).

Logging significantly threatens brown bear abundance and distribution. Extensive clearcutting of old-growth timber on private and state land is in progress or planned in Subunits 6A, 6C, and 6D. Old-growth stands are important areas for coastal bears (Schoen 1990, Schoen and Beier 1988, Schoen *et al.* 1986). Logging also provides access roads, increased human activity, and developments that increase bear-human interactions that lead to increased mortality (McLellan and Shackleton 1988, Smith and VanDaele 1989).

MANAGEMENT DIRECTION

Management Objective

The management objective for Unit 6 brown bears is to maintain a brown bear population capable of sustaining a minimum annual harvest of 35 bears to include a minimum of 60% males, with a minimum average skull size of 23 inches.

METHODS

I estimated the number of bears using methods developed by Griese (1991), Miller (1988) and Grauvogel (1990). I quantified the amount of habitat within major drainages and estimated the bear density in each major drainage. I calculated the number of bears by multiplying bear density habitat area and summing the results to obtain population estimates for the unit, subunits, and harvest areas within subunits. Bear habitat was defined as non-glaciated land below 3,000 feet elevation within bear range. The density estimates were based on local knowledge, previous estimates in Unit 6 (Griese 1991, Campbell and Griese 1987), and densities calculated elsewhere in Alaska (Barnes *et al.* 1988, Schoen and Beier 1988).

A range of annual allowable harvest (AAH) was estimated as 5% of the population. A second constraint was that harvest of females >2 years-old should not be more than 2% of the estimated total population (Taylor *et al.* 1987). Because reproductive data were not available in Unit 6, this rate was arbitrarily set at a level slightly more conservative than the 5.7% calculated for ideal conditions by Miller (1990).

I estimated the total harvest by adding reported harvest and estimated illegal kill. Data were summarized in 10 harvest areas, each with similar biogeographic and harvest characteristics (Figure 1). The reported harvest included all bears sealed after being taken by hunters or killed for other reasons, such as in DLP incidents. Information collected included: skull size, sex, age, date of kill, number of days hunted, location of kill, method of transportation and hunter residency. Unsuccessful hunters were not required to report. I estimated the illegal kill using local reports and observations.

RESULTS AND DISCUSSION

Population Status and Trend

The estimated population in Unit 6 was 493-1,003 bears (Table 1). The greatest numbers were in Subunit 6D (184-417), followed by Subunits 6A (161-329), 6B (79-124) and 6C (69-133). Bear numbers were probably stable in all subunits, except Subunit 6D where bears may have declined during the past 5 years as a consequence of excessive harvests.

Mortality

Harvest:

Season and Bag Limit. The hunting season for resident and nonresident hunters in Unit 6, except Montague Island, was 1 September to 30 May. On Montague Island, the season for resident and nonresident hunters was 1 April to 15 May. The bag limit for the entire

unit was 1 bear every 4 regulatory years. The taking of cubs (bears ≤ 2-years-old) or females accompanied by cubs was prohibited.

Board of Game Actions. Effective regulatory year 1992-93, the Board of Game changed the season to delay the opening in Subunit 6D (except Montague Island) from 1 September to 1 October. The season was shortened in response to concern that harvests on Hinchinbrook Island and the mainland, between Rude River and Ellamar, exceeded estimated AAH. The public proposed the change and ADF&G supported the reduction.

Hunter Harvest. Reported hunter kill during 1990-91 and 1991-92 for Unit 6 was 50 and 48, respectively (Table 2). Most were taken from Subunit 6D (33 in 1990-91 and 24 in 1991-92). Total hunter take was lower than the 60 animals reported in 1987-88 and 1988-89, but higher than the 44 bears reported in 1989-90. The 1989-90 take was unusually low as hunters were probably deterred by the *Exxon Valdez* oil spill in PWS.

During 1990-91 and 1991-92, males were 58% and 60% of the hunter kill; mean skull sizes were 21.6 inches and 23.6 inches (Table 3), respectively. Proportion of males in the harvest was similar to the previous 3 years. Skull size in 1990-91 was the lowest in the past 5 years and was a historical low for Unit 6. Most smaller bears came from Subunit 6D, where the mean skull size was 20.4 inches, the lowest value recorded for this subunit.

The upper limit of the estimated range of AAH was reached or exceeded in most of Unit 6 during both years of this report period (Table 1). The AAH for the unit was 24-52 bears, of which not more than 9-22 should be females >2-years-old. Estimated total take and take of females >2-years-old was 60 and 23 during 1990-91, and 58 and 22 during 1991-92. Most of the kill exceeding AAH occurred in the Rude River-Ellamar and Hinchinbrook Island areas of Subunit 6D. This pattern of reaching or exceeding AAH also occurred during the previous 3 regulatory years (Griese 1991).

Hunter Residency. Nonresidents harvested most bears in Unit 6 during 1990-91 (56%) and 1991-92 (50%) (Table 4). In Subunits 6C and 6D, local residents and nonlocal residents of Alaska took higher proportions of the harvest. This occurred because these subunits were more accessible by road or boat, and there were fewer nonresident hunters than in other subunits. This harvest pattern was unchanged over the past 5 years.

Harvest Chronology. Most bears were taken during May (50% in 1990-91 and 42% in 1991-92) and September (16% in 1990-91 and 32% in 1991-92) (Table 5). This was also the pattern among subunits during this report period and over the past 5 years.

Transport Methods. Airplanes were the most important method of transportation unitwide (Table 6). In Subunit 6C, off-road vehicles, 3- or 4-wheelers, and highway vehicles were more important than aircraft because of road access. In Subunit 6D, boats were important, along with aircraft, because the relatively sheltered waters of PWS allow use of small boats. These patterns were typical of the past 5 years.

Other Mortality. Nonhunting and estimated illegal kill totaled 10 animals during each year of this report period (Table 2). This was lower than each of the previous 3 years.

Nonregulatory Management Problems/Needs. Timber harvesting was in progress or planned in brown bear habitat throughout the unit except Subunit 6B. Logging in Subunit 6D, Montague Island and on the PWS mainland between Rude River and Ellamar, was of particular concern.

On Montague Island, logging was scheduled to begin in Patton Bay during summer 1993. Construction of a haul road around the south end of the island to move logs from Patton Bay to a log transfer site in MacLeod Harbor began in fall 1992. Important bear habitat will be lost and bear-human interactions will probably result in increased bear mortalities. Estimated bear numbers on Montague Island were already low (23-58) and the allowed harvest (AAH) is only 1-3 bears annually.

Logging has been extensive between Rude River and Ellamar (Two Moon Bay/Hells Hole). Additional cutting was scheduled for the north-side of Port Fidalgo and Nelson Bay. As logging expands, brown bear habitat declines, access improves and nonhunting mortality increases. Bear numbers may already be declining because of excessive hunter harvests, and additional mortality associated with timber management will exacerbate the situation.

CONCLUSIONS AND RECOMMENDATIONS

Management objectives were only partially achieved. The objective of maintaining a brown bear population capable of sustaining a harvest of 35 bears was easily met. However, during 1990/91, objectives for a minimum of 60% males in the take, with a minimum average skull size of 23 inches were not achieved. This was primarily the result of a high proportion of females and young bears in the harvest in Subunit 6D. It may have occurred because excessive harvests during the past 5 years caused a downward trend in numbers and reduced the availability of large males.

Action taken by the Board of Game may alleviate the overharvesting problem in Subunit 6D. The season opening for the unit, starting in regulatory year 1992-93, will be delayed from 1 September to 1 October (except Montague Island which does not open until 1 April). This change should reduce the total harvest and the proportion of females in the kill. However, the harvest in Subunit 6D should be closely monitored, and additional regulatory changes adopted if the harvest is not within the estimated AAH.

Logged areas unitwide should be given special attention. Bear harvests should be closely monitored, particularly nonhunting and illegal kills. The cumulative effects of timber management should be quantified to assess the affects on the bear population. Contractors should be monitored to assure operator compliance with guidelines for handling garbage

and other attractants and to ensure that education/enforcement actions are taken when necessary.

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Table 1. Brown bear estimated population, annual allowable harvest and total harvest, 1990-91.

Subunit	Area	Population	Annual allowable harvest	Total estimated harvest[a] 1990	1991	Annual allowable harvest F>2 yr old	Estimated[a] harvest F>2 yr old 1990	1991
6A	Icy Bay-Cape Suckling	100-208	5-10	3	3	2-4	1	2
	Cape Suckling-Katalla	58-111	3-6	4	8	1-2	1	3
	Kayak Is	3-10	0-1	0	0	0-0	0	0
6A Total		161-329	8-17	7	11	3-6	2	5
6B	----	79-124	4-6	11	9	2-3	5	5
6C	----	69-133	3-7	4	10	1-3	1	3
6D	Rude River-Ellamar	67-125	3-6	19	15	1-3	7	6
	Valdez Arm	18-54	1-3	3	1	0-1	1	0
	Western PWS	11-22	1-2	0	1	1-2	0	1
	Montague Is	23-58	1-3	1	1	0-1	1	0
	Hinchinbrook Is	55-139	3-7	14	8	1-3	6	2
	Hawkins Is	10-19	0-1	1	2	0-0	0	0
6D Total		184-417	9-22	38	28	3-10	15	9
Unit 6 Total		493-1003	24-52	60	58	9-22	23	22

[a] Includes hunter kill, nonhunting kill, and estimated illegal kill.

Table 2. Unit 6 brown bear harvest, 1987-91.

Subunit	Regulatory year	Reported								Estimated illegal kill	Total estimated kill					
		Hunter kill					Nonhunting kill									
		M	F	(%)	Unk.	Total	M	F	Unk.		M	(%)	F	(%)	Unk.	Total
6A																
1987	Fall 87	6	3	(33)	0	9	0	0	0	1	6	(67)	3	(33)	0	10
	Spring 88	6	2	(25)	0	8	0	0	0	0	6	(75)	2	(25)	0	8
	Total	12	5	(29)	0	17	0	0	0	1	12	(71)	5	(29)	0	18
1988	Fall 88	8	2	(20)	0	10	0	0	0	1	8	(80)	2	(20)	0	11
	Spring 89	3	0	(0)	0	3	0	0	0	0	3	(100)	0	(0)	0	3
	Total	11	2	(15)	0	13	0	0	0	1	11	(85)	2	(15)	0	14
1989	Fall 89	2	2	(50)	1	5	0	3	0	0	2	(29)	5	(71)	1	8
	Spring 90	6	0	(0)	0	6	0	0	0	0	6	(100)	0	(0)	0	6
	Total	8	2	(20)	1	11	0	3	0	0	8	(62)	5	(38)	1	14
1990	Fall 90	1	1	(50)	1	3	0	1	0	0	1	(33)	2	(67)	1	4
	Spring 91	2	0	(0)	1	3	0	0	0	0	2	(100)	0	(0)	1	3
	Total	3	1	(25)	2	6	0	1	0	0	3	(60)	2	(40)	2	7
1991	Fall 91	2	3	(60)	0	5	0	0	0	1	2	(40)	3	(60)	0	6
	Spring 92	3	2	(40)	0	5	0	0	0	0	3	(60)	2	(40)	0	5
	Total	5	5	(50)	0	10	0	0	0	1	5	(50)	5	(50)	0	11
6B	1987															
	Fall 87	1	2	(67)	0	3	0	0	0	1	1	(33)	2	(67)	0	4
	Spring 88	2	2	(50)	0	4	0	0	0	1	2	(50)	2	(50)	0	5
	Total	3	4	(57)	0	7	0	0	0	2	3	(43)	4	(57)	0	9

Table 2. Continued.

Subunit	Regulatory year	Reported Hunter kill M	F	(%)	Unk.	Total	Reported Nonhunting kill M	F	Unk.	Estimated illegal kill	Total estimated kill M	(%)	F	(%)	Unk.	Total
6B																
1988	Fall 88	2	2	(50)	0	4	0	1	0	1	2	(40)	3	(60)	0	6
	Spring 89	4	1	(20)	1	6	0	0	0	1	4	(80)	1	(20)	1	7
	Total	6	3	(33)	1	10	0	1	0	2	6	(60)	4	(40)	1	13
1989	Fall 89	0	0	(0)	0	0	0	0	0	0	0	(0)	0	(0)	0	0
	Spring 90	2	2	(50)	0	4	0	0	0	1	2	(50)	2	(50)	0	5
	Total	2	2	(50)	0	4	0	0	0	1	2	(50)	2	(50)	0	5
1990	Fall 90	2	2	(50)	0	4	0	0	0	1	2	(50)	2	(50)	0	5
	Spring 91	3	2	(40)	0	5	0	0	0	1	3	(60)	2	(40)	0	6
	Total	5	4	(44)	0	9	0	0	0	2	5	(56)	4	(44)	0	11
1991	Fall 91	1	3	(75)	0	4	0	0	0	1	1	(25)	3	(75)	0	5
	Spring 92	2	2	(50)	0	4	0	0	0	0	2	(50)	2	(50)	0	4
	Total	3	5	(63)	0	8	0	0	0	1	3	(38)	5	(63)	0	9
6C	1987															
	Fall 87	2	1	(33)	0	3	0	0	0	2	2	(67)	1	(33)	0	5
	Spring 88	2	1	(33)	0	3	0	0	0	1	2	(67)	1	(33)	0	4
	Total	4	2	(33)	0	6	0	0	0	3	4	(67)	2	(33)	0	9
1988	Fall 88	1	2	(67)	0	3	0	1	0	1	1	(25)	3	(75)	0	5
	Spring 89	1	0	(0)	0	1	0	0	0	1	1	(100)	0	(0)	0	2
	Total	2	2	(50)	0	4	0	1	0	2	2	(40)	3	(60)	0	7

Table 2. Continued.

Subunit	Regulatory year	Reported								Estimated illegal kill	Total estimated kill					
		Hunter kill					Nonhunting kill									
		M	F	(%)	Unk.	Total	M	F	Unk.		M	(%)	F	(%)	Unk.	Total
6C	1989															
	Fall 89	3	0	(0)	0	3	0	0	0	1	3	(100)	0	(0)	0	4
	Spring 90	1	1	(50)	0	2	0	0	0	1	1	(50)	1	(50)	0	3
	Total	4	1	(20)	0	5	0	0	0	2	4	(80)	1	(20)	0	7
1990	Fall 90	1	0	(0)	0	1	0	0	0	1	1	(100)	0	(0)	0	2
	Spring 91	1	0	(0)	0	1	0	0	0	1	1	(100)	0	(0)	0	2
	Total	2	0	(0)	0	2	0	0	0	2	2	(100)	0	(0)	0	4
1991	Fall 91	2	0	(0)	0	2	0	2	0	1	2	(50)	2	(50)	0	5
	Spring 92	3	1	(25)	0	4	0	0	0	1	3	(75)	1	(25)	0	5
	Total	5	1	(17)	0	6	0	2	0	2	5	(63)	3	(38)	0	10
6D	1987															
	Fall 87	6	4	(40)	0	10	1	4	0	4	7	(47)	8	(53)	0	19
	Spring 88	9	11	(55)	0	20	0	0	0	1	9	(45)	11	(55)	0	21
	Total	15	15	(50)	0	30	1	4	0	5	16	(46)	19	(54)	0	40
1988	Fall 88	7	6	(46)	1	14	0	3	0	2	7	(44)	9	(56)	1	19
	Spring 89	13	5	(28)	1	19	0	0	0	1	13	(72)	5	(28)	1	20
	Total	20	11	(35)	2	33	0	3	0	3	20	(59)	14	(41)	2	39
1989	Fall 89	3	3	(50)	1	7	0	0	0	1	3	(50)	3	(50)	1	8
	Spring 90	11	6	(35)	0	17	0	0	0	1	11	(65)	6	(35)	0	18
	Total	14	9	(39)	1	24	0	0	0	2	14	(61)	9	(39)	1	26

Table 2. Continued.

Subunit	Regulatory year	Reported Hunter kill M	F	(%)	Unk.	Total	Reported Nonhunting kill M	F	Unk.	Estimated illegal kill	Total estimated kill M	(%)	F	(%)	Unk.	Total
6D	1990															
	Fall 90	8	6	(43)	2	16	0	0	1	3	8	(57)	6	(43)	3	20
	Spring 91	7	7	(50)	3	17	0	0	0	1	7	(54)	7	(50)	3	18
	Total	15	13	(46)	5	33	0	0	1	4	15	(56)	13	(46)	6	38
1991	Fall 91	8	4	(33)	0	12	0	0	1	2	8	(67)	4	(33)	1	15
	Spring 92	8	4	(33)	0	12	0	0	0	1	8	(67)	4	(33)	0	13
	Total	16	8	(33)	0	24	0	0	1	3	16	(67)	8	(33)	1	28
Unit 6	1987															
Total	Fall 87	15	10	(40)	0	25	1	4	0	8	16	(53)	14	(47)	0	38
	Spring 88	19	16	(46)	0	35	0	0	0	3	19	(54)	16	(46)	0	38
	Total	34	26	(43)	0	60	1	4	0	11	35	(54)	30	(46)	0	76
1988	Fall 88	18	12	(40)	1	31	0	5	0	5	18	(51)	17	(49)	1	41
	Spring 89	21	6	(22)	2	29	0	0	0	3	21	(78)	6	(22)	2	32
	Total	39	18	(32)	3	60	0	5	0	8	39	(63)	23	(37)	3	73
1989	Fall 89	8	5	(38)	2	15	0	3	0	2	8	(50)	8	(50)	2	20
	Spring 90	20	9	(31)	0	29	0	0	0	3	20	(69)	9	(31)	0	32
	Total	28	14	(33)	2	44	0	3	0	5	28	(62)	17	(38)	2	52
1990	Fall 90	12	9	(43)	3	24	0	1	1	5	12	(55)	10	(45)	4	31
	Spring 91	13	9	(38)	4	26	0	0	0	3	13	(59)	9	(41)	4	29
	Total	25	18	(42)	7	50	0	1	1	8	25	(57)	18	(43)	8	60

Table 2. Continued.

Subunit	Regulatory year	Reported								Estimated illegal kill	Total estimated kill					
		Hunter kill					Nonhunting kill									
		M	F	(%)	Unk.	Total	M	F	Unk.		M	(%)	F	(%)	Unk.	Total
1991	Fall 91	13	10	(43)	0	23	0	2	1	5	13	(52)	12	(48)	1	31
	Spring 92	16	9	(36)	0	25	0	0	0	2	16	(64)	9	(36)	0	27
	Total	29	19	(40)	0	48	0	2	1	7	29	(58)	21	(42)	15	8

Table 3. Unit 6 brown bear mean skull size and age, 1987-91.

Regulatory year	Males				Females			
	Skull size	n	Age	n	Skull size	n	Age	n
1987/88	23.0	32	6.3	34	21.2	24	7.5	26
1988/89	23.6	38	7.9	38	19.7	18	4.6	17
1989/90	24.2	26	7.5	27	22.0	14	6.8	14
1990/91	21.2	23	4.8	25	21.1	18	9.2	18
1991/92	23.6	28	7.9	28	21.0	19	7.6	19

Table 4. Unit 6 brown bear successful hunter residency, 1987-91.

Subunit	Regulatory year	Local[a] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
6A	1987/88	1	(5)	1	(5)	15	(88)	17
	1988/89	1	(7)	4	(30)	8	(61)	13
	1989/90	1	(9)	0	(0)	10	(90)	11
	1990/91	0	(0)	3	(50)	3	(50)	6
	1991/92	0	(0)	1	(10)	9	(90)	10
6B	1987/88	3	(42)	0	(0)	4	(57)	7
	1988/89	3	(30)	0	(0)	7	(70)	10
	1989/90	0	(0)	0	(0)	4	(100)	4
	1990/91	0	(0)	0	(0)	9	(100)	9
	1991/92	2	(25)	1	(12)	5	(62)	8
6C	1987/88	4	(66)	2	(33)	0	(0)	6
	1988/89	1	(25)	2	(50)	1	(25)	4
	1989/90	4	(80)	0	(0)	1	(20)	5
	1990/91	1	(50)	1	(50)	0	(0)	2
	1991/92	3	(50)	2	(33)	1	(16)	6
6D	1987/88	3	(10)	14	(46)	13	(43)	30
	1988/89	2	(6)	16	(48)	15	(45)	33
	1989/90	0	(0)	11	(45)	13	(54)	24
	1990/91	6	(18)	11	(33)	16	(48)	33
	1991/92	3	(12)	12	(50)	9	(37)	24
Unit 6 Total	1987/88	11	(18)	17	(28)	32	(53)	60
	1988/89	7	(11)	22	(36)	31	(51)	60
	1989/90	5	(11)	11	(25)	28	(63)	44
	1990/91	7	(14)	15	(30)	28	(56)	50
	1991/92	8	(16)	16	(33)	24	(50)	48

[a] Resident of Unit 6.

Table 5. Unit 6 brown bear harvest chronology percent by time period, 1987-91.

Subunit	Regulatory year	Harvest Periods: September 1-15	September 16-30	October 1-15	October 16-31	November 1-15	November 16-30	April 1-15	April 16-30	May 1-15	May 16-31	n
6A	1987/88	18	24	12	0	0	0	0	18	18	12	17
	1988/89	38	23	15	0	0	0	8	15	0	0	13
	1989/90	36	0	9	0	0	0	9	18	9	18	11
	1990/91	17	17	17	0	0	0	0	0	17	33	6
	1991/92	30	20	0	0	0	0	0	30	20	0	10
6B	1987/88	14	0	29	0	0	0	0	29	14	14	7
	1988/89	30	0	10	0	0	0	10	20	30	0	10
	1989/90	0	0	0	0	0	0	25	0	25	50	4
	1990/91	0	11	33	0	0	0	0	11	11	33	9
	1991/92	0	38	13	0	0	0	0	13	13	25	8
6C	1987/88	0	17	17	0	17	0	0	17	0	33	6
	1988/89	50	0	0	0	0	25	0	0	0	25	4
	1989/90	40	20	0	0	0	0	0	20	20	0	5
	1990/91	0	0	0	50	0	0	0	0	50	0	2
	1991/92	17	0	0	17	0	0	0	17	33	17	6
6D	1987/88	3	7	10	7	7	0	0	3	27	37	30
	1988/89	6	12	6	12	6	0	0	6	18	33	33
	1989/90	0	17	8	4	0	0	0	0	21	50	24
	1990/91	15	0	24	9	0	0	0	0	21	30	33
	1991/92	13	13	13	8	4	0	0	0	25	25	24
Unit 6 Total	1987/88	8	12	13	3	5	0	0	12	20	27	60
	1988/89	20	12	8	7	3	2	3	10	15	20	60
	1989/90	14	11	7	2	0	0	5	7	18	36	44
	1990/91	12	4	24	8	0	0	0	2	20	30	50
	1991/92	15	17	8	6	2	0	0	10	23	19	48

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Table 6. Unit 6 brown bear harvest percent by transport method, 1987-91.

Subunit	Regulatory year	Percent of harvest						n
		Airplane	Boat	3 or 4-Wheeler	ORV	Highway Vehicle	Unknown	
6A	1987/88	88	12	0	0	0	0	17
	1988/89	77	8	0	15	0	0	13
	1989/90	91	9	0	0	0	0	11
	1990/91	100	0	0	0	0	0	6
	1991/92	100	0	0	0	0	0	10
6B	1987/88	57	0	0	0	29	14	7
	1988/89	70	10	0	10	10	0	10
	1989/90	100	0	0	0	0	0	4
	1990/91	100	0	0	0	0	0	9
	1991/92	38	0	0	0	50	13	8
6C	1987/88	0	17	17	33	17	17	6
	1988/89	50	0	0	25	25	0	4
	1989/90	0	0	0	0	0	100	5
	1990/91	0	0	50	0	0	50	2
	1991/92	0	33	0	0	67	0	6
6D	1987/88	33	67	0	0	0	0	30
	1988/89	39	55	0	0	0	6	33
	1989/90	29	71	0	0	0	0	24
	1990/91	33	52	0	3	0	12	33
	1991/92	25	67	0	0	0	8	24
Unit 6 Total	1987/88	48	38	2	3	5	3	60
	1988/89	53	33	0	7	3	3	60
	1989/90	48	41	0	0	0	11	44
	1990/91	52	34	2	2	0	10	50
	1991/92	40	38	0	0	17	6	48

LOCATION

Game Management Units: 7 (3,520 mi^2) and 15 (4,876 mi^2)

Geographic Description: Kenai Peninsula

BACKGROUND

Brown bears are found throughout most remote lowland forests and intermountain valleys of the Kenai Peninsula and most historical brown bear range remains occupied. Field observations and analysis of data suggest that brown bear densities are highest in the forested lowlands west of the Kenai Mountains.

The Kenai Peninsula is comprised primarily of federally owned lands. The USFS (Chugach National Forest) is the principle land owner in Unit 7 (ca. 2,000 mi^2) along with the National Park Service (Kenai Fjords National Park) (ca. 885 mi^2). In Unit 15, the USFWS (Kenai National Wildlife Refuge) is responsible for management of 3,062 mi^2. Ownership of the remainder of Unit 15 varies between municipal, state, and private lands.

Brown bears were first given game status in 1902 (Miller 1990a) with liberal seasons and bag limits. For example, in 1937-38 the season was 1 September to 20 June and the bag limit was 2 brown bears for coastal areas in southcentral and all of southeastern Alaska. The rest of the state did not have a closed season and there was no bag limit. At the time of statehood, the bag limit was 1 brown bear. Cubs and sows with cubs were protected. The season dates have remained fairly constant with a peak length of 45 days and a minimum season length of 20 days. In 1978, a 10-day spring season was open for Unit 15 and extended to the current 15-day season (10-15 May) in 1980. The Unit 7 spring season opened in 1980, concurrently with Unit 15. The bag limit was reduced in 1967, from 1 bear per year to 1 bear every 4 years.

Scant information is available about the population dynamics and natural history of brown bears on the Kenai Peninsula although some inferences can be drawn from research in other regions of Alaska and Canada. In 1984, representatives of the USFWS, USFS, and ADF&G formed the Interagency Brown Bear Study Team (IBBST) to discuss brown bear management and research needs on the Kenai Peninsula and to coordinate joint studies. The IBBST completed a baseline inventory (Bevins *et al.* 1984, Risdahl *et al.* 1986) of salmon streams and known high-use brown bear areas, and detailed ground and habitat surveys (Schloeder *et al.* 1987 and Jacobs *et al.* 1988) on the Kenai Peninsula. The IBBST is drafting an interagency brown bear management plan using guidelines provided by Jacobs (1989). Staff members at the Chugach National Forest are working on a cumulative effects model for brown bears for the Kenai.

MANAGEMENT DIRECTION

The management objective for Unit 7 brown bears is to maintain an estimated population of 250 brown bears with a sex and age structure that will sustain a harvest comprised of at least 60% males.

METHODS

Cost effective survey techniques to accurately determine brown bear population size over large forested areas do not exist. We derived a population estimate by assessing the amount of suitable habitat and estimates of bear density.

Suitable brown bear habitat was estimated by mapping (1:250,000 topographic map) harvest locations of brown bears killed between 1961 and 1991. We approximated the area used by brown bears by including areas surrounding the harvest location of similar habitat and calculated the area within the polygon for each game management unit (Figure 1). All land above mean high tide, roads, water bodies (except Skilak and Tustemena lakes), and municipalities were included. We made 2 assumptions in using this technique; 1) all bears were harvested within their normal home ranges and 2) similar adjacent land was also considered suitable habitat.

Miller (pers. comm.) suggested the density of brown bears on the Kenai was probably lower than other areas in southcentral Alaska (27.1 bears per 1,000 km^2). We estimated bear density on the Kenai was 20 bears/1,000 km^2 (Miller pers. comm.) and we calculated 13,848 km^2 of suitable brown bear habitat on the Kenai Peninsula. We devised a brown bear population estimate for Units 7 and 15 by dividing the suitable habitat by the density estimate.

Since 1961, a mandatory sealing program has provided information on all harvested bears including distribution and sex-age composition.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The brown bear population estimate calculated for Units 7 and 15 was 277 bears.

Distribution and Movements: Brown bears occur throughout the Kenai Peninsula with the exception of coastal areas of Kenai Fjords National Park and the southern portions of the peninsula (Schloeder *et al.* 1987, Jacobs *et al.* 1988).

Mortality

Harvest:

Season and Bag Limit. The bag limit for Units 7 and 15 was 1 bear every 4 regulatory years. The bear hunting season was 15 September to 15 October and 10-25 May for subsistence, resident, and nonresident hunters.

Board of Game Action and Emergency Orders. In 1989 the Board of Game shortened the fall brown bear season by 14 days creating a fall opening date of 15 September. The reason for this change was to reduce the incidental take of brown bears by moose hunters.

Hunter Harvest. Fourteen brown bears were harvested in Units 7 and 15 during the 1990-91 regulatory year including 8 males (57%), 5 females (35%), and 1 of undetermined sex (7%) (Table 1). Two bears (undetermined sex) were killed in Unit 7 and 2 bears (males) were taken in Subunit 15A that were not sport-harvested.

Fifteen bears were taken in 1991-92 including 8 males (53%) 6 females (40%) and 1 of undetermined sex (7%). Of the 15, 2 bears were killed in Unit 7 (1 non-sport). Two additional non-sport kills were reported that included a male in Subunit 15B and a female in Subunit 15C.

Hunter Residency and Success. Local residents harvested 64% and 42% of the bears for regulatory years 1990 and 1991, respectively. Nonlocal residents took 9% and 25% while nonresidents took 27% and 33% in each of the 2 regulatory years, respectively (Table 2).

Harvest Chronology. Most bears were taken during the fall season and only 1 bear has been taken in October since the season was shortened (Table 3). The moose and fall brown bear seasons overlapped by 6 days. The percentage of fall bears harvested during the concurrent moose and bear seasons was 67% in 1990 and 57% in 1991.

Transport Methods. Successful brown bear hunters used all transportation methods with the exception of snowmachine during 1990 and 1991 (Table 4).

Non Regulatory Management Problems/Needs

The department and other resource management agencies should implement a brown bear management plan. The IBBST Draft Management Plan will provide the framework for such a working plan when it is completed.

The logging proposed to control the spread of spruce bark beetles (Dick *et al.* 1992) could be a major factor affecting the abundance of brown bears. The Forest Health Management Plan encompasses approximately 60% of the Kenai Peninsula and most brown bear habitat. The plan prioritizes over 426,000 acres of forest lands for salvage cutting.

Logging mature forests will affect brown bears in numerous ways including fragmentation of forest habitat and development of an extensive road system.

CONCLUSION AND RECOMMENDATIONS

Management objectives are being met. The current brown bear season and bag limit on the Kenai Peninsula appear to allow for a sustainable harvest. Miller (1990b) used computer simulations to derive a maximum sustainable hunting rate of 5.7% of a population of brown bears under optimum productivity. Miller further noted that harvest density divided by population density would provide a rough estimate of harvest rate. Using these criteria (area 13,848 km^2, mean harvest 12.0 bears, and population density 20/1,000 km^2), the estimated harvest rate was 4.3%. This harvest rate, 4.3%, was conservative enough to account for error in the estimated parameters. Under the current management objective, an estimated population of 250 brown bears could sustain an average annual harvest of 14 bears.

Taylor *et al.* (1987) noted that survival of adult female bears was the main factor affecting population dynamics. To maintain a stable population of 250 bears on the Kenai Peninsula, the maximum sustainable harvest of females should not exceed 40%, or less than 6 female bears annually. We need to closely monitor the harvest of adult female bears particularly during the fall season. If the harvest is substantially over the recommended annual quota of 6 females or 14 bears, the ADF&G will act to curtail the harvest.

The long-term health of brown bears on the Kenai Peninsula depends upon maintaining quality bear habitat. Two activities will affect bear abundance: 1) the proposed forest management plan (Dick *et al.* 1992) will affect bears by logging mature forest stands and building roads into previously inaccessible areas; and 2) commercial, recreational, and residential developments on the Kenai Peninsula will continue to reduce the quantity and quality of brown bear habitat.

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Table 1. Units 7 and 15 brown bear harvest, 1985-91.

Regulatory year	Reported: Hunter Kill M	F	Unk.	Total	Reported: Non-hunting kill[a] M	F	Unk.	Total estimated kill: M	(%)	F	(%)	Unk.	(%)	Total
1985														
Fall 85	6	5	1	12	0	2	0	6	(43)	7	(50)	1	(7)	14
Spring 86	1	1	1	3	1	0	0	2	(50)	1	(25)	1	(25)	4
Total	7	6	2	15	1	2	0	8	(44)	8	(44)	2	(11)	18
1986														
Fall 86	3	9	0	12	1	0	0	4	(31)	9	(69)	0	(0)	13
Spring 87	3	1	0	4	0	0	0	3	(75)	1	(25)	0	(0)	4
Total	6	10	0	16	1	0	1	7	941)	10	(59)	1	(0)	18
1987														
Fall 87	5	3	0	8	0	0	0	5	(63)	3	(37)	0	(0)	8
Spring 88	2	2	0	4	0	0	0	2	(50)	2	950)	0	(0)	4
Total	7	5	0	12	0	0	0	7	(58)	5	942)	0	(0)	12
1988														
Fall 88	4	5	0	9	0	1	0	4	(40)	6	(60)	0	(0)	10
Spring 89	3	0	0	3	0	0	0	3	(100)	0	(0)	0	(0)	3
Total	7	5	0	12	0	1	0	7	(54)	6	(46)	0	(0)	13
1989														
Fall 89	1	1	0	2	0	1	0	1	(33)	2	(66)	0	(0)	3
Spring 90	1	3	0	4	0	0	0	1	(25)	3	(75)	0	(0)	4
Total	2	4	0	6	0	1	0	2	(29)	5	(61)	0	(0)	7
1990														
Fall 90	4	2	0	6	1	0	0	5	(71)	2	(29)	0	(0)	7
Spring 91	2	3	0	5	1	0	1	3	(43)	3	(43)	1	(14)	7
Total	6	5	0	11	2	0	1	8	957)	5	935)	1	(7)	14

Table 1. Continued.

Regulatory year	Reported							Total estimated kill						
	Hunter Kill				Non-hunting kill[a]									
	M	F	Unk.	Total	M	F	Unk.	M	(%)	F	(%)	Unk.	(%)	Total
1991														
Fall 91	4	4	0	8	1	1	0	5	(50)	5	(50)	0	(0)	10
Spring 92	3	1	0	4	0	0	1	3	(60)	1	(20)	1	(20)	5
Total	7	5	0	12	1	1	1	8	(53)	6	940)	1	(7)	15

[a] Includes DLP kills, research mortalities, and other known human-caused accidental mortality.

Table 2. Unit 7 and 15 brown bear successful hunter residency, 1985-91.

Regulatory year	Local[a] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1985-86	6	(40)	7	(47)	2	(13)	15
1986-87	11	(69)	4	(25)	1	(6)	16
1987-88	4	(33)	5	(42)	3	(25)	12
1988-89	7	(58)	0	(00)	5	(42)	12
1989-90	4	(67)	1	(17)	1	(17)	6
1990-91	7	(64)	1	(9)	3	(27)	11
1991-92	5	(42)	3	(25)	4	(33)	12

Table 3. Units 7 and 15 brown bear harvest chronology percent by time period, 1985-91.

Regulatory year	Harvest periods			n
	September	October	May	
1985-86	9	3	3	15
1986-87	9	3	4	16
1987-88	5	3	4	12
1988-89	9	0	3	12
1989-90	2	0	4	6
1991-92	7	1	4	12

Table 4. Units 7 and 15 brown bear harvest by transport method, 1985-91.

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3 or 4-wheeler	Snowmachine	ORV	Highway vehicle	Walk	Unk.	n
1985	1	2	5	0	0	2	1	1	3	15
1986	2	1	3	0	0	3	2	2	3	16
1987	3	3	2	0	0	0	4	0	0	12
1988	1	5	1	0	0	2	2	0	1	12
1989	1	0	2	0	0	0	0	1	2	6
1990	1	3	1	1	0	1	2	1	1	11
1991	2	3	2	0	0	1	1	1	2	12

LOCATION

Game Management Unit: 8 (5,097 mi^2)

Geographical Description: Kodiak and Adjacent Islands

BACKGROUND

Brown bears occur on Kodiak, Afognak and closely adjacent smaller islands in stable and relatively high populations. Most of the habitat is remote and relatively undeveloped, except in northeastern Kodiak Island near the city of Kodiak. The Kodiak National Wildlife Refuge (KNWR), created by Executive Order of President Franklin D. Roosevelt in 1941, originally contained approximately 60% of the 3 million acres of bear habitat in Unit 8. Several hundred thousand acres of land, including approximately 310,000 acres from the KNWR, are being conveyed to Native village corporations under the Alaska Native Claims Settlement Act of 1971 and via the Alaska National Interest Lands Conservation Act of 1980. Development of private lands, growth of the human population, increasing recreational hunting and sport fishing, logging, commercial fishing and hydroelectric power development are potential threats to brown bears.

Brown bear management in Unit 8 evolved from virtually unregulated commercial harvests before 1925 to the present system of closely regulated permit hunting. Troyer (1961) documented the early history of brown bear hunting and federal management until 1960, when ADF&G assumed management. At that time, recreational hunting for brown bears was well established with an 8 month long general season.

In the mid-1960s, high harvests prompted ADF&G to close the fall season in the Karluk Lake and Uyak Bay areas in 1967 and 1968. The USFWS subsequently imposed a land-use permit requirement for brown bear hunting on the KNWR in 1968 to distribute hunting effort and harvests. Although that system initially reduced harvests and promoted better hunter distribution, sharp increases beginning in 1972 prompted the USFWS to limit the number of land-use permits in 1975. The state objected to that encroachment on its authority to manage resident game populations. The Board of Game responded by establishing the present, limited permit hunting system, for brown bears for the spring 1976 season. The USFWS deferred to the new regulation, and dropped the land-use permit system. The state system allocated a minimum of 60% of the available bear permits to Alaska residents. A fixed number of permits was assigned to each of 26 hunting areas with approximately a 60:40 ratio of resident to nonresident allocation within each hunting area. The Guide Licensing and Control Board assigned exclusive guiding areas (EGA) to 20 guides in Unit 8 in 1975. Each guide had a guarantee of bear hunting clients each season with the EGA system in place and approximately 40% of the available bear permits allocated to nonresidents.

Only minor changes in bear hunting regulations have occurred since 1976. Responding to increased harvests, the board has progressively delayed the fall season opening date on Afognak Island. Afognak and part of northeastern Kodiak Island were changed from an unlimited permit hunt to a limited permit hunt in 1987-88. The Board of Game adopted a regulation, proposed by guides, which changed the method for issuing permits to nonresident hunters from a lottery to a "first-come, first-served" registration system in 1983-84.

The Alaska Supreme Court invalidated EGAs in 1988, thereby creating an opportunity for additional licensed guides in Unit 8. Anticipating competition, the guides who held EGAs have lined-up well in advance of the date permits became available each season, since fall 1989.

Research by ADF&G and USFWS on several aspects of the population status and life history of the Kodiak brown bear has been underway since 1982. A 5-year study of the affects of construction and operation of the Terror Lake hydroelectric project on brown bears was completed in 1986 (Smith and Van Daele 1988; Smith and Van Daele 1990). A 6-year study of habitat use by female brown bears and evaluation of ground and aerial surveys began in 1983 (Barnes 1986, 1990a). Management implications of denning ecology of Kodiak brown bears was addressed in a recent publication (Van Daele *et al.* 1990). In 1987, a brown bear density estimation technique, using the capture re-capture technique of Miller *et al.* (1987) was applied to 2 study areas on Kodiak Island (Barnes *et al.* 1988).

MANAGEMENT DIRECTION

Management Objectives

The management objective for Unit 8 brown bears is to maintain a brown bear population that will sustain an annual harvest of 150 bears composed of at least 60% males.

METHODS

We collected harvest data from mandatory hunter reports and the sealing program, which required hunters to bring the hide and skull of each bear to the Kodiak ADF&G office for inspection. We determined bear ages from cementum annuli of premolar teeth removed from each bear. Mandatory hunting reports provided information on hunting effort and success. We monitored hunting activity in the field with periodic patrols by boat and aircraft.

In 1988, a long-term study of productivity and survival of female brown bears began under a cooperative agreement between the USFWS, ADF&G and the Kodiak Brown

Bear Research and Habitat Maintenance Trust. Forty-one radio-collared female bears were monitored in 1992 (Barnes and Smith 1992).

Brown bear abundance in 3 study areas was investigated using replicate aerial surveys done cooperatively with the USFWS during 21-31 May 1992. The objective was to develop procedures for population trend surveys. Two fixed-wing aircraft (PA-18), each with a pilot and 1 observer, were used to search for bears in 3 study sites. The study sites, each approximately 100-135 mi^2, were located in the Sturgeon River, Olga Lakes and Aliulik Peninsula areas of southern Kodiak Island. Two replicate surveys were done in the Sturgeon River area and 3 replicate surveys were done in the other 2 study sites.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: In 1987, the brown bear population in Unit 8 was estimated at 2,732 bears by extrapolating from a brown bear density estimate done in 2 study areas (Smith 1991). Another density estimate, using the capture-recapture technique developed by Miller *et al.* (1987) is scheduled for 1993 in the Aliulik Peninsula. Results of that density estimate will be used to refine the previous population estimates for Unit 8.

The aerial surveys done in 3 study areas of southern Kodiak Island in May 1992, indicated differences in relative abundance among areas (Barnes 1992). The mean number of independent bears/mi^2 observed for the 3 areas was: Sturgeon 0.18, Olga Lakes 0.09, and Aliulik Peninsula 0.24. The mean number of bears/hr was: Sturgeon 2.5, Olga Lakes 1.7, and Aliulik Peninsula 3.7.

The relative abundance of bears observed in the 3 study areas differed from the extrapolated population predictions reported by Barnes *et al.* (1988). Bears were more abundant than expected in the Aliulik Peninsula and less abundant than expected in the Olga Lakes and Sturgeon River sites. The aerial surveys will be repeated in 1993 in the Olga Lakes and Sturgeon study areas, along with a brown bear density estimate using mark-recapture techniques in the Aliulik Peninsula. Comparing results of the 1992 and 1993 surveys with the density estimate for the Aliulik will facilitate further evaluation of aerial surveys as a population trend index.

Population Composition: The USFWS conducted aerial surveys along salmon streams of southwestern Kodiak Island that indicated the composition of the brown bear population was stable (Table 1). The percentage of single bears ranged from 44-55% from 1985-1991.

Barnes and Smith (1992) documented a weaning rate of 45% for 108 litters of newborn cubs (255 individuals) produced by radiocollared bears monitored from 1986-1992.

Complete losses of litters occurred in 43% of the litters, partial losses occurred in 31%, and 27% of the litters did not incur any losses.

Distribution and Movements: A study on brown bear-human interactions associated with deer hunting on the KNWR characterized hunter attitudes toward bears, documented the incidence of hunter-bear conflicts, and monitored movements of bears in relation to deer hunting activity (Barnes in press; Barnes 1990b). The study was initiated by the USFWS because of concern about an increasing trend in the killing of brown bears in defense of life and property by deer hunters. The study area encompassed 1,400 km^2 in Uyak Bay, Zachar Bay, Spiridon Bay and Little River drainages of western Kodiak Island. Forty-two brown bears were radio-collared, and bears were relocated at 7-10 day intervals from April-December in 1988-1991. Deer hunting activity was monitored by field observations, from annual mail hunter questionnaire surveys conducted by the ADF&G, and with a special hunter survey distributed to hunters during the study. Interactions with deer hunters were documented for 11 radiocollared bears. Two instrumented bears, both females with yearling cubs, became conditioned to foods associated with deer hunting. It was estimated that more than 40% of the bear population had little or no interaction with deer hunters based on the frequency with which radiocollared bears ranged within $\leq$ 5 km of coastal deer hunting areas. Two unmarked bears were killed in the study area by deer hunters in DLP incidents. One radiocollared female was killed while raiding fish smokers in a village outside the study area. Most hunters reported being aware of potential conflicts with bears but few reported threatening encounters with bears. A need to estimate the incidence of unreported killings of bears by deer hunters was identified. Improved education and information programs for deer hunters were recommended.

Mortality

Harvest: Harvest data by regulatory year for 1985-91 are presented in Tables 2 through 8. Documented human-caused mortality averaged 175.6 bears annually and ranged from 155 in 1989 to 208 in 1985 (Table 2). A slight decline occurred in mean annual mortality from 180.2 bears in 1985-1989 to 164.0 bears in 1990-91.

Season and Bag Limit. The season for residents and nonresidents in that portion of Kodiak Island east of a line from the mouth of Saltery Creek to Crag Point, and Spruce Island was 25 October to 30 November and 1 April to 15 May. The bag limit was 1 bear every 4 regulatory years by registration permit only. In the remainder of Unit 8, the season dates were the same and the bag limit was 1 bear every 4 regulatory years by permit only. Residents, and nonresidents accompanied by a resident within the second degree of kindred, may take bear by drawing permit only; nonresidents guided by a registered, master, or Class A assistant guide may take bear by registration permit only.

Board of Game Actions and Emergency Orders. The Board of Game did not take any regulatory actions affecting Unit 8 brown bears in 1990-91 or 1991-92.

Hunter Harvest. The mean annual sport harvest for 1990 and 1991 was 152.5 bears, a slight decline from the 167.6 bears reported for 1985-1989. The fall harvest in 1990 and 1991 averaged 46.5 bears, a decline from 58.8 bears in 1985-89. The spring harvest in 1990 and 1991 averaged 106 bears compared to 108.8 bears for the 1985-89 period.

The mean percentage of females in the harvest in 1990 and 1991 was 35%, a slight decline from the 37% females in 1985-89.

Permit Hunts. The number of permits issued was stable (Table 3), but the number of permits issued for the northeastern Kodiak Island registration permit hunt increased markedly in 1991-92 (Table 4). We attributed the increase to increased interest by local bear hunters in fall 1991, after an unusually high frequency of bear sightings near the town of Kodiak in late summer and early fall. The number of registration permits issued increased from 54 in fall 1990 to 110 in fall 1991. The harvest in the registration hunt increased from 0 in fall 1990 to 4 in fall 1991.

The competition for available nonresident registration permits previously noted by Smith (1991) continued, with guides maintaining a line at the Kodiak ADF&G office several days in advance of the dates when the permits became available. The most conflict occurred among guides competing for permits in permit hunt areas located on state and private lands. The temporary moratorium on issuing special-use permits for guiding on the KNWR, imposed by the USFWS in 1988, continued, thereby assuring that guides operating on refuge lands received the permits. However, in a few cases where permit hunting areas included large parcels of Native-owned land, conflicts occurred among guides with special-use permits for federal lands and guides with exclusive hunting leases negotiated with private landowners.

Competition is growing among an increasing number of guides for bear permits in hunting areas where land is predominantly state owned. The Commercial Services Board is developing regulations to limit the number of guides which could, if enacted, alleviate the competition for bear permits.

Hunter Residency and Success. Hunter success has ranged from 42-49% since 1987 when Afognak Island and an additional area of northeastern Kodiak Island were included in the limited permit hunts (Table 3). Hunter success in those areas was lower than most of Kodiak Island, and the slight overall decline in hunter success was expected.

Nonresidents have harvested more than one-half of the bears taken each year since 1986 (Table 5). Alaska residents residing outside Unit 8 have harvested 32-34% of the annual harvest since 1989.

Harvest Chronology. November and May were the months of highest harvest for the fall and spring seasons, respectively (Table 6). Most hunters schedule their hunts to take advantage of peak bear activity in late spring and early fall.

Transport Methods. Most hunters travel to hunting areas by charter aircraft and use small, inflatable boats or skiffs to travel within the hunting area. Table 7 contains hunter transport statistics.

Other Mortality: Nonhunting and illegal kills ranged from 9 in 1987 to 19 in 1985 (Table 2). The largest source of nonhunting mortality was DLP kills which ranged from 7-11 annually from 1987-1992. During that period, 45 DLP incidents were reported, and 55 bears were killed. Deer hunters accounted for 22 (42%) kills and 10 (27%) kills occurred at remote villages and residences. In analyzing 88 DLP incidents from 1974-1986, deer hunters were involved in 51% of the kills, and villagers accounted for 23% of the kills (Smith *et al.* 1989).

The incidence of illegal or unreported killing of bears is believed to be low, but bears which have been shot are occasionally found. It is difficult to estimate the magnitude of this mortality, but it should be monitored carefully.

Habitat

Assessment: Most brown bear habitat is undeveloped and only seasonally occupied by humans. There are approximately 3 million acres of brown bear habitat on Kodiak, Afognak and adjacent islands in Unit 8. Nearly one-half of that acreage is contained in the Kodiak National Wildlife Refuge. More than 300,000 acres of the original 1.8 million acres of refuge, mostly prime coastal and riparian brown bear habitat, is being transferred to Native corporations. These corporations have indicated willingness to sell critical wildlife habitat, but they are beginning to develop subdivisions, lodges and recreational cabins near brown bear concentrations on salmon streams and in coastal areas. Other incompatible developments include commercial timber harvest on Afognak Island, proposed expansion of the Terror Lake hydroelectric project, expanding rural settlement, commercial fishing, and increasing recreational activities in remote areas, including hunting, sport fishing, and wildlife viewing.

Resource management agencies, private landowners, and local government need to commit serious efforts toward planning land developments that assure maximum compatibility with bears. Maintaining optimal brown bear populations is economically important to the tourist industry including hunters and bear viewers. Staff members of the KNWR are addressing many of these issues in their planning efforts, proposing extensive regulations to minimize human impacts in important bear habitat (USFWS 1987).

Nonregulatory Management Problems/Needs

Nuisance bear problems in the 5 remote villages and near Kodiak city are exacerbated by inadequate garbage disposal. Improperly maintained landfills in villages continue to attract bears, resulting in several DLP bear kills annually.

In 1991, nuisance bear problems were unusually troublesome near Kodiak city. Several bears regularly visited the municipal dump and fed in dumpsters, traversed subdivisions, and fed on salmon in local streams. Developing environmentally sound and economically feasible garbage disposal will require a multi-agency approach, working closely with local and village governments.

Greater commitment to providing public educational programs about bear/human conflicts, bear ecology and management is a desirable long-term goal. Ignorance by hunters of proper behavior in bear encounters/habitat is a contributory factor in many DLP incidents.

Development of a managed brown bear viewing program similar to the McNeil River State Game Sanctuary has been under consideration for several years. In summer 1990, the USFWS established a bear viewing program on a 2-year, trial basis, on Dog Salmon River near Frazer Lake fish pass. The program was popular with the public, but because of site limitations, including the short period that bears were present and conflicts with the fishery management project, it was decided to move the program to O'Malley River in the Karluk Lake drainage, for a 2-year trial (USFWS 1992). The program was scheduled to be conducted by the USFWS in 1992, and turned-over to a private enterprise in 1993. A 3-year study by USFWS to determine the effects of a managed viewing program on bears at O'Malley River began in June, 1991. Observers stationed at a field camp, overlooking the O'Malley River, recorded activities of bears, and bear interactions with photographers and other visitors in 1991. During the 1991 study, 66 interactions between bears and people were recorded, and in 22 (33%) instances the bears retreated from the people (USFWS 1992). Among 58 independent bears identified in the O'Malley study area in 1991, only 11 (19%) exhibited moderate to high tolerance of humans. A decline in bear use in the O'Malley drainage was predicted in response to increased visits by humans.

CONCLUSIONS AND RECOMMENDATIONS

Current regulations limiting participation in the brown bear hunt provide adequate control of harvest and distribution of hunting pressure. The harvest is stable with male bears predominating in the harvests. The allocation of nonresident hunting permits continues to be a troublesome administrative problem requiring a joint solution involving the guiding industry, regulatory agencies, and private landowners.

The changing status of lands from public to private ownership and increasing pressures for developing lands in important habitat pose serious threats to the future of the Kodiak brown bear. Although current negotiations between private landowners and the federal government offer hope that critical bear habitat will be restored to the KNWR, approximately 50% of the habitat will remain subject to potentially incompatible developments. The cumulative effects of expanding human settlements, proliferating recreational cabins, and increasing commercial exploitation of sport fishing, bear viewing,

deer hunting, and tourism pose long-term threats to the brown bear population. The immediate economic incentives tend to outweigh the long-term perspective when governmental agencies responsible for permitting land use debate the issues. Recent efforts of the Kodiak Island Borough to regulate development of private lands in remote areas using its zoning powers have been extremely controversial. An analysis of the Kodiak brown bear habitat issues recently published by the Kodiak Brown Bear Research and Habitat Maintenance Trust recommends the Trust expand its role in brown bear conservation and suggests strategies to facilitate habitat preservation (LTN Group, 1992).

We must address problems such as the lack of a coordinated, interagency land-use planning effort, strong resistance by private landowners to government regulation, and increased marketing and availability of small parcels of private land in prime coastal and riparian habitat. The ADF&G should work with the USFWS to inventory brown bear habitat and to develop strategies for long-term protection of habitat. Current research on brown bear reproduction and population trends provide a sound basis for managing harvest and other sources of human-induced bear mortality. Managing development and growing human settlement in areas previously occupied by brown bears poses a much more difficult challenge.

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Table 1. Unit 8 aerial stream counts of brown bears*, 1985-1991.

Regulatory year	No. complete surveys	Single bears No. %	Maternal bears No. %	Yearling+cubs No. %	New cubs No. %	Total
1985	10	434 (54)	110 (14)	189 (24)	67 (8)	800
1986	10	445 (55)	115 (14)	191 (24)	54 (7)	805
1987	8	205 (53)	58 (15)	92 (24)	31 (8)	386
1988	4	117 (51)	39 (17)	50 (22)	23 (10)	229
1989	9	406 (46)	148 (17)	284 (32)	54 (6)	892
1990	8	460 (44)	177 (17)	273 (26)	126 (12)	1,036
1991	9	529 (52)	156 (15)	210 (21)	129 (13)	1,024

* From Kodiak National Wildlife Refuge files; standardized low-level surveys along selected streams on southwestern Kodiak Island.

Table 2. Unit 8 brown bear harvest[a], 1985-91.

Regulatory year	Reported												Total kill			
	Hunter kill				Non-hunting kill[b]				Illegal kill[c]							
	M	F (%)	Unk.	Total	M	F	Unk.	Total	M	F	Unk.	Total	M (%)	F (%)	Unk.	Total
1985																
Fall 85	52	31 (37)	0	83	4	8	0	12	0	1	2	3	56 (57)	40 (41)	2	98
Spring 86	70	34 (33)	0	104	1	1	1	3	2	1	0	3	73 (66)	36 (33)	1	110
Total	122	65 (35)	0	187	5	9	1	15	2	2	2	6	129 (62)	76 (37)	3	208
1986																
Fall 86	25	37 (60)	0	62	6	6	0	12	0	3	0	3	31 (40)	46 (60)	0	77
Spring 87	71	30 (30)	0	101	1	2	1	4	0	0	0	0	72 (69)	32 (30)	1	105
Total	96	67 (41)	0	163	7	8	1	16	0	3	0	3	103 (57)	78 (45)	1	182
1987																
Fall 87	25	25 (50)	0	50	5	2	1	8	0	0	0	0	30 (52)	27 (47)	1	58
Spring 88	80	40 (33)	1	121	0	0	0	0	0	0	1	1	80 (66)	40 (33)	2	122
Total	105	65 (38)	1	171	5	2	1	8	0	0	1	1	110 (62)	67 (38)	3	180
1988																
Fall 88	30	23 (43)	1	54	1	7	1	9	0	0	0	0	31 (51)	30 (49)	2	63
Spring 89	73	39 (35)	0	112	0	1	0	1	0	0	0	0	73 (65)	40 (35)	0	113
Total	103	62 (38)	1	166	1	8	1	10	0	0	0	0	104 (60)	70 (40)	2	176
1989																
Fall 89	25	20 (44)	0	45	2	6	1	9	1	0	0	1	28 (58)	20 (42)	1	49
Spring 90	74	32 (30)	0	106	0	0	0	0	0	0	0	0	74 (70)	32 (30)	0	106
Total	99	52 (34)	0	151	2	6	1	9	1	0	0	1	102 (66)	52 (34)	1	155

Table 2. Continued.

Regulatory year	Reported												Total kill			
	Hunter kill				Non-hunting kill[b]				Illegal kill[c]							
	M	F (%)	Unk.	Total	M	F	Unk.	Total	M	F	Unk.	Total	M (%)	F (%)	Unk.	Total
1990																
Fall 90	30	21 (41)	0	51	5	5	0	10	1	1	0	2	36 (57)	27 (43)	0	63
Spring 91	69	29 (30)	0	98	0	0	0	0	0	0	0	0	69 (70)	29 (30)	0	98
Total	99	50 (34)	0	149	5	5	0	10	1	1	0	2	105 (65)	56 (35)	0	161
1991																
Fall 91	25	16 (39)	1	42	3	4	0	7	0	0	0	0	28 (58)	20 (42)	1	49
Spring 92	72	40 (36)	2	114	3	0	0	3	0	1	0	1	75 (65)	41 (35)	2	118
Total	97	56 (37)	3	156	6	4	0	10	0	1	0	1	103 (63)	61 (37)	3	167

[a] Permits required for all hunters.

[b] Includes defense of life or property, research, and other verified human-caused accidental mortality; may include bears which were not sealed, but reported killed by reliable sources.

[c] Includes sub-legal age bears, sows with cubs, out-of-season kills, and bears found shot.

Table 3. Unit 8 brown bear harvest data for permit hunt numbers 201-259, 1985-1991.

Hunt	Regulatory year	Permits Issued	Permits returned	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males %	Females %	Unk.	Total[c] harvest
Fall	1985-86	84	83	2	33	67	34 (63)	20 (37)	0	54
(#201-229)	1986-87	87	85	1	45	55	21 (48)	23 (52)	0	44
	1987-88[a]	126	126	3	61	39	23 (48)	25 (52)	0	48
	1988-89[b]	139	139	6	62	38	28 (57)	21 (43)	1	50
	1989-90	127	127	5	65	35	22 (52)	20 (48)	0	42
	1990-91	124	123	2	57	43	30 (59)	21 (41)	0	51
	1991-92	119	119	8	67	33	21 (58)	15 (42)	1	37
Spring	1985-86	156	151	1	43	57	53 (65)	29 (35)	0	82
(#231-259)	1986-87[a]	164	164	2	47	53	62 (73)	23 (27)	0	85
	1987-88[b]	222	221	2	45	55	77 (66)	39 (34)	1	117
	1988-89	216	216	1	34	66	73 (65)	39 (35)	0	112
	1989-90	234	232	6	54	46	70 (69)	32 (31)	0	102
	1990-91	221	221	1	66	44	68 (71)	28 (29)	0	96
	1991-92	227	225	6	50	50	69 (66)	35 (34)	2	106
Combined Spring & Fall										
	1985-86	240	234	1	40	60	87 (64)	49 (36)	0	136
(#201-259)	1986-87	251	249	2	47	53	83 (64)	46 (36)	0	129
	1987-88[a]	348	347	3	51	49	100 (61)	64 (39)	1	165
	1988-89[b]	355	355	3	53	47	101 (63)	60 (37)	1	162
	1989-90	361	359	5	58	42	92 (64)	52 (36)	0	144
	1990-91	345	344	1	57	43	98 (67)	49 (33)	0	147
	1991-92	346	344	6	57	43	90 (64)	50 (36)	3	143

[a] Afognak Island group and additional areas of northeastern Kodiak Island (Hunt areas 227-229, 257-259) first included.
[b] Changed to single drawing for residents for fall and spring hunts; 2 drawings in previous years.
[c] Harvest figures may differ slightly from those in Table A because of differences in classification of illegal kills and unresolved discrepancies in hunter reports.

Table 4. Unit 8 brown bear harvest data for permit[a] hunt numbers R230 and R260, 1985-1991.

Hunt	Regulatory year	Permits Issued	Permits returned	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males %	Females %	Unk.	Total[c] harvest
Fall	1985-86	535	495	29	92	8	17 (61)	11 (39)	0	28
(#201-229)	1986-87	425	387	39	92	8	3 (16)	16 (84)	0	19
	1987-88	106	102	53	98	2	2 (100)	0 -	0	2
	1988-89	85	78	46	92	8	2 (50)	2 (50)	0	4
	1989-90	88	80	43	94	6	3 (100)	0 -	0	3
	1990-91	54	51	30	100	0	0 -	0 -	0	0
	1991-92	110	108	40	94	6	4[c] (80)	1 (20)	0	5[c]
Spring	1985-86	154	141	25	83	17	16 (84)	3 (16)	0	19
(#231-259)	1986-87	140	136	23	84	16	9 (56)	7 (44)	0	16
	1987-88	51	51	57	86	14	2 (67)	1 (33)	0	3
	1988-89	50	41	22	100	0	0 -	0 -	0	0
	1989-90	55	51	41	87	13	4 (100)	0 -	0	4
	1990-91	63	60	37	95	5	1 (50)	1 (50)	0	2
	1991-92	73	71	15	87	13	3 (38)	5 (62)	0	8
Combined Spring & Fall										
	1985-86	689	636	28	90	10	33 (67)	14 (33)	0	47
(#201-259)	1986-87	565	523	35	90	10	12 (34)	23 (66)	0	35
	1987-88[a]	157	153	54	94	6	4 (80)	1 (20)	0	5
	1988-89[b]	135	119	38	96	4	2 (50)	2 (50)	0	4
	1989-90	143	131	42	92	8	7 (100)	0 -	0	7
	1990-91	117	111	34	97	3	1 (50)	1 (50)	0	2
	1991-92	183	179	30	91	9	7[c] (54)	6 (46)	0	13[c]

[a] No limit on number of permits issued.

[b] Afognak Island group and part of northeastern Kodiak Island changed to limited permit hunts #227-229 and #257-259.

[c] Includes 1 bear killed by a sport hunter without a permit (not included in success rate of permittees).

Table 5. Unit 8 brown bear successful hunter[a] residency, 1985-91.

Regulatory year	Local[b] resident (%)	Nonlocal resident (%)	Nonresident[c] (%)	Total successful hunters
1985/86	95 (51)	____	90 (49)	185
1986/87	66 (40)	----	100 (60)	166
1987/88	78 (46)	----	92 (54)	170
1988/89	71 (43)	----	94 (57)	165
1989/90	11 (7)	49 (33)	90 (60)	150
1990/91	7 (5)	47 (32)	95 (63)	149
1991/92	14 (9)	53 (34)	88 (57)	155

[a] Permits required for all hunters; does not include sport hunters who killed bear without a permit, so may differ from other tables.
[b] All Alaskan residents included until 1989-90.
[c] Includes the following successful non-residents guided by next-of-kin: 1986/87 --3, 1987/88 --3, 1988/89 --4, 1989/90 --1, 1990/91 --2, 1991/92 --0.

Table 6. Unit 8 brown bear harvest chronology by season and month, 1985-1991.

	Fall			Spring			
Regulatory year	October No. %	November No. %	Total No.	April No. %	May No. %	Total No.	Regulatory year Total[a]
1985-86	31 (37)	52 (63)	83	49 (47)	55 (53)	104	187
1986-87	24 (38)	39 (62)	63	39 (39)	61 (61)	100	163
1987-88	28 (57)	21 (43)	49	41 (34)	80 (66)	121	170
1988-89	17 (31)	37 (69)	54	40 (36)	72 (64)	112	166
1989-90	21 (47)	24 (53)	45	36 (34)	70 (66)	106	151
1990-91	22 (43)	29 (57)	51	46 (47)	52 (53)	98	149
1991-92	20 (49)	21 (51)	41	50 (44)	64 (56)	114	155

[a] May differ slightly from Table 1 because of different classification of illegal sport harvest.

Table 7. Unit 8 brown bear harvest[a] percent by transport method, 1985-91.

Regulatory year	Percent of harvest								n
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1985-86	82	0	13	0	0	1	3	1	187
1986-87	81	0	18	0	0	0	1	0	163
1987-88	85	0	12	0	0	1	0	2	170
1988-89	74	0	24	0	0	0	0	2	166
1989-90	73	1	21	1	0	0	1	4	151
1990-91	72	0	25	0	0	1	1	1	149
1991-92	51	0	41	0	0	1	7	0	156

[a] Permits required for all hunters; however, sport kills by hunters without permits are included here.

Table 8. Unit 8 sport killed brown bear skull size and age by sex, 1980-81 through 1991-92.

Regulatory year	Mean skull size males	(N)	Mean age males	(N)	Mean skull size females	(N)	Mean age females	(N)
1980-81	24.0	93	6.2	101	21.6	45	6.9	48
1981-82	24.2	78	6.5	79	21.7	39	7.1	39
1982-83	24.4	89	7.2	98	22.1	55	8.6	59
1983-84	24.6	128	7.4	130	21.6	60	7.9	62
1984-85	24.7	99	7.3	102	22.0	45	7.8	51
1985-86	24.5	116	7.4	120	21.9	57	7.2	64
1986-87	24.8	93	7.6	96	21.9	60	8.5	64
1987-88	24.6	100	6.7	104	21.8	63	6.6	65
1988-89	25.5	98	9.1	103	21.6	53	7.4	61
1989-90	25.4	96	9.0	97	21.6	48	8.7	52
1990-91	25.3	97	8.6	95	21.7	43	8.0	50
1991-92	25.0	91	8.4	96	21.7	52	8.0	56

LOCATION

Game Management Unit: 9 (33,638 mi^2)

Geographic Description: Alaska Peninsula

BACKGROUND

The Alaska Peninsula is a premiere producer of large brown bears, and the Board of Game has placed a high priority on maintaining the quality of this population. Because of relatively easy aircraft access and the high quality of bear trophies in the unit, an active guiding industry developed during the 1960s. As hunting pressures increased, several studies on brown bear ecology were initiated. During the late 1960s and early 1970s ADF&G engaged in research at McNeil River State Game Sanctuary to investigate reproductive biology and survival rates of brown bears. A succession of graduate students from Utah State University studied bear behavior at McNeil River during the early 1970s.

An intensive study was conducted during the early 1970s near Black Lake in the central portion of Subunit 9E. From 1970 to 1975, 344 bears were captured and marked to acquire information on reproductive performance, movements, and harvest rates. More recently, efforts have been directed at further analyzing the data from this study to better understand the population dynamics of an exploited bear population. In 1988 an interagency study was initiated at Black Lake to assess the current status of the bear population (Sellers and Miller 1991, Miller and Sellers 1992), and to make comparisons with conditions in the early 1970s. The 1989 *Exxon Valdez* oil spill (EVOS) lead to another research project to assess damage to the brown bear population along the coast of Katmai National Park. This study is continuing under NPS funding with the primary objective of measuring population parameters of an unhunted brown bear population.

High harvests coincided with poor salmon escapements in most drainages in 1972 and 1973; this indicated that hunting seasons should be reduced. Harvest statistics and the high percentage of marked bears killed in the Black Lake area also supported a reduction in hunting. Emergency closures were declared for all of Unit 9 during spring 1974 and for the central portion of the Alaska Peninsula during spring 1975. At the spring 1975 board meeting the present system of alternating seasons (open in the fall of odd-numbered years and the spring of even-numbered years) was adopted to keep harvests within the quota of 150 bears per year for the area south of the Naknek River. This system reduced harvests substantially from 1976 to 1981 and allowed the bear population to recover.

In 1984, the board abandoned the harvest quota (150 bears) for the area south of the Naknek River, and endorsed more flexible objectives (Sellers and McNay 1984): (1) maintain maximum opportunity to hunt bears and avoid a drawing permit system; (2) continue both spring and fall hunts, maintain a desirable sex ratio in the bear population,

and allow hunters to select either season; (3) maintain hunting seasons long enough so that severe weather would be unlikely to eliminate the entire season; and (4) handle chronic bear threats to villages through better sanitation, public education, and, only as a last resort when other measures prove ineffective, through special permit hunts.

During fall 1988, the Alaska Supreme Court ruled that the exclusive guide area system unconstitutional. This allowed the number of registered guides operating in Unit 9 to increase; however, federal land management agencies did not issue commercial-use licenses to new guides on federal lands. This limited new guides to hunting on either state or private lands. The USFWS reallocated guide areas in January 1993, and the Commercial Services Board is expected to award new guide areas in 1993. With over 70% of the Unit 9 harvest coming from guided hunts, stability in the guide industry is a key part of the management program.

MANAGEMENT DIRECTION

Management Objectives

The management objectives for Unit 9 brown bears are to maintain a high bear density with a sex and age structure that will sustain a harvest composed of 60% males with 50 males, 8 or more years-old taken during the combined fall/spring season.

METHODS

Historically, brown bear managers have relied heavily on interpretation of harvest statistics (i.e., total harvest, sex ratios, age composition) to monitor bear populations. In recent years some attention has been given to using various computer models (Tait 1983, Harris 1984) to aid in evaluating usefulness of harvest data. While this approach has not been abandoned, harvest data has inherent problems (Miller and Miller 1990) and supplementary means of detecting changes in heavily exploited bear populations are needed.

Aerial surveys of bears concentrated along salmon streams have been used periodically since 1958, primarily to detect major changes in population composition. Erickson and Siniff (1963) identified limitations of these surveys, recommending procedures to standardize the technique. Surveys have been conducted subsequently near Black Lake by ADF&G, in the Becharof, Ugashik and Izembek areas by USFWS, and in Katmai National Park by NPS. The ADF&G entered into a cooperative agreement with the USFWS and NPS to conduct a comprehensive study near Black Lake, and an EVOS study initiated in 1989 along the Katmai coast is continuing under NPS funding.

RESULTS AND DISCUSSION

Population Status and Trend

The brown bear population in Unit 9 was depressed during the mid-1970s because of high harvests, low salmon escapements, and severe winters. With the reduced harvests during the late 1970s, bear densities increased until 1985. Although the population remains high, growth has stopped. Aerial surveys at Black Lake from 1985-92 indicated a stable population (Sellers and Miller in prep.).

Population Size: Brown bear densities vary within Unit 9; densities were lower in western Subunit 9B and the Bristol Bay coastal plain. Results from the 1989 census at Black Lake showed an overall density of a bear/2.08 mi^2 for a 469 mi^2 study area. Within the study area, density varied among count units from a bear/1-7 mi^2 depending on habitat type (Miller and Sellers 1992). Results from this census were extrapolated to all of Unit 9 (Sellers and Miller 1991). Estimated population size by Subunit was 296, 879, 429, 3176, and 900 for Subunits 9A, 9B, 9C, 9E, and 9D, respectively. These estimates do not include National Park lands or McNeil River State Game Sanctuary. In the portion of Unit 9 open to brown bear hunting, the total population was estimated at 5,679 bears, with an overall density of a bear/4.13 mi^2 (93 bears/1,000 km^2) (Sellers and Miller 1991). I estimated that national parks within Unit 9 and McNeil River State Game Sanctuary contain an additional 2,000-2,500 brown bears.

Population Composition: Evidence from the ongoing Black Lake study and analysis of harvest data show a change in the population composition since the early 1970s that is believed to be correlated to differences in harvest rates. The Black Lake capture samples during the early 1970s showed an adult (i.e. $\geq$ 5 years old) sex ratio of 21 males:100 females. The 1988-89 capture sample showed a significantly higher ratio of 39 males:100 females (t=1.62, df=194, P=0.052). The average age of adult males increased from a mean of 7.19 years in the early 1970s to 9.92 years in 1988 (Mann-Whitney, T=87.5, P=0.080) (Sellers and Miller in prep.). The average age of adult females also increased from a mean of 9.57 years during the early 1970s to 12.21 years for 1988 (Mann-Whitney, T=1,345, P=0.003).

The composition of bears classified during replicate stream surveys at Black Lake also showed changes in population composition which were believed to reflect significant changes in harvest rates beginning in the mid-1960s. This analysis was based on the percentage of "single" bears (i.e. not in family groups) in the population. Family groups of cubs and yearlings were protected by hunting regulations, so that hunting tended to reduce the proportion of single bears in the population (Sellers and McNay 1984). During 1958-61, when harvests were extremely low, an average of 46% (range=37-55%) of 1,365 brown bears classified during summer surveys were single bears. This was higher (t=6.81, P=0.002) than the average of 21% single bears (range=17-26%) for 2,078 bears classified from 1967 to 1976 when the population was affected by excessive harvests. Restrictive

regulations, beginning in 1974, led to reduced harvests and the population began recovering during the late 1970s and early 1980s. During 1984-92, an average of 36% (range=27-49%) of 5,896 bears classified during stream surveys were single, significantly higher than during 1967-76 (t = 5.42, P = < 0.001), yet lower than during the period of 1958-61 (t = 2.40, P = 0.052).

I believe the circumstances of excessive harvests in the early 1970s and subsequent population recovery that were documented at Black Lake apply to Unit 9 in general. Analysis of harvest data presented below support this hypothesis.

Mortality

Harvest:

Season and Bag Limit. The hunting season in Subunit 9C, Naknek River drainage, was from 1 September to 31 October and between 1 May and 30 June. The bag limit was 1 bear every 4 regulatory years by registration permit only.

The open season in Subunits 9A and 9B was 1 October to 21 October in odd numbered years and 10 May to 25 May in even numbered years. The season for the remainder of Unit 9, including the registration permit hunt in the Cold Bay road system was 7 October to 21 October in odd numbered years and 10 May to 25 May in even numbered years. The bag limit was 1 bear every 4 regulatory years.

Board of Game Action and Emergency Orders. The Board of Game has not acted on Unit 9 brown bear seasons since spring 1990. Because changes to the Cold Bay registration permit hunt #262 did not get codified, the fall 1990 and spring 1991 seasons were closed by emergency order. The fall 1991 and spring 1992 hunts were closed by emergency order after hunters took the quota of 2 bears.

In 1991 legislation was passed to enlarge the McNeil River State Game Sanctuary and create the McNeil River State Game Refuge upon formal operation of the newly constructed Paint River fish ladder. The Legislature directed the Board of Game to determine whether the new refuge should be closed to brown bear hunting (the new sanctuary lands were closed to all hunting and trapping in the legislation). The board considered this controversial issue at its fall 1991 meeting. Based on past harvests and estimated bear densities, the department recommended harvests in that portion of Subunit 9A from Contact Point south to the boundary of McNeil River State Game Sanctuary average not more than 3 brown bears per calendar year. The board did not make a final decision on whether to continue bear hunting in this area, but rather directed the ADF&G to undertake a public planning process for the new refuge. Until the planing process was completed, the board endorsed the recommended harvest guideline of 3 bears per season. Because 5 brown bears were killed in this area in the fall 1991 season, the spring 1992

season was closed by emergency order from Contact Point south to the McNeil River State Game Sanctuary boundary.

The Big Creek portion of the Naknek drainage registration hunt #261F was closed by emergency order on 19 September 1992 after hunters harvested 5 bears. Considerable hunting pressure was exerted in this area (primarily because of a proliferation of jet boats and the activity of 1 guide), and with the season only 25% completed, the closure was issued to prevent an overharvest of bears that probably were not involved in complaints within the communities along the Naknek River.

Hunter Harvest. The reported harvest for the 1991-92 regulatory year was 540 brown bears, including 359 males (67%), 176 (33%) females, and 5 bears of unspecified sex. Sixteen bears were also killed in nonhunting circumstances (Table 1). I estimated the actual nonsport mortality at 50 bears. The 1991-92 harvest was the same as reported in 1989-90. All subunits experienced harvests similar to the previous open regulatory year (Tables 2-7); however, Subunits 9D and 9E showed a slight decrease in the fall harvest and an increase in the spring kill. This change in distribution of the harvest reflected the delayed fall opening in 1991.

The sex ratio for bears killed in Unit 9 averaged 65% males from 1987 to 1991. The number of trophy-sized males (i.e. $\geq$ 8 years-old) in the harvest has increased from an average 51 (range=41-58) during the period of population recovery from 1975-76 through 1981-82, to 73 (range=61-80) for 1983-84 through 1987-88, to 119 for 1989-88 through 1991-92. Not only has the number of mature males in the harvest increase, but the proportion of the harvest comprised of mature males has also increased for these 3 time periods: 14.3% for 1975-76 through 1981-82; 16.9% for 1983-84 through 1987-88; and 21.9% for 1989-90 through 1991-92. It should be noted these changes in harvest patterns occurred over a period when the hunting regulations were relatively stable except for an extra 6 days in the October season for 1985, 1987, and 1989.

Permit Hunts. The registration permit hunt in the Naknek drainage was designed to minimize bear-human conflicts in the most heavily settled portion of Unit 9. Participation in fall hunts was higher because some moose and caribou hunters obtained a permit "just in case" they encountered a bear. During the 1990 regulatory year, 6 bears (4 males and 2 females) were killed during fall and 2 males and 1 of unknown sex were killed during the spring hunt (Table 7). During the 1991 regulatory year, 4 males were killed during fall and 1 male during spring (Table 7). Since the 1987 regulatory year, 20 of 42 bears (48%) taken in this permit hunt were either confirmed or suspected of having been in conflicts with humans.

Closure of the Big Creek portion of the drainage by emergency order on 19 September 1992 caused the first noted battle over allocation among user groups. Because 4 of the 5 bears killed in the Big Creek drainage before the EO closure were taken by 1 guide's hunters, some resident hunters voiced the opinion that this hunt should be open only to

resident hunters. Since 1987, 12.6% of the permits issued have been for nonresidents. During the same period, 35.4% of the harvest has been by nonresidents; about the same percentage of the harvest has been by local residents; and other Alaska residents (primarily associated with the military) have taken the remainder. The increased use of jet boats by residents to access the upper sections of Big Creek during September when bears are foraging for salmon does little to focus hunting pressure on problem bears near the settled areas of the drainage. Hunting by resident and guided hunters in remote portions of the drainage has increased and was essentially a sport hunting opportunity. Part of the reason for the restriction against use of aircraft for this annual hunt was to concentrate hunting effort near the road system where conflicts between people and bears were a chronic problem. Conversely, the killing of a young bear (clearly a chronic "nuisance" bear) at a local hotel's dumpster was also widely criticized as amounting to hunting over bait, despite previous efforts by hotel employees and department staff to chase the bear away. Participation and results of this hunt need close monitoring to ensure the management objectives are being addressed.

The registration permit hunt in the Cold Bay area was also designed to minimize bear-human conflicts. In 1983, the Izembek National Wildlife Refuge (INWR) staff expressed concern that the number of local brown bears was too low; they believed problem bears were not common. Consequently, the Board of Game only authorized this hunt when it was determined that problem bears were present. The hunt was not conducted from 1984 until fall 1989. During this period, the bear population apparently increased, and the USFWS and the department agreed it was impractical to have a season by emergency announcement in response to nuisance bear complaints. Thus, the registration permit hunt was changed to coincide with the normal unitwide season, with a seasonal quota of 2 bears or a regulatory year quota of 4 bears. The fall 1991 quota was taken in 2 days, and the spring 1992 quota in 9 days. For both seasons, a total of 12 hunters received permits (Table 8). Although there were still some administrative problems with this hunt, this system appeared preferable to the uncertainties of previous years.

Hunter Residency. The number of nonresident hunters has increased in the past 7 years from 296 in 1985 to 409 in 1991-92 (Table 9). This appeared to be a combination of some established guides booking more clients and an influx of new guides, especially in 1989-90 after the state Supreme Court ruled against exclusive guide areas. Despite a moratorium on new guiding operations on federal lands, I estimate 15-20 new guides have been operating on state or private lands in Unit 9 since 1989.

Harvest Chronology. Before 1985, the fall season began on 7 October. When the opening date was moved to 1 October the pattern of harvest also shifted (Table 10); 47% of the fall harvest occurred during the first 6 days of October during 1985-89. Fall harvest composition was examined to determine if adult females were harvested in a higher proportion during any part of the 3-week season, but no pattern was evident. The percentages of adult females in the harvest for 1985-89 were 25.6%, 27.5% and 26.5%

for 1-6 October, 7-14 October, and 15-21 October, respectively. The opening date for the general season in Subunits 9C, 9D, and 9E was moved back to 7 October in 1991.

The spring hunt chronology can be affected by weather. For example, the very late spring of 1986 caused very low hunter success during the first week of the season (Table 10).

Transportation Methods. During unitwide brown bear hunts, over 80% of the successful hunters used aircraft, with boats being the next most common method of transportation (Table 11). The INWR staff submitted a proposal to create a state controlled use area within the Joshua Green River drainage to prohibit the use of motorized vehicles, except boats. This proposal was prompted because federal regulations, closing the area to aircraft landings, were voided under ANILCA in 1980 and the public recently discovered that aircraft access was not prohibited. Because of the area's proximity to Cold Bay and the numerous landing "strips" within the area, a significant increase in bear hunting activity and harvest would be expected without reinstituting the prohibition against aircraft. The ADF&G supported this return to past access restrictions because the level of hunter effort and success were acceptable when aircraft were not used.

Analysis of Long Term Harvest Data:

Historical Harvest Levels. Bear sealing was not required before 1961, but knowledgeable USFWS employees estimated that fewer than 100 bears/year were killed by hunters on the Alaska Peninsula during the 1950s. There were rumors of significant illegal killing of bears along certain stretches of coast by commercial fishermen. The reported annual harvest for Unit 9 during 1961-63 averaged 143 bears (range=133-154). For the next 3 regulatory years (1964-66), the Unit 9 harvests were 189, 212, and 237. During 1967-70, the reported harvests dropped to an average of 141 (range=109-170), but regulatory changes during this period led to illegal bootlegging of bears out of Unit 9. Records from 4 major taxidermy shops outside Alaska showed 37% of Alaska brown bears received for mounting in 1968 and 1969 were unsealed (Faro 1970). Thus the harvest record during this period, especially for 1969, were suspected of underrepresenting the actual sport harvest of bears. By 1971 the regulations were changed to reduce the benefit to guides from bootlegged bears, and the reported harvest was 203 bears. The 1972 regulatory year harvest jumped to 313 bears.

Several statistics, as reported below, indicated that sustainable levels of harvest were exceeded, especially in Subunit 9E. Spring seasons were closed by EO in 1974 and 1975. Nevertheless, the average annual harvest from 1971-75 was 234 bears. By 1976, Unit 9 was open for bear hunting in the spring of even numbered years and fall of odd numbered years. During the next 7 years (1976-82), harvests averaged 165 bears/year, and the bear population grew substantially. Beginning with the 1981 regulatory year, harvests started to expand. Since 1986, the average annual harvest has been 273 bears.

Historical Harvests - Black Lake. The pattern described above for Unit 9 also occurred at Black Lake. The Black Lake study area was encompassed by Uniform Code Units (UCUs) 09E-1201 and 09E-2001. Bear harvests began increasing in 1966, and from 1966-68 averaged 29 bears (range=25-33) per year. The reported harvests in 1969 and 1970 dropped significantly (17 and 11, respectively), but this resulted from illegal bootlegging (Faro 1970) rather than an actual reduction of harvests. During 1971-73, an average of 31.3 bears (range=27-35) was harvested within this area. Following emergency closures in this area for spring seasons in 1974 and 1975, the average harvest from 1974-87 was 18 bears (range=14-23). From 1988 to 1992, the average harvest increased to 22 bears/year (range=18-31).

Exploitation Rates:

Harvest of Marked Bears. The Black Lake study allows comparison among exploitation rates from the early 1970s with current levels, and evaluation of whether harvest statistics reflect changes in the bear population measured independently. Annual exploitation rates for various sex/age cohorts ≥ 2 years-old were calculated based on the maximum number of marked bears at risk each year (i.e. not adjusted for natural mortality). The average annual exploitation rates during 1970-73 were higher than calculated for 1988-92 (adult males, 18.8 versus 8.8%; adult females, 4.4 versus 2.4%; immature males, 16.7% versus 8.5%; and immature females, 9.0 versus 8.6%) (Sellers and Miller in prep). Applying these sex-age specific harvest rates to the population as reconstructed from capture samples (Miller and Sellers 1992, Sellers and Miller in prep.), the overall harvest rate for bears ≥ 2 years old was 10.5% during the early 1970s and 6.2% during the current study. For the entire population the harvest rates were 8.4% and 4.8% in the early 1970s and currently, respectively.

Extrapolated Harvest Rates - Black Lake. The current population estimate, as extrapolated from the 1989 Black Lake census, for UCUs 09E-1201 and 09E-2001 (3,970 km^2) is 460 bears of all ages or 335 bears ≥ 2 years old. An annual average of 22 (range=18-31) bears were killed within this area during 1988-92. The average annual harvest for 1988-92 was 4.8% for all bears and 6.6% for bears ≥ 2 years old (Sellers and Miller in prep). These rates compare favorably with corresponding rates of 4.8% and 6.2% calculated above for marked bears.

Several independent data (e.g., results of aerial bear surveys along salmon streams, L. Glenn's estimate in Miller and Ballard 1982, preliminary Jolly-Seber calculations) suggested the bear population density was lower than currently estimated (perhaps by ≥ 50%) during the early 1970s. Even if the population was only 30% lower during the early 1970s (i.e., 322 total bears), the exploitation rate then would have been about 9.7% (31.3/322), twice as high as calculated for the past 5 years.

Extrapolated Harvest Rates - Subunits 9E and 9D. Since 1987, the average annual harvest for Subunit 9D was 57 bears (range=37-69), which is 6.3% of the extrapolated population

estimate. For Subunit 9E, the average annual harvest was 161 bears (range=141-183), yielding an average harvest of 5.1%.

Harvest Statistics. To test whether harvest statistics reflected differences in exploitation rates and bear population characteristics, I tested several parameters from the Unit 9 harvests between 1971-75 and 1985-91. If harvest rates exceeded sustainable rates during the early 1970s, causing a depletion of adult males, and if restrictive regulations during the late 1970s and early 1980s allowed the population to recover, then harvests after 1985 should have higher proportion and higher mean age of males compared to harvests during 1971-75. Males harvested during spring seasons during 1985-91 had a higher average age (8.11 years, SE = 0.17) than those killed during 1971-75 (7.28 years, SE = 0.30) (t = 2.39, $P < 0.02$, n = 882). Male skull sizes from recent harvests were also larger (24.97 inches, SE = 0.09 vs. 24.42 inches, SE = 0.20) (t = 2.51, $P < 0.02$, n = 870). Males harvested from fall seasons during 1985-91 also were older (6.18 years, SE = 0.19 versus 5.70 years, SE = 0.22) (t = 1.65, $P < 0.10$, n = 976) and had larger skulls (23.03 inches, SE = 0.11 versus 22.66 inches, SE = 0.14) (t = 2.11, $P < 0.05$, n = 977) compared to males harvested during 1971-75. The percentage of males in the kill during fall seasons during 1985-91 was higher (57.27% versus 53.17%) (X^2 = 2.99, P = 0.08) compared to harvests during 1971-75. The proportion of males in spring harvests was also higher, though not significantly, in recent years (72.81% versus 69.84%) (X^2 = 1.17, P = 0.28). No differences were found for females killed during these 2 periods.

These results suggest that harvest statistics for males reflect changes in population composition caused by exploitation rates during the early 1970s that, based on work at Black Lake, may have been approximately 100% higher than during the past 5 years. The ability of a wildlife manager to rely on harvest statistics to detect smaller changes in exploitation rates or population composition is still dubious, especially where sample sizes are relatively small.

Other Mortality: Preliminary estimates of survival rates (calculated exclusing hunter kills) from the Black Lake study indicated natural mortality was a significant factor for females and young bears. For the first 5 years of this study, annual survival rates for cubs, yearlings, and females >2 years old were 0.56, 0.83, and 0.92, respectively (Sellers and Miller in prep.).

CONCLUSIONS AND RECOMMENDATIONS

Brown bear populations do not lend themselves to convenient methods to monitor trends in density or composition. Harvest statistics are useful, but a manager cannot expect to gain a confident appraisal on the status of the population solely from sex and age composition of the harvest. Stream surveys on the Alaska Peninsula should be continued. The Black Lake surveys suggested a relatively stable and high population. Harvests have increased significantly during the 1980s, and the population appears to have stopped

growing. In 1990, we presented the Board of Game with our best population estimates based on extrapolation from the Black Lake study. For the area of Unit 9 open to hunting, this estimate was 5,679 bears. Using an allowable harvest rate of 5%, the annual sustainable harvest is 284 bears. During 1987-92, the calendar year harvests have been 263, 254, 291, 269, 275, 274. It appears the regulation change implemented in 1991 stabilized the harvest at the prescribed level. At this time I do not recommend establishing new harvest guidelines based on extrapolated population estimates for each subunit. It appears Subunit 9B can sustain an increased harvest, but population estimates for this area are crude and harvests are increasing (Table 3). I recommend obtaining a quality density estimate for an area having habitat similar to that found north of Subunit 9E. Although local management issues continue to move towards "micro-management" (e.g., McNeil Refuge, Katmai Preserve, Naknek registration hunt, the proposed Joshua Green Controlled Use Area), major changes to regulations are not recommended at this time.

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Table 1. Unit 9 Brown Bear Harvest including permit hunts, 1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	132	119	12	263							
Spring 88	165	70	7	242							
Total	297	189	19	505	5	3	1	302 (59)	192 (37)	20 (4)	514
1988											
Fall 88	6	6	0	12							
Spring 89	3	1	0	4							
Total	9	7	0	16	3	4	0	12 (52)	11 (48)	0	23
1989											
Fall 89	164	112	11	287							
Spring 90	199	58	5	262							
Total	363	170	16	549	5	1	1	368 (66)	171 (31)	17 (3)	556
1990											
Fall 90	4	2	0	6							
Spring 91	2	0	1	3							
Total	6	2	1	9	1	3	1	7 (47)	5 (33)	3 (20)	15
1991											
Fall 91	162	108	2	272							
Spring 92	197	68	3	268							
Total	359	176	5	540	6	10	0	365 (66)	186 (33)	5 (1)	556

[a] Includes permit hunt harvests.

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 2. Subunit 9A brown bear harvest, 1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	11	12	2	25							
Spring 88	19	7	2	28							
Total	30	19	4	53	1	0	0	21 (53)	19 (47)	4	54
1988											
Fall 88	0	0	0	0							
Spring 89	0	0	0	0							
Total	0	0	0	0	0	0	0	0	0	0	0
1989											
Fall 89	5	6	1	12							
Spring 90	25	7	1	33							
Total	30	13	2	45	0	0	0	30 (70)	13 (30)	2	45
1990											
Fall 90	0	0	0	0							
Spring 91	0	0	0	0							
Total	0	0	0	0	0	0	0	0	0	0	0
1991											
Fall 91	9	9	1	19							
Spring 92	18	5	1	24							
Total	27	14	2	43	0	0	0	27 (66)	14 (34)	2	43

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 3. Subunit 9B brown bear harvest,1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	11	5	1	17							
Spring 88	5	0	1	6							
Total	16	5	2	23	2	0	1	18 (69)	5 (19)	3	26
1988											
Fall 88	0	0	0	0							
Spring 89	0	0	0	0							
Total	0	0	0	0	1	4	0	1	4	0	5
1989											
Fall 89	10	10	0	20							
Spring 90	8	1	2	11							
Total	18	11	2	31	0	0	0	18 (58)	11 (35)	2	31
1990											
Fall 90	0	0	0	0							
Spring 91	0	0	0	0							
Total	0	0	0	0	0	1	0	0	1 (100)	0	1
1991											
Fall 91	17	10	0	27							
Spring 92	4	3	0	7							
Total	21	13	0	34	0	0	0	21 (62)	13 (38)	0	34

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 4. Subunit 9C brown bear harvest[a], 1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	2	8	1	11							
Spring 88	2	0	2	4							
Total	4	8	3	15	0	0	0	4 (27)	8 (53)	3	15
1988											
Fall 88	6	6	0	12							
Spring 89	3	1	0	4							
Total	9	7	0	16	1	4	0	10 (48)	11 (52)	0	21
1989											
Fall 89	9	2	0	11							
Spring 90	7	1	0	8							
Total	16	3	0	19	3	1	0	19 (83)	4 (17)	0	23
1990											
Fall 90	4	2	0	6							
Spring 91	2	0	1	3							
Total		6	2	1	9	0	0	0	6 (75)	2 (25)	19
1991											
Fall 91	13	3	0	16							
Spring 92	4	4	0	8							
Total	17	7	0	24	3	4	0	20 (65)	11 (35)	0	31

[a] Includes permit hunt harvest.

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 5. Subunit 9D brown bear harvest[a], 1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	24	11	2	37							
Spring 88	44	19	0	63							
Total	68	30	2	100	1	0	0	69 (69)	30 (30)	2 (1)	101
1988											
Fall 88	0	0	0	0							
Spring 89	0	0	0	0							
Total	0	0	0	0	0	0	0	0	0	0	0
1989											
Fall 89	37	24	0	61							
Spring 90	49	16	0	65							
Total	86	40	0	126	0	0	0	86 (68)	40 (32)	0	126
1990											
Fall 90	0	0	0	0							
Spring 91	0	0	0	0							
Total	0	0	0	0	0	0	1	0	0	1	1
1991											
Fall 91	20	23	1	44							
Spring 92	51	18	0	69							
Total	71	41	1	113	0	0	0	71 (63)	41 (37)	1	113

[a] Includes permit hunt harvest.

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 6. Subunit 9E brown bear harvest, 1987-1991.

Regulatory year	Reported: Hunter kill M	F	Unk.	Total	Non-hunting kill[b] M	F	Unk.	Total reported kill M (%)	F (%)	Unk. (%)	Total
1987											
Fall 87	84	83	6	173							
Spring 88	95	44	2	141							
Total	179	127	8	314	1	3	0	180 (57)	130 (41)	8	318
1988											
Fall 88	0	0	0	0							
Spring 89	0	0	0	0							
Total	0	0	0	0	1	0	0	1	0	0	1
1989											
Fall 89	103	70	10	183							
Spring 90	110	33	2	145							
Total	213	103	12	328	1	0	2	214 (65)	103 (31)	14(4)	331
1990											
Fall 90	0	0	0	0							
Spring 91	0	0	0	0							
Total	0	0	0	0	1	2	1	1	2	1	4
1991											
Fall 91	103	63	0	166							
Spring 92	120	38	2	160							
Total	223	101	2	326	2	6	0	225 (69)	107 (31)	2	334

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.

Table 7. Subunit 9C, Naknek Drainage, brown bear harvest data by permit hunt. 1987-91.

Hunt No. /Area	Year	Permits issued	Number did not hunt	Number unsuccessful hunters	Number successful hunters	Number did not report	Males	Females	Total
261F	1987	27	3	12	3	9	0	3	3
	1988	58	5	19	12	22	7	5	12
	1989	52	4	15	8	25	6	2	8
	1990	51	4	13	6	31	4	2	6
	1991	43	7	12	4	20	4	0	4
261S	1988	12	1	2	0	9	0	0	0
	1989	21	2	15	4	0	3	1	4
	1990	14	2	5	0	7	0	0	0
	1991	12	0	9	3	0	2	0	3[a]
	1992	12	0	5	1	6	1	0	1

[a] Includes 1 of unknown sex.

Table 8. Subunit 9D, Cold Bay, brown bear harvest data by permit hunt. 1987-91.

Hunt No. /Area	Year	Permits issued	Number did not hunt	Number unsuccessful hunters	Number successful hunters	Number did not report	Males	Females	Total
262F	1987		No hunt						
	1988		No hunt						
	1989	14	0	6	2	6	2	0	2[a]
	1990		No hunt						
	1991	8	0	6	2	0	2	0	2[a]
262S	1988		No hunt						
	1989		No hunt						
	1990	13	0	5	2	6	1	1	2[a]
	1991		No hunt						
	1992	4	0	2	2	0	1	1	2[a]

[a] Harvest quota of 2 bears; hunt closed by Emergency Order.

Table 9. Unit 9 brown bear successful hunter residency[a] 1987-91.

Regulatory year	Unit resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total Successful hunters
1987-88	25	(5)	139	(28)	339	(67)	505
1988-89	9	(56)	4	(25)	3	(19)	16
1989-90	20	(4)	124	(23)	405	(74)	549
1990-91	1	(11)	3	(33)	5	(56)	9
1991-92	13	(2)	118	(22)	409	(76)	540

[a] Includes permit hunt harvest.
[b] A "local resident" refers to someone who resides in Unit 9.

Table 10. Unit 9 harvest chronology percent by time period, 1981-91.

Regulatory year	October harvest			May harvest	
	1-6 Oct	7-13 Oct	14-21 Oct	10-17 May	18-25 May
1981-82	0[a]	64	36	66	34
1983-84	0[a]	72	28	58	42
1985-86	45	29	26	47	53
1987-88	47	35	17	60	40
1989-90	47	30	23	55	45
1991-92	10[b]	65	25	59	41

[a] The general season for all of Unit 9 opened on Oct. 7.
[b] The general seasons in Subunits 9C, 9D, and 9E opened on Oct. 7.

Table 11. Unit 9 brown bear harvest[a] by transport methods, 1987-1991.

Regulatory year	Percent of harvest								n
	Airplane	Horse	Boat	3 or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1987-88	81	0	13	0	0	1	0	3	505
1988-89	0	0	50	0	0	0	25	12	16
1989-90	85	0	9	0	0	1	1	2	549
1990-91	0	0	33	0	0	22	33	11	9
1991-92	87	0	10	0	0	1	0	2	540

[a] Includes permit hunt harvest.

LOCATION

Game Management Unit: 10 (1,536 mi^2)

Geographic Description: Unimak Island

BACKGROUND

Unimak Island is the only area in Unit 10 occupied by brown bears. The island is classified a wilderness area and is managed by the Izembek National Wildlife Refuge (INWR). Brown bear hunting on Unimak Island was administered by the USFWS from 1949 to 1979 and by the ADF&G after 1979. Fifteen drawing permits are issued each year; 7 for the spring hunt and 8 for the fall. The primary management objective is to provide opportunities to hunt large brown bears under aesthetically pleasing conditions. Number of hunters is limited; harvests are maintained below maximum-sustained yield.

MANAGEMENT DIRECTION

Management Objective

The management objective for Unit 10 brown bears is to maintain a high bear density with a sex and age structure that will sustain a harvest of at least 60% males.

METHODS

The USFWS periodically conducts aerial bear surveys on Unimak Island in late summer. Interpretation of harvest data to reflect population status is not possible with the very low number of bears killed annually.

RESULTS AND DISCUSSION

Population Status and Trend

The Unimak Island brown bear population appears to be maintained by natural regulatory mechanisms at a relatively stable level.

Population Size: Brown bear population size and density were not specifically evaluated on Unimak Island. Results of past surveys and extrapolation of density estimates made elsewhere in Alaska suggested over 200 bears on the island.

Mortality

Harvest:

Season and Bag Limit. The open seasons for residents and nonresidents were 1-21 October and 10-25 May. The bag limit was 1 brown bear every 4 regulatory years by drawing permit only; 15 permits were issued annually.

Hunter Harvest. Since 1985, annual harvests from Unimak Island have averaged 6 bears (range = 4-8). Males have made-up 79% of the harvest since 1987 (Table 1).

Hunter Residency and Success. In the past 5 years, 10% of the successful hunters were nonresidents, versus 72% for Unit 9. Of those who actually hunted, 60% were successful.

CONCLUSIONS AND RECOMMENDATIONS

The brown bear population on Unimak Island appears stable and the drawing permit hunt meets management objectives. I do not recommend any changes in the permit hunt at this time. I recommend continuing late summer aerial surveys flown by the INWR, and the entire island should be stratified to facilitate refinement of the bear density estimate.

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Table 1. Unit 10 brown bear harvest data by permit hunt, 1987-91.

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
						M	F	Total
275 Fall Unit 10	1987-88[a]	8	13	17	83	4	1	5
	1988-89	8	75	0	100	1	1	2
	1989-90	8	50	0	100	3	1	4
	1990-91	8	37	0	100	5	0	5
	1991-92	8	13	43	57	1	3	4
276 Spring Unit 10	1987-88	7	29	40	60	3	0	3
	1988-89	7	29	60	40	2	0	2
	1989-90[a]	7	33	75	25	1	0	1
	1990-91[a]	7	0	50	50	3	0	3
	1991-92	7	86	100	0	0	0	0
Totals for all permit hunts	1987-88	15	20	27	73	7	1	8
	1988-89	15	53	29	71	3	1	4
	1989-90	15	40	38	62	4	1	5
	1990-91	15	21	27	73	8	0	8
	1991-92	15	47	50	50	1	3	4

[a] 1 permittee did not report.

LOCATION

Game Management Unit: 11 (13,257 mi^2)

Geographical Description: Wrangell Mountains

BACKGROUND

Brown bears were numerous in Unit 11 before 1948-1953, when federal poisoning programs directed at controlling wolves incidentally reduced bear numbers. After wolf control ended, bear numbers increased, and by the mid-1970s bears were abundant.

Brown bear harvests averaged 16 (range = 8-27) bears per year throughout the 1960s and 1970s, but declined substantially after 1978, when much of Unit 11 was included in Wrangell-St. Elias National Park and Preserve. Since 1979, hunting pressure has declined and harvests have averaged only 7 bears (range = 3-12) per year.

MANAGEMENT DIRECTION

Management Objectives

The management objective for Unit 10 brown bears is to maintain a brown bear population that will sustain an annual harvest of 25 bears composed of at least 50% males.

METHODS

We monitored the brown bear harvest by sealing skulls and hides of harvested bears. Skulls of sealed bears were measured, sex of bears determined, and a premolar tooth extracted for aging. Information on date and location of the harvest as well as number of days afield was also obtained from successful hunters.

RESULTS AND DISCUSSION

Population Status and Trend

Population data were unavailable for brown bears in Unit 11 because surveys or censuses have not been conducted. Frequent observations of bears by ADF&G staff and the public suggested a relatively abundant and well distributed population of brown bears. A population trend was not evident.

Distribution and Movements: Based on incidental observations and harvest locations, brown bears inhabit all habitats within Unit 11 except high elevation glaciers. There has not been a bear movement study conducted in Unit 11 but we suspect the movement patterns are similar to those in Unit 13. After den emergence, most bears, except females with cubs-of-the-year (COYS), move into riparian areas to feed on sprouting plants and overwintered berries. They also scavenge carcasses of ungulates that died during winter. Females with COYS tend to stay at higher elevations to avoid contact with other bears. Throughout the summer, brown bears in Unit 11 feed in many habitats. In late summer, bears generally move into subalpine habitats to feed in ripening blueberries. Bears feed on salmon in many streams throughout Unit 11 during late summer and fall. Most brown bears in Unit 11 probably den at elevations >3,500, feet with a preference for southern aspects.

Mortality

Harvest:

Seasons and Bag Limits. The open seasons for resident and nonresident hunters in Unit 11 was 1 September to 31 October and 25 April to 31 May. The bag limit was 1 bear every 4 regulatory years.

Board of Game Actions and Emergency Orders. In view of reduced hunter effort, season dates were liberalized in 1981 and 1982 to provide more hunting opportunities. During spring 1989, the board extended the spring season by 6 days. This action was taken to align the closing date with that of Unit 13, and was not expected to result in a substantial increase in harvest. The board determined there was no subsistence use of brown bears in Unit 11 effective 1 July 1989. The National Park Service (NPS) adopted this board subsistence determination and closed all brown bear hunting in those portions of Unit 11 that were designated "hard" park. The NPS position was that only subsistence hunting by local rural residents was allowed in the "hard" park.

Hunter Harvest. Nine brown bears were reported killed during 1990-91 while only 3 bears were reported during 1991-92 (Table 1). Percent males in the harvest exceeded current management guidelines of 50% or more males harvested in both years. The mean age for males was 6.1 years in 1990-91 and 11.0 years in 1991-92. The mean age for males over the past 10 years was 7.5 years.

Hunter Residency and Success. Nonresident hunters took only 1 brown bear during each of the last 2 seasons (Table 2). The annual harvest by nonresidents has declined from an average of 11 (range = 2-18) bears per year between 1961 and 1978 to an average of 2 per year (range = 0-6) since 1978. Local residents harvested 2 bears in each of the last 2 seasons, while nonlocal Alaska residents took 6 in 1990-91. Successful bear hunters averaged 1.7 days during 1991-92. The 20-year hunter effort data shows a mean of 3.8 days spent to take a bear in Unit 11.

Harvest Chronology. Sixty-seven percent of the 1990-91 and 67% of the 1991-92 brown bear harvest occurred during fall (Table 3). Since initiating sealing records in 1961, 82% of the Unit 11 brown bear harvest occurred during fall, presumably because combination hunts for more than 1 species were possible. A noticeable exception was 1989-90 when 58% (n=7) of the take occurred during spring and was attributed to increased guiding activity that year. Spring harvests were higher in the 1970s when more guides were active in Unit 11.

Transport Methods. Aircraft are the most used transport mode followed by highway vehicles, ORVs, and boats (Table 4). Use of ground transportation in Unit 11 is very restricted; the only access points are along the Nabesna or Chitina-McCarthy roads.

Other Mortality: Nonhunting kills were all taken in DLP incidents. Although much of the unit is remote with few cabins, most bear problems that result in the killing of a problem bear occur near homesites and cabins along the Nabesna and McCarthy roads. Because of the work involved with salvaging and preserving the hides and skulls of DLP bears, more bears are probably killed each year than are reported. Compliance with reporting requirements on DLP bears would be higher if individuals were not required to salvage the hide and skull. Since most summer hides are worthless, DLP requirements could be changed so that during June, July, and August, only skulls and claws need be surrendered. This would undoubtedly increase reporting compliance, but might also increase DLP kills as the requirement to salvage the hide may often be a disincentive to killing bears.

Habitat

Assessment: Because of the remoteness of this unit, few cabins or homesites exist. Future settlement will be limited because much of the land is now included in Wrangell-St. Elias National Park. Private inholdings or Park Service facilities would be the only source of development, but there are not any major projects or development plans that might adversely affect brown bears. Overall, Unit 11 is considered good brown bear habitat because of the variety of vegetation types, large tracts of undeveloped land, and many salmon streams throughout the unit.

CONCLUSIONS AND RECOMMENDATIONS

From 1961 to 1978, brown bear harvests averaged 16 bears per year; since 1979, harvests have averaged 7 per year. The declines in the total and nonresident harvests were the result of the establishment of Wrangell-St. Elias National Park and Preserve. National Park Service regulations prohibit sport hunting in portions of the unit designated as "park." From 1979 until 1989, subsistence hunting for brown bears by local residents was allowed in park designated areas. However, aircraft use was not allowed to access park areas, thus effectively closing most of the park to bear hunting. The NPS closed

subsistence brown bear hunting in 1989 after the Alaska Board of Game determined brown bears were not a customary and traditional subsistence animal in Unit 11. Sport hunting of brown bears and aircraft access were allowed in areas designated as "preserve," which constitutes less than 50% of Unit 11.

The percent harvest of males has remained consistent since 1961, averaging 61%. This exceeded the management objective of maintaining a minimum of 50% males in the harvest. Mean age and skull sizes fluctuated yearly. Generally, bears taken in Unit 11 were older and larger than those taken in adjacent Unit 13, where harvest rates were higher.

Bear harvests were very low, and they occurred in limited areas. Harvests apparently did not affect the brown bear population in Unit 11.

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Table 1. Unit 11 brown bear harvest[a], 1987-92.

Regulatory year	Hunter kill					Non-hunting kill[a]			Estimated kill[b]		Total estimated kill					
	M	F	(%)	Unk.	Total	M	F	Unk.	Unreported	Illegal	M	(%)	F	(%)	Unk.	Total
1987-88																
Fall 87	2	2	(50)	--	4	--	--	--	--	--	2	(50)	2	(50)	--	4
Spring 88	0	1	(100)	--	1	--	--	--	--	--	0		1	(100)	--	1
Total	2	3	(60)	--	5	0	0	1	1	1	2	(40)	3	(60)	3	8
1988-89																
Fall 88	4	1	(20)	--	5	--	--	--	--	--	4	(80)	1	(20)	--	5
Spring 89	2	0		1	3	1	--	--	--	--	3	(100)	0		1	4
Total	6	1	(14)	1	8	1	0	0	1	1	7	(88)	1	(12)	3	11
1989-90																
Fall 89	2	2	(50)	1	5	--	--	--	--	--	2	(50)	2	(50)	1	5
Spring 90	5	2	(27)	--	7	--	--	--	--	--	5	(71)	2	(29)	--	7
Total	7	4	(33)	1	12	0	0	0	1	1	7	(64)	4	(36)	3	14
1990-91																
Fall 90	5	3	(38)	--	8	--	--	--	--	--	5	(63)	3	(38)	--	8
Spring 91	0	1	(100)	--	1	--	--	--	--	--	0	(0)	1	(100)	--	1
Total	5	4	(44)	--	9	1	0	0	1	1	6	(60)	4	(40)	2	12
1991-92																
Fall 91	2	0		--	2	--	--	--	--	--	2	(100)		0	--	2
Spring 92	1	0		0	1	--	--	--	--	--	1	(100)		0	0	1
Total	3	0		0	3	0	0	0	1	1	3	(100)		0	2	5

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.
[b] Estimated kill by year, not by season.

Table 2. Unit 11 brown bear successful hunter residency, 1987-92.

Regulatory year	Local[a] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1987/88	3	(60)	0	(0)	2	(40)	5
1988/89	2	(25)	4	(50)	2	(25)	8
1989/90	4	(33)	3	(25)	5	(42)	12
1990/91	2	(22)	6	(67)	1	(11)	9
1991/92	2	(67)	0	(0)	1	(33)	3

[a] Local means residents of Units 11 or 13.

Table 3. Unit 11 brown bear harvest chronology percent by time period, 1987-92.

Regulatory year	Harvest percent				
	September	October	April	May	n
1987-88	60	20	--	20	5
1988-89	50	12	--	38	8
1989-90	33	8	8	50	12
1990-91	89	--	--	11	9
1991-92	67	--	--	33	3

Table 4 . Unit 11 brown bear harvest percent by transport method, 1987-91.

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3-or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown	n
1987/88	40	0	0	0	0	0	40	20	5
1988/89	50	0	0	0	0	25	12	12	8
1989/90	42	8	17	0	0	8	17	8	12
1990/91	44	0	0	0	0	11	33	11	9
1991/92	33	0	0	0	0	0	33	33	3

LOCATION

Game Management Unit: 12 (10,000 mi^2)

Geographical Description: Upper Tanana and White River drainages; includes the northern Alaska Range east of the Robertson River, and the Mentasta, Nutzotin, and northern Wrangell Mountains

BACKGROUND

Grizzly bears are distributed throughout most of Unit 12. The only area (approximately 2,500 mi^2) that is probably not being used by bears is dominated by unvegetated high mountains (>7,000 ft.) or large ice fields. Little is known about the population trend of grizzly bears in Unit 12, but based on historical harvest data most of the unit probably supported natural densities of grizzly bears. In those portions of Unit 12 that were mined extensively or had human settlements, the bear population since the early 1900s has been periodically regulated at low levels.

Since 1900, grizzly bears have been actively sought by hunters in southeastern Unit 12. Bear hunting regulations became more restrictive at the time of statehood until the early 1980s as guiding activity increased in the unit. During the 1970s the unit's moose population declined substantially and grizzly bears were found to be an important predator on moose calves. In an attempt to reduce bear predation on the declining moose population, grizzly bear hunting regulations were liberalized in 1981.

During the mid-1980s, bear harvests increased by 29% in response to the more liberal seasons and bag limits. Concurrently, the survival of moose calves to 5 months of age improved in eastern Unit 12 and the moose population throughout Unit 12 slowly increased. Management objectives call for reduction of grizzly bear harvests once moose numbers approach stated objectives or there is indication that the harvest levels are too high to ensure the viability of the bear population.

MANAGEMENT DIRECTION

Management Goal

The management goal is to provide maximum opportunity to participate in hunting grizzly bears in Unit 12. In recent years Unit 12 bears have also been managed to allow recovery of the unit's moose populations. Regardless of management goals for moose, however, bears in Unit 12 will be managed to ensure that the long term viability of the grizzly population will be not be jeopardized.

Management Objectives

Manage to effect temporary reductions in the grizzly bear population or the extent of bear predation where bear predation is limiting moose population growth (e.g., below food-limiting densities with fall calf:cow ratios <25:100).

After moose populations increase to desired levels, reduce bear harvests to reverse bear population declines.

METHODS

All grizzly bears taken in Unit 12 must be sealed before being transported from the unit. During the sealing process we take skull measurements, determine the sex of each bear, and extract a premolar tooth. Other hunt-related information is also recorded. Premolar teeth are sent to Anchorage to be aged.

RESULTS AND DISCUSSION

Population Status and Trend

The Unit 12 grizzly bear harvest has declined since 1988-89, indicating that local bear populations may have been reduced at least near popular hunting areas. However, harvest data indices (skull size, age, and sex ratio of harvested bears) do not indicate a decline (Fig. 1-3). The three areas where most of the harvest has occurred are the Tok River drainages, the vicinity of the Nabesna Road, and the Chisana River area. The estimated kill density for these areas ranged from 6.5 (Chisana) to 6.9 (Tok and Nabesna) bears/1,000 km^2 which is not excessive for the area's estimated bear density (12 bears/1,000 km^2). Based on these data and considering the low harvest that takes place in the rest of Unit 12, I believe the overall bear population in this unit is stable.

Mortality

Harvest:

Season and Bag Limit.

Unit 12	Sept. 1-May 31	One bear

A bear taken in this unit does not count against the one bear/4 years bag limit in other units. However, no person may take more than one bear statewide per regulatory year.

Board of Game Actions. During the spring 1990 meeting, the board shortened the grizzly bear season in Unit 12 by 10 to 20 days by adopting a 31 May closure. The board also reduced the bag limit from one bear/year to one bear/4 years. These restrictions were supported by the Division of Wildlife Conservation based on a preliminary analysis of the harvest trends. These restrictions were very unpopular with the public and the local advisory committee requested that the area biologist re-analyze the data to see if more restrictive bag limits were necessary. Based on harvest data and on harvest distribution, I concluded there was no evidence indicating a substantial grizzly bear population decline in Unit 12. During the spring 1992 meeting, based on department recommendations, the board reestablished the one grizzly bear/year bag limit for Unit 12.

Hunter Harvest. During the 1991-92 regulatory year hunters reported taking 11 bears (7 males, 4 females), which is slightly below the 5-year average harvest of 14 bears (Table 1). Reported harvests during the past 5 years have declined 40% from the mean annual harvest for the previous 5 years (1982-83 to 1986-87). The period 1982-83 to 1986-87 was the first 5 years of liberalized hunting regulations and included the 2 years of no trophy tag requirement for state residents.

The lack of a trophy tag requirement during 1984 and 1985 significantly influenced the annual Unit 12 bear harvest when 30 and 28 bears were harvested respectively. Only in 1973-74 has the harvest in Unit 12 been that high (28 bears). After the 1986 Board of Game decision to require Unit 12 hunters to carry a resident trophy tag, the harvest declined and remained within the recorded harvest range since 1966 (10-23).

Hunter Residency and Success. During 1991-92, resident hunters took 33% of the grizzly bears in Unit 12, compared with the 5-year average of 60% (Table 2). The reduced resident harvest was because of the new bag limit of one bear/4 years. Before the one bear/year regulation in 1982, nonresident hunters took 63% of the harvested grizzly bears in Unit 12 compared with 34% after the regulation was enacted. Of all the regulation liberalizations, the bag limit of one bear/year was probably the most responsible for keeping harvests by resident hunters relatively high.

Harvest Chronology. During 1991-92, 64% of the harvested grizzly bears were taken during September; the 5-year average was 67% (Table 3). Historically, most of the harvest has been taken during September when moose and caribou hunters are afield.

Transport Methods. Similar to past years, airplanes and horses were used by most successful grizzly bear hunters during 1991-92 in Unit 12 (Table 4). Hunters using 3- and 4-wheeler all-terrain vehicles in the unit have not reported harvesting a grizzly bear during the past 5 years.

Other Mortality: Intraspecific mortality inflicted by adult male bears is probably the greatest source of nonhunting bear mortality in Unit 12. Taking of grizzly bears in DLP incidents has been minimal.

Habitat

Assessment: Unit 12 constitutes good grizzly bear habitat with the exception of about 2,500 mi^2 of unvegetated mountaintops and ice fields. Bear habitat has remained relatively undisturbed except for a few small communities, the Alaska Highway, and the Tok Cutoff. Like most other areas in interior Alaska, streams in Unit 12 do not contain good seasonal salmon runs.

Enhancement: Maintenance of a near-natural fire regime through provisions of the *Alaska Interagency Fire Management Plan: Fortymile Area* constitutes the only action taken in the unit to restore overall habitat diversity and productivity for all species. Restoration of moose and caribou abundance would also benefit grizzly bears indirectly through increased availability of ungulate biomass.

CONCLUSIONS AND RECOMMENDATIONS

Grizzly bears continue to be well-distributed throughout Unit 12 and the population is probably stable. Liberal harvest regulations probably have caused slight population declines in some of the accessible, popular hunting areas.

Liberal grizzly bear harvest regulations were adopted in Unit 12 in an attempt to temporarily reduce grizzly bear predation on moose. During the period of liberal regulations, the bear harvest increased slightly though probably not enough to cause a significant decline in the grizzly bear population. The effects of the liberal harvest regulations on moose calf survival are not yet known.

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Table 1. Unit 12 grizzly bear harvest, 1987-92.

Regulatory year	Reported: Hunter kill M	F	Unk	Total	Reported: Non-hunting kill[a] M	F	Unk	Estimated kill: Unreported	Illegal	Total estimated kill: M	(%)	F	(%)	Unk	Total
1987-88															
Fall 87	10	4	1	15	1	0	0	0	0	11	(69)	4	(25)	1 (6)	16
Spring 88	2	2	0	4	0	0	0	0	0	2	(50)	2	(50)	0 (0)	4
Total	12	6	1	19	1	0	0	0	0	13	(65)	6	(30)	1 (5)	20
1988-89															
Fall 88	7	1	0	8	0	0	0	0	0	7	(88)	1	(13)	0	8
Spring 89	0	2	0	2	0	0	0	0	0	0	(0)	2	(100)	0	2
Total	7	3	0	10	0	0	0	0	0	7	(70)	3	(30)	0	10
1989-90															
Fall 89	5	6	0	11	0	0	0	0	0	5	(45)	6	(55)	0	11
Spring 90	2	0	0	2	0	0	0	0	0	2	(100)	0	(0)	0	2
Total	7	6	0	13	0	0	0	0	0	7	(54)	6	(46)	0	13
1990-91															
Fall 90	7	4	0	11	0	0	0	0	0	7	(64)	4	(36)	0	11
Spring 91	2	3	0	5	0	0	0	0	0	2	(40)	3	(60)	0	5
Total	9	7	0	16	0	0	0	0	0	9	(56)	7	(44)	0	16
1991-92															
Fall 91	3	4	0	7	1	0	0	0	0	4	(50)	4	(50)	0	8
Spring 92	2	0	0	2	1	0	0	0	0	3	(100)	0	(0)	0	3
Total	5	4	0	9	2	0	0	0	0	7	(64)	4	(36)	0	11

[a] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

Table 2. Unit 12 grizzly bear successful hunter residency, 1987-92.

Regulatory year	Unit resident	(%)	Other residents	(%)	Nonresident	(%)	Total successful hunters
1987-88	4	(21)	10	(53)	5	(26)	19
1988-89	3	(30)	4	(40)	3	(30)	10
1989-90	6	(46)	3	(23)	4	(31)	13
1990-91	2	(12)	7	(44)	7	(44)	16
1991-92	0	(0)	3	(33)	6	(67)	9

Table 3. Unit 12 grizzly bear harvest chronology by time period, 1987-92.

Regulatory year	Harvest periods												n
	September	(%)	October	(%)	November	(%)	April	(%)	May	(%)	June	(%)	
1987-88	13	(65)	2	(10)	0	(0)	0	(0)	0	(0)	4	(20)	20[a]
1988-89	6	(60)	2	(20)	0	(0)	0	(0)	2	(20)	0	(0)	10
1989-90	10	(77)	0	(0)	0	(0)	0	(0)	2	(15)	0	(0)	13[a]
1990-91	11	(69)	0	(0)	0	(0)	1	(6)	4	(25)	0	(0)	16
1991-92	7	(64)	0	(0)	0	(0)	1	(9)	1	(9)	0	(0)	11[b]

[a] Includes one DLP bear.
[b] Includes two DLP bears.

Table 4. Unit 12 grizzly bear harvest by transport method, 1987-92.

Regulatory year	Harvest: Airplane (%)	Horse (%)	Boat (%)	3- or 4-Wheeler (%)	Snowmachine (%)	ORV (%)	Highway vehicle (%)	Walking (%)	Unk (%)	n
1987-88	7 (37)	3 (16)	0 (0)	0 (0)	0 (0)	4 (21)	2 (11)	1 (5)	2 (11)	19
1988-89	0 (0)	3 (30)	1 (10)	0 (0)	0 (0)	0 (0)	4 (40)	1 (10)	1 (10)	10
1989-90	4 (31)	2 (15)	1 (8)	0 (0)	1 (8)	4 (31)	0 (0)	0 (0)	1 (8)	13[a]
1990-91	6 (38)	4 (25)	0 (0)	0 (0)	0 (0)	2 (13)	2 (13)	1 (6)	1 (6)	16
1991-92	6 (67)	2 (22)	0 (0)	0 (0)	1 (11)	0 (0)	0 (0)	0 (0)	0 (0)	9

[a] Includes 1 DLP bear.

Table 5. Unit 19 brown bear harvest chronology percentage by time period, 1985-92.

Regulatory year	Harvest periods: September	October	November	April	May	June	n
1985-86	61	17	0	0	22	0	23
1986-87	62	15	0	0	23	0	26
1987-88	72	8	0	0	19	0	36
1988-89	80	7	0	0	13	0	30
1989-90	76	15	0	0	9	0	34
1990-91	61	5	0	5	29	0	38
1991-92	71	6	0	6	16	0	31

Table 6. Unit 19 brown bear harvest percentage by transport method, 1985-92.

Regulatory year	Percent of harvest									n
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Walking	Unknown	
1985-86	83	0	9	0	0	0	0	0	9	23
1986-87	92	0	0	0	0	8	0	0	0	26
1987-88	81	3	8	0	0	6	0	0	3	36
1988-89	77	10	3	0	0	3	0	3	3	30
1989-90	82	3	6	0	0	6	0	0	3	34
1990-91	100	0	0	0	0	0	0	0	0	38
1991-92	84	0	3	0	0	0	3	0	10	31

LOCATION

Game Management Unit: 13 (22,857 mi^2)

Geographical Description: Nelchina Basin

BACKGROUND

The brown bear harvest in Unit 13 increased substantially during the early and mid-1980s. The average annual harvests for the periods between 1961 and 1969, 1970 and 1979, and 1980 and 1987 were 39, 58, and 109 brown bears, respectively. Interest in brown bear hunting by recreational hunters was high between 1980 and 1987, when seasons and bag limits were liberalized.

MANAGEMENT DIRECTION

Management Objectives

The management objectives for Unit 13 brown bears are to maintain a population of 600-1,200 bears and maintain an average annual harvest of fewer than 25 females with an overall average harvest of fewer than 75 bears beginning in 1992.

METHODS

Department representatives sealed skulls and hides of harvested bears. They measured skulls, determined sex, and extracted a premolar tooth for aging. Sealers collected information on date and location of harvest and time spent afield by successful hunters.

RESULTS AND DISCUSSION

Population Status and Trend

Brown bears were considered numerous in Unit 13 before 1948-53 when federal poisoning programs directed at controlling wolves incidentally reduced bear numbers. Brown bears were again considered numerous in Unit 13 by the mid-to-late-1970s, and the population was increasing. During this period, Ballard *et al.* (1980) considered the unit had high bear densities for an Interior area. The bear population probably ceased growing about 1980 when harvest rates increased. Miller (1993) estimated that since 1980 there has been an overall reduction, between 23% and 48%, in Unit 13 bear numbers. He

estimated larger declines in Subunits 13E, 13B and 13A, while the population was stable in Subunit 13C and stable-to-increasing in Sucunit 13D.

Population Size: A population estimate during the late 1970s was approximately 1,500 brown bears. In 1979, a density estimate was obtained during a brown bear transplant along the upper Susitna River in Subunits 13B and 13E. The resulting estimate was 1 bear/16 mi^2 and 1 bear ≥2.0 years of age/30 mi^2 (Ballard *et al.* 1982, Miller 1988). A second density estimate of 1 bear/13.8 mi^2 (1 bear ≥2.0 years/20.2 mi^2) was obtained in 1985 in an adjacent area near the Susitna River (Miller 1987) in Subunit 13E.

In 1987 another density estimate was obtained for a portion of the upper Susitna River to determine if bear numbers had changed since 1979 (Miller 1988). An estimated density of 1 bear/35 mi^2 (1 bear ≥2.0 years/55 mi^2) was obtained, suggesting that the density in the upper Susitna River area was roughly one-half of that in 1979. The density estimates obtained in 1985 and 1987 were applied to the remainder of Unit 13, using a subjective stratification of the unit, resulting in a preliminary population estimate of 1,228 brown bears, of which 823 were ≥2.0 years-of-age (Miller 1990b). My population estimate for Unit 13 was 800-1,200 bears. Based on a sustainable harvest rate model, 640-1,120 bears were estimated to occur in Unit 13 (Miller 1993).

Population Composition: Miller (1993) reported that during 1980-1988, brown bear litters averaged 2.1 cubs-of-the-year, 1.9 yearlings and 1.8 two-year-olds. The estimated reproductive interval was 4.1 years, and the observed age at first reproduction was 5.6 years (range = 4-9). Based on these reproductive parameters, the brown bear population in Unit 13 has a typical reproductive potential for an Interior population, similar to that found north of the Alaska Range (Reynolds 1993).

Distribution and Movements: Miller (1987), using minimum convex polygons, reported average home range estimates of 749 mi^2 for males and 193 mi^2 for females. He, as well as Reynolds (1993), noted a pattern of subadult dispersal, when 2- or 3-year-old males emigrated away from the home range of their mother. Female offspring showed little dispersal, and usually stayed in maternal home ranges. After den emergence, most bears, except females with cubs-of-the-year (COYs), move down to river bottoms to feed on sprouting plants and overwintered berries and to scavenge carcasses of ungulates that died during winter. Females with COYs remained at higher elevations and minimized contact with other bears. Miller also reported movements that may have been influenced by caribou and moose calving and by the seasonal presence of salmon in streams. Spraker *et al.* (1981) and Ballard *et al.* (1982) reported additional information on movements and home ranges of bears radio-collared for research projects in Unit 13.

Mortality

Harvest:

Season and Bag Limit: The hunting season in Unit 13 (except Subunit 13D) for resident and nonresident hunters was 10 September to 31 May; and 1 September to 31 May in Subunit 13D. The bag limit was 1 bear every 4 regulatory years.

Board of Game Actions and Emergency Orders. Before 1980, the management objective for brown bears in Unit 13 was to maintain a sustained-yield harvest while providing the greatest possible opportunity for hunters to participate in hunting brown bears. To allow all to participate yet limit harvests, seasons were generally short and there was no spring season. In 1980, after research data suggested that reduced brown bear numbers could increase moose calf survival (Ballard and Larson 1987, Ballard and Miller 1990), the Board of Game began to liberalize the season in Unit 13, including opening a spring season. In 1982 the board liberalized the bag limit to 1 bear per year in order to increase harvests and reduce the population.

In 1987 the board reestablished the bag limit of 1 bear every 4 years to reduce the incentive for hunters to report taking bears in Unit 13 that were killed in other units having more restrictive bag limits. Such "bootleg" reporting of bears from Unit 13 reduced our ability to determine population trends because of inaccurate harvest data. I estimated the magnitude of bootlegging at 10% of the harvest but the actual number of bears illegally reported was not determined.

During its spring 1990 meeting, when the current season was established, the Board of Game passed the first reduction in season length for most of Unit 13 since 1983. Effective in fall 1990, the fall brown bear season did not open until 10 September, except in Subunit 13D, which was not changed (1 September). The reason for delaying the opening for 10 days was to reduce the incidental take of brown bears, especially females, by moose and caribou hunters.

Hunter Harvest. The reported 1991-92 sport harvest of brown bears was 75. This take was 23 (23%) bears below the 1989-90 harvest of 98. The average yearly harvest during the 5-year period, 1982-87, when harvests were the highest, was 125 bears. The average annual harvest during the 5-year period, 1988-92 was 82 bears a year (range = 73-98).

The 1991-92 brown bear harvest by subunits included: 13A - 15 bears, 13B - 7, 13C - 5, 13D - 6, and 13E - 42. In all subunits except Subunit 13E the reported harvests were well below harvest levels reported from 1984-87. In Subunit 13E, the harvest of 42 bears approached the high annual harvest of 45 bears reported during the 4 peak harvest years from 1984-87.

The 1991-92 harvest was 56 (75%) males, and 19 (25%) females (Table 1). Males comprised 67% or more of the harvest in all subunits. The mean skull size was 22.6 inches for males and 19.1 inches for females. The mean age was 6.7 years for males and 3.9 years for females. The mean age of all males taken exceeded the 19-year average of 6.0 years. However, the mean age for the females in the harvest was well below the 19-year average of 7.0 years.

Although interpretation of size and age data is difficult, the lower mean age observed for females could mean more juvenile females were present in the harvest. An increase in young females suggests either good recruitment or that the harvest rate of mature females has declined. The average age of females in the harvest initially increases in heavily harvested populations. The take of females 5 years-of-age or older and considered to be breeding females was 7, which was 6 less than the 13 taken in each of the prior 2 years. During the 4-year period of maximum harvests (1984-87) the number of females, over 5 years-of-age in the annual harvests averaged 31 (range = 28-36).

Mean age data for males taken in Subunit 13E indicated 22 males ≥ 5 years-of-age were taken in 1991-92. This was numerically the highest harvest ever reported for males ≥ 5 years-of-age in Subunit 13E. It was twice the average of 11 males (range = 7-17) ≥ 5 years taken during the peak harvest years from 1983-87. Most of the harvest of old males occurred during early spring. High harvests of old males are a recent development; during the periods of high harvests the average age of males in the harvest was younger, as would be expected from a heavily exploited population.

Hunter Residency and Success. Nonresident hunters took 37 (49%) bears in 1991-92 (Table 2). The nonresident harvests over the past 3 seasons were some of the highest reported in years. Over the past 31 years, nonresident hunters averaged 28 bears a year. Local residents took 4 (5%) bears this year, compared to an average of 8 bears per year over the 1985-91 report period. Nonlocal Alaskans took 34 (45%) bears compared to an average of 57 bears a year they took between 1985-91. The decline in harvests resulted from a decrease in the resident take. Successful hunters averaged 4.9 days in the field to take a bear in 1991-92. This was the highest reported effort since 1987-88 when it took 5.1 days to take a bear and also exceeded the 23-year average of 3.7 days. However, effort data fluctuated among years and a trend was not evident. It took less time (4.3 days) to take a bear during fall than in spring (5.4 days). Nonresidents spent more time hunting than residents, averaging 6.5 days hunting compared to only 3.4 days for residents.

Harvest Chronology. Hunters harvested 33 (44%) bears during fall 1991, and 42 (56%) animals during spring 1992 (Table 3). Males comprised 64% (21) and 83% (35) of the fall and spring harvests, respectively. The spring harvests in 1990 and 1991 were numerically greater than the fall harvests. In prior years, fall harvests exceeded the spring take. Hunters harvested 26 (62%) bears in Subunit 13E during spring 1992. They accounted for 22 animals before 25 April. The average spring harvest for Subunit 13E,

before 1990, was 9 bears a year. In Subunit 13E, the spring 1990 and 1991 harvests were 25 and 20 bears, respectively. The spring harvests also increased in Subunit 13A during 1990 and 1992 with 10 and 11 bears taken, respectively. During spring seasons, the percentage of females taken increases through the season, and often during the last week more females than males may be taken (Miller 1990a). The total number of bears taken late in the spring season, however, is usually low because snow melt limits hunter access. The potential for overharvesting females is greater in the fall because more hunters are afield as hunting seasons are open for other species. These hunters may be more likely to take the first legal bear they see. During the period of high harvests from 1984-87, females averaged 54% of the fall harvests.

Transport Methods. Aircraft were the most important method of transportation in Unit 13, followed by snowmachines, ORVs, and highway vehicles (Table 4). During the 1990 spring bear season, the use of snowmachines increased in Subunits 13A and 13E, as deep snow conditions allowed unrestricted travel through the back country. Snowmachines have grown in popularity and in 1991 and 1992, they were the second most popular transport method reported by successful bear hunters. New snowmachine models are powerful and reliable and hunters have the potential to reach areas formally too rough or remote for older model snowmachines.

Other Mortality

An average of 2.6 bears per year (n = 76) were killed in Unit 13 in defense of life or property (DLP) since 1961. Between 1985 and 1990, only 7 DLP bears were reported. DLP killings increased during the last 2 years with 5 DLPs reported in 1990-91 and 6 in 1991-92. The reported DLP harvest was a minimum number as some bears were shot and not reported, especially at remote cabins, homesites, and mining claims. The state requirement to salvage the hide often deters individuals from reporting DLP bears because of the effort required. Also, bears are not reported because individuals fear they may be cited if their DLP claim is not valid.

Miller (1990b) reported average natural mortality rates of 33% for cubs-of-the-year and 16% for yearlings during 1978-1989. He also documented intraspecific predation by brown bears as a source of natural mortality, especially in cubs and yearlings. However, Miller (1990c) concluded there was no evidence of an increase in cub survivorship in portions of Unit 13 where densities of adult males were reduced because of increased harvests. Similar conclusions were reached by Reynolds (1993).

Mortality rates for 104 radio-collared or marked brown bears from 1980-1992 were reported by Miller (1993). Annual harvest rates for marked bears ranged from 3-17% and averaged 8%. The annual harvest rate for females in a declining population in the northcentral Alaska Range was 10.4% (Reynolds 1993).

Habitat

Assessment: Bears monitored near Valdez Creek avoided the large mining operation in that area (Miller 1988). Development in remote areas in Unit 13 could reduce brown bear habitat in the unit. Also, more bears are reported killed in DLP situations at remote sites (33%) than are reported for any other site category (Miller and Chihuly 1987). The number of remote cabins and homesites in Unit 13 has increased substantially over the past 15 years. A continuing increase in the number of remote cabins will adversely affect brown bears in Unit 13.

Nonregulatory Management Problems/Needs

An important brown bear management problem is the divergent public attitude towards brown bears. Some people like to see brown bears and favor management objectives that would provide a large number of bears. In contrast, some people, especially local residents, do not like living in proximity to bears. These individuals have usually experienced property damage, had livestock or pets killed by bears, or fear personal injury. Periodical publications encourage and maintain the public's fear of bears. The frequent "scare" articles in the media are hard to overcome, and they perpetuate and promote the bear/human conflict problem.

The bear/human problem was elevated appreciably in early 1992 when a woman was killed and partially consumed by a black bear at her cabin in Subunit 13A. The fear of all bears increased substantially and caused an increase in bear complaints to ADF&G. Rumors of unreported shootings, where bears may have been wounded or killed, increased during the 2-4 week period that followed this incident.

In dealing with bear/human conflicts at remote sites, my recommendation is the ADF&G maintain its policy of not killing or relocating problem bears. The policy is problematic near homesites and recreational areas such as Kenny Lake or Lake Louise where there are numerous dwellings. An action plan or policy is needed for semi-developed areas, especially along the road system, where frequent bear/human conflicts occur.

CONCLUSIONS AND RECOMMENDATIONS

A major brown bear management problem is the difficulty in obtaining population estimates. Because of their low density and secretive behavior, spotting and counting bears is very difficult and expensive. This is especially true of interior grizzly populations that do not congregate on salmon streams and that are wary of motorized vehicles. In most units, counts have never been conducted. Population estimates for Unit 13 are based on unitwide extrapolations of measured bear density in small study areas. Density estimates were obtained on 2 adjacent study areas during 3 population estimation attempts over a 9-year period between 1979-1987. One study area was censused twice and thus

provided trend data. Confidence intervals obtained during the 2 surveys suggested the estimates varied from exhibiting no change in bear numbers versus a 50% decline. The fact that human harvests have been very high on the study area supports the conclusion that a substantial decline occurred. However, gold mining activity increased appreciably between the study periods and could have contributed to the decline. Current density estimates are based on field data and their use in extrapolating a unitwide bear estimate is justified. However, caution is needed when using density estimates for a small area to infer population estimates for a large area. My current population estimate of 800-1,200 bears reflects this uncertainty.

The public, especially Unit 13 residents involved with Fish and Game advisory committees, does not believe ADF&G brown bear population estimates for Unit 13. They feel bear numbers are increasing, not declining, and there are more brown bears than 10 or 15 years ago. In line with these opinions, local advisory committees continue to propose hunting regulations that increase the season length and bag limits and eliminate the bear tag fee for residents. Local residents feel bear numbers can withstand additional harvests, bears should be reduced (especially around developed areas), and moose calf survivorship would improve if the number of brown bears were reduced.

Sport hunting is a major source of mortality for brown bears in Unit 13. Attempts have been made to use harvest data, especially the total kill, to predict the impact of sport hunting on bear numbers. A maximum sustainable harvest rate for brown bears in Unit 13 is estimated at 5.7% per year (8% for bears ≥2.0 years) (Miller 1988). The number of old (≥5 years) females in the harvest is particularly important and should be maintained at a low level estimated to be less than 30 adult females a year.

Brown bear harvests between 1980 and 1987 were high and exceeded the calculated sustainable harvest rates for both conservative and liberal population estimates (Miller 1993). Bear numbers in Unit 13 during this period would have to exceed densities found in Denali National Park to have supported the reported take without declining (Miller 1993). Miller (1993) concluded that bear harvests had caused a significant decline in the Unit 13 bear population. This conclusion may be incorrect if it is easier to census bears in Denali Park where they are conditioned to human disturbance and are not hunted. Census activities over small study areas in Unit 13 could result in lower estimates because bears hide or move out of the study area, resulting in a lower population estimate. I feel Unit 13 has the potential to support a bear population as dense as found in Denali National Park and certainly as productive. Much higher ungulate populations are found in Unit 13 than in Denali National Park and salmon are available in portions of the unit but not in Denali National Park. Uncertainty over bear population estimates makes it difficult to calculate trends in bear populations using the sustainable harvest model favored by Miller (1993).

Hunting regulations became more restrictive when the management objective of maintaining a stable brown bear population was adopted in 1987. With a population

estimate of 1,200 bears in 1987, the sustainable harvest rate was 70 bears. The average harvest since 1987 has been 82 bears a year; thus exceeding the calculated sustainable rate by an average of 14 bears a year. Assuming the population estimate approximated actual bear numbers, I conclude the sport harvest is causing a decline in the Unit 13 bear population, even with the reduction in season dates and bag limits.

The use of calculated sustainable harvest rates as a means to determine population trends assumes the average productivity of the population is known and the population is closed. Miller (1993) provided reproductive data needed to adequately determine recruitment parameters but the Unit 13 brown bear population may not be a closed population.

Brown bears are fully or partially protected in both Denali and Wrangell-St. Elias National Parks. These parks are adjacent to Unit 13 and may provide a source of immigrants. Bear kills were plotted based upon reported kill locations. Although many of these locations were in heavily hunted areas, they bordered areas lightly hunted or closed to hunting. This supports the conclusion that bears are immigrating into heavily harvested areas. I believe immigration was not great enough to have prevented a population decline under prior (1984-87) harvest levels. The importance of immigrants increases, however, as harvests decline and we attempt to determine a sustainable harvest level.

Harvests are not uniformly distributed throughout the unit. Much of the Unit 13 brown bear harvest comes from more open habitats and from areas with available hunter access. These areas are bounded by portions of the unit that have been relatively inaccessible or have overstory vegetation that reduces visibility and results in numerically lower bear harvests. This heterogeneity creates problems for trend estimates based on sustainable harvest rates.

Additional harvest indicators suggesting a decline in bear densities in Unit 13 were presented by Miller (1993). He discussed why a decrease in the percentage of males and ages of males taken during fall suggested a declining population. An increase in the number of females harvested and the percentage of females in the harvest was also observed. These patterns were evident after a period of high harvests in the late 1980s, supporting the conclusion that bear numbers had indeed been reduced.

Analysis of recent harvest data, especially over the last 2 years, suggests that trends observed during periods of high harvest may not be continuing. Specifically, the percentage of males in the harvest, including the fall, has increased. The age of the males taken has also increased with more males ≥ 5 years-of-age taken the last 2 years than during periods of high harvests. A higher percentage of older males in the harvest is not what is expected from a population that has been over-exploited for 13 years. Also, the number of sows harvested was well below the calculated sustainable harvest level.

Effort data does not support the conclusion that the bear population has been greatly reduced. Nothing indicates that it takes more time for successful hunters to harvest a brown bear in Unit 13. As bear numbers decline, the obvious expectation is that it would take longer to find a bear. This has not been observed. Unfortunately, the lack of data on number of unsuccessful hunters and their effort precludes complete analysis of trends in hunter effort. I recommend we begin to collect effort data for unsuccessful hunters.

Miller (1993) provided very important harvest data that was inconsistent with the conclusion that the Unit 13 bear population has been appreciably reduced. He reported the harvest rate for all marked bears ≥2 years was 8% during his study. The allowable harvest rate for bears ≥2 years of age was calculated at 8%, thus the observed harvest rate for marked bears was identical to the allowable harvest. This was an important finding because most of these bears were marked in the upper Susitna study areas in Subunit 13E where harvest rates and hunting pressure have been the highest. Elsewhere in Unit 13 the harvest rates have been lower.

Future management actions on brown bear hunting in Unit 13 will depend upon the management objective. If the management objective is changed, to decrease brown bear populations, harvests will need to increase. This would be the management scenario if the board adopts recommendations from the public. Lengthening the season in September, opening on 1 September instead of 10 September, would be the preferred option. Hunting brown bears is popular and the earlier season would coincide with other hunting seasons and afford a mixed-bag hunt and increase the incidental take of brown bears. Harvests of adult females have historically been high in autumn, thus productivity might be reduced.

A management objective that calls for stabilizing the brown bear population at current levels, then allowing the population to increase, would require management action that reduces the harvest. This is the recommended objective if the board wants to promote bear hunting. Harvests of between 60-65 bears, of which 60% or more are males, should allow bear numbers to stabilize and possibly increase depending upon immigration. To reduce the harvest to this level, I recommend that spring season be shortened and open on 25 April. Although more males are taken at this time, the overall harvest is high. Use of snowmachines has increased the last 2 years and I believe the use of snowmachines to enter previously unhunted denning areas accounts for part of the increase in old males taken during the last 2 years. Harvest chronology for spring season has shifted so that the harvest the last 2 years was before 1 May, by hunters using snowmachines. The greatest potential for overharvesting occurs in spring because of the increase in the number of snowmachines and their efficiency. If the management objective is to ensure the population does not decline, the board should consider reductions in the spring season.

Biologists are scheduled to conduct a bear survey in Subunit 13E during 1993 and 1994. This work should give further insight into the trend in the bear population since the last census in 1985 and guide future management.

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Table 1. Unit 13 brown bear harvest, 1987-92.

Regulatory year	Hunter Kill						Non-hunting kill[a]			Total estimated kill					
	M	(%)	F	(%)	Unk.	Total	M	F	Unk.	M	(%)	F	(%)	Unk.	Total
1987-88															
Fall 87	18	(35)	33	(65)	7	58	--	--	--	18	(35)	33	(65)	7	58
Spring 88	14	(74)	5	(26)	0	19	--	--	--	14	(74)	5	(26)	0	19
Total	32	(46)	38	(54)	7	77	2	1	0	34	(47)	39	(53)	7	80
1988-99															
Fall 88	30	(65)	16	(35)	2	48	--	--	--	30	(65)	16	(35)	2	48
Spring 89	14	(58)	10	(42)	1	25	--	--	--	14	(58)	10	(42)	1	25
Total	44	(63)	26	(37)	3	73	1	1	0	45	(63)	27	(37)	3	75
1989-90															
Fall 89	25	(54)	21	(46)	6	52	--	--	--	25	(54)	21	(46)	6	52
Spring 90	30	(68)	14	(32)	2	46	--	--	--	30	(68)	14	(32)	2	46
Total	55	(61)	35	(39)	8	98	1	0	0	56	(62)	35	(38)	8	99
1990-91															
Fall 90	22	(65)	12	(35)	3	37	--	--	--	22	(65)	12	(35)	3	37
Spring 91	35	(78)	10	(22)	3	48	--	--	--	35	(78)	10	(22)	3	48
Total	57	(72)	22	(28)	6	85	4	0	1	61	(73)	22	(27)	7	90
1991-92															
Fall 91	21	(64)	12	(36)	0	33	--	--	--	21	(64)	12	(36)	0	33
Spring 92	35	(83)	7	(17)	0	42	--	--	--	35	(83)	7	(17)	0	42
Total	56	(75)	19	(25)	0	75	2	4	0	58	(72)	23	(28)	0	81

[a] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality.
[b] Estimates not made because of a lack of supporting data.

Table 2. Unit 13 brown bear successful hunter residency, 1987-92.

Regulatory year	Local[a] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1987-88	3	(4)	47	(61)	27	(35)	77
1988-89	3	(4)	42	(58)	28	(38)	73
1989-90	12	(12)	49	(50)	37	(38)	98
1990-91	12	(14)	38	(45)	35	(41)	85
1991-92	4	(5)	34	(45)	37	(49)	75

[a] Local resident means resident of Unit 13.

Table 3. Unit 13 brown bear harvest chronology percent by time period, 1987-92.

Regulatory year	Harvest periods: September %	(n)	October %	(n)	November %	(n)	April %	(n)	May %	(n)	n
1987-88	69	(53)	5	(4)	1	(1)	12	(9)	13	(10)	77
1988-89	63	(46)	3	(2)	--	--	15	(11)	19	(14)	73
1989-90	50	(49)	3	(3)	--	--	32	(31)	15	(15)	98
1990-91	37	(31)	7	(6)	--	--	29	(25)	27	(23)	85
1991-92	43	(32)	1	(1)	--	--	38	(28)	18	(13)	74

Table 4. Unit 13 brown bear harvest percent by transport method, 1987-92.

Regulatory year	Percent of harvest									n
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Walk	Unk.	
1987-88	41	9	4	0	0	26	12	4	4	73
1988-89	41	6	10	0	6	16	12	5	4	73
1989-90	29	10	4	1	17	17	12	1	8	98
1990-91	35	3	1	4	17	13	14	8	5	85
1991-92	41	3	4	0	19	13	11	3	7	75

LOCATION

Game Management Unit: 14 (6,625 mi^2)

Geographic Description: Upper Cook Inlet

BACKGROUND

Brown bear distribution and abundance has been affected in much of Unit 14 by urbanization, agricultural development and remote settlement. Density estimates from adjacent Unit 13 have been used to establish a population range of 168-262 bears in Unit 14 (Grauvogel 1990). Although the technique used to estimate a unitwide population was the best available, applying it to an adjacent unit, absent field studies, may have resulted in substantial error. Griese (1991) indicated that if maximum population estimators were accurate, then the 1985-89 harvests approximated sustainable harvest. Griese concluded that reduced fall seasons and harvests were appropriate because he had little confidence in Unit 14 brown bear population estimates and trends.

MANAGEMENT DIRECTION

Management Goals

Management goals have been assigned to each subunit of Unit 14. In Subunit 14A the goals were to provide the maximum opportunity to participate in hunting brown bears and, secondarily, to provide for optimum harvests of brown bears. In Subunit 14B the goal was to provide the maximum opportunity to participate in hunting brown bears. In Subunit 14C the goals were to provide an opportunity to view, photograph, and enjoy brown bears and, secondarily, to provide an opportunity to hunt brown bears under aesthetically pleasing conditions.

Management Objectives

The management objective for Unit 14 brown bears it to maintain a brown bear population that appears largely unaffected by human harvest.

Human Use Objectives: To allow optimum opportunity to hunt brown bears with an annual average harvest of 6-10 bears including less than 3 females greater or equal to 3 years-of-age.

METHODS

Department personnel interviewed hunters when they presented bears for sealing of skulls and hides. Skulls were measured, sex of bears determined, a premolar tooth extracted for aging, and information on date and location of kill and hunter effort obtained from successful hunters. Harvest data were compared with previous years.

RESULTS AND DISCUSSION

Population Status and Trend

Field work was not done to evaluate brown bear population size or trend in Unit 14. An earlier conclusion, that days hunted per successful bear hunter suggested a decreasing availability of bears, appeared inadequate. An increasing trend from 1985 to 1988 peaked at 5.4 days/bear in 1988 and subsequently declined 39% to an average of 3.3 days/bear from 1989 to 1991.

Population Size: Previous population estimates in Subunit 14C, based on sightings of females and their cubs-of-the-year in alpine habitat, were of little value because only 1 adult bear was observed during 1992.

Mortality

Harvest:

Season and Bag Limit. The brown bear hunting season in Subunits 14A and 14C, for resident and nonresident hunters, was 1 September to 10 October. The hunting season in Subunit 14B was 1 September to 31 October and 10 May to 25 May. The bag limit in Unit 14 was 1 bear every 4 regulatory years. Harvesting cubs or females accompanied by cubs was prohibited.

Board of Game Actions and Emergency Orders. The Board of Game did not adopt any proposals that affected brown bears in this unit during this report period.

Hunter Harvest. The 1991-92 reported harvest of 13 bears represented an increase from the previous year and also was above the average (12) of the previous 4 years (Table 1). Males represented 62% of the harvest for which sex was known. This was consistent with the annual mean of 63% males (n=43) killed in the previous 4 years (Table 1). Mean skull size of male bears killed (excluding 1 yearling) in 1991-92 was 21 inches (n=5); the mean of 26 male skulls from the previous 4 years was 21.3 inches.

During 1990-91 and 1991-92, 78% and 54%, respectively, of the hunter-killed bears in Unit 14 came from Subunit 14A. During the 3 regulatory years before 1990-91, 73% of

hunter-killed bears came from Subunit 14B. The last brown bear legally taken by a hunter in Subunit 14C was during the 1986-87 season.

Hunter Residency and Success. Unit 14 residents continued to account for most of Unit 14 brown bear harvest. Unit residents killed 69% of 13 hunter-killed bears during 1991-92 (Table 2). The previous 4-year average kill by unit residents was 77%. Nonresidents took 4 bears (31%) in 1991-92, the largest harvest during the 1987-91 period. Nonresidents were responsible for 21% of the harvest during the previous 4 years.

Harvest Chronology. Few bears were killed during spring season in Unit 14. One bear was taken each year during the 1991 and 1992 spring seasons, which was similar to the average harvest (1) for the previous 3 springs (Table 3). Hunters killed 77% of the 1991-92 harvest in September, compared to 92% in September in the previous 4 years.

Transport Methods. Successful hunters in Unit 14 used a variety of transportation methods, favoring ORVs and 3/4-wheeled cycles most years. However, in 1991-92 only 15% of successful hunters used ORVs while 38% used aircraft (Table 4). Eighty percent of successful hunters using aircraft were nonresident hunters.

Other Mortality. Five bears were killed in DLP incidents during 1990-91 and 2 in 1991-92. Four additional bears were killed during the same period, 3 by trains and 1 taken illegally. These nonhunting kills (11) exceeded the total (6) taken during the previous 5 years. Unreported brown bear deaths in Unit 14 could be substantially higher.

CONCLUSIONS AND RECOMMENDATIONS

Previous tentative conclusions (Griese 1991) regarding population status and trends based on objective harvest parameters (i.e. percent males in the harvest, changes in transport means, sows with cubs-of-the-year observed in alpine habitat, days hunted per successful bear hunter) appear questionable. Attempts to determine status and trends, if management objectives are met, must rely on these objective data as well as subjective analysis.

Male bears comprised 63% of mean hunter harvest of 12.2 bears over the past 5 regulatory years. Nine (60%) of 15 nonhunting kills over the same period were males. During 1990-91 and 1991-92 combined, 69% of the known mortalities were males. Average days hunted per successful bear hunter during 1989-90 through 1991-92 declined to 3.3 days compared to 1987-88 and 1988-89 average of 5.3 days.

Miller (1990) suggested that sustainable harvest levels for "highly productive brown bear populations" was 5.7% of the population. A "best case" scenario population estimate of 222 bears in Subunits 14A and 14B (Grauvogel 1990) would provide an annual harvest of 12.6 bears, similar to the 1987-1991 mean harvest of 12.2 bears. A minimum population estimate of 144 huntable bears (excludes 75% of Subunit 14C closed to bear

hunting) provides for a mean harvest of 8.2 bears. Hunter and nonhunter kills combined during 1990-91 and 1991-92 totaled 15 and 18 bears respectively.

Recent harvest increases may relate to exploitation of Subunit 14A bears which averaged 27% of the Unit 14 harvest from 1987-88 through 1989-90 and 78% and 54%, respectively, in 1990-91 and 1991-92. Bears dispersing from Unit 13 or unhunted portions of Subunit 14C may have contributed to the increased harvest.

Brown bear trend counts have not been conducted in Unit 14. Cost, extensive human development, diverse habitat, low density bear populations and numerous other high priority areas will probably preclude trend counts in the near future. Current estimates range from 185-239 bears, and remain tentative at best.

Record high overall mortality in both 1990-91 and 1991-92, coupled with ongoing habitat loss through human encroachment, dictate a conservative management strategy. I recommend the fall season be reduced by 6 days and not open until 21 September, beginning in 1993, through emergency order.

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Table 1. Unit 14 brown bear harvest, 1987-91.

Regulatory year	Reported								Estimated unreported kill[b]	Total estimated kill					
	Hunter kill					Non-hunting kill[a]									
	M	F	(%)	Unk.	Total	M	F	Unk.		M	(%)	F	(%)	Unk.	Total
1987															
Fall 87	5	4	944)	0	9	0	0	0	0	5	(56)	4	(44)	0	9
Spring 88	1	1	(50)	0	2	1	2	0	1	2	(40)	3	(60)	1	6
Total	6	5	(45)	0	11	1	2	0	1	7	(50)	7	(50)	1	15
1988															
Fall 88	8	4	(33)	3	15	1	0	0	1	9	(69)	4	(31)	4	17
Spring 89	0	0	(--)	0	15	0	0	0	0	0	(--)	0	(--)	0	0
Total	8	4	(33)	3	15	1	0	0	1	9	(69)	4	(31)	4	17
1989															
Fall 89	6	4	(40)	2	12	0	0	1	1	6	(60)	4	(40)	4	14
Spring 90	0	1	(100)	0	1	0	1	0	0	0	(00)	2	(100)	0	2
Total	6	5	(45)	2	13	0	1	1	1	6	(50)	6	950)	4	16
1990															
Fall 90	7	1	(13)	0	8	1	2	1	1	8	(73)	3	(27)	1	13
Spring 91	0	1	(100)	0	1	2	0	0	0	2	(67)	1	(33)	0	3
Total	7	2	(22)	0	9	3	2	1	1	10	(71)	4	(29)	2	16
1991															
Fall 91	7	5	(42)	0	12	4	1	0	1	11	(65)	6	(35)	1	18
Spring 92	1	0	(0)	0	1	0	0	0	0	1	(100)	0	(00)	0	1
Total	8	5	(38)	0	13	4	1	0	1	12	(67)	6	(33)	0	19

[a] Includes DLP kills, illegal kills, other known human-caused accidental mortality, and non-fatal removal of orphaned cubs.
[b] Includes 5% unreported bear kills.

Table 2. Unit 14 brown bear successful hunter residency, 1987-91.

Regulatory year	Local[a] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1987/88	8	(73)	0	(0)	3	(27)	11
1988/89	11	(73)	1	(7)	3	(20)	15
1989/90	10	(77)	0	(0)	3	(23)	13
1990/91	8	(89)	0	(0)	1	(11)	9
1991/92	9	(69)	0	(0)	4	(31)	13

[a] Unit 14 residents

Table 3. Unit 14 brown bear harvest chronology percent by time period, 1987-91.

Regulatory year	Harvest periods						
	September		October		May		
	1-15	16-30	1-15	16-31	1-15	16-31	n
1987/88	27	45	0	9	0	18	11
1988/89	80	20	0	0	0	0	15
1989/90	31	38	8	15	0	8	13
1990/91	56	11	11	11	0	11	9
1991/92	46	31	15	0	0	8	13

Table 4. Unit 14 brown bear harvest percent by transport method, 1987-91.

Regulatory year	Percent of harvest						n
	Airplane	Horse	Boat	ORV	Highway vehicle	Other/ Unknown	
1987/88	44	11	11	22	0	11	9
1988/89	20	0	13	33	7	27	15
1989/90	17	17	8	17	17	25	12
1990/91	0	11	11	33	33	11	9
1991/92	38	8	8	15	15	15	13

LOCATION

Game Management Unit: 16 (12,255 mi^2)

Geographical Description: West side of Cook Inlet

BACKGROUND

The size or density of the brown bear population in Unit 16 is unknown. Brown bears inhabit most of Unit 16, except Kalgin Island. Faro (1990) suspected highest densities occurred in the foothills of the Alaska Range. Lacking surveys or censuses, biologists have tracked population trends through hunter harvest statistics.

Area biologists analyzed harvest data and concluded that liberalized bear hunting seasons, beginning in 1985, caused reduced densities of brown bears. Faro (1990) identified decreasing average age of bears as evidence that increased harvests reduced population densities in areas readily accessible to hunters. Griese (1991) believed a declining population hypothesis was supported by 1) a substantial decline in the fall harvest, 2) an increase in number of hunting days required to harvest a bear, and 3) subtle declines in ages and skull sizes of fall male bears.

MANAGEMENT DIRECTION

Management Goal

The management goal for Unit 16 brown bears is to provide optimum opportunity to participate in hunting brown bears.

Management Objective

The management objective for Unit 16 brown bears is to maintain a brown bear population that will sustain an annual harvest of 50 bears composed of at least 50% males.

METHODS

Biologists monitored brown bear harvests by sealing skulls and hides of harvested brown bears. Skulls were measured, sex of bears was determined, a premolar tooth was extracted for aging, and date and location of kill and hunter effort were recorded.

I estimated the population size by extrapolating suspected bear densities to a measured area of potential habitat. I used 1:250,000 USGS maps to delete glaciers, lakes, large rivers and areas above 5,000 feet elevation from potential habitat. I assumed densities to be intermediate to 0.07 bears/mi^2 reported for the middle Susitna River (Miller 1988) and 0.49 bears/mi^2 reported for Black Lake (Miller and Sellers 1992). I subjectively assigned densities to uniform coding units at 100% to 15% of maximum potential. Assigned densities varied by remoteness, abundance of salmon streams, and proximity to adjacent study areas. I guessed that bear densities ranged from 0 bears/mi^2 on Kalgin Island to 0.25 bears/mi^2 in the semi-coastal Redoubt Bay drainages.

I used 6% of the estimated population level as a maximum allowable harvest objective. Miller (1990) produced a sustainable harvest level of 5.7% (bears aged >2.0 years) for a computer simulated bear population. I considered harvest of females >2.0 years at 2%, 2.5% and 3% of the total population for establishing harvest objectives for the female component. By assuming my estimate of the population included the actual population size, I compared reported and estimated harvest levels to objective levels.

Hunter efficiency was evaluated by comparing the average number of days afield by successful bear hunters.

RESULTS AND DISCUSSION

Population Status and Trend

While estimated harvests suggested that bear populations have stabilized since 1989, increases in the number of days hunted by successful fall hunters and lower mean age of bears killed, indicated a decline. A decline in total harvest could indicate a population decline in Subunit 16B between 1985 and 1989 (Griese 1991). Since 1989, harvests suggested stability, and in Subunit 16A, harvests suggested an increasing population. However, in Subunit 16B fall hunter efficiency declined 5% from 1988-89. Mean age of bears unitwide also declined 6% from the previous 5-year mean.

Population Size: I estimated the brown bear population in Unit 16 contained 820 bears (range = 586-1,156) (Appendix A). I estimated that 77% of Unit 16 was potential bear habitat. My estimates produced subunit densities approaching 0.05 bears/mi^2 in Subunit 16A and 0.08 bears/mi^2 in Subunit 16B. Estimated densities were similar to 0.07 bears/mi^2 reported in the middle Susitna River drainage (Miller 1988) and to 0.09 bears/mi^2 observed in Denali National Park (Dean 1987).

Mortality

Estimated annual mortality for the years 1990-91, averaged 79 bears. This estimate included 13.5 bears in Subunit 16A (Table 1) and 55.5 bears in Subunit 16B (Table 2). Annual estimated mortality was 10% of the population estimate (7-13% of the range).

Average mortality included 2 females greater than 2-years-old in Subunit 16A and 19 females greater than 2-years-old in Subunit 16B. Bear hunters were responsible for 88% of mortality in females greater than 2-years-old, 67% of which occurred during fall.

Mortality among females greater than 2-years-old was estimated at 1.6-3.2% of the estimated population range. These harvest levels were in the range of populations managed for 40-50% females in the harvest. If one assumed that 6% of the total population was sustainable, harvest objectives for females equate to 2.5-3% females in the harvest.

Harvest:

Season and Bag Limit. The open hunting season for brown bears in Unit 16 for resident and nonresident hunters was from 1 September to 25 May. The bag limit was 1 bear every 4 regulatory years.

Board of Game Actions and Emergency Orders. The board has not taken action to change seasons and bag limits in Unit 16 since liberalizing seasons in 1985. Before 1985, the season was 1 September to 31 October and 10-25 May. In 1985 the board extended the season to 1 September to 25 May.

Hunter Harvest. Hunters killed fewer bears in Subunit 16B during 1990-91 than during 1985-89, however, this harvest pattern was reversed in Subunit 16A. During 1990-91, hunters killed an average of 12 bears in Subunit 16A (Table 1) and 50 bears in Subunit 16B (Table 2). During 1985-89, hunters killed an average of 6.8 bears in Subunit 16A and 67.2 bears in Subunit 16B (Griese 1991). The legal harvest of 44 bears in Subunit 16B during 1990 was the lowest since the season was liberalized in 1985. The decline in harvest in Subunit 16B resulted from a low harvest during spring 1991 (Table 2). While spring harvest in Subunit 16A increased slightly, the fall harvest increased substantially (Table 1).

An increase in the fall bear harvest in Subunit 16A did not appear related to moose hunters. Moose hunting season was reduced from 30 days to 10 days for fall 1990. During fall 1991, Subunit 16A had a 15-day moose hunting season. As a result, the number of moose hunters afield declined substantially between 1989 and 1991 (Griese 1993).

Hunter efficiency in the fall declined in Subunit 16B. During the autumns of 1990-91 successful bear hunters averaged 6.58 (n = 53) days of hunting before killing a bear. The

1990-91 average was 5% greater than the 1988-89 average (6.26 days, n = 53) and 13% greater than the 1985-87 average (5.84 days, n = 135). Hunting days increased despite reductions in the length of moose season, which eliminated an alternative reason to be in the woods.

Using only successful hunter effort could strongly bias evaluations of bear abundance or vulnerability. Missing from the analysis are overall hunter success and effort of unsuccessful hunters. A significant shift in overall hunter success may mask or support trends indicated by successful hunter-days.

Evaluation of mean age and skull sizes for males (Table 3) and females (Table 4) for 1985-91 indicated reduced mean ages of all bears. The mean age of males during 1990-91 (7.3 years, n = 78) was less than the previous 5-year mean during 1985-89 (7.8 years, n = 218). Likewise, the mean age of females declined from 7.1 years (n = 116) to 6.6 years (n = 36).

Mean age of male bears harvested during fall may have stabilized. Griese (1991) identified a 17% decline in mean ages between 1985-87 and 1988-89. Mean ages of fall males for 1988-89 was 4.98 years (n = 22). Mean age of fall males for 1990-91 was 4.97 years (n = 35).

All but 2 of the 42 females harvested were aged at greater than 2-years-old during 1990-91. Both young females were estimated at 1.8 years-of-age.

Hunter Residency and Success. Residency distribution of successful bear hunters changed little during 1987-91 (Table 5). Guided, nonresident hunters accounted for 52% (mean = 32) of the harvest during 1990-91. During 1985-89, an average of 55% of successful hunters were nonresidents (Griese 1991).

Harvest Chronology. Harvests occurred predominantly during September (49%) and April (35%) (Table 6). The harvest of females remained heavily weighted to September (Figure 1) while the male harvest was greatest during spring (Tables 1 and 2). Bear harvests during September included more females than during spring; typically, more females are available to hunters and fall hunters tend to be less selective.

Transport Methods. While hunters who used aircraft accounted for 70% of the total harvest during 1990-91 (Table 7), use of snowmachines during the spring increased. Use of snowmachines during spring seasons of 1990-91 represented the highest percentage in the last 7 years. Prolonged deep snow cover and increasing popularity of snowmachines among bear hunters were responsible.

Other Mortality: An average of 2.5 bears killed in DLP incidents during 1990-91 in Unit 16 represented an increase from the previous 5-year average of 1 bear. Individuals claiming DLP reported killing 5 female bears in Subunit 16B during 1990-91 (Table 2).

The DLP harvest in Subunit 16B represented 18% of the total female (greater than 2-years-old) harvest for the subunit.

I estimated the unreported harvest of bears in Unit 16 was equivalent to 5% of the reported kill (Tables 2 and 3). The unreported kill may have been underestimated.

CONCLUSIONS AND RECOMMENDATIONS

I estimated the Unit 16 brown bear population ranges between 586 and 1,156 bears. The number of bears killed by humans during 1990-1992 was estimated at 138 bears, and at least 32 of the bears killed were females. Though harvests during this period suggested management objectives were achieved, I believe the bear population is inadequate to sustain past harvest levels. The estimated brown bear harvests during 1990-91 averaged 69 bears, well above the objective of 50 bears. Males comprised 66% of the harvest, exceeding minimum objectives. Harvests since season liberalization in 1985, have declined, suggesting the brown bear population was not able to sustain higher harvests.

Harvest exceeded estimated sustainable levels for all but the high end of the estimated population range. If the bear population was less than 1,150, the average harvests since 1985 have exceeded 6% of the population. An annual sustainable harvest rate of 6%, based on the estimated population, would yield a harvest of 35 to 69 bears annually.

Harvests of females during this period apparently did not exceed the maximum objective level of 3% (50% of 6%). During 1990-91, harvests averaged 20 female bears. Objective harvest levels for the estimated population ranged between 17.6 and 34.7 females greater than 2-years-old. However, harvest objectives vary among Alaska game management units and a maximum of 40% (2.5% of population) females in the harvest is often used as an objective for sustainable harvest levels. Because it is possible Unit 16 bear numbers have declined, a more conservative female component, 30-35% (2% of population), may be necessary for population recovery.

Decreased hunter efficiency during autumn in Subunit 16B was a reflection of reduced bear abundance. Griese (1991) felt that fall hunter effort best reflected overall bear availability. Days reported hunting by successful hunters continued to increase during this period. In addition, a decline in the mean ages of harvested bears reflected reduced availability of older bears.

If reduced availability of bears to hunters correctly implies a population decline, a harvest reduction is justified. I believe a population decline occurred during 1985-91. Since hunter harvest is controllable, steps should be taken to harvest within sustainable levels.

The estimated sustainable annual harvest is 49-59 bears, with not more than 16 females greater than 2-years-old. I am employing the best population estimate of 822 (Appendix

A.) and 980 bears, half-way to the high-end estimate, to calculate sustainable harvest. At the conservative 2% female harvest level, total female (greater than 2-years-old) harvests should not exceed 17 bears. Since average nonhunting mortality may be as high as 7 bears and 80-90% female, hunter harvests should be managed for 42-52 bears with fewer than 11-12 females greater than 2-years-old.

The proposed reduction in hunter harvests could be reached by eliminating hunting during the first 2 weeks of September. Hunter harvest has been concentrated in September and April, and April produces predominantly males. Females are killed primarily during September or as DLPs. Since DLP mortality is essentially uncontrollable, the obvious option to minimize female harvests while reducing total harvests would be to reduce hunting during September.

Because harvests have been declining, harvest reduction objectives were based on the most recent 4-year average of hunter harvests, 61 bears. A hunter harvest reduction of 9-19 bears would represent a 15-30% reduction in recent harvest trends. The period 1-15 September has accounted for 30% of the total hunter harvests and 42% of the females killed by bear hunters.

I recommend the following course of action:

1. I recommend the department propose a brown bear season of 15 September to 25 May.

2. I strongly recommend research staff strive to develop affordable survey or census methods which provide adequate population trend data to support harvest strategies. The alternative is to budget for a Miller *et al.* (1987) census.

3. I recommend the initiation of mandatory hunter reporting for all brown bear hunters to acquire information on hunter effort (Griese 1991).

4. I recommend adoption of 5-year population objectives which include a maximum allowable harvest of 55 bears and a maximum allowable harvest of 18 females greater than 2-years-old.

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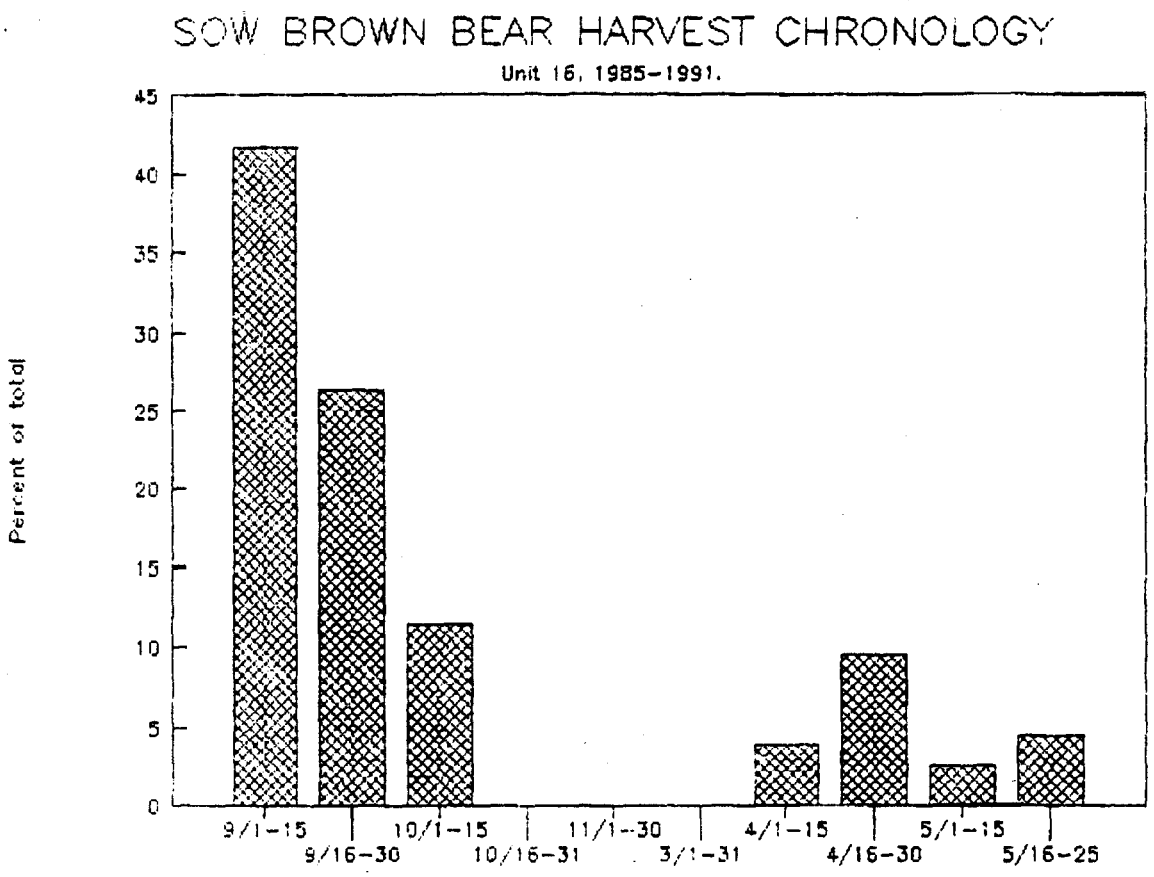

Figure 1. Chronological distribution of female brown bear harvested by hunters during 1985-91 in Unit 16, Alaska.

Table 1. Subunit 16A brown bear harvest[a], 1987-91.

Regulatory year	Reported: Hunter kill M	F (%)	Unk.	Total	Reported: Non-hunting kill[a] M	F	Unk.	Estimated unreported kill[b]	Total estimated kill M (%)	F (%)	Unk.	Total
1987												
Fall 87	5	6 (55)	0	11	0	0	0	1	5 (45)	6 (55)	1	12
Spring 88	1	1 (50)	0	2	0	0	0	1	1 (50)	1 (50)	1	3
Total	6	7 (54)	0	13	0	0	0	2	6 (46)	7 (54)	2	15
1988												
Fall 88	1	1 (50)	0	2	0	0	0	0	1 (50)	1 (50)	6	2
Spring 89	2	0 (0)	0	2	0	0	0	0	2(100)	0 (0)	0	2
Total	3	1 (25)	0	4	0	0	0	0	3 (75)	1 (25)	0	4
1989												
Fall 89	2	2 (50)	1	5	0	0	0	0	2 (50)	2 (50)	1	5
Spring 90	1	0 (0)	0	1	0	0	0	1	1(100)	0 (0)	1	2
Total	3	2 (40)	1	6	0	0	0	1	3 (60)	2 (40)	2	7
1990												
Fall 90	5	2 (29)	1	3	0	0	0	1	5 (71)	2 (29)	2	9
Spring 91	2	1 (33)	0	3	0	0	0	0	2 (67)	1 (33)	0	3
Total	7	3 (30)	1	11	0	0	0	1	7 (70)	3 (30)	2	12
1991												
Fall 91	8	1 (11)	1	10	0	0	0	1	8 (89)	1 (11)	2	11
Spring 92	3	0 (0)	0	3	0	0	0	1	3 (100)	0 (0)	1	4
Total	11	1 (3)	1	13	0	0	0	2	11 (92)	1 (8)	3	15

[a] Includes defense of life or property kills, illegal kills, and other known human-caused accidental mortality.

Table 2. Subunit 16B brown bear harvest[a], 1987-91.

Regulatory year	Reported							Estimated unreported kill[b]	Total estimated kill			
	Hunter kill				Non-hunting kill[a]							
	M	F (%)	Unk.	Total	M	F	Unk.		M (%)	F (%)	Unk.	Total
1987												
Fall 87	17	20 (54)	6	43	0	0	0	3	17 (46)	20 (54)	9	46
Spring 88	22	3 (12)	2	27	0	0	0	0	22 (88)	3 (12)	2	27
Total	39	23 (37)	8	70	0	0	0	3	39 (63)	23 (37)	11	73
1988												
Fall 88	13	13 (50)	2	28	1	0	0	3	14 (52)	13 (48)	5	32
Spring 89	25	3 (11)	1	29	0	0	0	1	25 (89)	3 (11)	2	30
Total	38	16 (30)	3	57	1	0	0	4	39 (71)	16 (29)	7	62
1989												
Fall 89	10	11 (52)	3	24	0	0	0	3	10 (48)	11 (52)	6	27
Spring 90	23	4.(15)	2	29	1	0	0	0	24 (86)	4 (14)	2	30
Total	33	15 (31)	5	53	1	0	0	3	34 (69)	15 (31)	8	57
1990												
Fall 90	14	11 (44)	1	26	0	2	0	2	14 (52)	13 (48)	3	30
Spring 91	15	3 (17)	0	18	0	1	0	1	15 (79)	4 (21)	1	20
Total	29	14 (33)	1	44	0	3	0	3	29 (63)	17 (37)	4	50
1991												
Fall 91	9	14 (61)	1	24	0	2	0	3	9 (36)	16 (64)	4	29
Spring 92	25	5 (17)	2	32	0	0	0	0	25 (83)	5 (17)	2	32
Total	34	19 (36)	3	56	0	2	0	3	34 (62)	21 (38)	6	61

[a] Includes defense of life or property kills, illegal kills, and other known human-caused accidental mortality.

Table 3. Unit 16 age and skull size of male brown bear harvest, 1985-91.

Regulatory year	Fall				Spring				Total			
	Mean skull size (in)	n	Mean age	n	Mean skull size (in)	n	Mean age	n	Mean skull size (in)	n	Mean age	n
1985/86	21.4	24	6.3	27	25.3	21	9.1	25	23.2	45	7.6	52
1986/87	22.0	20	6.8	22	23.9	27	9.0	29	23.1	47	8.1	51
1987/88	21.7	22	4.9	22	24.9	23	8.3	23	23.3	45	6.7	45
1988/89	20.3	13	4.8	14	24.7	26	9.8	27	23.2	39	8.1	41
1989/90	20.4	11	5.3	8	24.5	24	10.0	21	23.2	35	8.7	29
1985-89	21.3	90	5.8	93	24.6	121	9.2	125	23.2	211	7.8	218
1990/91	21.3	19	4.1	18	25.5	17	10.4	17	23.3	36	7.1	35
1991/92	21.4	17	5.9	17	24.2	26	8.4	26	23.1	43	7.4	43
1990-91	21.3	36	5.0	35	24.7	43	9.2	43	23.2	79	7.3	78

Table 4. Unit 16 age and skull size of female brown bear harvest, 1985-91.

Regulatory year	Fall				Spring				Total			
	Mean skull size (in)	n	Mean age	n	Mean skull size (in)	n	Mean age	n	Mean skull size (in)	n	Mean age	n
1985/86	20.2	27	7.3	26	20.2	4	4.2	4	20.2	31	6.9	30
1986/87	19.7	14	7.0	14	21.0	8	9.5	8	20.2	22	7.9	22
1987/88	20.1	25	6.2	27	20.8	4	11.9	4	20.2	29	6.9	31
1988/89	19.6	14	6.5	14	20.8	3	6.4	3	19.8	17	6.5	17
1989/90	20.0	13	6.9	12	21.1	4	7.3	4	20.3	17	7.0	16
1985-89	20.0	93	6.8	93	20.8	23	8.2	23	20.2	116	7.1	116
1990/91	19.9	12	6.3	13	20.9	4	4.8	4	20.1	16	5.9	17
1991/92	19.2	13	7.3	14	21.3	5	6.7	5	19.8	18	7.2	19
1990-91	19.5	25	6.8	27	21.1	9	5.9	9	20.0	34	6.6	36

Table 5. Unit 16 brown bear successful hunter residency, 1987-91.

Regulatory year	Local[a] resident	(%)	Non-local resident	(%)	Nonresident	(%)	Total successful hunters
1987/88	0	(0)	37	(44)	47	(56)	84
1988/89	0	(0)	25	(41)	36	(59)	61
1989/90	0	(0)	22	(37)	37	(63)	59
1990/91	0	(0)	25	(45)	30	(55)	55
1991/92	1	(1)	32	(48)	34	(51)	67

[a] Unit 16 residents

Table 6. Unit 16 brown bear harvest chronology percent by time period, 1987-91.

Regulatory year	Harvest periods						
	September %	October %	November %	March %	April %	May %	n
1987/88	61	5	0	1	26	7	84
1988/89	46	3	0	7	34	10	61
1989/90	41	8	0	2	41	8	59
1990/91	55	4	4	0	35	4	55
1991/92	38	10	0	0	40	12	68
1987-91	49	6	1	2	35	8	327

Table 7. Unit 16 brown bear harvest percent by transport method, 1987-91.

Regulatory year	Percent of harvest							
	Airplane %	Horse %	Boat %	Snowmachine %	ORV %	Highway vehicle %	Unknown %	n
1987/88	75	2	5	1	8	4	5	84
1988/89	84	7	2	0	2	2	5	61
1989/90	81	3	3	3	5	0	3	59
1990/91	80	0	6	6	2	4	4	55
1991/92	62	4	9	9	2	3	12	68

Appendix A. Unit 16 Brown Bear Population Estimate (Calculation documentation)

ASSUMPTIONS: Densities range between 0.01 bear/mi^2 in settled areas of 16A
0.25 bears/mi^2 in salmon-rich/semi-coastal sw 16B
(bracketing densities from adjacent areas are:
1.43 bears/mi^2 at Katmai NM
0.49 bears/mi^2 at Black Lake
0.09 bears/mi^2 at Denali NP
0.07 bears/mi^2 at Middle Susitna R.
0.03 bears/mi^2 at Upper Susitna R.)

Non-habitat includes glaciers, large lakes, large rivers, and dense human settlements.

Densities are influenced by density of remote cabins, human/fisherman access and use, salmon abundance, vegetation types, proximity to coastal areas, and impressions of densities in reference to Middle Susitna R. densities.

Subunit	UCU	mi^2	% habitat	Estimated bear habitat	Est. den. (*.01) low	Est. den. (*.01) b.g.	Est. den. (*.01) high	Est. no. bears low	Est. no. bears b.g.	Est. no. bears high
16A	0101	55.1	90	49.6	2	3	4	1.0	1.5	2.0
	0102	106.2	70	74.3	2	3	4	1.5	2.2	3.0
	0103	26.8	70	18.8	1	2	3	0.2	0.4	0.6
	0201	59.1	100	59.1	2	3	4	1.2	1.8	2.4
	0301	47.6	100	47.6	2	3	4	1.0	1.4	1.9
	0401	90.0	100	90.0	5	7	9	4.5	6.3	8.1
	0402	62.1	100	62.1	6	8	10	3.7	5.0	6.2
	0403	177.7	50	88.9	6	8	10	5.3	7.1	8.9
	0501	175.3	100	175.3	5	6	8	8.8	10.5	14.0
	0601	72.0	100	72.0	3	5	7	2.2	3.6	5.0
	0701	292.0	100	292.0	3	4	5	8.8	11.7	14.6
	0702	75.6	90	68.0	2	4	6	1.4	2.7	4.1
	0703	156.0	90	140.4	2	4	6	2.8	5.6	8.4
	0704	64.6	80	51.7	3	4	5	1.6	2.1	2.6
	0801	77.3	80	61.8	2	3	4	1.2	1.9	2.5
	0901	38.3	70	26.8	2	3	4	0.5	0.8	1.1
	1001	62.2	70	43.5	2	3	4	0.9	1.3	1.7
	1101	28.8	100	28.8	4	5	6	1.2	1.4	1.7
	1102	124.3	55	68.4	5	7	10	3.4	4.8	6.8
	1201	59.0	100	59.0	5	7	10	3.0	4.1	5.9
Subtotal		1,850.0	85	1578.1				53.9	76.2	101.5
					Average density =			0.034	0.048	0.064

Appendix A. (cont'd). Unit 16 Brown Bear Population Estimate (Calculation documentation)

Subunit	UCU	mi^2	% habitat	Estimated bear habitat	Est. den. (*.01) low	Est. den. (*.01) b.g.	Est. den. (*.01) high	Est. no. bears low	Est. no. bears b.g.	Est. no. bears high
16B	0101	116.4	70	81.5	2	3	4	1.6	2.4	3.3
	0201	325.7	100	325.7	5	7	10	16.3	22.8	32.6
	0301	249.9	100	249.9	3	5	7	7.5	12.5	17.5
	0302	123.9	90	111.5	5	8	11	5.6	8.9	12.3
	0401	43.6	90	39.2	5	7	9	2.0	2.7	3.5
	0402	73.7	90	66.3	6	8	10	4.0	5.3	6.6
	0403	280.5	35	98.2	6	8	10	5.9	7.9	9.8
	0501	138.6	100	138.6	5	7	9	6.9	9.7	12.5
	0502	287.0	90	258.3	6	8	10	15.5	20.7	25.8
	0601	316.3	90	284.7	4	6	8	11.4	17.1	22.8
	0602	420.5	95	399.5	5	7	9	20.0	28.0	36.0
	0603	485.2	65	315.4	5	7	9	15.8	22.1	28.4
	0604	187.1	90	168.4	6	8	10	10.1	13.5	16.8
	0605	354.0	95	336.3	5	7	9	16.8	23.5	30.3
	0606	72.1	90	64.9	3	5	8	1.9	3.2	5.2
	0607	522.6	80	418.1	5	7	9	20.9	29.3	37.6
	0701	107.8	100	107.8	6	8	10	6.5	8.6	10.8
	0801	155.0	100	155.0	6	8	10	9.3	12.4	15.5
	0901	222.2	90	200.0	5	7	9	10.0	14.0	18.0
	0902	55.0	100	55.0	6	9	11	3.3	5.0	6.1
	0903	159.6	80	127.7	6	8	10	7.7	10.2	12.8
	0904	43.2	100	43.2	6	8	10	2.6	3.5	4.3
	1001	41.3	100	41.3	6	9	11	2.5	3.7	4.5
	1101	496.8	70	347.8	6	8	10	20.9	27.8	34.8
	1201	701.5	50	350.8	6	8	10	21.0	28.1	35.1
	1301	224.5	100	224.5	7	9	12	15.7	20.2	26.9
	1401	446.0	85	379.1	8	10	15	30.3	37.9	56.9
	1402	491.5	50	245.8	8	10	15	19.7	24.6	36.9
	1501	319.6	100	319.6	6	8	10	19.2	25.6	32.0
	1601	733.8	70	513.7	8	12	20	41.1	61.6	102.7
	1602	293.8	30	88.1	5	7	10	4.4	6.2	8.8
	1603	766.6	45	345.0	5	7	10	17.2	24.1	34.5
	1701	204.1	90	183.7	10	15	25	18.4	27.6	45.9
	1702	449.0	70	314.3	10	15	25	31.4	47.1	78.6
	1703	318.8	70	223.2	10	15	25	22.3	33.5	55.8
	1704	84.8	90	76.3	10	15	25	7.6	11.4	19.1
	1801	70.0	70	49.0	10	15	25	4.9	7.4	12.3
	1901	23.1	90	20.8	0	0	0	0.0	0.0	0.0
Subtotal		12,255.1	76	9346.0				532.1	746.2	1054.6
					Average density			0.057	0.080	0.113
Unit 16 total		14,105.1	77	10924.5				586.0	822.4	1156.0
					Average density			0.054	0.075	0.106

LOCATION

Game Management Unit: 17 (18,800 mi^2)

Geographical Description: Northern Bristol Bay

BACKGROUND

Brown bears are common throughout Unit 17. Bear research has not been conducted in the unit; consequently, we do not have a complete understanding of the density, denning areas, and other aspects of the bear population. Brown bears are seasonally abundant along salmon spawning areas in tributaries to the Nushagak, Mulchatna, Togiak, and the Kulukak Rivers as well as along the Wood River Lakes. We also see bears near postcalving aggregations of caribou throughout the range of the Mulchatna caribou herd.

Bears in Unit 17 are neither as abundant, nor as large as those found along the Alaska Peninsula, so there has never been as much hunting pressure on this bear population. Annual harvests have rarely exceeded 50 bears per year. Before 1970, few bears were reported as harvested from the unit. In 1973, the Board of Game established alternate year seasons in Unit 9, resulting in an increase in the number of bear hunters in Unit 17. From 1970 to 1981, the harvest was generally balanced between spring and fall seasons. During the past decade higher harvests occurred during fall seasons (Figure 1).

One reason for the increase in fall bear harvests was an increase in hunting pressure on the Mulchatna caribou herd as it has nearly quintupled in number during the past decade (Van Daele, in press). Moose harvests have also increased dramatically during this period. As more hunters were afield pursuing caribou and moose, they killed more bears either incidentally or during combination hunts. There was a decline in the proportion of males in the annual harvests from 1981-1988 (Figure 2). This trend was stalled after the fall hunting season in Subunit 17B was delayed by 10 days in 1989. The mean skull size of harvested males did not show any dramatic changes from 1 year to the next, but the mean skull size of harvested females has been below the long-term average for 6 of the past 7 years (Figure 3).

Reported harvests are only a part of the brown bears killed in the unit. Many local residents have a low tolerance for bears near villages and fish sites and they commonly kill bears in these areas. Few if any of nonhunting mortalities are reported to the department. All villages, including the community of Dillingham, have open landfills that attract bears during spring, summer, and fall. Residential garbage, dog food, and fish-drying racks also bring bears close to humans. Because of the widespread occurrence of these unreported kills, any conclusions based solely on harvest data must be viewed with caution.

MANAGEMENT DIRECTION

Management Objective

The management objective for brown bears in Unit 17 is to maintain a brown bear population that will sustain an annual harvest of 50 bears composed of at least 50% males.

METHODS

Each brown bear legally harvested or killed in a DLP incident in the unit was sealed, the skull measured, sex determined, and a premolar tooth extracted and aged. We recorded data on hunter residency, number of days hunted, date of kill, transportation used, and location of the kill at the time of sealing. When possible, we investigated circumstances surrounding DLP and illegal kills. We collected subjective population data during caribou and moose surveys. We also used reports from field workers to estimate bear population trends.

RESULTS AND DISCUSSION

Population Status and Trend

Harvest data for the past decade suggested portions of the bear population may be showing signs of overharvest. At the same time, local residents and field workers with the department, the USFWS, and the Alaska Division of State Parks have reported an increase in bear sightings and "nuisance" bears.

Unitwide the brown bear population was stable to increasing. This was the case in most of Subunits 17A, 17C, and the remote portions of 17B. Bears living in portions of Subunit 17B along the Nushagak and Mulchatna Rivers experienced the greatest harvest pressure. This portion of the bear population has probably been declining for several years.

Population Size: We have not attempted to estimate the brown bear population size or density in Unit 17. Densities appeared to be much lower than those observed along the Alaska Peninsula. Incidental observations suggested a population density comparable to that observed in the Susitna River study area (2.79 bears/100 km^2) (Miller *et al.* 1987). This yields a population estimate of 1,350 bears in Unit 17.

Distribution and Movements: There is a paucity of information on distribution and movements of brown bears in this unit. Bears concentrate along salmon spawning streams throughout summer and fall. Individual bears and family groups are commonly observed

near postcalving aggregations of caribou in June and July. We have observed den sites in the mountains west of the Wood River Lake system.

Mortality

Harvest:

Season and Bag Limit. The brown bear season in Subunits 17A and 17C was 10-25 May during spring and 10 September to 10 October during autumn. The bag limit was 1 bear every 4 regulatory years. The bear season in Subunit 17B was 10-25 May in spring and 20 September to 10 October in fall; the bag limit was 1 bear every 4 regulatory years.

Board of Game Actions and Emergency Orders. The Board of Game eliminated the subsistence brown bear hunting season in Unit 17 after the 1989-90 hunting seasons. This action was prompted by fear of overharvests when court decisions declared all Alaskans were subsistence users.

During its spring 1992 meeting, the Board of Game and the Federal Subsistence Board adopted regulations allowing subsistence harvests of brown bears in Unit 18 and portions of Subunits 17A and 17B. Subsistence hunters were allowed to take 1 bear per year by registration permit. A bear tag was not required. Hunters had to salvage the meat and report their kill to the department. Hides and skulls were not required to be sealed if they remained in the unit where they were harvested. No emergency orders were issued during this report period.

Hunter Harvest. During the 1991-92 seasons, hunters in Unit 17 harvested 45 brown bears, including 26 males (58%), 17 females (38%), and 2 of unknown sex (4%) (Table 1). This harvest was comparable to the mean annual harvest of the previous 5 years (48.2 bears). Harvest levels quickly rebounded after the fall season in Subunit 17B was reduced by 10 days in 1989-90.

The average skull size of harvested bears was 23 inches (n=25) for males and 20.1 inches (n=16) for females. Three bears (2 males and 1 female) were killed in Subunit 17A, 32 (18 males, 12 females and 2 unknown) were killed in Subunit 17B, and 10 (6 males and 4 females) were reported from Subunit 17C. In the past 5 years, 81% of the bears harvested in the unit have been taken in Subunit 17B (Table 2).

Hunter Residency and Success. Nonresidents accounted for 84% of the bears harvested in the unit during this report period. There was a noticeable decrease in the percentage of bears taken by nonlocal Alaska residents during the past 3 years (Table 3). Conversely, the proportion taken by nonresidents increased. Data on hunter success were not collected.

Harvest Chronology. Thirty-two bears were killed during the fall 1991 hunting season and 13 bears were killed during the spring 1992 season. September has been the month

that most bears were harvested in Unit 17. This corresponded with the moose hunting season (1-20 September). The 10-day delay in the start of the Subunit 17B fall hunting season, beginning in 1989-90, resulted in a shift in the harvest chronology (Table 4).

Transport Methods. Most successful bear hunters in Unit 17 used aircraft for access. Boats were the only other consistently used form of access (Table 5).

Other Mortality: Two brown bears were found dead along the Dillingham road system during this report period. A young female bear was shot in the Aleknagik dump and left there. Only the paws and gall bladder were removed from this bear. The other, an adult male, was found along the Snake Lake road where it had been hauled and dumped over a cutbank. There were no reports of bears killed in DLP incidents in Unit 17.

Habitat

Assessment: Brown bear habitat in Unit 17 is virtually unaltered and in excellent condition. Salmon stocks are carefully managed and escapements are adequate for the needs of the bear population. Increasing ungulate populations in the unit also provide an abundant food supply for bears. Human settlements are relatively small and unobtrusive, and the increased localized food supplies around these settlements in the form of human food and garbage probably enhance the areas as bear habitat. However, bears using areas frequented by humans are at risk of being shot.

Nonregulatory Problems/Needs

A cooperative ADF&G/USFWS research project began during spring 1992. The objectives of this project were to estimate bear densities, collect population data, and delineate habitat-use patterns for brown bears in portions of the Togiak and Yukon Delta National Wildlife Refuges (Unit 18). The project was funded by the USFWS and was initiated in response to liberalized bear hunting and reporting regulations in the area.

The lack of objective data on the population parameters of the Unit 17 bear population and the paucity of information on nonhunting mortality make effective management difficult. The department should develop and pursue other cooperative bear research programs with the USFWS and the National Park Service to determine bear density in at least a portion of Unit 17.

There was an increase in bear/human encounters along the Mulchatna River during fall 1992. Moose and caribou hunters complained of bears raiding camps and claiming hunter kills in the field. This increase may have been the result of bears seeking alternate food sources because unusually high water levels and muddy conditions adversely affected traditional fishing areas. It may have also been caused by a few individual bears that have learned to take advantage of the abundant food provided by the migrating caribou herd and the large number of hunters concentrated on the Mulchatna River corridor.

We should continue to encourage local residents to report all bears killed and provide them with information on bear behavior and ways to minimize problems with bears. Nonlethal methods of dealing with nuisance bears should be stressed. We should also work with local village governments and the Department of Environmental Conservation to improve landfills so they are less attractive to bears. The Dillingham dump was consistently used by at least 30 individual bears during this report period.

CONCLUSIONS AND RECOMMENDATIONS

The population objective of maintaining a brown bear population that will support a harvest of 50 bears per year is being met although this level of harvest has only been achieved during 4 regulatory years since the inception of mandatory sealing in 1962. Subjective evidence suggests the population is large enough to support such a harvest if the level of nonhunting mortality is reduced. The population objective of at least 50% males in the harvest has been exceeded in most years, but the sex ratio of the total bear harvest for the unit is unknown.

One of the most significant problems with the bear population is the unequal distribution of harvest. The bear population along the Nushagak and Mulchatna Rivers should be monitored closely for signs of overharvest. Efforts to better distribute hunting pressure to other areas of the unit are showing some signs of success and should be continued.

Changing the attitude of many local residents toward bears is a significant challenge. We have instituted a multi-faceted approach including education, enforcement, and implementation of nonlethal methods to minimize antagonistic bear-human encounters. It is difficult to objectively measure the success of these efforts, but there appears to have been some improvement in recent years.

LITERATURE CITED

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Table 1. Unit 17 brown bear harvest, 1987-91.

Regulatory year	Hunter Kill				Non-hunting Kill				Total reported kill			
	Male	Female	Unk	Total	Male	Female	Unk	Total	Male	Female	Unk	Total
1987												
Fall 87	18	32	0	50	0	0	0	0	18	32	0	50
Spring 88	9	0	0	9	1	0	0	1	10	0	0	10
Total	27	32	0	59	1	0	0	1	28	32	0	60
1988												
Fall 88	20	15	1	36	2	0	1	3	22	15	2	39
Spring 89	10	0	0	10	0	0	0	0	10	0	0	10
Total	30	15	1	46	2	0	1	3	32	15	2	49
1989												
Fall 89	11	7	0	18	0	0	1	1	11	7	1	19
Spring 90	10	0	0	10	0	0	1	1	10	0	1	11
Total	21	7	0	28	0	0	2	2	21	7	2	30
1990												
Fall 90	18	14	2	34	2	0	1	3	20	14	3	37
Spring 91	17	3	0	20	0	0	0	0	17	3	0	20
Total	35	17	2	54	2	0	1	3	37	17	3	57
1991												
Fall 91	13	17	2	32	1	1	0	2	14	18	2	34
Spring 82	13	0	0	13	0	0	0	0	13	0	0	13
Total	26	17	2	45	1	1	0	2	27	18	2	47

Table 2. Unit 17 brown bear harvest by subunit, 1987 - 1991.

Regulatory year	Subunit 17(A) MM	FF	Unk	Total	17(B) MM	FF	Unk	Total	17(C) MM	FF	Unk	Total	Unit 17 Total MM	FF	Unk	Total
1987/88	8	9	0	17	18	22	0	40	1	1	0	2	27	32	0	59
1988/89	4	1	0	5	26	14	1	41	0	0	0	0	30	15	1	46
1989/90	1	1	0	2	20	6	0	26	0	0	0	0	21	7	0	28
1990/91	1	3	0	4	33	13	2	48	1	1	0	2	35	17	2	54
1991/92	2	1	0	3	18	12	2	32	6	4	0	10	26	17	2	45

Table 3. Unit 17 brown bear successful hunter residency, 1987-91.

Regulatory year	Local[a] resident (%)	Nonlocal resident (%)	Nonresident (%)	Total successful hunters
1987/88	5 (8%)	13 (22%)	41 (69%)	59
1988/89	1 (2%)	14 (30%)	31 (67%)	46
1989/90	0 (--)	3 (11%)	25 (89%)	28
1990/91	3 (6%)	4 (7%)	47 (87%)	54
1991/92	5 (11%)	2 (4%)	38 (84%)	45

[a] - residents of Unit 17

Table 4. Unit 17 brown bear harvest chronology percent by time period, 1987-91.

Regulatory year	Spring season				Fall season			n
	1-15 Apr	16-30 Apr	1-15 May	16-30 May	1-15 Sep	16-30 Sep	1-15 Oct	
1987/88[a]	---	---	7%	8%	22%	47%	15%	59
1988/89[a]	---	---	11%	11%	37%	33%	9%	46
1989/90[b]	---	---	21%	14%	4%	32%	29%	28
1990/91[c]	---	---	13%	24%	2%	37%	24%	54
1991/92[c]	---	---	11%	16%	7%	53%	11%	45

[a] - Season dates:

Spring -	Subunits 17(A)&(C)	10 Apr - 25 May (subsistence)
	Subunits 17(A)&(C)	10 May - 25 May (resident/nonresident)
	Subunit 17(B)	10 May - 25 May
Fall -	Unit 17	10 Sep - 10 Oct

[b] - Season dates:

Spring -	Subunits 17(A)&(C)	10 Apr - 25 May (subsistence)
	Subunits 17(A)&(C)	10 May - 25 May (resident/nonresident)
	Subunit 17(B)	10 May - 25 May
Fall -	Subunits 17(A)&(C)	10 Sep - 10 Oct
	Subunit 17(B)	20 Sep - 10 Oct

[c] - Season dates:

Spring -	Unit 17	10 May - 25 May
Fall -	Subunits 17(A)&(C)	10 Sep - 10 Oct
	Subunit 17(B)	20 Sep - 10 Oct

Table 5. Unit 17 brown bear harvest percent by transport method, 1987 - 1991.

Regulatory year	Percent of Harvest									n
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Walk	Unknown	
1987/88	83.1%	--	11.9%	--	--	--	--	--	--	59
1988/89	91.3%	--	4.3%	--	--	--	--	2.2%	2.2%	46
1989/90	96.4%	--	--	--	--	--	--	--	3.6%	28
1990/91	96.3%	--	3.7%	--	--	--	--	--	--	54
1986/87	80.0%	--	15.6%	--	--	--	--	--	4.4%	45

LOCATION

Game Management Unit: 18 (42,000 mi^2)

Geographical Description: Yukon-Kuskokwim Delta

BACKGROUND

Brown/grizzly bears are moderate in density and stable in number in Unit 18. Highest densities are found in the Kilbuck Mountains southeast of Bethel and in the Andreafsky Mountains/Nulato Hills north of the Yukon River. Although annual harvests vary markedly, reported harvests in recent years have declined.

Reported harvests from Unit 18 from 1970 to 1978 averaged 2.0 bears/year, and increased to 14.6 bears/year from 1979 to 1986. The record reported harvest was 23 bears in 1981. We believe that unreported harvests which includes bears taken for subsistence uses and in DLP incidents were substantial, and may have exceeded reported harvest in some years.

The subsistence harvest is localized to a few westward drainages of the Kilbuck Mountains, the Andreafsky-Atchuelinguk drainages and the Kanektok-Goodnews drainages. The size of the subsistence harvests ranges from 5 to 10 bears annually in years without adequate snow for travel, and probably averages 10-20 bears in years characterized by good spring snow conditions.

MANAGEMENT DIRECTION

The following management goals have been established for Unit 18:

1) Maintain brown/grizzly bear populations at existing levels in Unit 18.

a) Monitor harvests through the sealing program and contacts with the public.
b) Improve compliance with existing bear harvest reporting requirements.

5) Coordinate with FWS biologists from the Yukon Delta National Wildlife Refuge (YDNWR) and the Togiak National Wildlife Refuge (TNWR) to plan a capture/ recapture study that can be used to calculate brown bear densities in Unit 18.

2) Minimize adverse interactions between bears and the public.

a) Inform and recommend to the public methods to minimize bear-human conflicts. The public will be alerted about the presence of bears and where feasible, efforts will be made to prevent access by bears to human food or garbage.

3) Develop subsistence brown bear regulations in cooperation with the public, local leaders, and other agencies.

a) Work with Association of Village Council Presidents (AVCP) and FWS staff to develop more culturally appropriate ways to regulate bear hunting by subsistence hunters and to gather brown/grizzly bear harvest information.

METHODS

We observed bears incidentally during aerial surveys directed at other species, and during a stream survey conducted during summer 1991. Informal reports from the public were compiled along with interviews of local residents concerning bear distribution and subsistence harvest.

The sealing of bears took place at villages, at the ADF&G office in Bethel, and at hunters' residences. Sealing certificate information was analyzed to determine location, and sex and age composition of bears reported taken during the year. Local residents were contacted by telephone, mail, radio, and television announcements, and by newspaper articles regarding hunting season dates and bag limits, bear tag fees, sealing requirements, and other pertinent bear management regulations. Brown bear management was also discussed at public meetings with special emphasis on the need for better harvest reporting.

We contacted village leaders, hunters, and law enforcement personnel in an effort to minimize bear-human conflicts at camps and dumps. At villages we posted public notices about different ways to reduce adverse encounters between bears and the public.

Department staff met with residents of Kwethluk, Akiachak, Akiak, Tuluksak, and Platinum to discuss the viability of a bear harvest ticket reporting system similar to that used for moose and caribou. Meetings were held with AVCP natural resource staff to discuss bear seasons for subsistence hunters, elimination of sealing and tagging requirements, and a bear harvest ticket. We met with FWS refuge and Subsistence Division staff to develop subsistence regulations. Meetings were also held among FWS refuge staff, FWS subsistence staff, and ADF&G management staff to plan a cooperative brown bear research project within the YDNWR, the TNWR, portions of Subunit 17B, and Unit 18 to estimate brown bear densities.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The size of the brown bear population in Unit 18 appears moderately low in suitable montane and riparian habitat. Previous authors have estimated that the

brown bear population in Unit 18 numbers approximately 300-500 bears. The trend of the bear population appears stable, recovering from the high harvest levels of the late 1970s and early 1980s.

Although no statistically valid bear density estimate has been developed for Unit 18, density estimates have been calculated for other areas of Alaska using a modified capture-recapture technique (Miller *et al.* 1987). The closest density estimates applicable to this region occurred in Unit 22 and the Noatak area in northern Unit 23. Based upon the relative availability of quality habitat among the 2 study areas and Unit 18, I believe that the Unit 18 bear population probably falls between these 2 estimates. I averaged the bear densities for all bears of different age and sex between the Noatak and the Nome census areas, and derived an estimate of 21.5 bears/1000 km^2 for a low density estimate, 23.5 bears/1000 km^2 for a mean density estimate, and 27.0 bears/1000 km^2 for a high density estimate.

If we assume that good quality habitat based upon harvest records and habitat type is found within Uniform Coding Units (UCUs) 0301, 0401, 0203, 1601, 1501, 1301, 1701, and 1801, the total area for these UCUs is 14,592 km^2. Using the above density estimates, the Unit 18 bear population estimate for all bears of different age and sex would range from 313 bears to 392 bears, with a mean of 343 bears. Because the validity of using density estimates from other areas to derive population estimates is questionable, these population estimates should be regarded as preliminary.

Distribution and Movements: Salmon streams such as the Kisaralik and Kwethluk Rivers in the Kilbuck Mountains, and the Andreafsky River north of St. Marys support greater brown bear densities than are found elsewhere in the unit during summer months. The forested riparian corridors of the Yukon River and tributaries of the Kuskokwim in Unit 18 support moderate densities of brown bears in lowland habitats. The vast treeless lowland of the Yukon-Kuskokwim Delta contains very few bears, although dispersal does occur through riparian and deltaic habitats.

Mortality

Season and Bag Limit:

Unit 18	Subsistence/ Resident Seasons	Nonresident Season
One bear every 4 regulatory years	Sept. 10--Oct. 10	Sept. 10--Oct. 10
	April 10--May 25	May 10--May 25

Harvest

Human-induced Harvest: Reported harvests have declined dramatically since 1984, and have fluctuated between 1 and 9 bears annually (Figure 1). The reported harvest for the 1990-91 season is 3 bears, and 4 bears for the 1991-92 season (Table 1).

A subsistence brown bear harvest is conducted annually in spring by a few families in the upper Kwethluk drainage, and near the Kanektok and Goodnews River drainages. The estimated subsistence harvest of brown bears probably averages 5 to 10 bears per year. This harvest is not reported through the formal system because local residents are reluctant to purchase tags and seal hides and skulls although they freely provide harvest information if interviewed. During the 1990-91 regulatory year, 2 bears may have been harvested by villagers of Goodnews Bay and 2 bears may have been harvested by the villagers of Kwethluk during the 1991-92 season. Two bears may have been taken buy subsistence hunters along the lower Yukon River during the 1991-92 season.

Locally intensive brown bear subsistence harvest occurs approximately once every 5 years by lower Kuskokwim Bay villagers when snow conditions facilitate spring travel by snowmachines. Up to 20 bears were taken near Goodnews Bay in 1985.

We do not believe that current harvest levels of brown bears in Unit 18 are excessive, although harvests in 1981 and 1985 probably approached sustained yield limits. If we assume 5% of the population can be safely harvested annually, Unit 18 should produce an annual harvestable surplus of 15 to 35 bears. Because much of the subsistence harvest is unreported, we currently cannot document with accuracy when harvests begin to exceed sustained yield limits.

Hunter Residency and Success: One guided nonresident hunter and 2 unguided resident hunters harvested bears in Unit 18 during the 1990-91 season. Two guided nonresident hunters and 2 unguided resident hunters harvested bears in Unit 18 during the 1991-92 season. Thirty Unit 18 residents purchased brown/grizzly bear tags during the 1991-92 regulatory year from the Bethel ADF&G office. There were probably another 50 bear tags purchased from other vendors within Unit 18. However, most of these individuals hunted in Subunits 17B, 19A, 19B, 21A, and 21E. Because unsuccessful hunters were not required to report, we could not calculate hunter success rates.

Harvest Chronology: One bear was harvested during the fall 1990 season, and 2 were harvested during spring 1991. For the regulatory year 1991-92, all 4 bears were taken during fall. Two male bears and 2 female bears were reportedly harvested during the 1991-92 regulatory year.

Transport Methods: The guided nonresident hunters used aircraft for transportation. The resident hunters used aircraft for transportation during the 1990-91 season, 1 resident

hunter used a boat for transportation during the 1991-92 season, and the remainder used aircraft for hunting access.

Subsistence hunters normally use snowmachines, boats, and aircraft for transportation. These patterns are typical and have changed little over the last 10 years. Aircraft charters are occasionally used to transport subsistence hunters to Heart Lake and the Tikchik Lakes. Most subsistence hunters from Goodnews Bay, Platinum, Marshall, and Quinhagak use snowmachines for access during spring.

Habitat

Assessment: Unit 18 contains approximately 14,000 km^2 of fair to excellent brown bear habitat in the Kilbuck and Andreafsky Mountain ranges. Additional lowland riparian corridor habitats surrounded by tundra support moderate densities of brown bears along the Yukon River and tributaries of the Kuskokwim River. The number of brown bears in lowland riparian habitats may be substantial but estimates of density await comprehensive research. The brown bear habitat in Unit 18 is believed to be slightly below carrying capacity. Most brown bear habitat in Unit 18 is protected by the Yukon Delta National Wildlife Refuge and land status is not expected to change.

Board of Game Actions and Emergency Orders

In 1989 the Board of Game allowed a trial harvest bag limit of 1 bear per year by Kwethluk residents only. The board requested additional data on subsistence take by Kwethluk residents who indicated they would provide such data. Because the data were not provided and because of the December 1990 McDowell court decision, the 1 bear per every 4 year bag limit was reinstated for Unit 18. The McDowell decision invalidated the state subsistence statute, and all Alaska residents became eligible "subsistence" hunters.

The Board of Game later asked the ADF&G to develop subsistence brown bear regulations for consideration at its spring 1992 meeting. Work has begun between the FWS, ADF&G, and village governments to establish brown bear management areas with special subsistence regulations.

CONCLUSIONS AND RECOMMENDATIONS

We believe that brown/grizzly bears are moderate in density and stable in number in Unit 18. Average annual harvests have varied markedly, depending upon spring weather, snow cover, and interest by nonresident and subsistence hunters. Record high harvests of 23 bears were reported taken in 1981 by nonresidents, and more than 20 bears were taken by subsistence hunters during spring 1985. Reported harvests have recently declined because of lack of guiding activity.

Habitat for brown bears in Unit 18 includes both montane and lowland riparian areas. The montane habitats appear excellent for brown bears. The brown bear population in lowland riparian corridors, particularly along the Yukon River may be substantial, but quantitative data are lacking.

Management decisions have been based only on reported harvest. The utility of such data would be enhanced if actual population size, density, and range were known. Brown bear studies in Unit 18 have been a low priority under current budgetary and manpower restrictions, but recent requests by local residents for increased subsistence hunting opportunities and establishment of new guide-outfitter hunting areas have elevated the issue in priority. I strongly recommend a comprehensive brown bear population study.

The USFWS is willing to assist in such a study. Certain key drainages will need to be included in the study area, especially the Kisaralik, Kwethluk, and Kasigluk drainages. A study plan is being drafted to examine brown bear density, movements, and population parameters. The area of possible study will probably include UCUs 1501, 1601, 1701, and 1801. Most of the reported bear harvest for the last 21 years has taken place within these UCUs (Figure 2.).

One of the more pressing problems within Unit 18 is the continued unreported harvest of brown/grizzly bears. Many rural residents are reluctant to purchase the $25 tag, and to seal hides and skulls. Wildlife managers must rely primarily on harvest statistics derived from the mandatory sealing regulation to evaluate trends in bear populations. If inaccurate or incomplete, harvest statistics are impossible to interpret. A large, unreported harvest negates the value of our harvest data, and compromises our ability to detect trends in bear populations.

Alternative means of reporting bear harvest and elimination of the $25 tag fee (which is considered a trophy fee by subsistence hunters) may improve compliance with the regulations and our ability to gather harvest information. Development of subsistence hunting regulations for those hunters who use the meat for food, rather than for the trophy hunter, may encourage subsistence hunters to participate in the bear management process. Longer hunting seasons, a bear harvest ticket, elimination of the $25 tag fee, and voluntary sealing may represent positive steps toward alleviating this problem.

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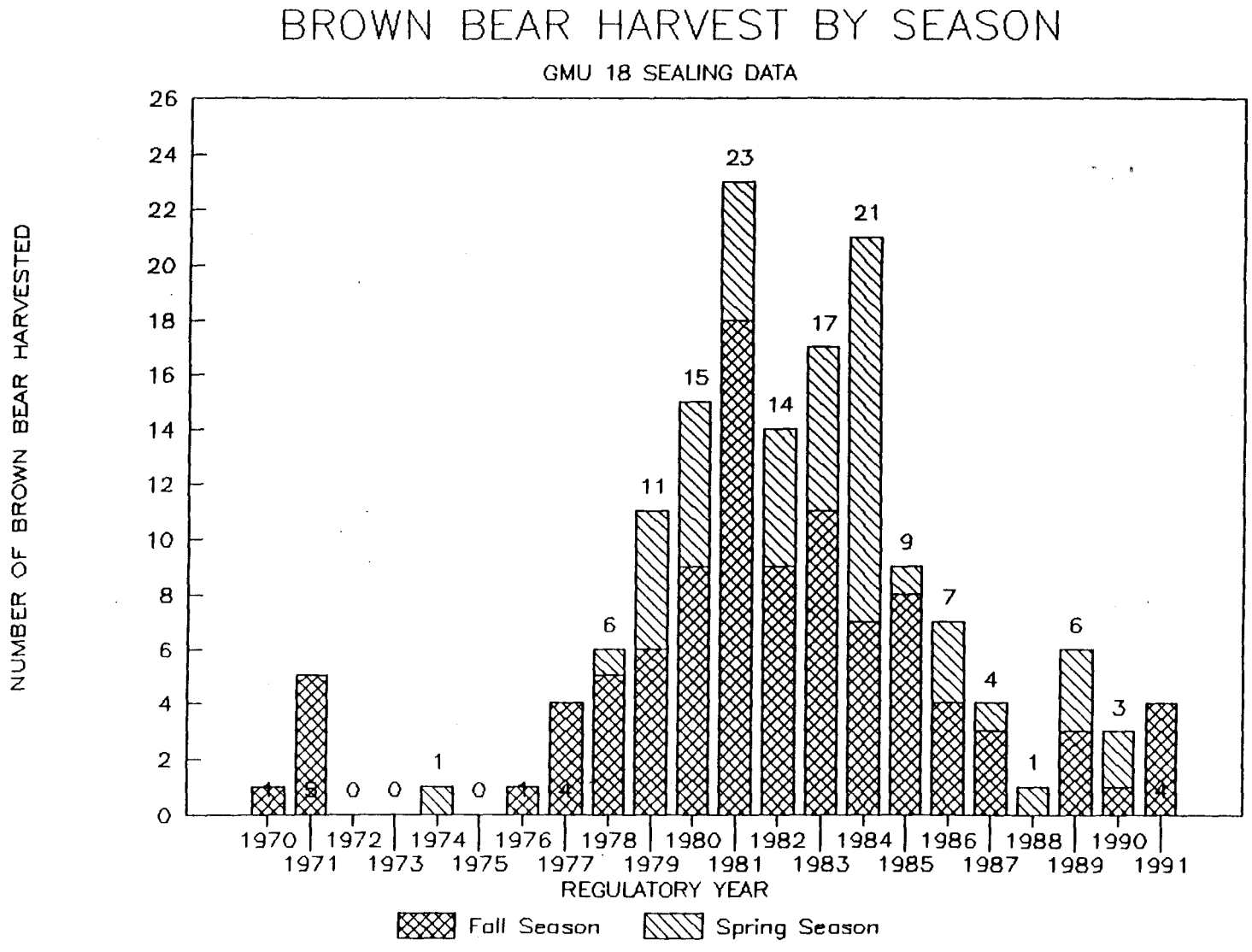

Figure 1. Unit 18, brown bear harvest by season, 1970-1991.

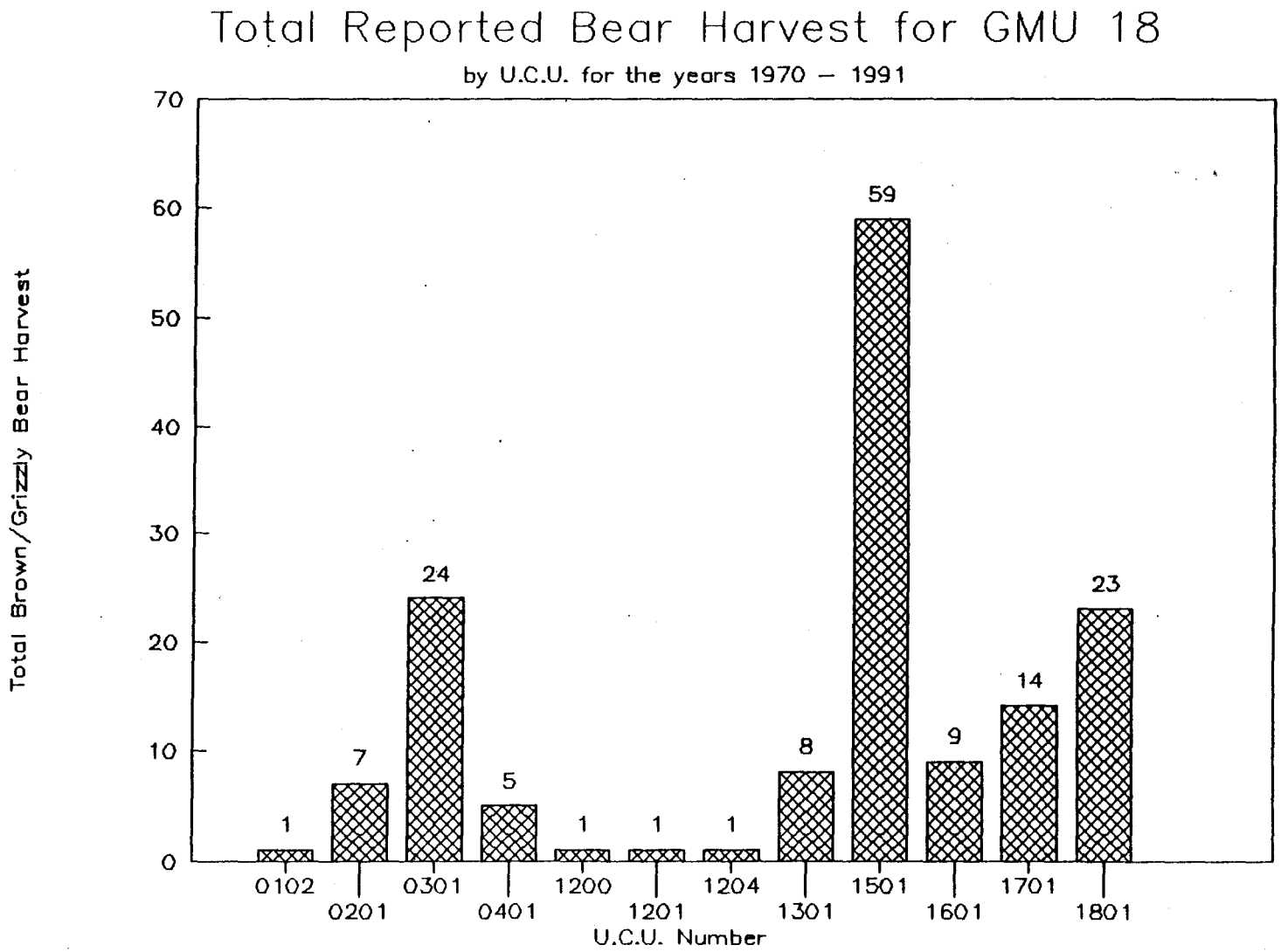

Figure 2. Unit 18, total reported bear harvest by uniform coding unit, 1970-1991.

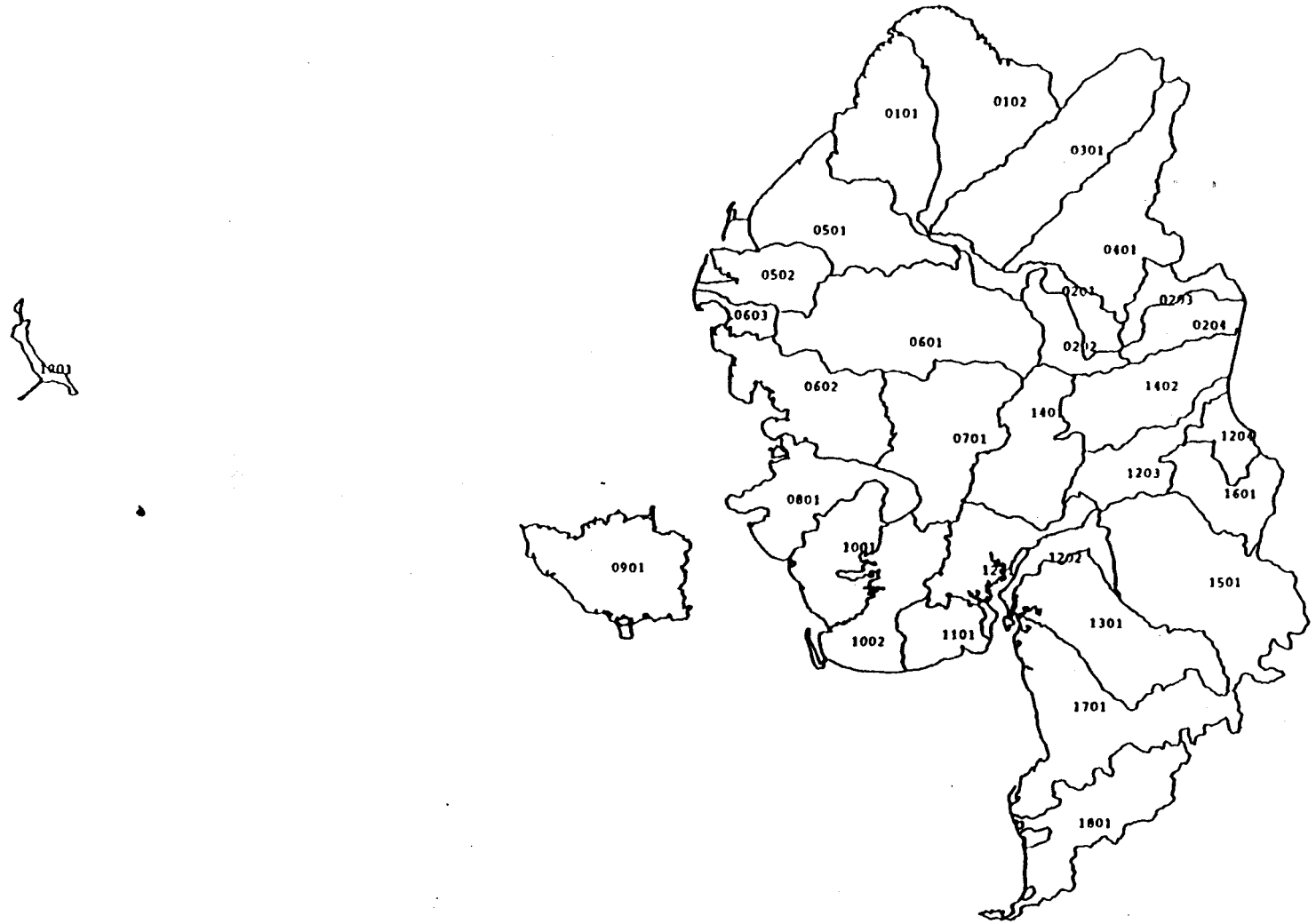

Figure 3. Unit 18 map with minor/specific codes displayed.

Table 1. Unit 18 brown bear harvest, 1987-1991.

Regulatory year	Reported harvest: Hunter kill M	F	(%)	Unk.	Total	Other kills[a] M	F	Unk.	Est. kill: Unreported illegal	Total estimated kill: M	(%)	F	(%)	Unk.	Total
1987															
Fall 1987	2	1		0	3										
Spring 1988	1	0		0	1	0			10						
Total	3	1		0	4					3	(75)	1	(25)	10	14
1988															
Fall 1988	0	1		0	1										
Spring 1989	0	0		0	0	0			10						
Total	0	1		0	1					0	(00)	1	(100)	10	11
1989															
Fall 1989	2	1		0	3										
Spring 1990	2	1		0	3	2			5						
Total	4	2		0	6					4	(67)	2	(33)	7	13
1990															
Fall 1990	0	1		0	1										
Spring 1991	2	0		0	2	0			10						
Total	2	1		0	3					2	(67)	1	(33)	10	11
1991															
Fall 1991	2	2		0	4										
Spring 1992	0	0		0	0	0			5						
Total	2	2		0	4					2	(50)	2	(50)	5	9

[a] Non-hunting includes defense of life or property kills, research mortalities, and other known-caused accidental mortality.

LOCATION

Game Management Unit: 19 (37,000 mi^2)

Geographical Description: All drainages of the Kuskokwim River upstream of the village of Kalskag

BACKGROUND

Although brown/grizzly bears are distributed throughout Unit 19, interest in sport harvest varies within portions of the unit. In higher elevations within the Alaska Range and foothills (Subunits 19B and 19C) there is moderate harvest pressure. Hunting is generally light in other portions of the unit.

No population estimation surveys have been conducted in the area, thus densities are only speculative. Harvests have generally fluctuated with season lengths and probably do not provide a good indication of population level or status. During the first decade following the mandatory requirement to seal brown bear hides and skulls, harvest was light, averaging about 15 bears annually. During the 1970s, harvest dramatically increased and seasons were shortened severely, leading to harvest declines by the early 1980s. Throughout the 1980s, harvests remained relatively stable at about 28 bears annually. Recent season liberalizations served to increase the annual harvest slightly, but based on incidental observations and discussions with hunters and guides in the area, it appears that brown bear numbers are slowly increasing in Unit 19.

MANAGEMENT DIRECTION

Management Goals

There are three existing consumptive use management goals for brown bears in Unit 19. The goal for that portion of the unit north of the Kuskokwim River is to provide the greatest sustained opportunity to hunt brown bears. For the southern portion of Unit 19, the goal is to provide an opportunity to hunt brown bears under aesthetically pleasing conditions. South of the Kuskokwim River upstream from Aniak, the goal is to provide the opportunity to take large bears with a secondary goal to provide the opportunity to hunt bears under aesthetically pleasing conditions.

Management Objectives

1) Manage brown bear populations that will sustain a mean annual harvest of at least 30 bears with a minimum of 50% males in the harvest.

2) Increase legal harvests of brown bears in and around villages, fish camps, and other human habitations during open seasons to reduce human-bear conflicts during closed seasons.

METHODS

No surveys designed to count bears have been conducted in Unit 19. Harvest trend, based on sealing documents, is reviewed annually and regulations are amended when harvest data indicate the need.

RESULTS AND DISCUSSION

Population Size and Composition

A rough population estimate of 900 brown bears in the unit was provided by Pegau (1987). No bear surveys have been conducted since. However, using reasonable density figures for different qualities of brown bear habitat produces a similar estimate. Subunit 19B probably contains about 7,500 mi^2 of the best bear habitat in this unit, with an estimated density of 40 bears/1,000 mi^2, for a total of about 300 bears. Subunit 19C has an estimated 5,200 mi^2 of good habitat (40 bears/1,000 mi^2 = 210 bears) and about 1,500 mi^2 of poor habitat (13 bears/1,000 mi^2 = 30 bears). Subunit 19D generally contains poor habitat (13 bears/1,000 mi^2 = 165 bears). Subunit 19A has habitat which probably contains about 20 bears/1,000 mi^2, for a total of about 200 bears. Using these figures, the total estimate is 905 brown bears for Unit 19, which equates to a density of 24.4 bears/1,000 mi^2 in this unit.

Because no formal survey work has been conducted, the trend of the Unit 19 brown bear population is unclear. From analyses of harvest data, present human use of the brown bear population appears moderate. Assuming that Pegau's (1987) estimate of 900 bears is reasonably accurate, the 1990-91 and 1991-92 reported harvest of 38 and 31 bears, respectively, constitutes an annual harvest of about 4% of the population.

Mortality

Harvest: Following relatively low harvests throughout the 1960s (1961-70 mean annual harvest = 15.2 bears), there was an increase through the 1970s (1971-80 mean annual harvest = 53.7). From 1981 through 1991, reported harvests were moderate in comparison to the 2 previous decades (1981-91 mean annual harvest = 28 bears) (Figure 1). Most of the harvest occurs in Subunits 19B and 19C, with Subunits 19A and 19D providing lower annual harvests (Table 1).

Season and Bag Limit.

Units and Bag Limits	Subsistence Open Seasons	Resident/ Nonresident Open Seasons
Units 19(A) 19 (C) and 19(D) One bear every 4 regulatory years.		Sept. 1-May 31
Units 19(A) and 19(B) those portions within the Western Alaska Brown Bear Management Area One bear every regulatory year by registration permit.	Sept. 1-May 31	
Unit 19(B) One bear every 4 regulatory years.		Sept. 10-May 25

Subsistence hunters in the Western Alaska Brown Bear Management area are required to have a registration permit but are not required to have the resident $25 brown bear tag. The meat must be salvaged for human consumption, and the hide and skull do not have to be sealed if they remain within the unit.

Board of Game Actions. Beginning with the 1990-91 regulatory year, the Board of Game authorized a longer season throughout Unit 19. Rather than having split fall and spring seasons totaling 46-56 days, the board made minor changes to fall opening and spring closing dates and elected to leave the winter period open. Initially, it appears that season length has increased almost 5-fold; however, because of winter denning, brown bear hunting opportunities will effectively increase only slightly. The Western Alaska Brown Bear Management Area was established in 1992 in portions of several game management units, including portions of Subunits 19A and 19B to provide a way to address subsistence use concerns. Subsistence harvest in this area is by registration permit only.

Sex Ratio in the Harvest. Because present harvest levels are considered at low enough levels that population impacts from hunting are negligible, annual sex ratios of harvested bears have fluctuated. Generally, the proportion of males in the harvest has been near 60% (Table 2), but this has fluctuated from a low of 29% (1966) to a high of 77% (1971) from 1961 to 1992. Generally, we assume that a preponderance of males in the harvest reflects a healthy population, given low to moderate hunting effort. However, many Unit 19 brown bears are harvested on multi-species hunts, and hunters are not necessarily attempting to take a record-class animal. Therefore, harvest of females (except those with cubs or yearlings) is not avoided. Until brown bear hunting effort becomes more intensive

in Unit 19, I feel that a management scheme designed to harvest greater than 50% males should afford the protection needed to sustain the population.

Hunter Residency and Success. During the last 31 years while sealing has been mandatory, 829 of 1,017 bears (82%) have been harvested by nonresidents of the state, and in only one year has reported nonresident harvest been below 50% (Tables 3 and 4). This further points out the high use of the resource by guides and their nonresident clients. No information is available on success rates by brown bear hunters in the unit.

Harvest Chronology. Spring harvests were anticipated to increase during the lengthened season beginning in regulatory year 1990-91 (Table 5). The spring harvest percentages increased to 34% and 23% in 1990-91 and 1991-92 respectively. As was expected, most bears taken in spring were males (54% in 1990-91 and 71% in 1991-92). No bears were taken during the extended fall season (Oct. 11-Dec. 31) in Unit 19 during the 1990-91 season, and only 2 were taken during this time period in the 1991-92 season.

Method of Transportation. Aircraft is the primary access method for hunters in Unit 19 (Table 6). Use of boats, horses, and ORVs declined substantially after 1989 when access was almost exclusively by aircraft.

CONCLUSIONS AND RECOMMENDATIONS

Because current seasons and bag limits are apparently allowing a modest bear harvest and there are no apparent signs of decline in the population (based on sealing data, mean annual ages of harvested bears, days per successful hunter, and sex ratios), further harvest restrictions appear unnecessary. However, because the Board of Game authorized longer seasons beginning during the 1990-91 season and increased harvest has been noted, close scrutiny of the sealing data must occur annually and changes enacted if warranted.

Brown bear predation on moose and caribou is not presently an apparent widespread problem in the unit.

Annual review of sealing certificate data will continue. If sex ratios in the harvest begin to favor females, changes in season lengths should be considered. Mean ages of harvested bears have fluctuated from year to year, but it appears that the older-age component of the population remains intact.

Personal contacts in villages and fish camps by ADF&G and Fish and Wildlife Protection personnel will continue to stress the need for documentation of harvests, whether they are legal harvests or are taken under DLP provisions. Because of the present regulation requiring a $25 resident brown bear tag except for subsistence hunters in the Western Alaska Brown Bear Management Area, I think compliance with reporting requirements by local residents is low.

LITERATURE CITED

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Table 1. Annual harvest[a] of brown bears by Subunit in Unit 19, 1977-92.

Regulatory year	Subunits				Total
	A	B	C	D	
1977-78	0	26	23	0	49
1978-79	14	35	23	3	75
1979-80	11	30	20	0	61
1980-81	7	27	18	3	55
1981-82	0	3	22	6	31
1982-83	3	2	16	3	24
1983-84	8	5	15	3	31
1984-85	4	7	11	1	23
1985-86	4	12	4	3	23
1986-87	4	12	9	1	26
1987-88	5	18	12	2	37
1988-89	3	10	16	1	30
1989-90	0	15	16	3	34
1990-91	2	15	14	7	38
1991-92	3	17	9	2	31
Total	68	234	228	38	568

[a] Includes 5 bears taken in defense of life or property.

Table 2. Spring, fall, and annual harvest of brown bears in Unit 19, 1986-92.

Regulatory year	Reported: Hunter kill M	F	Unk	Total	Reported: Non-hunting kill M	F	Unk	Total estimated kill M	(%)	F	(%)	Unk	Total
1986-87													
Fall 86	13	5	2	20	0	0	0	13	(72)	5	(18)	2	20
Spring 87	5	1	0	6	0	0	0	5	(83)	1	(17)	0	6
Total	18	6	2	26	0	0	0	18	(75)	6	(25)	2	26
1987-88													
Fall 87	16	11	1	28	1	0	0	17	(61)	11	(49)	1	29
Spring 88	6	1	0	7	0	0	0	6	(86)	1	(14)	0	7
Total	22	12	1	35	1	0	0	23	(66)	12	(34)	1	36
1988-89													
Fall 88	14	10	1	25	1	0	0	15	(60)	10	(40)	1	26
Spring 89	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
Total	17	11	1	29	1	0	0	18	(62)	11	(38)	1	30
1989-90													
Fall 89	10	18	3	31	0	0	0	10	(36)	18	(64)	3	31
Spring 90	2	1	0	3	0	0	0	2	(67)	1	(33)	0	3
Total	12	19	3	34	0	0	0	12	(39)	19	(61)	3	34
1990-91													
Fall 90	16	9	0	25	0	0	0	16	(64)	9	(36)	0	25
Spring 91	7	5	1	13	0	0	0	7	(54)	5	(38)	1	13
Total	23	14	1	38	0	0	0	23	(61)	14	(37)	1	38
1991-92													
Fall 91	11	12	1	24	0	0	0	11	(46)	12	(50)	1	24
Spring 92	5	2	0	7	0	0	0	5	(71)	2	(29)	0	7
Total	16	14	1	31	0	0	0	16	(52)	14	(45)	1	31

[a] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

Table 3. Unit 19 brown bear successful hunter residency, 1985-92.

Regulatory year	Resident	(%)	Nonresident	(%)	Total successful hunters
1985-86	8	(35)	15	(65)	23
1986-87	7	(27)	19	(73)	26
1987-88	8	(22)	28	(78)	36
1988-89	1	(3)	29	(97)	30
1989-90	5	(15)	29	(85)	34
1990-91	5	(13)	33	(87)	38
1991-92	6	(19)	25	(81)	31

Table 4. Percentage of nonresident successful brown bear hunters in Unit 19, Alaska, 1961-92.

Regulatory Year	No. of nonresidents	Total Percent nonresidents	successful hunters
1961-62	9	64	14
1962-63	4	33	12
1963-64	7	70	10
1964-65	12	60	20
1965-66	14	82	17
1966-67	14	82	17
1967-68	10	71	14
1968-69	9	64	14
1969-70	8	73	11
1970-71	22	79	28
1971-72	19	68	28
1972-73	33	75	44
1973-74	53	77	69
1974-75	45	90	50
1975-76	38	93	41
1976-77	54	84	64
1977-78	43	88	49
1978-79	66	88	75
1979-80	50	83	60
1980-81	53	96	55
1981-82	24	77	31
1982-83	21	91	23
1983-84	26	87	30
1984-85	17	74	23
1985-86	15	65	23
1986-87	19	73	26
1987-88	28	78	36
1988-89	29	97	30
1989-90	29	85	34
1990-91	33	87	38
1991-92	25	31	31
Total	829	82	1,017

LOCATION

Game Management Subunits: 20A, 20B, 20C, 20F, and 25C (39,228 mi^2)

Geographical Description: Central and Lower Tanana Valley, and Middle Yukon River drainages

BACKGROUND

Grizzly bears occur throughout this area, with highest densities in the Alaska Range portions of Subunits 20A and 20C. In a portion of the Subunit 20A mountains, a long-term grizzly bear research project began in 1981 to (1) gather baseline data on population status and reproductive biology (1981-85) (Reynolds and Hechtel 1986), and (2) to study the effects of high exploitation rates on grizzly bear population dynamics (1986-91) (Reynolds and Boudreau 1992, Reynolds 1993). During the latter phase of the project, grizzly bears in the study area were deliberately subjected to high harvest (>11% of the population versus ≤6% before 1981. As a result, Reynolds (1993) documented a 20% decline in the bears (≥2 years old) in this area since 1981. The grizzly bear density within the Subunit 20C mountains is higher than in the Subunit 20A mountains, but is largely protected from hunting because it is within the original boundaries of Denali National Park. Eastern Subunit 20B (upper Chena and Salcha River drainages) supports a moderate density of grizzly bears and has been the second area (in addition to Subunit 20A mountains) where harvest has been concentrated within this study area. Grizzly bear populations in the remainder of the study area are approximately half the density (or less) as the Subunit 20A mountains, and are harvested less intensively.

Grizzly bears have been shown to be a significant predator of moose in Unit 13 (Ballard *et al.* 1981) and Subunit 20E (Gasaway *et al.* 1992) but not on the Tanana Flats portion of Subunit 20A (Gasaway *et al.* 1983). Grizzly bears also probably impact moose and caribou populations in this study area, but predation rates by grizzly bears have not been investigated here. Since 1990-91, the previous fall and spring grizzly bear hunting seasons have been combined into a 1 September - 31 May season, with a bag limit of one bear every four years.

In response to an increasing human population and interest in hunting grizzly bears, McNay (1991) analyzed harvest and population data from this study area to develop specific management objectives and harvest quotas. These quotas were based on a sustainable harvest rate of 8% of the total population (Miller 1990). To interpret harvest data from subunits where annual harvests are relatively small and variable, we used a 3-year mean harvest quotas.

MANAGEMENT DIRECTION

Management Goals

Within all subunits:

- Maintain healthy grizzly populations and the ecosystems upon which they depend.
- Provide people with an opportunity to hunt, view, and photograph grizzly bears.
- Avoid human-grizzly interactions that threaten human life and property.

Additionally in Subunit 20A:

- Provide for scientific and educational use of grizzly bears.

Additionally in Subunit 20C:

- Maintain a grizzly population within Denali National Park that is largely unaffected by human activity and that is not subjected to hunting.

Management Objectives

Subunit 20A Mountains:

- Manage harvests to sustain a mean annual exploitation rate of 10-15% of the estimated grizzly population 2 years or older until 1992.

Subunit 20B East:

- Manage human-caused mortality to provide a stable grizzly bear population.
- Manage mean annual human-caused mortality at or below 6 bears 2 years or older.
- Manage for an average at least 55% males in the annual harvest.

Subunit 20C (that portion within Denali National Park):

- Maintain a closed season on grizzly bears.

Subunit 20A Flats, 20B West, remainder of 20C, 20F, and 25C:

- Manage harvest to provide stable grizzly bear populations with a combined mean annual human-caused mortality of up to 26 bears 2 years or older, provided that at least 55% are males.
- Manage the 3-year mean annual harvests with the following quotas: 3 bears from Subunit 20A Flats, 3 bears from Subunit 20B West, 7 bears from Subunit 20C, 7 bears from Subunit 20F, and 6 bears from Subunit 25C.

(Note: The objectives listed in the last management report referenced bears older than 2 years old, rather than ≥2 years old. However, the text of that report discussed data for bears ≥2 years old and we assume that was the intended age objective. We also changed some of the previous references to harvest to human-caused mortality, which lumps harvest by hunters with DLP and research mortalities).

METHODS

Harvest

We used grizzly bear sealing certificates for data on kill location, date of kill, sex, skull size, defense of life or property, hunter residency, transportation method, kill type (hunter harvest, illegal kill, research mortality, etc.), and commercial services used. We coded sealing certificates from bears killed in this study area according to Uniform Coding Units (UCUs). We suggested revisions in the bear sealing certificate format and content, many of which were incorporated into new certificates printed in June 1992. During sealing, we collected premolars for age determination. Most of the grizzly bears harvested in this study area were sealed in the regional department office in Fairbanks; there are no authorized private-sector bear sealers in the Fairbanks area. We used a printout of sealing data provided by the Statistics Section (9 April 1993) for our database.

Population Size and Density

H. Reynolds and I stratified Subunits 20A, 20B, 20C, 20F, and 25C into 4 grizzly bear density strata: low, medium, high, and super. Low density areas were those containing significant human development, areas of poorly drained soils, or permafrost areas predominated by black spruce. Medium density areas included upland forest and tundra habitats at elevations generally between 500 and 1,500 feet. High density areas were those most similar in elevation and habitat to areas of known density in Subunits 20A, 20E, and 13E. Super density areas included habitat similar to the high density areas, but where no harvest is permitted. We assigned UCUs into a stratum based on topography, habitat, and accessibility to humans.

We calculated the total area within each stratum using the mi^2 listed for each UCU (Uniform Coding Units - Square Mile Listing, Version 2.0, July 28, 1990). Square miles were converted to km^2 using a correction factor of 2.59. We excluded approximately 1,300 km^2 area of glaciers and land above 6,000 feet from the Subunit 20A high density stratum, and 1,000 km^2 of similar topography in the Subunit 20C super stratum.

We estimated grizzly bear (all ages) densities in each of four stratum on the following basis: low, 1-3 bears/1,000 km^2; medium, 510 bears/1,000 km^2, high, 14-17 bears/1,000 km^2, and super, 20-30 bears/1,000 km^2. I then multiplied the area for each stratum by the range of bear densities for that stratum to calculate a population estimate. We estimated the status of the population in each subunit as stable, increasing, or decreasing.

We recalculated the size of the Subunit 20A Mountains zone using sizes for UCUs listed in the UCU printout. We now consider this zone to include 7,980 km^2 of bear habitat (9,275 km^2 minus about 1,295 km^2 block of glaciers and land above 6,000 ft). The Subunit 20A Mountains zone has previously been reported to include 9,315 km^2.

Population Composition

The only sex and age composition data available for grizzly bears in this study area is from research in a portion of the Subunit 20A Mountains (3,160 km^2) (Reynolds, pers. commun.). I calculated the number of bears in each sex and age category for the entire Subunit 20A Mountains (7,981 km^2 of bear habitat) by multiplying the estimated population size by the percentage of the population within each sex and age class (adjusted for closure), as indicated by the research project.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

Stratification. We classified 62% of the 99,116 km^2 of potential grizzly bear habitat within this study area as low density (1-3 grizzly bears/1,000 km^2), 21% as medium density (5-10/1,000), 8% as high density (14-17/1,000), and 8% as super (20-30/1,000) (Table 1). Our rationale for this stratification is as follows.

Subunit 20A. We considered the foothills of Subunit 20A high density with a range of 14-17 bears/1,000 km^2. We estimated this range based on research in the central foothills where densities ranged from 16.7 total bears/1,000 km^2 for a 3,160 km^2 area in 1992 (Reynolds 1993) to 14.6/1,000 in a subset of that area in 1993 (Reynolds, pers. commun.). Although we recognize that densities in the foothills outside this study area may be different, we believe that overall, the range of 14-17/1,000 km^2 was representative of the entire foothills.

The Subunit 20A Tanana Flats are relatively poor grizzly bear habitat and we classified it as low density. Many grizzly bears on the Tanana Flats are probably dispersers from the foothills, bears traveling through enroute to other areas, or bears making forays into the flats from the foothills. We estimated that the flats provide habitat for 20 grizzly bears, or 2.5 bears/1,000 km^2. Our range of 1-3/1,000 was an adjustment downward slightly from the 2.5 so that the low stratum was more representative of even lower densities found in other subunits.

Subunit 20C. We classified the Alaska Range portion of Subunit 20C as super, with 20-30 grizzly bears/1,000 km^2. Although Dean (1987) estimated 34 bears/1,000 km^2 for

a portion of this area in 1983, Dean's surveys were in the core area along the Denali Park Road where densities were probably highest within the stratum. We assumed that densities would be similar to, or higher than, the 23 bears/1,000 km^2 that Reynolds documented in Subunit 20A in 1981. Densities are higher in the Alaska Range portion of Subunit 20C than in Subunit 20A because most of the former is within the old Denali National Park, which is closed to hunting. Most of the portion that is outside the old park is within the new park, which is relatively inaccessible and open to federal subsistence hunters only.

We classified a small portion of northwestern Subunit 20C as medium density. The range of 5-10 bears/1,000 km^2 is reasonable because habitat quality is less than that in the Subunit 20A foothills and higher than that in the flats. This area is adjacent to some fair grizzly bear habitat in the upper Kuskokwim drainage, is open to hunting, but is relatively inaccessible.

We considered the remainder of Subunit 20C to be low density, although it may have slightly higher densities than the low density stratum in the Subunit 20A flats. The Subunit 20C flats have salmon streams, bears that disperse from the super-high stratum, and relatively low hunting pressure.

Subunit 20B. We classified most of Subunit 20B as low density because of the moderate habitat, high density of people, and good access. Better habitat in the Sawtooth Mountains in the western portion was included in the low density stratum because of the good access and the proximity to human activity. We considered the upper Chena and Salcha Rivers as medium density because of the better habitat and relative inaccessibility.

Subunit 20F. The Tozitna River drainage/Ray Mountains portion of Subunit 20F has relatively good grizzly bear habitat and we classified it as medium density. It is relatively inaccessible and we do not have much information from that area.

We classified the remainder of Subunit 20F as low density. Even though there is some good habitat in the Sawtooth Mountains that area supports moderate human activity. Much of the rest of the area includes lowlands and relatively poor grizzly bear habitat.

Subunit 25C. We considered the mountainous portion of Subunit 25C as medium density. This is an extension of the medium density area of eastern Subunit 20B and also includes the White Mountains. Although habitat is good, a road and numerous trails exist through the area. Hunters take grizzly bears incidental to their pursuit of caribou and moose.

Population Estimate. Extrapolating from this stratification, we estimated that 446-782 grizzly bears (all ages) inhabit this study area (Table 1). Using the midpoint of the population estimate (614 bears), the combined subunit density is probably about 6.2 grizzly bears/1,000 km^2. Subunits 20C and 20A had the highest densities (8.8 and 8.5/1,000, respectively) and Subunit 20B the lowest (3.4/1,000). Estimates for number of

grizzly bears (all ages) in each subunit included: 120-160 in Subunit 20A, 47-112 in Subunit 20B, 195-326 in Subunit 20C, 36-83 in Subunit 20F, and 48-101 in Subunit 25C.

Because of our objective to manage the Subunit 20A Mountains harvest based on the number of bears ≥2 years old, we also estimated that 111 grizzly bears ≥2 years old (13.9 bears ≥2 years old/1,000 km^2 (Reynolds, pers. commun.) for 7,980 km^2 of bear habitat) inhabit that area. This compares to approximately 134 bears of all ages in the same area.

Population Composition: By extrapolating from composition data obtained in the research study area in a portion of Subunit 20A Mountains (Table 2), I estimate that during spring 1992, the population of 134 bears (all ages) in the entire Subunit 20A Mountains included 46 bears ≥6 years old (34 females, 12 males), 65 bears 2-5 years old (40 females, 25 males), and 23 bears ≤1 year old (no sex data) (Table 3).

Reynolds (1993) summarized the average productivity of the population between 1982 and 1992 in his study area as follows. Female grizzly bears produced their first litters at 6.2 years and their first surviving litters at 7.1 years. They had 2.1 cubs of the year (n = 43) and 2.0 offspring weaned as 2- or 3-year olds (n = 20). Although the difference in mean litter size between cubs and yearlings is small, it is primarily because of the mortality of entire litters rather than high survival rates. Females produced weaned offspring in an average of 4-year intervals.

Distribution and Movements: Based on research from 1981-1992 in a portion of the Subunit 20A Mountains (Reynolds 1993), the following patterns of fidelity to maternal or established home ranges were found. All females (n = 44) remained near their maternal home ranges and none emigrated from the study area. In contrast, all males weaned or captured as 2- or 3-year olds emigrated from their maternal or established home ranges within 2 years. Males ≥4 years old immigrated into the study area, with none later emigrating from the study area.

Mortality

Harvest:

Season and Bag Limit. During regulatory years 1990-91, 1991-92, and 1992-93, the resident and nonresident open season for grizzly bears was 1 September - 31 May with a bag limit of 1 bear every 4 regulatory years.

Board of Game Actions and Emergency Orders. The board took no action directly affecting grizzly bears in this study area during its fall 1990, spring 1991, or fall 1992 meetings. In spring 1992 the board passed a proposal I had submitted to require that evidence of sex be retained on all black and grizzly bear hides until the hide has been sealed. Indirectly, we thought that board actions that closed hunting on the Delta caribou

herd in fall 1992 would decrease harvest of grizzly bears because fewer hunters would be in the field.

Harvest by Hunters. Harvest in Subunit 20A, 20B, 20C, 20F, and 25C has been relatively stable during the last 5 years, with a mean of 29 bears. The exception during this time period was in 1989-90 when hunters reported harvesting 43 grizzly bears, nearly twice than during the other 4 years (Tables 4(a-e)). Most of this increased kill occurred in Subunit 20A. In 1990-91, hunters reported taking 22 grizzly bears in the 5 subunits. In 1991-92, harvest increased slightly to 25 grizzly bears.

In addition to harvest by hunters, 4 grizzly bears from Subunit 20B were killed in DLP incidents in fall 1991, 3 males and 1 female. In the Subunit 20A Mountains 3 2-year-old females and at least 2 bears of unknown sex were probably killed illegally during 1991 and 1992, respectively. We did not include this unreported information in our calculations.

Harvest Zones.

Subunit 20A Mountains. During the last 3 years, 34 grizzly bears were killed by humans in the Subunit 20A Mountains. Nineteen bears were killed in 1989-90 (17 hunter harvest, 2 DLP yearlings), 5 in 1990-91, and 10 in 1991-92 (Table 4). Of these 34 bears, 2 were <2 years old, 25 were ≥2 years old, and 7 were of unknown age. If all the unknown age bears were ≥2 years old, then the 3-year mean annual harvest would include 10.7 bears ≥2 years old. This is approximately 10% of the estimated population of 111 grizzly bears ≥2 years old (13.9 bears/1,000 km^2 for 7,981 km^2 of bear habitat). If none of the bears of unknown age were ≥2 years old, then the 3-year mean annual harvest would include 8.3 bears, or approximately 7% of the estimated population of bears ≥2 years old. Because it is illegal to harvest cub or yearling grizzly bears, I assume that most bears of unknown age were 2 years or older, making 10% the more accurate estimate.

Fourteen of the 34 harvested grizzly bears were females, including 4 <6 years old, 5 ≥6 years old, and 5 of unknown age. If all unknown age females were ≥6 years old, then the 3-year mean harvest would include 3.3 females ≥6 years old. If all unknown age females were <6 years old, then the 3-year mean harvest would include 1.7 females ≥6 years old. If 30% of the bears ≥2 years old are females ≥6 years old (Reynolds, pers. commun.), then this area would include approximately 33 female bears ≥6 years old. The mean harvest of 1.7 to 3.3 adult females per year would be 5 to 10% of the adult female population.

Subunit 20B East. From 1989-90 through 1991-92, 21 grizzly bears were reported killed in Subunit 20B East, including 5 DLP and 16 hunter harvest (Table 4). Of these 21 bears, 3 were <2 years old, and 14 were ≥2 years old, and 4 were of unknown age. If all unknown age bears were ≥2 years old, then the 3-year mean annual harvest would include 6.0 bears ≥2 years old. If all unknown age bears were <2 years old, then the 3-year mean annual harvest would include 4.7 bears ≥2 years old. Although 52% (11/21) of the bears

killed during this 3-year period were males, only 44% (7/16) of the non-DLP bears were males.

Subunit 20A Flats, 20B West, 20C, 20F, and 25C Combined: From 1989-90 through 1991-92, 45 grizzly bears were reported harvested from these subunits, including 42 hunter harvests and 3 DLPs (Table 4). These 45 bears included 1 bear <2 years old, 38 bears ≥2 years old, and 6 of unknown age. If all unknown bears were ≥2 years old, then the 3-year mean annual harvest would include 14.7 bears ≥2 years old. If all of the bears of unknown age were <2 years old, then the 3-year mean annual harvest would include 12.7 bears ≥2 years old. Sixty-seven percent (29/43) of the bears of known sex were males. Sixty percent (26/43) of the hunter harvests were males.

The 3-year (1989-90 through 1991-92) mean annual subunit grizzly bear harvests were as follows: 2.3 in Subunit 20A Flats, 3.3 in Subunit 20B West (2.7 if DLPs excluded), 5.3 in Subunit 20C (5.0 if DLPs excluded), 2.3 in Subunit 20F, and 1.7 in Subunit 25C (Table 4).

Harvest Density. For each harvest zone, I calculated a harvest density by dividing the 3-year mean annual harvest of grizzly bears (≥2 years old) by the area within that zone (Table 4). The resulting harvest rates included 1.3 bears (≥2 years old)/1,000 km^2 for the Subunit 20A Mountains, 0.5/1,000 for Subunit 20B East, and 0.2/1,000 for the combined Subunits 20A Flats, 20B West, 20C, 20F, and 25C. These harvest densities reflect the combination of bear density and hunting effort, an indicator of hunting pressure in the absence of other information on hunting effort.

Hunter Residency and Success. Seventy-seven percent (111/144) of the successful grizzly bear hunters in the study area during the last 5 years were Alaska residents, with 57% (82/144) being local residents (residents of the unit they harvested the bear in) (Table 5). Twenty-three percent (33/144) of successful hunters were nonresidents.

Harvest Chronology. During the last 5 years, 77% of the 144 grizzly bears harvested in the study area were taken in September (Table 6). Grizzly bear harvests are generally higher in fall than in spring because many bears are taken opportunistically by hunters primarily hunting moose, caribou, or sheep. Only 21% of the harvest was taken in April or May.

Transport Methods. The methods of transportation used by successful grizzly bear hunters have not changed substantially during the last 5 years. The most popular methods included aircraft (28%), highway vehicle (19%), horse (15%), and ORV (14%) (Table 7).

Other Mortality: During his research in the Subunit 20A Mountains from 1981-1992, Reynolds (1993) observed mean natural mortality rates of 23% for cubs-of-the-year (n = 80), 6% for yearlings (n = 67), 5% for 2-year-olds (n = 39), and 2.5% for adult females (n = 45). These rates included only offspring under maternal care. Reynolds could not

determine causes of natural mortality for cubs, yearlings, and 2-year-olds that disappeared while accompanying their mother. However, cannibalism by adult males was suspected as the major cause and has been documented in Alaska (Alaska Range, south of Alaska Range, Brooks Range) and in Canada (see review by Reynolds 1993). Four adult females died of non-human-related causes; 2 were eaten by adult males, presumably while they were defending offspring, 1 was found dead and eaten before she would have weaned her young, and 1 was found dead in her collapsed den.

Habitat Assessment and Enhancement

As human development expands into grizzly bear habitat, human-bear conflicts often increase. For instance, in fall 1992, a problem was identified at a squatter campsite in Hornet Creek (Subunit 20A), adjacent to the entrance Denali National Park and Preserve. Up to 150 seasonal campers had been using the area and had no facilities for garbage disposals, human waste, or food storage. The lack of facilities began attracting bears, and during summer 1992, a black bear was shot in the campsite and a nuisance grizzly bear was shot at a nearby lodge. In February 1993, the Office of the Governor's Division of Governmental Coordination conducted a strategy session in the area to seek solutions to problems associated with unauthorized use of state land and related bear-human conflicts along the Parks Highway near Denali National Park and Preserve. Participants included 5 state agencies, the NPS, Denali Borough, several major local employers, the Denali Citizen's Council, and local residents. Through cooperative efforts, the squatter's campsite was closed and efforts to reduce human-bear conflicts seemed successful.

CONCLUSIONS AND RECOMMENDATIONS

We now estimate that 450-787 grizzly bears (all ages) live within the 101,601 km^2 of this study area. Excluding the 2,300 km^2 we considered non-bear habitat, density estimates for each subunit ranged from 3.4 to 8.8 grizzly bears/1,000 km^2.

Harvest has been most intensive in Subunit 20A Mountains, and to a lesser degree in Subunit 20B East. Because of widely varying grizzly bear densities and harvest, we will continue to examine harvest and population data based on the three harvest zones discussed below.

Subunit 20A Mountains: We met our objective to harvest 10-15% of the grizzly bear population (≥2 years old) until 1992. The 3-year mean annual harvest (1989-90 through 1991-92) of about 10.7 bears was 10% of the estimated population of 111 bears. High harvest rates have resulted in a decline in the grizzly bear population; by 1992, the population of bears ≥2 years old in the research study area declined 20% since 1981 (Reynolds 1993).

The number of productive females within a population is the most important factor in the rate of growth or decline in grizzly bear populations (Craighead *et al.* 1976, Knight and Eberhardt 1984). The number of adult females in the research study area of Subunit 20A was relatively stable (21-23) from 1981-89 when harvest rates were 6.3%. However, the projected adult female population in spring 1993 was only 14, after harvest rates of 16.7% from 1989-92. Unless the number of productive females recovers, the population will probably continue to decline (Reynolds 1993). Because of fidelity to maternal home ranges, females will probably not emigrate into this area.

To allow the population to recover, Reynolds (1993) now recommends that beginning in fall 1992 mean harvest rates be reduced to 3% of the adult females and no more than 6-8% of bears ≥2 years old until at least 1995. We expected the bear harvest to decrease in fall 1992 without changing grizzly bear hunting regulations because the caribou hunting season was closed and fewer hunters would be in the field. However, the preliminary data from the 1992-93 season indicate that 23 grizzly bears were harvested from the Subunit 20A Mountains, which is more than twice the previous-3-year mean. We will continue to analyze our data and propose regulatory changes to the board in spring 1994, if necessary.

Subunit 20B East: We are meeting one of the two objectives to manage grizzly bear mortality in Subunit 20B East to provide for a stable population. The 3-year mean harvest (including DLPs) in Subunit 20B East was at, but did not exceed, the maximum sustainable rate of 6 bears (≥2 years old) per year during the 1989-90 through 1991-92 period. However, the total mortality and the harvest by hunters consisted of fewer males (52% and 44%, respectively) than our objective for at least 55% males. We should monitor harvest in Subunit 20B East carefully during the next report period to ensure that the maximum sustainable harvest is not exceeded.

Subunits 20A Flats, 20B West, 20C, 20F, and 25C Combined: The grizzly bear population is probably stable in these remaining areas. We are meeting all of our objectives for the grizzly bear mortality in these combined subunits. The 3-year (1989-90 to 1991-92) mean annual human-caused mortality in this area was about half of our objective of up to 26 bears ≥2 years old (12.7 - 15.3 bears). In addition, 60% of the bears harvested by hunters were males, which also meets our objective for at least 55% males.

The 3-year mean annual bear harvest stayed within our quotas for: 3 from Subunit 20A Flats (2.3), 3 from Subunit 20B West (3.3, or 2.7 if DLPs excluded), 7 from Subunit 20C (5.3, or 5.0 if DLPs excluded), 7 from Subunit 20F (2.3), and 6 from Subunit 25C (1.7).

Recommendations for Objectives

Both grizzly bear harvests by humans and other human-caused mortality (DLP kills, research activities) can affect the stability of the grizzly bear population. Therefore, I am rewording objectives to clarify that all sources of human-caused mortality will be

considered when comparing the current harvest rate with the maximum sustainable rate listed in our objectives.

Human-bear conflicts have increased with the increasing human population and increasing human activity in grizzly bear habitat. Between 1980 and 1990, the human population in the North Star Borough increased 44% (53,983 to 77,720, respectively). To minimize human-bear conflicts during the next report period, we plan to produce and distribute several handouts for the public. Some handouts will help hunters be more selective when hunting bears, illustrating the differences between male and female grizzly bears, older versus younger grizzly bears, and grizzly bears versus black bears. Other handouts will continue to provide information to the public about bear behavior, proper garbage disposal, and food storage, etc. to reduce conflicts.

I recommend that our current objectives be revised as:

Subunit 20A Mountains:

- Decrease human-caused grizzly bear mortality until at least 1995 by managing for a 3-year mean annual human-caused mortality of no more than 3% of the adult females (≥6 years old), and no more than 6% of the bears ≥2 years old.

- Cooperate with a new research project (W-24-1, Study 4.25) whose objectives are:

    - To determine the length of time necessary for recovery or stabilization of a reduced grizzly bear population following reductions in human-caused mortality rates; and

    - To measure the recovery responses in the dynamics of the population, especially female population size, total population size, and production and survival of offspring.

Subunit 20B East:

- Manage human-caused grizzly bear mortality to provide a stable population with a 3-year mean annual human-caused mortality of up to 6 bears ≥2 years old, with an average of at least 55% males.

Subunit 20C within the original boundaries of Denali National Park:

- Maintain a closed season on grizzly bear hunting.

Subunit 20A Flats, 20B West, remainder of 20C, 20F, and 25C combined:

- Manage human-caused mortality to provide stable grizzly bear populations with a 3-year mean annual human-caused mortality of up to 26 grizzly bears ≥2 years old, with an average of at least 55% males.

- Manage the 3-year mean annual human-caused grizzly bear mortality from individual areas with the following quotas: 3 bears from Subunit 20A Flats, 3 from Subunit 20B West, 7 from Subunit 20C, 7 from Subunit 20F, and 6 from Subunit 25C.

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Table 1. Grizzly bear population (all ages) estimates in Subunits 20A, 20B, 20C, 20F, and 25C based on stratifying by bear density, Spring 1993.

Subunit	Area in density strata (km^2)[a]					Grizzly bear population estimate[b]						Bear density[d]	Population trend
	Super	High	Med	Low	Total[c]	Super	High	Med	Low	Total	Midpoint		
20A	0	9,275 -1,295[c] 7,980	0	8,136	16,116	0	112-136	0	8-24	120-160	140	8.5	Declining
20B	0	0	5,864	17,742	23,606	0	0	29-59	18-53	47-112	80	3.4	Stable?
20C	9,382 -1,000[c] 8,382	0	1,487	19,957	29,826	168-251	0	7-15	20-60	195-326	261	8.8	Stable?
20F	0	0	4,928	11,303	16,231	0	0	25-49	11-34	36-83	60	3.6	Stable?
25C	0	0	8,657	4,680	13,337	0	0	43-87	5-14	48-101	74	5.5	Stable?
Total	8,382 (8%)	7,980 (8%)	20,936 (21%)	61,818 (62%)	99,116	168-251	112-136	104-210	62-185	446-782	614	6.2	

[a] Density estimate for each stratum:
Super = 20-30 grizzly bears (all ages)/1,000 km^2
High = 14-17 " "
Med = 5-10 " "
Low = 1-3 " "

[b] (Area) x (density estimate for that stratum).

[c] Large blocks of glaciers and area above 6,000' were excluded as non-bear habitat.

[d] Number of grizzly bears (all ages)/1,000 km^2

Table 2. Percentage of grizzly bear population (adjusted for closure) by sex and age in a portion of Subunit 20A mountains, Spring 1992 (Reynolds, pers. commun.).

	All bears				Bears >2 years old		
Age	Female	Male	Unknown	Total	Female	Male	Total
≥6	25	9	--	34	11	30	41
2-5	30	19	--	49	23	36	59
≤1	--	--	17	17	--	--	--
Total	55	28	17	100	34	66	100

Table 3. Estimated sex and age composition of grizzly bear population in Subunit 20A Mountains[a], Spring 1992.

	No. of bears (all ages)				No. bears ≥2 years old		
Age	Female	Male	Unknown	Total	Female	Male	Total
≥6	34	12	--	46	12	33	45
2-5	40	25	--	65	26	40	66
≤1	--	--	23	23	--	--	--
Total	74	37	23	134	38	73	111

[a] Extrapolated using population estimate (Reynolds, pers. commun.); (1) 16.8 bears all ages/1000 km^2 for 7980 km^2 = 134 bears of all ages; (2) 13.9 bears ≥2 years old/1000 km^2 for 7980 km^2 = 111 bears ≥2 years old; and composition data in Table 2.

Table 4(a). Subunit 20A grizzly bear harvest[a], 1987-88 through 1991-92.

Regulatory year	Reported							Total estimated kill[c]					
	Hunter kill				Non-hunting kill[b]								
	M	F	Unk	Total	M	F	Unk	M	(%)	F	(%)	Unk	Total
1987-88													
Fall 87	8	7	0	15	0	0	0	8	(53)	7	(47)	0	15
Spring 88	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	8	7	0	15	0	0	0	8	(53)	7	(47)	0	15
1988-89													
Fall 88	4	6	0	10	0	0	0	4	(40)	6	(60)	0	10
Spring 89	2	2	0	4	0	0	0	2	(50)	2	(50)	0	4
Total	6	8	0	14	0	0	0	6	(43)	8	(57)	0	14
1989-90													
Fall 89	8	7	1	16	1	1	0	9	(53)	8	(47)	1	18
Spring 90	3	2	0	5	0	0	0	3	(60)	2	(40)	0	5
Total	11	9	1	21	1	1	0	12	(54)	10	(46)	1	23
1990-91													
Fall 90	3	0	0	3	0	0	0	3	(100)	0	(0)	0	3
Spring 91	1	1	0	2	0	0	0	1	(50)	1	(50)	0	2
Total	4	1	0	5	0	0	0	4	(80)	1	(20)	0	5
1991-92													
Fall 91	5	6	1	12	0	0	0	5	(45)	6	(55)	1	12
Spring 92	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	6	6	1	13	0	0	0	6	(50)	6	(50)	1	13

[a] Data from 4/9/93 harvest printout.

[b] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality. These data not included in tables of chronology, transport, etc.

[c] Percentages include only bears of known sex.

Table 4(c). Subunit 20C grizzly bear harvest, 1987-88 through 1991-92.

Regulatory year	Reported							Total estimated kill[c]					
	Hunter kill				Non-hunting kill[a]								
	M	F	Unk	Total	M	F	Unk	M	(%)	F	(%)	Unk	Total
1987-88													
Fall 87	2	0	0	2	1	0	0	3	(100)	0	(0)	0	3
Spring 88	2	0	0	2	0	0	0	2	(100)	0	(0)	0	2
Total	4	0	0	4	1	0	0	5	(100)	0	(0)	0	5
1989-89													
Fall 88	3	0	0	3	0	0	0	3	(100)	0	(0)	0	3
Spring 89	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	4	0	0	4	0	0	0	4	(100)	0	(0)	0	4
1989-90													
Fall 89	1	1	0	2	1	0	0	2	(67)	1	(33)	0	3
Spring 90	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
Total	4	2	0	6	1	0	0	5	(71)	2	(29)	0	7
1990-91													
Fall 90	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
Spring 91	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
1991-92													
Fall 91	3	2	0	5	0	0	0	3	(60)	2	(40)	0	5
Spring 92	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	3	2	0	5	0	0	0	3	(60)	2	(40)	0	5

[a] Data from 4/9/93 harvest printout.

[b] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality. These data not included in tables of chronology, transport, etc.

[c] Percentages include only bears of known sex.

Table 4(d). Subunit 20F grizzly bear harvest, 1987-88 through 1991-92.

Regulatory year	Reported: Hunter kill M	F	Unk	Total	Reported: Non-hunting kill[a] M	F	Unk	Total estimated kill[c] M	(%)	F	(%)	Unk	Total
1987-88													
Fall 87	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Spring 88	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
1988-89													
Fall 88	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Spring 89	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	2	0	0	2	0	0	0	2	(100)	0	(0)	0	2
1989-90													
Fall 89	3	0	0	3	0	0	0	3	(100)	0	(0)	0	3
Spring 90	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	4	0	0	4	0	0	0	4	(100)	0	(0)	0	4
1990-91													
Fall 90	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Spring 91	0	1	0	1	0	0	0	0	(0)	1	(100)	0	1
Total	1	1	0	2	0	0	0	1	(50)	1	(50)	0	2
1991-92													
Fall 91	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Spring 92	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1

[a] Data from 4/9/93 harvest printout.

[b] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality. These data not included in tables of chronology, transport, etc.

[c] Percentages include only bears of known sex.

Table 4(e). Subunit 25C grizzly bear harvest, 1987-88 through 1991-92.

Regulatory year	Reported							Total estimated kill[c]					
	Hunter kill				Non-hunting kill[a]								
	M	F	Unk	Total	M	F	Unk	M	(%)	F	(%)	Unk	Total
1987-88													
Fall 87	0	1	0	1	0	0	0	0	(0)	1	(100)	0	1
Spring 88	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	1	1	0	2	0	0	0	1	(50)	1	(50)	0	2
1988-89													
Fall 88	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
Spring 89	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	3	1	0	4	0	0	0	3	(75)	1	(25)	0	4
1989-90													
Fall 89	2	0	0	2	0	0	0	2	(100)	0	(0)	0	2
Spring 90	1	0	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	3	0	0	3	0	0	0	3	(100)	0	(0)	0	3
1990-91													
Fall 90	1	0	1	2	0	0	0	1	(100)	0	(0)	1	2
Spring 91	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	1	0	1	2	0	0	0	1	(100)	0	(0)	1	2
1991-92													
Fall 91	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Spring 92	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	0	0	0	0	0	0	0	0	(0)	0	(0)	0	0

[a] Data from 4/9/93 harvest printout.

[b] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality. These data not included in tables of chronology, transport, etc.

[c] Percentage include only bears of known sex.

Table 5. Harvest of grizzly bears in 3 harvest zones within Subunit 20A, 20B, 20C, 20F, and 25C, 1989-90 through 1991-92.

Harvest zone	Area (km^2)	Regulatory year	No. bears harvested		3-year mean harvest[c]		Harvest objectives[c]
			All ages[a]	≥2 yrs[b]	All ages	≥2 yrs[b]	
20A Mtns	7,980[e]	1989-90	19 (2)	18			11-17 bears (≥2 yrs)/
		1990-91	5	5			year (= 10-15% of
		1991-92	10	9			estimated population of
		Total	34 (2)	32	11.3	10.7	111 bears ≥2 yrs)
20B East	12,766	1989-90	8 (4)	5			
		1990-91	6	6			≤6 bears (≥2 yrs)/year,
		1991-92	7 (1)	7			at least 55% of which
		Total	21 (5)	18	7.0	6.0	are males
Combined 20A Flats, 20B West, 20C, 20F, 25C	68,060[f]	1989-90	23 (1)	23			
		1990-91	11	10			≤26 bears (≥2 yrs)/year,
		1991-92	11 (2)	11			at least 55% of which
		Total	45 (3)	44	15.0	14.7	are males
Total	88,806[ef]		100 (10)	94	33.3	31.3	

[a] Parentheses indicate how many of these bears were killed by other than hunter harvest (i.e. defense of life and property, research activities)
[b] Assuming all bears of unknown age were ≥2 years old
[c] For all human-caused mortality
[d] 3-year mean harvest of bears ≥2 years/1,000 km^2
[e] Excludes about 1,300 km^2 of non-bear habitat in glaciers and above 6,000 ft.
[f] Excludes 11,500 km^2 that is closed to hunting in Denali National Park

Table 6. Residency of successful grizzly bear hunters, 1987-88 through 1991-92, combined Subunits 20A, 20B, 20C, 20F, and 25C.

Regulatory year	Alaska Residents						Nonresident		n
	Local[a]		Nonlocal		Total				
	No.	%	No.	%	No.	%	No.	%	
1987-88	12	48	5	20	17	68	8	32	25
1988-89	17	59	5	17	22	76	7	24	29
1989-90	29	67	8	19	37	86	6	14	43
1990-91	10	45	5	23	15	68	7	32	22
1991-92	14	56	6	24	20	80	5	20	25
5-Year total	82	57	29	20	111	77	33	23	144

[a] Local = Resident of the game management unit in which the bear was harvested.

Table 7. Percentage of grizzly bear harvest taken by time period, 1987-88 through 1991-92, combined Subunits 20A, 20B, 20C, 20F, and 25C.

Regulatory year	Percentage of Harvest								n
	September					May			
	1-15	16-30	Total	October	April	1-15	16-31	Total	
1987-88	68	16	84	4	12	0	0	0	25
1988-89	59	14	72	7	7	3	10	14	29
1989-90	53	12	65	5	7	2	21	23	43
1990-91	50	9	59	14	0	5	23	27	22
1991-92	64	24	88	0	4	0	8	8	25
5-Year total	58	15	73	6	6	2	13	15	144

Table 8. Percentage of grizzly bear harvest taken by transport method, 1987-88 through 1991-92, combined Subunits 20A, 20B, 20C, 20F, and 25C.

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Other/ unknown	n
1987-88	36	28	8	0	4	16	8	0	25
1988-89	24	17	10	3	0	14	17	14	29
1989-90	28	12	5	0	2	21	21	12	43
1990-91	18	9	18	5	0	14	18	18	22
1991-92	36	8	16	0	0	0	28	8	25
5-Year total	28	15	10	1	1	14	19	11	144

[a] Does not include defense of life or property, research mortality, or other human-caused accidental mortality.

LOCATION

Game Management Subunit: 20D (5,720 mi^2)

Geographical Description: Central Tanana Valley near Delta Junction

BACKGROUND

Grizzly bears are distributed throughout Subunit 20D; however, the Tanana River separates grizzly bear habitat into two distinct types within the subunit. Subunit 20D, south of the Tanana River, is adjacent and similar to habitat described by Reynolds (1990) for the foothills and mountains of the northcentral Alaska Range. Grizzly bear habitat in Subunit 20D north of the Tanana River is adjacent and similar to habitat described in Subunit 20E by Gasaway *et al.* (1990) for the hills north of the Tanana River.

Hunter access to southern Subunit 20D is excellent, while hunter access is limited in northern Subunit 20D. Although little work has been accomplished to estimate grizzly bear population size in Subunit 20D, grizzly bear seasons have been liberal.

MANAGEMENT OBJECTIVES

In Subunit 20D south of the Tanana River, the management objective is to manage a stable bear population to provide a mean annual harvest not to exceed 5% of the estimated population >2 years old, with a minimum of 60% males in the kill.

In Subunit 20D north of the Tanana River, the management objective is to liberalize the season and bag limit to increase the mean annual harvest of grizzly bears to 8-10% of the estimated population >2 years old, until moose calf survival increases to at least 30 calves:100 cows for three consecutive years.

METHODS

Successful hunters were required to have grizzly bears sealed at ADF&G offices. Data collected from each grizzly bear included sex, skull length and width, transportation used by the hunter, date of kill, number of days hunted, location of kill, and hunter name and address. A premolar tooth was extracted from each bear skull for use in age determination.

RESULTS AND DISCUSSION

Population Status and Trend

North of the Tanana River, the grizzly bear population is naturally regulated because of very low human-induced mortality. South of the Tanana River, the grizzly bear population probably decreased during this report period because of high harvest levels.

Population Size:

Southern Subunit 20D. No data were collected during this report period to alter the previous population estimate of 44-68 bears >2 years old (DuBois 1991). Anecdotal reports from hunters, pilots, and local residents indicate that more bears were seen in the area by the public, and long-term local residents think bear populations may be increasing. However, based on human-induced mortality during this report period, the bear population has probably decreased.

Northern Subunit 20D. No data were collected during this report period to alter the previous population estimate of 92 bears >2 years (DuBois 1991).

Population Composition: Grizzly bear population composition is unknown for Subunit 20D. Because cubs or females accompanied by cubs are illegal to harvest, the sex ratio of the harvest was not used to estimate population composition.

The sex composition of the harvest from 1990-91 through fall 1992-93 consisted of 7 males and 8 females south of the Tanana River and 2 males and 1 female north of the Tanana River (Table 1).

Distribution and Movements: Grizzly bears are distributed throughout Subunit 20D; however, no specific information on patterns of grizzly bear distribution or movements is available. There were numerous reports of grizzly bears in and around Delta Junction during fall 1992. During one incident, a grizzly sow with two large cubs killed a moose calf between two houses in a subdivision.

Mortality

Harvest:

Season and Bag Limit.

July 1, 1990-June 30, 1992:	Sept. 1-May 31	One bear every 4 regulatory years
July 1, 1992-June 30, 1993:		
South of the Tanana River	Sept. 1-May 31	One bear every 4 regulatory years

North of the Tanana River Aug. 10-June 30 One bear every year.

Bears taken north of the Tanana River must be sealed in Delta before hunters leave the unit unless the bear is to be sealed in Tok.

Human-induced Mortality. The total estimated harvest in Subunit 20D was 7 bears during 1990-91, 7 bears during 1991-92, and 9 bears during the fall portion of the 1992-93 season. Mean bear mortality during the previous 5 years from 1985-86 to 1989-90 was 7 bears/year.

Total estimated human mortality during 1990-91 and 1991-92 was 4.4-5.2% of the estimated grizzly bear population each year. Mortality during the fall portion of the 1992-93 season was an estimated 5.6-6.6% of the subunit grizzly bear population.

Southern Subunit 20D: Harvest increased in southern Subunit 20D during this report period. Reported harvest was 6 bears during 1990-91, 5 bears during 1991-92, and 7 bears during fall 1992 (Table 1). The 1991-92 harvest was not representative of hunting effort in Subunit 20D because 2 males and 1 female were illegally taken by one hunter who mistakenly shot them for black bears at a bait station. Also, the high harvest during the fall portion of the 1992-93 season was due in part to 3 problem bears being shot by people that used hunting licenses instead of taking the bears in DLP incidents. In addition, one DLP bear was killed in 1991-92 and one was killed in fall 1992 (Table 2). Harvest during the 5-year period 1985-86 through 1989-90 averaged 4 bears/year.

The high harvest during this report period is probably because food-related movement by bears has resulted in increased contact between bears and the public. Evidence of this is the increased number of bear sightings in Subunit 20D during this period and the increased number of "problem bears" that were killed by individuals with hunting licenses. I do not think there has been a significant increase in hunters or hunting activity to account for the increased harvest.

Reported harvest, including bears killed in DLP incidents was an estimated 8.8-13.6% of the southern Subunit 20D population during 1990-91, 8.%-13.6% during 1991-92, and 11.8-16.7% during the fall portion of the 1992-93 season. This harvest exceeds the harvest objective for southern Subunit 20D.

Because of the relatively small number of bears killed in Subunit 20D, the combined harvest of 1990-91, 1991-92, and fall 1992-93 was used to estimate the sex ratio of the harvest. The combined hunter harvest resulted in 53% males in the harvest, which was slightly below the harvest objective (Table 1).

Northern Subunit 20D: Harvest continued to be low in northern Subunit 20D. Only 2 male bears and 1 female bear were reported killed during the 1990-91, 1991-92, and fall

1992-93 hunting seasons. This harvest ranged from 1% to 2% of the estimated population and failed to meet the objective of harvesting 8-10% of the population.

Hunter Residency and Success. No significant changes occurred in residency of Subunit 20D bear hunters. All grizzly bears killed during the 1990-91, 1991-92, and fall portion of the 1992-93 season were killed by Alaskan residents, and 71% were killed by local residents (Table 3).

Transport Methods. Most transportation types are used to take bears in Subunit 20D; however, highway vehicles and feet were the most commonly used transportation types during this report period (Table 5).

Harvest Chronology. No significant change occurred in harvest chronology during this report period. In Subunit 20D most grizzly bears were taken during fall hunting season. During the combined 1990-91 through fall 1992-93 hunting seasons, 56% of the bears were killed during fall, 31% during spring, and 13% at other times (Table 4).

Natural Mortality: The rate of natural mortality has not been estimated for grizzly bears in Subunit 20D but is probably similar to rates reported for adjacent Subunit 20A (Reynolds 1990).

Board of Game Actions and Emergency Orders. The Alaska Board of Game liberalized the grizzly bear hunting season and bag limit in Subunit 20D north of the Tanana River effective 1 July 1992 to 10 August - 30 June with a bag limit of one bear every year. The intent of this liberalization was to provide greater hunting opportunity in an area that has low bear harvest.

CONCLUSIONS AND RECOMMENDATIONS

Southern Subunit 20D: Grizzly bear harvest in southern Subunit 20D exceeded the management objective and is probably causing a reduction in the grizzly bear population in this area. The increased harvest is most probably because of food-related movement of bears in the area, resulting in greater human/bear interactions and higher bear mortality, rather than from an increase in hunting activity. Illegal harvest of 3 bears in 1991-92 also contributed to the high harvest. I do not anticipate the high harvest rate will continue if factors contributing to increased bear movement return to normal.

Reynolds (1990) reported that harvest of 8-9% of bears >2 years old has depressed grizzly bear populations in the northcentral Alaska Range at a rate of 2% per year. Based on approximations of southern Subunit 20D population size, grizzly bears in southern Subunit 20D have apparently experienced heavy harvest during this report period and the population may have declined.

Although the harvest in southern Subunit 20D may result in a decline in the bear population, it has a significant benefit for ungulate populations. There is significant demand for human use of moose and caribou in southern Subunit 20D, and current population objectives are to increase the size of these populations; reduced grizzly bear predation should help achieve these objectives. Therefore, reduced grizzly bear numbers in southern Subunit 20D are cause for concern, but this must be balanced with benefits to achieving moose and caribou population objectives.

I do not recommend any changes to seasons and bag limits at this time; however, the harvest of grizzly bears should be monitored closely during the next several years.

Northern Subunit 20D: The grizzly bear harvest in northern Subunit 20D continues to be below the management objective, and the bear population is probably naturally regulated depending on prey availability. The low harvest does not meet the current management objective for this area. Predators, including grizzly bears, in northern Subunit 20D are probably responsible for poor moose calf survival. Current moose population objectives call for increasing the size of the moose population in northern Subunit 20D. Because of the low grizzly bear harvest in northern Subunit 20D, seasons and bag limits were recently liberalized in this area in accordance with management objectives. Because grizzly bear seasons and bag limits were liberalized during this report period, I do not recommend further changes as this time.

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Table 1. Annual reported harvest of male and female grizzly bears, north and south of the Tanana River in Subunit 20D, 1985 through fall 1992.

Regulatory	South of Tanana				North of Tanana				Unk		
year	M	F	Total	%	M	F	Total	%	M	F	Total
1985-86	1	3	4	44	2	1	3	33	2	0	9
1986-87	3	1	4	100	0	0	0	0	0	0	4
1987-88	6	2	8	89	0	1	1	11	0	0	9
1988-89	1	2	3	50	2	0	2	33	1	0	6
1989-90	1	0	1	50	1	0	1	50	0	0	2
1990-91	2	3	5	83	0	1	1	17	0	0	6
1991-92	2	3	5	100	0	0	0	0	0	0	5
1992-93[a]	3	2	5	75	2	0	2	25	0	0	7

[a] Harvest from 1 July 1992 to 31 December 1992.

Table 2. Subunit 20D grizzly bear harvest[a], fall-spring 1985 through fall 1992.

Regulatory year	Reported							Estimated kill		Total reported and estimated kill			
	Hunter kill				Non-hunting kill[b]								
	M	F	Unk	Total	M	F	Unk	Unreported	Illegal	M	F	Unk	Total
1988-89													
Fall 88	4	1	0	5	0	0	0	1	0	4	1	1	6
Spring 89	0	1	0	1	0	0	0	0	0	0	1	0	1
Total	4	2	0	6	0	0	0	1	0	4	2	1	7
1989-90													
Fall 89	2	0	0	2	0	0	0	1	0	2	0	1	3
Spring 90	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	0	0	2	0	0	0	1	0	2	0	1	3
1990-91													
Fall 90	2	2	0	4	0	0	0	1	0	2	2	1	5
Spring 91	0	2	0	2	0	0	0	0	0	0	2	0	2
Total	2	4	0	6	0	0	0	1	0	2	4	1	7
1991-92													
Fall 91	0	0	0	0	0	1	0	1	0	0	1	1	2
Spring 92	2	3	0	5	0	0	0	0	0	2	3	0	5
Total	2	3	0	5	0	1	0	1	0	2	4	1	7
1992													
Fall 92	5	2	0	7	1	0	0	1	0	6	2	1	9

[a] There are no permit hunts in Subunit 20D.

[b] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

Table 3. Subunit 20D grizzly bear successful hunter residency, 1985-92.

Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total successful hunters
1985-86	4	5	0	0	9
1986-87	3	0	0	1	4
1987-88	4	2	1	0	7
1988-89	5	0	1	0	6
1989-90	3	1	0	0	4
1990-91	4	3	0	0	7
1991-92	3	0	0	0	3
1992-93	5	2	0	0	7

[a] Residents of Subunit 20D.

Table 4. Subunit 20D grizzly bear harvest chronology percentage by time period, 1985-86 through fall 1992.

Regulatory year	Harvest periods							
	September	October	November	April	May	June	Other	n
1985-86	6	0	0	0	3	0	0	9
1986-87	1	0	0	0	2	0	1	4
1987-88	6	1	0	0	1	0	1	9
1988-89	4	1	0	1	0	0	0	6
1989-90	2	0	0	0	0	0	0	2
1990-91	2	0	0	0	0	0	0	2
1991-92	1	0	0	0	4	1	0	6
1992-93	3	3	0	0	0	0	2	8

Table 5. Subunit 20D grizzly bear harvest percentage by transport method, 1985-86 through fall 1992.

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3- or 4- Wheeler	Snowmachine	ORV	Highway vehicle	Foot	Unknown	n
1985-86	11	11	22	0	0	22	0	33	0	9
1986-87	0	0	0	0	25	0	50	25	0	4
1987-88	11	33	0	0	22	11	0	11	11	9
1988-89	0	0	33	0	0	17	33	0	17	6
1989-90	0	0	50	0	0	0	0	50	0	2
1990-91	0	0	0	0	0	100	0	0	0	2
1991-92	0	0	0	0	17	17	0	67	0	6
1992-93	13	13	13	0	0	0	50	13	0	8

LOCATION

Game Management Unit: 20E (11,000 mi^2)

Geographical Description: Fortymile, Charley, and Ladue River drainages, including the Tanana Uplands and all drainages into the south bank of the Yukon River upstream from and including the Charley River drainage

BACKGROUND

The grizzly bear population in Subunit 20E declined to low levels during the 1950s as a result of an intensive, year-round federal predator control program. After the program ended, bears were lightly exploited throughout the 1960s and 1970s and the population increased. By the mid-1980s the Subunit 20E grizzly bear population was estimated to be 12-16 bears/1,000 km^2 (Boertje *et al.* 1987).

During the early 1980s moose densities in Subunit 20E were low (0.2 moose/mi^2) and grizzly bears were found to be a major factor in limiting this population (Gasaway *et al.* 1992). Grizzly bear hunting regulations were liberalized beginning in 1981 in an attempt to reduce bear predation on moose. Liberalizations included lengthening the season, increasing the bag limit from 1 bear every 4 years to 1 bear per year, and removing the $25 resident tag fee requirement. Grizzly bear harvests increased from a mean harvest of 3 bears/year during 1966-81 to an annual mean of 18 bears/year during 1981-88. Since 1989, under the same liberal regulations the reported harvest has declined indicating that hunters successfully reduced the bear population in at least a portion of the subunit.

Survival of moose calves to 5 months of age in Subunit 20E increased significantly ($p < 0.05$) between 1981 and 1990, during liberalized bear seasons. This increased calf survival was believed to be related to a reduction in the number of predators per prey animal as moose numbers had slowly increased in areas where bear numbers were decreasing.

MANAGEMENT DIRECTION

Management Goal

The management goal for Subunit brown bears is to provide maximum opportunity to participate in hunting grizzly bears in Subunit 20E.

Management Objectives

Management objectives for Subunit 20E brown bears are to: 1) manage to effect temporary reductions in the grizzly bear population or to reduce the extent of bear predation where it is limiting moose population growth (e.g., moose populations are below food-limiting densities with fall calf:cow ratios <25:100); and 2) after moose populations increase to desired levels, reduce bear harvests to stop or reverse bear population declines.

When developing grizzly bear and wolf management goals in a multi-prey, multi-predator system, the management goals and objectives of the area's moose and caribou populations must also be considered. In Subunit 20E the management goals and objectives for the area's moose population and for the Fortymile caribou herd are to allow substantial increases by the year 2000. Both these prey populations are currently predator limited. For this reason, grizzly bear populations in Subunit 20E will be managed at lower than natural densities through use of liberal harvest regulations.

METHODS

Grizzly bears harvested in Subunit 20E must be sealed in the subunit or in Tok before being transported out of the area. During the sealing process, the sex of the bear is determined, skull measurements are taken, a premolar tooth is extracted, and information on date and location of harvest and time spent afield are obtained. Premolar teeth are sent to Anchorage to be aged by either ADF&G personnel or a reliable contractor.

To test the effects of low to high grizzly bear harvest on moose calf survival to 5 months of age in Subunit 20E, I calculated a regression of calves/100 cows and calves/survey hour against time from 1977 (4 years before liberalized bear seasons) to 1991. Using harvest locations and average home range sizes reported for Interior grizzly bears (Miller, 1987), I determined a treatment area (greatest bear harvest) and a control area (limited bear harvest). I used a T-test to compare calf recruitment between the 2 areas (Zar 1974).

To determine the harvest intensity for the treatment and control areas, I calculated the kill density for each area using procedures outlined by S. D. Miller (pers. commun.).

RESULTS AND DISCUSSION

Population Status and Trend

Since 1981, grizzly bear numbers have declined in accessible areas of Subunit 20E. This assertion is based on several harvest data parameters including: declining annual harvests, decreasing average skull size of harvested males, increasing average age of harvested females, and reduced sightings by the public and department personnel. The greatest

declines have occurred in the Middle Fork, West Fork, Dennison Fork, and Mosquito Fork drainages. Bear densities in the remainder of the subunit (the Ladue River, Sixtymile River, and lower Charley River drainages) probably have not changed much since 1981.

Mortality

Harvest:

Season and Bag Limit.

Subunit 20E	Aug. 10-June 30	One bear

A bear taken in this unit does not count against the one bear every 4 years bag limits in other units; however, no person may take more than one bear, statewide, per regulatory year. A $25 resident tag fee is required to hunt grizzly bears in Subunit 20E.

Board of Game Actions and Emergency Orders. During the spring 1990 meeting, the board expanded the regulation requiring state residents to purchase a $25 resident grizzly bear tag to hunt grizzly bears to include Subunit 20E.

Hunter Harvest. During the 1991-92 regulatory year hunters reported taking 11 grizzly bears (5 males and 6 females), which is comparable with the previous year but below the 5-year average of 14.6 bears (Table 1). Grizzly bear harvests substantially increased in 1982-83 and remained high until 1988-89 (average annual harvest = 18.9) in response to the more liberal seasons and bag limits. Harvests have declined steadily since that time (average harvest = 11.3) even though hunting regulations have remained liberal and hunting pressure has increased. During 1991-92, males represented 45% of the harvest but the sample size was small (11). The overall harvest sex ratio over the past 5 years in Subunit 20E was 55% male.

Most grizzly bear harvest in Subunit 20E occurs between the Dennison Fork on the east, the Middle Fork on the north and west, and the Mosquito Fork on the south. Taking the average home ranges of Interior grizzly bears into account, the area affected by the harvest is 4,644 mi^2 (12,028 km^2). This area will be referred to as the treated area. Since 1981, 124 grizzly bears were harvested (12.4/year) in the treated area. The kill density (no. harvested bears/10,000 km^2) ranged between 5.8 and 15.8 and averaged 9.7. Based on calculations by S. D. Miller (pers. commun.), the grizzly bear population in Subunit 20E would have had to be approximately 20 bears/1,000 km^2 to sustain that high of a harvest. Between 1982 and 1985, the bear population would have had to be closer to 30 bears/1,000 km^2 to withstand the harvest intensity during that period. Boertje *et al.* (1987) estimated the 1986 Subunit 20E bear density to be between 12 and 16 bears/1,000 km^2.

In Subunit 20E, during the period of increased harvest the average skull size of harvested males declined (Fig. 1) and the average age of harvested females increased (Fig. 2). I

have not yet separated and compared the harvest data indices between the treated and the control areas.

A population density estimate was not obtained in Subunit 20E prior to liberalizing the grizzly bear harvest regulations. To estimate the magnitude of the population decline in the treated area, I used the 1981 density estimate from Subunit 20A (Reynolds pers. commun.) (22.7 bears/1,000 km^2) as the pre-1981 estimate for Subunit 20E. I believe the 1981 bear densities were comparable between Subunits 20A and 20E because the quantity and quality of grizzly bear habitat are similar and because both were lightly harvested. Based on that assumption, between 1981 and 1986 the grizzly bear population in the central portion of Subunit 20E declined from 273 to 192 bears at an annual rate of 5.9%.

Hunter Residency and Success. During the 1991-92 season resident hunters took 100% of the grizzly bears in Subunit 20E, compared to the 5-year average of 90% (Table 2). Few guides conduct hunts for nonresidents in this area, and current bear hunting regulations are designed to encourage incidental taking of grizzly bears by resident hunters primarily seeking moose and caribou.

Harvest Chronology. During the past 5 years, in Subunit 20E most grizzly bears were harvested during August and September (71%) when most moose and caribou hunters were afield (Table 3). Most bears taken during spring were taken purposefully, with May and June being the most popular months for spring bear hunts.

Transport Methods. During 1991-92 highway vehicles (36%) were used by most successful grizzly bear hunters in Subunit 20E (Table 4). During the previous 5 years, airplanes were the mode of transportation used by most successful bear hunters (40%). Few bears are taken by hunters using 3- and 4-wheelers. The few popular all-terrain vehicle trails possibly experience so much traffic that they are avoided by grizzly bears during periods of greatest use.

Other Mortality: No bears were reported taken in DLP incidents during this report period. Possible reasons for the lack of reported DLP kills in recent years is that bear season is closed from 1 July though 9 August and that bears have been significantly reduced in the accessible areas of the unit. Most natural grizzly bear mortality in this area is probably the result of intraspecific strife and cannibalism as discussed by Boertje *et al.* (1987).

Habitat

Assessment: Virtually all of Subunit 20E is inhabited by grizzly bears. Few human developments exist in this area with the exception of the small communities of Eagle, Boundary, and Chicken and the Taylor Highway. Bear habitat remains largely intact and undisturbed; however, habitat diversity has been affected by the abnormally high level of wildfire suppression during the 1960s and 1970s. The subunit offers a variety of forbs and berries for grizzly bears; however, there are no arctic ground squirrels and few

opportunities for salmon, food types known to be important to grizzly bears in other areas.

Enhancement: *The Alaska Interagency Fire Management Plan: Fortymile Area* was implemented in the early 1980s and dictates that over 60% of the area will receive only limited action fire suppression. This means that fires occurring in this area will only receive monitoring and not suppression action except under exceptionally severe fire conditions. Recurring wildfires increase habitat heterogeneity and productivity for bears and other species from which bears derive benefits as predators and scavengers.

Nonregulatory Management Problems/Needs

In 1981 the grizzly bear harvest regulations were liberalized in Subunit 20E to cause a decrease in the bear population to benefit moose. Initial analyses demonstrated that survival of neonatal moose increased substantially after bear reductions (Boertje and Kelleyhouse 1993). To further define the effects of bear harvest on moose calf survival, I attempted to compare moose calf survival between the treated area and an area that has received little bear harvest and presumably still supports a more natural density of bears (Ladue River, Billy Creek, and the Tower Bluff area). I assumed that wolves would not confound this analysis as wolf densities are estimated to be similar between the two areas. The analysis showed that both the treated area and the control area showed a significant increase ($p < 0.05$) in calf survival to 5 months of age. Furthermore, there was no difference in the slopes of the regression lines between the two areas, indicating that the increase in calf survival was similar.

I do not have any alternate hypotheses why moose calf survival in the untreated area was comparable with the treated area. Two possible confounding problems are: (1) the effects of the bear harvest extends further than I assumed and (2) the burn in a portion of the control area was large enough that it caused a decrease in the hunting efficiency of predators similar to that which Schwartz and Franzman (1989) observed on the Kenai Peninsula and therefore acted like the treated area. After reviewing the data from both Unit 13 and Subunit 20E we realize that we really do not understand the effects of a harvest-caused reduction of a grizzly bear population on moose calf survival.

To date there have been two areas, Unit 13 and Subunit 20E, where bear harvest has been liberalized to cause an increase in moose calf survival without a corresponding research project to document the outcome. We still do not know the effects of compensatory predation by bears or wolves after the bear population has been reduced or if this management technique will only work with certain ungulate densities. Increasing the harvest of predators through conventional hunting and trapping is presently a socially accepted method of predator control. Members of the public believe that it works, supports our present programs, and are asking for more bear reduction programs to be initiated. To be responsible managers of all wildlife species, I believe it is time for us to find out when and how harvest-caused predator reductions affect ungulate calf survival.

To address this problem, I recommend a calf mortality study be conducted in both Subunit 20E and Unit 13.

CONCLUSIONS AND RECOMMENDATIONS

Grizzly bear management in Subunit 20E has been successful in providing for maximum bear hunting opportunity and possibly, simultaneously benefiting management of depressed moose and caribou populations. The overall subunit bear population probably has not changed much since 1981, even under very liberal hunting regulations as most harvest is restricted to the central portion of the subunit. However, in this treated area, annual kill densities have ranged from 5.8 to 15.8/10,000 km^2 since 1981 and have caused a decline (up to 30%) in grizzly bear numbers.

I recommend that the current management objectives be retained; however, a concurrent research program should be initiated to document the effects of predation by a reduced bear population on a low density moose population. Following recommendations by Gasaway *et al.* (1992), I further recommend that wolf control be considered to augment the effects of increased bear harvests to allow more rapid recovery of moose and caribou populations.

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Table 1. Subunit 20E grizzly bear harvest, 1987-92.

Regulatory year	Reported							Estimated kill		Total estimated kill					
	Hunter kill				Non-hunting kill[a]										
	M	F	Unk	Total	M	F	Unk	Unreported	Illegal	M	(%)	F	(%)	Unk	Total
1987-88[b]															
Fall 87	8	10	0	18	0	0	0	0	0	8	(44)	10	(56)	0	18
Spring 88	2	2	0	4	0	0	0	0	0	2	(50)	2	(50)	0	4
Total	10	12	0	22	0	0	0	0	0	10	(45)	12	(55)	0	22
1988-89															
Fall 88	7	8	0	15	0	0	0	0	0	7	(47)	8	(53)	0	15
Spring 89	2	0	0	2	0	0	0	0	0	2	(100)	0	(0)	0	2
Total	9	8	0	17	0	0	0	0	0	9	(53)	8	(47)	0	17
1989-90															
Fall 89	4	2	0	6	0	0	0	0	0	4	(67)	2	(33)	0	6
Spring 90	3	1	0	4	0	0	0	0	0	3	(75)	1	(25)	0	4
Total	7	3	0	10	0	0	0	0	0	7	(70)	3	(30)	0	10
1990-91															
Fall 90	7	3	0	10	0	0	0	0	0	7	(70)	3	(30)	0	10
Spring 91	2	1	0	3	0	0	0	0	0	2	(67)	1	(33)	0	3
Total	9	4	0	13	0	0	0	0	0	9	(69)	4	(31)	0	13
1991-92															
Fall 91	2	4	0	6	0	0	0	0	0	2	(33)	4	(67)	0	6
Spring 92	3	2	0	5	0	0	0	0	0	3	(60)	2	(40)	0	5
Total	5	6	0	11	0	0	0	0	0	5	(45)	6	(55)	0	11

[a] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

[b] 10 Aug. - 30 June, 1 bear/year, no bear tag required for residents.

Table 2. Subunit 20E grizzly bear successful hunter residency, 1987-92.

Regulatory year	Local resident	(%)	Nonresident	(%)	Unknown	(%)	Total successful hunters
1987-88	18	(82)	2	(9)	2	(9)	22
1988-89	14	(82)	2	(12)	1	(6)	17
1989-90	9	(90)	1	(10)	0	(0)	10
1990-91	12	(92)	1	(8)	0	(0)	13
1991-92	11	(100)	0	(0)	0	(0)	11

Table 3. Subunit 20E brown bear harvest chronology percentage by time period, 1987-92.

Regulatory year	Harvest periods							
	August	September	October	November	April	May	June	n
1987-88	7	10	1	0	1	3	0	22
1988-89	3	12	0	0	0	1	1	17
1989-90	1	5	0	0	1	2	1	10
1990-91	2	7	0	0	0	3	1	13
1991-92	3	2	1	0	0	1	4	11

LOCATION

Game Management Unit: 21 (35,000 mi^2)

Geographical Description: Middle Yukon River, including lower Koyukuk River, Innoko River, Nowitna River and Melozitna River

BACKGROUND

Grizzly bears occur in low to moderate numbers throughout the area, with highest numbers in the more mountainous areas. Populations have been stable or slowly increasing with low annual harvests of usually less than 10 bears per year.

MANAGEMENT DIRECTION

Management Goals

To protect, maintain, and enhance the grizzly bear population and its habitat in concert with other components of the ecosystem.

Management Objectives

To manage a grizzly population that will sustain a minimum annual harvest of 10 bears.

To increase compliance with bear sealing requirements by local hunters; to reduce the bear-human conflicts that arise at summer fish camps along the Yukon River; and to determine the amount of unreported harvest.

METHODS

The reported harvest was monitored through sealing requirements. The nuisance bear problem will be addressed through education, legal harvest of problem bears, and changes in regulations.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: I believe the population has been stable or slowly increasing based on field observations, nuisance reports, and hunter sightings during the past 10 years. No

surveys have been conducted in the area; however, rough population estimates have been made based on known bear densities found in similar habitats in other Interior units. Using a figure of 1 bear/40 mi^2 in the best bear habitat and 1 bear/100 mi^2 in the rest of the area, I estimate the population at 500-600 bears. The best bear habitat is found in the Nulato Hills area of Subunits 21D and 21E and throughout Subunit 21C.

Mortality

Harvest: Hunting pressure on bears in the unit is low (Table 1) although the season has been liberalized from 47 days in 1981 to 129 in 1982-83, 139 in 1984-86, 180 from 1987 to 1990, and to 273 days at present. The area does have potential to produce trophy class grizzly bears, with 13 out of 75 bears making the Boone and Crocket minimum score during the last 10 years. The number of bears that were taken at fish camps and not reported is unknown but is estimated at a maximum of 10 bears per year.

Seasons and Bag Limits.

Unit 21	Sept. 1-May 31	One bear every 4 regulatory years

Board of Game Actions and Emergency Orders. During the past 5 years Board of Game regulatory actions have liberalized the season by increasing season lengths. The $25 tag fee was waived in the unit during 1985 and 1986, but was reinstated in 1987. The justification for the liberalization in season length was that by increasing the harvest during spring guided hunts the unreported number of bears taken in DLP incidents should decline. The tag fee was also waived to increase the incidental harvest and relieve the hardship of tag fees on low-income license holders. In 1990 the board simplified the regulations by standardizing the season in the unit for all hunters and aligned the season with that for Units 19, 20, and 24. During periods of liberal regulations, hunters did not respond through increased harvests; the 10-year average annual harvest remains at 7 bears.

One reason local hunters have not responded to the increase in season length is that their Athapaskan beliefs about their relationships to grizzly bears may have more effect on their hunting habits than do Fish and Game regulations. Unit residents do not like the bears around their houses and most women are not allowed to eat the meat or come in contact with a bear hide. The seasons are as liberal as possible although the tag fee is still required. Removal of the tag fee might increase the incidental harvest reported by one to two animals per year.

Hunter Residency and Success. There is no set pattern of harvest among user groups (Table 2) and most bears are taken during fall incidental to moose hunting. The new guide area regulations may provide more opportunities for spring bear hunting.

CONCLUSIONS AND RECOMMENDATIONS

The management objective for grizzly bears in Unit 21 is to allow for a minimum reported harvest of 10 bears annually. At present, the estimated annual reported and unreported harvest is below the estimated sustainable harvest. Until the tag fee is removed and hunting habits change, the human harvest will have a negligible effect on grizzly populations in Unit 21. Educational efforts must be made to reduce the present level of unreported harvest.

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Table 1. Unit 21 grizzly bear harvest, 1987-92.

Regulatory year	Reported							Estimated kill		Total estimated kill			
	Hunter kill				Non-hunting kill[a]								
	M	F	Unk	Total	M	F	Unk	Unreported	Illegal	M	F	Unk	Total
1987-88													
Fall 87	1	4	0	5	1	1	0	5	0	2	5	5	12
Spring 88	1	0	0	1	0	0	0	5	0	1	0	5	6
Total	2	4	0	6	1	1	0	10	0	3	5	10	18
1988-89													
Fall 88	4	0	0	4	0	0	0	5	0	4	0	5	9
Spring 89	0	0	0	0	0	0	0	5	0	0	0	5	5
Total	4	0	0	4	0	0	0	10	0	4	0	10	14
1989-90													
Fall 89	2	2	0	4	0	0	0	5	0	2	2	5	9
Spring 90	3	3	0	6	0	0	0	5	0	3	3	5	11
Total	5	5	0	10	0	0	0	10	0	5	5	10	20
1990-91													
Fall 90	2	1	0	3	0	0	0	5	0	2	1	5	8
Spring 91	1	4	0	5	0	0	0	5	0	1	4	5	10
Total	3	5	0	8	0	0	0	10	0	3	5	10	18
1991-92													
Fall 91	0	0	0	0	0	0	0	5	0	0	0	5	5
Spring 92	4	2	0	6	1	0	0	4	0	5	2	4	11
Total	4	2	0	6	1	0	0	9	0	5	2	9	16
1992-93													
Fall 92	0	0	0	0	0	0	0	5	0	0	0	5	5
Spring 93	N/A												
Total	N/A												

[a] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

Table 2. Unit 21 grizzly bear successful hunter residency, 1987-92.

Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total successful hunters
1987-88	4	0	4	8
1988-89	2	1	1	4
1989-90	1	3	6	10
1990-91	1	2	0	3
1991-92	2	3	3	8
Fall 1992	0	0	6	6

[a] Unit 21 residents.

LOCATION

Game Management Unit: 22 (25,200 mi^2)

Geographical Description: Seward Peninsula and that portion of the Nulato Hills draining west into Norton Sound

BACKGROUND

Activities associated with gold mining and reindeer herding are thought to have severely depleted Unit 22 grizzly bear numbers during the early 1900s. It was not until these activities declined substantially during the 1940s that bear numbers began to slowly recover (Grauvogel 1986). The population has since continued to increase in most areas, presumably in response to higher densities of moose, reindeer, and numerous marine mammal carcasses on the beaches.

A 3-year grizzly bear study began within a 2,447 mi^2 portion of the unit during spring 1989 (Smith *et al.* 1990). Results of this study have contributed additional data concerning densities, distribution, productivity, and mortality factors affecting Unit 22 bear populations.

Interest in harvesting bears by recreational hunters, principally from the Nome area, and trophy hunters remains high. Mineral exploitation and reindeer herding activities on the Seward Peninsula continue to increase. Reindeer herders frequently complain of increasing adverse interactions between reindeer and grizzly bears. Confrontations between bears and individuals involved in outdoor activities such as camping and hunting have increased, and many local residents perceive that bear densities in some areas are too high.

MANAGEMENT DIRECTION

The management goals and objectives established for grizzly bears in Unit 22 are:

1) Maintain grizzly bear populations at existing levels in Unit 22.
   - 1a. Assess harvest and collect specimens as needed.
   - 1b. Improve compliance with bear harvest reporting requirements.
   - 1c. Seal bears and monitor harvest.
2) Minimize adverse interactions between the public and bears.
3) Develop a grizzly bear management plan.

METHODS

A 3-year study entitled "Demography of Seward Peninsula Grizzly Bears in Relation to Human Exploitation and Reindeer Herding" began in June 1989.

Objectives of the study were to:

1) Estimate sex and age composition of grizzly bears within the selected study area.

2) Determine general movement patterns and home ranges of marked adult grizzly bears within the selected study area.

3) Estimate spring density and bear numbers within representative habitats.

4) Estimate reproductive and mortality rates of grizzly bears

5) Estimate and compare harvest levels of grizzly bears within Unit 22 to rates reported in the literature.

6) Identify crucial habitats of grizzly bears on the Seward Peninsula.

7) Investigate the effects of bear predation on reindeer.

A census was conducted within a portion of the study area during spring 1991 (Miller and Nelson, unpublished report). A summary of the census effort is provided in Appendix I. The bear density estimate from the census area was subsequently extrapolated to a 12,509 mi^2 study area (32,408 km^2) encompassing portions of Subunits 22B and 22E, and all of Subunits 22C and 22D. This area was divided into 6 subareas on the basis of habitat, food availability, and harvest intensity. The estimate for bears greater than 2-years-old was used because we were comparing minimum known overall harvest with the estimated density of bears available to be harvested. Densities for each of the subareas were estimated through subjective extrapolation by 4 biologists knowledgeable with Unit 22 bear populations. All extrapolations were made through consensus of opinion.

Additional bear observations were recorded during bear radiotelemetry flights and during surveys of other game species. We also gathered information through general conversation with local residents. We summarized harvest data from sealing certificates.

RESULTS AND DISCUSSIONS

Population Status and Trend

Population Size: Grizzly bear numbers continued to increase throughout most drainages of Unit 22. However, the rate and magnitude of this increase remains unknown. The bear study provided insight into the current population size and status of bears within a small portion of Unit 22. However, comparative data for other areas in Unit 22 are unavailable.

The bear census conducted in a 2,067 km^2 (798 mi^2) portion of Unit 22 during spring 1991 yielded the following density estimates. Bears of all ages were calculated at 29.1 bears/1,000 km^2 (95% CI = 26.1-33.4) or 75.4 bears/1,000 mi^2 (95% CI = 67.6-86.5. Density for bears >2 years old was estimated at 17.9 bears/1,000 km^2 (95% CI = 15.0-22.7) or 46.4 bears/1,000 mi^2 (95% CI = 38.9-58.8).

The density estimate of grizzly bears >2 years old for the 12,509 mi^2 extrapolated study area was 458 bears (1 bear/27 mi^2). Densities within each of the 6 areas ranged from a high in the western portion of Subunit 22B of 1 bear/20 mi^2 to a low in the southern portion of Subunit 22E of 1 bear/39 mi^2.

Very little data are available about the density of grizzly bears in Subunit 22A and the eastern portion of Subunit 22B. However, in an attempt to derive a rough density estimate of grizzly bears in all of Unit 22, I combined the density estimate for all bears in the western portion of the unit with estimates derived from discussions with several local residents knowledgeable with bear densities in the eastern portion of the unit. I believe that the Unit 22 bear population numbers approximately 851 bears (1/26 mi^2) to 1,086 bears (1/21 mi^2) for bears of all ages. Because of the subjective approach used to calculate the overall density estimate for Unit 22, these estimates should be regarded as tentative.

Mortality

Season and Bag Limit:

Subunit 22A

All Hunters	Subsistence/ Resident Season	Nonresident Season
One bear every 4 regulatory years	Sept. 1 - Oct. 31	Sept. 1 - Oct. 31
	Apr. 15 - May 25	Apr. 15 - May 25

Subunit 22C

	Subsistence/ Resident hunters:	
One bear every 4 regulatory years.	Sept. 1 - Oct. 31 May 10 - May 25	
Nonresident Hunters:		
One bear every 4 regulatory years by by drawing permit only. Up to 20 permits may be issued in combination with Unit 22B, 22D and 22E.		Sept. 1 - Oct. 31 May 10 - May 25
Remainder of Unit 22		
	Subsistence/ Resident Hunters:	
One bear every 4 regulatory years	Sept. 1 - Oct. 31 Apr. 15 - May 24	
Nonresident Hunters:		
One bear every 4 regulatory years by drawing permit only. Up to 20 permits may be issued in combination with Subunit 22C.		Sept. 1 - Oct. 31 Apr. 15 - May 25

Harvest

Human-induced Mortality: Most of the known harvest of grizzly bears within Unit 22 is attributable to: 1) recreational harvest; 2) DLP kills associated with camping and other outdoor activities; and, 3) DLP kills associated with reindeer herding.

The annual Unit 22 harvest of bears taken under current regulations, seasons, and bag limits is largely recreational. Limited data indicate that subsistence use of grizzly bears in Unit 22 is minimal (Conger *et al.* 1990). The average annual harvest during this report period (fall 1990 to spring 1992) was 44.5 bears (n=89). More bears (65%) were taken

during spring because bears are more easily observed, hunter effort is greater, and bears tend to be more accessible to hunters using snowmachines as transportation.

Historical harvest data collected since the sealing requirement was instituted in the early 1960s indicate that more male bears were harvested than females. The reported harvest of the preceding 2 years was no exception. Sex composition of the harvest from fall 1990 through spring 1992 was 72% males and 28% females. The mean age of harvested males was 7.3 years (n=61), of females 7.7 years (n=25), and of both sexes combined 7.4 years (n=86).

Seven bears were reported as non-hunting kills during this report period (Table 1). One bear was illegally taken, 5 were killed by reindeer herders in DLP incidents, and the remaining bear was reported as a DLP kill within the village of Brevig Mission. These totals do not represent the actual number of non-hunting kills for this report period and, at best, represent a minimum estimate. Each year, we receive unverified reports of bears being shot and left unattended, or of not being sealed. The accuracy of these reports is unknown. I estimate that an additional 10 to 30 bears are killed annually and not reported.

A breakdown of harvest by subunit for regulatory years 1990 and 1991 is presented in Table 2. The presence of more suitable habitat, longer seasons, and higher hunting effort probably account for the higher harvests observed in Subunits 22A and 22B.

Hunter Residency and Success: Nonresident hunter success rates are high unitwide. In Subunit 22A, where nonresident hunting opportunity has not been restricted by drawing permit quotas, nonresident harvests surpass that of residents. Because nonresident effort throughout the remainder of the unit is restricted by a drawing permit quota (10 in spring and 10 in fall), resident harvests normally exceed nonresident harvests (Table 3). The data also indicate that local residents of Unit 22 typically harvest more bears annually than nonlocal Alaska resident hunters.

Under the present harvest reporting system, evaluating hunter effort and success is difficult. With the exception of nonresident permittees, unsuccessful hunters are not required to fill out a hunter report or contact ADF&G representatives about the success of their hunts. Conversations with some unit residents who have hunted bears in the past indicate that hunter success is generally higher in spring, particularly when suitable snow conditions for travelling and tracking exist.

Limited harvest success data are available from nonresident hunters who draw permits to hunt bears in Subunits 22B, 22C, 22D, and 22E (Table 4). For the spring hunts occurring during the 2-year period, 15 out of 18 nonresident hunters (83%) who hunted were successful in harvesting bears. For the fall hunts during the same time period, only 4 of 11 permittees (36%) hunting successfully harvested bears.

Permit Hunts: Nonresidents were required by the Board of Game in 1980 to obtain a drawing permit to hunt in all of Unit 22. The following year, at the ADF&G's request, the board eliminated the requirement in Subunit 22A. Since that time, 20 drawing permits (10 in spring and 10 in fall) have been available annually to nonresidents wanting to hunt bears in Subunits 22B, 22C, 22D, and 22E. Undrawn permits for these hunts are made available on a first-come, first-served basis at the ADF&G office in Nome. Interest by nonresidents in hunting grizzly bears in Unit 22 is generated in most cases by registered guides attempting to sell hunts. All permits were allocated during the spring and fall seasons for the past 2 years (Table 4).

Harvest Chronology: The spring bear harvest typically exceeds the fall harvest, and the harvest pattern during the past 2 years was no exception (Table 5). Many local hunters prefer to hunt bears in spring when snowcover is present because access to select hunting areas is made easier by the use of snowmachines, and bears are easier to locate and track. During fall, access is more limited and bears are generally not as visible.

Transport Methods: Three road systems transect the middle portion of Unit 22 making it possible for many bear hunters to reach suitable habitat which might otherwise be considered inaccessible. Although the data suggest that harvests occurring along the road corridors are low (Table 6), these roads are frequently used as access points for hunters using boats, ORVs, and snowmachines. Aircraft use within the unit is primarily limited to registered guides moving clients in and out of camps. Other transport methods are used from the camps. As previously mentioned, snowmachines are the major type of transportation used during the spring hunt. These data were obtained from sealing certificates and often do not accurately reflect the actual transportation methods used. The choices available on sealing certificates do not offer methods such as snowmachines, 4-wheelers, or highway vehicles. If the hunter checked "other" rather than being specific, the response was subsequently tabulated as "unknown". This problem has been solved this year by the use of a new style of sealing certificate.

Board of Game Actions and Emergency Orders

From 1990 to 1992, numerous proposals from the public, guides, and interested organizations requesting more liberal seasons and bag limits, and larger nonresident permit quotas were presented to the Board of Game. During spring 1992 the board amended a proposal requesting the deletion of nonresident permits in Unit 22 to one which would increase the total number of permits issued throughout the unit to 25. This amended proposal created 2 nonresident drawing hunts. Beginning in fall 1992, 20 drawing permits are available to nonresidents wanting to hunt in Subunits 22B and 22C, and 5 drawing permits available for those wanting to hunt in Subunits 22D and 22E.

CONCLUSIONS AND RECOMMENDATIONS

Interest in grizzly bears by hunters and others on the Seward Peninsula continues to increase steadily. Reindeer herders, campers, and miners consistently complain of "too many bears." Other local residents strongly believe that increasing bear numbers are a major cause of moose calf mortality. The grizzly bear research project addressing productivity, population density, and interactions with ungulate populations which began in spring 1989 has provided valuable data on bear density, mortality, and productivity. Future results of the study will assist the ADF&G in addressing these concerns.

Harvest reporting within the unit falls into 2 categories: 1) sealing of bears taken during established hunting seasons; and, 2) reporting of bears killed in DLP incidents. Compliance in both categories is high for the community of Nome. However, compliance with harvest reporting and sealing requirements in other rural villages remains very low. Bears continue to be killed by some rural residents and reindeer herders, and are not reported. Many individuals consider bears nuisances and do not believe it worth their time or effort to skin a bear and/or report the incident, especially if they are required by law to surrender the hide and skull to the department. Consideration should be given to changing current statewide regulations regarding bears taken in DLP incidents in order to improve overall compliance.

It is common knowledge that conventional wildlife management principles are not widely accepted by many residents of Unit 22. Many hunters within the unit do not purchase hunting licenses or hunt entirely within established season dates and/or bag limits. Until these larger problems are resolved, improved compliance with existing grizzly bear regulations will probably not be forthcoming.

Until more is known about the status of the Seward Peninsula grizzly bear population and current regulations are accepted by the public with a greater degree of satisfaction, any regulatory change which may increase the harvest of grizzly bears within Unit 22 should not be implemented.

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Table 1. Unit 22 brown bear harvest[a], for regulatory years 1990 and 1991.

Regulatory year	Reported Harvest											
	Hunter kill				Non-hunting kill[b]				Total kill			
	M	F	Unk.	Total	M	F	Unk.	Total	M	F	Unk.	Total
1990												
Fall 90	7	9	0	16	0	0	0	0	7	9	0	16
Spring 91	25	4	0	29	3	0	0	3	28	4	0	32
Total	32	13	0	45	3	0	0	3	35	13	0	48
1991												
Fall 91	9	5	1	15	0	0	0	0	9	5	1	15
Spring 92	23	6	0	29	3	1	0	4	26	7	0	33
Total	32	11	1	44	3	1	0	4	35	12	1	48

[a] Figures also include permit hunt harvest. [b] Represents the total known harvest.

Table 2. Unit 22 brown bear harvest[a] by Subunit, for regulatory years 1990 and 1991.

Regulatory year	Subunit										
	22A		22B		22C			22D		22E	
	M	F	M	F	M	F	Unk.	M	F	M	F
1990											
Fall 90	2	3	3	1	1	5		1	0	0	0
Spring 91	4	1	15	3	1	0		5	0	0	0
1991											
Fall 91	5	1	2	0	2	1	1	0	3	0	0
Spring 92	7	2	12	3	0	1		1	0	3	0

[a] Figures represent legal harvest only.

Table 3. Unit 22 brown bear successful hunters[a] by residency for regulatory years 1990 and 1991.

Regulatory year	Local[b] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1990-91	19	42	5	11	21	47	45
1991-92	19	43	5	11	20	46	44

[a] Figures include successful drawing permit hunters.
[b] Those hunters residing in Unit 22.

Table 4. Unit 22 brown bear harvest data for permit hunts, regulatory years 1990 and 1991.

Regulatory year	Permits issued	Number of hunters				Bear Harvest		
		Applicants	Did not hunt	Unsuccessful hunters	Successful hunters	Males	Females	Total harvest
Fall Permit Hunts								
1990-91	10	16	1	6	3	1	2	3
1991-92	10	21	6	1	1	1	0	1
Spring Permit Hunts								
1990-91	10	10	0	0	10	10	0	10
1991-92	10	18	2	3	5	5	0	5
Totals for all Permit Hunts								
1990-91	20	26	1	6	13	11	2	13
1991-92	20	39	8	4	6	6	0	6

Table 5. Unit 22 brown bear harvest[a] chronology by month for regulatory years 1990 and 1991.

Regulatory year	Fall			Spring			Total
	September	October	n	April	May	n	n
1990-91	16	0	16	24	5	29	45
1991-92	15	0	15	20	9	29	44

[a] Figures also include permit hunt harvest.

Table 6. Unit 22 brown bear harvest[a] by transport method for regulatory years 1990 and 1991.

Regulatory year	Harvest							
	Airplane	Boat	Snowmachine	ORV	Highway vehicle	Walk	Unknown	n
1990-91	8	4	6	3	4	0	20	45
1991-92	5	1	4	5	0	0	29	44

[a] Figures also include permit hunt information.

Appendix I. Summary of the grizzly bear census conducted in Unit 22 during spring 1991.

Capture-mark-resight (CMR) techniques were use to estimate grizzly bear density in a 2,067 km^2 (798 mi^2) study area on Alaska's Seward Peninsula north of Nome during early June 1991. The study area contained abundant herds of domestic reindeer that are utilized by bears and small runs of salmon that are little utilized by bears. Five replicate CMR searches were used to obtain population estimates of 60.2 bears of all ages, 37.0 bears >2.0, and 30.1 independent bears. Corresponding density estimates were 29.1 bears of all ages/1,000 km^2 (95% CI = 26.1-33.4) or 75.4/1,000 mi^2 (95% CI = 67.6-86.5). Density was estimated as 17.9 bears >2.0/1,000 km^2 (95% CI = 15.0-22.7) or 46.4/1,000 mi^2 (95% CI = 38.9-58.8). For "independent" bears (excludes accompanied offspring of all ages), density was 14.6 bears/1,000 km^2 (95% CI = 12.1-18.4) or 37.8/1,000 mi^2 (95% CI = 31.3-47.7). The estimate for all bears was thought to have an overestimation bias associated with an artificially inflated crop of newborn cubs (COY) during spring 1991. This bias did not exist for the units of bears >2.0 and for "independent" bears. There was little difference between results obtained using 3 different estimators (bear days, mean Lincoln-Petersen, and a maximum likelihood estimator) on the CMR data.

This estimate placed the study area density between that estimated using similar techniques for the center of GMU 13 and in the Noatak study area of GMU 23. Prior to the density estimate, 7 of 8 persons who ranked themselves as highly knowledgeable about bear populations in the study area correctly guessed that bear density in this area was between densities observed in the GMU 13 and GMU 23 study areas. This suggests that persons with extensive first-hand experience with local bear populations are frequently able to make reasonable guesses of bear density when provided with comparison data from other areas. Observers in search aircraft demonstrated a tendency to overestimate ages of yearling bears accompanying radio-marked females. This bias would tend to inflate estimates in units of bears >2.0. There were differences between teams in number of bears spotted per hour of search effort with the best team observing 1.9 bears for ever bear observed by the worst team. Overall, an independent bear was seen for every 2.35 hours of search effort. There were no statistically significant differences in sightability of bears by class (females with COY, females with older offspring, single females, and males). As in other studies, however, females with COY had relatively low sightabilities.

Density estimates obtained within the census area were extrapolated to a 32,408 km^2 (12,509 mi^2), and compared to available harvest data. The extrapolated population of grizzly bears >2 was 458 bears (1 bear/71 km^2) ranging from a low of 420 bears (1 bear/77 km^2) to a high of 495 bears (1 bear/65 km^2). A comparison of these data with the current harvest levels suggest the bear population in the western portion of the unit is being harvested at a rate close to the perceived sustainable level.

LOCATION

Game Management Unit: 23 (43,000 mi^2)

Geographical Description: Kotzebue Sound and western Brooks Range

BACKGROUND

In 1961 the ADF&G established grizzly bear hunting regulations and sealing requirements in Unit 23. These regulations were created assuming that the primary use of grizzly bears is trophy hunting. However, Inupiat hunters in inland communities of Unit 23 have traditionally harvested grizzly bears for meat and hides. In response to frustration over hunting regulations for grizzly bears and other species, ADF&G staff began an extensive review of existing regulations in Unit 23 during 1986. In addition, the Subsistence Division conducted a research project to evaluate harvest and use of bears by rural residents of Unit 22 and 23 (Loon and Georgette 1989).

Biological research on grizzly bears in Unit 23 is limited to a baseline study of density, movements, and productivity of bears near the Red Dog Mine (Ballard *et al.* 1991). This study was conducted by the ADF&G in cooperation with the National Park Service (NPS) from 1986-90. The primary objective of the study was to determine the density of grizzly bears in the area proposed for mine development. A census conducted in 1987, 3 years before the mine went into full production, yielded a density estimate of 1 adult bear (2.5 years-and-older) per 25.7 mi^2 in the study area. A post-development census, which is part of the original study plan, has not been conducted. The NPS has continued to relocate bears 2 to 3 times a year to collect information on productivity, mortality, and habitat use.

MANAGEMENT DIRECTION

The following management objectives were established for grizzly bear populations in Unit 23:

1) Maintain a minimum density of 1 adult bear per 30 mi^2 in the Noatak drainage. A census, comparable to that completed in 1987, should be conducted by 1997 or before any further mining development occurs.

2) Develop and distribute a questionnaire by 1994 that will quantify public perception of Unit 23 grizzly bear abundance and population trends. This questionnaire should be statistically valid and repeatable at 3 to 5 year intervals. Results will be used to alert biologists to potential problems in individual areas within Unit 23.

3) Develop an alternate harvest reporting system by 1994 that will improve the accuracy of harvest data by at least 50%, and will be more culturally acceptable to rural residents. Development of an alternate harvest reporting system will require some means for evaluating its accuracy, feasibility, and cost effectiveness.

METHODS

During May 1990, the NPS re-collared female bears captured at the beginning of the Red Dog study and radio-collared additional females to maintain an adequate sample size necessary for estimating harvest rates, productivity, and natural mortality. Procedures described in Ballard *et al.* (1991) were followed; however, cubs-of-the-year were not captured. Radio-collared bears were monitored weekly during spring 1991 to document den emergence dates in the Noatak River drainage. Harvest information was summarized from sealing documents and radiotelemetry data.

In an attempt to use data collected during the Red Dog census for developing a unitwide bear population estimate, we asked knowledgeable individuals to participate in an estimation exercise similar to that conducted in Unit 22 (S. Miller, pers. commun.). We provided 20 individuals having extensive experience in Unit 23 with a map describing locations and density estimates for bears in 6 northern and interior Alaska brown bear census areas, and a map of Unit 23 divided into nine subareas. We then asked participants to estimate densities of bears in the subareas (along with a lower and upper density estimate), and to indicate their level of confidence in their estimate.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The results of the density questionnaire were inconclusive. Ten of 20 individuals responded. There was no general agreement for densities in any subarea other than for the Red Dog census area. Levels of confidence were typically low. The exercise identified areas, such as the upper Kobuk, where even subjective information is lacking. According to hunters and knowledgeable local residents, grizzly bears in most areas were reported to be abundant and either increasing or at higher levels than in previous years. For the Noatak, these observations coincide with Ballard's observations of increased cub production and survival in 1989 and 1990 (Ballard *et al.* 1991).

Population Composition: During 1991, 11 of 28 collared females had cubs-of-the-year based on observations made up to 1 week after den emergence. Four females were observed with 3 cubs each. Den emergence dates for females ranged from 10 April through 15 May. Females with cubs typically did not emerge until after 1 May, and remained near dens through 10 May.

Mortality

Season and Bag Limits:

Unit 23	Subsistence/ Resident Hunters: Season	Nonresident Resident Season
1 bear every 4 years	Sept. 1-Oct. 10	
		April 15-May 25
Nonresident Hunters: 1 bear every 4 years by drawing permit only; up to 25 permits will be issued.		Sept. 1-Oct. 10
		April 15-May 25

Harvest:

Human-induced Mortality: In 1990, hunters killed 36 bears (23 males and 13 females), and 3 additional bears were killed in DLP incidents. In 1991, hunters killed 34 bears (25 males and 9 females). A truck on the Red Dog Mine road struck and killed an additional bear. These figures do not suggest that any significant change in harvest and DLP kills is occurring in Unit 23 (Table 1). As in past years, most of the harvest occurred during September and April (Table 2). Most of the harvest (74-88%) occurred in the Noatak drainage during both years.

As in previous years, hunters harvested a larger percentage of males during spring. Given the low percentage of actual harvest that is reported, the value of sex and age analysis of harvested bears is questionable. Indicators based on sex and age of harvested bears are not very sensitive to changes in population size or demography. They will lag behind any real change in population structure because larger and older animals are sought by hunters who typically report their harvest.

Before the fall hunting season in 1990, the NPS regularly located 32 radio-collared females. During fall 1990, hunters shot 2 of these bears (#08 with no offspring, #69 with 2 yearlings). During spring 1991 female #102 was killed, head and claws removed and left in the field. If #102 is included in the harvest, a 9.4% harvest occurred for the sample of radio-collared females (n=32). This is higher than the 8% estimate of sustainable harvest made by Ballard *et al.* (1991) using a model developed by Miller and Miller (1988). This model assumes that males are more vulnerable to harvest than females.

Thirty-three females with functional radio collars were alive before the 1991 fall hunting season. In 1991 hunters harvested 1 radio-collared female during fall and none during spring. The annual harvest of radio-collared bears in 1991 was 3.1%.

As of October 1992, there were 29 active radio-collared females in the study area. Currently, the NPS does not plan to maintain a sample of radio-collared bears. Bears with collars will continue to be monitored by the NPS 2 to 3 times a year while the collars are functional.

Hunter Residency and Success: Local Unit 23 residents reported taking far fewer bears than nonlocal residents (12 verses 24 in 1990, 9 verses 26 in 1991). Because non-compliance with harvest reporting requirements by local residents is widespread, the proportion of the total harvest attributable to local unit residents is probably higher than reported. The reported harvest is evenly distributed between nonlocal residents and nonresidents for both years (Table 3).

Transport Methods: As in past years, most hunters used aircraft for transportation to bear hunting areas (64% in 1990-91 and 60% in 1991-92) (Table 4). The next form of transportation most commonly used was snowmobiles during the spring hunts (19% in 1990-91 and 34% in 1991-92). Five successful hunters used boats in 1990-91 and 2 successful hunters did in 1991-92.

Permit Hunts: The ADF&G issued all 18 permits for the fall 1990 nonresident permit hunt. Two permit holders did not hunt, 5 hunted but were unsuccessful and 7 were successful. In spring 1991, 6 of the 7 permit holders hunted and shot bears. During the fall permit hunt in 1991, 1 permittee did not hunt, 7 hunted and shot bears, and 8 hunted but were not successful. In spring 1992, 6 applications were received for 7 permits, and all 6 hunted and 5 were successful. This was the first time there were fewer applicants for the Unit 23 spring hunt than permits available.

Natural Mortality: Of the 25 cubs associated with radio-collared sows, 22 survived through 23 September 1991 (88%). The study average for this time period was 87% (1986-1990). Survival for yearlings was 71% (15 out of 21), which was lower than the study average of 89%. There was no mortality of cubs associated with the capture work.

Habitat

Assessment: The study of development impacts of the Red Dog Mine has provided some baseline data on habitat use by bears in that area. The study report identified concern over disruption of den site selection by bears using the area. One incident of den disruption occurred in September 1991 when mine operators established and used a material site immediately below an active den. The bear subsequently abandoned the den. General activity at the mine does not appear to be displacing bears from denning habitat surrounding the mine, except at sites actively worked.

In May 1991, biologists recaptured 2 bears with satellite collars that failed in 1987 in the same locations as their capture in 1985. This suggests that no displacement had been caused by development. The last re-collaring effort took place in spring 1991.

No date is set for the recommended post-development census. Plans exist for future expansion of the mine site west toward the Kelly River drainage. Because the mine has been in full production, we should begin planning for a post-development census. Resulting data will be valuable for evaluating the impact of future development on grizzly bear populations.

Board of Game Actions and Emergency Orders

The Board of Game established the Northwest Brown Bear Management Area and a new subsistence season at its spring 1992 board meeting. The subsistence season is in addition to the existing sport season, and went into effect 1 July 1992. Under the new subsistence regulations, residents will be allowed to harvest 1 bear a year from 1 September through 31 May. Aircraft will not be allowed to be used for transportation to the field, and all meat must be salvaged for human consumption. Hides and skulls need not be salvaged; however, if the hide is salvaged and transported out of the Management Area it will require sealing. The head and paws will be removed at the time of sealing to destroy the trophy value of the hide.

CONCLUSIONS AND RECOMMENDATIONS

The following management actions are recommended for grizzly bears in Unit 23:

1. Distribute a questionnaire to collect information on the public's perception of bear densities and population trends during 1995.

2. Conduct a minimum of 1 spring reconnaissance flight in the upper Noatak and Kobuk River drainages annually to increase familiarity with bear distribution and densities.

3. Pursue development of low-cost methods to monitor bear population trends such as the use of a line-intercept track sampling technique (Becker 1991) or sampling densities of den sites.

4. Develop and evaluate an alternate harvest reporting system that would be more culturally acceptable to local rural residents.

5. Continue monitoring radio-collared females near the Red Dog Mine.

6. Inform local residents of the new subsistence grizzly bear regulations. Distribution of the registration permits and information during the first year of the new season may help improve harvest reporting compliance. Replication of a study similar to that conducted by Loon and Georgette (1989) should be considered to evaluate reporting compliance with the new subsistence season.

7. Re-census the Red Dog mine area before 1997 and before any further expansion occurs.

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Table 1. Unit 23 grizzly bear harvest[a], 1985-91.

Year	Reported kill						Nonhunting[b] kill			Total estimated kill					
	M	(%)	F	(%)	Unk.	Total	M	F	Unk.	M	(%)	F	(%)	Unk.	Total
1985															
Fall 85	7	(64)	4	(36)	2	13									
Spring 86	7	(78)	2	(22)	0	9									
Total	14	(70)	6	(30)	2	22	1	3	1	15	(62)	9	(38)	3	27
1986															
Fall 86	11	(55)	9	(45)	0	20									
Spring 87	11	(85)	2	(15)	0	1									
Total	22	(67)	11	(33)	0	33	1	2	1	23	(64)	13	(36)	1	37
1987															
Fall 87	12	(63)	7	(37)	1	20									
Spring 88	3	(100)	0	0	3										
Total	15	(68)	7	(32)	1	23	0	0	0	15	(68)	7	(24)	1	23
1988															
Fall 88	11	(73)	4	(27)	0	15									
Spring 89	14	(78)	4	(22)	1	19									
Total	25	(76)	8	(24)	1	34	2	0	0	27	(77)	8	(23)	1	36
1989															
Fall 89	9	(50)	9	(50)	2	20									
Spring 90	10	(91)	1	(09)	0	11									
Total	19	(66)	10	(34)	2	31	2	3	0	21	(62)	13	(38)	2	36

Table 1. (continued).

Year	Reported kill						Nonhunting[b] kill			Total estimated kill					
	M	(%)	F	(%)	Unk.	Total	M	F	Unk.	M	(%)	F	(%)	Unk.	Total
1990															
Fall 90	9	(47)	10	(53)	0	19									
Spring 91	14	(82)	3	(18)	0	17									
Total	23	(64)	13	(36)	0	36	1	1	1	24	(63)	14	(37)	1	39
1991															
Fall 91	10	(62)	5	(31)	1	16									
Spring 92	15	(79)	4	(21)	0	19									
Total	25	(71)	9	(26)	1	35	0	1	0	25	(69)	10	(28)	1	36

[a] Includes spring and fall nonresident permit hunts.
[b] Includes defense of life or property kills, research mortalities, and other human caused accidental mortality.

Table 2. Chronology of Unit 23 grizzly bear harvest[a] by number and percent (in parentheses) during 1985-91.

Regulatory year	August	September	October	April	May	Total
1985-86		13 (59)		4 (18)	5 (23)	22
1986-87		20 (61)		8 (24)	5 (15)	33
1987-88		17 (74)	3 (13)	1 (4)	3 (9)	24
1988-89		13 (38)	2 (6)	12 (35)	7 (21)	34
1989-90	1 (3)	16 (52)	3 (10)	7 (23)	4 (13)	31
1990-91		18 (50)	1 (3)	14 (39)	3 (8)	36
1991-92		15 (43)	1 (3)	16 (46)	3 (8)	35

[a] Includes nonresident permit hunts but excludes non-hunting mortalities.

Table 3. Unit 23 grizzly bear harvest[a] by hunter residence, 1985-91.

Regulatory year	Local resident[b]	Nonlocal resident	Nonresident	Total
1985-86	9 (41)	3 (14)	10 (45)	22
1986-87	6 (18)	12 (36)	15 (45)	33
1987-88	4 (17)	10 (43)	9 (39)	23
1988-89	17 (50)	8 (24)	9 (26)	34
1989-90	9 (29)	9 (29)	13 (42)	31
1990-91	12 (33)	11 (31)	13 (36)	36
1991-92	9 (26)	14 (40)	12 (34)	35

[a] Includes nonresident permit hunts and excludes nonhunting mortalities.
[b] "Local resident" defined as a resident of Unit 23.

Table 4. Unit 23 grizzly bear harvest[a] (percent) by transport method, 1985-91.

Regulatory year	Airplane	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	Total
1985-86	15 (68)	1 (4)		5 (23)					21
1986-87	19 (58)	7 (21)		5 (15)			1 (3)	1	33
1987-88	17 (74)	4 (17)	1 (4)		1 (4)				23
1988-89	13 (38)	3 (9)		11 (32)	7 (21)				34
1989-90	21 (68)	3 (10)		6 (19)	1 (3)				31
1990-91	23 (64)	5 (14)	1 (3)	7 (19)					36
1991-92	21 (60)	2 (6)		12 (34)					35

[a] Includes nonresident permit hunts and excludes non-hunting mortalities.

LOCATION

Game Management Unit: 24 (26,092 mi^2)

Geographical Description: Koyukuk River drainage upstream from the Dulbi River

BACKGROUND

Grizzly bears occur in moderate numbers throughout the area with higher numbers in more mountainous areas. Upland areas compose about one-third of the unit. Information is scant about bear populations within the unit and most past references about bear density were based on studies conducted on the northern slopes of the Brooks Range in Unit 26 (Crook 1972, Reynolds 1976, Reynolds and Hechtel 1984), or in the southwestern Brooks Range in Unit 23 (Ballard *et al.* 1988). Unfortunately, all of these studies were conducted in portions of the Brooks Range where open terrain makes observations and hunting relatively easy, and the applicability of study results to Unit 24 is questionable.

Reynolds (1987) estimated the bear population in the northern portion of the unit at 165-220 in 1986. In 1987 Reynolds (1989) estimated the bear population in the same area at 450 bears with an overall unit population of 770–930 animals based on densities estimated in Subunits 26B and 26C (i.e., Arctic National Wildlife Refuge). The harvest since 1961 has rarely exceeded 15 bears/year. An exception to this pattern occurred in the early 1970s when bear hunting on the Alaska Peninsula was closed on an alternate-year basis; this resulted in increased bear hunting pressure over the rest of the state. The annual harvest of bears in Unit 24 reached a maximum of 31 during that period. To prevent overharvest, a drawing permit system was in place from 1977 to 1985.

Bear populations have been stable and slowly increasing; annual harvests have been low, usually less than 15 bears. Local hunting pressure has been low, although the opening of the Dalton Highway to the public has increased the number of potential hunters. Historically, bears were an important source of food and hides for local Natives; however, now they rarely hunt bears, except for some residents of Anaktuvuk Pass.

MANAGEMENT DIRECTION

Management Goals

The management goals for Unit 24 brown bears are to protect, maintain, and enhance the grizzly bear population and its habitat in concert with other components of the ecosystem.

Management Objectives

The management objectives for Unit 24 brown bears are: 1) to manage a grizzly bear population that will sustain a maximum annual harvest of 20 bears in the northern portion of the unit and a maximum harvest of 15 bears in the remainder of the unit; 2) to reduce nuisance bear complaints, to increase sealing compliance, and to reduce the unreported harvest of bears in the unit; and 3) to work with U.S. National Park Service and USFWS to determine bear density throughout the unit.

METHODS

We monitored harvest through sealing requirements. The nuisance bear problem will be addressed through education of local residents, selective removal of problem bears, and changes in regulations.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: I believe the population has been stable or slowly increasing based on field observations, nuisance reports, and hunter sightings of bears during the past 10 years. Also, the total estimated harvest has been less than 4% of the grizzly bear population per year which may contribute to an increasing population.

No surveys have been conducted in the area; however, population estimates were made based on bear densities found in similar habitats on the northern slopes of the Brooks Range. In the mountains, foothills, and coastal plain of the Canning River area, bear densities ranged from 10.0 to 17.5 bears/1,000 mi^2 (Reynolds 1976). In contrast, in a study area in the western Brooks Range, densities were about 40 bears/1,000 mi^2; these higher densities were thought to be because of the large number of caribou in the area (Reynolds and Hechtel 1984). However, Reynolds (1987) used a figure of 10 bears/1,000 mi^2 in estimating the overall North Slope population in both mountainous and coastal plain habitat. In 1987 Reynolds (1989) estimated the density of bears within Gates of the Arctic National Park (7,000 mi^2) at 33 bears/1,000 mi^2. Outside the park within the Brooks Range (6,500 mi^2) he estimated the density at 33/1,000 mi^2, and in the remainder of the unit (14,500 mi^2) he estimated the density at 22-33 bears/1,000 mi^2. Most of Unit 24 has a fairly substantial ungulate prey base and spawning salmon streams, thus Reynolds' (1987) estimate of 770-930 is probably close to the Unit 24 population.

Mortality

Harvest: Hunting pressure on bears in the southern part of the unit is low although the season length has been liberalized from 55 days during 1981-83, to 137 days during 1984-89, and to 273 days during 1990-91. During the report period the number of bears harvested by sport hunters dropped from the 10-year average of 10.8 bears per year (Table 1). The number of bears that were taken at fish camps and by trappers and not reported is unknown but is estimated to be less than four bears annually.

Seasons and Bag Limits.

Unit 24	Sept. 1-May 31	One bear every 4 regulatory years

Board of Game Actions and Emergency Orders. During 1977, in response to evidence of overharvest in the Brooks Range (Units 23-26), the Board of Game established a drawing permit system in Unit 24 with 40 permits available. In 1978 the area in which permits were required was reduced from the entire unit to only the northern part of the unit. The number of permits remained at 40. In 1982, when Gates of the Arctic National Park was created, the number of drawing permits available outside the park was reduced to 20. For subsistence hunters within the park, the season was lengthened to remain open all year, bag limits increased to one per year, and a registration permit system was established with 10 available permits. In 1983 the number of drawing permits outside the park was increased to 40 again.

In 1984, the number of drawing permits was reduced to 30 and the number of registration permits for subsistence users in the park increased to 20. In 1985 the drawing permit system was changed to a registration permit system with a harvest quota of 20 bears. In 1987 the quota was reduced to 15 bears and the registration permit system within the park was eliminated. In 1990, the board eliminated any requirement for permits and made the season uniform throughout the unit. The season is now aligned with seasons in Units 19, 20, and 21.

In 1992 the board adopted the Northwest Alaska Brown Bear Management Area that included the unit west of the Dalton Highway Corridor Management Area. The season length remained the same but the bag limit is one bear per year. All meat must be salvaged, sealing requirements are waived if the hide and skull remain within the management area, there is no fee, and aircraft cannot be used. Results from this regulation are unknown, but interest in obtaining permits so far has been low.

Hunter Residency and Success. In prior reports there were no trends in harvest but with the retirement of two guides in the Bettles area and the reduction in hunting area by the creation of Gates of the Arctic National Park some changes may occur. Most bear hunting is now incidental to fall moose hunting by Alaska residents (Table 2). Very few nonresidents now go on spring bear hunts.

CONCLUSIONS AND RECOMMENDATIONS

The management objective for grizzly bears within the unit is to maintain a grizzly bear population that can sustain a harvest that does not exceed 20 bears in the northern portion of the unit or 15 bears in the southern portion of the unit. The annual reported and estimated unreported harvest for the entire unit was estimated at an average of 12.5 bears per year. Based on the estimated sustainable harvest rate of 4% elsewhere in interior Alaska, a harvest of 31-37 bears could be sustained in this unit. There is some likelihood that localized overhunting could occur near the Dalton Highway. However, the grizzly bear population is probably not susceptible to overharvest because hunting is restricted within Gates of the Arctic National Park; much of the rest of the unit is more heavily forested and difficult to hunt.

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Table 1. Unit 24 grizzly bear harvest, 1987-92.

Regulatory year	Reported							Estimated kill		Total estimated kill			
	Hunter kill				Non-hunting kill[a]								
	M	F	Unk	Total	M	F	Unk	Unreported	Illegal	M	F	Unk	Total
1987-88													
Fall 87	11	2	0	13	1	1	0	n/a	n/a	12	3	n/a	15
Spring 88	2	0	0	2	0	0	0	n/a	n/a	2	0	n/a	2
Total	13	2	0	15	1	1	0	3	2	14	3	5	22
1988-89													
Fall 88	6	4	2	12	0	0	0	n/a	n/a	6	4	2	12
Spring 89	2	0	0	2	0	0	0	n/a	n/a	2	0	n/a	2
Total	8	4	2	14	0	0	0	3	2	8	4	7	19
1989-90													
Fall 89	4	2	1	7	0	0	0	n/a	n/a	4	2	1	7
Spring 90	1	1	0	2	0	0	0	n/a	n/a	1	1	n/a	2
Total	5	3	1	9	0	0	0	3	2	5	3	6	14
1990-91													
Fall 90	8	5	0	13	0	1	0	n/a	n/a	8	6	n/a	14
Spring 91	0	2	0	2	0	0	0	n/a	n/a	0	2	n/a	2
Total	8	7	0	15	0	1	0	3	2	8	8	5	21
1991-92													
Fall 91	5	2	0	7	0	0	0	n/a	n/a	5	2	n/a	7
Spring 92	1	0	0	1	0	0	0	n/a	n/a	1	0	n/a	1
Total	6	2	0	8	0	0	0	3	2	6	2	5	13
Fall 1992													
Fall 92	6	5	0	11	0	0	1	n/a	n/a	6	5	1	12
Spring 93	n/a												
Total	n/a												

[a] Includes defense of life or property kills, research mortalities, and other known human-caused accidental mortality.

Table 2. Unit 24 grizzly bear successful hunter[a] residency, 1987-92.

Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total successful hunters
1987-88	4	4	9	17
1988-89	2	7	5	14
1989-90	1	5	4	10
1990-91	3	9	3	15
1991-92	0	4	4	8
Fall 1992	1	5	5	11

[a] Permit hunts are included.
[b] Unit residents.

LOCATION

Game Management Unit: Subunits 25A, 25B, 25D, 26B, and 26C (75,000 mi^2)

Geographical Description: Eastern North Slope of the Brooks Range and the upper Yukon River Drainage

BACKGROUND

The reduction in grizzly bear numbers in the 1960s, primarily from aircraft-supported hunting associated with guiding, caused the application of very conservative management. Subunits 26B and 26C were closed to grizzly bear hunting in 1971-72, and a variety of regulations including drawing permit hunts have since been used to limit harvest and foster an increase in numbers. A conservative harvest objective of 4-6% of the estimated populations has been used in recent years.

MANAGEMENT DIRECTION

Management Goals

Management goals for the areas brown bears are to: 1) protect, maintain, and enhance the grizzly bear populations and habitat in concert with other components of the ecosystem; 2) provide the opportunity to hunt grizzly bears under aesthetically pleasing conditions in the eastern Brooks Range; and 3) in the upper Yukon and Porcupine drainages, provide the greatest sustained opportunity to participate in hunting grizzly bears.

Management Objectives

Unit 25: Maintain a mean annual harvest of less than 35 bears, with a minimum of 60% males in the harvest.

Subunits 26B and 26C: Maintain a mean annual harvest of less than 25 bears, with a minimum of 60% males in the harvest.

METHODS

Grizzly bear population density was estimated in Subunits 26B (1973-75) and 26C (1982-87) (Reynolds 1976, Garner *et al.* 1984, Reynolds and Hechtel 1984) and extrapolated to other areas. Harvest data are obtained from mandatory sealing documents.

RESULTS AND DISCUSSION

Population Status and Trend

The reduction in harvest resulted from conservative regulations, including the permit system used since 1977, has fostered an apparent increase in the number of grizzlies in Subunits 25A, 26B, and 26C. The trend in Subunit 26B is probably decreasing or stable based on an estimated population size and harvest in excess of 4% of the estimated population. The long-term population trend in Subunits 25B and 25D is less well known, but grizzlies are common throughout the area and numbers are probably stable. People long familiar with these areas generally report that grizzlies are more abundant in these areas in recent years.

Population Size: The only available estimates of population size are those extrapolated from studies in two small (1,500-2,500 mi^2) areas of representative habitat (Reynolds 1976, Reynolds and Hechtel 1984), and studies in northern Arctic National Wildlife Refuge (ANWR) (Reynolds and Garner, 1987). Extrapolating from these estimated densities yielded a population estimate of 1,320-1,570 bears for the western Brooks Range and upper Yukon River (Table 1).

Distribution and Movements: Grizzly bears are distributed throughout the area. Densities are generally highest in the foothills of the Brooks Range and lowest on the coastal plain of the North Slope. An artificially high concentration of bears has developed near Prudhoe Bay as a result of the availability of discarded food, with 23 grizzlies known to occur in the area of 1,500 mi^2 (R. Shideler, pers commun.). The movement of some grizzlies from the mountains to the Porcupine caribou herd calving area on the coastal plain has been observed. Grizzly bears are also known to concentrate near salmon spawning areas on the Sheenjek River in Subunit 25A.

Mortality

Season and Bag Limit.

Units and Bag Limits	Resident Open Seasons	Nonresident Open Seasons
Unit 25(A) within the Hodzana River drainage One bear every 4 regulatory years.	Sept. 1-May 20	Sept. 1-May 20
Remainder of Unit 25(A) One bear every 4 regulatory years.	Sept. 1-May 20	

Nonresident hunters: One bear every 4 regulatory years by drawing permit only; up to 36 permits may be issued.		Sept. 1-May 20
Units 25(B) and 25(D) One bear every 4 regulatory years.	Sept. 1-May 31	Sept. 1-May 31
Units 26(B) and 26(C) Resident hunters: One bear every 4 regulatory years	Sept. 1-May 31	
Nonresident hunters: One bear every 4 regulatory years by drawing permit only; up to 10 permits may be issued (20 permits total-10 for each unit.		Sept. 1-May 20

Board of Game Actions and Emergency Orders. Drawing permits were required for all hunters wishing to hunt grizzly bears in Subunits 25A, 26B and 26C beginning in 1977-78. Since that time, as bear populations recovered, regulatory changes have mainly included applying the permit requirement to nonresidents only and slightly increasing the number of permits issued in some areas. The requirement for a drawing permit for nonresidents only was applied to nonresidents in Subunits 25A and 26C beginning in 1984-85, and in Subunit 26B beginning in 1987-88. Drawing permits are presently required only for nonresidents in all areas.

Hunter Harvest. Thirty seven bears were harvested in 1990-91, and 46 were taken in 1991-92 (Tables 2-6). Most were taken in Subunits 25A, 26B and 26C, where permits are required for nonresident hunters. The overall harvest has been nearly stable during the past 5 years, ranging from 37 to 43 bears. This is higher than harvests during the late 1970s and early 1980s (Table 2) but is generally lower than the 4-6% harvest goal except in Subunit 26B. Generally higher harvests in recent years are probably a result of more hunting activity in some areas, perhaps in combination with increasing populations.

The only area where harvests continue to exceed the conservative harvest objective is Subunit 26B, where from 9-17 bears have been taken in each of the last 5 years. While the harvest exceeds the objective by varying amounts, it represents a maximum of 8% of

the estimated population, and the total harvest in Subunits 26B and 26C has usually been at or below the harvest objective of 25 bears annually (29 were reported taken in 1991-92). Reports from hunters and casual observations suggest that bears continue to be common in Subunit 26B. While it is difficult to know whether increased harvest restrictions are necessary, the access and hunting pressure adjacent to the Dalton Highway indicate the situation should be closely monitored.

The proportion of males in the overall harvest was 62% in 1990-91 and 71% in 1991-92. The sex composition of the harvest generally meets or exceeds the objective of a minimum of 60% males. Most bears are taken during fall hunts.

Permit Hunts. During 1990-91 and 1991-92 drawing permits were required for nonresident hunters in Subunits 25A, 26B, and 26C. The fall, spring, and total harvest in each subunit are given in Tables 7-9. The harvests by permit holders in 1990-91 and 1991-92 were 17 and 18, compared to total harvests in the permit areas of 32 and 40, respectively. Most grizzlies are taken during fall hunts, except in Subunit 26B where the numbers taken in fall and spring are approximately equal (Table 8).

Hunter Residency and Success. Residents accounted for 51% and 47% of the successful hunters in Subunits 25A, 25B, 25D, 26B and 26C during the 1990-91 and 1991-92 seasons, respectively (Tables 10-13). Only a few local residents report taking bears, and these figures probably underestimate the number taken by local hunters by a small amount, particularly in Subunits 25A, 25B and 25D.

Transport Methods. Most grizzly bears are harvested in aircraft-supported hunts, with a few being taken by hunters using snowmachines, boats or highway vehicles (near the Dalton Highway).

Other Mortality: The number of grizzly bears taken and not reported is unknown, but there are occasional reports of bears being killed but not sealed, especially near villages. Some of this harvest probably occurs in DLP incidents. Local residents of this area do not often specifically hunt bears, but commonly encounter them in the course of other activities. More education among local residents about the need for harvest reporting and sealing is necessary. Two male bears were reported taken in DLP incidents in Subunit 26C during fall 1991.

Relatively little is known about natural mortality of grizzly bears in northeastern Alaska. Reynolds and Hechtel (1984) observed natural mortality rates in the western Brooks Range of 47% for cubs, 12% for yearlings, and 13% for 2-year-olds.

CONCLUSIONS AND RECOMMENDATIONS

Current management objectives are generally being met in the area and harvests are at what we consider sustainable levels. The one area where harvest is greater than the objective is in Subunit 26B where 9-17 bears have been taken by hunters in the last 5 years. The current harvest objective is 8 bears. This situation should be re-evaluated in cooperation with department bear biologists to review and possibly revise bear management objectives.

The existing permit system for nonresidents should be re-evaluated in view of the establishment of guide areas by the USFWS in the Arctic National Wildlife Refuge and the Yukon Flats National Wildlife Refuge. The present geographic distribution of permits does not correspond to the new guide areas. Another problem has been the timing of permit issuance relative to the opening of hunting season. The short time between permit drawing and the hunting season has made it difficult for hunters and guides in terms of booking hunts. The establishment of stable guide areas in most of the area currently affected by permits provides an opportunity to develop a more efficient and coherent harvest allocation system for nonresidents. This possibility should be explored.

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Table 1. Sustainable and reported 1990 grizzly bear harvests in the Brooks Range based on estimated population densities and an allowable harvest rate of 4%.

Area	Area (mi^2)	1991 Mortality[a] Estimated density/ 100 mi^2	Estimated population size	Allowable harvest @ 4%	Permit areas	Non-permit areas
Unit 25						
A	19,500	2.2	430	17	15	0
B and D	22,000	1.7-2.2	380-480	15-19		2
Subunit 26B						
Northern[b]	7,500	1.0	80	3		
Southern[b]	6,100	2.2	130	5		
Subtotal	13,600		210	8	17	
Subunit 26C	9,100	3.3-5.0	300-450	12-18	12	
Total	77,800		1,320-1,570	52-62	44	2

[a] Includes all human-caused mortality. In permit areas, permits are required for nonresidents. In open areas of Unit 25, no permits are required.

[b] Northern and southern portions of Subunit 26B correspond to areas of different estimated grizzly bear densities.

Table 2. Human-caused mortality of grizzly bears in Units 25 and 26, 1977-91.

Unit	Estimated population	Human-caused mortality Mean for 1977-84	1987	1988	1989	1990	1991
Nonpermit areas							
25B, 25D	380-480	4.4	8	6	5	5	2
Permit areas							
25A	430	10.1	13	21	15	14	15
26B	210	4.9	14	9	16	12	17
26C	300-450	2.4	8	7	4	6	12
Subtotal	940-1,090	17.4	35	37	35	32	40
Total	1,320-1,570	21.8	43	43	40	37	46

Table 3. Subunit 25A brown bear harvest[ab], 1987-92.

Regulatory year	Reported: Hunter kill M	F	(%)[1]	Unk	Total	Reported: Non-hunting kill[c] M	F	Unk	Total estimated kill M	(%)	F	(%)	Unk	Total
1987-88														
Fall 87	6	6	(50)	0	12	0	0	0	6	(50)	6	(50)	0	12
Spring 88	1	0	(0)	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	7	6	(46)	0	13	0	0	0	7	(54)	6	(46)	0	13
1988-89														
Fall 88	14	7	(33)	0	21	0	0	0	14	(67)	7	(33)	0	21
Spring 89	0	0	(0)	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	14	7	(33)	0	21	0	0	0	14	(67)	7	(33)	0	21
1989-90														
Fall 89	6	6	(50)	0	12	1	1	1	7	(47)	7	(47)	1	15
Spring 90	0	0	(0)	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	6	6	(50)	0	12	1	1	1	7	(47)	7	(47)	1	15
1990-91														
Fall 90	6	3	(33)	0	9	0	0	0	6	(66)	3	(33)	0	9
Spring	3	2	(40)	0	5	0	0	0	3	(60)	2	(40)	0	5
Total	9	5	(36)	0	14	0	0	0	9	(64)	5	(36)	0	14
1991-92														
Fall 91	7	3	(30)	2	12	0	0	0	7	(70)	3	(30)	2	12
Spring 92	3	0	(0)	0	3	0	0	0	3	(100)	0	(0)	0	3
Total	10	3	(30)	2	15	0	0	0	10	(77)	3	(23)	2	15

[a] Note whether permit hunt harvest is included or excluded

[b] No estimate was made of unreported or illegal kills

[c] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality

Notes for use of table

1. Percentages are based on bears whose sex was known

Table 4. Subunits 25B and 25D brown bear harvest[a], 1987-92.

Regulatory year	Reported								Total estimated kill					
	Hunter kill					Non-hunting kill[b]								
	M	F	(%)	Unk	Total	M	F	Unk	M	(%)	F	(%)	Unk	Total
1987-88														
Fall 87	1	3	(75)	0	4	2	0	0	3	(50)	3	(50)	0	6
Spring 88	1	0	(0)	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	2	3	(60)	0	5	2	0	0	4	(57)	3	(43)	0	7
1988-89														
Fall 88	3	1	(25)	0	4	0	0	0	3	(75)	1	(25)	0	4
Spring 89	0	0	(0)	0	0	0	0	0	0	(0)	0	(0)	0	0
Total	3	1	(25)	0	4	0	0	0	3	(75)	1	(25)	0	4
1989-90														
Fall 89	1	1	(50)	0	2	0	0	0	1	(50)	1	(50)	0	2
Spring 90	3	0	(0)	0	3	0	0	0	3	(100)	0	(0)	0	3
Total	4	1	(20)	0	5	0	0	0	4	(80)	1	(20)	0	5
1990-91														
Fall 90	1	2	(66)	0	3	0	0	0	1	(33)	2	(66)	0	3
Spring	1	1	(50)	0	2	0	0	0	1	(50)	1	(50)	0	2
Total	2	3	(60)	0	5	0	0	0	2	(40)	3	(60)	0	5
1991-92														
Fall 91	1	0	(0)	0	1	0	0	0	1	(100)	0	(0)	0	1
Spring 92	0	1	(100)	0	0	0	0	0	0	(0)	1	(100)	0	0
Total	1	1	(50)	0	2	0	0	0	1	(50)	1	(50)	0	2

[a] Note whether permit hunt harvest is included or excluded

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality

Table 5. Subunit 26B brown bear harvest[a], 1987-92.

Regulatory year	Reported: Hunter kill M	F	(%)	Unk	Total	Reported: Non-hunting kill[b] M	F	Unk	Total estimated kill M	(%)	F	(%)	Unk	Total
1987-88														
Fall 87	8	2	(20)	0	10	1	0	0	9	(82)	2	(18)	0	11
Spring 88	3	0	(0)	0	3	0	0	0	3	(100)	0	(0)	0	3
Total	11	2	(15)	0	13	1	0	0	12	(86)	2	(14)	0	14
1988-89														
Fall 88	3	3	(50)	0	6	0	0	0	3	(50)	3	(50)	0	6
Spring 89	2	0	(0)	1	3	0	0	0	2	(67)	0	(0)	1	3
Total	5	3	(37)	1	9	0	0	0	5	(56)	3	(33)	1	9
1989-90														
Fall 89	6	5	(45)	0	11	1	0	0	7	(58)	5	(42)	0	12
Spring 90	3	1	(25)	0	4	0	0	0	3	(75)	1	(25)	0	4
Total	9	6	(40)	0	15	1	0	0	10	(63)	6	(37)	0	16
1990-91														
Fall 90	3	5	(62)	0	8	0	0	0	3	(38)	5	(62)	0	8
Spring	4	0	(0)	0	4	0	0	0	4	(100)	0	(0)	0	4
Total	7	5	(42)	0	12	0	0	0	7	(58)	5	(42)	0	12
1991-92														
Fall 91	8	5	(38)	0	13	0	0	0	8	(62)	5	(38)	0	13
Spring 92	4	0	(0)	0	4	0	0	0	4	(100)	0	(0)	0	4
Total	12	5	(29)	0	17	0	0	0	12	(71)	5	(29)	0	17

[a] Note whether permit hunt harvest is included or excluded

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality

Table 6. Subunit 26C brown bear harvest[a], 1987-92.

Regulatory year	Reported								Total estimated kill					
	Hunter kill					Non-hunting kill[c]								
	M	F	(%)[1]	Unk	Total	M	F	Unk	M	(%)	F	(%)	Unk	Total
1987-88														
Fall 87	3	3	(50)	0	6	0	0	0	3	(50)	3	(50)	0	6
Spring 88	2	0	(0)	0	2	0	0	0	2	(100)	0	(0)	0	2
Total	5	3	(36)	0	8	0	0	0	5	(63)	3	(37)	0	8
1988-89														
Fall 88	5	0	(0)	0	5	1	0	0	6	(100)	0	(0)	0	6
Spring 89	1	0	(0)	0	1	0	0	0	1	(100)	0	(0)	0	1
Total	6	0	(0)	0	6	1	0	0	7	(100)	0	(0)	0	7
1989-90														
Fall 89	1	1	(50)	0	2	1	0	0	2	(67)	1	(33)	0	3
Spring 90	0	0	(0)	0	0	0	1	0	0	(0)	1	(100)	0	1
Total	1	1	(50)	0	2	1	1	0	2	(50)	2	(50)	0	4
1990-91														
Fall 90	3	1	(25)	0	4	0	0	0	3	(75)	1	(25)	0	4
Spring	2	0	(0)	0	2	0	0	0	2	(100)	0	(0)	0	2
Total	5	1	(20)	0	6	0	0	0	5	(80)	1	(20)	0	6
1991-92														
Fall 91	4	2	(30)	0	6	2	0	2	6	(75)	2	(25)	2	10
Spring 92	1	1	(50)	0	2	0	0	0	1	(50)	1	(50)	0	2
Total	5	3	(36)	0	8	2	0	2	7	(70)	3	(30)	2	12

[a] Note whether permit hunt harvest is included or excluded

[b] Includes Defense of Life or Property kills, research mortalities, and other known human-caused accidental mortality

Table 7. Subunit 25A brown bear harvest data by permit hunt, 1987-92.

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males	Females	Unk	Total harvest
Fall hunts	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
(283,284,	1988/89	32	n/a	48	52	9	2	0	11
285)	1989/90	n/a	n/a	n/a	n/a	n/a	n/a	10	10
	1990/91	14	43	14	43	5	1	0	6
	1991/92	11	36	9	54	4	2	0	6
Spring	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
hunts	1988/89	n/a	n/a	n/a	n/a	0	0	0	0
(292,293,	1989/90	n/a	100	0	0	0	0	0	0
294)	1990/91	0	n/a	0	0	0	0	0	0
	1991/92	3	33	0	66	2	0	0	2
Totals for	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
all permit	1988/89	n/a	n/a	n/a	n/a	9	2	0	11
hunts	1989/90	n/a	n/a	n/a	n/a	n/a	n/a	10	10
	1990/91	14	n/a	n/a	n/a	5	1	0	6
	1991/92	14	36	7	57	6	2	0	8

Table 8. Subunit 26B brown bear harvest data by permit hunt, 1987-92.

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males	Females	Unk	Total harvest
Fall hunts	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
(288)	1988/89	n/a	n/a	1	3	1	2	0	3
	1989/90	n/a	n/a	n/a	n/a	n/a	n/a	4	4
	1990/91	6	33	0	66	1	2	1	4
	1991/92	6	33	0	66	4	0	0	4
Spring	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
hunts	1988/89	n/a	n/a	n/a	n/a	3	0	0	3
(297)	1989/90	n/a	n/a	n/a	n/a	0	0	3	3
	1990/91	4	0	0	100	4	0	0	4
	1991/92	4	25	0	75	3	0	0	3
Totals for	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
all permit	1988/89	n/a	n/a	n/a	n/a	4	2	0	6
hunts	1989/90	n/a	n/a	n/a	n/a	n/a	n/a	7	7
	1990/91	10	20	0	80	5	2	1	8
	1991/92	10	30	0	70	7	0	0	7

Table 9. Subunit 26C brown bear harvest data by permit hunt, 1987-92.

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males	Females	Unk	Total harvest
Fall hunts	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
(289,290)	1988/89					2	0	0	2
	1989/90					0	0	2	2
	1990/91	3				1	0	0	1
	1991/92	6				3	0	0	3
Spring	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
hunts	1988/89		0	0	100	1	0	0	1
(280,298)	1989/90	0	0	0	0	0	0	0	0
	1990/91	2	0	0	100	2	0	0	2
	1991/92	1	0	0	0	0	0	0	0
Totals for	1987/88	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
all permit	1988/89	n/a	n/a	n/a	n/a	3	0	0	3
hunts	1989/90	n/a	n/a	n/a	n/a	0	0	2	2
	1990/91	5	n/a	n/a	n/a	3	0	0	3
	1991/92	7	n/a	n/a	n/a	3	0	0	3

Table 10. Subunit 25A brown bear successful hunter[a] residency, 1985-92.

Regulatory Year	Local[b] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1985/86	1	(11)	2	(22)	6	(67)	8
1986/87	0	(0)	6	(50)	6	(50)	12
1987/88	0	(0)	3	(23)	10	(77)	13
1988/89	1	(5)	8	(38)	12	(57)	21
1989/90	1	(8)	2	(17)	9	(75)	12
1990/91	2	(14)	6	(43)	6	(43)	14
1991/92	1	(7)	4	(27)	10	(67)	15

[a] Note whether hunters in permit hunts are excluded
[b] Includes only residents of the subunit

Table 11. Subunit 25B and 25D brown bear successful hunter[a] residency, 1985-92.

Regulatory Year	Local[b] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1985/86	0	(0)	0	(0)	2	(100)	2
1986/87	0	(0)	1	(25)	3	(75)	4
1987/88	0	(0)	2	(40)	3	(60)	5
1988/89	1	(25)	0	(0)	3	(75)	4
1989/90	1	(20)	1	(20)	3	(60)	5
1990/91	1	(20)	3	(60)	1	(20)	5
1991/92	0	(0)	0	(0)	2	(100)	2

[a] Note whether hunters in permit hunts are excluded
[b] Includes only residents of the subunit

Table 12. Subunit 26B brown bear successful hunter[a] residency, 1985-92.

Regulatory Year	Local[b] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1985/86	0	(0)	0	(0)	6	(100)	6
1986/87	0	(0)	2	(40)	3	(60)	5
1987/88	0	(0)	6	(46)	7	(54)	13
1988/89	0	(0)	4	(44)	5	(56)	9
1989/90	0	(0)	7	(47)	8	(53)	15
1990/91	0	(0)	4	(33)	8	(66)	12
1991/92	0	(0)	10	(59)	7	(41)	17

[a] Note whether hunters in permit hunts are excluded
[b] Includes only residents of the subunit

Table 13. Subunit 26C brown bear successful hunter[a] residency, 1985-92.

Regulatory Year	Local[b] resident	(%)	Nonlocal resident	(%)	Nonresident	(%)	Total successful hunters
1985/86	0	(0)	4	(66)	2	(33)	6
1986/87	0	(0)	6	(66)	3	(33)	9
1987/88	0	(0)	5	(63)	3	(37)	8
1988/89	0	(0)	3	(50)	3	(50)	6
1989/90	0	(0)	0	(0)	2	(100)	2
1990/91	0	(0)	3	(50)	3	(50)	6
1991/92	0	(0)	4	(50)	4	(50)	8

[a] Excludes hunts requiring permits
[b] Includes only residents of the subunit

LOCATION

Game Management Subunit: 26A (56,000 mi^2)

Geographical Description: Western North Slope

BACKGROUND

Densities of brown/grizzly bears vary widely in Subunit 26A, with densities highest in the foothills of the Brooks Range and lowest in the northern portion of the unit. Bear populations were reduced during the 1960s by hunting, but are currently stable or slowly increasing. Interest in hunting bears has remained high in Subunit 26A. Unreported harvest has been, and continues to be, a significant problem affecting bear management.

MANAGEMENT DIRECTION

Grizzly bear management objectives established for Subunit 26A are to: 1) maintain a grizzly bear population of approximately 900 bears or greater; 2) maintain a harvest success rate of least 60%; and 3) minimize adverse interactions between grizzly bears and the public.

METHODS

We conducted a census in a study area in the Utukok and Kokolik drainages in Subunit 26A West (west of 159° longitude) during June 1992 using a mark-recapture technique with radio-collared bears functioning as the "marked" animals. This census was part of a radiotelemetry study in the southern portion of Subunit 26A which has been underway for many years, and results were reported in previous research progress reports (Reynolds 1983, 1984, and 1989). We compiled harvest data from sealing certificates to determine the number of bears harvested, locations of take, and the sex and age composition of bears harvested.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The current population estimate for bears in Subunit 26A is 900-1,120 bears (Reynolds 1989). Four hundred bears are estimated in Subunit 26A West and 500-720 are estimated in Subunit 26A East (Table 1). This represents a substantial increase from the pre-1987 population estimate of 645-780 bears.

Bear populations in the Brooks Range apparently declined during the 1960s due to guiding activity (Reynolds, pers. com.), and have been recovering since permit hunts were instituted during the 1977-78 regulatory year (Trent 1988). Bear densities appear to be at high levels relative to carrying capacity of the habitat.

Population Composition: The most recent population composition and productivity data are available from Reynolds (1984) for the western portion of the unit in the Utukok and Kokolik drainages. The sex ratio for bears older than 1 year was approximately 40 males:60 females; for cubs and yearlings it was approximately 50:50, but may have slightly favored females.

Age composition was as follows: cubs-of-the-year, 13%; yearlings, 10%; 2-year-olds, 14%; 3- and 4-year-olds, 11%; and bears over 5 years, 52%. Mean age at first reproduction was 8.0 years, mean litter size was 2.0 cubs, mean reproductive interval was 4.0 years, and mean productivity was 0.5 cubs/year.

Distribution and Movements: We estimate the density of bears at 1.0 bears/100 mi^2 in the northern part of Subunit 26A West and 5.0 bears/100 mi^2 in the southern portion of Subunit 26A West. In Subunit 26A East, the density is estimated at 0.3 bears/100 mi^2 in the coastal plain and 2.2 to 3.3 bears/100 mi^2 in the mountainous southern region (Reynolds 1989).

A census was conducted in a study area encompassing the Utukok and Kokolik drainages in Subunit 26A West during June of 1992, and a mean density of 7.7 bears/100 mi^2 was calculated. The 95% confidence interval is 7.3 to 8.2 bears/100 mi^2 (Reynolds, pers. commun.).

Mortality

Harvest:

Season and Bag Limit.

Subunit 26A		
Subsistence/ Resident Hunters: One bear every 4 regulatory years	Subsistence/ Resident Season Sept. 1-May 31	Nonresident Season
Nonresident Hunters: One bear every 4 regulatory years by drawing permit only. Up to 12 permits may be		Sept. 1- May 20

issued in Unit 26A East
and 22 permits in Unit
26A West.

Human-induced Harvest: We sealed 32 bears during 1990-91. One bear was killed in a DLP incident, and hunters harvested the remainder. Sixteen bears were killed in Subunit 26A West and 16 in Subunit 26A East (Table 1). Twenty-four bears were males and 8 were females (Table 2).

We sealed 34 bears during 1991-92. One bear was killed in a DLP incident. Thirteen bears were killed in Subunit 26A West and 21 in Subunit 26A East (Table 1). Twenty-eight bears were males and 5 were females (Table 2).

The 1990-91 and 1991-92 reported harvest of 32 and 34 bears, respectively, is higher than any previous year (Table 2). This coincides with an increase in the number of permits available to nonresident hunters, and in 1990-91 nonresident hunters accounted for most of the increase in bears taken. However, in 1991-92 most of the increase was attributable to nonlocal residents (Table 5).

At least 5 bears in 1990-91 and 8 bears in 1991-92 harvested by North Slope residents were unreported; actual harvests were at least 37 and 42 bears. Additional unreported bears may have been taken by resident and guided nonresident hunters (Table 2).

For bears harvested during 1990-91, the mean skull size for males was 21.1 inches and 19.5 inches for females; the mean age was 10.1 years for males and 7.8 years for females. During 1991-92, the mean skull size for males was 20.0 inches and 19.9 inches for females; the mean age was 7.9 years for males and 16.6 years for females (Table 3).

Permit Hunts: Bears were harvested under 4 nonresident permit hunts in Subunit 26A. Hunts 286 and 295 are for Subunit 26A East, and Hunts 287 and 296 are for Subunit 26A West. The seasons for all permit hunts in Subunit 26A are the same (1 Sept.-20 May), but drawings are held for Hunts 295 and 296 during December, so they are in effect spring hunts. The number of hunters, success rate, and number and sex of animals harvested during the permit hunts are summarized in Table 4.

Hunter Residency and Success: Of the 31 bears sealed in Subunit 26A during 1990-91, 21 were harvested by nonresidents, 9 by nonlocal Alaska residents, and 1 by a North Slope resident. During 1991-92, 16 of 33 bears were harvested by nonresidents, 15 by nonlocal Alaska residents, and 2 by North Slope residents (Table 5). Nonresident success rate was 81% during 1990-91, and 95% during 1991-92 (Table 4). No data on success rates are available for resident hunters.

Harvest Chronology: During 1990-91 one bear was harvested in August, 18 in September, 1 in October, 1 in April, and 10 in May. In 1991-92 25 bears were harvested during September, 2 during October, 3 during April, and 3 during May (Table 6).

Transport Methods: Most bear hunters continued to use aircraft as transportation in Subunit 26A. During 1990-91 aircraft were used for transportation by 26 hunters, ORVs by 3 hunters, and 2 were unknown. Thirty hunters used aircraft during 1991-92, 2 used snowmachines, and 1 was unknown (Table 7).

Natural Mortality

No recent estimate of natural mortality for grizzly bears in Subunit 26A is available. However, Reynolds and Hechtel (1983) reported mortality rates among offspring accompanied by marked adult females in the western Brooks Range to be 44% for cubs, 9% for yearlings, and 14% for 2-year-olds from 1977-81.

Habitat

Assessment: Most of the brown bear habitat in Subunit 26A remains undisturbed and supports a fairly large and growing population of bears. It would be difficult to evaluate many of the food sources for brown bears in Subunit 26A, such as herbivorous forage and ground squirrels. At least seasonally, however, increasing numbers of caribou and a stable population of moose represent a large food resource available to bears.

Potential hazards to brown bear habitat include oil and mineral exploration and development. Exploration is currently underway in Subunit 26A, including areas within the foothills on the north side of the Brooks Mountain Range.

Some areas in Subunit 26A, particularly some east/west oriented ridges, are used more heavily than the surrounding area by brown bears for at least part of the year. An attempt should be made to catalogue as many of these areas as possible. These areas should be considered critical habitat for brown bears, and given special protection in the future.

Board of Game Action and Emergency Orders

Regulations changed considerably after the 1989-90 season. During 1989-90 there was a fall season of 1 September - 31 October for all hunters. A spring season was held 10 May - 31 May for residents and nonresidents, and 1 April - 31 May for subsistence hunters (Anaktuvuk Pass residents only). Anaktuvuk Pass residents were also allowed to harvest a bear every regulatory year.

Beginning with the 1990-91 season, subsistence hunters were not differentiated from resident hunters, and both groups had a season from 1 September - 31 May and were allowed 1 bear every 4 years. The nonresident season was 1 September - 20 May.

Nonresidents were still required to obtain a drawing permit. The quota of nonresident drawing permits was increased from 8 to 12 in Subunit 26A East, and remained at 22 for Subunit 26A West.

CONCLUSIONS AND RECOMMENDATIONS

The 1990-91 and 1991-92 reported harvest of 32 and 34 bears is higher than any previous year. However, if we assume that safe harvest limits should not exceed 4% of the population, the allowable sustained yield is approximately 36-47 bears, and the reported harvest was within this limit both years. The known harvest was 37 bears for 1990-91 and 42 bears for 1991-92 (includes reported harvests and known unreported harvests), and the 4% harvest limit was not exceeded in either Subunit 26A East or Subunit 26A West. Hunters and pilots have also reported seeing increasing numbers of bears in Subunit 26A in recent years. Therefore, we recommend no regulatory changes at this time.

Oil and mineral exploration and development are potential hazards to brown bear habitat. Reynolds (pers. com.) has stated that some areas, particularly some east/west oriented ridges, have very high brown bear densities. We should attempt to locate as many of these critical habitat areas as possible and catalogue them so they can be given special protection during upcoming mineral exploration and development projects.

A significant management problem in Subunit 26A has been non-reporting of bear harvest and non-compliance with bear hunting regulations. In an effort to better accommodate rural hunting practices, the Board of Game established the Northwest Alaska Brown Bear Management Area along with more liberal bear hunting regulations during 1992. This hunt was designed for people who hunt bears for meat, and does not require a bear tag or for the bear to be sealed. Meat must be retrieved, but the hide and skull need not. In order to prevent trophy hunters from taking advantage of these relaxed requirements, it is illegal to transport the hide from the management area unless the trophy value has been destroyed. In addition, aircraft cannot be used in any way during the hunt. Hopefully, this new set of hunting regulations will improve harvest reporting and compliance.

One problem not addressed by the above regulatory system is that obtaining accurate harvest information still depends upon hunters buying licenses. Many local hunters do not buy hunting licenses or report their harvest. To obtain more accurate harvest information, a system of collecting harvest information from North Slope residents that is separate from the licensing system needs to be developed.

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Survey-Inventory Coordinator

Table 1. Reported harvest of grizzly bears in Subunit 26A, 1985-92.

Unit	Estimated population size	Harvest of 4%	Reported harvest							
			1985	1986	1987	1988	1988-89[a]	1989-90[a]	1990-91	1991-92
26A West	400	16	3	5	15	11	25	12[b]	16	13[b]
26A East	500-720	20-29	7	13	11	10	6	14	16[b]	21
Total	900-1,180	36-47	10	18	26	21	31	26	32	34

[a] Based on regulatory year. All other years are based on calendar year.
[b] Includes a DLP-killed bear.

Table 2. Subunit 26A brown bear harvest[a], 1985-92.

Regulatory year	Reported: Hunter kill M	(%)	F	(%)	Unk.	Non-hunting kill[b] Total reported	Estimated kill Unreported illegal	Total Estimated kill
1985								
Fall 85	3	42.9	4	57.1				
Spring 86	2	40.0	3	60.0				
Total	5	41.7	7	58.3	2	14	5- 7	19-21
1986								
Fall 86	10	76.9	3	23.1				
Spring 87	6	85.7	1	14.3				
Total	16	80.0	4	20.0		20	8-11	28-31
1987								
Fall 87	11	57.9	8	42.1				
Spring 88	2	66.7	1	33.3				
Total	13	59.1	9	40.9		22	8-12	30-34
1988								
Fall 88	12	70.6	5	29.4				
Spring 89	11	78.6	3	21.4				
Total	23	74.0	8	26.0		31	12-17	43-48
1989	10	47.4	9	47.4	1			
Fall 89	7	100.0	0	0				
Spring 90								
Total	17			9	1	27	8-13	34-39

Table 2. (cont'd.).

Regulatory year	Reported: Hunter kill M	(%)	F	(%)	Unk.	Non-hunting kill[b] Total reported	Estimated kill Unreported illegal	Total Estimated kill
1990								
Fall 90	15	(75)	5	(25)			1	5-8 37-40
Spring 91	8	(75)	3	(27)				
Total	23	(74)	8	(26)		32		
1991								
Fall 91	22		5			1	1	
Spring 92	6	(100)	0					
Total	28		5				34	5-8 39-42

[a] Permit hunt harvest included.

[b] Includes DLP kills, research mortalities, and other known human-caused accidental mortality.

Table 3. Subunit 26A brown bear skull size and age, 1985-91.

Year	Mean skull size				Mean age			
	Male	n	Female	n	Male	n	Female	n
1985	20.6	5	20.2	5	8.8	5	10.3	5
1986	20.9	10	19.2	5	8.2	12	4.6	5
1987	22.5	16	20.0	9	11.1	16	11.9	9
1988	22.0	14	19.9	6	11.2	13	9.2	6
1989	21.5	17	19.7	8	9.8	16	11.7	9
1990	21.1	22	19.5	8	10.1	22	7.8	8
1991	20.0	28	19.9	5	7.9	25	16.6	4

Table 4. Subunit 26A brown bear harvest data by permit hunt, 1988-92.

Hunt no. /area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males (%)	Females (%)	Unk.	Total harvest
Fall									
291/293	1988-89	21	8 (38)	1 (8)	12 (92)	8 (67)	4 (33)		12
286/287	1989-90	21	7 (33)	4 (29)	10 (71)	7 (70)	3 (30)		10
Spring									
292/294	1988-89	9	1 (11)	0	8 (100)	7 (88)	1 (12)		8
295/296	1989-90	9	3 (33)	3 (50)	3 (50)	3 (100)	0		3
Totals for all permit hunts	1988-89	30	9 (30)	1	20 (95)	15 (75)	5 (25)		20
	1989-90	30	10 (33)	7 (35)	13 (65)	10 (77)	3 (23)		13
Fall									
286	1990-91	8	1 (13)	2 (29)	5 (71)	2 (40)	3 (62)		5
287		11	0	3 (27)	8 (73)	7 (88)	1 (12)		8
295		4	0	0 (0)	1 (100)	1 (100)	0 (0)		1
296		7	1 (14)	0 (0)	7 (100)	4 (57)	3 (43)		7
Total		28	2 (7)	5 (19)	21 (81)	14 (67)	7 (33)		21
286 East	1991-92	8	0	0	0 (0)	8 (100)	7 (88)	0	8
287 West		11	2 (18)	1 (11)	8 (89)	6 (75)	1 (13)	1 (13)	8
295 East Winter		2	1 (50)	0 (0)	1 (100)	1 (100)	0	0	1
296 West Winter		1	0	0 (0)	1 (100)	1 (100)	0	0	1
Total		22	3 (14)	1 (5)	18 (95)	15 (83)	1 (16)	2 (11)	18

Table 5. Subunit 26A brown bear successful hunter[a] residency, 1985-92.

Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Unknown	Total successful hunters
1985-86	2	7	2	1	12
1986-87	0	8	12		20
1987-88	1	8	13		22
1988-89	1	10	20		31
1989-90	2	12	13		27
1990-91	1	9	21		31
1991-92	2	15	16		33

[a] Hunters in permit hunts are included.
[b] Local means North Slope residents.

Table 6. Subunit 26A brown bear harvest chronology percent by time period, 1985-92.

Regulatory year	Harvest periods							n
	August	September	October	November	April	May	June	
1985-86		6	1	0	0	5		12
1986-87		13	0	0	0	7	0	20
1987-88		19	0	0	0	3	0	22
1988-89		17	0	0	0	14	0	31
1989-90	1[a]	18	1	0	0	7	0	27
1990-91	1	18	1	0	1	10	0	31
1991-92	0	25	2	0	3	3	0	33

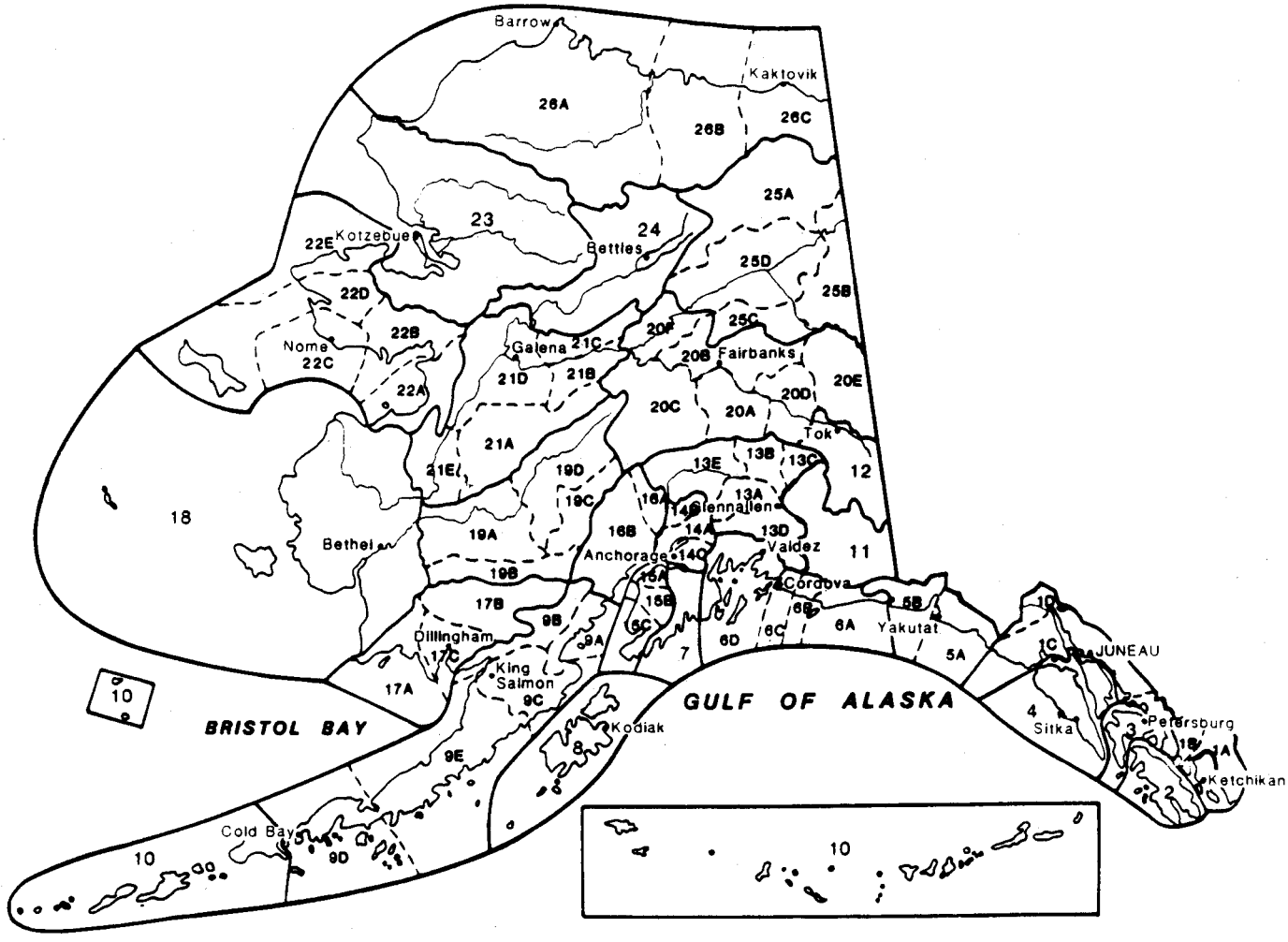
[a] DLP kill.

Table 7. Subunit 26A brown bear harvest[a] percent by transport method, 1985-92.

Regulatory year	Percent of harvest							n
	Airplane	Horse	Boat	Snowmachine	ORV	Walk	Unknown	
1985-86	7 (50)	2 (14)		3 (22)		1(7)	1 (7)	14
1986-87	19 (95)				1 (5)			20
1987-88	20 (92)			1 (4)	1 (4)			22
1988-89	27 (87)		3 (10)		1 (3)			31
1989-90	21 (81)		3 (11)	1 (4)	1 (4)		1 (4)	27
1990-91	26 (84)				3 (10)		2 (6)	31
1991-92	30 (91)			2 (6)			1 (33)	

[a] Permit harvest hunt is included.

Alaska's Game Management Units



Federal Aid in Wildlife Restoration

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.