

Muskox Management Report

of survey-inventory activities
1 July 1998–30 June 2000

Mary V. Hicks, Editor
Alaska Department of Fish and Game
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ADF&G

Please note that population and harvest data in this report are estimates and may be refined at a later date.

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If used in part, the reference would include the author's name, unit number, and page numbers. Authors' names can be found at the end of each unit section.

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LOCATION

GAME MANAGEMENT UNIT: 18 (41,159 mi²)

GEOGRAPHIC DESCRIPTION: Yukon–Kuskokwim Delta

BACKGROUND

NUNIVAK ISLAND

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 a minimum of 628 animals in spring 2000.

NELSON ISLAND

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. When the population approached the management goal of 200–250 animals in 1981, the first hunting season was opened. Partially in response to a population decline in 1994 and 1995, the Nelson Island Muskox Herd Cooperative Management Plan was initially drafted and followed in 1995. In this plan our goal is at least 250 animals. For approximately 20 years, the Nelson Island muskox population has fluctuated between a high of 297 animals and a low of 123. In 2000 the population was a minimum of 233.

YUKON–KUSKOKWIM DELTA

Having originally emigrated from Nelson Island, fewer than 100 muskoxen inhabit the mainland of the Yukon–Kuskokwim Delta. Mainland muskoxen are scattered in small groups from the Kilbuck Mountains south of the Kuskokwim River to the Andreafsky Mountains north of the Yukon River. During surveys of other species, agency biologists and aircraft pilots have observed muskoxen. Poaching is a major factor preventing the mainland population from becoming firmly established. Wandering muskoxen may actually return to Nelson Island. This behavior complicates muskox management for Nelson Island and makes it difficult to determine the size of the mainland population.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The muskox management goals for Unit 18 are to determine the population, distribution, sex and age composition, productivity, mortality, hunting pressure, population trends, and habitat conditions.

MANAGEMENT OBJECTIVES

The muskox management objectives for Unit 18 are listed below:

- Survey populations on Nunivak and Nelson Islands, using fixed-wing and rotary-wing aircraft in alternate years, to estimate population size and composition.
- Maintain a posthunt population of at least 250 muskoxen on Nelson Island and 500–550 on Nunivak Island.
- Issue drawing and registration permits for harvesting muskoxen to maintain optimal size, composition, and productivity of the muskox populations on Nunivak and Nelson Islands.
- Provide hunter orientation and checkout to ensure hunters understand permit requirements, properly identify legal muskoxen, and report their harvest timely and correctly.
- Determine the distribution and dispersal of muskoxen on the mainland.
- Use the cooperative management plans for Nunivak and Nelson Islands.

METHODS

During 13–15 October 1999, we used a Robinson R-44 helicopter on Nunivak Island to conduct a population census. During this census we classified muskoxen as yearlings, 2-year-old males and females, 3-year-old males and females, 4-year-old and older males and females, or as unclassified. Note that the terminology describing these cohorts is somewhat unorthodox and is explained by the history of muskox surveys. Previously, we conducted composition counts using 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 to 9 months younger than the named classes.

We used fixed-wing aircraft during 12–13 July 2000 on Nunivak Island and during 18 July 1999 and 22 June 2000 on Nelson Island to conduct population censuses. When using fixed-wing aircraft, we were unable to obtain composition information beyond classifying calves and older animals.

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 lost through stranding on ice floes or small offshore islands, but during the reporting period there were no reports of stranding. The reproductive ability of the Nunivak Island population has been sufficient to recover quickly from previous losses. As the population declines and recovers, the harvest is adjusted accordingly (Table 1).

During the 1980s, hunters harvested Nelson Island muskoxen at rates approaching 15% and the population remained stable. In 1993 and 1994 the population had declined to a low of 149. To reverse the decline, we reduced the harvest rate with a bulls-only hunt and closure of the 1995 and 1996 seasons. The population began to recover after the 1995 calving season. By 1996 the population had recovered sufficiently to resume harvests in the spring of 1997. The conservative harvests of 1997 and 1998 and the strong recovery of the Nelson Island population allowed an increase in the number of permits. The population had increased to 297 by 1999. In the 1998–99 and 1999–00 hunting seasons, the harvest was increased to the maximum allowable, 15 bull and 15 cow muskoxen.

We counted only 233 muskoxen during the 2000 census. During winter of 1999–2000, we received several reports of poaching on Nelson Island and sightings of several muskox groups on the mainland. We receive reports of muskoxen on the mainland every year, but a population is not firmly established. Reports have ranged from single animals to as many as 15. Factors such as poaching and emigration probably contributed to the lower than expected count in the 2000 census. In the past there have been similar fluctuations. When the population is lower than 250, the Nelson Island Muskox Herd Cooperative Management Plan calls for no harvest (Table 2 and 3).

Population Size

During a helicopter census of Nunivak Island conducted on 13–15 October 1999, we counted 620 muskoxen in 78 groups, ranging in size from 1 to 34 animals. During a fixed-wing census of Nunivak Island conducted on 12–13 July 2000, we counted 628 muskoxen in 78 groups. Both the 1999 and 2000 census numbers appear higher than the stated goal. However, the population goals are for posthunt, precalving periods; these were postcalving counts. In 1999 the population without calves was 507 and in 2000 it was 526. During both years the population was well within the population goals (Table 4 and 5).

On 18 July 1999 and on 22 June 2000, we censused Nelson Island muskoxen using fixed-wing aircraft. In 1999 we counted 297 muskoxen and in 2000 we counted 233.

We do not have sufficient survey information to estimate accurately the population of mainland muskoxen. Incidental observations indicate the population is small and widely dispersed. Some muskoxen probably return to Nelson Island from the mainland, confounding census data for both areas.

Population Composition

Using a helicopter census 13–15 October 1999, we determined the composition of the Nunivak Island muskox population. We classified 620 muskoxen observed in 78 groups. We found 158 adult males (4+ years old), 135 adult females (4+ years old), 69 3-year-old males, 58 3-year-old females, 39 2-year-old males, 48 2-year-old females, and 113 yearlings (Table 4).

We counted 628 muskoxen on 12–13 July 2000, using a fixed-wing aircraft on Nunivak Island. Of these, 526 were adults and 102 were calves. We classified only adults and calves in this survey (Table 5).

The postcalving Nelson Island muskox population was determined during a fixed-wing survey on 18 July 1999. We observed 297 muskoxen, 60 of which were calves (Table 6). In a similar Nelson Island survey on 22 June 2000, we observed 233 muskoxen of which 61 were calves (Table 7).

We have minimal composition information for mainland muskoxen. One group of 3 bulls was seen near Three Step Mountain south and east of the Kuskokwim River. A group of 15 reported south of Pilot Station comprised bulls and cows. Another group of 15 seen between Eek and Quinhagak also comprised bulls and cows.

Distribution and Movements

During aerial surveys on Nunivak Island, muskoxen were uniformly distributed throughout the island. During winter, muskoxen avoid deep snow, and in summer they disperse throughout the interior of the island.

Nelson Island muskoxen are throughout the island but are concentrated on the cliffs near Cape Vancouver and on hills northeast of Tununak. Individuals and small herds are on the hills in the central portion of the island and along the escarpment above Nightmute.

In the past, we have had reports of muskoxen in the Kilbuck Mountains, northeast to the Portage Mountains near Lower Kalskag, northwest into the Andraefsky Mountains, and west to the Askinuk Mountains. Solitary old males are usually the first muskoxen to be seen in new areas.

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. A 4-year-old female that was probably born on Nelson Island was radiocollared 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. A hunter subsequently shot this muskox on 24 March 1990 near Toksook Bay on Nelson Island, approximately 200 miles west of its last known location.

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, with up to 45 cow permits to 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 gave the department the regulatory authority to issue up to 45 bull and up to 45 cow permits on Nunivak Island. For the 1998–1999 and the 1999–2000 regulatory years, the department offered 5 cow and 10 bull permits for Nunivak Island muskoxen for the fall hunt and 40 cow and 35 bull permits for the spring hunt.

During its spring 1992 meeting, the board gave the department the regulatory 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 current regulation allows adjustment of harvest 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. In the 1998–1999 and 1999–2000 seasons, 15 bull and 15 cow permits were issued for Nelson Island.

Human-Induced Harvest. Hunting of Nunivak Island muskoxen was regulated by drawing permits and registration permits for fall and spring hunts for both years of 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, we select an alternate permittee from the spring list of permit applicants. The 1998–1999 harvest from drawing permits included 8 bulls in the fall and 35 in the spring. Of these, 6 were alternate permittees. The 1999–2000 harvest from drawing permits included 5 bulls in the fall and 41 in the spring (Table 1). Five of these hunters were alternate permittees.

We distribute registration permits for hunting Nunivak Island cows 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 35 permits available in Mekoryuk for the spring hunt during the 1998–1999 and 1999–2000 seasons. All hunters were successful at harvesting muskoxen. Unfortunately, 4 spring cow hunters mistakenly shot bulls.

We distribute Nelson Island registration permits on a first-come, first-served basis. The location from which these registration permits are distributed rotates through the local villages from Newtok to Tooksook Bay, to Tununak, Nightmute, and Chefornak. In 1998–1999 15 bull and 15 cow permits were distributed in Tununak, and in 1999–2000 15 bull and 15 cow permits were distributed in Nightmute. All Nelson Island hunters in 1998–1999 and all but 1 cow permit recipient in 1999–2000 were successful.

We occasionally receive reports of muskoxen taken illegally. During this report period, 2 bull muskoxen were killed near Greenstone Ridge in the Kilbuck Mountains. We also received several reports of muskoxen taken illegally on Nelson Island. However, the number of animals taken is difficult to determine because we received reports from several anonymous callers, possibly regarding the same incident.

Permit Hunts. All hunts for muskoxen in Unit 18 are either by drawing permit or registration permit; the Human-Induced Harvest section includes specific information regarding issued permits.

Hunter Residency and Success. Most drawing permittees for Nunivak Island are residents of Alaska. In 1998–1999 1 bull hunter was a nonresident and in 1999–2000 3 were nonresidents. All registration hunters were residents. For information on hunter success, see the Human-Induced Harvest section.

Harvest Chronology. Most cow hunters on Nunivak Island harvested their muskoxen between late February and mid March during periods of increasing daylight hours and milder weather. Nelson Island hunters also take most of their animals late season. Bull hunters on Nunivak Island usually hunted with guides or transporters. These hunters must fit their hunts into the times available with a particular guide or transporter and, consequently, are evenly distributed throughout the season.

Transport Methods. In fall most hunters use a boat or ATV. All access in the winter season is by snowmachine.

Other Mortality

No natural predators of muskoxen are present on Nunivak Island, and large predators are rare on Nelson Island. The few mainland muskoxen are in areas that have a few wolves and grizzly bears, but we have received no reports of predation on muskoxen in Unit 18. Most natural mortality is from accidents such as freezing, stranding, falling off cliffs, and falling through the ice of rivers, bays, or tidal areas. There were no reports of natural mortality during this reporting period.

HABITAT

Assessment

No direct study of habitat was undertaken during the report period. On Nunivak Island we believe the reindeer have overgrazed the lichen range, yet muskoxen taken by hunters in recent years are reported to be in good condition. The muskoxen taken on Nelson Island are also reported in good condition. The habitat for both islands seems in excellent condition. The muskox habitat on the mainland is extensive and could support a much larger population.

Enhancement

We are meeting our muskox population goals because of the habitat on Nelson and Nunivak Island. The habitat on the mainland is essentially unused. We are not considering habitat enhancement projects.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

There were no activities related to nonregulatory muskox management issues in Unit 18 during the reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak Island muskox population is characterized by high productivity and low natural mortality. We will reduce the harvest of bulls and cows when the posthunt, precalving population is below 500 animals. With the existing population, high harvest levels are warranted. The management goals for Nunivak Island muskoxen 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 reach the mainland. The recent drop in population on Nelson Island from 297 in 1999 to 233 in 2000 is probably due to emigration and illegal harvests, both of which were reported in the winter of 1999–2000.

Variable annual harvests are needed to effectively manage the population in response to emigration and other natural losses. While the population is between 250 and 300 animals, we

are harvesting variable numbers of muskoxen at a rate not exceeding 10% of the population to maintain healthy age and sex components in the population. The Nelson Island Muskox Herd Cooperative Management Plan calls for the cessation of hunting when the population is below 250 animals. During the 22 June 2000 survey, we counted only 233 muskoxen. Appropriate management actions for Nelson Island muskoxen need to be considered in consultation with, and support from, local hunters.

We continue to receive reports of mainland muskoxen, but illegal take of these animals is a key factor in preventing establishment of a reproductively viable population. Fewer than 100 muskoxen inhabit the extensive areas of mainland habitat. Although low numbers for mainland muskoxen are discouraging, there is still potential for a population to become established, particularly with the concern and cooperation shown by villagers from Nelson Island and with continued growth of the Nelson Island muskox population.

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.

LITERATURE CITED

PREPARED BY:

Phillip Perry
Wildlife Biologist I

SUBMITTED BY:

Peter Bente
Survey-Inventory Coordinator

REVIEWED BY:

Roger Seavoy
Wildlife Biologist III

Table 1 Unit 18 harvest of Nunivak Island muskoxen, 1975–2000

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	47	26		73
1994	35	23		58
1995	20	5		25
1996	20	19		39
1997	25	24		49
1998	26	30		56
1999	43	45 ^a		88
2000	46 ^b	40		86
Total	820	678	1	1498

^a One cow taken by a bull hunter

^b Three bulls taken by cow hunters; one bull taken by a bull hunter

Table 2 Unit 18 Nelson Island muskoxen population, 1973–2000

Year	No harvest/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	
1999		297	
2000		233	

Table 3 Unit 18 permits and hunting harvest of Nelson Island muskoxen, 1981–2000

Year	Number of Permits available		Muskoxen harvested		Number of Applicants
	Female	Male	Female	Male	
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	58
1991	15	15	10	14	34
1992	15	15	15	15	30
1993	0	30	0	30	37
1994	5	25	5	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
1999	15	15	15	15	30
2000	15	15	14	15	30

Table 4 Unit 18 composition of Nunivak Island muskoxen 13–15 October 1999

Age ^a	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	158	25%	135	22%			293	47%
3 years	69	11%	58	9%			127	20%
2 years	39	6%	48	8%			87	14%
Yearlings					113	18%	113	18%
Total	266	43%	241	39%	113	18%	620	100%

^aPrevious surveys were conducted in the spring when the youngest cohort was called "short yearling." Even though current surveys are earlier in the season, we retain old terminology; thus, the actual age of these cohorts is about 6 months younger than given.

Table 5 Unit 18 composition of Nunivak Island muskoxen 12-13 July 2000

Age ^a	Total	(%)
Adults	526	84%
Yearlings	102	16%
Total	628	100%

^aThis survey used a fixed-wing aircraft and the only composition recorded is adults and calves.

Table 6 Unit 18 composition of Nelson Island muskoxen 18 July 1999

Age ^a	Total	(%)
Adults	237	80%
Yearlings	60	20%
Total	297	100%

^aThis survey used a fixed-wing aircraft and the only composition recorded is adults and calves

Table 7 Unit 18 composition of Nelson Island muskoxen 22 June 2000.

Age ^a	Total	(%)
Adults	173	74%
Yearlings	60	26%
Total	233	100%

^a This survey used a fixed-wing aircraft and the only composition recorded is adults and calves

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi²) and southwest portion of 23 (1920 mi²)

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 April 2000 was estimated at 1797 animals.

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

MANAGEMENT DIRECTION

Recommendations from the Seward Peninsula Muskox Cooperators Group guide management for muskoxen on the Seward Peninsula. 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 among agencies and user groups
- Administer Tier II hunts in Units 22D, 22E, and 23SW (the portion of Unit 23 west of and including the Buckland River drainage) in cooperation with federal managers of federal subsistence hunts in these units

METHODS

A Seward Peninsula muskox census was completed 13 March–18 April 2000 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. We divided the area into 16 survey units and searched these areas thoroughly, using primarily Cessna 185 and Super Cub aircraft. We completed a minimum count of muskoxen in the census area 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.

Department and NPS staff organized and facilitated village meetings in Units 22B, 22C, 22D, 22E, and 23SW to discuss possible changes to muskox hunting regulations. The department helped organize and participated in a Muskox Cooperators Group meeting, held in Nome 8–10 August 2000, at which hunt recommendations were formulated for the Board of Game and Federal Subsistence Board. In November 2000 the board adopted most of the proposals generated by the Cooperators.

Department staff provided assistance with the Tier II application process in the Nome and Kotzebue offices and traveled to all villages in Units 22D, 22E, and 23SW to help hunters fill out Tier II application forms. Department and NPS staff met in person with all first-time muskox permittees to explain the hunt requirements and identification of muskoxen by sex and age.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During the cooperative census completed in April 2000, we counted 1797 muskoxen in 132 groups in Units 22B, 22C, 22D, 22E and 23 (Table 1 and Fig 1). This is a minimum estimate because it does not include muskoxen missed during the censuses. The 2000 census estimate indicates the population has increased an average of 12½% annually since 1998, only slightly less than the 14% average annual growth rate documented between reintroduction in 1970 and 1998 (Fig 2). This difference is within the range of error of the census, and no change in productivity of the population is evident with a 2½% average annual harvest. The high productivity and constant growth rate of Seward Peninsula muskoxen indicate they are not yet approaching carrying capacity on the Seward Peninsula. However, in more populated units where muskoxen have long been established, some growth rates have slowed.

The greatest population growth was documented in Unit 22B. In 1998, we counted 27 bulls and in 2000 we observed 159 muskoxen of mixed age and sex (Table 2). We are aware that the 1998 census failed to find some muskoxen inhabiting Unit 22B, but the increased number of mixed age and sex groups and widespread occurrence of muskoxen in the western part of the unit marks a significant change since 1998.

In Unit 22C we counted 148 muskoxen. Population growth in Unit 22C has been steady but slower than in other units, increasing an average of 9% annually since 1998. The Unit 22D population initially grew the fastest and has grown the largest, 774 muskoxen in 2000, which is 43% of the entire Seward Peninsula muskox population. Annual growth, however, slowed to 4% between 1998 and 2000. Population growth in Unit 22E has averaged 14% annually since 1998 with 461 muskoxen counted in 2000. In Unit 23SW 255 we counted muskoxen, and growth averaged 12% between 1998 and 2000 (Table 2).

Population Composition

During the spring 2000 census, observers recorded the number of short yearlings seen in each group. Observations indicate that short yearlings comprised 14% of the population (Table 1). However, this percentage may be imprecise because identification of yearlings in large tightly grouped herds is difficult to observe from fixed-wing aircraft.

In western Unit 22B we observed several large mixed age/sex groups, and the combined recruitment rate was estimated at 9%. Calf production and recruitment have increased since 1998 when only 1 short yearling was seen and the population in Unit 22B was comprised largely of solitary bull and small bull groups. Recruitment is still lower in Unit 22B than in other units, which is to be expected because muskox are just beginning to move into the central and eastern parts of the unit and bulls are typically first to pioneer new habitat. Bulls still primarily inhabit the eastern periphery of winter muskox range in Unit 22B in the Darby and Kwiktalik Mountains.

Recruitment rates in other Seward Peninsula units were quite similar at 13% in Units 22C and 23SW, 14% in Unit 22D, and 15% in Unit 22E.

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 and extend its range during the reporting period. Reports of muskoxen east of the Seward Peninsula in the Nulato Hills and Selawik and Kobuk river drainages are becoming more common. Figure 1 shows the distribution of muskoxen on the Seward Peninsula in Spring 2000 during the most recent census.

When muskoxen were reintroduced to the Seward Peninsula, they were released on the southern part of the peninsula in Units 22C and 22D. Although muskoxen have extended their range throughout Units 22C, 22D and now 22B, they are most numerous on the northern peninsula where habitat is probably more favorable. Units 22E, northern 22D, and 23SW tend to have less snow accumulation, more available wintering habitat, and extensive dry tundra habitat with plentiful sedges and grasses, which are preferred foods. The southern peninsula is partly forested and accumulates more snow, and rocky rugged terrain may provide fewer suitable vegetated wintering areas.

In Units 22C and 22D, 2000 recruitment estimates greatly exceeded growth rates, indicating dispersal of muskoxen from those units. In Unit 22C the population grew an average of 9% annually between 1998 and 2000. Yearlings, however, made up 16% of the animals counted in 1998 and 13% in 2000. Natural mortality is probably low and hunting is not allowed. The difference between yearling recruitment and growth rate indicates animals are dispersing from Unit 22C into other areas. In Unit 22D annual growth slowed to 4% between 1998 and 2000 yet recruitment was estimated at 14% in both censuses. Harvest in Unit 22D averaged 2% annually (15 bulls). It is likely that a significant number of muskoxen in Unit 22D are now emigrating to populate other areas. The dramatic increase in the Unit 22B muskox population can probably be attributed to immigration from Units 22C and 22D.

During the last 2 years, annual growth rates in Units 22E and 23SW were similar to recruitment estimates, indicating that most animals from these units are remaining there. However, muskoxen are also to the east on the Baldwin Peninsula, in the Tagagawik River drainage, and the Nulato Hills; these animals probably migrated out of Unit 23SW.

We have never found muskoxen east of the Darby Mountains in Unit 22B during spring censuses. However, since 1998 we have had reports of muskoxen near Granite Mountain and in the Koyuk River drainage during the summer months. Collaring studies (Jim Dau, personal communication) have shown bulls may travel long distances to summer in new locations and then return to winter in familiar areas. Muskoxen may repeat this pattern for several years, after which a bull may return to the new area in the spring with a few cows and remain there. This gradual colonization is probably occurring in eastern Unit 22B.

MORTALITY

Harvest

Season and Bag Limit. In March 1998 the Board of Game established Tier II subsistence hunts in a portion of Unit 22D, Unit 22E, and a portion of Unit 23. State Tier II hunts are conducted in combination with federal subsistence hunts for federally qualified subsistence users on federal public lands.

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22D That portion north and west of Granley Harbor, Imuruk Basin, and the Pilgrim River drainage.	1 Aug–15 Mar (Subsistence hunt only)	No open season
1 bull by Tier II subsistence hunting permit only; up to 30 bulls may be taken.		
Unit 22E	1 Aug–15 Mar (Subsistence hunt only)	No open season
1 bull by Tier II subsistence hunting permit only; up to 15 bulls may be taken.		
Remainder of Unit 22	No open season	No open season
Unit 23 That portion on the Seward Peninsula west of and including the Buckland River drainage.	1 Aug–15 Mar (Subsistence hunt only)	No open season
1 bull by Tier II subsistence hunting permit only; up to 8 bulls may be taken.		

Board of Game Actions and Emergency Orders. In November 2000 the board received several proposals developed by the Seward Peninsula Muskox Cooperators during their August 2000 meeting in Nome. The board adopted regulatory changes to the existing Tier II hunts in Units 22D, 22E and 23SW, and established new Tier II hunts in Units 22B and 22C. These regulatory changes will go into effect 1 July 2001.

As requested by the cooperators, Tier II hunts were established in Units 22B and 22C for bulls only. In Unit 22B a 5% harvest rate allows 8 bulls to be harvested in combination with a federal subsistence hunt. In Unit 22B the season will be 1 August–15 March, except along the Nome–Council Road where the opening will be delayed until 1 November to protect roadside viewing opportunities. In Unit 22C two hunt areas were established with a 3% harvest of bulls, allowing a take of 4 bulls. No federal land exists in Unit 22C so all harvest will be by

state Tier II permit. The hunt areas and seasons were selected to protect muskoxen located near Nome and to preserve important wildlife viewing along the road system in Units 22B and 22C. Two permits will be issued for the Eldorado and Bonanza river drainages during 1 August–30 September and 2 permits for a 1 February–15 March season will be issued for the area west of the Sinuk River.

The board extended muskox hunting in Unit 22D to include the entire unit and established a 2% either sex harvest in the unit as requested by the cooperators. A separate hunt area near Teller, west of Canyon Creek, was established with a 1 September–15 March season that delays hunting along the Nome–Teller Road until after the peak of the summer tourist season. The continued 5% harvest rate provides a harvestable surplus of 7 muskoxen, not more than 3 of which may be cows. Although there is some federal land in this hunt area, all hunting will be by Tier II permit as requested by the cooperators. The remainder of Unit 22D comprises a separate hunt area with a harvestable surplus of 32 muskoxen, not more than 13 of which may be cows. A harvest of 26 muskoxen will be allocated to the state Tier II hunt and 6 to the federal subsistence hunt. The season in the Pilgrim River drainage will be delayed until 1 November–15 March to protect muskox viewing along the road system in the Pilgrim River drainage during the snow-free season.

In Units 22E and 23SW, the cooperators requested a 3% either sex harvest. However, the board was concerned about slowing population growth because statewide pressure exists for less restrictive hunts. They rejected a 3% either sex harvest as being too high, but established a 2% either sex harvest in Units 22E and 23SW. The harvestable surplus in Unit 22E, at a continued 5% harvest rate, will be 23 muskoxen, not more than 9 of which may be cows. In Unit 23SW 13 muskoxen may be taken, not more than 5 of which may be cows.

Human-Induced Harvest. In 1998–1999 26 muskoxen were harvested by Tier II permit and 11 were taken with federal permits for a total harvest of 37 muskoxen. In Unit 22D a total of 23 muskoxen were taken, 11 were taken in Unit 22E and 3 in Unit 23SW. In 1999–2000 19 Tier II permits were filled and 8 federal permits were filled for a combined harvest of 27 muskoxen. In Unit 22D 15 muskoxen were harvested, 11 were taken in Unit 22E and 1 in Unit 23SW. Tables 3 and 4 show the number of permits issued and filled in 1998–1999 and 1999–2000 for the state and federal hunts in each unit and community.

During this reporting period the harvest rate in Unit 22D averaged 2.5%. In 22E the harvest rate averaged 3%, and in Unit 23SW the harvest rate averaged 1%. In all units hunters took considerably less than the authorized 5% harvestable surplus. This prompted a request at the August 2000 Cooperators meeting to consider success rates when issuing permits and issuing up to a third more permits to help achieve a harvest closer to the harvest quota. This procedure will be implemented for the 2001–2002 hunt.

Three additional nonhunting mortalities were documented during this reporting period. In Unit 22E the taking of a young bull muskox was authorized after repeated attempts over a period of 6 months failed to drive it away from a camp on the Serpentine River. Another muskox of unknown sex was shot and left along the Serpentine River. Shishmaref residents reported the incident to Fish and Wildlife protection, and a citation was issued for the illegal activity. In Unit 22D an adult bull was shot when a hunter misidentified a limping muskox as

one he had shot and wounded, resulting in the harvest of 2 muskoxen. The muskox had severely overgrown hooves, which undoubtedly resulted in a serious limp. The meat was salvaged and given to the Nome senior center.

In 2000 growth of the muskox population allowed state and federal managers to increase the total number of permits issued from 64 to 74 to maintain a potential 5% harvest rate in each unit. The difficulty of accessing remote federal public lands in Unit 22D prompted the villages of Teller and Brevig to request the Federal Subsistence Board to transfer 6 of 12 federal permits to the state. The request was granted and in 2000–2001 33 Tier II permits were issued for Unit 22D. Higher success rates in state hunts resulted in a shift of additional permits to state hunts in other units as well. Table 5 presents the allocation of the 1999–2000 permits by unit and hunt manager.

In all hunt areas there were considerably more applicants for Tier II permits than there were permits available. In 1998 there were 183 applicants for 35 Tier II permits; 76 applicants for Unit 22D, 54 for Unit 22E, and 53 for Unit 23SW. In 1999 280 people applied for 35 Tier II permits; 185 applicants for Unit 22D, 62 applied for Unit 22E and 33 for Unit 23SW. In 2000 214 applicants applied for 56 Tier II permits; 115 people applied for Unit 22D, 63 for Unit 22E, and 36 for Unit 23SW.

Permit Hunts. All hunting is by Tier II Subsistence Hunting Permit. See previous section for harvest summary of permit hunts.

Hunter Residency and Success. During 1998–1999 35 Tier II permits were issued for Seward Peninsula muskox hunts and 26 were filled for a 74% success rate. Twenty-nine federal permits were issued and 11 were filled, resulting in a success rate of 38%. During 1999–2000 19 of 35 Tier II permits were filled with a 54% success rate. Eight of 29 federal permits were filled for a 28% success rate. Tables 3 and 4 show the number of permits issued and filled in 1998–1999 and 1999–2000 in the state and federal hunts in each unit and community.

Success rates in Unit 22E have been higher than in other units. Shishmaref hunters have been relatively successful under both state and federal hunts. Muskoxen inhabit federal and private lands close to the village and a growing number of residents have developed a taste for this new resource. In Wales state permits are readily filled, but success with federal permits is low because federal lands are distant. Few Wales residents have been successful in obtaining state Tier II permits because Shishmaref residents have a longer history of harvesting muskox under the federal system and therefore score higher on their Tier II applications for past harvest of muskox than do Wales residents.

Success rates in Unit 22D varied by community (Tables 3 and 4). Permittees from White Mountain have had 100% success, even with having to travel long distances to find animals on state managed lands in Unit 22D. Nome hunters were relatively successful in 1998 (78% filled their permits), but in 1999 no one from Nome received a permit. In 1999, applications from Unit 22D villages increased and village residents outscored Nome residents based on the higher cost of living in the villages. Success rates in the villages of Brevig and Teller have been variable, but are higher in the state Tier II hunt than in the federal hunt. In 1998 all Brevig and Teller Tier II applicants received a permit, and most permits (80%) were filled. In

1999 many more people from those villages applied and received permits, but fewer permits (35%) were filled than in the previous year. Several factors probably contribute to poor success rates in these villages. Most of the applicants from Brevig and Teller are traditional subsistence hunters whose hunting activities are directed by traditional food preferences, economics, practicality and convenience. When hunters apply in May for a muskox permit, they have no way of knowing whether hunting muskox many months later will be the most desirable and practical means of feeding their family and dependents or whether transportation will be available to hunt muskox. If not, the permits are not transferable so some inevitably go unfilled. Federal permits are least likely to be filled because of the long travel distances required to reach federal lands.

Success rates in Unit 23SW have been very low. Residents of Buckland and Deering have been reluctant to shift federal permits to the state Tier II hunt so most of the permits allow hunting only on distant federal lands.

Harvest Chronology. In 1998 53% of the harvest in Unit 22D occurred in August or September and 47% of the harvest was in February or March. In 1999 in Unit 22D, only 20% of the harvest occurred during August–October and 80% occurred during January–March. We attribute the larger summer and fall harvest in 1998 to Nome hunters who hunted along the Kougarok Road. A few Teller hunters hunt by boat in the summer or fall, but generally hunting is by snowmachine in late February or early March.

In Unit 22E 85% to 89% of the harvest occurred during January–March, the vast majority during the last two weeks of the season. Occasionally Shishmaref hunters harvested muskoxen in summer, using boats or four-wheelers in Wales. In Unit 23SW all harvest occurred in March.

Transport Methods. There were no activities to determine transport methods to harvest muskox in Unit 22 and Unit 23 SW during the reporting period.

Other Mortality

During this reporting period we had no meaningful measure of natural mortality of Seward Peninsula muskoxen. The public frequently observes old muskoxen, and we believe mortality from predation and disease is low.

Some predation by bears occurs on the Seward Peninsula, but the steady growth rate and consistently high recruitment documented for Seward Peninsula muskoxen is evidence that predation is not yet significantly affecting the population. Wolf numbers are increasing on the Seward Peninsula, but we have no information about wolf predation on muskoxen. The public has reported bears killing muskoxen in the Deering and Wales areas. In spring 2000, bear hunters found fresh carcasses of a cow muskox, a newborn calf or well-developed fetus, and 2 young muskoxen (sex and age unknown) lying within a few feet of each other on a ridge top in the Kigluaik Mountains, evidently killed by a bear. Staff and the public reported sightings of bears feeding on muskox carcasses, but in most cases it is not known if bears were predators or scavengers. Pat Reynolds, FWS biologist, noted that bears became increasingly successful at preying upon muskoxen after muskoxen had been introduced into the Arctic National Wildlife Refuge (personal communication). As more bears learn to prey on

muskozen, we can expect predation to have a greater impact on growth of the Seward Peninsula muskox population.

HABITAT

Assessment

There were no muskox habitat assessment activities on the Seward Peninsula during the reporting period.

Enhancement

There were no muskox habitat enhancement activities on the Seward Peninsula during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Conflicts with Humans and Wildlife

The majority of participants at the Muskox Cooperators Group meeting and other public meetings continue to support population growth and range extension of Seward Peninsula muskozen and to support management policies that encourage future increases in hunting opportunity. Since hunting has been allowed, more people have come to value muskozen as a subsistence resource, and negative attitudes toward muskozen have decreased. However, resentment lingers over the reintroduction of muskozen to the Seward Peninsula without consultation and awareness of local people. Some Seward Peninsula residents, especially in Teller and Shishmaref, favor capping or reducing the population in their immediate areas. Subsistence gatherers complain that muskozen compete with them for greens and trample traditional berry picking areas. Although there are no reports of anyone being harmed by muskozen, their presence near villages, camps, and berry picking areas is often frightening. When threatened, muskozen 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. In November 2000 the board addressed the concerns of Teller residents by establishing a hunt area around Teller with a 5% harvest rate. We hope that hunting pressure will drive the animals away from the village and reduce conflicts. Until the advent of the state Tier II hunt in Unit 22E, hunters could harvest muskozen only on federal lands and permits could not be used to take muskozen on Native Corporation lands near Shishmaref. Now Tier II permit holders can use their permits to harvest animals that present problems near the village or camps.

Muskox and Reindeer

For many years after muskozen were introduced to the Seward Peninsula, reindeer herders complained that muskozen compete with and displace reindeer. There is widespread concern across the Arctic about displacement of caribou by muskozen, and these concerns cannot be dismissed. Reindeer and muskozen eat some of the same forage species, but widespread competition for habitat has not been documented on the Seward Peninsula or Nunivak Island. At Reindeer Herders Association meetings during this reporting period, complaints about muskozen were not voiced. We do not know whether concerns have been allayed or simply

overshadowed by more immediate problems associated with caribou wintering on the Seward Peninsula.

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 where local residents, tourists, photographers, cinematographers, and wildlife enthusiasts from around the world seek out and enjoy watching these unusual animals. In August 2000 the Seward Peninsula Muskox Cooperators reaffirmed their commitment to protect viewing opportunities in Unit 22C and along much of the Nome road system in other units where new muskox hunts are being established. As recommended by the cooperators, all but the most remote parts of Unit 22C will remain closed to hunting to allow herd growth, minimal harassment, and easily accessible viewing opportunities for the public. Where new hunts in Unit 22B and southern Unit 22D have been approved, the season along the road system generally will be delayed so muskoxen cannot be hunted from the road when it is open to vehicle traffic. Since 1998 muskox hunting along the northern Kougarak Road in Unit 22D has provided evidence that hunting is likely to displace muskoxen, driving them away from the road, spoiling opportunity for viewing.

A newly established hunt area in southwestern Unit 22D where the season was delayed only until 1 September may adversely affect one of the better viewing areas close to Teller along the Nome–Teller Road. However, the area is on Teller Native Corporation land and the cooperators were uncomfortable recommending that private property be set aside for wildlife viewing against the wishes of the landowner.

CONCLUSIONS AND RECOMMENDATIONS

The Seward Peninsula muskox population has continued to grow at a rate close to the 14% average annual increase exhibited since reintroduction in 1970. Range extension into suitable habitat in Unit 22, southwestern Unit 23, and points eastward continues with no indication that muskoxen are approaching carrying capacity on the Seward Peninsula. The Seward Peninsula Muskox Cooperators favor conservative harvest rates to ensure future population growth and increased harvest.

During this reporting period, state Tier II hunts were implemented in Units 22D, 22E and 23SW and conducted in combination with federal subsistence hunts on federal public lands. The public has received the state hunts very well because they allow more convenient harvest opportunities on state and private lands near villages, provide hunting opportunities to more people, and spread the harvest across a larger segment of the muskox population. In November 2000 the board established new Tier II hunts in Unit 22B, a portion of Unit 22C, and southern Unit 22D. They also authorized a 2% either-sex harvest in Units 22D, 22E, and 23SW. These changes go into effect July 1, 2001.

Tier II hunts limit opportunity to Seward Peninsula residents, and sometimes village residents, outscoring other applicants, draw these hunts exclusively. As the muskox population increases, we must work to establish hunting opportunities for a wider range of users while still ensuring adequate opportunity for local subsistence hunters.

The Tier II application process is difficult and confusing for applicants and requires a huge amount of staff time to administer. Tier II hunts will probably continue for some time so we should work to make the process easier for the public and ourselves, perhaps by rewording the Tier II questions to make them self-explanatory.

Muskox viewing continues to be a high priority in areas near Nome and along much of the road system, and the cooperators have attempted to structure new hunts to ensure that hunting does not affect the animals in areas most important for viewing. Near Nome and on the road system, we must watch for changes in behavior and distribution of muskoxen that are attributable to hunting and recommend adjustments to hunt areas or timing as necessary.

Some local residents continue to be upset by the muskoxen near villages and camps and by competition between muskoxen and subsistence users for greens and berries at traditional gathering sites. Traditional knowledge about muskoxen has long been lost and fear of muskoxen and lack of understanding of their behavior are partly responsible for current negative attitudes. Efforts to educate residents about muskox behavior may be helpful. Distribution of Claudia Ihl's poster explaining muskox behavior to schools and community centers in Seward Peninsula communities would be a worthwhile first step. Hunting has been the best antidote for resentment toward muskoxen. Now that hunting muskoxen is allowed, more people are learning to value this new resource for its meat and qiviut, the warm wool undercoat.

Establishment of cow hunts and the possibility of future increases in harvest rates in some hunt areas make it increasingly important to monitor sex and age composition of Seward Peninsula muskoxen. We have little baseline composition data, and it is important to collect this information before population composition is skewed by harvest. We should periodically monitor effects of increased harvest rates and cow hunts on the population structure if we are to ensure our goal of continued natural growth and herd expansion. We recommend conducting composition surveys every 4 years immediately following a census, beginning in 2002.

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PREPARED BY:

Kate Persons
Wildlife Biologist III

SUBMITTED BY:

Peter J Bente
Survey-Inventory Coordinator

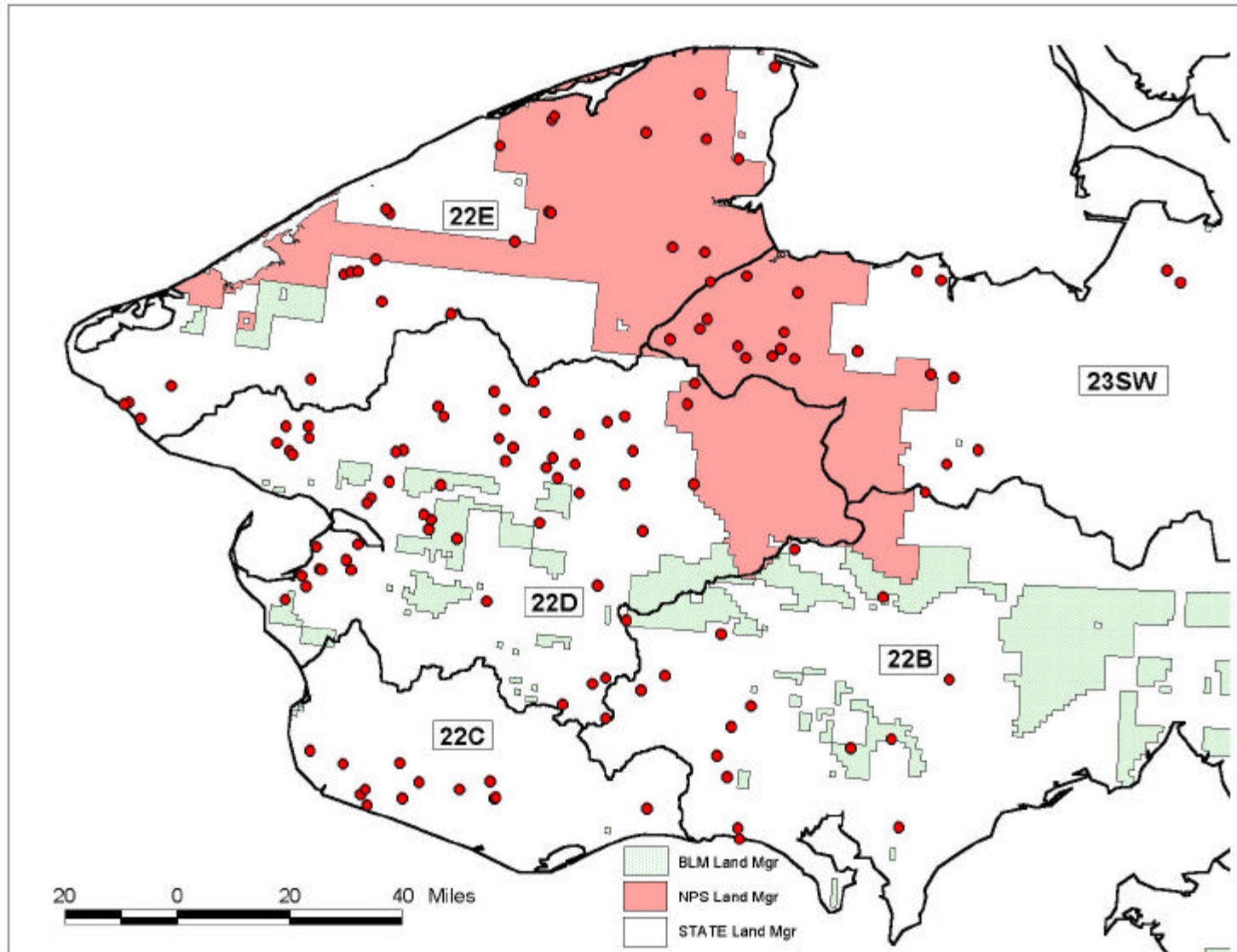


Figure 1 Location of Seward Peninsula muskox groups, spring 2000 census

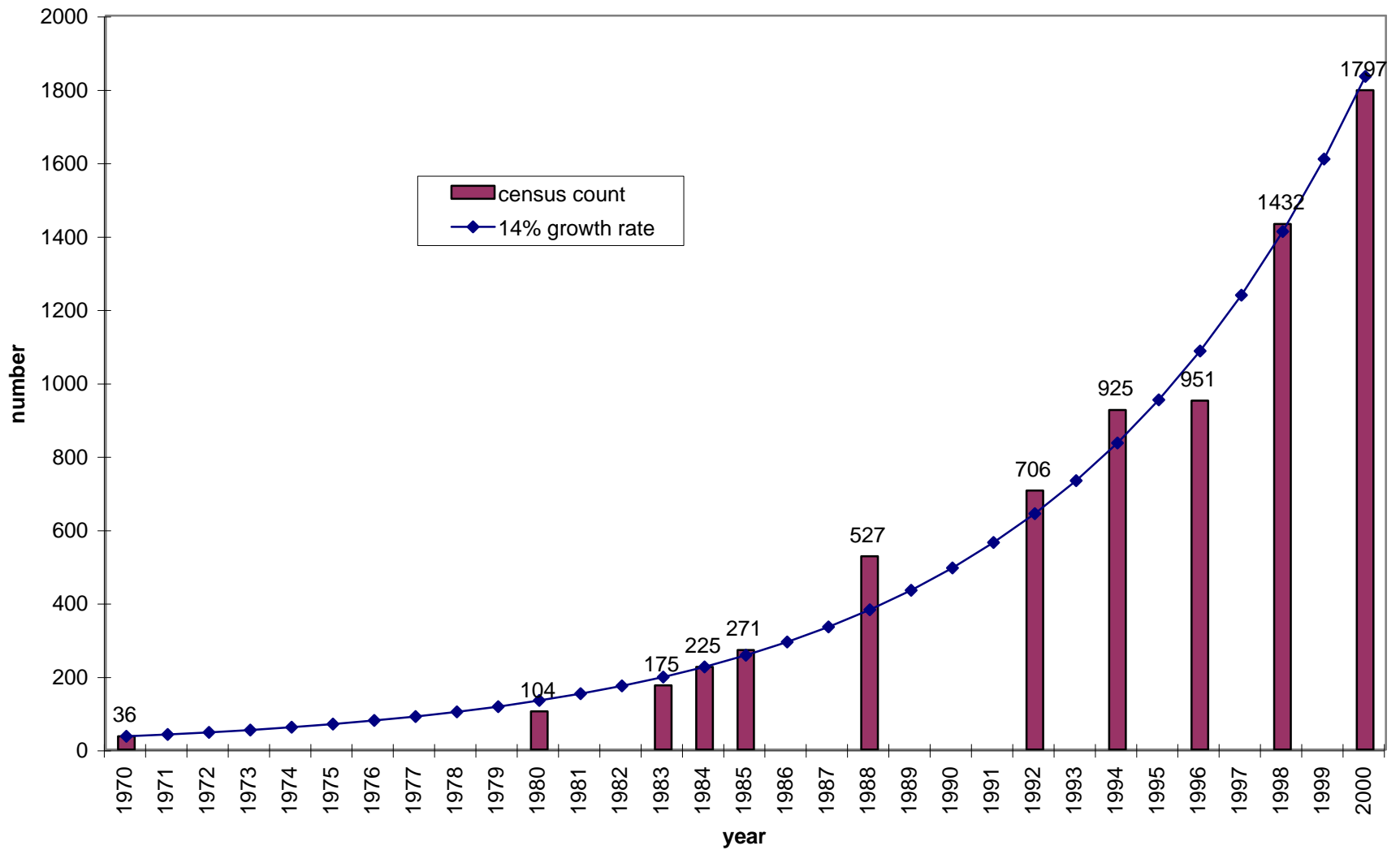


Figure 2 Estimated and counted number of Seward Peninsula muskoxen, 1970–2000

Table 1 Unit 22 and southwestern Unit 23 Seward Peninsula muskox census and composition results, spring 2000

Unit	Groups	Adults	Yearlings	Unclassified	Total
22B	17	144	15	0	159
22C	13	120	19	9	148
22D	56	662	112	0	774
22E	26	301	71	89	461
23SW	20	222	33	0	255
Total	132	1449	250	98	1797

Table 2 Unit 22 And Southwestern Unit 23 Seward Peninsula Muskox Census Results, 1992–2000

Year	Unit					Total
	22B	22C	22D	22E	23	
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
2000	159	148	774	461	255	1797

Table 3 Results (by number) of Seward Peninsula Muskox Hunts, 1998–1999

Hunt area and residence	State permits issued	State permits filled	Federal permits issued	Federal permits filled
UNIT 22D				
Brevig Mission	4	3	6	2
Golovin	1	0	0	0
Nome	9	7	0	0
Teller	6	5	6	2
White Mountain	4	4	0	0
Total	24	19	12	4
UNIT 22E				
Shishmaref	5	3	5	5
Wales	4	3	4	0
Total	9	6	9	5
Unit 23SW				
Buckland	0	0	5	0
Deering	2	1	3	2
Total	2	1	8	2
All hunt area - Total	35	26	29	11

Table 4 Results (by number) of Seward Peninsula Muskox Hunts, 1999–2000

Hunt area and residence	State permits issued	State permits filled	Federal permits issued	Federal permits filled
UNIT 22D				
Brevig Mission	12	4	4	2
Teller	8	3	8	2
White Mountain	4	4	0	0
Total	24	11	12	4
UNIT 22E				
Shishmaref	7	5	5	3
Wales	2	2	4	1
Total	9	7	9	4
Unit 23SW				
Buckland	0	0	5	0
Deering	2	1	3	0
Total	2	1	8	0
All hunt areas - Total	35	19	29	8

Table 5 Allocation of Seward Peninsula muskox permits for 1999–2000 season

Unit	State Tier II permits	Federal permits	Total
22D	33	6	39
22E	15	8	23
23	8	4	12
All units	56	18	74

LOCATION

GAME MANAGEMENT UNIT: U23 (43,422mi²)

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 muskoxen 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 are in Unit 23, and both are products of translocations from Nunivak Island. The department released 36 muskoxen on the southwestern portion of the Seward Peninsula near Teller in 1970. In 1981 the department released an additional 35 muskoxen in the same area. Muskox inhabiting that portion of Unit 23 between the Buckland and Goodhope Rivers are part of the Seward Peninsula population that resulted from these translocations near Teller. This 2001 Muskox Management Report (pages 13–30) includes descriptions of the muskox population in Unit 22 and the southwestern portion of Unit 23.

In 1970 the department also released 36 muskox near Cape Thompson. In 1977 the department released an additional 34 muskox at the same location. Of the 4 translocations of muskox to Alaska, the Cape Thompson population has grown least. Currently, the muskox 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 unit report covers only the Cape Thompson muskox population in northwestern Unit 23.

In addition to these relatively discrete populations, widely scattered muskox occur in groups of 1 or 2 individuals throughout most of the unit.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- 1 To allow for growth and expansion of muskox into historic ranges.
- 2 To provide for subsistence and recreational hunting on a sustained yield basis.
- 3 To provide for nonconsumptive uses; e.g., viewing and photography.

MANAGEMENT OBJECTIVES

- 1 To census the Cape Thompson population annually.
- 2 To monitor the sex and age composition of this muskox population.
- 3 To minimize effects of development (e.g., mines and roads), hunting, and tourism on muskox and their habitat.

METHODS

POPULATION STATUS AND TREND

Population Size

Since 1997 the Department, National Park Service (NPS), and Selawik Refuge have cooperatively censused the Cape Thompson muskox population annually from fixed-wing aircraft during June–July. The census area includes that portion of Unit 23 between the mouth of the Noatak River and Cape Lisburne within approximately 20 miles of the coast of the Chukchi Sea. Search effort focuses on known ranges and potential muskox habitat along ridgelines and riparian areas. We aerial search other areas less intensively. To minimize disturbance, pilots approached groups of muskox at 1000–2000 ft above ground level and crew repeatedly counted during a gradual, low power, spiral descent.

Population Composition

Little composition data has been collected for this population. During censuses we classified only calves and adults (all others, including immature animals). The NPS contracted a University of Alaska wildlife graduate student to collect composition data from ground-based observations on Cape Krusenstern National Monument during spring 1999 and 2001. These results will be included in the 2003 muskox management report.

Distribution and Movements

Locations of muskox observed during censuses were recorded using Global Positioning System (GPS) coordinates. Locations of muskox observed opportunistically during other work were also recorded using GPS coordinates. In addition, casual conversations between department staff and local residents, commercial operators, hunters, and nonconsumptive users provided information regarding the distribution of muskoxen in Unit 23.

MORTALITY

We did not monitor muskox mortality in this portion of Unit 23 during the reporting period.

Harvest

Harvest during the 2000–2001 regulatory year was monitored through the Tier II hunt report system and through phone calls to permit winners.

HABITAT

Assessment

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 (Fig. 1, Table 1). In contrast, the Seward Peninsula muskox population has grown about 14% annually during the same period. All muskox population estimates for Unit 23 are minimum counts. We feel they accurately represent temporal trends in abundance, even though we may overlook a small, unknown proportion of the population during aerial counts.

Population Composition

We classified 111 muskox during the composition surveys conducted from the ground during April 1999 (C. Ihl, personal communication). For muskox ≥ 2 years old, the bull:cow ratio was 87:100 and the yearling:cow ratio was 48:100. Since 1997, aerial censuses indicate calf production has been consistently high (Table 1). During the June and July 2000 census, the ratio of calves to adults was 30:100; in that census we counted 41 groups of muskoxen, 327 adults (adult = >12-months), and 97 calves (1–2 months) for a total of 424 muskoxen in the northwest portion of Unit 23 (Table 1).

Distribution and Movements

Muskoxen in this area rarely venture >15 miles inland from the Chukchi Sea coastline and exhibit strong fidelity to seasonal ranges. This probably occurs because chronic high coastal winds minimize snow depth on exposed ridges during winter and possibly the winds lower ambient air temperature during summer. Although snow depth in this coastal region is minimal, the quantity and quality of forage appears very limited during winter. When snow depth exceeds 10–12 inches, muskoxen move to exposed, sparsely vegetated domes and ridges where snow cover is minimal. During winter muskox survive on body-fat reserves and extremely conservative behavior to compensate for low intake of food. In contrast, food in this area during summer appears abundant. Unlike caribou during summer, muskoxen seem oblivious to insect harassment. In summer muskoxen use riparian areas and frequently wade in rivers and lagoons, perhaps to play and cool off.

During 1996–1997 most muskoxen that inhabited the Tahinichok Hills, Rabbit Creek, and Jade Creek area shifted their center of habitation 15–30 miles southeast to occupy the western portion of the Igichuk Hills. These muskox continued to use this area year-round during this reporting period. Beginning in 1999 many muskox that had resided year-round in the Ogotoruk Creek/Cape Thompson area shifted their range north to the Lisburne Hills.

Small groups of widely scattered muskox are throughout the entire Noatak River drainage, the Kobuk River drainage at least as far east as the Ambler River, and the Selawik drainage including the middle Tagagawik River and headwaters of Derby Creek. Almost invariably, these muskoxen are mature bulls. I have observed only 1 mixed sex/age group outside the core range on the Seward Peninsula or Cape Thompson: 5 individuals were near the border of Units 21D and 23 during June 1992.

MORTALITY

Harvest

Season and Bag Limit. There was no harvest for the Cape Thompson muskox population during this reporting period. However, the first muskox hunt in this area was during the 2000–2001 regulatory year (after this reporting period). Six permits were issued, 4 to residents of Point Hope and 2 to residents of Kivalina, and a Point Hope resident harvested 1 muskox.

Board of Game Actions and Emergency Orders. The Board of Game established a Tier II hunt (TX107) in that portion of Unit 23 north and west of the Noatak River at their fall 1999 meeting. The season was August 1–March 15, and the bag limit was 1 bull by Tier II subsistence hunting permit. Trophy value was to be destroyed by removing 3 inches of horn if the head was taken outside Unit 23. This hunt went into effect during the 2000–2001 regulatory year. No emergency orders were issued for muskox in northwest Unit 23 during this reporting period.

Hunter/Trapper Harvest. No hunt occurred during this reporting period in the northwest portion of Unit 23. Harvests of muskox from the Seward Peninsula portion of Unit 23 are reported in the Unit 22 muskox management report.

Permit Hunts. No permit hunt occurred during this period in the northwest portion of Unit 23.

Hunter Residency and Success. No hunt occurred during this segment period in the northwest portion of Unit 23.

Harvest Chronology. No hunt occurred during this reporting period in the northwest portion of Unit 23.

Transport Methods. No hunt occurred during this period in the northwest portion of Unit 23.

Natural Mortality

A guide reported an old bull muskox killed by a brown bear in the upper Kivalina River drainage during May 2001 (P. Driver, personal communication). I suspect this was a lone bull I had repeatedly seen in that area since 1999. In previous years I have received reports of a golden eagle killing a neonate muskox (B. Johnson, personal communication) and a sow brown bear killing a yearling muskox (L. Crumpton, personal communication), both near Cape Thompson.

Other Mortality

In September 2000 the Department of Public Safety received a report that a bull muskox had been shot and killed near the winter trail that crosses Cape Thompson and that another bull had been wounded (J. Rodgers, personal communication). The public safety officer later observed an entire muskox carcass in this location, but weather precluded searching for the wounded muskox.

HABITAT

Assessment

There were no muskox habitat assessment activities in Unit 23 during the reporting period.

Enhancement

There were no muskox habitat enhancement activities in Unit 23 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Conflicts among muskox, caribou, and reindeer

Many local residents of northwest Alaska feel that muskox displace caribou and reindeer through behavioral interactions and the presence of muskox quiviut (undercoat) and feces in areas used by each 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 muskox to Unit 23. In addition to the perception that muskox displace caribou and reindeer from important hunting and herding areas, local residents picking berries during late summer feel threatened by muskoxen, even though no one has ever been harmed by a muskox in this area (and perhaps Alaska). Local residents also resent that they were not consulted before muskox were introduced to this unit. This negative local sentiment toward muskox has diminished somewhat on the Seward Peninsula with the establishment of limited hunting opportunities.

During August and September when muskox are rutting, bulls sometimes wander into communities, including Kotzebue, and onto airport runways. These muskox have usually been chased away with vehicles without harm to people, the muskox, or property. However, there has been property damage at Deering where muskoxen have repeatedly pushed over grave crosses by using them as scratching poles.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- 1 Two distinct populations of muskox 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 Drainages. Both populations stem from translocations initiated by the department in 1970. Muskoxen are scattered throughout much of the rest of Unit 23.
- 2 The Cape Thompson population has grown approximately 8% annually since 1970. Of the 4 translocations of muskox to Alaska, the Cape Thompson population has grown least.
- 3 Muskox exhibit strong fidelity to seasonal ranges. This characteristic is most pronounced for large mixed sex/age groups.
- 4 Muskox use riparian areas during summer. Water, gravel bars, and willows seem to attract them.

- 5 When snow depth exceeds 10–12 inches, muskox winter on exposed, sparsely vegetated domes and ridges where snow cover is minimal. Muskox use body-fat reserves and extremely conservative behavior to survive through winter.

Recommendations

- 1 Muskoxen are vulnerable to human harvests. They are easy to find and normally do not flee when approached. The effects of hunting muskox are not limited to harvesting individuals from the population. The greater effect of harvests may lie in repeated harassment of large mixed sex/age groups as hunters approach these groups. Energetic costs associated with flight and increased activity associated with hunting may affect mortality rates, especially when snow is deep or snow accumulates in early winter. Muskox defensive behavior predisposes them to wounding losses when bullets pass through one individual and into another. I suggest:
 - a. Muskox harvests in Unit 23 should be conservative until the department can assess harvest impacts to the population.
 - b. Hunters should be encouraged to focus on bull groups.
 - c. Hunting should not be allowed after mid-March to protect pregnant cows from disturbance as they approach parturition. Cows are already at high-energy demands during late pregnancy and lactation when their fat reserves are lowest.
- 2 Hunts should be cooperatively managed by state and federal agencies in this portion of Unit 23.
- 3 Department staff should continue to assist the public with Tier II muskox applications when necessary because many local residents find them confusing. Local license vendors should be trained and encouraged to help residents with applications. The Kotzebue office has inadequate staff to travel to all 5 villages (Buckland, Deering, Noatak, Kivalina, and Point Hope) within the 2 hunt areas during May to assist with filling out permit applications. This logistics problem may give village residents the impression that the department is unfairly soliciting local participation in these hunts.

PREPARED BY:

Jim Dau
Wildlife Biologist III

SUBMITTED BY:

Peter J. Bente
Survey-Inventory Coordinator

Table 1 Muskox census results for the northwest portion of Unit 23, 1988–2000

	May 1988	June 1994	March 1997	June 1997	June 1998	June 1999	June/July 2000
Groups	14	19	24	26	39	34	41
Adults ^a	106	215	291	212	322	299	327
Calves ^b	17	18		49	65	75	97
Total	123	233	291	261	387	374	424
Calves:100 Adults	16	8		23	20	25	30

^a “Adult” defined as any muskox >12 months old

^b “Calf” defined as any muskox 1-2 months old

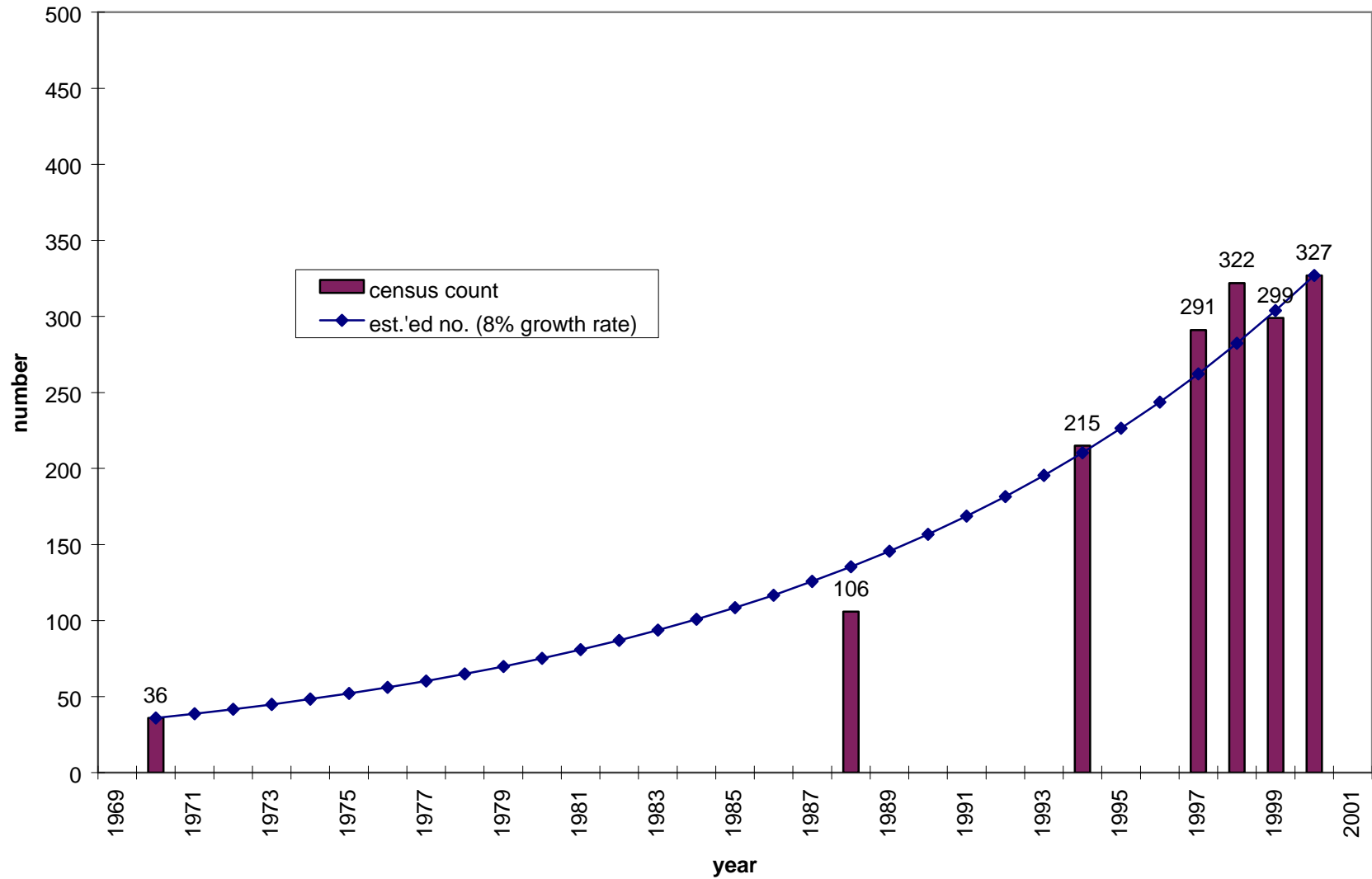


Figure 1 Counted and estimated number of muskox >12 months old in the northwest portion of Unit 23, 1970-2000

LOCATION

GAME MANAGEMENT UNITS: 26B and 26C (26,000 mi²)

GEOGRAPHIC DESCRIPTION: Central and Eastern Arctic Slope

BACKGROUND

Muskox populations in Alaska declined or, in some areas, disappeared before firearms were widely available. Yet before the availability of firearms, hunting by humans appears to have been an important factor in the disappearance of muskoxen (Lent 1998). However, the last records of muskoxen in Alaska were in the late 1800s or early 1900s when hunters used firearms to take groups and individual muskoxen. The department reintroduced muskoxen 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. The department translocated these animals 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. Hunters have harvested small numbers of bulls 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).

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

MANAGEMENT DIRECTION

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).

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 late March or early April by flying transects and drainages in Units 26B and 26C using a Cessna 185. Whenever possible, two observers were in the back and one 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 adjacent tributaries and bluffs. 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 April 2000 the transect method also was applied to Unit 26B East. In addition to flying transects, we tracked radiocollared females to locate groups of muskoxen.

We conducted ground-based composition counts in Units 26B and 26C in late June or early July. We first located groups of muskoxen by fixed-wing aircraft, helicopter, and radiotracking, then classified animals from the ground as >4 years old, 3 years old, 2 years old, yearling, or calf and as male or female. We used a *t*-test to compare population data from different years.

During 1994–1995 through 2000–2001, we monitored 8–10 radiocollared adult females to locate muskoxen during 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 R-44 helicopter to locate muskoxen and determined if there were adult females in the group. We dropped off one person before the 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 radio 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 0.5 ml doses of carfentanil were 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. In July 2000 a truck driver noticed the radio collar on a muskox near Sagwon Bluffs had slipped partially off her head and was hanging on her face. ADF&G and FWS staff darted the

muskox and recollared her, fitting the collar more tightly. Two more adult females were darted and radiocollared by ADF&G staff in June and July 2001.

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 Jul–30 Jun; e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

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 Unit 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 RY94 and subsequently may have stabilized or declined slightly (Table 1). The number of animals observed in April 2000 was 523. We still expected an increase in the population in the 1980s and early 1990s due to continuous exploitation of new habitat. The recent decline was perhaps due to animals emigrating to the Yukon Territory, increased predation by brown bears, and a slower rate of increase by animals in Unit 26C. However, analysis of the data to determine trend revealed little change over the past 10 years. The mean number of muskoxen observed (± 1 [s]) was 551 ± 48 during 1996 through 2000, and 529 ± 82 observed during the 5 years before 1996 ($P = 0.67$).

Muskoxen observed during precalving surveys in Unit 26B increased steadily during the 1980s and fluctuated during the 1990s. The number of animals observed in April 2000 was 277. No surveys were conducted in 2001. The mean number of muskoxen observed (± 1 [s]) was 253 ± 31 during 1996 through 2000, which was not much different from 223 ± 70 observed during the 5 years before 1996 ($P = 0.38$; Table 1). However, the mean number of muskoxen observed was higher during the past 5 years, indicating a possible 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, emigration out of the area, and recruitment. Once systematic surveys were conducted in Unit 26B West, these fluctuations were reflected mostly 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, remaining relatively constant during 1997 through 2000.

Muskoxen observed in Unit 26C during precalving surveys seemed stable at approximately 325 muskoxen for 5 years and decreased to 256 in 1999 and 246 in 2000 (Table 1). However, analysis of these data over a 10-year period revealed no trends. The mean number of muskoxen observed (± 1 [s]) was 297 ± 43 during 1996 through 2000, which was not much different from 306 ± 22 observed during the 5 years before RY95 ($P = 0.77$; Table 1). Immigration from Unit 26B and emigration into Unit 26B and the Yukon Territory could have caused lower numbers of muskoxen recently observed in Unit 26C. Nonetheless, calf production and yearling recruitment (discussed below) also

were lower in Unit 26C; thus, population dynamics may be changing. Although analysis over a 10-year period revealed no trends in total population size, recruitment may have equaled mortality because muskoxen are long-lived. Population size probably will be affected if calf production and recruitment continue to decline dramatically.

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 (P Reynolds, FWS, personal communication).

Population Composition

Composition survey data for Units 26B and 26C combined indicated that calf production declined during 1996 through 2000 (Table 1). Mean percent calves ($\pm 1 [s]$) was $13\% \pm 2\%$ during 1996 through 2000, which was considerably lower than $17\% \pm 3\%$ observed during the 5 years before 1996 ($P = 0.02$). This difference was also observed in calves:100 females >2 years. Mean calves:100 females >2 years ($\pm 1 [s]$) was 31 ± 7 during 1996 through 2000, also considerably lower than 49 ± 12 observed during the 5 years before 1996 ($P = 0.003$). In addition, yearling recruitment (mean percent yearlings $\pm 1 [s]$) was also lower during 1996 through 1997 ($P = 0.05$; 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 indicating that there were adequate bulls to breed cows during 1996 through 2000.

In Unit 26B, mean percent calves ($\pm 1 [s]$) was $16\% \pm 6\%$ during 1996 through 2000 and was not much different than $19\% \pm 4\%$ observed during the 5 years before 1996 ($P = 0.60$). Mean calves:100 females >2 years ($\pm 1 [s]$) was 39 ± 18 during 1996 through 2000 and 51 ± 11 observed during the 5 years before 1996 ($P = 0.17$). Percent yearlings also had little change ($\bar{x} \pm 1 [s] = 13\% \pm 4\%$, $\bar{x} \pm 1 [s] = 13\% \pm 5\%$, $P = 0.34$). Percent calves, calves:100 females >2 years, and percent yearlings in 2001 did not deviate much from the 1996–2000 means (16%, 48:100, and 14%). Annual bull (>3 years):100 cow (>2 years) ratios were similar between the 2 5-year periods ($P = 0.30$) and were 35–62 during 1996 through 2000. Variability in bull:cow ratios may correlate to a difficulty in locating bull groups, which is related to search effort.

In Unit 26C, mean percent calves ($\pm 1 [s]$) was $10\% \pm 7\%$ during 1996 through 2000, which was considerably lower than $16\% \pm 4\%$ observed during the 5 years before 1996 ($P = 0.03$). This difference was also observed in calves:100 females >2 years. Mean calves:100 females >2 years ($\pm 1 [s]$) was 24 ± 19 during 1996 through 2000 and 45 ± 11 observed during the 5 years before 1996 ($P = 0.02$). Yearling recruitment (mean percent yearlings $\pm 1 [s]$) also was lower during 1996 through 2000 ($P = 0.007$). During 1999 and 2000, both percent calves and percent yearlings (7%, 8% and 1%, 9%, respectively) were lower than the previous 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 have increased their efficiency as predators of muskoxen (P Reynolds, FWS, personal communication). Because muskoxen have not existed in Unit 26B as long as in Unit 26C, brown bears in Unit 26B may not be as efficient at preying on muskoxen as those in Unit 26C. Habitat also may have affected calf production. Unit 26B probably has more suitable habitat to exploit. In addition, weather patterns (particularly in spring and winter) are different in Unit 26C compared to Unit 26B because of the close proximity of the Brooks Range to the coast in Unit 26C.

Deeper snows and harder snow crust may occur in Unit 26C, making foraging more difficult during winter (P Reynolds, FWS, personal communication). In addition, a very late spring occurred on the North Slope in 2000. Annual bull (>3 years):cow (>2 years) ratios were not different between the 2 5-year periods ($P = 0.55$; Table 1) and ranged from 40 to 60 bulls (>3 years):100 cows (>2 years) during 1996 through 2000.

Distribution and Movements

Until recently, muskoxen in northeastern Alaska were primarily in Unit 26C. Approximately 40% of the population is now in Unit 26B. Muskoxen have also extended their range eastward into the Yukon. In March and April 2000, Canadian biologists estimated the Yukon population at 150 muskoxen. Small numbers of muskoxen are also as far west as Fish Creek, west of the Colville River in Unit 26A. A few bull muskox have recently been sighted at various locations near the Yukon River between Galena and Eagle. We do not know if 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 frequently. 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. During summer 1998, 3-D seismic activity for oil and gas exploration increased dramatically in the Itkillik Hills 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 mi) 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 mi from Franklin Bluffs). In addition, a female that was captured from the Franklin Bluffs group in April 1999 was located on the coast in late June, having joined a different group (approximately 25 mi).

MORTALITY

Harvest

Seasons and Bag Limits. 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 during the months of October and March in Units 26B (Hunt TX1010) and 26C (Hunts TX1012 and TX1014) beginning in RY90. In RY92, US Fish and Wildlife Service (FWS) took over management of subsistence hunting of muskoxen in Unit 26C, and the state season was closed to prevent overharvest. During RY96, 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 RY97. For RY98 through RY99, the season for the Tier II hunt (TX108), Unit 26B west of the Dalton Highway, was changed to 15 September through 31 March for any muskox. In addition,

the Tier II hunt (TX110), Unit 26B east of the Dalton Highway, was changed to a Tier I registration hunt (RX110) opened by emergency order and closed no later than 30 March with a harvest quota of 4 muskoxen. A drawing hunt (DX112) was established with 3 permits issued for 1 bull muskoxen with 20 Sep–10 Oct and 10–30 Mar seasons. For RY99, the seasons remained the same, but the area for RX110 was changed to Unit 26B east of the Dalton Highway Management Corridor. For RY00, the Tier II hunt (TX108) was extended further by opening the hunt on 1 August. All other seasons and bag limits remained the same.

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 through 1999–2000	9; Tier II; 1 muskox	15 Sep–31 Mar	No open season
2000–2001	10; Tier II; 1 muskox	1 Aug–31 Mar	No open season
2001–2002	9; Tier II; 1 muskox	1 Aug–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 through 2001–2002	(harvest quota of 4); Tier I; 1 muskox and 3; Drawing; 1 bull	To be announced; season closed no later than 31 Mar and 20 Sep–10 Oct; 10–30 Mar	No open season
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 through 2001–2002	15; Federal; 1 bull (3 permits for females)	15 Sep–31 Mar	No open season

Board of Game Actions and Emergency Orders. 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) was also 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 \$25.00 resident muskox tag fee 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 or other North Slope villages 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. During fall 2000, the legislature changed the wording in Title 19 so the new hunting regulation was immediately implemented.

Hunter/Trapper Harvest. Hunting for muskoxen in the eastern North Slope was allowed only under permit. The number of permits available and weather conditions such as snow and fog influenced the harvest. The total reported harvest in Units 26B and 26C has been 5–18 since RY90 when both units were opened to hunting and has been <2.5% of the total population, except for RY98 when it was 4% (Table 2). In all of Unit 26B, reported harvest was 0–10 during RY90 through RY99. During RY95 through RY99, harvest in Unit 26B West was 2–5 and in Unit 26B East it was 1–6 (Table 2). Reported harvest in Unit 26C was 5–11 during RY90 through RY99. Restrictions in regulations ensure a low harvest. Some hunters did not report their harvests, despite the permit systems.

Hunter Residency and Success. Before RY90 muskoxen were harvested under a registration permit system in which both residents and nonresidents could participate (Golden 1989; Lenart 1999). From RY90 through RY97, state Tier II or federal subsistence permits were issued only to local residents (Unit 26; Table 2). Beginning in RY98, nonlocal residents could participate in the registration and drawing hunts east of the Dalton Highway in Unit 26B; residency and success for these hunts are in Table 3. Since RY86, success has been 73–100% for Unit 26B and 26C combined and residency included predominantly local residents (Table 4). 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 we had included unreturned reports.

Transport Methods and Harvest Chronology. Hunters relied primarily on snowmachines to hunt muskoxen. However, hunters also used aircraft in a few fall hunts, and beginning in RY96 a few hunters used boats (Table 5).

Chronology of harvest depends mostly on weather (e.g., snow, fog, temperature, and rivers freezing). During RY95 through RY99, approximately 50% of the harvest occurred in March for

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 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 in 26C and in the future may become a more important source of mortality. Late winter storms contribute to mortality of calves, yearlings, and old adults, but these losses are generally minimal. 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 capture-related. 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. We suspect she was killed by a brown bear because we saw a brown bear near the carcass and another bear nearby. Another muskoxen collar was on mortality mode in July 1999 on the Toolik River. Because the collar was in the river, we were unable to investigate. Thus, 3 of the 12 muskoxen collared in April 1999 were dead by July 1999.

Other Mortality

Some human-caused mortality is capture-related, and some occurs on the Dalton Highway from vehicles hitting muskoxen. Causes of many mortalities are unknown. A mortality, probably from the previous winter, was discovered in July 2000. This animal was originally captured near Sagwon Bluffs and was found dead in the upper Canning River. Two more mortalities occurred between 20 April 2001 and mid-June 2001. One muskox was found on the Canning delta and the other was on the Kadleroshik River. We found a muskox that had been collared in July 2001 dead on August 2001, 20 miles from the capture site. This last mortality probably was not capture-related because of this distance.

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 during the 1980s. 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, personal communication).

CONCLUSIONS AND RECOMMENDATIONS

The overall population size in Units 26B and 26C appears to be relatively stable, but the dynamics of populations in the subunits is different with substantial declines in calf survival and yearling recruitment in Unit 26C, but not in Unit 26B. The major factors influencing this were probably brown bears becoming more efficient predators and annual variation in weather affecting female body condition and winter foraging.

Harvest was below 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 muskox population in the future.

ACCOMPLISHMENTS

We met our first and fourth goals 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. We worked with local residents to address Goal 2 to minimize detrimental effects that muskoxen may have on caribou and caribou hunting; no such effects were noted during this reporting period. We met Goal 3 by cooperating with FWS to share information on population data, interpretation of data, and cooperating in the field to conduct composition counts and surveys. 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. We also worked with the North Slope Borough and local residents to address concerns about the RX110 registration hunt and about new boundaries for the TX110 hunt.

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PREPARED BY:

Elizabeth A Lenart
Wildlife Biologist II

SUBMITTED BY:

Doreen Parker McNeill
Assistant Management Coordinator

REVIEWED BY:

Patrick Valkenburg
Research Coordinator

Laura A McCarthy
Publications Technician II

Table 1 Unit 26B and 26C muskoxen minimum population estimate and composition counts, 1987–2001^a

Location ^d /Year	Minimum population estimate ^b		Postcalving composition surveys ^c					
	Muskoxen observed	Unit 26B (West) ^e	Muskoxen classified (excluding calves)	Bulls >3 yr:100 cows>2 yr (number bulls >3 yr)	Calves:100 cows>2 yr (number cows >2 yr)	Percent yearlings (n)	Percent calves (n)	
UNITS 26B & 26C								
1987	390		339 (275)	28 (37)	48 (133)	12 (42)	19 (64)	
1988	410		371 (287)	42 (49)	71 (118)	16 (60)	23 (84)	
1989	484		280 (236)	29 (32)	39 (112)	14 (40)	16 (44)	
1990	454		369 (311)	41 (56)	43 (135)	15 (57)	16 (58)	
1991	438		475 (380)	50 (76)	63 (179)	11 (54)	20 (95)	
1992	507		517 (435)	51 (97)	43 (191)	16 (82)	16 (82)	
1993	563		535 (426)	43 (83)	56 (194)	11 (61)	20 (109)	
1994	484		432 (361)	51 (76)	48 (148)	16 (70)	16 (71)	
1995	651		385 (338)	57 (80)	33 (141)	12 (47)	12 (47)	
1996	598		239 (198)	40 (39)	42 (98)	9 (22)	17 (41)	
1997	633		485 (431)	47 (93)	28 (196)	14 (70)	11 (54)	
1998	538		308 (264)	36 (48)	33 (132)	10 (30)	14 (44)	
1999	493		466 (419)	61 (120)	25 (198)	9 (44)	10 (47)	
2000	523		356 (314)	38 (63) ^f	25 (165)	10 (34)	12 (42)	
2001	n/a		n/a	n/a	n/a	n/a	n/a	
UNIT 26B								
1990	122		83 (69)	41 (14)	41 (34)	13 (11)	17 (14)	
1991	156		98 (75)	69 (24)	66 (35)	9 (9)	24 (23)	
1992	224		193 (162)	43 (33)	40 (77)	16 (31)	16 (31)	
1993	237		131 (103)	41 (21)	55 (51)	8 (10)	21 (28)	
1994	166		91 (76)	46 (13)	54 (28)	21 (19)	17 (15)	
1995	330		145 (123)	55 (29)	42 (53)	10 (15)	15 (22)	
1996	266		44 (41)	35 (8)	13 (23)	11 (5)	7 (3)	
1997	279	92	123 (107)	46 (23)	32 (50)	20 (24)	13 (16)	
1998	207	79	97 (78)	24 (10)	45 (42)	10 (10)	20 (19)	
1999	237	96	194 (162)	62 (44)	45 (71)	12 (23)	17 (32)	
2000	277	90	172 (131)	35 (24) ^f	60 (68)	10 (17)	24 (41)	
2001	258 ^g	107 ^g	286 (239)	64 (63) ^f	48 (98)	14 (39)	16 (47)	
UNIT 26C								
1990	332		286 (242)	42 (42)	44 (101)	16 (46)	15 (44)	
1991	282		377 (305)	36 (52)	50 (144)	12 (45)	19 (72)	
1992	283		324 (273)	56 (64)	45 (114)	16 (51)	16 (51)	
1993	326		404 (323)	43 (62)	57 (143)	13 (51)	20 (81)	

Location ^d /Year	Minimum population estimate ^b		Postcalving composition surveys ^c					
	Muskoxen observed	Unit 26B (West) ^e	Muskoxen classified (excluding calves)	Bulls >3 yr:100 cows>2 yr (number bulls >3 yr)	Calves:100 cows>2 yr (number cows >2 yr)	Percent yearlings (<i>n</i>)	Percent calves (<i>n</i>)	
1994	318		341 (285)	53 (63)	47 (120)	15 (51)	16 (56)	
1995	321		240 (215)	58 (51)	28 (88)	13 (32)	10 (25)	
1996	332		195 (157)	41 (31)	51 (75)	9 (17)	20 (38)	
1997	324		362 (324)	48 (70)	26 (146)	13 (46)	11 (38)	
1998	331		211 (186)	42 (38)	28 (90)	10 (20)	12 (25)	
1999	256		272 (257)	60 (76)	14 (127)	8 (21)	7 (15)	
2000	246		184 (183)	40 (39)	1 (97)	9 (17)	<1 (1)	
2001	n/a		n/a	n/a	n/a	n/a	n/a	

^a Data source for Unit 26C for all years and for Unit 26B for 1986–1987 through 1997–1998; PE Reynolds, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.

^b Minimum population estimates were determined during late March or early April and based on total muskoxen observed.

^c Postcalving composition classification was conducted during mid-June through early July.

^d Unit 26C surveys encompassed the Canning to Clarence Rivers. Unit 26B surveys occurred east of the Sagavanirktok River until RY96 when the entire subunit from Colville to Canning Rivers was surveyed.

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

^f Beginning in 2000, 3-year-old bulls were included for Unit 26B.

^g Estimated from June composition by excluding calves and including observations of adults not classified.

Table 2 Unit 26B and 26C muskoxen harvest data by permit hunt, regulatory years 1986–1987 through 2000–2001

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)	8	0	8
1991–1992	TX1010	26B	2	2	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
	RX1013 (F)	26C	10	9	8	8 (100)	8	0	8
1993–1994	TX110	26B	2	2	1	1 (100)	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	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)	14	9	5	3 (60)	3	0	3
	DX112	26B (East)	3	3	3	3 (100)	3	0	3
	RX1013 (F)	26C	15	15	11	8 (73)	8	0	8
1999–2000	TX108	26B (West)	9	9	5	1 (11)	1	0	1
	RX110	26B (East)	3	3	0		0	0	0
	DX112	26B (East)	3	3	2	2 (100)	2	0	2
	RX1013 (F)	26C	15	15	10	8 (80)	8	0	8
2000–2001 ^e	TX108	26B (West)	10 ^f	10	6	5 (83)	4	1	5
	RX110	26B (East)	20 ^g	6	6	6 (100)	6	0	6
	DX112	26B (East)	3	3	3	3 (100)	3	0	3
	RX1013 (F)	26C	15	n/a	n/a	n/a	n/a	n/a	n/a

^a Hunt types: RX = registration; TX = tier II; DX = drawing; F = federal hunt; 1007 = Unit 26C; 1010 and 110 = east of Dalton Hwy and since RY99 = east of Dalton Hwy Mgmt Corridor; 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 federal hunts because unused permits are reissued. In hunt RX110, unlimited number of permits available; harvest quota = 4.

^c Determined from returned reports.

^d Illegal animal.

^e Preliminary data.

^f Only 9 permits were to be issued; but due to a mistake in Stats section, 10 were issued and this was not considered a biological problem.

^g Approximately 25 permits were issued in Nuiqsut; but the vendor did not retain the overlays; so we are uncertain about the exact number issued.

Table 3 Hunts RX110 and DX112 muskoxen hunter residency and success, regulatory years 1998–1999 through 2000–2001

Hunt/ Regulatory year	Successful			Unsuccessful			Total hunters
	Local ^a resident	Nonlocal resident	Total (%)	Local ^a resident	Nonlocal resident	Total (%)	
RX110							
1998–1999	2	1	3 (60)	1	1	2 (40)	5
1999–2000	0	0	0	0	0	0	0
2000–2001	4	2	6 (100)	0	0	0	6
DX112							
1998–1999	0	3	3 (100)	0	0	0	3
1999–2000	0	2	2 (100)	0	0	0	2
2000–2001	0	3	3 (100)	0	0	0	3

^a Local resident is a resident of Unit 26.

Table 4 Units 26B and 26C muskoxen hunter residency and success, regulatory years 1986–1987 through 1999–2000

Regulatory ^a year	Successful				Unsuccessful				Total hunters ^c
	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	
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	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)	3	0	0	3 (27)	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	14	4	0	18 (78)	4	1	0	5 (22)	23
1999–2000	9	2	0	11 (73)	4	0	0	4 (27)	15

^a Before RY86 only Alaska residents were allowed to hunt muskoxen. In RY90 through RY97 muskoxen hunting was limited to local residents of Unit 26. In RY98, that portion of Unit 26B, east of the Dalton Highway was opened to include all Alaska residents.

^b Local is a resident of Unit 26.

^c From hunters who reported that they hunted.

Table 5 Units 26B and 26C muskoxen harvest by transport method, regulatory years 1986–1987 through 1999–2000

Regulatory year	Harvest by transport method					Total ^a
	Highway vehicle	Airplane	Dog team	Snowmachine	Boat	
1986–1987	0	0	0	3	0	3
1987–1988	0	2	0	4	0	6
1988–1989	0	2	0	4	0	6
1989–1990	0	9	0	1	0	10
1990–1991	0	1	1	6	0	8
1991–1992	0	0	0	5	0	5
1992–1993	0	0	0	8	0	8
1993–1994	0	1	0	7	0	8
1994–1995	0	0	0	9	0	9
1995–1996	0	2	0	9	0	11
1996–1997	0	0	0	13	1	14
1997–1998	0	0	0	8	1	9
1998–1999	1	0	0	15	2	18
1999–2000	2	0	0	9	0	11

^a Total hunters reporting.