Muskox
Management Report
of survey-inventory activities
1 July 2000–30 June 2002

Carole Healy, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation

ADF&G

Funded through
Federal Aid in Wildlife Restoration
Grants W-27-4 and 5
DECEMBER 2003

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

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MUSKOX MANAGEMENT REPORT

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MUSKOX MANAGEMENT REPORT

From: 1 July 2000
To: 30 June 2002

LOCATION

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

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

NUNIVAK ISLAND

Muskox were once widely distributed in northern and western Alaska but were extirpated throughout their range by the middle or late 1800s. In 1929, with the support of the Alaska Territorial Legislature, the US Congress initiated a program to reintroduce muskox in Alaska. During 1935–1936, 31 muskox were introduced from Greenland to Nunivak Island in Unit 18 as the first step toward reintroducing this species to Alaska. The Nunivak Island population grew slowly until approximately 1958 and then it 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 Island muskox population, which had a minimum of 609 animals in fall 2001.

NELSON ISLAND

During 1967–1968, 23 subadult muskox 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. In 1981, when the population approached the management goal of 200–250 animals, 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 adopted in 1995. The management plan sets a population goal of at least 250 animals and, for the past 20 years, the Nelson Island muskox population has fluctuated between a high of 297 animals and a low of 123 animals. In 2001 the population was a minimum of 306.

YUKON–KUSKOKWIM DELTA

Having originally emigrated from Nelson Island, fewer than 100 muskox inhabit the mainland of the Yukon–Kuskokwim Delta. Mainland muskox 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 muskox expanding into new range. However, poaching is a major factor preventing the mainland population from becoming firmly established. Also, wandering muskox 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 size, distribution, sex and age composition, productivity, mortality, hunting pressure, population trends, and habitat conditions.

MANAGEMENT OBJECTIVES

- 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 muskox on Nelson Island and 500–550 on Nunivak Island.

- Issue drawing and registration permits for harvesting muskox to maintain optimal herd size, composition, and productivity of the muskox populations on Nunivak and Nelson Islands.

- Provide hunter orientation and posthunt checkout to ensure hunters understand permit requirements, properly identify legal muskoxen, and report their harvests timely and correctly.

- Determine the distribution and dispersal of muskox on the mainland.

- Use the cooperative management plans for Nunivak and Nelson Islands.

METHODS

During 6-8 October 2001, we used a Robinson R-44 helicopter on Nunivak Island to conduct a population census. During this census we classified muskox 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 a fixed-wing aircraft during 12–14 July 2000 on Nunivak Island and 28 July 2001 on Nelson Island to conduct population censuses. When using fixed-wing aircraft we are unable to obtain composition beyond classifying calves and older age animals.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Throughout the reporting period the population on Nunivak Island has remained healthy and productive. The population trend of 500–550 animals post-hunt pre-calving is kept stable by using drawing and registration permits to take about 90 animals a year.

The population on Nelson Island fluctuates much more than the Nunivak Island population. Several factors contribute to this. These include human-induced mortality and movements on and off the island.

Population Size

During a fixed-wing census of Nunivak Island conducted on 12–13 July 2000, we counted 628 muskoxen in 78 groups. During a helicopter census of Nunivak Island conducted on 6-8 October 2001, we counted 609 muskox. Both the 2000 and 2001 census numbers appear higher than the management goal for the population. However, the population goals are for post-hunt, pre-calving periods; the census results are post-calving counts. In 2000 the population without calves was 526 and in 2001 it was 515. During both years the population was well within the population management goals.

On 22 June 2000 and 28 July 2001 we censused Nelson Island muskoxen using fixed-wing aircraft. We counted 233 in June 2000 and 306 in July 2001 (Table 1).

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 in both areas.

Population Composition

On Nunivak Island, we counted 628 muskox on 12–13 July 2000, using a Cessna 182 fixed-wing aircraft (Table 2). Of these, 102 were calves and 526 were greater than 1-year-old. We classified only calves and greater than 1-year-old muskox.

Using a Robinson R-44 on 6–8 October 2001, we determined the composition of the Nunivak Island population. We found 148 adult males (4+ years-old), 167 adult females (4+ years-old), 56 3-year-old males, 28 3-year-old females, 67 2-year-old males, 48 2 –year-old females, 94 calves and one unknown (Table 3). The total is 609 muskox.

On 22 June 2000, we counted 233 Nelson Island muskox during a census using a Cessna 182 fixed-wing aircraft. Sixty muskox were calves and 173 were greater than one year old. On 28 July 2001, we counted 306 muskox on Nelson Island using an Aviat Husky fixed-wing aircraft. Eighty of these were calves and the rest, 226 were greater than one year old (Table 4).

Distribution and Movements

During summer 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 found 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 Andreafsky 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 Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Nunivak Island		
Residents and Nonresidents: 1 bull by drawing permit only, with up to 10 permits to be issued for the fall season and up to 35 permits to be issued for the spring season; or 1 cow by registration permit only, with up to 45 permits for cows to be issued	1 Sep-30 Sep (General hunt only) 1 Feb-15 Mar (General hunt only)	1 Sep-30 Sep 1 Feb-15 Mar

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
on a first-come, first served basis.		
Unit 18, Nelson Island		
Residents and Nonresidents: 1 muskox by registration permit only; up to 42 permits will be issued on a first-come, first-served basis.	1 Feb-25 Mar (General hunt only)	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.

At the Fall 2001 Board of Game meeting, the board adopted a proposal to increase the maximum numbers of permits available for the Nelson Island from up to 30 to up to 42. This regulation is effective beginning July 2002.

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 2000–2001 harvest from drawing permits included 9 bulls in the fall and 36 in the spring. The 2001–2002 harvest from drawing permits included 7 bulls in the fall and 38 in the spring (Table 5).

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 2000–2001 and 2001–2002 seasons. Forty-three were successful in 2000–2001 and 40 were successful in 2001–2002 (Table 5).

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 Tooksok Bay, Tununak, Nightmute, and Chefornak. In 2001 there was no hunt in Nelson Island. In 2002, 30 permits were issued in Cheforank. Thirty-three muskox were taken during this hunt, 19 bulls and 14 cows (Table 6).

We occasionally receive reports of muskoxen taken illegally. During this reporting 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 permit hunts.

Hunter Residency and Success. Most drawing permitees for Nunivak Island are residents of Alaska. In 2000–2001 one bull hunter was a nonresident and in 2001–2002 three 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; consequently, 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 assessment was attempted during the reporting period. On Nunivak Island we believe 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 to be 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 suitable habitat on Nelson and Nunivak Island. The habitat on the mainland is essentially unused. We are not considering habitat enhancement projects for muskox in Unit 18.

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 post-hunt, pre-calving population is below 500 animals. With the existing population, high harvest levels are needed and 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. After a public meeting in Toksook Bay in January of 2001 no hunt was conducted in 2001. The next year to population was at 306 animals so a hunt was held with 36 permits available.

We continue to receive reports of muskox occurring on the mainland 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.

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Table 1 Unit 18 Nelson Island muskoxen population, 1973–2001

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	
2001		306	

Table 2 Composition of muskox on Nunivak Island, Unit 18, July 2000[a]

Survey date	Adults	Yearlings	Total
12-13 July 2000	526 (84%)	102 (16%)	628 (100%)

[a] Survey used a fixed-wing aircraft and composition was recorded only as adults and calves.

Table 3 Composition of muskox on Nunivak Island, Unit 18, 8 October 2001

Age[a]	Male	(%)	Female	(%)	Unknown	(%)	Total	(%)
4+ years	148	24%	167	27			315	52%
3 years	56	9%	28	5%			84	14%
2 years	67	11%	48	8%			115	19%
Yearling					95	16%	95	16%
Total	271	44%	243	39%	95	16%	95	16%

[a]Previous 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 4 Composition of muskox on Nelson Island, Unit 18, June 2000 and July 2001[a]

Survey date	Adults	Yearlings	Total
22 June 2000	173 (74%)	60 (26%)	233 (100%)
28 July 2001	226 (74%)	80 (26%)	306 (100%)

[a] Surveys used a fixed-wing aircraft and composition was recorded only as adults and calves.

Table 5 Unit 18 harvest of Nunivak Island muskoxen, 1975–2002

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
2001	46	43		89
2002	45	40		85
Total	911	761	1	1672

[a] One cow taken by a bull hunter

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

Table 6 Unit 18 permits and hunting harvest of Nelson Island muskoxen, 1981–2002

	Number of Permits available		Muskoxen harvested		Number of
Year	Female	Male	Female	Male	Applicants
1981	20	0	20	0	129
1982	30	0	19	8	34
1983	0	25	0	25	37
1984	15	15	9	14	33
1985	15	15	14	16	33
1986	15	15	14	10	50+
1987	15	15	14	16	34
1988	15	15	15	15	30
1989	15	15	15	14	30
1990	15	15	14	15	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
2001	0	0	0	0	0
2002	21	15	19	14	36

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MUSKOX MANAGEMENT REPORT

From: 1 July 2000
To: 30 June 2002

LOCATION

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

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

BACKGROUND

Historical accounts indicate muskoxen disappeared from Alaska by the late 1800s and may have disappeared from the Seward Peninsula hundreds of years earlier. In 1970, 36 muskoxen were reintroduced to the southern portion of the Seward Peninsula from Nunivak Island. An additional 35 muskoxen from the Nunivak Island herd were translocated to the existing population in 1981 (Machida 1997). Since 1970 the population has grown steadily and in April 2002 was estimated at 2050 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 southwestern Unit 23. Migration to the east of the Seward Peninsula has occurred and muskox have been reported in the northern portion of Unit 22A, in Unit 23 along the Tagagawik River drainage and in the Purcell Mountains, in Unit 21 along the Yukon River drainage as far east as Ruby, and in the vicinity of Huslia in Unit 24.

MANAGEMENT DIRECTION

Muskox management on the Seward Peninsula is guided by recommendations from the Seward Peninsula Muskox Cooperators Group. The group is composed of staff from ADF&G, 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 from 1992 through 1994 (Nelson 1994) and follow the guidelines of the ADF&G 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 22B, 22C, 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 13–27 March 2002 in Units 22B, 22C, 22D, 22E and 23SW. Staff from ADF&G, NPS, BLM, FWS, 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, Cessna 207 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 when possible, and recorded GPS coordinates.

Following the muskox census a comprehensive sex and age composition survey of Seward Peninsula muskoxen was undertaken for the first time. We used a helicopter to visit a sample of muskox groups in each subunit located during the census. Over 1200 muskoxen were

classified by age and sex between March 27 and May 18, 2002. ADF&G staff completed the fieldwork, amd NPS, BLM and the Alaska National Guard contributed funding for the age-sex composition work.

The Muskox Cooperators Group did not meet during this reporting period. However, in response to requests by residents of Unit 22E, Unit 22 area biologist Kate Persons organized a series of public meetings in Wales and Shishmaref concerning muskox management in Unit 22E. A proposal to increase the harvest rate and establish a drawing hunt for mature bull muskoxen in Unit 22E was formulated and circulated among participants of the 2000 cooperators meeting, requesting comments. Respondents were supportive and the Board of Game and Federal Subsistence Board adopted the proposed changes, which went into effect in 2002.

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

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During the March 2002 census, we counted 2050 muskoxen in 156 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 census. The 2002 census estimate indicates the population has increased an average of 7% annually since 2000, which is a 50% decrease in growth rate from the 14% average annual growth rate documented between reintroduction in 1970 and 2000 (Fig 2). It is likely that the Seward Peninsula muskox population did in fact grow more slowly during this reporting period, but some of the change in growth rate indicated by our census count may have resulted from undercounting in parts of 6 sample units in Units 22D and 23SW where patchy snow cover reduced sightability of muskox.

Muskoxen are now well established in Unit 22B west of the Darby Mountains. In 2002 we counted 189 animals in 18 groups (Table 2). In this area the 2000–2002 growth rate averaged 8% annually. The density of muskoxen in western Unit 22B was 0.07 muskoxen/mi^2, which is a lower density than we observed in other parts of the Seward Peninsula in 2002, but not surprising since they have occupied the area for a relatively short time. The higher densities found in other units indicate that further population growth in western Unit 22B is likely, although the forested portions of Unit 22B may not support the higher densities found in open tundra regions of the western Seward Peninsula.

In Unit 22C the number of muskoxen increased by 74% from 148 muskoxen in 2000 to 257 muskoxen in 22 groups in 2002 (Tables 1 and 2). A 37% annual growth rate cannot be attributed entirely to reproduction and probably represents a shift in winter range by some groups from Unit 22D into Unit 22C. We noted a large increase in the number of muskoxen in

the Moon Mountains in western Unit 22C and a decreased number of animals wintering the adjoining southwestern portion of Unit 22D. The density of muskoxen in Unit 22C was 0.15 muskoxen/mi^2, which is similar to the density in Units 22D and 22E.

Initially (after introduction) population growth was fastest in Unit 22D, but growth has since slowed and the population may have stabilized. Between 1998 and 2000 population growth slowed to 4%, and between 2000 and 2002 census results indicate the population was virtually stable at 771 muskoxen in 57 groups in 2002 (Tables 1 and 2). However, due to poor sightability in some parts of Unit 22D some muskoxen may have been missed during the 2002 census. The density of muskoxen in Unit 22D calculated from census counts in 2000 and 2002 was 0.16 muskoxen/mi^2 which is the highest density we have recorded on the Seward Peninsula.

In Unit 22E we counted 632 muskoxen in 45 groups (Table 1) which represents a 19% annual growth rate since 2000. The muskox density in Unit 22E was 0.15 muskoxen/mi^2. However, there was an 11% annual decline in the number of muskoxen found in adjacent Unit 23SW between 2000 and 2002. In 2002 we observed 201 muskoxen in 15 groups (Table 1). The large annual increase in Unit 22E and the decline in Unit 23SW can probably be attributed in part to redistribution of muskox between those two units on their winter range. In 2002 muskoxen density in Unit 23SW was 0.12 muskoxen/mi^2.

Muskox density is highest in Unit 22D (0.16 muskoxen/mi^2) and has been relatively stable since 1998. Densities in Unit 22C and 22E (0.15 muskoxen/mi^2) are now approaching the density found in Unit 22D. It is possible that densities in the western part of the Seward Peninsula are reaching a critical limit and that future growth may be primarily to the east.

Although we manage muskoxen on the Seward Peninsula by subunit, and harvest quotas are determined by the subunit census count, it is important to recognize that there is continuous movement of individuals and groups between subunits and the number of animals in a given subunit is constantly changing. The home ranges of many groups straddle subunit boundaries and many animals occupy more than one subunit during the course of a year. Therefore the overall Seward Peninsula census count rather than subunit counts should be the basis for assessing population status and trends.

In the future, censuses will be scheduled every 3 years rather than biannually to accommodate more frequent moose censuses in Unit 22.

Population Composition

During past censuses we classified adults and yearlings while over-flying each group to generate a recruitment estimate. This year we were not able to accurately classify animals from the Cessna 207 that was used to census Units 22B, 22C, and parts of Unit 22D. Instead we obtained this information from ground-based composition surveys in all subunits immediately following the census. Groups located during the census were visited by helicopter and group members were classified as: bulls 4-years-or-older, 3-year-old bulls, 2-year-old bulls, cows 4-years-or-older, 3-year-old cows, cows 3-or 4-years-or-older (in cases where we did not get a head-on view to distinguish these classes), 2-year-old cows, yearlings or unknown (Tables 3–7).

In Units 22B, 22C and 23SW, where 15–22 groups per unit were identified during the census, we attempted to visit all groups during the composition survey. In those units we moved sequentially from one group to the next nearest group and group size had no bearing on whether a group was visited. There we used the raw data to estimate bull:cow ratios and recruitment rates because a large proportion of known groups and animals were classified and group size did not influence group selection.

In Unit 22B 94% of the animals (178 of 189 muskoxen) found in the 2002 census were classified by sex and age (Table 3). The ratio of mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 58:100. The yearling:cow ratio was 48:100 and yearling recruitment was 18% (Table 8). All sex/age classes were well represented. Fourteen percent of the muskoxen in Unit 22B were 2-year-olds (7% bulls and 7% cows), and a minimum of 18% (7% bulls, 11% cows) were 3-year-olds. An additional 6% were cows that were at least 3 years of age. The high, fairly consistent portion of yearling, 2-year-old and 3-year-old animals indicates fairly high calf survival over the last few years and a high likelihood that yearlings are surviving to adulthood.

In Unit 22C 81% of the animals (208 of 257 muskoxen) found in the 2002 census were classified by sex and age (Table 4). The ratio of mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 70:100. The yearling:cow ratio was 57:100 and yearling recruitment was 19% (Table 8). As in Unit 22B, animals of younger age classes were well represented. Eighteen percent of muskoxen classified in Unit 22C were 2-year-olds (10% bulls and 8% cows), and a minimum of 21% were 3-year-olds (7% bulls, 14% cows). An additional 2% were cows that were at least 3 years of age.

In Unit 23SW 88% of the animals (170 of 196 muskoxen) found in the 2002 census were classified by sex and age (Table 5). The ratio of mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 46:100. The yearling:cow ratio was 31:100 and yearling recruitment was 13% (Table 8). The 2- and 3-year-old age classes were well represented; 21% of the muskoxen classified in Unit 23SW were 2-year-olds (9% bulls, 12% cows), and 17% were 3-year-olds (5% bulls, 12% cows). However, yearlings comprised a smaller portion of the population and the yearling:cow ratio and recruitment rate were markedly lower than in other units.

In Units 22D and 22E more groups were located during the census than could be visited during the composition survey (57 groups in 22D and 45 in 22E). Our estimates of bull:cow ratios and recruitment were derived from observations of 59% of the muskoxen censused in Unit 22D and 50% of the muskoxen censused in Unit 22E. We distributed our sampling effort in the composition survey geographically throughout Units 22D and 22E, but a disproportionately large number of the groups sampled were large groups of mixed age and sex and few of the smaller groups that were likely to be all bulls were sampled, thus bulls were under represented. To attempt to correct for this and obtain more accurate estimates of bulls, we assumed all censused muskoxen in groups of 6 or fewer animals were mature bulls. We subtracted the number of assumed bulls in these small groups from the total number of muskoxen censused in the unit. The remaining muskoxen found in the unit during the census were classified by age and sex in proportion to those classified during the composition survey. Then, the previously subtracted number of assumed bulls was added to the estimated number

of mature bulls prior to calculating bull:cow and yearling:cow ratios and a recruitment estimates for each unit.

In Unit 22D the ratio of adjusted mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 44:100. The yearling:cow ratio was 41:100 and yearling recruitment was 20% (Table 8). Fourteen percent of muskoxen classified in Unit 22D were 2-year-olds (7% bulls and 7% cows), and a minimum of 15% were 3-year-olds (4% bulls, 11% cows). An additional 2% were cows that were at least 3 years of age.

In Unit 22E the ratio of adjusted mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 63:100. The yearling:cow ratio was 49:100 and yearling recruitment was 18% (Table 8). Twenty percent of muskoxen classified in Unit 22E were 2-year-olds (10% bulls and 10% cows), and a minimum of 15% were 3-year-olds (6% bulls, 9% cows). An additional 1% were cows of at least 3 years of age.

The highest bull:cow ratios were found in Units 22C and 22E, where population growth was highest and the lowest bull:cow ratios were found in Units 22D and 23SW where the population was stable or declining (Table 8). Population growth in Units 22C and 22E was greater than could be accounted for by reproduction alone and was likely due in large part to emigration from Units 22D and 23SW. Since bulls are more likely than cows to pioneer new territory and move from established home ranges it is not surprising that bulls are more numerous in Units 22C and 22E and less abundant in Units 22D and 23SW. Bulls from Unit 23SW are also likely moving into new territory to the east of the peninsula.

Harvest is also a factor contributing to observed bull:cow ratios. In Units 22D and 22E actual harvest rates during this reporting period were the same (3.5%). In Unit 22D harvest was almost exclusively bulls, whereas in Unit 22E in 2001–2002, half the harvest was cows. In 23SW the actual harvest rate averaged 2.5% and 27% of the harvest was cows. Unit 22C has been virtually unaffected by hunting; a muskox season was not established until 2001–2002 when the actual harvest rate was 1%.

The yearling:cow ratios are lower in Units 22D and 23SW than in other units. In Unit 22D the 2- and 3-year-old age classes are also proportionally smaller than in other units. These factors, combined with lack of population growth since 1998, may be a sign of decreased productivity and an indication that muskoxen in Unit 22D are reaching carrying capacity. In Unit 23SW the 2- and 3-year-old age classes were well represented and only yearlings were noticeably less numerous.

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, Kobuk and Yukon River drainages are becoming more common, including large groups of mixed age and sex. Figure 1 shows the distribution of muskoxen on the Seward Peninsula in spring 2002 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. Muskoxen have extended their range

throughout Units 22C, 22D and western 22B and 23SW. Muskox density is highest in Unit 22D, but densities in Units 22C and 22E are approaching that in Unit 22D. Densities in Unit 23SW have been consistently lower for unknown reasons. The population is growing rapidly in western Unit 22B, but Unit 22B is partly forested and accumulates more snow than areas to the north and west, and may provide less favorable habitat and fewer suitable, windswept wintering areas.

With the exception of two single bulls found on the eastern slopes of the Darby Mountains in 2002, we have never found muskoxen east of the Darby Mountains in Unit 22B during spring censuses. However, gradual colonization is probably occurring in eastern Unit 22B. Since 1998 we have had reports of muskoxen near Elim, Granite Mountain and in the Koyuk River drainage during the summer months. In winter 2002 a group of 3 muskoxen was reported near Koyuk but we did not find them during our census. In April 2003 a group of 6 muskoxen was reported by caribou hunters near Granite Mountain.

In Units 22B, 22D and 23SW, 2002 recruitment estimates exceeded growth rates. The difference can in part be attributed to harvest, predation and natural mortality, but it is likely that immigration of muskoxen explains why recruitment exceeds growth in these areas.

Between 2000 and 2002, the number of muskoxen in Unit 23SW declined by an average of 11% annually. In 2002 recruitment was estimated at 13%. The reduction in numbers in spite of reasonably good recruitment could in part be a result of undercounting due to patchy snow cover, but emigration is probably the greatest factor. Several large groups were close to the Unit 23SW/22E boundary and movements between the two units are expected. Also, it is probable that animals from Unit 23SW are responsible for populating areas to the east in the Tagagawik, Selawik and Kobuk River drainages, and the Nulato Hills.

MORTALITY

Harvest

Season and Bag Limit. Since 1998 the State has administered Tier II subsistence hunts in a portion of Unit 22D, Unit 22E, and Unit 23SW. In 2001 Tier II hunts were established in the remainder of Unit 22D, 22B and 22C. State Tier II hunts are conducted in combination with federal subsistence hunts for federally qualified subsistence users on federal public lands in Units 22B, 22D, 22E and 23SW.

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
2000–2001		
Unit 22D, that portion north and west of Granley Harbor, Imuruk Basin, and the Pilgrim River drainage.		
1 bull by Tier II subsistence hunting permit only; up to 30 bulls may be taken.	1 Aug–15 Mar (Subsistence hunt only)	No open season

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22E 1 bull by Tier II subsistence hunting permit only; up to 15 bulls may be taken.	1 Aug–15 Mar (Subsistence hunt only)	No open season
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 bull by Tier II subsistence hunting permit only; up to 8 bulls may be taken.	1 Aug–15 Mar (Subsistence hunt only)	No open season
2001-2002		
Unit 22B, that portion within the Fox River drainage upstream of the Fox River bridge, and within one mile of the Fox River bridge, and within one mile of the Council Road east of the Fox River Bridge		
1 bull by Tier II subsistence hunting permit only; the total harvest may not exceed 8 bulls in Unit 22B	1 Nov–15 Mar (Subsistence hunt only)	No open season
Remainder of Unit 22B		
1 bull by Tier II subsistence hunting permit only; the total harvest may not exceed 8 bulls in Unit 22B	1 Aug–15 Mar (Subsistence hunt only)	No open season
Unit 22C, that portion west of the west bank of the Bonanza River, north of the north bank of Bonanza Channel and		

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Safety Sound, east of the east bank of the flowage connecting Safety Sound with the confluence of the Eldorado and Flambeau rivers, and east of and including the Eldorado River drainage		
1 bull by Tier II subsistence hunting permit only; up to 2 bulls may be taken	1 Aug–30 Sep (Subsistence hunt only)	No open season
Unit 22C, that portion west of the west bank of the Sinuk River		
1 bull by Tier II subsistence hunting permit only; up to 2 bulls may be taken	1 Feb–15 Mar (Subsistence hunt only)	No open season
Remainder of Unit 22C	No open season	No open season
Unit 22D Southwest, that portion west of the Tisuk River drainage, west of the west bank of the unnamed creek originating at the unit boundary opposite the headwaters of McAdam's Creek to its confluence with Canyon Creek, and west of the west bank of Canyon Creek to its confluence with Tuksuk Channel		
1 musk ox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period Jan. 1 –Mar. 15, up to 7 musk oxen may be taken; however, not more than 3 cows may be	1 Sep–15 Mar (Subsistence hunt only)	No open season

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
taken; total harvest may not exceed 7 musk oxen in Unit 22D southwest		
Unit 22D Upper Pilgrim River, that portion within the Pilgrim River drainage upstream of Pilgrim Hot Springs		
1 musk ox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period Jan 1 – Mar. 15, up to 32 musk oxen may be taken in combination with the remainder of Unit 22D; however, not more than 13 cows may be taken and total harvest may not exceed 32 musk oxen in Unit 22D, excluding Unit 22Dsouthwest	1 Nov–15 Mar (Subsistence hunt only)	No open season
Remainder of Unit 22D		
1 musk ox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period Jan 1 – Mar. 15, up to 32 musk oxen may be taken in combination with Unit 22D Upper Pilgrim River; however, not more than 13 cows may be taken and total harvest may not exceed 32 musk oxen in Unit 22D excluding Unit 22D southwest	1 Aug–15 Mar (Subsistence hunt only)	No open season
Unit 22E		

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
1 musk ox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period Jan. 1-Mar. 15; up to 23 musk oxen may be taken; however, not more than 9 cows may be taken; the total harvest may not exceed 23 musk oxen in Unit 22E	1 Aug–15 Mar (Subsistence hunt only)	No open season
Remainder of Unit 22	No open season	No open season
Unit 23 southwest, that portion on the Seward Peninsula west of and including the Buckland River drainage 1 musk ox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period Jan. 1-Mar. 15; up to 13 musk oxen may be taken; however, not more than 5 cows may be taken; the total harvest may not exceed 13 musk oxen in Unit 23 southwest		
1 bull by Tier II subsistence hunting permit only; up to 15 bulls may be taken	1 Aug–15 Mar (Subsistence hunt only)	No open season

Board of Game Actions and Emergency Orders. In November 2001 the Board of Game adopted a proposal developed by residents of Unit 22E and endorsed by the Muskox Cooperators Group. The Board: 1) increased the muskox harvest rate in Unit 22E to 8%; 2) established a 4% harvest rate for cow muskoxen in Unit 22E; 3) maintained a Tier II subsistence hunt for any muskox in Unit 22E; and 4) established a resident drawing hunt for mature bull muskoxen in Unit 22E. The Board also increased the allowable harvest quotas in Units 22B, 22C, 22D and 23SW to allow a continued 5% harvest rate as the muskox population grows. These changes went into effect 1 July 2002.

In January 2002, the Board changed the application procedure for Tier II muskox hunts in Units 22 and 23 by removing the question on availability of alternative resources. This allows a more equitable distribution of permits by preventing individuals who have previously harvested muskoxen from outscoring other applicants and automatically winning permits on a yearly basis. This change was implemented for the 2002–2003 Tier II application period in May 2002.

On 11 March 2002 an emergency order was issued closing the season for cow muskoxen on state managed lands in Unit 22E. At that time a harvest of 9 cow muskoxen (2% of the total muskox population in Unit 22E) was authorized. The harvest of 8 cows had been reported and because much of the harvest typically occurs quickly within the last few days of the muskox season, the cow season was closed on March 11 to prevent the cow harvest from exceeding the quota. However, cow harvest continued on federal lands in Unit 22E where a 3% cow harvest rate was authorized and the combined 2001–2002 cow harvest was 12 cow muskoxen.

Human-Induced Harvest. In 2000–2001 35 bulls were harvested by Tier II permit and 9 were taken with federal permits for a total harvest of 44 bulls. In Unit 22D a total of 22 bulls were taken, 16 were taken in Unit 22E and 6 in Unit 23SW. In 2001–2002 hunting opportunity increased with the advent of hunts in Units 22B, 22C; addition of previously closed portions of Unit 22D; and cow seasons in Units 22D, 22E and 23SW. Also, permits were issued in excess of the harvest quota to attempt to reach the harvest quota. A total of 54 Tier II permits were filled (40 bulls and 14 cows) and 12 federal permits were filled (5 bulls and 7 cows) for a combined harvest of 66 muskoxen (45 bulls and 21 cows). In Unit 22B 6 bulls were taken (bulls only hunt), in Unit 22C 2 bulls were taken (bulls only hunt), in Unit 22D 26 muskoxen were harvested (20 bulls and 6 cows), 21 were taken in Unit 22E (9 bulls and 12 cows) and 8 muskoxen were harvested in Unit 23SW (5 bulls and 3 cows). Tables 9 and 10 show the number of permits issued and filled in 2000–2001 and 2001–2002 for the state and federal hunts in each unit and community.

During this reporting period the allowable harvest rates recommended by the Cooperators and adopted by the Board were 5% in Unit 22B (bulls only), 3% in Unit 22C (bulls only); and 5% in Units 22D, Unit 22E and 23 SW (including up to a 2% cow harvest). The Federal Subsistence Board approved the same harvest rates on Federal public lands with one exception; they adopted a 3% allowable cow harvest in Units 22E and 23SW. During the 2000 regulatory year actual harvest rates were 3% in Units 22D and 22E and 2% in Unit 23SW. Harvest rates in all subunits and in both State and Federal hunts had consistently been lower than the harvest quotas, so in 2001–2002 the number of permits issued in Units 22D, 22E and 23SW was increased by 15%–33% depending on previous success rates. In the newly established hunts in Units 22B, 22C and 22D SW additional permits above the harvest quota were not issued since there was no data on which to base probable success rates. In 2001–2002 the actual harvest rate in Unit 22B was 3%, 1% in Unit 22C, 4% in Unit 22D, 2% in Unit 22D SW, 4% in Unit 22E and 3% in Unit 23 SW.

In all hunt areas there were considerably more applicants for Tier II permits than there were permits available. In 2000 there were 214 applicants for 56 Tier II permits; 115 applicants for Unit 22D, 63 for Unit 22E, and 36 for Unit 23SW. In 2001 286 people applied for 72 Tier II

permits; 104 for Unit 22B, 86 applicants for Unit 22C, 137 applicants for Unit 22D, 82 applied for Unit 22E and 31 for Unit 23SW.

A number of non-hunting kills occurred during this reporting period. In Unit 22B a mature bull muskox was killed in defense of life and property after it wandered into the village of Golovin and presented a safety hazard. When efforts by community members to drive the animal from town were unsuccessful, permission was given to kill the bull and distribute the meat among community members.

In Unit 22E two muskoxen, a bull and a cow, were illegally shot and left in the vicinity of Tin City. No meat was salvaged. An investigation by Fish and Wildlife Protection failed to find the perpetrators.

In two separate incidents in Unit 23 Buckland residents were paid to kill crippled bull muskoxen that were found near the village. In one case a bull suffered a broken humerus, in the other a broken back. Another muskox was shot accidentally near Buckland by a hunter who mistook it for a black bear. The hunter was cited by Fish and Wildlife Protection. In each instance the meat was distributed in the village.

Permit Hunts. All hunting during this reporting period was by Tier II Subsistence Hunting Permit on State managed lands and by Federal Subsistence permit on Federal public lands. To insure applicants are primarily subsistence hunters, trophy destruction of muskoxen taken in Tier II hunts is required if the skull is removed from Unit 22 or Unit 23. See the previous section for a harvest summary of permit hunts. In the 2002 regulatory year a drawing hunt for mature bull muskoxen began in Unit 22E.

Hunter Residency and Success. During 2000–2001 56 Tier II permits were issued for Seward Peninsula muskox hunts and 35 were filled for a 63% success rate. Eighteen federal permits were issued and 9 were filled, resulting in a 50% success rate. During 2001–2002 54 of 72 Tier II permits were filled for a 75% success rate. Twelve of 31 federal permits were filled for a 39% success rate. Tables 9 and 10 show the number of permits issued and filled during this reporting period in the state and federal hunts in each unit and community.

In 2001–2002 muskox hunting began in Unit 22B and all Tier II permits were awarded to residents of Unit 22B. Residents of Elim and Koyuk received a total of 5 state Tier II permits and 4 of them were filled. The 3 Federal permits were issued to hunters in Koyuk and Golovin to insure that residents in every Unit 22B village had an opportunity to hunt muskoxen. Two out of 3 federal permits were filled. There is considerable interest in Unit 22B in hunting muskoxen, especially in light of declining moose populations.

Nome residents were awarded the 4 Tier II permits in 2 Unit 22C muskox hunts that began in the 2001–2002 regulatory year. In the 1 Aug –30 Sept hunt in an eastern, roadless portion of Unit 22C no muskoxen were taken although both permittees hunted hard. In the winter hunt west of the Sinuk River both permits were filled. In general, Nome hunters are highly motivated and successful at taking muskoxen.

Success rates in Unit 22D varied by community (Tables 9 and 10). Permittees from White Mountain have had 100% success, in spite of long travel distances required to find animals on

state managed lands in Unit 22D. Nome hunters were relatively successful, averaging a 75% success rate during this reporting period. Success rates in Brevig have been variable, but are higher in the state Tier II hunt than in the federal hunt on distant federal lands. Teller residents typically have a lower success rate. In 2000–2001 none of the 10 state and federal permits issued to Teller residents were filled. In 2001–2002 a new hunt area was opened up in Unit 22D SW along the Nome-Teller Road. All 7 permits were awarded to Teller residents and 3 were filled. None of the 4 State and Federal permits issued to Teller residents in the remainder of Unit 22D were filled.

Success rates in Unit 22E have been 70% or higher. A growing number of Unit 22E residents have developed a taste for this new resource and appreciate the increasing opportunity to hunt muskoxen at a time when moose are less abundant. Shishmaref hunters have been relatively successful under both state and federal hunts. Muskoxen inhabit federal and private lands close to the village and are easily accessible to all permit holders. In Wales state permits are more readily filled than federal permits because federal lands are distant. Relatively few Wales residents were successful in obtaining state Tier II permits because Shishmaref residents have a longer history of harvesting muskoxen under the federal system and therefore scored higher on their Tier II applications for past harvest of muskoxen than did Wales residents. In May 2002, elimination of the alternative resources question on Tier II applications for Unit 22 and 23 muskox hunts helped alleviate this problem.

Success rates in Unit 23SW increased during this reporting period. In 1998 when the State Tier II hunt began, residents of Unit 23SW were skeptical that local people would compete successfully for Tier II permits. Through a request to the cooperators group and concurrence by State and Federal Boards, only 25% of the available permits were allotted to the State Tier II hunt. However, federal lands are far from Buckland and the hunting success rates were low. This factor and the success of village residents in obtaining Tier II permits in other hunt areas, persuaded residents of Unit 23SW to request that more permits be allotted to the State hunt. Beginning in 2000–2001, 2/3 of available permits were issued by the State and success rates increased, particularly for Buckland hunters with State permits.

Several factors contribute to inconsistent or low success rates in villages. Most of the applicants 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 muskoxen 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 muskoxen. If not, the permits are not transferable so some inevitably go unfilled. Federal permits are least likely to be filled when long travel distances are required to reach federal lands.

Harvest Chronology. During this reporting period 100% of the harvest in Units 22B and 22C occurred in February or March. In Unit 22D 53% of the harvest occurred during January–March, 14% of the harvest was taken in August, 18% in September, 12% in October and 4% in November. In Unit 22E 84% of the harvest occurred in February–March, 5% in August and 11% in September. In Unit 23SW 92% of the harvest occurred in March and 8% in occurred in August.

Transport Methods. Most Seward Peninsula muskox hunters harvest during the winter months using snowmachines for transportation. In Unit 22D 47% of the harvest was taken from August–November, and those hunters primarily used highway vehicles and 4-wheelers for transportation.

Other Mortality

During this reporting period we had no meaningful measure of natural mortality of Seward Peninsula muskoxen. We frequently observe old muskoxen, and believe mortality from disease and predation has been relatively low. However, there is some indication that predation may be in increasing as bears learn to prey on muskoxen and wolf numbers increase on the Seward Peninsula.

Since the last reporting period we have had additional reports of bears killing muskoxen in the area around Ear Mountain in Unit 22E. In September 2000 a miner in the Kougarok River reported seeing a bear kill an old bull muskox near her camp by Taylor. She also reported that wolves had killed and partially eaten 7 of 13 muskoxen calves in a nearby herd at Trinity Creek. The calves were approximately 2–3 weeks old and were killed in deep snow immediately following a storm in mid April 2001. Staff and the public reported other sightings of bears and wolves feeding on muskoxen carcasses, but in most cases it is not known if bears were predators or scavengers.

Pat Reynolds, FWS biologist, reports that bears became increasingly successful at preying upon muskoxen in the Arctic National Wildlife Refuge. Bear predation on adult muskoxen and impacts of predation events on calf survival are believed to be impacting muskox population dynamics in the Refuge (Reynolds et al. 2002). As more Seward Peninsula bears learn to prey on muskoxen, we can expect predation to have a greater impact on growth of the muskox population. Increasing numbers of wolves associated with western arctic herd caribou wintering in the area are also likely to increase predation on muskoxen.

We learned of several carcasses of bulls with obvious injuries or abscesses, one near Buckland and 2 near Tin City that may have died of injuries sustained during the rut.

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 muskoxen and to support management policies that encourage future increases in hunting opportunity. Since hunting has been allowed, more people have come to value muskoxen as a subsistence resource, and negative attitudes toward muskoxen have decreased. However, resentment lingers over the reintroduction of muskoxen 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 muskoxen compete with them for greens and trample traditional berry picking areas. Although there are no reports of anyone being harmed by muskoxen, their presence near villages, camps, and berry picking areas is often frightening. When threatened, muskoxen generally hold their ground rather than flee; this behavior contributes to people's dislike of them because it is sometimes impossible to drive them from areas where they are not wanted. In 2000 the board addressed the concerns of Teller residents by establishing a hunt area around Teller with a 5% harvest rate. In 2001 the State and Federal boards increased the harvest rate for muskoxen in Unit 22E to 8% and allowed 4% harvest of cows to slow population growth in that unit. Over time increased hunting pressure around villages and camps will hopefully drive the animals away from the villages and reduce conflicts.

Muskox and Reindeer

For many years after muskoxen were introduced to the Seward Peninsula, reindeer herders complained that muskoxen compete with and displace reindeer. There is widespread concern across the Arctic about displacement of caribou by muskoxen, and these concerns cannot be dismissed. However, habitat and diet selection studies have found that although reindeer and muskoxen often occupy the same feeding areas, they select different forage species (Ihl and Klein 2001). Neither interspecies avoidance nor competition for habitat has been documented on the Seward Peninsula or Nunivak Island. At Reindeer Herders Association meetings during this reporting period, complaints about muskoxen 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. The Seward Peninsula Muskox Cooperators have maintained their commitment to protect viewing opportunities in Unit 22C and along much of the Nome road system. As recommended by the cooperators, all but the most remote parts of Unit 22C 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 were approved, the season along the road system generally was delayed so muskoxen could not be hunted from the road when the road is open to vehicle

traffic. Since 1998 muskox hunting along the northern Kougarok Road in Unit 22D has provided evidence that hunting is likely to displace muskoxen, driving them away from the road, spoiling opportunity for viewing.

In 2001 hunting began in southwestern Unit 22D along the Nome–Teller Road which is one of the most consistent viewing areas. The season was delayed until 1 September, but there was concern that hunting activity might adversely affect viewing opportunities in the area. However most of the harvest has taken place in the winter months when the road is closed and the fall harvest of 2 muskoxen from the road has not discernibly effected distribution of muskoxen in the area.

CONCLUSIONS AND RECOMMENDATIONS

The 2002 muskox census showed the Seward Peninsula muskox population increased an average of a 7% annually since 2000, which is half of the 14% average annual increase exhibited since reintroduction in 1970. Although undercounting in a few sample units may have contributed to the observed reduction in growth rate, other factors suggest that population growth may in fact be slowing and densities on the western part of the Seward Peninsula may be reaching a critical limit. Muskox density is highest in Unit 22D (0.16 muskoxen/mi^2) and the population there has shown little growth since 1998. Recruitment rates in Unit 22D however, have remained high and we believe muskoxen from Unit 22D have been emigrating to Units 22C and 22E. The Unit 22D yearling:cow ratio observed in the 2002 composition survey is somewhat lower than that observed in other units, except Unit 23SW. It may be that habitat, suitable wintering areas, density related behavioral factors, predation, other natural mortality or other factors are limiting further population growth. Densities in Units 22C and 22E are now approaching the density in Unit 22D. If speculation is correct that a critical density is being reached, we will see future growth of the population primarily in Unit 22B and in areas to the east of the Seward Peninsula. If population growth levels off, it will be important to determine what is limiting growth so we can insure that our harvest strategy is appropriate.

Range extension to areas east of the Seward Peninsula continued with more frequent observations of muskoxen in the Nulato Hills and Selawik, Kobuk and Yukon River drainages, including sightings of large groups of mixed age and sex.

We conducted the first comprehensive composition survey of Seward Peninsula muskoxen during this reporting period, collecting baseline composition data in areas that are not yet significantly impacted by harvest. We plan to conduct composition surveys every 6 years immediately following a census to monitor changes in population structure.

The Seward Peninsula Muskox Cooperators continue to favor conservative harvest rates in most areas to ensure future population growth and increased harvest. Within those guidelines, new regulations were implemented during this reporting period that increased hunting opportunity by: 1) establishing new Tier II hunts in Units 22B, 22C and 22DSW and a Federal subsistence hunt in Unit 22B; 2) allowing a 2% cow harvest on state lands in Units 22D, 22E, and 23SW and Federal lands in 22D and a 3% cow harvest on Federal lands in Units 22E and 23SW; 3) attempting to reach the harvest quota by calculating previous success

rates and issuing up to 33% more permits in a given hunt area. The board also authorized an 8% harvest rate for muskoxen in Unit 22E with a 4% allowable cow harvest and a drawing hunt for mature bull muskoxen in Unit 22E, effective 1 July 2002.

Seward Peninsula residents are now generally satisfied with the opportunities provided by the combination of Tier II hunts on State managed lands and Federal subsistence hunts on Federal lands. The newly authorized drawing hunt in Unit 22E provides some long awaited opportunity for other Alaska residents and those who want to hunt for trophies. Whether the muskox population increases or stabilizes, we must work to establish hunting opportunities for a wider range of users while still ensuring adequate opportunity for local subsistence hunters.

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. 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.

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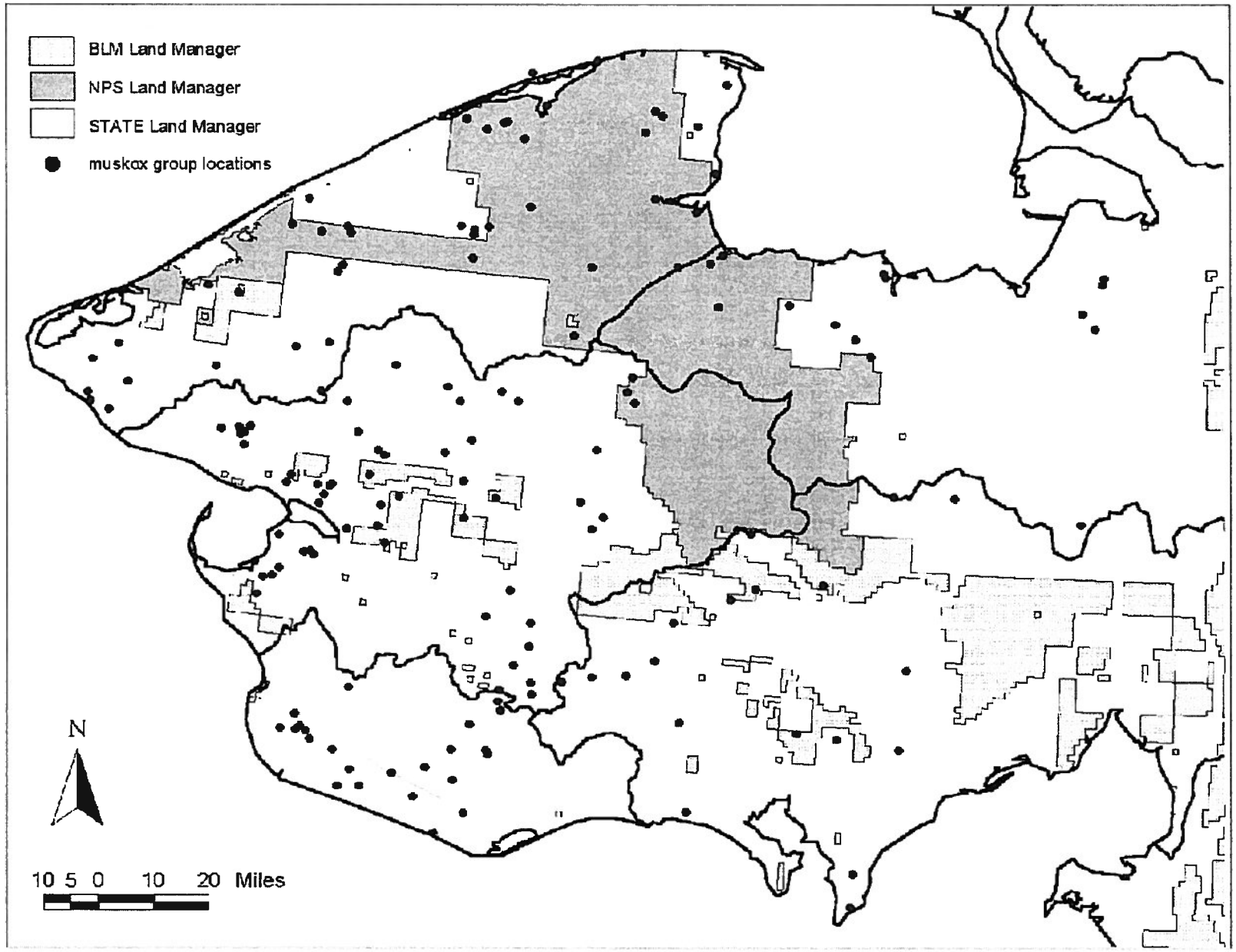

Figure 1 Location of Seward Peninsula muskox groups, spring 2002 census

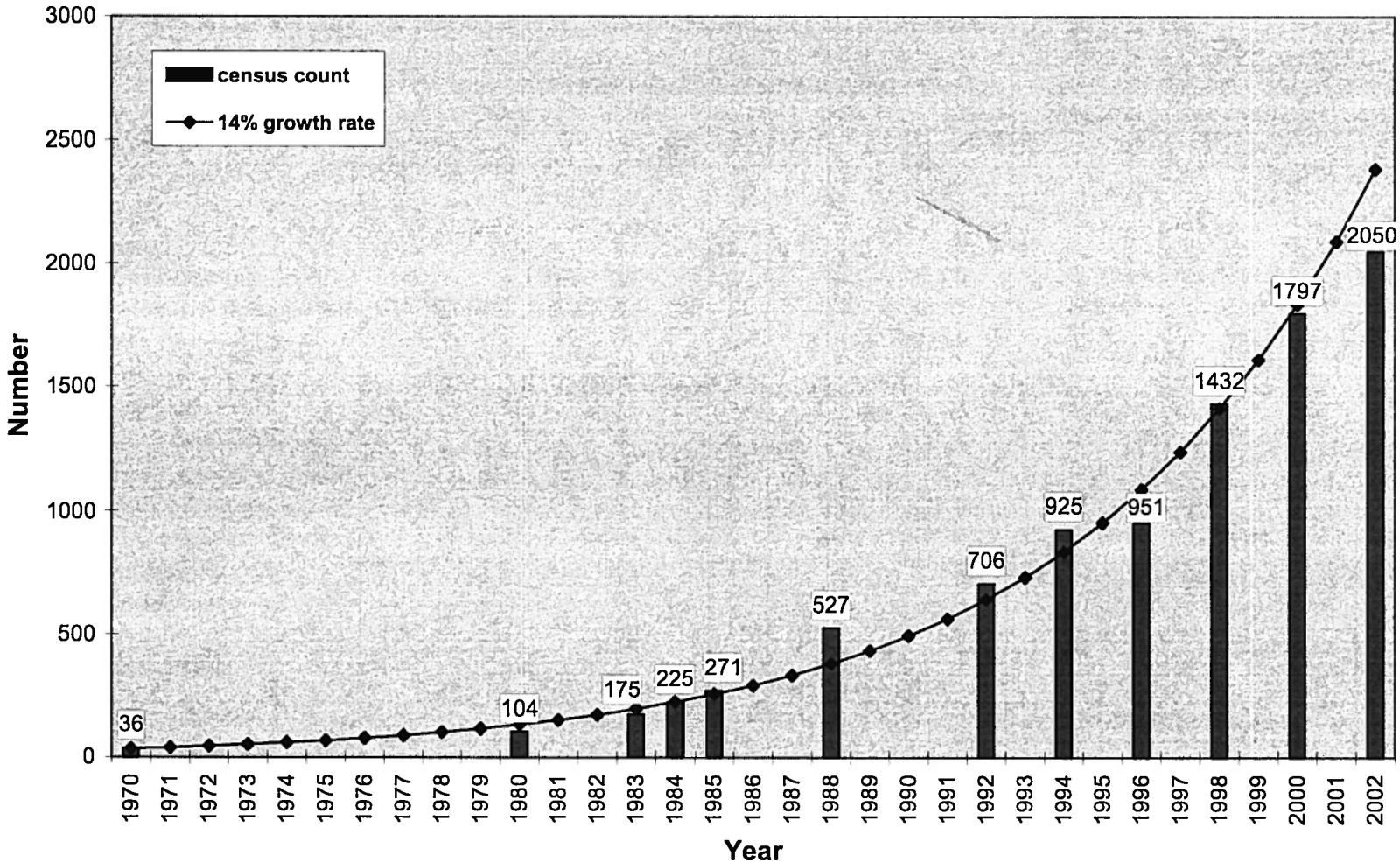

Figure 2 Estimated and counted number of Seward Peninsula muskoxen, 1970–2002

Table 1 Seward Peninsula muskox census results, Units 22 and 23 Southwest, spring 2002

Unit	Groups	Total
22B	18	189
22C	22	257
22D	57	771
22E	45	632
23SW	15	201
Total	156	2050

Table 2 Seward Peninsula muskox census results, Units 22 and 23 Southwest, 1992–2002

	Unit					
Year	22B	22C	22D	22E	23SW	Total
1992	3	49	340	180	134	706
1994	11	79	405	184	246	926
1996	51	87	308	327	178	951
1998	27	124	714	362	205	1432
2000	159	148	774	461	255	1797
2002	189	257	771	632	201	2050

Table 3 Age and sex classification for 16 groups of muskoxen in Unit 22B[1], 28–29 Mar 2002

Location	Total	≥ 4-yr-old bull	3-yr-old bull	2-yr-old bull	≥ 4-yr-old cow	3-yr-old cow	3- or 4-yr-old cow	2-yr-old cow	Year-ling.	Calf	Unk.
Unit 22B											
Group 23, Cape Darby	5	5	0	0	0	0	0	0	0	0	0
Group 24, Bluff	12	2	1	2	3	2	0	1	1	0	0
Group 26, Darbys	2	2	0	0	0	0	0	0	0	0	0
Group 27, N. of Battleship	16	3	2	2	6	0	0	0	3	0	0
Group 28, Headwaters of Aggie Cr	20	2	1	1	5	2	0	4	5	0	0
Group 29, Btwn Bear and Fox R.	3	3	0	0	0	0	0	0	0	0	0
Group 30, American Creek	43	4	3	3	11	4	5	1	12	0	0
Group 31, Lost Creek	43	1	5	4	10	6	5	5	6	0	1
Group 32, Above Casadepaga	1	1	0	0	0	0	0	0	0	0	0
Group 33 NW of Casa River mouth	3	3	0	0	0	0	0	0	0	0	0
Group 34, Darby Mountains	2	2	0	0	0	0	0	0	0	0	0
Group 35, Above Kingsley Creek	2	2	0	0	0	0	0	0	0	0	0
Group 36, Bendelebens	8	4	1	1	1	0	0	1	0	0	0
Group 37, Bendelebens	9	2	0	0	1	3	0	1	2	0	0
Group 38, Bendelebens	3	2	0	0	1	0	0	0	0	0	0
Group 39, Bendelebens	6	1	0	0	0	2	0	0	3	0	0
Subtotal	178	39	13	13	38	19	10	13	32	0	1
Percentage	100%	22%	7%	7%	21%	11%	6%	7%	18%	0%	1%

[1] 178 of 189 (94%) muskoxen found in the 2002 census in Unit 22B were classified during this composition survey

Table 4 Age and sex classification for 15 groups of muskoxen in Unit 22C[1], 27 Mar 2002

Location	Total	≥ 4-yr-old bull	3-yr-old bull	2-yr-old bull	≥ 4-yr-old cow	3-yr-old cow	3- or 4-yr-old cow	2-yr-old cow	Year-ling.	Calf	Unk.
Unit 22C											
Group 1, E. of Army Peak	18	1	2	0	4	5	2	1	3	0	0
Group 2, Banner Creek	2	2	0	0	0	0	0	0	0	0	0
Group 5, Cripple Creek	9	9	0	0	0	0	0	0	0	0	0
Group 6, Osborne Creek	6	6	0	0	0	0	0	0	0	0	0
Group 9, Hill E. of Sinuk	1	1	0	0	0	0	0	0	0	0	0
Group 12, Engstrom Hill	13	3	0	2	3	1	0	1	4	0	0
Group 13, Moon Mountains	6	6	0	0	0	0	0	0	0	0	0
Group 14, Moon Mountains	33	5	3	3	9	6	0	3	4	0	0
Group 15, Moon Mountains	25	1	2	2	5	6	1	1	7	0	0
Group 16, Moon Mountains	7	7	0	0	0	0	0	0	0	0	0
Group 17, Moon Mountains	13	2	3	0	3	11	0	0	4	0	0
Group 18, Fox Creek	37	3	4	8	5	3	2	4	8	0	0
Group 19, Gasman Creek	14	0	0	5	1	3	0	3	2	0	0
Group 20, E. of Johnson Creek	11	2	0	0	2	2	0	1	4	0	0
Group 21, Upper Eldorado River	13	1	0	0	3	3	0	2	4	0	0
Subtotal	208	49	14	20	35	30	5	16	40	0	0
Percentage	100%	24%	7%	10%	17%	14%	2%	8%	19%	0%	0%

[1] 208 of 257 (81%) muskoxen found in the 2002 census in Unit 22C were classified during this composition survey

Table 5 Age and sex classification for 13 groups of muskoxen in Unit 23SW[1], 7 Apr 2002

Location	Total	≥ 4-yr-old bull	3-yr-old bull	2-yr-old bull	≥ 4-yr-old cow	3-yr-old cow	3- or 4-yr-old cow	2-yr-old cow	Year-ling.	Calf	Unk.
Unit 23SW											
Group 97, near Deering	4	4	0	0	0	0	0	0	0	0	0
Group 98, near Deering	28	4	0	2	9	2	0	5	6	0	0
Group 99, Burnt River	26	1	1	2	8	4	0	4	6	0	0
Group 100, Utica	12	3	0	2	6	0	0	1	0	0	0
Group 101, Cunningham Creek	13	1	0	2	7	2	0	1	0	0	0
Group 102, Mouth of Goodhope	25	6	0	0	8	4	0	3	4	0	0
Group 103, Lower Goodhope	13	1	1	2	5	2	0	2	0	0	0
Group 104, Cripple River	3	3	0	0	0	0	0	0	0	0	0
Group 105, Burnt River	7	1	2	0	2	0	0	1	1	0	0
Group 149, S. of Clem Mountain	2	2	0	0	0	0	0	0	0	0	0
Group 150, S. of Clem Mountain	1	1	0	0	0	0	0	0	0	0	0
Group 151, Buckland River	31	1	4	5	7	6	0	3	5	0	0
Group 152, Buckland River	5	5	0	0	0	0	0	0	0	0	0
Subtotal	170	33	8	15	52	20	0	20	22	0	0
Percentage	100%	19%	5%	9%	31%	12%	0%	12%	13%	0%	0%

[1] 170 of 196 (88%) muskoxen found in the 2002 census in Unit 22SW were classified during this composition survey

Table 6 Age and sex classification for 21 groups of muskoxen in Unit 22D[1], 29 Mar–3 April 2002

Location	Total	≥ 4-yr-old bull	3-yr-old bull	2-yr-old bull	≥ 4-yr-old cow	3-yr-old cow	3- or 4-yr-old cow	2-yr-old cow	Year-ling.	Calf	Unk.
Unit 22D											
Group 42, S. of Salmon Lake	13	2	0	1	3	2	0	2	4	0	0
Group 46, Eagle Creek VABM	38	6	0	5	9	4	2	2	10	0	0
Group 49, 22D SW, Eagle Creek	20	2	0	1	6	3	0	1	7	0	0
Group 51, Hens and Chickens	35	3	5	3	9	4	0	2	9	0	0
Group 52, Lucky Strike Ck.	11	11	0	0	0	0	0	0	0	0	0
Groups 53&54, Dese Ck.	46	7	2	3	14	2	0	3	14	0	1
Group 56, Lower Agiapuk	7	1	0	0	5	1	0	0	0	0	0
Group 57, McKinnley Ck.	12	4	0	0	4	0	0	2	2	0	0
Group 58, Flat Ck.	11	1	1	3	3	0	0	0	3	0	0
Group 60, Kaviruk River	15	1	0	1	5	4	0	0	4	0	0
Group 64, W. of Noxapaga	21	1	1	0	10	1	0	1	7	0	0
Group 65, Agiapuk	16	1	1	1	11	2	0	0	0	0	0
Groups 66&71, Red Mtn.	37	4	1	2	12	2	2	7	6	0	1
Group 67, Mukacharni Mtn.	35	1	1	7	10	5	0	6	5	0	0
Group 73, Hunter Ck.	20	8	2	0	6	4	0	0	0	0	0
Group 76, Black Mtn.	25	5	2	1	10	2	1	0	4	0	0
Group 78, Black Mtn.	48	3	1	1	25	6	3	2	7	0	0
Group 91, Eldorado Ck.	21	2	0	0	8	4	1	2	4	0	0
Group 94, Eldorado Ck.	16	0	0	1	7	3	0	3	2	0	0
Subtotal	447	63	17	30	157	49	9	33	88	0	2
Percentage	100%	14%	4%	7%	35%	11%	2%	7%	20%	0%	0%
Groups of 6 or fewer muskoxen											
Group 70, Kaviruk River	5	5	0	0	0	0	0	0	0	0	0
Group 92, Eldorado Ck.	2	2	0	0	0	0	0	0	0	0	0

[1] 454 of 771 (59%) muskoxen found in the 2002 census in Unit 22D were classified in this composition survey

Table 7 Age and sex classification for 14 groups of muskoxen in Unit 22E[1], 4 Apr and 18 May 2002

Location	Total[2]	≥ 4-yr-old bull	3-yr-old bull	2-yr-old bull	≥ 4-yr-old cow	3-yr-old cow	3- or 4-yr-old cow	2-yr-old cow	Year-ling.	Calf	Unk.
Unit 22E											
Group 110, Kugrupaga River[3]	28	2	2	2	9	1	3	2	7	6	0
Group 113, W of Cowpack Inlet[3]	40	10	0	5	10	4	0	3	8	7	0
Group 119, NE Devil Mtn. [3]	19	1	1	1	6	1	0	3	6	5	0
Group 121, NE Devil Mtn. [3]	31	4	2	1	13	3	0	0	8	10	0
Group 136, Ear Mtn.	35	9	1	5	8	3	0	2	7	0	0
Group 137, Ear Mtn.	18	7	2	0	6	0	0	2	1	0	0
Group 138, Upper Nukuk River	30	5	3	4	7	4	0	3	4	0	0
Group 140, York Mtns.	23	5	2	3	6	2	0	3	2	0	0
Group 155, Coast W. of York	19	1	1	4	5	4	0	2	2	0	0
Group 144, Potato Mtn.	7	5	2	0	0	0	0	0	0	0	0
Group 148, Btwn. Pish & Goodhope	31	4	2	4	9	4	0	4	4	0	0
Group 156, Kanauguk River	30	2	1	3	5	3	0	8	8	0	0
Subtotal	312	56	19	32	84	29	3	32	57	28	0
Percentage	100%	18%	6%	10%	27%	9%	1%	10%	18%	-[2]	0%
Groups of 6 or fewer muskoxen											
Group 114, SW of Cowpack Inlet	1	1	0	0	0	0	0	0	0	0	0
Group 157, Nuluk River	1	1	0	0	0	0	0	0	0	0	0

[1] 314 of 632 (50%) muskoxen found in the 2002 Unit 22E census were classified in this composition survey.

[2] Total does not include calves of the year because they had not yet been born when Groups 136-157 were classified in April.

[3] Groups 110-121 were classified in May after calving had begun. Calving may not have been finished at the time of the May survey.

Table 8 Results of Seward Peninsula muskox composition surveys, 2002

Unit	Number (%) muskoxen sampled	Bulls:100 cows[1]	% Yearlings	Yearlings:100 cows
22B[2]	178 muskox (94%)	58:100	18%	48:100
22C[2]	208 muskox (81%)	70:100	19%	57:100
22D[3]	454 muskox (59%)	44:100	20%	41:100
22E[4]	314 muskox (50%)	63:100	18%	49:100
23SW[2]	170 muskox (88%)	46:100	13%	31:100

[1] Bulls 4-years-old-or-older: 100 cows 3-years-old-or-older. Bulls younger than 4-years-old and cows younger than 3-years-old generally do not reproduce.

[2] In Units 22B, 22C and 23SW we used the raw data to estimate bull:cow ratios, yearling:cow ratios and recruitment rates because a large proportion of known groups and animals were classified and group size did not influence group selection.

[3] In Units 22D and 22E a disproportionately large number of the groups classified during the composition survey were large groups of mixed age and sex and few of the smaller groups that were likely to be all bulls were sampled, thus bulls were under represented. To attempt to obtain a more accurate estimate of bulls, we assumed all muskoxen in groups of 6 or fewer animals found during the census were bulls. In Unit 22D we found 52 muskoxen in these small groups and in the Unit 22E there were 35. We subtracted the number of assumed bulls in these small groups from the total number of muskoxen censused in the unit. The remaining muskoxen found in the unit during the census were classified by age and sex in proportion to those classified during the composition survey. Then, the previously subtracted number of assumed bulls was added to the estimated number of mature bulls prior to calculating bull:cow and yearling:cow ratios and the recruitment estimates for each unit.

Table 9 Permits issued and filled in state and federal muskox hunts on the Seward Peninsula, 2000–2001

Hunt area and residence	State permits issued	State permits filled	Federal permits issued	Federal permits filled
Unit 22D				
Brevig Mission	4	2	4	2
Nome	13	10	0	0
Teller	8	0	2	0
White Mountain	8	8	0	0
Total	33	20	6	2
Unit 22E				
Shishmaref	10	8	5	4
Wales	5	2	3	2
Total	15	10	8	6
Unit 23SW				
Buckland	4	3	2	1
Deering	3	1	2	0
Noorvik	1	1	0	0
Total	8	5	4	1
All hunt areas	56	35	18	9

Table 10 Results of state and federal muskox hunts on the Seward Peninsula, 2001–2002

Hunt area	Muskox harvest quota	Cow harvest quota	Nr. state permits issued	Nr. state permits filled, bulls	Nr. state permits filled, cows	Nr. federal permits issued	Nr. federal permits filled, bulls	Nr. federal permits filled, cows	Combined harvest, bull	Combined harvest, cow	Combined harvest, total
Unit 22B											
TX105	8	0	5	4	NA	3	2	NA	6	0	6
Elim	NA	NA	2	2	NA	0	NA	NA			
Golovin	NA	NA	0	0	NA	1	0	NA			
Koyuk	NA	NA	3	2	NA	0	NA	NA			
White Mtn	NA	NA	0	0	NA	2	0	NA			
Unit 22C											
TX100	2	0	2	0	NA	0	NA	NA	0	0	0
Nome	NA	NA	2	0	NA	NA	NA	NA			
TX101	2	0	2	2	NA	0	NA	NA	2	0	2
Nome	NA	NA	2	2	NA	NA	NA	NA			
Unit 22D											
TX102	32	13	30	20	6	7	0	0	20	6	26
Brevig	NA	NA	7	6	0	4	0	0			
Nome	NA	NA	15	11	1	0	NA	NA			
Teller	NA	NA	1	0	1	3	0	0			
White Mtn	NA	NA	7	3	4	0	NA	NA			
TX103	7	3	7	3	0	0	NA	NA	3	0	3
Teller			6	3	0	NA	NA	NA			
Golovin			1	0	0	NA	NA	NA			
Unit 22E											
TX104	23	9	15	6	7	15	3	5	9	12	21
Shishmaref	NA	NA	12	3	7	9	2	3			
Wales	NA	NA	3	3	0	6	1	2			
Unit 23SW											
TX106	13	5	11	5	1	6	0	2	5	3	8
Buckland	NA	NA	8	3	1	0	0	0			
Deering	NA	NA	1	1	0	6	0	2			
Kotzebue	NA	NA	2	1	0	0	0	0			

[1] Based on a 5% harvest rate in Units 22B, 22D, 22E, and 23SW; and a 3% harvest rate in Unit 22C

[2] Based on previous success rates in TX102, 15% more permits that the harvest quota were issued to achieve a harvest closer to the quota. In TX104, 30% more permits were issued and in TX106 33% more permits were issued.

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MUSKOX MANAGEMENT REPORT

From: 1 July 2000
To: 30 June 2002

LOCATION

GAME MANAGEMENT UNIT: 23 (43,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range and Kotzebue Sound

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 northwestern Canada) by the time whalers arrived. Although there is ample evidence of at least 2 genera of muskox (*Ovibos* and *Smybos*) in northwest Alaska from the Pleistocene period, there is little evidence that muskox existed south of the Brooks Range during the last several hundred years.

Two muskox populations currently inhabit Unit 23, and both are products of translocations from Nunivak Island. ADF&G released 36 muskoxen on the southwestern portion of the Seward Peninsula near Teller in 1970. In 1981 ADF&G released an additional 35 muskoxen in the same area. Muskox inhabiting the southwestern portion of Unit 23 between the Buckland and Goodhope Rivers are part of the Seward Peninsula population that resulted from these translocations near Teller. The Unit 22 Muskox Management Report covers the Seward Peninsula muskox population for Unit 22 and the southwestern portion of Unit 23.

In 1970 ADF&G also released 36 muskox near Cape Thompson. In 1977 ADF&G 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 'Cape Thompson' 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 the relatively discrete Seward Peninsula and Cape Thompson populations, muskox are widely scattered throughout most of the unit. Most muskox outside the 2 core ranges occur in small groups of 1-4 individuals, and most are bulls. However, mixed sex-age groups have been observed in the Selawik drainage during recent years. Muskox in the Noatak drainage probably emigrated from the Cape Thompson area, and those in the Selawik and Kobuk drainages probably came from the Seward Peninsula.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

1 To allow for growth and expansion of muskox into historic ranges.

2 To initially provide for subsistence hunting and eventually provide for recreational hunting of muskox on a sustained yield basis.

3 To provide for nonconsumptive uses of muskox; e.g., viewing and photography.

MANAGEMENT OBJECTIVES

1 To census the Cape Thompson population at least once every 3 years.

2 To monitor the sex and age composition of the Cape Thompson 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 ADF&G, National Park Service (NPS), and Selawik National Wildlife Refuge have cooperatively censused the Cape Thompson muskox population 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. The census area also includes a small portion of Unit 26A near Corwin Bluff. Search effort focuses on known ranges and prime muskox habitat along ridgelines and riparian areas. We search other areas less intensively. To minimize disturbance, we approach groups of muskox at 1000–2000 ft above ground level and repeatedly count them during a gradual, low power, spiral descent.

Population Composition

Composition information collected during spring censuses is limited to neonates, yearlings and adults for mixed sex-age groups. Bulls are identified in bull groups. The NPS and University of Alaska collected more detailed composition data from ground-based observations on Cape Krusenstern National Monument during spring 1999, 2001 and 2002.

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 ADF&G staff and local residents, commercial operators, hunters, and nonconsumptive users provided information regarding the distribution of muskoxen in Unit 23.

MORTALITY

No radio collars were deployed in this population during the reporting period; therefore, we did not estimate annual population mortality rates. We did examine kill sites to try to determine causes of muskox mortality.

Harvest

Harvest during the 2001–2002 and 2002–2003 regulatory years was monitored through the Tier II hunt report system and through phone calls to permit winners.

HABITAT

Assessment

ADF&G did not monitor muskox range condition in Unit 23 during the reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The census conducted in 2001 may have substantially underestimated muskox population size in this portion of the unit. Reports from NPS staff, commercial pilots and a guide in the area indicate we probably missed some groups of muskox during the census. Also, we may have undercounted some groups observed in riparian willow habitat because leaf out was advanced compared to previous years and some animals were difficult to see. No census was conducted in 2002 because leaf out occurred suddenly in late May–early June and we were concerned the problems encountered during the 2001 census would be repeated.

From 1970 to 2000 the Cape Thompson muskox population grew approximately 8% annually (Fig. 1, Table 1). In contrast, during the same time period the Seward Peninsula muskox population grew about 14% annually. For many years we interpreted this difference as an indication of habitat limitation in the northwestern portion of the unit. We now have enough distribution of data to delineate core muskox ranges on the Seward Peninsula and between Capes Lisburne and Krusenstern reasonably accurately. The highest density of muskoxen estimated for the northwestern portion of Unit 23 was 0.13 muskoxen/mi^2 in 2000 (excluding calves born that year). In comparison, the highest density observed on the Seward Peninsula was 0.16 muskox/mi^2 in 2002 (approximately 20% greater than northwestern Unit 23). This supports the decision to allow limited hunting of muskoxen in the northwestern portion of Unit 23.

Population Composition

The NPS classified 111 muskox during composition surveys conducted from the ground during April 1999 (C. Ihl, personal communication). For muskox $\geq$2-years-old, the bull:cow ratio was 87:100 and the yearling:cow ratio was 48:100. Based on aerial survey data, calf production was lower during 2001 (10 calves:100 adults) than in 1997–2001 (mean=25 calves:100 adults). Opportunistic observations made during April–June 2003 (after this reporting period) suggested calf production was low this year as well.

Distribution and Movements

Muskoxen in this area rarely venture >15 miles inland from the Chukchi Sea coastline and exhibit strong fidelity to this portion of the unit. This is probably because chronic high coastal winds minimize snow depth on exposed ridges during winter and lower ambient air temperature during summer. Although snow depth in this coastal region is minimal, the quantity and quality of forage appears limited during winter as well. In addition, muskox are extremely sociable animals, especially cows and immature individuals. This behavior probably slows muskox range expansion. Although small numbers of mature bulls routinely move into new areas, cows rarely do so.

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 is abundant and muskox store large amounts of fat. 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.

Prior to 1997 muskox in the northwest portion of Unit 23 were distributed in 2 relatively discreet subpopulations: one northwest of the Asikpak River (primarily between the Ogotoruk drainage and Cape Dyer) and one southeast of the Omikviorik River (primarily in the Tahinichok Mountains). Telemetry data suggest there was little exchange of individuals between these subpopulations. By 1997 this population had increased and muskox were distributed almost continuously between Cape Krusentstern and Cape Lisburne. In 1995, muskox first moved out of the Tahinichok Mountains and into the western portion of the Igicuk Hills. By 1997 muskox were using the entire Igichuk Hills and by 2001 they were regularly using the entire area between the lower Noatak River and Cape Krusenstern.

Small groups of widely scattered muskox now occur throughout the Noatak River drainage, the Kobuk River drainage almost to Walker Lake, and the Selawik drainage including the middle Tagagawik River, the headwaters of Derby Creek and the Purcell Mountains. Most of these muskoxen have been mature bulls distributed along riparian corridors. However, several mixed sex-age groups have been observed in the Selawik River drainage during recent years.

MORTALITY

Harvest

Season and Bag Limit. Since its inception during the 2000–2001 regulatory year, 6 permits for 1 bull muskox have been issued annually for the Tier II muskox hunt in northwest Unit 23 (TX107). The season throughout this reporting period was 1 Aug–15 March. The NPS has never allowed muskox hunting on Cape Krusenstern National Monument and there has never been a nonresident or resident general season hunt for muskox in Unit 23.

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
2000–2001 and 2001-2002		

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 23, Southwest, that portion on the Seward Peninsula west of and including the Buckland River drainage	(see Unit 22 report)	(see Unit 22 report)
Unit 23, that portion north and west of the Noatak River		
1 bull by Tier II subsistence hunting permit only; up to 15 bulls may be taken.	1 Aug–15 Mar (Subsistence hunt only)	No open season
Remainder of Unit 23	No open season	No open season

Board of Game Actions and Emergency Orders. There were no Board actions or emergency orders issued that affected muskoxen in Unit 23 during this reporting period.

Human-Induced Harvest. During 2001–2002 only 2 hunters reported the results of their hunts: 1 was unsuccessful and 1 did not hunt. During 2002–2003 five hunters reported taking 4 bulls and 1 cow. The harvested cow was mistakenly taken after it was misidentified as a bull. The hunter reported his mistake and was issued a warning citation by the Department of Public Safety. The head and hide of the cow were confiscated but the hunter was allowed to keep the meat. Harvests of muskox from the Seward Peninsula portion of Unit 23 are reported in the Unit 22 muskox management report.

Permit Hunts. See section above.

Hunter Residency and Success. All Tier II permits have been issued to residents of Point Hope, Kivalina or Noatak since the inception of this hunt. No hunters reported taking a muskox in 2001–2002. Five of 6 hunters (83%) were successful in 2002–2003.

Harvest Chronology. Most hunting was conducted during late February through the end of the season (March 15).

Transport Methods. All hunters accessed their hunting area via snow machine during both reporting periods.

Natural Mortality

While conducting the July 2001 muskox census, E. Kingik and I observed an adult cow muskox that had been killed by a brown bear minutes earlier near the lower Kukpuk River.

The bear was drinking within 200 m of the carcass and immediately became possessive of it when we approached in the Cub. The cows' throat was torn open but she had not been fed upon. Shortly afterward and within 3 miles of the freshly killed cow we discovered the hide and skeleton of a large bull muskox that had been repeatedly cached by a brown bear. The carcass was at least 1–2 months old at the time. I later hiked into this site but could not confirm the cause of death or the bulls' body condition at that time. Tooth wear suggested that the bull was very old.

Two employees of the Cape Lisburne long range radar station reported 1 or more brown bears had killed 4 muskoxen approximately 13 mi east of the station during late March 2003. Trooper Hildebrand and I each flew to the area in early June, picked up one of the employees (Mr. Rick Reed) and viewed the site from a Super Cub. We could not land and by the time we reached the site the carcasses had been completely consumed and scattered; therefore, we only looked at the few remains from the air. Three of the carcasses were within 3–10 m of each other. The other carcass (of a 2-yr-old bull) was about 150 m away. All of the carcasses were within 2–3 mi of the coast beside a small creek that contained deep snow at the time of the kills. The skulls had been salvaged and were from a 4-yr-old bull, two 2-yr-old bulls and a 3-yr-old cow. The employees had video footage of 4 bears at the kill site one of which had a large flap of skin torn from behind a foreleg. Reed said one of the bulls had a tuft of fur caught in a horn tip that he speculated may have come from the bear. The employees were certain these muskox had been part of a group of 12 remaining animals that were nearby when they discovered the site and when we viewed them from the Cubs.

While enroute home from this site I observed a medium-sized male brown bear on a muskox carcass 11 mi northwest of Kivalina village and within 0.5 mi of the beach. I landed the following day and determined the cow had been killed within the previous week. She had been in good body condition when she died based on the appearance of her femur marrow. Nine muskox were within 0.5 mi of the kill site when I initially found it.

Many incidents of bears killing muskox have been observed throughout Unit 26 (G. Carroll, H. Reynolds and P. Reynolds, pers. commun.; see also Reynolds unpub. rep. and Reynolds et al. 2002). Before 2001 I received few reports of bears killing muskox and all of those were from the vicinity of Deering. My observations and those of other field staff who work with muskox in northern Alaska suggest brown bears have only recently discovered muskox as a source of food, and that they are a very effective predator on them. It appears that brown bears have become or are becoming an important mortality source capable of substantially reducing muskox populations. I have never received a report or observed evidence of wolves killing muskox in Unit 23.

In the early 1990s a local pilot and falconer observed a mature Golden eagle on a 1- or 2-month-old muskox calf carcass near Cape Thompson. A mixed sex-age group of muskox was nearby. He was certain the eagle had killed the calf. Eagles are probably not a primary source of mortality for muskox calves.

While investigating the caribou die offs that occurred in 1994–1995 and 1999–2000, it was striking that we found only 1 fresh muskox carcass (in 1995) even though the entire muskox population was within the zone of caribou deaths. This illustrated the striking difference

between muskox and caribou survival strategies during winter. It also showed that muskox, with their conservative energy budgets, are better able to survive difficult winter conditions than caribou.

Other Mortality

In November 2001 I received a report that the carcass of a bull muskox had been found on the coast 10–12 mi northwest of Shesalik Spit. I examined the carcass with 2 local residents and we found the bull had been shot through 1 mandible with a small caliber rifle. He appeared to have survived for weeks or months after being wounded and was in surprisingly good body condition with a full rumen at the time of his death. I suspect the bull died from the large abscess that had developed as result of this wound. Unsubstantiated rumors circulated that 2 minors had shot at a bull near their camp at Shesalik earlier that fall but no citation was ever issued.

In October 2001 ADF&G staff observed a mature cow muskox that had been recently shot and abandoned at the tip of the Tigara Peninsula. No information was available and no investigation was conducted.

Illegal harvests have been a continuous and probably small source of mortality for muskox in northwest Unit 23 since at least the late 1980s.

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 still feel that muskox displace caribou and reindeer through behavioral interactions and the presence of muskox quiviut (undercoat) and feces in areas where they are sympatric. 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). Also, after >30 years, local residents still resent that they were not consulted before muskox were introduced to this unit. This negative local sentiment toward muskox has diminished slightly 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 without harming people, 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 ADF&G 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. However, density of muskox in northwest Unit 23 is currently comparable to that on the Seward Peninsula.

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 do not flee far when approached. The effects of hunting muskox are not limited to removing individuals from the population. A greater indirect effect of hunting on muskox may lie in repeated disturbance of large mixed sex/age groups as hunters approach them. Energetic costs of flight and stress associated with hunting may affect mortality rates especially when snow is deep or occurs during 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 ADF&G can assess their impact on the population.

    b. Harvest should be limited to bulls and hunters should be encouraged to focus on bull groups rather than mixed sex-age 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 when their fat reserves are lowest.

2 Conduct an aerial census of muskox in this area during March or April 2004. This should be a high priority because we have not conducted a reasonably accurate census since 2000 and because brown bears may be reducing muskox numbers in this portion of the Unit.

3 Local license vendors should be trained and encouraged to help residents with Tier II applications.

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Table 1 Muskox census results for the northwest portion of Unit 23, 1988–2001

	May 1988	June 1994	March 1997	June 1997	June 1998	June 1999	June/July 2000	July 2001
Groups	14	19	24	26	39	34	41	37
Adults[a]	106	215	291	212	322	299	327	236
Calves[b]	17	18		49	65	75	97	23
Total	123	233	291	261	387	374	424	259
Calves:100 Adults	16	8		23	20	25	30	10

[a] "Adult" defined as any muskox >12 months old

[b] "Calf" defined as any muskox 1-2 months old

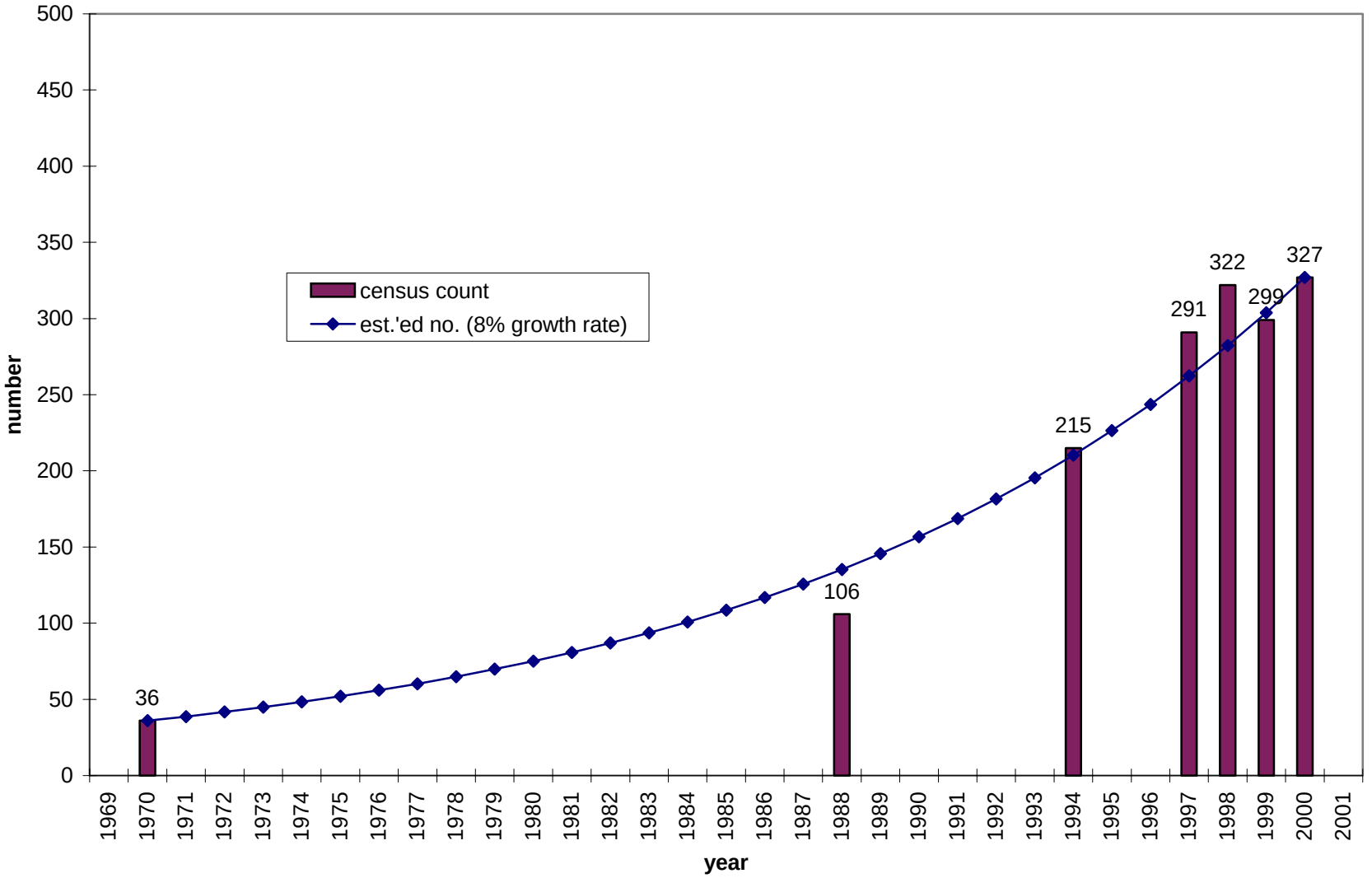

Figure 1 Counted and estimated number of muskox >12 months old in the northwest portion of Unit 23, 1970-2000 (2001 census not included because total count probably inaccurate)

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MUSKOX MANAGEMENT REPORT

From: 1 July 2000
To: 30 June 2002

LOCATION

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

GEOGRAPHIC DESCRIPTION: Central and Eastern Arctic Slope

BACKGROUND

Muskox populations in Alaska declined or, in some areas, disappeared before firearms were widely available. Before the availability of firearms, hunting 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. ADF&G reintroduced muskoxen from Nunivak Island to the eastern North Slope in 1969 and 1970 when 51 animals were released on Barter Island and 13 were released at Kavik River. The number of muskoxen increased steadily during the 1970s and 1980s in Unit 26C, and expanded eastward into Yukon, Canada and westward into Unit 26B and eastern Unit 26A during the late 1980s and early 1990s. The population was considered stable during the mid–1990s at around 500–600 muskoxen in Units 26B and 26C with perhaps an additional 100 animals in Yukon, Canada. Beginning in 1999, calf production, yearling recruitment, and number of adults declined substantially in Unit 26C. Muskoxen numbers in Unit 26B appeared stable to slightly increasing. 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).

MANAGEMENT DIRECTION

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 of the North Slope Muskox Working Group included representatives from local villages, Alaska Department of Fish and Game (ADF&G), the North Slope Borough, and affected federal agencies. The group developed the North Slope Muskox Harvest Plan and all agencies, including ADF&G, signed the plan in February 1999. Some goals and objectives in this report were adopted directly from the plan.

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 1–4).
- Conduct precalving surveys in early April to obtain a minimum count.
- Conduct ground-based composition counts to determine herd composition.
- Maintain 8–10 radio collars on adult female muskoxen to assist in locating groups of muskoxen during precalving surveys and composition counts.
- Administer 3 permit hunts and monitor results of the hunts.

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 1–3).
- Administer 3 permit hunts and monitor results of the hunts.

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, 2 observers were in the back and 1 was in the front of the aircraft. Bright, sunny days provided the best survey conditions. Transects were flown at approximately 90 mph at 500–1000 ft above ground level, depending on visibility. Systematic surveys were not done in Unit 26B west of the Dalton Highway (Unit 26B West) until March 1997. In Unit 26B West, 6-mile long transects oriented north–south were distributed from 70ºN to 69º15'N. In April 1999 transects extended further south to 69ºN, and transects were also flown in the area approximately halfway between the Itkillik and Colville Rivers. In Unit 26B, east of the Dalton Highway (Unit 26B East), we surveyed major drainages and some of the smaller adjacent tributaries and bluffs beginning in 1986. In April 2000, the transect method also was applied to Unit 26B East. In 2001 and 2002 we again surveyed major drainages and smaller adjacent tributaries and bluffs in Units 26B East. Staff from the Arctic National Wildlife Refuge surveyed major drainages and smaller adjacent tributaries and bluffs in Units 26C beginning in 1978. In 2002 they surveyed the

area using a grid (Reynolds 2002; P Reynolds, FWS, personal communication). In addition to flying surveys, we tracked radiocollared females to locate groups of muskoxen.

To determine herd composition, we conducted ground-based composition counts in Units 26B and 26C in late June or early July. We first located groups of muskoxen by radiotracking from a fixed-wing aircraft or helicopter, then classified animals from the ground as >4 years old, 3 years old, 2 years old, yearling, or calf and as male or female.

To locate muskoxen during precalving surveys and composition counts during 1994–1995 through 2001–2002, we monitored 8–10 radiocollared adult females. In April 1999 ADF&G deployed radio collars on 12 adult (≥3 years) female muskoxen in 11 groups distributed between the Itkillik River and the Ivishak River in Unit 26B using methods described in Lenart 1999. In June and July 2001 and June 2002, 3 more radio collars were deployed on adult females by darting them with a CO_2 powered short-range projector pistol instead of a rifle powered by external charges.

HARVEST

For Unit 26B 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), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001). We obtained harvest data from FWS for Unit 26C.

We examined the population and harvest data by grouping the data in 5 different ways: 1) Units 26B and 26C combined, 2) Unit 26B, 3) Unit 26C, 4) Unit 26B West, and 5) Unit 26B East.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The number of muskoxen observed during precalving surveys in Unit 26B increased steadily during the early 1990s and fluctuated slightly during the mid 1990s before stabilizing at approximately 250–300 muskoxen since 1999 (Table 1). No surveys were conducted in 2001; but we estimated the minimum population to be 258 from a composition count completed in June by excluding calves and including observations of adults not classified. The number of animals observed in April 2002 was 284. Factors that influenced the fluctuation during the mid 1990s probably were immigration into Unit 26B from Unit 26C, lack of systematic precalving surveys in Unit 26B West until spring 1997, emigration out of the area, and recruitment. Since 1997 these fluctuations were reflected mostly in Unit 26B East, perhaps because of animals moving back and forth across the Canning River (Units 26B East and 26C boundary). During 1997 through 2002 the population in Unit 26B West remained relatively constant at 90–107 muskoxen, except in 1998 when 79 animals were observed (Table 1). Percent calves observed in Unit 26B during the June composition was moderately good ranging 16–24% during the previous 5 years (1998–2002). Recruitment of yearlings (proportion of 1-year-old muskoxen in the population of muskoxen ≥ 1-year old) during this time was not high, but remained constant

(range: 13–16%). Thus, some yearling recruitment occurred and the population appeared stable to slightly increasing. Muskoxen are long-lived, yet because this population is not increasing at a faster rate, it is possible that mortality closely tracks recruitment. Some of the mortality in Unit 26B may have been caused by brown bears. There is evidence that brown bears have become efficient predators on muskoxen on the eastern North Slope (Reynolds et al. 2002).

The number of muskoxen observed in Unit 26C during precalving surveys seemed stable during 1990 through 1998 (range: 282–332; Table 1). Subsequently, the population declined in 1999 and continued to decline to 64 muskoxen observed in April 2002 (Table 1). Initially, emigration into Unit 26B and Yukon, Canada could have caused lower numbers of muskoxen to be observed. However, number of calves observed in early June and yearling recruitment also were lower in Unit 26C beginning in 1999. Thus, Reynolds (2002) suggested factors other than emigration that may have influenced the population were 1) annual variation in weather (e.g., crust forming on snow and long winters with deep snow making it difficult for foraging and late green-up of summer forage) affecting female body condition, calf survival, and yearling recruitment; 2) adults calving in alternate years; 3) brown bears becoming more efficient predators on muskoxen; 4) a group of muskoxen going out onto the coastal ice and not returning; and 5) disease making muskoxen more vulnerable to poor environmental conditions. For example, muskoxen in Alaska had a high serum antibody prevalence of malignant catarrhal fever (MCF) virus (95%; n =104; Zarnke et al. 2002). However, there was no evidence that muskoxen were experiencing clinical signs of MCF.

The combined number of muskoxen observed during precalving surveys in Units 26B and 26C declined considerably, with 426 muskoxen observed in 2001 and 348 in 2002 (Table 1). As mentioned previously, the decline in Unit 26C began in 1999, but was not evident with Unit 26B and 26C data combined until 2001. Recently, muskoxen have increased in Yukon, Canada and biologists estimated this population at 306 muskoxen in 2002 (P Reynolds, FWS, personal communication). Although some emigration from Unit 26C into Yukon and Unit 26B may have occurred; the population decline in Unit 26C cannot be attributed solely to this event. Factors such as weather, disease, and predation most likely were involved. We estimated that approximately 600–700 muskoxen now inhabit the eastern North Slope of Alaska and northwestern Canada.

Population Composition

In Unit 26B, percent calves was moderately good (range: 16–24%) during the previous 5 years (1998–2002; Table 1). Calves:100 females >2 years old also was good during 1998 through 2001 (range: 45–60:100); but was somewhat lower in 2002 (36:100). The number of bulls observed annually probably accounted for the differences in trend observed between percent calves and calves:100 females. Annual bull (>3 years):100 cow (>2 years) ratios fluctuated annually with a low bull:cow ratio one year and a high bull:cow ratio the next year (Table 1). Variability in bull:cow ratios may correlate to a difficulty in locating bull groups, which is related to search effort. Yearling recruitment (proportion of 1-year-old muskoxen in the population of muskoxen ≥ 1-year old) also was moderately good during 1998 through 2002 and did not vary (range: 13–16%; Table 1). We also separately examined composition data from Unit 26B West and Unit 26B East for 1997–2002 (Table 2). Percent calves and yearling recruitment during 1999–2002 was slightly more variable in Unit 26B East compared with Unit 26B West. However, no

trends were observed. Percent calves was higher in Unit 26B West compared with Unit 26B East in both 2001 and 2002, but this was not observed in yearling recruitment which was higher in Unit 26B West in 2002 and Unit 26B East in 2001.

In Unit 26C, percent calves was low during 1999 through 2001 (range: <1–7%) and yearling recruitment also was low (range: 0–9%; Table 1). Percent calves was slightly better in 2002 (10%) and no data was available for percent yearlings because muskoxen were classified as calves or muskoxen older than calves. Muskoxen were difficult to locate in June 2001 and 2002 and only 47 and 71 muskoxen were classified, respectively. One factor that may have affected yearling recruitment in Unit 26C is that brown bears have increased their efficiency as predators of muskoxen (Reynolds et al. 2002). 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 snow and harder snow crust may occur in Unit 26C, making foraging more difficult during winter (Reynolds 2002). Late springs occurred on the North Slope in 2000 and 2001 and may have influenced calf production in Unit 26C. Annual bull (>3 years):cow (>2 years) ratios ranged from 40 to 60 during the previous 5 years (1997–2001; no data available for 2002; Table 1).

We examined the combined composition data from Units 26B and 26C and no trends were observed in calf production or yearling recruitment during the past 5 years (1997–2001; Table 1); although recruitment was low in 2001 (7%). Because substantial declines in number of calves observed and yearling recruitment occurred in Unit 26C during 1999–2001, we expected overall percent calves and yearling recruitment in Units 26B and 26C to be low. This was not observed so we suggest that percent calves and yearling recruitment in Unit 26B was high enough to mask the decline in Unit 26C. However, this should not detract from the significance of the events occurring in Unit 26C. In Unit 26B and Unit 26C combined annual bull (>3 years):100 cow (>2 years) ratio was 36–61 during 1997–2001 (no data available for 2002) indicating there were adequate bulls for breeding.

Distribution and Movements

Muskoxen were reintroduced to the eastern North Slope in 1969 and 1970 at Barter Island and Kavik River, respectively. The number of muskoxen increased steadily during the 1970s and 1980s in Unit 26C, and they have extended their range eastward into Yukon, Canada as far east as Babbage River and westward into Unit 26B and the eastern part of Unit 26A as far west as Fish Creek. There have also been anecdotal reports of lone bulls and small groups of muskoxen south of the Brooks Range in Unit 25A, near Arctic Village since 1980. In 1999, 3 muskoxen were illegally harvested from a group of 10 muskoxen located north of Arctic Village. Of the 3 harvested animals, 2 were cows. This was the first documentation of a mixed-sex group south of the Brooks Range. There also was a sighting of a lone bull on the Yukon River in Unit 25B, near Eagle. We suspect that these animals originated from the Units 26B and 26C population. In addition, a few bull muskoxen and some small groups have recently been sighted at the Gisasa, Kateel, and Hogatza Rivers. Other reports of lone bulls have occurred in Nulato, Ruby, and on

the Yukon River across from Galena. We do not know if these small groups are mixed-sex or males only. We suspect that these animals originated from 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 in 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. In winter 1998–1999, 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. In RY96, state hunts in Unit 26B (TX108 and TX110) 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. From RY98 through RY99 the season for the Tier II hunt in Unit 26B west of the Dalton Highway (TX108) was changed to 15 September through 31 March for any muskox. In addition, the Tier II hunt in Unit 26B east of the Dalton Highway (TX110) was changed to a Tier I registration hunt (RX110) opened by emergency order and closed no later than 31 March with a harvest quota of 4 muskoxen. A drawing hunt was established in Unit 26B east of the Dalton Highway (DX112), 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 season for the Tier II (TX108) was lengthened by opening the hunt on 1 August versus 15 September. 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 through 2002–2003	9[a]; 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 bull	1–31 Mar	1–31 Mar
1988–1989 through 1989–1990	10; Registration; 1 bull	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

[a] In RY00, 10 Tier II permits were issued because of a discrepancy in scoring.

Alaska 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 "incidental" muskoxen in Unit 24 and Unit 26A and for "stranded" muskoxen statewide.

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 Management Area (DHCMA). Hunting by motorized vehicles is not allowed within the DHCMA. This would have allowed hunters from Nuiqsut or other North Slope villages to access the area east of the DHCMA 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. In fall 2000 the legislature changed the wording in Title 19 so the new hunting regulation was immediately implemented.

During their March 2002 meeting, the Board of Game considered a number of proposals related to bow hunting and the use of motorized vehicles in the DHCMA, some of which will affect muskox hunting opportunities for the DX112 hunt. The board established the North Slope Closed Area, which is closed to big game hunting. The area includes the portion of Unit 26B within ¼-mile of the Dalton Highway from Atigun Pass north to the Prudhoe Bay Closed Area. The board also established a requirement that hunters using the DHCMA mark arrows with their bow hunter education certification number, extended the restrictions on the use of motorized vehicles in the DHCMA to apply to the Prudhoe Bay Closed Area, and limited the use of licensed highway vehicles in the DHCMA to publicly maintained roads. Muskoxen seasons and bag limits were not changed. The boundary for the Tier II hunt (TX108) was extended westward to include Unit 26A, east of longitude 153°.

In August 2002 the Federal Subsistence Board reduced the total muskox harvest in Unit 26C to 2 bulls for the RY02 hunting season. If late winter–early spring muskox surveys in 2003 indicate more muskoxen are present in Unit 26C, the number of permits issued can be increased up to 3% of the estimated muskox population in Unit 26C and will be for bulls only.

Hunter/Trapper Harvest. Hunting for muskoxen in the eastern North Slope was allowed by permit only. 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 <4% of the estimated total population observed during precalving surveys (Table 3). In all of Unit 26B, reported harvest was 0–14 during RY90 through RY01 and was <5% of the Unit 26B segment of the population. During RY95 through RY99, harvest in Unit 26B West was 1–5 (<6%) and in Unit 26B East it was 1–9 (<5%; Table 3). Reported harvest in Unit 26C was 5–15 during RY90 through RY01 (<4%). Restrictions in regulations ensure a low harvest. Some hunters may not have reported 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 3). 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 4. Since RY86, success rate was probably high for Units 26B and 26C combined and hunters were predominantly local residents (Table 5). Success rates for Unit 26C were not available, but we suspect success rates were good for all the hunts (> 50%).

Transport Methods and Harvest Chronology. Hunters relied primarily on snowmachines to hunt muskoxen. However, hunters also used aircraft in some fall hunts during the early 1990s. Beginning in RY96 and continuing through RY01, a few hunters used boats (Table 6).

Chronology of harvest depends mostly on weather (e.g., snow, fog, temperature, and rivers freezing). During RY95 through RY01, 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 in April after the season was closed.

Natural Mortality

We have little data on natural mortality 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 (Reynolds et al. 2002). Wolves seem to be more abundant in Unit 26B than in Unit 26C and may become a more important source of mortality in the future. Late winter storms contribute to mortality of calves, yearlings, and old adults, but these losses are generally minimal.

Other Mortality

Some human-caused mortality is capture-related as suggested above, and some occurs on the Dalton Highway from vehicles hitting muskoxen. Causes of many of the 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 Kadleroshilik River. A muskox that was collared on the Colville River in June 2001 was found dead 25 miles north of the capture site at Ocean Point in October 2001. Mortality rate for radiocollared females was as follows: April 1999–May 2000, 14 muskoxen, 3 mortalities; 21%; May 2000–May 2001, 11 muskoxen, 1 mortality, 9%; May 2001–May 2002, 11 muskoxen, 3 mortalities, 27%.

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 probably adequate to support a larger population than currently exists in that area (P Reynolds, FWS, personal communication). There is some speculation that changes in forage quality and quantity on winter ranges in Unit 26C may be affecting reproduction and survival (Reynolds 2002). These changes may be related to annual variability in weather and related to snow depth, length of snow season, and icing conditions (Reynolds 2002).

CONCLUSIONS AND RECOMMENDATIONS

The overall population size in Units 26B and 26C declined considerably in 2001 and 2002, but the dynamics of populations in the subunits was different, with calf survival, yearling recruitment and number of adults declining in Unit 26C, but not in Unit 26B. The major factors influencing

this probably were annual variation in weather affecting female body condition and winter foraging, and brown bears becoming more efficient predators. However, to account for the low number of muskoxen observed in Unit 26C, emigration was most likely involved and disease may also have played a role (Reynolds 2002). 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.

We partially met our first goal to provide opportunities to harvest muskoxen while maintaining healthy, stable muskox populations. ADF&G administered 3 hunts in Unit 26B and FWS administered 1 hunt in Unit 26C. However, the population is not currently stable. In response to declining numbers in Unit 26C, the Federal Subsistence Board reduced the number of permits available for the Unit 26C hunt, with support from members of the North Slope Muskox Working Group and the community of Kaktovik.

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. 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 met our fourth goal of providing opportunities to view and photograph muskoxen. 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 did not meet our first objective to maintain a stable population of 500–650 muskoxen in Units 26B and 26C because the estimated population was 348 in 2002. We recommend that members of the North Slope Muskox Working Group meet to discuss and address the changes in the dynamics of the muskox population on the eastern North Slope.

We met our second objective to 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. The harvest rate was less than 10% annually and number of muskoxen in Unit 26B is stable to slightly increasing.

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TABLE 1 Units 26B and 26C muskoxen minimum population estimate and composition counts, 1987–2002[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)		Yearling recruitment %[f] (*n*)		Percent calves (*n*)	
UNITS 26B & 26C												
1987	390		339	(275)	28	(37)	48	(133)	15	(42)	19	(64)
1988	410		371	(287)	42	(49)	71	(118)	21	(60)	23	(84)
1989	484		280	(236)	29	(32)	39	(112)	17	(40)	16	(44)
1990	454		369	(311)	41	(56)	43	(135)	18	(57)	16	(58)
1991	438		475	(380)	50	(76)	63	(179)	14	(54)	20	(95)
1992	507		517	(435)	51	(97)	43	(191)	19	(82)	16	(82)
1993	563		535	(426)	43	(83)	56	(194)	14	(61)	20	(109)
1994	484		432	(361)	51	(76)	48	(148)	19	(70)	16	(71)
1995	651		385	(338)	57	(80)	33	(141)	14	(47)	12	(47)
1996	598		239	(198)	40	(39)	42	(98)	11	(22)	17	(41)
1997	603		485	(431)	48	(93)	28	(193)	16	(70)	11	(54)
1998	538		308	(264)	36	(48)	33	(132)	11	(30)	14	(44)
1999	491		466	(419)	61	(120)	25	(198)	10	(44)	10	(47)
2000[g]	523		356	(314)	38	(63)	25	(165)	11	(34)	12	(42)
2001[g]	426		333	(285)	41	(54)	36	(132)	8	(24)	14	(48)
2002[g]	348		312	(267)	n/a	n/a	n/a	n/a	n/a	n/a	14	(45)
UNIT 26B												
1990	122		83	(69)	41	(14)	41	(34)	16	(11)	17	(14)
1991	156		98	(75)	69	(24)	66	(35)	12	(9)	24	(23)
1992	224		193	(162)	43	(33)	40	(77)	19	(31)	16	(31)
1993	237		131	(103)	41	(21)	55	(51)	10	(10)	21	(28)
1994	166		91	(76)	46	(13)	54	(28)	25	(19)	17	(15)
1995	330		145	(123)	55	(29)	42	(53)	12	(15)	15	(22)
1996	266		44	(41)	35	(8)	13	(23)	11	(5)	7	(3)
1997	279	92	123	(107)	49	(23)	34	(47)	22	(24)	13	(16)
1998	207	79	97	(78)	24	(10)	45	(42)	13	(10)	20	(19)
1999	237	96	194	(162)	62	(44)	45	(71)	14	(23)	17	(32)
2000[g]	277	90	172	(131)	35	(24)	60	(68)	13	(17)	24	(41)
2001[g]	258[h]	107[h]	286	(239)	64	(63)	48	(98)	16	(39)	16	(47)
2002[g]	284	102	241	(203)	39	(41)	36	(105)	13	(24)	16	(38)
UNIT 26C												
1990	332		286	(242)	42	(42)	44	(101)	19	(46)	15	(44)
1991	282		377	(305)	36	(52)	50	(144)	15	(45)	19	(72)

Location[d]/Year	Minimum population estimate[b] Muskoxen observed	Unit 26B (West)[e]	Postcalving composition surveys[c] Muskoxen classified (excluding calves)		Bulls >3 yr:100 cows>2 yr (number bulls >3 yr)		Calves:100 cows>2 yr (number cows >2 yr)		Yearling recruitment %[f] (*n*)		Percent calves (*n*)	
1992	283		324	(273)	56	(64)	45	(114)	19	(51)	16	(51)
1993	326		404	(323)	43	(62)	57	(143)	16	(51)	20	(81)
1994	318		341	(285)	53	(63)	47	(120)	18	(51)	16	(56)
1995	321		240	(215)	58	(51)	28	(88)	15	(32)	10	(25)
1996	332		195	(157)	41	(31)	51	(75)	11	(17)	20	(38)
1997	324		362	(324)	48	(70)	26	(146)	14	(46)	11	(38)
1998	331		211	(186)	42	(38)	28	(90)	11	(20)	12	(25)
1999	254		272	(257)	60	(76)	14	(127)	8	(21)	7	(15)
2000	246		184	(183)	40	(39)	1	(97)	9	(17)	<1	(1)
2001	168		47	(59)	48	(13)	<1	(27)	0	(0)	2	(1)
2002	64		74	(64)	n/a	n/a	n/a	n/a	n/a	n/a	10	(7)

[a] Data source for Unit 26C for all years and for Unit 26B for 1987 through 1997; 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 the second week of 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 in Unit 26B and eastern Unit 26A. This number is also included in total number of muskoxen observed.

[f] Yearling recruitment is the proportion of 1-year-olds in the population of muskoxen ≥ 1-year old.

[g] Beginning in 2000, 3-year-old bulls were included in the "Bulls > 3 yr" category for Unit 26B.

[h] Muskoxen observed for Unit 26B was estimated from June composition by excluding calves and including observations of adults not classified.

TABLE 2 Postcalving composition surveys, Unit 26B West and Unit 26B East

	Unit 26B West[a] (*n*)				Unit 26B East[b] (*n*)			
Year	% Bulls >2yr	Yearling recruitment %[c]	% Calves	Calves:100 Cows >2yr	% Bulls >2yr	Yearling recruitment %[c]	% Calves	Calves:100 Cows >2yr
1997[d]	14 (4)	38 (10)	10 (3)	30 (10)	25 (24)	17 (14)	14 (13)	35 (37)
1998	na na	na na	na na	na na	na na	na na	na na	na na
1999[d]	20 (15)	14 (9)	17 (13)	38 (34)	25 (29)	14 (14)	16 (19)	51 (37)
2000	13 (9)	14 (8)	19 (13)	43 (30)	16 (15)	13 (9)	29 (28)	74 (38)
2001	21 (24)	12.5 (11)	22 (25)	68 (37)	22 (39)	18.5 (28)	13 (22)	36 (61)
2002	12 (13)	16 (14)	20 (22)	44 (50)	21 (28)	9 (10)	12 (16)	29 (55)

[a] Unit 26B West includes that portion of Unit 26B, west of the Dalton Highway.
[b] Unit 26B East includes that portion of Unit 26B, east of the Dalton Highway.
[c] Yearling recruitment is the proportion of 1-year-olds in the population of muskoxen ≥ 1-year old.
[d] Includes 3-year-old bulls and older for bull classification (no 2-year-olds included).

TABLE 3 Units 26B and 26C muskoxen harvest data by permit hunt, regulatory years 1986–1987 through 2001–2002

Regulatory year	Hunt/ Area[a]	Unit	Permits available[b]	Returned reports	Total Hunters	Successful hunters[c]	Bulls	Cows	Total harvest
1986–1987	RX1007	26C	5	5	5	5	5	0	5
1987–1988	RX1007	26C	5	5	5	5	6[d]	0	6
1988–1989	RX1007	26C	10	8	8	8	6	2[d]	8
1989–1990	RX1007	26C	10	10	10	10	10	0	10
1990–1991	TX1010	26B	2	2	2	2	2	0	2
	TX1012, 1014	26C	9	8	8	8	8	0	8
1991–1992	TX1010	26B	2	2	0	0	0	0	0
	TX1012, 1014	26C	9	9	5	5	5	0	5
1992–1993	TX1010	26B	2	2	0	0	0	0	0
	RX1013 (F)	26C	10	10	10	10	10	0	10
1993–1994	TX110	26B	2	2	1	1	1	0	1
	RX113 (F)	26C	10	n/a	n/a	8	8	0	8
1994–1995	TX110	26B	2	2	1	0	0	0	0
	RX113 (F)	26C	10	n/a	n/a	9	9	0	9
1995–1996	TX108	26B (West)	3	3	1	1	1	0	1
	TX110	26B (East)	2	2	2	2	2	0	2
	RX113 (F)	26C	10	n/a	n/a	9	8	1[d]	9
1996–1997	TX108	26B (West)	3	3	3	2	2	0	2
	TX110	26B (East)	2	2	1	1	1	0	1
	RX113 (F)	26C	15	n/a	n/a	15	12	3[d]	15
1997–1998	TX108	26B (West)	3	3	3	2	2	0	2
	TX110	26B (East)	2	2	1	1	1	0	1
	RX113 (F)	26C	15	n/a	n/a	10	9	1[d]	10
1998–1999	TX108	26B (West)	9	9	4	4	3	1	4
	RX110	26B (East)	14	9	5	3	3	0	3
	DX112	26B (East)	3	3	3	3	3	0	3
	RX113 (F)	26C	15	n/a	n/a	8	8	0	8
1999–2000	TX108	26B (West)	9	9	5	1	1	0	1
	RX110	26B (East)	3	3	0	0	0	0	0
	DX112	26B (East)	3	3	2	2	2	0	2
	RX113 (F)	26C	15	n/a	n/a	8	8	0	8
2000–2001	TX108	26B (West)	10[e]	10	6	5	4	1	5
	RX110	26B (East)	20[f]	6	6	6	6	0	6
	DX112	26B (East)	3	3	3	3	3	0	3
	RX113 (F)	26C	15	n/a	n/a	6	5	1	6
2001–2002	TX108	26B (West)	9	9	3	3	3	0	3
	RX110	26B (East)	5	5	4	4	4	0	4
	DX112	26B (East)	3	2	2	2	2	0	2
	RX113 (F)	26C	15	n/a	n/a	2	2	0	2

[a] Hunt areas: RX = registration; TX = Tier II; DX = drawing; F = federal hunt; 1007, 1013, 113 = 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; Hunt RX1013 (F) and RX113 (F) are not registration hunts—it is a lottery.
[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] Only 9 permits were supposed to be issued; but due to a mistake in scoring, 10 were issued and this was not considered a biological problem.
[f] Approximately 20 permits were issued in Nuiqsut; but the vendor did not retain the overlays; so we are uncertain about the exact number issued.

TABLE 4 Unit 26B East muskoxen hunter residency and success, regulatory years 1998–1999 through 2001–2002

Hunt/ Regulatory year	Successful			Unsuccessful			Total hunters
	Local[a] resident	Nonlocal resident	Total (%)	Local[a] resident	Nonlocal resident	Total (%)	
RX110[b]							
1998–1999	2	1	3 (60)	1	1	2 (40)	5
1999–2000	0	0	0	0	0	0 (0)	0
2000–2001	4	2	6 (100)	0	0	0 (0)	6
2001–2002	4	0	4 (100)	0	0	0 (0)	4
DX112[b]							
1998–1999	0	3	3 (100)	0	0	0 (0)	3
1999–2000	0	2	2 (100)	0	0	0 (0)	2
2000–2001	0	3	3 (100)	0	0	0 (0)	3
2001–2002	0	2	2 (100)	0	0	0 (0)	2

[a] Local resident is a resident of Unit 26.

[b] RX110 = Tier I registration hunt in Unit 26B, east of the DHCMA; DX112 = drawing hunt in Unit 26B, east of the Dalton Highway.

TABLE 5 Units 26B and 26C muskoxen hunter residency and success, regulatory years 1986–1987 through 2001–2002

Regulatory year[b]	Successful				Unsuccessful[a]				Total hunters[d]
	Local resident[c]	Nonlocal resident	Nonresident	Total	Local resident	Nonlocal resident	Nonresident	Total	
1986–1987	3	1	1	5	--	--	--	--	5
1987–1988	3	3	0	6[e]	--	--	--	--	5
1988–1989	4	4	0	8	--	--	--	--	8
1989–1990	2	7	1	10	--	--	--	--	10
1990–1991	10	0	0	10	--	--	--	--	10
1991–1992	5	0	0	5	--	--	--	--	5
1992–1993	10	0	0	10	--	--	--	--	11
1993–1994	9	0	0	9	--	--	--	--	9
1994–1995	9	0	0	9	--	--	--	--	11
1995–1996	12	0	0	12	--	--	--	--	12
1996–1997	18	0	0	18	--	--	--	--	19
1997–1998	13	0	0	13	--	--	--	--	14
1998–1999	14	4	0	18	--	--	--	--	23
1999–2000	9	2	0	11	--	--	--	--	15
2000–2001	15	5	0	20	--	--	--	--	21
2001–2002	9	2	0	11	--	--	--	--	11

[a] No data for 'Unsuccessful' hunters because of lack of reporting in Unit 26C.
[b] 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.
[c] Local is a resident of Unit 26.
[d] From hunt reports received.
[e] One illegal muskoxen.

TABLE 6 Units 26B and 26C muskoxen harvest by transport method, regulatory years 1986–1987 through 2001–2002

Regulatory year	Harvest by transport method					Total
	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	10	0	10
1993–1994	0	1	0	8	0	9
1994–1995	0	0	0	9	0	9
1995–1996	0	2	0	10	0	12
1996–1997	0	0	0	17	1	18
1997–1998	0	0	0	12	1	13
1998–1999	1	0	0	15	2	18
1999–2000	2	0	0	9	0	11
2000–2001	2	0	0	16	3	21
2001–2002	2	0	0	7	2	11

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge and attitudes for responsible hunting.

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