Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Management Report
Survey-Inventory Activities
1 July 1996 - 30 June 1998

MUSKOX

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Grants W-24-5 and W-27-1
Study 16.0
December 1999

STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
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LOCATION

GAME MANAGEMENT UNIT: 18 (41,159 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon–Kuskokwim Delta

BACKGROUND

Muskoxen were once widely distributed in northern and western Alaska but were extirpated by the middle or late 1800s. In 1929, with the support of the Alaska Territorial Legislature, the US Congress initiated a program to reintroduce muskoxen in Alaska. Thirty-one muskoxen were introduced from Greenland to Nunivak Island in Unit 18 during 1935–1936, as a first step toward reintroducing this species to Alaska. The Nunivak Island population grew slowly until approximately 1958, and then began a period of rapid growth. The first hunting season was opened in 1975, and the population has since fluctuated between 400 and 750 animals, exhibiting considerable reproductive potential even under heavy harvest regimes. Low natural mortality and absence of predators benefit the Nunivak muskox population, which had approximately 550 animals in spring 1998.

During 1967–1968, 23 subadult muskoxen were translocated from Nunivak Island to Nelson Island, 20 miles across Etolin Strait. The Nelson Island muskox population exhibited an average annual growth rate of 22% between 1968 and 1981. The first hunting season was opened in 1981 when the population approached the management goal of 200–250 animals. For approximately 10 years the Nelson Island muskox population remained stable, providing emigration to the mainland and stable harvests.

A census of Nelson Island muskoxen, completed in March 1994, showed a skewed population structure of 142 animals (too many adult bulls), with low calf numbers and poor herd growth. Since the population was below the management goal, meetings were held with the United Villages of Nelson Island (UVNI) to discuss a temporary elimination of annual harvests to promote herd growth. The department closed hunting seasons during 1995 and 1996 in an attempt to balance the sex ratio and to increase the number of mature cows in the population. After a period with no harvest, the Nelson Island muskox population rapidly recovered (Table 2).

Fewer than 100 muskoxen inhabit the mainland of the Yukon–Kuskokwim Delta, having originally emigrated from Nelson Island. Mainland muskoxen are widely distributed in small groups from the mouth of the Kuskokwim to the Andreafsky Mountains north of the Yukon River. During surveys of other species, agency biologists and aircraft pilots have observed muskoxen. However, the mainland population has not become firmly established. Poaching is sporadically reported and is probably a main factor preventing the mainland population from becoming established. Also, wandering muskoxen may actually return to Nelson Island when tidal inlets freeze. This behavior complicates muskox management for Nelson Island and makes it difficult to determine the size of the mainland population.

MANAGEMENT DIRECTION

The following management goals and objectives have been established for muskox in Unit 18:

- Maintain a posthunt population of approximately 250 muskoxen on Nelson Island and approximately 500–550 muskoxen on Nunivak Island.
- Survey populations on Nunivak Island using aerial and ground survey methods in cooperation with the US Fish and Wildlife Service (FWS) to estimate population size and composition.
- Survey populations on Nelson Island with helicopters and fixed-wing aircraft to estimate population size and composition.
- Issue drawing and registration permits for hunter harvest of muskoxen to maintain optimal size, composition, and productivity of the populations on Nunivak and Nelson Islands.
- Provide hunter orientation and checkout to ensure that hunters understand permit requirements, do not misidentify the animals they are permitted to harvest, and report sex, age, and location of harvested animals.
- Determine the distribution and dispersal of muskoxen on the mainland.
- Deploy and maintain up to 5 radio collars on mainland muskoxen to monitor population status and dispersal.
- Finalize a cooperative muskox management plan for Nunivak Island and Nelson Island, respectively.
- Participate in an interagency effort to finalize a reindeer–muskox management plan for Nunivak Island and verify that the goals and objectives are being implemented.

METHODS

During 25–28 August 1997 and 3–6 August 1998 a Bell Jet Ranger helicopter was used to survey total numbers and composition of muskox populations on Nelson and Nunivak Islands. Muskoxen were classified as yearlings, 2-year-old males and females, 3-year-old males and females, 4-year-old and older males and females, or unclassified. Note that the terminology describing these cohorts is somewhat unorthodox and is explained by the history of muskox surveys. Previously, we did composition counts only by snowmachines in late winter. The youngest cohort was called "short yearling" or "yearling" while the next older cohort was nearly 2 years old; members of the second cohort were called 2-year-olds and so forth for older cohorts. As surveys were completed earlier and earlier in the year, the older terminology was retained, but the actual age of animals in the age classes for the current, midsummer surveys is about 6 months younger than the named classes.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Throughout the reporting period the Nunivak Island muskox population remained healthy and productive. In previous years notable numbers of muskoxen have been occasionally lost through standing on ice floes or small offshore islands, but during the reporting period only a few animals were lost on offshore islands. The reproductive ability of the Nunivak Island population has been sufficient to recover quickly from these losses. As the population declines and recovers, harvest rates are adjusted accordingly (Table 1).

The Nelson Island muskox population remained stable from 1981 to 1986 at approximately 250 muskoxen during years of light to moderate snow accumulation (Table 2). The herd provided a nucleus for emigration to the mainland while sustaining high annual harvests during this period. Total muskox numbers declined on Nelson Island during the 1991–1992 regulatory year, following a 10-year period of stability with harvest rates approaching 15% (Tables 2 and 3). We used reduced harvest rates, selective harvest of bulls, and cessation of harvest during 1995 and 1996 to reverse the decline in numbers on Nelson Island. The 1994 population was approximately 65 animals below the management goal of 250 muskoxen. The herd began to recover after the 1995 calving season in response to cessation of harvest. The herd had recovered sufficiently by 1996 to resume harvests in spring 1997. The conservative harvests of 1997 and 1998 and the strong potential for recovery of the Nelson Island population will allow an increase in the number of permits for hunts in the future (Table 2).

Mainland muskoxen are descendants of the 23 muskoxen introduced to Nelson Island during 1967–1968 and have been sighted elsewhere in Unit 18 since then. The population has increased very slowly from an estimated 40 animals in 1984. Groups near Dall Lake and in the Askinuk Mountains near Cape Romanzof produced calves, but it is not known if those populations still exist. Muskoxen have been sporadically reported from most upland areas such as Kusilvak Mountain between the Yukon and Kuskokwim Rivers and from a few areas north of the Yukon River.

Population Size

During a helicopter survey of Nunivak Island conducted on 26–28 August 1997, we counted 594 animals in 112 groups. This was nearly a complete survey of the island. However, we may have missed small groups of muskoxen. The postcalving population was above the population management goal of 500–550, yet there is no evidence that habitats are being stressed by the population.

During the 3–5 August 1998 helicopter survey of Nunivak Island, we counted 634 animals in 119 groups. This, too, was nearly a complete survey of the island. While the intent was to survey the entire island, poor weather and the loss of a portion of our fuel to residents eager to salvage our fuel drums prevented us from finishing the survey. Again, the postcalving population was above the population management goal of 500–550. However, there is still no evidence that habitat is being stressed by the large population.

The Nelson Island muskox population continued its recovery from a decline that began in 1991. No registration permits were issued for Nelson Island muskoxen during the spring of 1995 or 1996. After surveys indicated recovering populations in 1995 and 1996 (Table 2), limited hunts were resumed in 1997. During the 25 August 1997 helicopter survey of Nelson Island, we found 265 animals in 36 groups. The following year on 6 August 1998, we counted 293 animals in 29 groups during a helicopter survey of Nelson Island.

We do not have sufficient survey information to accurately estimate the population of mainland muskoxen. Incidental observations indicate the population is widely dispersed and may be as high as 100 animals. Some muskoxen probably return to Nelson Island from the mainland, confounding census data for both areas. We believe the most likely locations for mainland muskox to become established are the relatively isolated western slopes of the Askinuk Mountains south of the mouth of the Yukon River. The physical features of the Askinuk Mountains resemble those on Nelson Island.

Population Composition

The composition of the Nunivak Island muskoxen population is available from the helicopter census conducted during 26–28 August 1997. We classified 594 muskoxen observed in 112 groups, ranging in size from 1 to 18 animals. We counted 139 adult males (4+ years old), 162 adult females (4+ years old), 43 3-year-old males, 43 3-year-old females, 42 2-year-old males, 46 2-year-old females, and 119 yearlings (Table 4).

Another helicopter census was conducted on Nunivak Island during 3–5 August 1998. We classified 634 muskoxen observed in 119 groups, ranging in size from 1 to 28 animals. We counted 164 adult males (4+ years old), 147 adult females (4+ years old), 45 3-year-old males, 55 3-year-old females, 50 2-year-old males, 75 2-year-old females, and 98 yearlings. This represents counts from all but 1 of 15 survey areas (Table 5).

The postcalving Nelson Island muskox population was determined during a helicopter survey on 25 August 1997. We classified 265 muskoxen observed in 36 groups, ranging in size from 1 to 30 animals. We counted 30 adult males (4+ years old), 72 adult females (4+ years old), 16 3-year-old males, 17 3-year-old females, 30 2-year-old males, 30 2-year-old females, and 70 yearlings (Table 6).

Another similar Nelson Island muskox population survey was conducted on 6 August 1998. We classified 293 muskoxen observed in 29 groups, ranging in size from 1 to 26 animals. We counted 34 adult males (4+ years old), 66 adult females (4+ years old), 32 3-year-old males, 34 3-year-old females, 27 2-year-old males, 32 2-year-old females, and 68 yearlings (Table 7). Note that mortality rates for all age and sex classes were low and reproduction rates were high. Thus, the Nelson Island muskox population has again exhibited the ability to grow rapidly.

We do not have composition information for mainland muskoxen.

Distribution and Movements

On Nunivak Island, muskoxen were uniformly distributed throughout the island in coastal and interior areas during aerial surveys completed in August. Muskoxen use wind-blown, *Elymus*-covered dunes in southern Nunivak after late winter snow accumulates on the remainder of the island. In summer they disperse throughout the interior of the island.

Typically, Nelson Island muskoxen are concentrated on the cliffs near Cape Vancouver and on the hills northeast of Tununak, although some individuals and small herds scatter on the hills in the central portion of the island and along the escarpment above Nightmute.

Muskoxen are not confined to Nelson Island. Local residents, pilots, and biologists have reported numerous sightings of mainland muskoxen since the late 1960s. These reports continued during this reporting period. Both male and female muskoxen often move to the mainland by crossing frozen tidal inlets during the months from November to May. Although some individuals remain on the mainland, others return to Nelson Island. The muskoxen movements between the island and the mainland across weakened tidal ice during spring and fall expose the muskoxen to drowning. These wanderings to and from the island explain some of the annual fluctuations in the size of the muskox population on Nelson Island.

The range of mainland muskoxen currently extends southeast to the mouth of the Kuskokwim River, northeast to the Portage Lakes-Hills area near Lower Kalskag, and northwest into the Andreafsky Mountains. The animals exhibit a general habitat preference for upland tundra and riparian corridors. Solitary old males are usually the first muskoxen to be seen in new areas.

Although the population is small, the amount of range expansion and long-range movements of mainland muskoxen has been remarkable. A 4-year-old female that was probably born on Nelson Island was collared on the mainland as a 3-year-old on 30 March 1989 south of the Yukon River near Pilot Station. By August 1989 this animal moved approximately 160 miles east to a location near the village of Lower Kalskag north of the Kuskokwim River. It was subsequently shot by a hunter on 24 March 1990 near Toksook Bay on Nelson Island, approximately 200 miles west of its last known location.

Department and FWS staff radiocollared 5 muskoxen (2 bulls and 3 cows) from herds of 9 and 12 animals south of the Yukon River between Bethel and Pilot Station in March 1989. Six yearlings were present in these herds. The collared animals have since died, but these animals had ranged westward to Pilot Station and Dall Lake and eastward to Kalskag and the upper Johnson River. No additional radio collars have been deployed during the reporting period. Radiotracking should be used to better understand the population size, distribution, and movements of mainland muskoxen.

MORTALITY

Harvest

Season and Bag Limit.

Unit and Bag Limit	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Nunivak Island Resident and Nonresident Hunters: 1 bull by drawing permit only. Up to 10 permits will be issued for the fall season and up to 35 permits will be issued for the spring season; or 1 cow by registration permit only. Forty-five cow permits (up to 5 in the fall and up to 40 in the spring) will be issued on a first-come, first-served basis.	1 Sep–30 Sep 1 Feb–15 Mar	1 Sep–30 Sep 1 Feb–15 Mar
Unit 18, Nelson Island Resident and Nonresident Hunters: 1 muskox by registration permit only. Up to 30 permits will be issued on a first-come, first-served basis.	1 Feb–25 Mar	1 Feb–25 Mar
Remainder of Unit 18	No open season	No open season

Board of Game Actions and Emergency Orders. In spring 1989 the Board of Game (board) gave ADF&G the discretionary power to issue up to 45 bull and 45 cow permits on Nunivak Island. For the 1996–1997 regulatory year, the department staff offered 5 cow and 5 bull permits for Nunivak Island muskox for the fall hunt and 25 cow and 20 bull permits for the spring hunt. During the 1997–1998 regulatory year, 5 cow and 5 bull permits were offered for the fall hunt, and 25 cow and 21 bull permits were offered for the spring. The odd number of bull permits offered was due to an administrative error during processing of a drawing permit application.

During its spring 1992 meeting, the board gave the department the discretionary authority to issue up to 30 muskox permits on Nelson Island. The old regulation required that we issue 15 bull and 15 cow permits annually. The new regulation allows adjustment of harvest levels for

each sex to compensate for changes in population size and composition. This harvest adjustment was first implemented during the spring hunt in 1993 when 30 bull-only permits were issued. No permits for Nelson Island muskoxen were issued in 1995 or 1996. However, during this reporting period, harvests have resumed with 10 bull and 10 cow permits offered during both the 1996–1997 and 1997–1998 seasons.

Human-Induced Mortality. Hunting of Nunivak Island muskoxen was regulated by both drawing permits and registration permits for fall and spring hunts for both years in the reporting period. In general, permits for hunting Nunivak Island bulls are distributed through the statewide drawing permit process. When drawing permit winners decline to hunt and have not been issued a permit, a replacement permittee is selected from the spring list of permit applicants. During this reporting period, all drawing hunt winners elected to hunt. These hunters usually hire local guides or transporters, and during this reporting period all were successful. The 1996–1997 harvest from drawing permits included 5 bulls in the fall and 20 in the spring. The 1997–1998 harvest from drawing permits included 5 bulls in the fall and 21 in the spring (Table 1).

In general, registration permits for hunting Nunivak Island cows are distributed on a first-come, first-served basis. There were 5 permits available in Bethel for the fall hunt, 5 more for the spring hunt, and 20 permits available in Mekoryuk for the spring hunt during the 1996–1997 and 1997–1998 seasons. All these hunters were successful except that 1 spring cow hunter mistakenly shot a bull.

On Nelson Island, the allocation of first-come, first-served registration permits rotates through the local villages in order from Newtok to Tooksok Bay to Tununak to Nightmute to Chefornak. In 1996–1997 10 bull and 10 cow permits were distributed in Newtok, while in 1997–1998 10 bull and 10 cow permits were distributed in Tooksok Bay. All hunters were successful except 3 cow permit recipients in 1996–1997.

Harvest Chronology. Most cow hunters on Nunivak Island took their muskoxen between late February and mid-March during periods of increasing daylight hours and milder weather. Bull hunters on Nunivak Island usually hunted with guides or transporters and scheduled hunts before the season.

Hunter Residency and Success. Most drawing permittees for Nunivak Island bulls were residents of Alaska. Success rates were 100% for 1996–1997 and 1997–1998. All cow hunters who actually hunted were successful. Only 3 Newtok residents in spring 1997 failed to hunt because of poor weather.

The local Native Corporation privately holds nearly all the land for the Nelson Island hunt, and nonshareholders must obtain permission to enter these lands. Almost all hunters are from local villages.

Transport Methods. Hunters used boats for the fall hunt on Nunivak Island and snowmachines for late winter hunts on Nunivak Island and Nelson Island.

Natural Mortality

Little quantitative information is available concerning natural mortality of muskoxen in Unit 18. No large predators (i.e., bears and wolves) inhabit Nunivak Island, and they are rare or nonexistent on Nelson Island and the Delta lowland. Most natural mortalities are the results of accidents such as falling off cliffs, breaking through ice of lakes and tidal streams, freezing in place while sleeping, and stranding on drifting sea ice. During this reporting period, there was little natural mortality.

HABITAT

Assessment

In the 3 main areas within Unit 18, habitat conditions vary from overgrazed to excellent, and use of these habitats by muskoxen differs. The Nunivak Island lichen range is considered overgrazed by reindeer, yet muskoxen harvested in recent years were reported to be in very good condition. The rapid recovery of the Nelson Island population over the past 5 years indicates the muskox range on the island is in good condition (Table 2). On the mainland, habitat available to muskoxen is considered excellent but little used. The potential exists for a much larger unitwide population.

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak Herd is characterized by high productivity and low natural mortality. Harvest of bulls and cows should be reduced when the posthunt, precalving population is below 550 animals. With the existing population, high harvest levels are warranted.

The department has received requests from the village of Mekoryuk for cooperative management authority. Because legislation is required for change of statutes, this request lies outside of the discretion of the department.

Muskoxen are still considered a priority species on Nunivak Island, but possible overgrazing of the lichen range by reindeer and erosion of the dune areas have become concerns on this unique refuge. The management plan goals for muskox populations on Nunivak Island include maintaining a minimum population of 500–550 muskoxen, translocating muskoxen to other areas of Alaska, and providing opportunities to hunt muskoxen.

Fluctuations in the observed size of the Nelson Island population are influenced by snow and ice conditions and the availability of escape terrain and forage. The Nelson Island population is not confined to the island because animals can cross frozen tidal inlets to the mainland from November to May. The Nelson Island muskox population continues to provide stable harvests.

Variable annual harvests are needed to effectively manage the herd in response to emigration and other natural losses. While the population is at or below 250 animals, we recommend harvesting variable numbers of cows and bulls at a rate not exceeding 10% of the population to maintain healthy age and sex components in the population. Harvest should be increased if the population increases above the management goal of 250 animals. Appropriate management actions for

Nelson Island muskoxen need to be considered in consultation with, and support from, local hunters.

Before this reporting period, mainland muskoxen in Unit 18 were reported to have increased in numbers and extended their range. While sporadic reports of mainland muskoxen continue, illegal take of these animals is a key factor in preventing establishment of a reproductively viable population. Fewer than 100 muskoxen are thought to inhabit the extensive areas of mainland habitat. While the mainland situation is bleak, there is still the potential for a population to become established, particularly with the concern and cooperation shown by villagers from Nelson Island and the Nelson Island herd's continued growth.

A comprehensive information and education program explaining the benefits of a larger muskox population on the mainland of Unit 18 should be prepared for the benefit of local residents. We may want to pursue a cooperative collaring project with the Yukon Delta National Wildlife Refuge and village councils to develop an educational program that encourages local residents to foster the establishment of a viable, harvestable mainland muskox population.

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Table 1 Unit 18 harvest of Nunivak Island muskox, 1975–1998

Year	Males	Females	Unknown	Total
1975	10	0		10
1976	68	3		71
1977	58	2		60
1978	40	0		40
1979	24	0		24
1980	10	11		21
1981	12	50		62
1982	13	49	1	63
1983	24	35		59
1984	22	36		58
1985	19	42		61
1986	31	43		74
1987	32	34		66
1988	35	35		70
1989	36	33		69
1990	39	31		70
1991	40	31		71
1992	45	31		76
1993	45+2[a]	25+1[b]		73
1994[c]	34+1[d]	23		58
1995	20	5		25
1996	20	19		39
1997	25	24		49
1998	26	30		56
Total	731	593	1	1325

[a] Two adult bulls found dead.

[b] One 2.5-year-old cow killed accidentally.

[c] Harvest was reduced during the 1993–1994 season in response to population decline.

[d] One mature bull taken by mistake by a cow hunter.

Table 2 Unit 18 Nelson Island muskoxen population, 1973–1998

Year	No hunting/precalving	Prehunt/precalving	Posthunt/precalving
1973	44		
1975	66		
1977	132		
1978	107		
1980	167		
1981		265	245
1982		217	190
1983		230	206
1984		200	176
1985		225	195
1986		287	263
1987		180	150
1988		213	183
1989		234	205
1990		239	208
1991		232	207
1992		214	182
1993		198	168
1994		149	123
1995	217		
1996	233		
1997	265		
1998	293		

Table 3 Unit 18 permits and hunting harvest of Nelson Island muskoxen, 1981–1998

	Number of Permits available		Muskox harvested		Number of
Year	Female	Male	Female	Male	Applicants
1981	20	0	20	0	129
1982	30	0	19	8	34
1983	0	25	0	25	37
1984	15	15	9	14	33
1985	15	15	14	16	33
1986	15	15	14	10	50+
1987	15	15	14	16	34
1988	15	15	15	15	30
1989	15	15	15	14	30
1990	15	15	14	15(+2[a])	58
1991	15	15	10	14(+1[a])	34
1992	15	15	15(+2[a])	15	30
1993	0	30	0	30	37
1994	5	25	5(+1[a])	21	31
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	10	10	7	10	20
1998	10	10	10	10	20

[a] Number of muskoxen found dead from wounding.

Table 4 Unit 18 composition of Nunivak Island muskoxen, August 1997

Age[a]	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	139	23%	162	27%			301	51%
3 years	43	7%	43	7%			86	14%
2 years	42	7%	46	8%			88	15%
Yearlings					119	20%	119	20%
Total	224	38%	251	42%	119	20%	594	100%

[a]Previous surveys were conducted in the spring when the youngest cohort was called "short yearling." As surveys were conducted earlier in the season, the old terminology was retained. The actual age of these cohorts is about six months younger than given.

Table 5 Unit 18 composition of Nunivak Island muskoxen, August 1998

Age[a]	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	164	26%	147	23%			311	49%
3 years	45	7%	55	9%			100	16%
2 years	50	8%	75	12%			125	20%
Yearlings					98	15%	98	15%
Total	259	41%	277	44%	98	15%	634	100%

[a] Previous surveys were conducted in the spring when the youngest cohort was called "short yearling." As surveys were conducted earlier in the season, the old terminology was retained. The actual age of these cohorts is about six months younger than given.

Table 6 Unit 18 composition of Nelson Island muskoxen, August 1997

Age[a]	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	30	11%	72	27%			102	38%
3 years	16	6%	17	6%			33	12%
2 years	30	11%	30	11%			60	23%
Yearlings					70	26%	70	26%
Total	76	29%	119	45%	70	26%	265	100%

[a] Previous surveys were conducted in the spring when the youngest cohort was called "short yearling." As surveys were conducted earlier in the season, the old terminology was retained. The actual age of these cohorts is about six months younger than given.

Table 7 Unit 18 composition of Nelson Island muskoxen, August 1998

Age[a]	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	34	12%	66	23%			100	34%
3 years	32	11%	34	12%			66	23%
2 years	27	9%	32	11%			59	20%
Yearlings					68	23%	68	23%
Total	93	32%	132	45%	68	23%	293	100%

[a] Previous surveys were conducted in the spring when the youngest cohort was called "short yearling." As surveys were conducted earlier in the season, the old terminology was retained. The actual age of these cohorts is about six months younger than given.

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi^2) and southwest portion of 23 (1920 mi^2)

GEOGRAPHIC DESCRIPTION: Seward Peninsula and that portion of the Nulato Hills draining west into Norton Sound

BACKGROUND

Historical accounts indicate muskoxen disappeared from Alaska by the late 1800s and may have disappeared from the Seward Peninsula hundreds of years earlier. In 1970 36 muskoxen were reintroduced to the southern portion of the Seward Peninsula from Nunivak Island. An additional 35 muskoxen from the Nunivak Island herd were translocated to the existing population in 1981 (Machida 1997). Since 1970 the population has grown an average of 14% annually and in March 1998 was estimated at 1432 animals.

Muskoxen have extended their range to occupy suitable habitat throughout the Seward Peninsula. Herds are well established in Units 22C, 22D, 22E and southwestern Unit 23. Movement has begun into Units 22B, the northern portion of 22A, the Nulato Hills, and the Buckland valley.

MANAGEMENT DIRECTION

Muskox management on the Seward Peninsula is guided by recommendations from the Seward Peninsula Muskox Cooperators Group. The group comprises staff from the department, National Park Service (NPS), US Bureau of Land Management (BLM), US Fish and Wildlife Service (FWS), Bering Straits Native Corporation, Kawerak Inc., Reindeer Herders Association, Northwest Alaska Native Association, residents of Seward Peninsula communities, and representatives from other interested groups or organizations. The following management goals form the basis of a cooperative interagency management plan for Seward Peninsula muskoxen developed during 1992 through 1994 (Nelson 1994) and follow the guidelines of the departmental Muskox Management Policies (ADF&G 1980).

MANAGEMENT GOALS

- Allow for continued growth and range expansion of the Seward Peninsula muskox population
- Provide for a limited harvest in a manner consistent with existing state and federal laws by following the goals/objectives endorsed by the Seward Peninsula Muskox Cooperators Group and the Seward Peninsula Cooperative Muskox Management Plan
- Manage muskoxen along the Nome road systems of Units 22B and 22C for viewing, education, and other nonconsumptive uses
- Work with local reindeer herding interests to minimize conflicts between reindeer and muskoxen

- Protect and maintain the habitats and other components of the ecosystem upon which muskoxen depend

- Encourage cooperation and sharing of information among agencies and users of the resource in developing and executing management and research programs

MANAGEMENT OBJECTIVES

- Complete censuses at 2-year intervals to document changes in population and distribution

- Participate in the Muskox Cooperators Group meetings and facilitate exchange of information and ideas between agencies and user groups

- Encourage establishment of a state-managed hunt in Units 22D, 22E, and 23SW (the portion of Unit 23 west of and including the Buckland River drainage) that will increase opportunity for participation, meet the needs of subsistence hunters, and distribute the harvest over a larger area than occurs under the federal hunt

METHODS

A Seward Peninsula muskox census was completed 10–13 March 1998 in Units 22B, 22C, 22D, 22E and 23SW. Staff from the department, NPS, BLM, FWS, Fish and Wildlife Protection and volunteer observers from Unit 22 villages participated in the census. The area was divided into 18 survey units, which were thoroughly searched by survey aircraft. A minimum count of muskoxen in the census area was obtained using the total coverage/direct count census method used in previous surveys. When muskoxen were located, we made a visual count, noted the number of short yearlings, and recorded GPS coordinates.

Sightings of muskoxen by the public continued to provide a valuable source of information on distribution and migration of muskoxen, particularly in Units 22A and 22B where muskox range is still significantly increasing.

The department helped organize and participated in a Muskox Cooperators Group meeting, held in Nome 21–23 January 1998. Department and NPS staff organized and facilitated village meetings in Units 22D, 22E, and 23SW to formulate hunt recommendations for the Board of Game and Federal Subsistence Board.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During the cooperative census completed in March 1998, 1432 muskoxen were counted in 108 groups in Units 22B, 22C, 22D, 22E and 23 (Table 1 and Fig 1). Since 1970, when muskoxen were reintroduced to the Seward Peninsula, population growth has averaged 14% annually (Fig 2). This growth rate is higher than rates described for populations further north and is

considered a minimum estimate because it does not include muskoxen missed during the censuses.

The 1998 estimate is a 51% increase over the 951 animals counted in the 1996 census (Table 2). This can be attributed largely to poor census conditions in 1996 rather than to a dramatic increase in population size. Snow conditions in 1996 were poor in many areas. The 1996 census was conducted over a 6-week period, during which time movement of animals in and out of areas already censused may have compromised accuracy of the census. The 1998 census was completed in 4 days, with excellent snow conditions.

Before 1998 we censused only the portion of Unit 22B west of and including the Darby Mountains. Despite the larger area covered in 1998, the census shows a decrease in the number of animals in Unit 22B (Table 2). This contradicts staff observations and reports from unit residents that indicate an increasing population in Unit 22B. Observations of bulls only groups, generally the first to populate new range, are becoming more frequent and widespread in Unit 22B and mixed age/sex groups are known to inhabit the Darby Mountains and the Granite Mountain and Traverse Peak areas.

The primary reason fewer muskoxen were counted in Unit 22B during the 1998 census is probably because some groups straddle the boundaries between Units 22B, 22C, and 22D, and these groups may have been found in different units in different census years. Additionally, the 1998 census effort in Unit 22B was not as high as in the other units; wider flight paths were flown and forested areas were not thoroughly examined. Because of this, we missed and did not count groups in the subunit.

Population Composition

During the March 1998 census, an attempt was made to record the number of short yearlings in each group. Observations indicate that short yearlings comprised 11% of the population (Table 1). However, identification of yearlings in large, tightly grouped herds can be difficult from a fixed-wing aircraft so this figure may be an underestimated and should be viewed with caution.

Recruitment was highest in Units 22C (16%) and 22D (14%). In Unit 23SW short yearling recruitment was estimated at 11% and was twice as high as the recruitment in Units 22E (5%) and 22B (4%). It is not surprising that recruitment in Unit 22E is lower than in eastern units due to harsher conditions and longer winters at the western tip of the Seward Peninsula. The population in Unit 22B is still comprised largely of solitary bulls or bull only groups, typically the first animals to pioneer new habitat. However, several known mixed age/sex groups in Unit 22B were not seen during this census so the 4% recruitment is unrealistically low for this unit.

No other age or sex classification of Seward Peninsula muskoxen was completed during the reporting period.

Distribution and Movements

The Seward Peninsula muskox population continued to increase in number and extend its range during the reporting period. Reports of muskoxen east of the Seward Peninsula in the Nulato Hills and Selawik and Kobuk drainages are becoming more common. Figure 1 shows the distribution of muskoxen on the Seward Peninsula in March 1999 during the most recent census.

MORTALITY

Harvest

Season and Bag Limit. No state hunt was conducted during the reporting period because the Federal Subsistence Board allocated the entire 3% harvest quota recommended by the Muskox Cooperators Group to the federal subsistence hunt.

Hunting was allowed only during a federal subsistence season during the reporting period. Registration permits for 1 bull muskox were available to residents of Units 22D, 22E, and 23 through the Federal Subsistence Management program during the 1996–1997 and 1997–1998 regulatory years. Twenty-six federal permits were issued for the 1996–1997 regulatory year. During the 1997–1998 season, 23 federal permits were available, but only 21 were issued due to lack of interest in Brevig Mission and Teller. Hunters were required to take their muskoxen only on federal public lands in the unit in which they reside. The established federal season was 1 September–31 January. However, during both years the season was extended by Special Action until 15 March at the request of village hunters who had not been able to hunt due to poor weather and traveling conditions in the hunt areas.

Board of Game Actions. In October 1997 the Board of Game reached a positive finding for customary and traditional use of muskox on the Seward Peninsula. The Board asked the Seward Peninsula Muskox Cooperators Group to identify the harvest necessary to meet subsistence needs and to develop recommendations for a state hunt for consideration at the March 1998 board meeting.

The Muskox Cooperators Group met 21–23 January 1998 in Nome. A majority of cooperators supported continued population growth and range extension, a slightly increased harvest rate, and combined federal/state hunts in Units 22D, 22E, and Unit 23SW. Following the Cooperators meeting, ADF&G and NPS staff held teleconferences and meetings with the villages in the hunt areas of Teller, Brevig Mission, Wales, Shishmaref, Buckland and Deering. Each community estimated its subsistence need for muskox, recommended a harvest rate and an allocation of permits between the state and federal hunts, and submitted their recommendations to the Alaska Board of Game and the Federal Subsistence Board.

In March 1998 the board made the 'subsistence need' determination for Seward Peninsula muskoxen and set the number at 100 muskoxen. The harvestable surplus in the proposed hunt area was determined to be 64 muskoxen, based on the 1998 population estimates for each unit in the hunt area and a 5% harvest rate recommended by the Muskox Cooperators Group and area villages. State law requires implementation of Tier II subsistence regulations when subsistence need exceeds harvestable surplus. Therefore, Tier II subsistence hunts were established in a portion of Unit 22D (north and west of Grantley Harbor, Imuruk Basin, and the Pilgrim River

drainage), Unit 22E, and a portion of Unit 23 (west of and including the Buckland River drainage). As recommended by the villages in the hunt area and the Muskox Cooperators Group, State Tier II hunts were planned and implemented in combination with existing federal subsistence hunts for federally qualified subsistence users on federal public land. The season for all hunts was set from 1 August to 15 March with a bag limit of 1 bull. See Table 3 for the number and allocation of permits planned for the 1998–1999 season.

Human-Induced Mortality. Hunters harvested 16 muskoxen during the 1996–1997 federal subsistence season. Six muskoxen were harvested from Unit 22D, 7 from Unit 22E, and 3 from Unit 23. During the 1997–1998 season 8 animals were taken, 3 from Unit 22D and 5 from Unit 22E. The difficulty of accessing remote federal public lands from the villages, except for Shishmaref, prevented many hunters from filling their permits.

Natural Mortality

No meaningful measure of natural mortality of Seward Peninsula muskoxen was obtained during the reporting period. However, the winters of 1996–1997 and 1997–1998 were both unusually mild with minimal snow cover. Many herds were able to feed in the well-vegetated valleys and lowlands for most of the winter without being forced onto barren, wind-swept ridge tops to avoid deep snow.

Staff and the public reported a number of sightings of bears feeding on muskox carcasses. Although it is not known if bears were predators or scavengers in these cases, observations of bears killing muskoxen in the Deering area have been reported. Pat Reynolds, FWS biologist, noted that bears became increasingly successful at preying upon muskoxen after muskoxen were introduced into the Arctic National Wildlife Refuge (pers. commun.), and bears on the Seward Peninsula may be learning this behavior as well.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Conflicts with Humans and Wildlife

The majority of participants at the Muskox Cooperators Group meeting and other public meetings supported current management policies that encourage growth and muskox range extension on the Seward Peninsula. Since hunting has been allowed, more people have come to value muskoxen as a subsistence resource and negative attitudes toward muskoxen have decreased. However, a vocal minority favored capping or reducing the population. Resentment lingers over the reintroduction of muskoxen to the Seward Peninsula without consulting local people. Reindeer herders and some local subsistence hunters voice concern that muskoxen may compete with and displace reindeer, caribou, and moose. Subsistence gatherers complain that muskoxen compete with them for greens and trample traditional berry picking areas. Although there are no reports of anyone being harmed by muskoxen, their presence near villages, camps, and berry picking areas is often considered frightening. When threatened, muskoxen generally hold their ground rather than flee; this behavior contributes to people's dislike of them because it is sometimes impossible to drive them from areas where they are not wanted.

Muskox Viewing

The Unit 22 road system provides a unique opportunity to view muskoxen in their natural habitat. There are few places where wild muskoxen are so easily accessible, and wildlife enthusiasts, tourists, photographers, and cinematographers from around the world, as well as local residents, seek out and enjoy watching these unusual animals. The Muskox Cooperators Group identified muskox viewing as an important use of the resource and recommended that Unit 22C remain closed to hunting to allow for herd growth, minimal harassment, and easily accessible viewing opportunities for the public. At this time the southern portion of Unit 22D (south of Grantley Harbor, Imuruk Basin, and the Pilgrim River drainage) is also closed to hunting, which protects the muskoxen along the Teller road.

CONCLUSIONS AND RECOMMENDATIONS

The Seward Peninsula muskox population continued to grow at an average rate of 14% annually and to move into suitable habitat in Unit 22, southwestern Unit 23, and the Nulato Hills. As the herd increases in size, the number of animals emigrating eastward will likely increase.

During this reporting period the Federal Subsistence Board allocated the 3% harvest quota entirely to federal hunts in Units 22D, 22E, and 23SW. Thus, the harvest came from federal public lands, and hunting opportunity was limited to federally qualified subsistence users. The federal hunts proved to be largely impractical due to long distances between the villages and federal lands, difficult traveling conditions, and numerous muskoxen near the villages on state and private lands could not be hunted.

In October 1997 the Board of Game reached a positive finding for customary and traditional use of muskox on the Seward Peninsula, making a Tier II subsistence hunt a possible option. In spring 1998 the state and federal boards implemented recommendations developed through a lengthy public process and allocated 35 permits to State Tier II hunts and 29 permits to Federal Subsistence hunts in Units 22D, 22E, and 23SW. This arrangement will hopefully satisfy subsistence hunters, provide hunting opportunity to more people, and spread the harvest across a larger segment of the muskox population.

The boards increased the harvest rate from 3 to 5%. Since 1970 the population has grown an average of 14% annually so a 5% harvest rate is still conservative and should provide continued herd growth and range extension on the Seward Peninsula. The season was lengthened to run from 1 August–15 March.

Tourism and wildlife viewing interests are strongly opposed to hunting along the road system. Units 22B, 22C, and the portion of 22D south of Grantley Harbor, Imuruk Basin, and the Pilgrim River continue to be managed primarily for wildlife viewing and nonconsumptive uses. Unit 22B is also being managed for maximum population growth and range.

Now that the state is managing a Tier II subsistence hunt, the following activities are recommended to ensure that management activities meet the goals described in the Seward Peninsula Cooperative Muskox Management Plan:

- Complete population censuses at 2-year intervals
- Complete composition surveys at 2-year intervals
- Monitor effects of hunting on group size, composition, and movements in heavily hunted areas and along the road system in Unit 22D
- Provide public assistance with the Tier II application process
- Provide hunter orientations for permit winners

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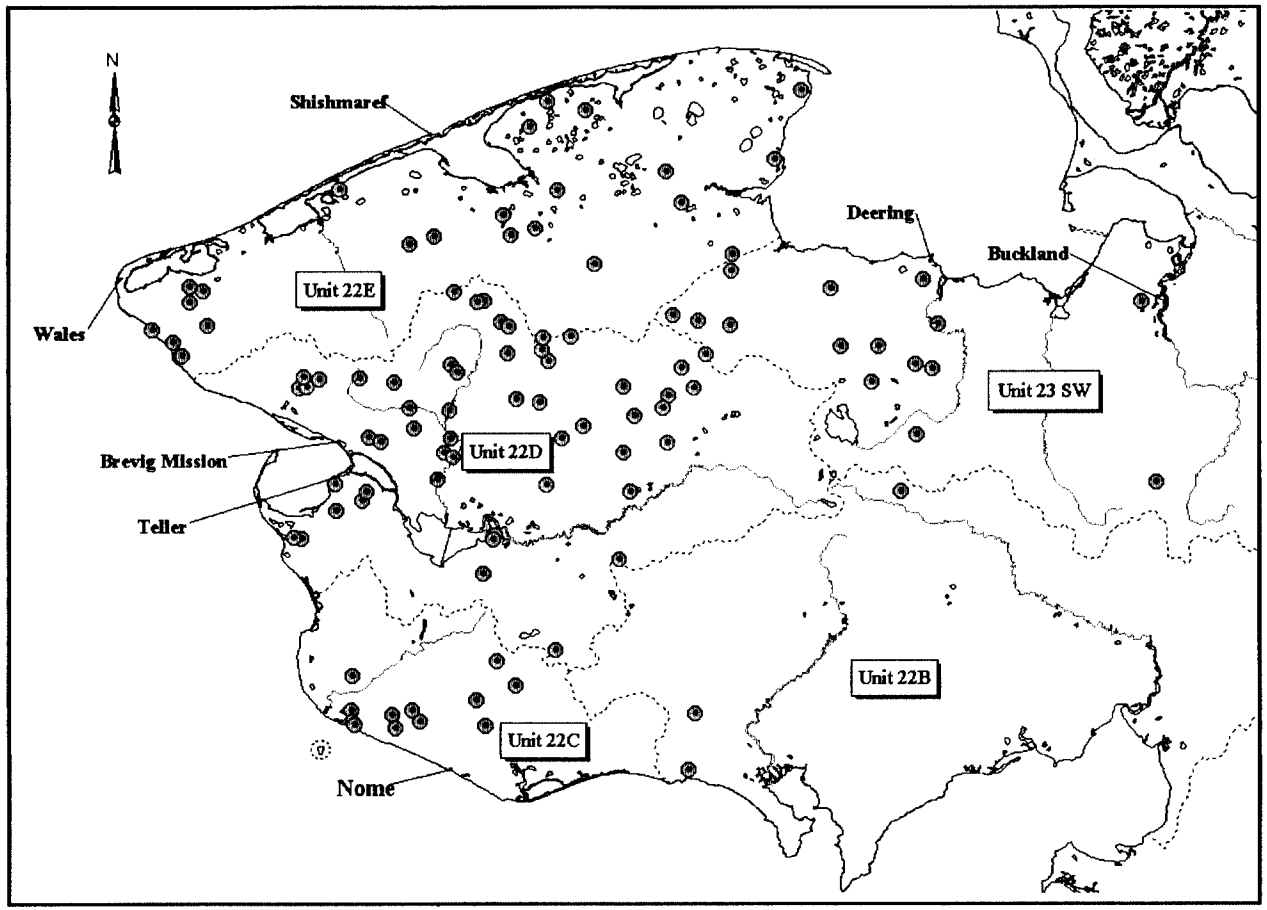

Figure 1 Location of Seward Peninsula muskox groups, March 1998 census

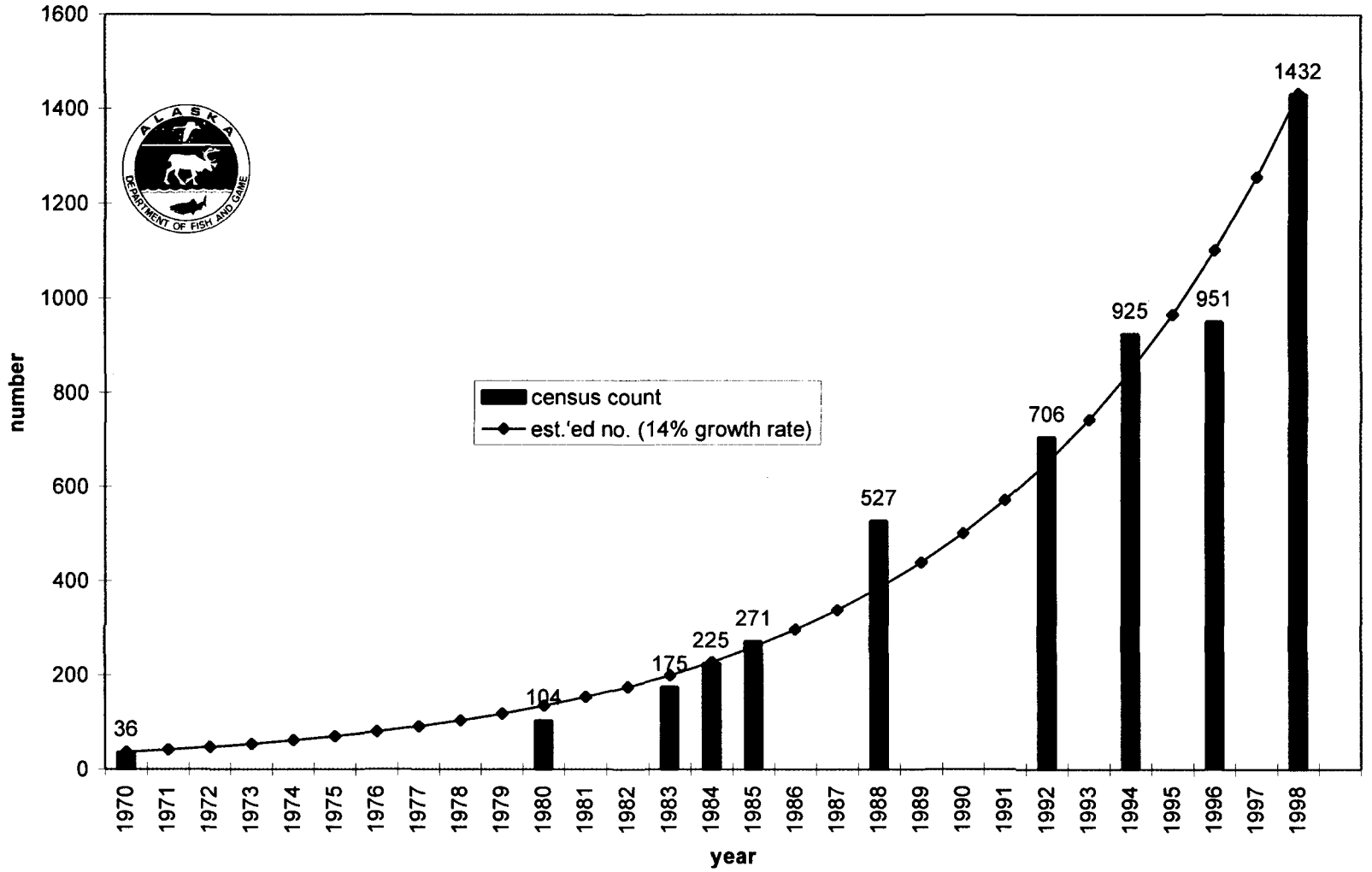

Figure 2 Estimated and counted number of Seward Peninsula muskoxen, 1970–1998

Table 1 Unit 22 (and portion of Unit 23) Seward Peninsula muskox census results, spring 1998

Unit	Groups	Adults	Yearlings	Total
22B	3	26	1	27
22C	12	104	20	124
22D	52	617	97	714
22E	25	343	19	362
23SW	16	182	23	205
Total	108	1272	160	1432

Table 2 Unit 22 Seward Peninsula muskox census results, 1992–1998

	Unit					
Year	22B	22C	22D	22E	23	Total
1992	3	49	340	180	134	706
1994	11	79	405	184	246	926
1996	51	87	308	327	178	951
1998	27	124	714	362	205	1432

Table 3 Unit 22 allocation of Seward Peninsula muskox permits for 1998–1999 season

Unit	State Tier II permits	Federal permits	Total permits
22D	24	12	36
22E	9	9	18
23	2	8	10
All Units	35	29	64

LOCATION

GAME MANAGEMENT UNIT: 23

GEOGRAPHIC DESCRIPTION: Kotzebue Sound and western Brooks Range

BACKGROUND

Muskoxen are indigenous to northwest Alaska; however, they disappeared before or during the nineteenth century for reasons unknown. The North Pacific whaling fleet is often credited with decimating muskox in this region. However, muskox may have already disappeared from Alaska (but not Canada) by the time whalers arrived. Although there is ample evidence of at least 2 genera of muskox (*Ovibos* and *Smybos*) in northwest Alaska from the Pleistocene period, there is little evidence that muskox existed south of the Brooks Range during the last several hundred years.

Two muskox populations currently inhabit Unit 23, and both resulted from translocations of Nunivak Island muskox. The department released 36 muskox on the southwestern portion of the Seward Peninsula near Teller in 1970. In 1981 an additional 35 muskox were released in the same area. Muskox inhabiting the portion of Unit 23 between the Buckland and Goodhope Rivers are part of the Seward Peninsula population resulting from these translocations. This population is covered in the 1999 Muskox Management Report for Unit 22 and the southwestern portion of Unit 23.

In 1970 the department also released 36 muskox near Cape Thompson in northwestern Unit 23. An additional 34 muskox were released at the same location in 1977. Of the 4 translocations of muskox from Nunivak Island to other portions of Alaska, this population has grown most slowly. Currently, the Cape Thompson population inhabits that portion of Unit 23 from the mouth of the Noatak River to Cape Lisburne within 15–20 miles of the Chukchi Sea. This management report covers only the Cape Thompson muskox population.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Allow for growth and expansion of Cape Thompson muskox into their historic ranges
- Eventually provide for subsistence and recreational hunting on a sustained yield basis
- Provide muskox for viewing and scientific study

MANAGEMENT OBJECTIVES

- To census the Cape Thompson population annually
- To monitor the sex and age composition of this muskox population at least biennially
- To determine if muskox displace caribou in this portion of Unit 23
- To monitor effects of industrial development, hunting, and tourism on muskox and their habitat

METHODS

We determined population size, status, and abundance of muskoxen through aerial censuses from fixed-wing aircraft. The census area included that portion of Unit 23 between the mouth of the Noatak River and Cape Lisburne within approximately 20 miles of the Chukchi Sea coast. Two censuses were conducted during the reporting period, one in June–early July 1997 and again during the same time period in 1998. Results of an additional census conducted June 1999 (after this reporting period) are also reported. Radiotelemetry was not employed to facilitate these censuses. Search effort during the censuses focused on known ranges and on potential muskox habitat, e.g. ridgelines and riparian areas. We searched all other areas less intensively. To minimize disturbance, groups of muskox were approached at 1000–2000 ft above ground level, then repeatedly counted during a gradual, low power, spiral descent. The 1998 and 1999 censuses were conducted cooperatively with the National Park Service (NPS).

In Unit 23, we have not systematically nor rigorously collected sex and age composition for muskox in this area. Occasionally, department staff has recorded opportunistic observations of group composition. Additionally, the NPS contracted a University of Alaska wildlife graduate student to collect composition data from ground-based observations on Cape Krusenstern National Monument during April 1999.

The locations of muskox groups observed during censuses were plotted on 1:250,000 US Geological Survey maps or recorded using Global Positioning System (GPS) latitude/longitude coordinates. While working on other projects, department staff observed many muskox groups and, using GPS coordinates, recorded the locations of these groups. In addition, casual conversations between department staff and local residents, commercial operators, hunters, and nonconsumptive users provided information regarding the distribution of muskox in Unit 23.

Radio collars were not deployed in this population during the reporting period. Therefore, we did not use radiotelemetry techniques to monitor muskox mortality in this portion of Unit 23. Additionally, there was no hunting season and no legal harvest for the Cape Thompson muskox population. Unreported and illegal harvest has occurred, and we have attempted to quantify this mortality.

The department did not monitor range condition for muskox in Unit 23 during the reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The Cape Thompson muskox population has grown approximately 8% annually since 1970 (Table 1, Fig 1). All of the population estimates for this portion of Unit 23 represent minimum counts because we almost certainly never achieve 100% sightability during the censuses. Nevertheless, these counts probably represent reasonably accurately temporal trends in abundance. The abundance of muskox in cohorts <4 years old indicates a small decline in total

number of adult muskox from 1998 to 1999. This probably resulted from missing animals during the 1999 census rather than an actual decline in abundance.

Population Composition

We classified 111 muskoxen during the composition surveys conducted from the ground during April 1999 (Table 2). For muskox ≥2 years old, the bull:cow ratio was 87:100 and the yearling:cow ratio was 48:100. Parturition was incomplete at the time of the surveys so we did not estimate initial production.

Distribution and Movements

Seasonal movements, range fidelity, and high use areas have been similar in recent years. Muskoxen in this area rarely venture >15 miles inland. This is probably because chronic and often strong coastal winds minimize snow depth on exposed ridges during winter and possibly lower ambient air temperature during summer. Although snow depth in this coastal region is minimal, the quantity and quality of winter forage is very limited. In contrast, food in this area during summer appears abundant. Unlike caribou, muskoxen appear virtually oblivious to insect harassment during summer. During warm summer days muskox frequently wade in rivers and lagoons, perhaps to aid thermoregulation.

During 1996–1997 most of the muskox that inhabited the Tahinichok Mountains, Rabbit Creek, and Jade Creek area shifted their center of habitation 15–30 miles southeast to the western portion of the Igichuk Hills. These muskoxen continued to use this area year-round during the reporting period.

As in past years, numerous sightings of small groups (1 or 2 individuals) of mature bulls occurred throughout the Noatak River drainage, across the western portion of Unit 26A, and in the Baird and De Long Mountains. The total number of dispersed bulls north of the Kobuk River probably totals <20–30 individuals. These bulls probably emigrated from the Cape Thompson population.

MORTALITY

Harvest

Season and Bag Limit. Muskox hunting was not allowed during the reporting period. As in past years, illegal harvest occurred during the reporting period. A mature bull and a 2-year-old bull appeared to have been shot and abandoned about 15 miles east of Point Hope in August 1996. Four adult muskox of unknown sex were shot and abandoned near Point Hope during July 1998.

Board of Game Actions and Emergency Orders. During October 1997 the Board of Game made a positive customary and traditional use finding for the Cape Thompson muskox population. However, it did not identify a level for subsistence need.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Conflicts Between Muskox and Reindeer or Caribou

Many local residents of northwest Alaska feel that muskox displace caribou through behavioral interactions and by the presence of muskox quiviut and feces in areas used by both species. Until this concern is adequately addressed, it will continue to impede management of muskox in northwest Alaska.

Conflicts Between Muskox and People

Many local residents resent the reintroduction of muskoxen to Unit 23. In addition to the perception that muskoxen displace caribou and reindeer from important hunting and herding areas, local residents feel threatened by muskoxen when picking berries during late summer, despite the fact that no one has ever been harmed by a muskox in this area (and perhaps Alaska). Local residents also resent they were not consulted before muskoxen were introduced to this unit. This negative local sentiment toward muskoxen seems to have diminished on the Seward Peninsula with the establishment of hunting opportunities.

During August and September when muskox are rutting, bulls sometimes wander into villages (even Kotzebue) and onto airport runways. In August 1997 a 3-year-old bull wandered into Deering and became cornered by kids and dogs in the middle of the village. Department staff immobilized the bull, loaded it into the bucket of a front-end loader, and transported it out of the community. In September 1998, using ATVs and 4-wheel drive vehicles, residents chased a bull away from the Kotzebue airport.

Proposed Harvest

With the establishment of muskox hunting on the Seward Peninsula, department staff began to receive an increasing number of requests to establish a hunting season for muskoxen between Capes Lisburne and Krusenstern. Department staff conducted public meetings in Noatak and Point Hope to assess local interest in hunting muskox; explain options for administering state and/or federal hunts in this area; inform the public about muskox biology, current population size and trend; and describe muskox hunts administered in other portions of the state. Residents of Kotzebue and Kivalina were transported to the Noatak meeting. At the Noatak meeting, people were equivocal about establishing a muskox hunt at this time but made it clear that if a hunt was established, the total harvest should be allocated to local subsistence hunters. In Point Hope people opposed establishing a hunt at that time out of concern that muskox meat may be contaminated by radionuclides from Project Chariot and out of fear that a hunt would attract sport hunters into their traditional subsistence hunting areas.

During summer 1998 federal subsistence staff conducted meetings in Point Hope, Kivalina, and Kotzebue. As in 1997, local residents were interested in hunting muskox but were not adamant that a hunt be established immediately. At the Kotzebue meeting, it was decided to hold a joint state–federal meeting to discuss muskox management in the northwest portion of Unit 23. This meeting was held in January 1999, and it was decided to submit companion proposals to the Board of Game and Federal Subsistence Board to establish cooperatively managed hunts in this area.

The proposals indicate a 1 August–15 March season, a 3% harvest rate (adult population), and bulls only harvest. The proposal to the board would be to establish a Tier II hunt.

Hunting should not extend beyond mid-March in order to protect pregnant cows from harassment incidental to the harvest of bulls for at least 1 month before calving. Cows are particularly vulnerable to harassment at this time because they endure high energetic costs of birth and lactation when their fat reserves are lowest.

CONCLUSIONS AND RECOMMENDATIONS

Two distinct populations of muskoxen inhabit Unit 23. One population ranges between Cape Lisburne and Cape Krusenstern within 15–20 miles of the coast. The other population is part of the Seward Peninsula muskox population and ranges between the Buckland and Goodhope River drainages. Both populations stem from translocations initiated by the department in 1970. The Cape Thompson population grew approximately 8% annually since 1970.

Muskoxen exhibit strong fidelity to seasonal ranges. This characteristic is most pronounced for large mixed sex/age groups, which makes them particularly vulnerable to repeated harassment from hunters. Muskox will even vacate areas of ample food to winter on exposed, sparsely vegetated domes and ridges where snow depth is minimal. Muskoxen rely on body-fat reserves and use extremely conservative behavior to survive in desolate areas through winter.

Muskoxen are vulnerable to human harvests. They are easy to find and normally do not flee when approached. The greater effects of harvests may not be the loss of individuals from hunting but the repeated harassment of large mixed sex/age groups as hunters approach them. The strong negative energy balance that muskoxen use to endure winter conditions probably reduces their ability to flee from hunting harassment. Also, muskoxen defensive behavior predisposes them to wounding losses when bullets inadvertently pass through 1 individual and into another. This raises several recommendations regarding muskox hunting in Unit 23:

- Muskox harvests in Unit 23 should be conservative until the department can assess effects of harvest on the population.
- Harvest should not extend beyond mid-March to avoid disturbances from hunters to female muskoxen during calving.
- Hunters should be encouraged to focus on bull groups.
- State and federal agencies should cooperatively manage hunts in this portion of Unit 23.

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Table 1 Unit 23 muskox census results for the northwest portion of the unit, 1988–1999

	May 1988	June 1994	March 1997	June 1997	June 1998	June 1999
Groups	14	19	24	26	39	34
Adults[a]	106	215	291	212	322	299
Calves[b]	17	18		49	65	75
Total	123	233	291	261	387	374

[a] "Adult" defined as any muskox >12 months old.
[b] "Calf" defined as any muskox 1–2 months old.

Table 2 Unit 23 sex and age composition of muskox on Cape Krusenstern National Monument, April 1999 (National Park Service, unpublished data)

Age	Males	Females	Unknown
4+ years	24	29	0
3 years	6	8	0
2 years	10	9	0
1 year	0	0	22
neonate	0	0	3

LOCATION

GAME MANAGEMENT UNITS: 26B and 26C (26,000 mi^2)

GEOGRAPHIC DESCRIPTION: Central and Eastern Arctic Slope

BACKGROUND

Muskox populations in Alaska declined or, in some areas, disappeared before firearms were widely available. The last records of muskoxen in Alaska involved the taking of groups or individuals with firearms in the late 1800s or early 1900s. Hunting by humans before the availability of firearms appears to have been an important factor in their disappearance (Lent 1998). Muskoxen were reintroduced to the eastern North Slope in 1969 and 1970 when 51 animals were released on Barter Island and 13 were released at Kavik River, respectively. These animals were transplanted from Nunivak Island. The number of muskoxen increased steadily during the 1970s, 1980s, and early 1990s, and recently has become stable. At least 700 muskoxen now inhabit the eastern North Slope of Alaska and northwestern Canada. Small numbers of bulls have been harvested annually in Unit 26C since 1983 and in Unit 26B since 1990. The history of muskoxen in northeastern Alaska was reviewed by Gunn (1982), Garner and Reynolds (1986), Golden (1989), and Lent (1998).

Efforts to address concerns by North Slope residents about possible interactions between muskoxen and caribou and the future management of muskoxen resulted in a management planning process on the North Slope. We initiated this process in April 1996. Participants included the Alaska Department of Fish and Game (ADF&G), the North Slope Borough, affected federal agencies, and local villages. The North Slope Muskox Harvest Plan was developed and all agencies, including ADF&G, signed the plan in February 1999.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Reestablish muskoxen throughout their historic range in Alaska
- Provide the opportunity to hunt, view, photograph, and enjoy muskoxen

MANAGEMENT OBJECTIVES

- Manage harvest below sustained yield to encourage population growth and dispersal of muskoxen
- Maintain a bull:cow ratio of at least 50:100 and an adult bull (>3 years):cow (>2 years) ratio of 35:100
- Maintain direct communication with local residents in Nuiqsut, Kaktovik, and Barrow about management decisions concerning the reintroduction, conservation, and hunting of muskoxen

METHODS

POPULATION SIZE AND COMPOSITION

ADF&G and US Fish and Wildlife Service (FWS) biologists cooperated to collect population data. To obtain a minimum count of muskoxen, we conducted precalving surveys in early April by flying transects and/or drainages in Units 26B and 26C using a Cessna 185. Whenever possible, 2 observers were in the back and 1 was in the front of the aircraft. Bright, sunny days provided the best survey conditions. Transects were flown at approximately 90 mph at 500–1000 ft above ground level, depending on visibility. In Unit 26B, east of the Dalton Highway (Unit 26B East) and in Unit 26C, we surveyed major drainages and some of the smaller tributaries and bluffs adjacent to them. In Unit 26B, west of the Dalton Highway (Unit 26B West), 6-mile long transects oriented north/south were distributed from 70°N to 69°15'N. In April 1999 transects extended further south to 69°N, and transects were also flown in the area approximately halfway between the Itkillik and Colville Rivers. Systematic surveys were not done in Unit 26B West until March 1997. In addition to flying transects, we tracked radiocollared females to facilitate locating groups of muskoxen. A survey in Unit 26C was not completed in spring 1999 due to poor weather.

We conducted ground-based composition counts in Units 26B and 26C in late June or early July. We located groups of muskoxen by fixed-wing aircraft, helicopter, and radiotracking. We classified animals as >4 years old, as 3 years old, 2 years old, yearling, calf, and as male or female. We conducted a *t*-test on population data and differences were considered significant at the $\alpha = 0.05$ level.

During 1994–1995 through 1998–1999, approximately 10 radiocollared adult females were monitored to facilitate locating muskoxen for precalving surveys and composition counts. In April 1999, ADF&G deployed radio collars on 12 adult (3+ years) female muskoxen in 11 groups. These groups were distributed between the Itkillik River and the Ivishak River in Unit 26B. We used an R44 helicopter to locate muskoxen and determined if there were adult females in the group. We dropped off 1 person while pilot and gunner darted a female muskox. After determining that the immobilizing dart had stricken the muskox, the helicopter pilot moved the aircraft away, and we waited 15 minutes before approaching the animal to determine if it was immobilized. If the muskox was facing into the sun, we repositioned her to face into the shade and covered her eyes with a blindfold. We removed the dart, applied neosporin to the wound, monitored temperature and respiration, and fitted a collar. We used 1.8 ml carfentanil citrate (Wildnil®, Wildlife Pharmaceuticals, Fort Collins, Colorado, USA) (concentration = 3 mg/ml), 0.15 ml xylazine hydrochloride (Anased®, Lloyd Laboratories, Shenandoah, Iowa, USA) (concentration = 100 mg/ml), and 2 cc propylene glycol in a 5 cc Cap-Chur® (Douglasville, Georgia, USA) dart propelled by green external charges. In some cases additional carfentanil was administered with a hand syringe. When the handling was completed, we reversed the effects of carfentanil citrate by administering 11 ml of naltrexone hydrochloride (Trexonil®, Wildlife Pharmaceuticals) (concentration = 50 mg/ml) or 100 mg naltrexone hydrochloride for each milligram of carfentanil citrate used in immobilizing the animal.

HARVEST

We monitored harvest and hunting effort based on harvest reports submitted by hunters. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY = 1 July–30 June).

We examined the population and harvest data by stratifying the area into 5 sections: Units 26B and 26C, Unit 26C, Unit 26B, Unit 26B West, and 26B East.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The number of muskoxen observed during precalving surveys in Units 26B and 26C increased during the late 1980s and early 1990s to 651 animals by RY 1994–1995 and subsequently may have stabilized or declined slightly (Table 1). The number of animals observed in April 1998 was 538 (no data are available for Unit 26C for April 1999). This decrease was perhaps due to animals emigrating to the Yukon Territory, missing groups of muskoxen during surveys, and/or a slower rate of increase because muskoxen may be approaching carrying capacity. However, analysis of the data to determine trend revealed no significant change over the past 10 years. The mean number of muskoxen observed (± 1 *s*) was 581 ± 62 during RY 1993–1994 through 1997–1998, not significantly different from 489 ± 44 observed during the 5 years before RY 1993–1994 ($P = 0.11$).

Muskoxen that were observed during precalving surveys in Unit 26B increased steadily during the 1980s and fluctuated during the 1990s. The number of animals observed in April 1999 was 237. The mean number of muskoxen observed (± 1 *s*) was 270 ± 45 during RY 1994–1995 through 1998–1999, which was not significantly different from 181 ± 43 observed during the 5 years before RY 1994–1995 ($P = 0.08$; Table 1). Although there was no significant difference ($\alpha = 0.05$), the mean number of muskoxen observed was higher during the past 5 years, indicating an increase. Factors that influenced the fluctuation during the 1990s were probably immigration into Unit 26B, lack of systematic precalving surveys in Unit 26B West until spring 1997, and emigration out of the area. Once systematic surveys were conducted in Unit 26B West, these fluctuations mostly were reflected in Unit 26B East, perhaps due to animals moving back and forth across the Canning River (Unit 26B and 26C boundary). Numbers in Unit 26B West were 79–96, thereby remaining relatively constant during RY 1996–1997 through 1998–1999.

Muskoxen observed in Unit 26C during precalving surveys stabilized around 320 during RY 1992–1993 through 1997–1998 (no data available for RY 1998–1999; Table 1). The mean number of muskoxen observed (±1 *s*) was 325 ± 5 during RY 1993–1994 through 1997–1998, which was not significantly different from 316 ± 30 observed during the 5 years before RY 1993–1994 ($P = 0.63$; Table 1). Although numbers seemed stable, there was immigration from Unit 26B and emigration into Unit 26B and the Yukon Territory.

Other factors that may have influenced the population were annual variation in weather affecting female body condition, calf survival, and yearling recruitment; adult calving on alternate years; and brown bears becoming more efficient predators on muskoxen (Pat Reynolds, pers. commun.).

Population Composition

Composition survey data for Units 26B and 26C combined indicated that calf production declined during RY 1994–1995 through 1998–1999 (Table 1). Mean percent calves (±1 *s*) was 13% ± 2% during RY 1994–1995 through 1998–1999, which was significantly lower than 18% ± 2% observed during the 5 years before RY 1994–1995 (P = 0.001). This difference was also observed in calves:100 females. Mean calves:100 females (±1 *s*) was 32 ± 6 during RY 1994–1995 through 1998–1999, significantly lower than 51 ± 8 observed during the 5 years before RY 1994–1995 (P = 0.002). A slower rate of increase (i.e., calf production) is expected as a growing population that is exploiting previously unused habitat approaches carrying capacity. In addition, yearling recruitment (mean percent yearlings ±1 *s*) was also significantly lower during RY 1994–1995 through 1998–1999 (P = 0.05; Table 1) than during the previous 5 years. The lower calf production and yearling recruitment occurred mostly in Unit 26C. Annual bull (>3 years):100 cow (>2 years) ratio was 36–61 during the past 5 years, and the overall bull:100 cows ratio was >50, indicating that there were adequate bulls to breed cows during RY 1994–1995 through 1998–1999.

In Unit 26B only, mean percent calves (±1 *s*) was 14% ± 4% during RY 1994–1995 through 1998–1999 and was not significantly different from 19% ± 3% observed during the 5 years before RY 1994–1995 (P = 0.22). Mean calves:100 females (±1 *s*) was 35 ± 12 during RY 1994–1995 through 1998–1999, which was not significantly different from 51 ± 10 observed during the 5 years prior to RY 1994–1995 (P = 0.17). Percent yearlings also was not significantly different ($\bar{x}$ ± 1 *s* = 13% ± 4%, $\bar{x}$ ± 1 *s* = 13% ± 5%, P = 0.75). Annual bull (>3 years):cow (>2 years) ratios were not significantly different between the 2 5-year periods (P = 0.72) and were 24–62 during RY 1994–1995 through 1998–1999.

In Unit 26C, mean percent calves (±1 *s*) was 12% ± 4% during RY 1994–1995 through 1998–1999 which was significantly lower than 17% ± 3% observed during the 5 years prior to RY 1994–1995 (P = 0.04). This difference was also observed in calves:100 females. Mean calves:100 females (±1 *s*) was 29 ± 12 during RY 1994–1995 through 1998–1999 which was significantly lower than 49 ± 5 observed during the 5 years before RY 1994–1995 (P = 0.03). Yearling recruitment (mean percent yearlings ±1 *s*) also was significantly lower during RY 1994–1995 through 1998–1999 (P = 0.009). During RY 1998–1999, both percent calves and percent yearlings were lower than the previous few years (7%, 8%; respectively) and the 5-year mean (12%, 11%; respectively). This did not occur in Unit 26B. One factor that may have affected yearling recruitment in Unit 26C is that brown bears there have become more efficient predators. Because muskoxen have not existed in Unit 26B as long as in Unit 26C, brown bears in Unit 26B may not be as efficient in predator behavior as those in Unit 26C. Calf production may also have been affected by habitat. Unit 26B probably has more habitat to exploit. Annual bull (>3 years):cow (>2 years) ratios were not significantly different between the 2 5-year periods (P = 0.40; Table 1) and ranged from 41–60 bulls:100 cows during RY 1994–1995 through 1998–1999.

Although calf production and yearling recruitment declined in Unit 26C and remained constant in Unit 26B when comparing 2 5-year periods, there was no significant difference in percent calves or percent yearlings between Units 26B and 26C during the past 5 years (RY 1994–1995 through RY 1998–1999; P = 0.29, P = 0.60; respectively; Table 1).

We suggest that the muskox population on the eastern North Slope has stabilized somewhat, although it may still be increasing slightly. Even though yearling recruitment declined in Unit26C, the mean percent yearlings observed was 11%, which may exceed or equal mortality rates in a long-lived species such as muskoxen. Mortality rates in adults probably were influenced by harvest, weather, and bear predation. Two factors that may have affected yearling recruitment were availability of winter forage (i.e., hard snow crust) and predation by brown bears. The lower calf production may be the result of a slower rate of increase because the population has grown and exploited the best available habitat. Calf productivity may be influenced more by availability and quality of summer and winter forage, females calving alternate years, poor weather during calving (i.e., cold, wind, and snow), and brown bear predation.

Distribution and Movements

Until recently, muskoxen in northeastern Alaska were primarily found in Unit 26C. Approximately 40% of the total population is now in Unit 26B. Muskoxen have also extended their range eastward into the Yukon. In March and April 1999, Canadian biologists estimated the total Yukon population at 135 muskoxen. Small numbers of muskoxen are also as far west as the Colville River in Unit 26A, and they may disperse even farther west in Unit 26A. A few bull muskox have recently been sighted at various locations near the Yukon River between Galena and Eagle. It is not known whether these animals originated from the eastern North Slope or the Seward Peninsula.

Muskoxen tend to form larger groups of 6–60 during the winter season and remain in one location for a long time. During summer they form smaller groups of 5–20 and move more.

Moderately long-range movements occurred during spring 1999 within Unit 26B. Approximately 50 muskoxen wintering and summering in the Itkillik Hills near Nuiqsut for the past 3 years left their group of 80–90 animals between July 1998 and March 1999 and traveled east to the Kuparuk River, approximately 32 miles. Seismic activity increased dramatically in the Itkillik Hills during summer 1998 and may have influenced this movement. However, a radiocollared female captured on the Kuparuk River in April 1999 was found near the Itkillik Hills on 9 June 1999. She may have been headed back to the Itkillik Hills group, although it is not known if she originally came from that group. Other interesting activity was the movement of a female captured and radiocollared on the Ivishak River in April 1999. She was found on Franklin Bluffs on 9 June 1999 (approximately 37 miles) with what appeared to be the Franklin Bluffs group. In late June, while trying to do composition counts, we could not locate the Franklin Bluffs group, and we did not hear this female's radio collar in the vicinity. However, she was located a couple days later on the Canning River with the Franklin Bluffs group (approximately 52 miles from Franklin Bluffs). In addition, a female that was captured from the Franklin Bluffs group in April 1999 was found on the coast in late June, having joined a different group (approximately 25 miles).

MORTALITY

Harvest

Seasons and Bag Limits.

Location/Regulatory year	Permits; Hunt type; Bag limit	Resident Open Season	Nonresident Open Season
Unit 26B			
1961–1962 through 1989–1990		No open season	No open season
1990–1991 through 1994–1995	2; Tier II; 1 bull	1–31 Oct; 1–31 Mar	No open season
Unit 26B, west of Dalton Hwy			
1995–1996	3; Tier II; 1 bull	1–31 Oct; 1–31 Mar	No open season
1996–1997 through 1997–1998	3; Tier II; 1 bull	15 Sep–15 Nov; 1–31 Mar	No open season
1998–1999	9; Tier II; 1 muskox	15 Sep–31 Mar	No open season
Unit 26B, east of Dalton Hwy			
1995–1996	2; Tier II; 1 bull	1–31 Oct; 1–31 Mar	No open season
1996–1997 through 1997–1998	2; Tier II;1 bull	15 Sep–15 Nov; 1–31 Mar	No open season
1998–1999	∞ (harvest quota of 4); Tier I; 1 muskox and 3; Drawing; 1 bull	To be announced; season closed no later than 30 Mar 20 Sep–10 Oct; 10–31 Mar	No open season 20 Sep-10 Oct; 10–31 Mar
Unit 26C			
1961–1962 through 1981–1982		No open season	No open season
1982–1983 through 1984–1985	5; Drawing; 1 bull	1–31 Mar	1–31 Mar
1985–1986 through 1987–1988	5; Registration;	1–31 Mar	1–31 Mar
1988–1989 through 1989–1990	10; Registration;	15 Aug–15 Sep; 1–31 Mar	15 Aug–15 Sep; 1–31 Mar
1990–1991 through 1991–1992	9; Tier II/Federal; 1 bull	1–31 Oct; 1–31 Mar	No open season
1992–1993 through 1993–1994	10; Federal; 1 bull	1–31 Oct; 1–31 Mar	No open season
1994–1995 through 1995–1996	10; Federal; 1 bull	1 Oct–15 Nov; 1–31 Mar	No open season
1996–1997 through 1997–1998	15; Federal; 1 bull	15 Sep–15 Mar	No open season
1998–1999	15; Federal; 1 bull (3 permits for females)	15 Sep–31 Mar	No open season

Board of Game Actions and Emergency Orders. ADF&G first opened a hunting season in Unit 26C in 1982 and in Unit 26B in 1990. The Board of Game instituted Tier II hunts for muskoxen in Units 26B (Hunt TX1010) and 26C (Hunts TX1012 and TX1014) beginning in RY 1990–1991. In RY 1992–1993, FWS took over management of subsistence hunting of muskoxen in Unit 26C. The state season was closed to prevent overharvesting. During RY 1996–1997, state hunts (TX108 and TX110) in Unit 26B were extended to include the last 2 weeks of September and the first 2 weeks of November. The federal subsistence hunt (RX1013) in Unit 26C was changed to 15 September through 31 March. These seasons remained the same for RY 1997–1998.

In January 1998 the North Slope Muskox Harvest Plan was presented to the board for review. The board asked the planning team to consult with other interest groups before their March 1998 meeting. In addition, the board passed a regulation that authorized ADF&G to issue permits for the taking of stranded muskoxen in Unit 26A.

In March 1998 the board dealt with several issues concerning muskoxen in Unit 26B. They determined that a harvest of no more than 20 muskoxen (Tier II Hunt TX108) was necessary to provide a reasonable opportunity for subsistence use in Unit 26B west of the Dalton Highway. They also decided that no more than 5 muskoxen were required to meet subsistence needs in Unit 26B east of the Dalton Highway (Tier I hunt RX110; replaced Tier II hunt TX110). Permits would be made available in Nuiqsut and Kaktovik, and the season would be announced by emergency order when snow conditions, weather, or other factors were suitable. A drawing permit hunt (DX112) also was established, with 3 permits issued for taking bull muskoxen in Unit 26B east of the Dalton Highway. The board determined that it was possible to have subsistence and drawing hunts in the same area because the population could be managed as 2 subpopulations: bulls and cows. These actions were consistent with the North Slope Muskoxen Harvest Plan. The resident muskox tag of $25.00 was waived for subsistence hunters in Units 26B and 26C. The board also passed a regulation allowing the use of snowmachines to transport game or hunters for the purpose of a direct crossing through the Dalton Highway Management Corridor (DHMC). Hunting by motorized vehicles is not allowed within the DHMC. This would have allowed hunters from Nuiqsut to access the area east of the DHMC in Unit 26B with snowmachines. However, the Department of Law determined that the regulation conflicted with the off-road vehicle prohibition in Title 19, so the regulation was not implemented.

Hunter/Trapper Harvest. Hunting for muskoxen in the eastern North Slope was allowed only under permit. Number of permits that were available and weather (e.g., snow conditions, fog) influenced the harvest. The total reported harvest in Units 26B and 26C has been 5–14 since RY 1990–1991 when both units were opened to hunting and has been <2.5% of the total population (Table 2). Restrictions in regulations ensure a low harvest. Yet, some harvest was not reported, despite the existence of the permit systems. Harvest in spring 1999 was influenced by weather because the temperature was -40 F during almost all of March.

Reported harvest in Unit 26B West was 2–4 and was 1–6 in Unit 26B East during RY 1995–1996 through 1998–1999 (these numbers are included in the Unit 26B reported harvest; Table 2). Harvest for these separate strata were also <2.5% of the estimated population. Reported harvest in Unit 26C was 5–11 during RY 1990–1991 through 1997–1998. In Unit 26B reported harvest was 0–7 during RY 1990–1991 through 1998–1999.

Hunter Residency and Success. Before RY 1990–1991 muskoxen were harvested under a registration permit system in which both residents and nonresidents could participate. From RY 1990–1991 through 1997–1998, state Tier II or federal subsistence permits were issued only to local residents (Tables 2 and 3). Beginning in RY 1998–1999, nonlocal residents could participate in the registration and drawing hunts east of the Dalton Highway in Unit 26B. Since RY 1985–1986 success has been 60–100% for Unit 26B and 26C combined. Success rates were determined from returned reports and were probably higher than actual success rates because some unsuccessful hunters did not return their reports. Nonetheless, success rate would still be high (>50%) if unreturned reports were included.

Transport Methods and Harvest Chronology. Hunters rely primarily on snowmachines to hunt muskoxen. However, aircraft were used in a few fall hunts (Table 4).

Chronology of harvest depends mostly on weather conditions (e.g., snow, fog, temperature, and rivers freezing). During RY 1995–1996 through 1997–1998, approximately 50% of the harvest occurred in March for both Units 26B and 26C combined. The remaining 50% was distributed between September, October, November, January, and April (after the season was closed).

Natural Mortality

We have little data on natural mortality of adults, calves, and yearlings in the eastern Arctic. Natural mortality among adults is presumed to be low. Brown bears kill both calf and adult muskoxen and have been a more important predator than wolves, at least in Unit 26C (Reynolds et al. 1992). Muskoxen mortality from predation was rarely observed before the last few years, but recently incidental observations indicate that predation by brown bears has increased. Wolves seem to be more abundant in Unit 26B than 26C and may become a more important source of mortality in the future. Late winter storms contribute to mortality of calves, yearlings, and old adults, but these losses are generally minimal. On the Dalton Highway mortality also occurs from vehicles hitting muskoxen

Two of the radiocollared females captured in April 1999 were found dead in May and June. One was found by snowmachiners approximately 1 month after her capture. She (and the group) was not far from the capture site. A brown bear sow with cubs was nearby and had been feeding on the carcass; however, this death may have been a capture-related mortality. Another female was heard on live mode on 5 June 1999 but not located that day. We radiotracked her 4 days later, and her collar was on mortality mode. At the site we saw a brown bear near the carcass and another one nearby. We suspect she was killed by a brown bear.

HABITAT

Various studies of the status of muskoxen habitat (O'Brien 1988) indicated forage was not limiting muskox population growth in Units 26B and 26C. Social factors were probably responsible for the apparent increased emigration from Unit 26C. Habitat in Unit 26B is adequate to support a larger population than currently exists in that area (P Reynolds, FWS, pers. commun.).

CONCLUSIONS AND RECOMMENDATIONS

The muskox population in Units 26B and 26C combined is probably stable or slightly increasing. The number of muskoxen observed during March 1998 was 538 (Unit 26B = 207 and Unit 26C = 331). The number of muskoxen observed during March 1999 in Unit 26B was 237. Even though yearling recruitment has declined during the past 5 years (particularly in Unit 26C), we suggest that recruitment rate may still equal or exceed mortality rates because muskoxen are long-lived. The average proportion of calves also was significantly lower during the past 5 years (again, particularly in Unit 26C), but this may simply mean the population is approaching habitat carrying capacity, at least in Unit 26C.

Harvest was below 2.5% of the entire population (Units 26B and 26C combined) and within each subpopulation (Unit 26B, Unit 26B West, Unit 26B East, and Unit 26C). Thus, harvest did not limit population growth. Brown bear predation has increased in the past 5 years and may have a greater influence on the population in the future.

We met our first objective of managing harvest to encourage population growth and dispersal of muskoxen and worked toward our goal of reestablishing muskoxen throughout their historic range. We met our second objective of maintaining a bull:cow ratio of 50:100 and an adult bull:cow ratio of 35:100 in Units 26B and 26C combined. However, these objectives should be revised to reflect the recommendations of the North Slope Muskox Harvest Plan. We achieved our third objective of maintaining direct communication with local residents by participating in the development of the plan.

We met our second goal of providing opportunities to hunt, view, photograph and enjoy muskoxen. We administered 3 hunts in Unit 26B, and viewing and photography were possible, particularly near the Dalton Highway where small groups congregate during summer. The opening of the Dalton Highway for public use resulted in increased traffic and greater interest in muskoxen by both hunters and nonhunters.

The FWS intends to continue monitoring muskoxen numbers, productivity, survival, and movements east of the Canning River in Unit 26C. ADF&G and FWS will continue working cooperatively to collect and interpret muskox population and harvest data in Units 26B and 26C.

Based on the recommendations of the North Slope Muskox Harvest Plan, we recommend that management goals and objectives for Units 26B and 26C be revised as follows:

Management Goals

1 Provide opportunities to harvest muskoxen while maintaining healthy, stable muskox populations

2 Minimize any detrimental effects that muskoxen may have on caribou and caribou hunting

3 Cooperate and share information about muskoxen among users (e.g., local and nonlocal residents and local, state, and federal agencies) to develop and implement harvest, management, and research programs

4 Provide opportunities to view and photograph muskoxen

Management Objectives

1 Maintain a stable population of 500–650 muskoxen in Units 26B and 26C (Goals 1, 2, 3, and 4)

2 Adjust harvest level in Unit 26B to stabilize the muskox population by harvesting at a rate of no more than 10% per year of the spring precalving population in Unit 26B (Goals 1, 2, and 3)

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Table 1 Unit 26B and 26C muskoxen composition counts and precalving surveys, regulatory years 1986–1987[a] through 1998–1999

Location[d]/ Regulatory year	Postcalving composition surveys[b]					Precalving surveys[c]	
	Muskoxen classified	Bulls >3 yr: 100 Cows >2 yr	Calves: 100 cows	Percent yrlg	Percent calves	Muskoxen observed	Unit 26B (West)[e]
Units 26B and 26C							
1986–1987	339	28	48	12	19	390	
1987–1988	371	42	71	16	23	410	
1988–1989	280	29	39	14	16	484	
1989–1990	369	41	43	15	16	454	
1990–1991	475	50	63	11	20	438	
1991–1992	517	51	43	16	16	507	
1992–1993	535	43	56	11	20	563	
1993–1994	432	51	48	16	16	484	
1994–1995	385	57	33	12	12	651	
1995–1996	239	40	42	9	17	598	
1996–1997	485	47	28	14	11	633	
1997–1998	308	36	33	10	14	538	
1998–1999	466	61	25	9	11	–	
Unit 26B							
1989–1990	83	41	41	13	17	122	
1990–1991	98	69	66	9	24	156	
1991–1992	193	43	40	16	16	224	
1992–1993	131	41	55	8	21	237	
1993–1994	91	46	54	21	17	166	
1994–1995	145	55	42	10	15	330	
1995–1996	44	35	13	11	7	266	
1996–1997[e]	123	46	32	20	13	309	92
1997–1998	97	24	45	10	20	207	79
1998–1999	194	62	45	12	17	237	96
Unit 26C							
1989–1990	286	42	44	16	15	332	
1990–1991	377	36	50	12	19	282	
1991–1992	324	56	45	16	16	283	
1992–1993	404	43	57	13	20	326	
1993–1994	341	53	47	15	16	318	
1994–1995	240	58	28	13	10	321	
1995–1996	195	41	51	9	20	332	
1996–1997	362	48	26	13	11	324	
1997–1998	211	42	28	10	12	331	
1998–1999	272	60	14	8	7	–	

[a] Data source for 1986–1987 through 1997–1998: PE Reynolds, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.

[b] Postcalving composition classifications were conducted during late June or early July.

[c] Precalving surveys were conducted during late March or early April and are based on total muskox observed.

[d] Unit 26C surveys encompassed the Canning to Clarence Rivers. Unit 26B surveys occurred east of the Sagavanirktok River until RY 1996–1997 when the entire subunit from Colville to Canning Rivers were surveyed.

[e] Number of muskoxen observed west of the Sagavanirktok River. This number is also included in total number of muskoxen observed.

Table 2 Unit 26B and 26C muskoxen harvest data by permit hunt, regulatory years 1986–1987 through 1998–1999

Regulatory year	Hunt/ Area[a]	Unit	Permits available[b]	Returned reports	Hunters	Successful hunters (%)[c]	Bulls	Cows	Total harvest
1986–1987	RX1007	26C	5	5	5	5 (100)	5	0	5
1987–1988	RX1007	26C	5	5	5	5 (100)	6[d]	0	6
1988–1989	RX1007	26C	10	8	8	8 (100)	6	2[d]	8
1989–1990	RX1007	26C	10	10	10	10 (100)	10	0	10
1990–1991	TX1010	26B	2	2	2	2 (100)	2	0	2
	TX1012, 1014	26C	9	8	8	8 (100)	5	0	8
1991–1992	TX1010	26B	2	2	0	(0)	0	0	0
	TX1012, 1014	26C	9	9	5	5 (100)	5	0	5
1992–1993	TX1010	26B	2	2	0	(0)	0	0	0
	RX1013 (F)	26C	10	9	8	8 (100)	10	0	8
1993–1994	TX110	26B	2	2	1	(1)	1	0	1
	RX1013 (F)	26C	10	9	7	7 (100)	7	0	7
1994–1995	TX110	26B	2	2	1	(0)	0	0	0
	RX1013 (F)	26C	10	10	10	9 (90)	9	0	9
1995–1996	TX108	26B (West)	3	3	1	1 (100)	1	0	1
	TX110	26B (East)	2	2	2	2 (100)	2	0	2
	RX1013 (F)	26C	10	9	8	8 (100)	8	0	8
1996–1997	TX108	26B (West)	3	3	3	2 (75)	2	0	2
	TX110	26B (East)	2	2	1	1 (100)	1	0	1
	RX1013 (F)	26C	15	12	12	11 (92)	10	1[d]	11
1997–1998	TX108	26B (West)	3	3	3	2 (67)	2	0	2
	TX110	26B (East)	2	2	1	1 (100)	1	0	1
	RX1013 (F)	26C	15	9	6	6 (100)	5	1[d]	6
1998–1999	TX108	26B (West)	9	9	4	4 (100)	3	1	4
	RX110	26B (East)	4[e]	3	5	3 (60)	3	0	3
	DX112	26B (East)	3	3	3	3 (100)	3	0	3
	RX1013 (F)	26C	15	na	na	na NA	na	na	na

[a] Hunt types: RX = registration; TX = tier II; DX=drawing; F = federal hunt; 1007 = Unit 26C; 1010 and 110 = east of Dalton Hwy; 112 = west of Dalton Hwy; 1012 = east of Jago River; 1014 = west of Jago River.

[b] Permits available may not always equal permits issued in the federal hunts because unused permits are reissued.

[c] Determined from returned reports.

[d] Illegal animal.

[e] Unlimited number of permits available; harvest quota = 4.

Table 3 Units 26B and 26C muskoxen hunter residency and success, regulatory years 1985–1986 through 1997–1998

Regulatory[a] year	Successful				Unsuccessful				Total hunters[c]
	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	
1985–1986	2	1	0	3 (60)	2	0	0	2 (40)	5
1986–1987	3	1	1	5 (100)	0	0	0	0	5
1987–1988	2	3	0	5 (100)	0	0	0	0	5
1988–1989	4	4	0	8 (100)	0	0	0	0 (40)	8
1989–1990	2	7	1	10 (100)	0	0	0	0	10
1990–1991	10	0	0	10 (100)	0	0	0	0	10
1991–1992	5	0	0	5 (100)	0	0	0	0	5
1992–1993	8	0	0	8 (73)	0	0	0	0	11
1993–1994	8	0	0	8 (100)	0	0	0	0	8
1994–1995	9	0	0	9 (82)	2	0	0	2 (18)	11
1995–1996	11	0	0	11 (100)	0	0	0	0	11
1996–1997	14	0	0	14 (87)	2	0	0	2 (12)	16
1997–1998	9	0	0	9 (90)	1	0	0	1 (10)	10
1998–1999[d]	6	4	0	10 na	1	1	0	2 na	12

[a] Before RY 1986–1987 only Alaska residents were allowed to hunt muskoxen. In RY 1990–1991 muskoxen hunting was limited to local residents. In RY 1998–1999, 1 hunt in 26B(East) was opened to include Alaska residents.

[b] Local is a resident of Unit 26.

[c] From hunters who reported that they hunted.

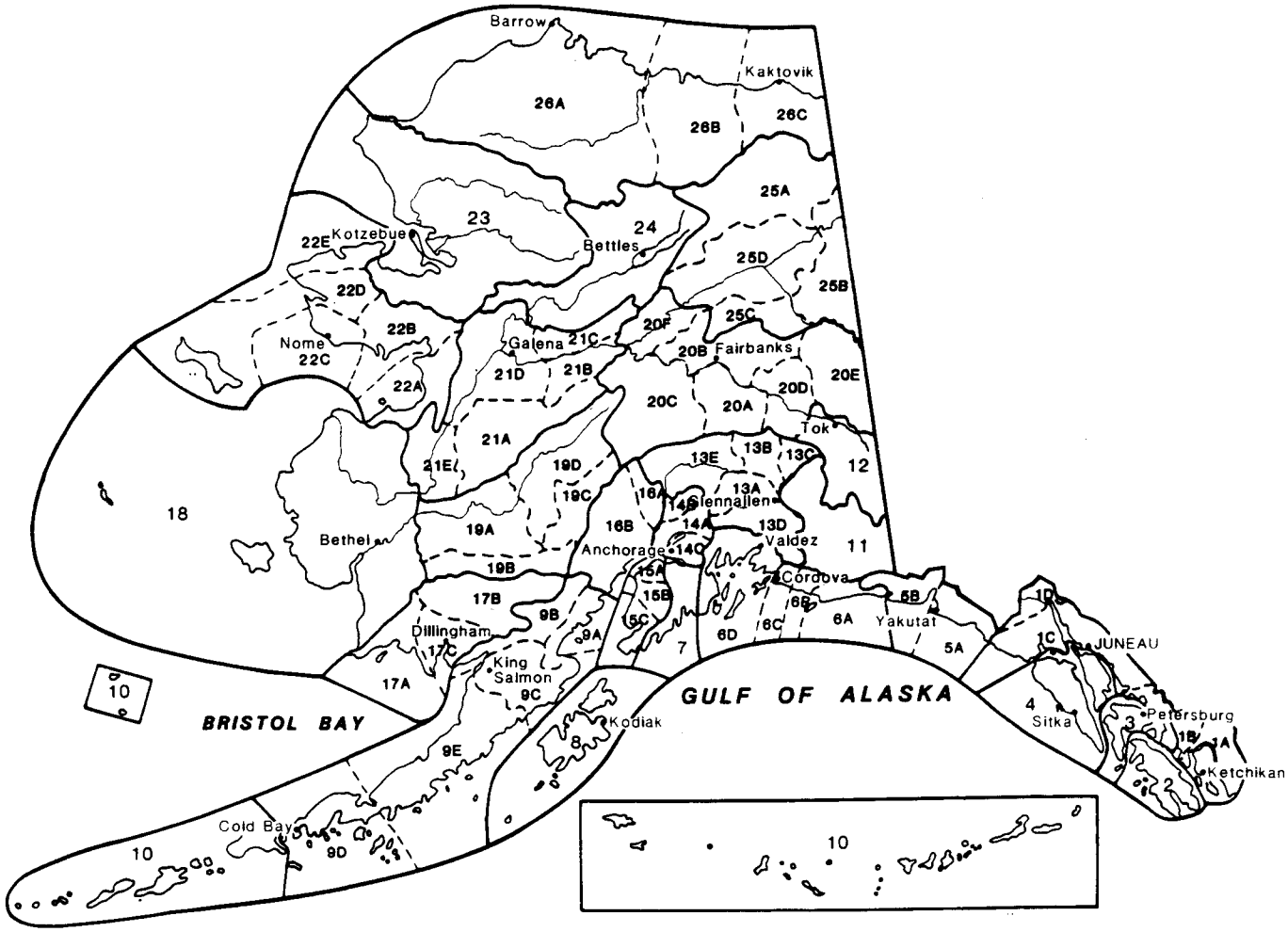
[d] Preliminary data; does not include Unit 26C.

Table 4 Units 26B and 26C muskoxen harvest by transport method, regulatory years 1986–1987 through 1998–1999

Regulatory year	Harvest by transport method					*n*
	Highway vehicle	Airplane	Dog team	Snowmachine	Boat	
1986–1987	0	0	0	3	0	3
1987–1988	0	2	0	6	0	8
1988–1989	0	2	0	3	0	5
1989–1990	0	9	0	1	0	10
1990–1991	0	1	1	6	0	8
1991–1992	0	0	0	4	0	4
1992–1993	0	0	0	9	0	9
1993–1994	0	1	0	7	0	8
1994–1995	0	0	0	8	0	8
1995–1996	0	2	0	6	0	8
1996–1997	0	0	1	14	0	15
1997–1998	0	0	1	8	0	9
1998–1999[a]	1	0	0	7	2	10

[a] Preliminary data; does not include Unit 26C.

Alaska's Game Management Units



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 allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

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