Muskox
Management Report
of survey-inventory activities
1 July 2004–30 June 2006

Patricia Harper, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation

Stephen Arthur, ADF&G

Funded through
Federal Aid in Wildlife Restoration
Grants W-33-3 and W-33-4, Project 16.0
2007

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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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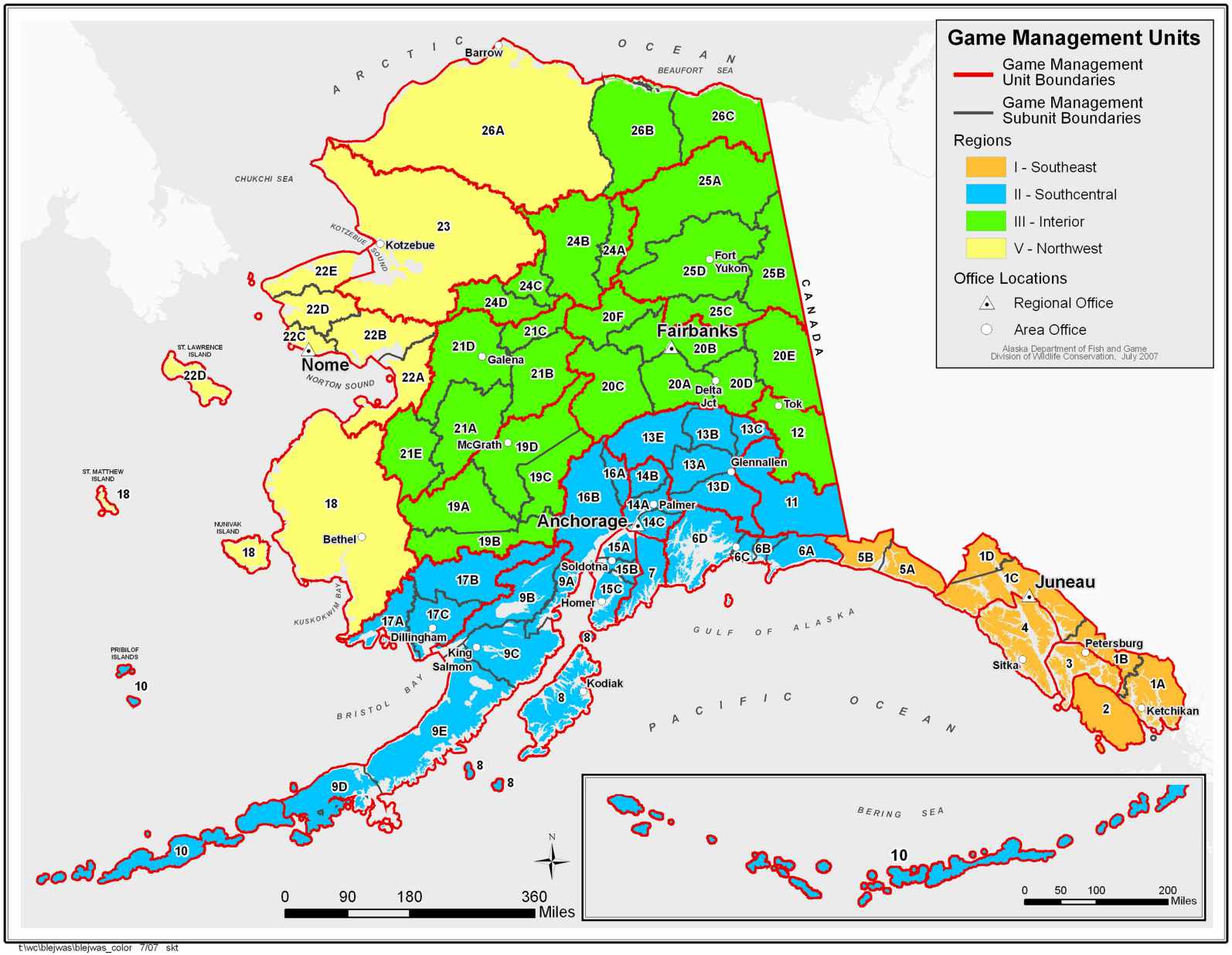

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WILDLIFE MANAGEMENT REPORT

Alaska Department of Fish and Game
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MUSKOX MANAGEMENT REPORT

From: 1 July 2004
To: 30 June 2006

LOCATION

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

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

NUNIVAK ISLAND

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

NELSON ISLAND

During 1967–1968, 23 subadult muskoxen were translocated from Nunivak Island to Nelson Island, 20 miles across Etolin Strait. The Nelson Island muskox population exhibited an average annual growth rate of 22% between 1968 and 1981. When the population approached the management goal of 200–250 animals in 1981, the first hunting season was opened. Partially in response to a population decline in 1994 and 1995, the Nelson Island Muskox Herd Cooperative Management Plan was developed and implemented in 1995. In this plan our goal is at least 250 animals. For approximately 20 years, the Nelson Island muskox population has fluctuated between a high of 297 animals and a low of 123.

YUKON–KUSKOKWIM DELTA

Having originally emigrated from Nelson Island, fewer than 100 muskoxen inhabit the mainland of the Yukon–Kuskokwim Delta. Mainland muskoxen are scattered in small groups from the Kilbuck Mountains south of the Kuskokwim River to the Andreafsky Mountains north of the

Yukon River. During surveys of other species, agency biologists and aircraft pilots have observed muskoxen. Poaching is a major factor preventing the mainland population from becoming firmly established. Wandering muskoxen may actually return to Nelson Island. This behavior complicates muskox management for Nelson Island and makes it difficult to determine the size of the mainland population.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The muskox management goals for Unit 18 are to maintain stable populations of muskox capable of providing sustained yield harvest and other nonconsumptive uses.

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 muskoxen on Nelson Island and 500–550 on Nunivak Island.

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

- Provide hunter orientation and 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 muskoxen on the mainland.

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

METHODS

We used an Aviat A-1B Husky on Nunivak Island to conduct population censuses in July 2004 and July 2005. A population census was conducted on Nelson Island using the same airplane in 2004 but a census was not conducted on Nelson Island in 2005 due to inadequate survey weather conditions. During these censuses muskoxen were classified as yearlings, 2-year-olds, 3-year-old males, 3-year-old and older females, 4-year-old and older males, 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Throughout the reporting period, the population on Nunivak Island remained healthy and productive. The trend is a stable population kept at 500-550 animals posthunt and precalving by using drawing and registration permits to take about 90 animals a year.

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

Population Size

During a fixed-wing census of Nunivak Island conducted in July 2004, we counted 638 muskoxen. During a fixed-wing census of Nunivak Island conducted in July 2005, we counted 588 muskoxen.

In August 2004, we censused Nelson Island muskoxen using a fixed-wing aircraft and counted 318 muskoxen. A census on Nelson Island in 2005 was not conducted due to poor survey weather. Table 1 shows the history of population size on Nelson Island during the period 1981–2004.

We do not have survey information to estimate 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

In 2004 we classified the muskoxen on Nunivak as 156 four-year-old or older bulls, 177 three-year-old or older cows, 40 three-year-old-bulls, 113 two-year-olds, 112 yearlings and 40 unknown (Table 2). In 2005 we classified the muskoxen as 161 four-year-old or older bulls, 143 three-year-old or older cows, 13 three-year-old-bulls, 91 two-year-olds, 110 yearlings and 70 unknown (Table 3).

During the August 2004 Nelson Island census we found 51 four-year-old or older bulls, 91 three-year-old or older cows, 25 three-year-old-bulls, 58 two-year-olds, 65 yearlings and 28 unknown (Table 4).

Distribution and Movements

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

Nelson Island muskoxen are distributed 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 U.S. Fish and Wildlife Service 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.

2004–2005 and 2005–2006	Resident Open Season (Subsistence and	Nonresident
Unit and Bag Limits	General Hunts)	Open Season
Unit 18, Nunivak Island RESIDENTS and NONRESIDENTS**:**		
1 bull by drawing permit only. Up to 10 permits will be issued for the fall season and up to 35 for spring season; or 1 cow by registration permit only, with up to 45 cow permits issued on a first-come, first-served basis.	1 Sep–30 Sep 1 Feb–15 Mar	1 Sep–30 Sep 1 Feb–15 Mar
Unit 18, Nelson Island 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	1 Feb–25 Mar
Remainder of Unit 18	No open season	No open season

Board of Game Actions and Emergency Orders. In Fall 2005 the board gave the department the regulatory authority to issue up to 60 bull and up to 60 cow permits on Nunivak Island. This regulation did not take effect until the 2006–2007 regulatory year. This is an increase from the

up to 45 bull and cow permits that were allowed during this report period. For the 2004-2005 and the 2005-2006 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 the Board of Game meeting in spring 1992, 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 approved a proposal to increase the maximum numbers of permits available for the Nelson Island hunt from up to 30 to up to 42.

In March of 2006 the BOG passed an Emergency Regulation that extended the muskox season on Nunivak Island until the end of March. The extenuating circumstances were that the only airport on Nunivak Island was closed due to weather and runway maintenance equipment breakdowns. This regulation allowed hunters to harvest approximately 15 more muskox than would have been harvested if the season closed on 15 March.

Hunting of Nunivak Island muskoxen was regulated by drawing and registration permits for fall and spring hunts for both years of the reporting period. The history of total harvest of bulls and cows for the period 1992–2006 is shown in Table 5. 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 2004–2005 harvest from drawing permits was 43 bulls. The 2005–2006 harvest from drawing permits included 5 bulls in the fall and 32 in the spring. Four of these hunters were alternate permittees.

We distribute registration permits for hunting Nunivak Island cows on a first-come, first-served basis. There were 5 permits available in Bethel for the fall hunt, 5 for the spring hunt, and 35 permits available in Mekoryuk for the spring hunt for each of the 2004–2005 and 2005–2006 regulatory years.

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 Toksook Bay, to Tununak, Nightmute, and Chefornak. The history of total applicants, total permits issued and total harvest of bulls and cows for the period 1981–2006 is shown in Table 6. In 2004–2005, 23 bull and 15 cow permits were distributed in Tununak, and in 2005–2006, 23 bull and 15 cow permits were distributed in Nightmute. Twenty-one bulls and 14 cows were harvested in 2004–2005. Fifteen bulls, 11 cows, and 2 of unknown sex were harvested in 2005–2006.

We occasionally receive reports of muskoxen taken illegally. However, the number of animals taken is difficult to determine because we may hear of the same animals from more than one source; and we do not hear of some muskoxen that are taken illegally. During 2004–2005 and

2005–2006 there were approximately 5 muskoxen reported to be illegally harvested on the mainland.

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

Hunter Residency and Success. Most drawing permittees for Nunivak Island are residents of Alaska. One nonresident was drawn in 2004–2005 and 2 nonresidents in 2005–2006, with only one nonresident actually hunting in 2006. All registration hunters were residents. For information on hunter success, see the Human Harvest section of this report.

Harvest Chronology. Most cow hunters on Nunivak Island harvested their muskox 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, all-terrain vehicle (ATV), or a small aircraft to access the hunting areas. All access in the winter season is by snowmachine.

Other Mortality

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

HABITAT

Assessment

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

Enhancement

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

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

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

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak Island muskox population is characterized by high productivity and low natural mortality. We will reduce the harvest of bulls and cows when the posthunt, precalving population is below 500 animals. With the existing population, high harvest levels are warranted. The management objectives 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. Although 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.

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

A comprehensive information and education program explaining the benefits of a larger muskox population on the mainland of Unit 18 should be prepared for the benefit of local residents. We may want to pursue a cooperative 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 muskox population, 1981–2004

Year	No harvest/precalving	Prehunt/precalving	Posthunt/precalving
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	
2002		293	
2003		327	
2004		318	

TABLE 2 Unit 18 Nunivak Island muskox composition, July 2004

Age	Male (%)	Female (%)	Unknown (%)	Total (%)
Adults[a]	156 (24)	177 (28)		333 (52)
3 years	40 (6)			40 (6)
2 years			113 (18)	113 (18)
Yearlings			112 (18)	112 (18)
Unknown			40 (6)	40 (6)
Total	196 (30)	177 (28)	265 (42)	638 (100)

[a] Adults are considered 3 year and older cows and 4 year old and older bulls

TABLE 3 Unit 18 Nunivak Island muskox composition, July 2005

Age	Male (%)	Female (%)	Unknown (%)	Total (%)
Adults[a]	161 (27)	143 (24)		304 (52)
3 years	13 (2)			13 (2)
2 years			91 (15)	91 (15)
Yearlings			110 (18)	110 (18)
Unknown			70 (12)	70 (12)
Total	174 (29)	143 (24)	271 (46)	588 (100)

[a] Adults are considered 3 year and older cows and 4 year old and older bulls

TABLE 4 Unit 18 Nelson Island muskox composition, August 2004

Age	Male (%)	Female (%)	Unknown (%)	Total (%)
Adults[a]	51 (16)	91 (29)		142 (45)
3 years	25 (8)			25 (8)
2 years			58 (18)	58 (18)
Yearlings			65 (20)	65 (20)
Unknown			28 (9)	28 (9)
Total	76 (24)	91 (29)	151 (47)	318 (100)

[a] Adults are considered 3 year and older cows and 4 year old and older bulls

TABLE 5 Unit 18 harvest of Nunivak Island muskoxen, 1992–2006

Year	Males	Females	Unknown	Total
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	45	42		87
2002	43	41		84
2003	45	43		88
2004	45	42		87
2005	43	44		87
2006	37	38		75
Total	565	493	0	1058

[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, 1992–2006

	Number of permits available		Muskoxen harvested		Number of
Year	Female	Male	Female	Male	applicants
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	14		30+
2003	15	23	14	22	30+
2004	15	24	14	24	30+
2005	15	23	14	21	38
2006	15	23	11	15	38

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MUSKOX MANAGEMENT REPORT

From: 1 July 2004
To: 30 June 2006

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 2005 was estimated at 2387 animals (Figure 1, Tables 1 and 2).

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 (Figure 2). 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 Cooperators). The group is comprised of staff from the department, National Park Service (NPS), U.S. Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS), Bering Straits Native Corporation, Kawerak Inc., Reindeer Herders Association, Northwest Alaska Native Association, residents of Seward Peninsula communities, and representatives from other interested groups or organizations. The following management goals form the basis of a cooperative interagency management plan for Seward Peninsula muskoxen developed during 1992 through 1994 (Nelson 1994) and follow the guidelines of the department's 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 3-year intervals to document changes in population and distribution. (Note: The Department completed a muskox census in 2007, which was a 2-year interval, to accommodate a change in the moose census schedule.)

- Complete composition surveys on an annual basis in at least one subunit on the Seward Peninsula to document changes in age and sex structure of the population.

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

- Administer a resident drawing hunt in Unit 22E and Tier II subsistence 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 22 February–6 April 2005 in Units 22B, 22C, 22D, 22E and 23SW. Staff from the department, NPS, BLM, and FWS 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 Global Positioning System (GPS) coordinates.

Muskox composition surveys were completed 10–25 April 2005 and 6–28 April 2006 using helicopter access to previously identified groups. At each group, a team of two trained observers used binoculars and spotting scopes to classify muskox into 7 sex-age groups based on body size, conformation, and horn size/shape characteristics. Muskox 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, 2-year-old cows, and yearlings. In 2005 the counts were funded and completed jointly by the department and NPS following the recently completed muskox census. We used a Robertson R-44 helicopter to visit 37 muskox groups in Unit 22E, where we classified 495 animals. In 2006 muskox groups were identified with GPS locations during moose census stratification flights in Unit 22D. Following the moose census (with funding contributions by NPS), department staff visited 31 muskox groups by R-44 helicopter and classified 503 animals. In both years, during the composition surveys we also collected urine and fecal samples for analysis.

The Cooperators met in Nome in June 2005 to develop muskox proposals for submission to the Alaska Board of Game and the Federal Subsistence Board (FSB).

Department staff provided assistance with the Tier II application process in the Nome and Kotzebue offices and they traveled to all villages in Units 22B, 22D, 22E, and 23SW to help hunters fill out Tier II application forms. Department and NPS staff discussed hunt requirements and identification of muskoxen by sex and age with all first-time muskox permittees. Hunter orientation materials were also placed on the department website to provide information about muskox hunting to drawing and Tier II permit winners.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The 2005 Seward Peninsula muskox census found 2387 animals (1751 adults, 239 yearlings, 397 unclassified) in 173 groups. We counted 326 muskoxen in Unit 22B, 220 muskoxen in Unit 22C, 796 muskoxen in Unit 22D, 863 muskoxen in Unit 22E, and 182 muskoxen in Unit 23 Southwest (Table 1). No muskoxen were found in the census area east of the Seward Peninsula in the Selawik Refuge.

Snow cover was complete in most parts of the census area and sightability was generally very good. Cloud cover initially interfered with complete coverage of Sample Unit 3, but the area was resurveyed when conditions improved and a few new groups were discovered. Survey conditions should not have adversely affected the census results.

The 2005 census count of 2387 muskoxen shows a 16.4% increase in population size since 2002, when 2050 muskoxen were counted. This represents an average annual increase of 5.5% since 2002. Most of the growth occurred in Units 22B and 22E, while numbers remained relatively stable in Units 22C and 22D and 23SW. Many groups were found close to subunit boundaries and the relatively small fluctuations in numbers seen in these units from one census to the next are probably mostly due to group movements across subunit boundaries.

Unit 22B: Muskoxen are now well established in Unit 22B west of the Darby Mountains, where we counted 326 muskoxen and the growth rate averaged 24% annually between 2002 and 2005. This was the highest average annual growth rate documented in the 2005 census and cannot be accounted for by calf production alone because cows produce only 1 calf annually. Thus, growth in Unit 22B had to be due in part to immigration from other subunits.

For the first time we found a small number of muskoxen in eastern Unit 22B during a census. Sightings are increasingly common there during summer months, but (to date) few muskoxen have been found wintering in the area.

Unit 22C: We found 220 muskoxen in Unit 22C, which is a 5% average annual decrease in numbers since 2002. After slow steady growth through the 1990s, the number of muskoxen in Unit 22C increased 37% annually between 2000 and 2002 (Table 2). It is likely that immigration into Unit 22B is in part responsible for the slight reduction in numbers seen in the 2005 census.

Unit 22D: We found 796 muskoxen in Unit 22D, which represents a 1% average annual increase since 2002 when 771 muskoxen were counted. Population growth was initially fastest in Unit 22D, but between 1998 and 2000 average annual growth slowed to 4% and there has been little growth in Unit 22D since 2000 (Table 2).

Unit 22E: We counted 863 muskoxen in Unit 22E, which is now the subunit with the largest number and the highest density of muskoxen; 0.21 muskoxen/mi^2. The number of animals counted is a 12% average annual increase since 2002.

Unit 23SW: We counted 182 muskoxen in Unit 23SW, which is a 3% average annual decrease in numbers since 2002. By the early 1990s muskoxen were well established in Unit 23 SW, but since 1994 the population has been relatively stable with much of the variation attributed to group movements between Unit 23SW and surrounding subunits because many groups occur near subunit boundaries. Emigration from Unit 23SW is also likely responsible for colonization of areas to the east of the Seward Peninsula in the Nulato Hills and Selawik, Kobuk and Yukon River drainages.

The next census of the Seward Peninsula muskox population is scheduled for March 2007.

Population Composition

The results of composition surveys in Units 22E and 22D are shown in Table 3. In April 2005 we sampled 37 groups in Unit 22E, classified 495 muskoxen, and found the ratio of mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 36:100. The yearling:cow ratio was 33:100 and 15% of the classified animals were yearlings. All sex/age classes were well represented. Sixteen percent of the muskoxen in Unit 22E were 2-year-olds (9% bulls and 7% cows), and 20% (6% bulls, 14% cows) were 3-year-olds. The high, fairly consistent proportion of yearling, 2-year-old and 3-year-old animals was similar to 2002 results (Table 3) and indicates both good calf survival over the last few years and a high likelihood that most yearlings are surviving to adulthood.

In Unit 22D the ratio of mature bulls (4-years-or-older) to mature cows (cows 3- or 4-years-or-older) was 42:100. The yearling:cow ratio was 36:100 and 16% of the classified animals were

yearlings. Ten percent of muskoxen classified in Unit 22C were 2-year-olds (5% bulls and 5% cows), and 14% were 3-year-olds (6% bulls, 8% cows).

Mature bulls tend to be undercounted in composition surveys relative to other segments of the population because they are often alone and difficult to spot during our censuses. Although the bull:cow ratios are minimums they should still be useful to show trends through time.

Yearling composition data was also obtained during the 2005 census (Table 2). In Unit 22B 15% of the animals seen and classified were yearlings, in Unit 22C 9% were yearlings, in Unit 22D 8% were yearlings, in Unit 22E 16% were yearlings, and in Unit 23SW 18% were yearlings. Although identification of yearlings from the air during the census is not entirely accurate, counts by experienced observers in the census appear to be close enough to counts made on the ground during composition surveys to detect major changes in yearling composition. In Unit 22E there was a 1% difference between the proportion of yearlings estimated in the 2005 census (16%) and the 2005 composition survey count (15%). The small and reduced proportion of yearlings observed in Unit 22D in the 2005 census (8%) was confirmed during the 2006 Unit 22D composition survey in which the 2 year-old cohort was 10% of the total number of animals classified.

Distribution and Movements

The inclusion of a portion of the Selawik Wildlife Refuge in the 2005 census was intended to help document the range extension of muskoxen to the east of the Seward Peninsula, but no muskoxen were found in the expanded census area. However staff and public observations indicate the Seward Peninsula muskox population continued to extend its range during the reporting period. Reports of muskoxen in other areas 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 2 shows the distribution of muskoxen on the Seward Peninsula in spring 2005 during the most recent census.

For the first time we found a small mixed sex group in eastern Unit 22B during a census. Sightings are increasingly common there during summer months, but thus far few muskoxen have been found wintering in the area.

MORTALITY

Harvest

Season and Bag Limit. During this reporting period the State administered Tier II subsistence hunts in Unit 22B, Unit 22C, Unit 22D, Unit 22E, and Unit 23SW and a resident drawing hunt in Unit 22E. 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.

2004-2005 and 2005-2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
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 16 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 16 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 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 3 bulls may be taken	1 Aug–30 Sep (Subsistence hunt only)	No open season

2004-2005 and 2005-2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22C, that portion west of the west bank of the Sinuk River		
1 bull by Tier II subsistence hunting permit only; up to 3 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 muskox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period 1 Jan –15 Mar; up to 9 muskoxen may be taken; however, not more than 4 cows may be taken; total harvest may not exceed 9 muskoxen in Unit 22D southwest	1 Sep–15 Mar (Subsistence hunt only)	No open season
Unit 22D, Pilgrim River drainage		
1 muskox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period 1 Jan –	1 Nov–15 Mar (Subsistence hunt only)	No open season

2004-2005 and 2005-2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
15 Mar, up to 41 muskoxen may be taken in combination with the remainder of Unit 22D; however, not more than 17 cows may be taken and total harvest may not exceed 41 muskoxen in Unit 22D, excluding Unit 22Dsouthwest		
Remainder of Unit 22D		
1 muskox 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 41 musk oxen may be taken in combination with Unit 22D Upper Pilgrim River; however, not more than 17 cows may be taken and total harvest may not exceed 41 muskoxen in Unit 22D excluding Unit 22D southwest	1 Aug–15 Mar (Subsistence hunt only)	No open season
Unit 22E		
1 muskox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period 1 Jan–15Mar; up to 50 muskoxen may be taken; however, not more than 25 cows may be taken; the total harvest may not exceed 50 muskoxen in Unit 22E	1 Aug–15 Mar (Subsistence hunt only)	No open season
1 bull 4-year-old or older by drawing permit only; up to 10 permits may be issued	1 Feb–15 Mar	No open season

2004-2005 and 2005-2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
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 muskox per regulatory year by Tier II subsistence hunting permit only; however, cows may be taken only during the period 1 Jan–15 Mar; up to 17 muskoxen may be taken; however, not more than 7 cows may be taken; the total harvest may not exceed 17 muskoxen in Unit 23 southwest	1 Aug–15 Mar (Subsistence hunt only)	No open season

Board of Game Actions and Emergency Orders. In November 2005 the Board of Game made a number of changes to Seward Peninsula muskox regulations that will go into effect in the 2006–2007 regulatory year. The Board adjusted the amount necessary for subsistence (ANS) for Seward Peninsula muskox to include an ANS range of 40–52 muskoxen in Unit 22E and established a Tier I subsistence registration hunt in Unit 22E as proposed by The Cooperators. The season for the muskox drawing hunt in Unit 22E was lengthened to 1 August–15 March and a nonresident season was established, with 10% of the drawing permits allocated to nonresidents.

In Unit 22C the board adopted a proposal from The Cooperators that combined and expanded the existing Tier II hunt areas and changed the season to 1 Jan–15 Mar.

The Board also adopted The Cooperators proposal that simplified regulations in all Seward Peninsula muskox hunts and replaced harvest quotas with "up to" harvest rate guidelines. The harvest rate guidelines for Unit 22B and Unit 22D remainder is 5%, and in Unit 22C, Unit 22D southwest, Unit 22E, and Unit 23SW the harvest rate guideline is 8%.

An emergency order was issued on March 8, 2006 closing Tier II hunt TX103 in Unit 22D SW when the harvest quota of 8 bull muskoxen was reached.

Human-Induced Harvest. In 2004–2005 42 bulls and 7 cows were harvested by Tier II permit, 9 bulls were taken by drawing permit and 16 bulls and 2 cows were taken with federal permits for a total harvest of 76 muskoxen (67 bulls and 9 cows). In Unit 22B a total of 7 bulls and 1 cow were taken (bulls only hunt), in Unit 22C 4 bulls were harvested (bulls only hunt), in Unit 22D

17 bulls and 2 cows were taken, 34 bulls and 4 cows were taken in Unit 22E and 5 bulls and 2 cows were harvested in Unit 23SW. Table 4 shows the number of permits issued and filled in 2004–2005 for state and federal hunts in each unit and community.

In 2005–2006 a total of 77 Tier II permits were filled (58 bulls and 19 cows), 7 bulls were taken by drawing permit and 8 federal permits were filled (5 bulls and 3 cows) for a combined harvest of 92 muskoxen (70 bulls and 22 cows). In Unit 22B 10 bulls were taken (bulls only hunt), in Unit 22C 5 bulls were taken (bulls only hunt), in Unit 22D 32 muskoxen were harvested (25 bulls and 7 cows), 41 were taken in Unit 22E (30 bulls and 11 cows) and 4 muskoxen were harvested in Unit 23SW (0 bulls and 4 cows). Table 5 shows the number of permits issued and filled in 2005–2006 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 State and Federal Boards were 5% in Unit 22B (bulls only), 3% in Unit 22C (bulls only); 5% in Units 22D and 23 SW (including up to a 2% cow harvest), and 8% in Unit 22E (including up to a 4% cow harvest). Actual harvest rates in all subunits in both state and federal hunts have consistently been lower than the harvest quotas, so in 2004–2005 we issued 15%–33% more permits than the harvest quota depending on previous success rates in the hunt area. Harvest still fell short of the quota, so in 2005–2006 we issued up to 75% more permits than the quota. As a result we reached a harvest quota for the first time in a Tier II hunt and closed TX103 in Unit 22D SW. The quota was 8 muskoxen and 9 bulls were taken.

In 2004–2005 the actual harvest rates were 4% in Unit 22B, 2% in Unit 22C, 2% in Unit 22D, 6% in 22E and 3.5% in Unit 23 SW. During the 2005–2006 regulatory year actual harvest rates were 3% in Unit 22B, 2% in Unit 22C, 4% in Unit 22D, 4.6% in Unit 22E, and 2% in 23SW.

In all hunt areas there were considerably more applicants for Tier II permits than there were permits available. In 2004 there were 501 applications for 115 Tier II permits; 85 for Unit 22B, 133 applications for Unit 22C, 175 applications for Unit 22D, 74 for Unit 22E and 44 for Unit 23SW. In 2005 511 applications were submitted for 136 Tier II permits; 85 for Unit 22B, 133 applications for Unit 22C, 175 for Unit 22D, 74 applications for Unit 22E and 44 for Unit 23SW.

Permit Hunts. Hunting during this reporting period was by Tier II Subsistence Hunting Permit or by Drawing Permit (Unit 22E only) on state-managed lands and by federal subsistence permit on federal public lands. Trophy destruction of muskoxen taken in Tier II hunts is required if the skull is removed from Unit 22 or Unit 23 to insure applicants are primarily subsistence hunters. See the previous section for a harvest summary of permit hunts.

Hunter Residency and Success. During 2004–2005 115 Tier II permits were issued for Seward Peninsula muskox hunts and 58 were filled for a 50% success rate. Fifty-one federal permits were issued and 18 were filled, resulting in a 35% success rate. In 2005–2006 134 Tier II permits were issued. Seventy-seven of 134 Tier II permits were filled for a 57% success rate. Eight of 52 federal permits were filled for a 15% success rate. Tables 4 and 5 show the number of permits issued and filled during this reporting period in the state and federal hunts in each unit and community.

In 2004–2005 Unit 22B Tier II permits were awarded to residents of Unit 22B who resided in Elim, Golovin Koyuk, and White Mountain. Unit 22B residents filled 6 of 14 permits. Five Federal permits were issued to Unit 22B residents and 2 hunters were successful. In 2005–2006 21 Tier II permits went to residents of Elim, Golovin, Koyuk, White Mountain, Nome (Unit 22C), and Unalakleet (Unit 22A), and 10 permits were filled. Seven federal permits were issued to residents of Unit 22B but no hunters were successful. In general there has been considerable interest in Unit 22B villages in hunting muskoxen, especially in light of declining moose populations.

Nome residents were awarded 10 of the 14 Tier II permits issued for Unit 22C during the reporting period. The remaining permits went to residents of Unalakleet (Unit 22A), White Mountain (Unit 22B), and Kotzebue (Unit 23). Seven of 10 Nome residents (70%) filled their permits and one of four (25%) of hunters from other communities were successful.

Success rates in Unit 22D varied by community (Tables 4 and 5). Tier II permits were issued to hunters from Brevig Mission, Buckland, Golovin, Nome, Teller, White Mountain and Unalakleet. Nome hunters received 54% (51 of 95) of permits issued during the reporting period and filled 38 permits, averaging a 75% success rate. Brevig residents were issued 15 permits of which 3 were filled for a 20% success rate. One person from Buckland, one from Golovin and 3 Unalakleet residents received permits and 100% were filled. Teller residents received 20 permits and filled 2 (10%) of them. White Mountain residents filled 2 of 4 permits issued for a 50% success rate.

It appears the demand for muskox permits has been met for residents in Unit 22E. In 2004–2005 all eligible households in Unit 22E who applied were awarded Tier II permits. In 2005–2006 all eligible Tier II applicants statewide for Unit 22E received permits and 10 permits were left unsubscribed. Permits were issued to residents of both Unit 22E villages (Shishmaref and Wales) and several communities outside of Unit 22E, including Anchorage, Big Lake, Buckland, Eagle River, Nome, Stebbins, and Talkeetna. Hunters living outside of Unit 22E received 16 of 75 Tier II permits, harvested 7 muskoxen and experienced a 44% success rate during the reporting period. Unit 22E residents received 59 permits and harvested muskoxen 59% of the time.

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. Prior to 2002, few Wales residents were successful in obtaining state Tier II permits because they were outscored by Shishmaref residents who were more successful at harvesting muskoxen in the federal hunt, but elimination of the alternative resources question on Tier II applications for Unit 22 and 23 muskox hunts helped alleviate this problem (Persons 2005).

Tier II permits for Unit 23SW were issued to residents of Buckland and Deering during the reporting period. Hunters received 20 permits and harvested muskoxen 40% of the time. Ten federal permits were issued to residents of Buckland and Deering during the same time period and hunters averaged a 30% success rate. Buckland is far from federal lands and the success rate for Buckland residents with Federal permits is typically low.

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. Access to muskox habitat during snow free months can be difficult for hunters living off the road system, so hunters from many villages wait to hunt until the later part of February and early March when days are longer and they can travel by snowmachine. If the weather is stormy during that time period often little harvest occurs. Federal permits are least likely to be filled when long travel distances are required to reach federal lands (Persons 2005).

In the drawing hunt a total of 20 permits were issued during the reporting period, and 16 (80%) hunters harvested muskoxen. The bag limit for the Unit 22E drawing hunt is a mature bull, 4-years old or older.

Harvest Chronology. In 2004-2005 the proportion of harvest in each subunit showed variation throughout the season: Unit 22B - January (17%), March (83%); Unit 22C - February (50%), March (50%); Unit 22D - August (6%), September (18%), October (6%), November (12%), December (6%), January (23%), March (29%); Unit 22E - August (13%), September (7%), October (7%), February (7%), and March (60%). In general, low harvests were noted in the first months of the hunting season and high harvests were reported during the last six weeks of the season (February and March).

In 2005-2006 the proportion of harvest in each subunit showed variation throughout the season: Unit 22B – September (20%), October (20%), February (10%), March (50%); Unit 22C – September (20%) and March (80%); Unit 22D – August (16%), September (9%), October (9%), November (13%), January (03%), February (22%), March (25%), unknown (3%); and Unit 22E – August (7%), September (7%) and November (4%) and March (81%). In general, low harvests were noted in the early season and high harvests were reported late in the season.

Transport Methods. In all units the majority of Seward Peninsula muskox harvest occurred during the winter months and snowmachines were used for transportation. Hunters reported snowmachines were used to hunt 70%, 3 or 4-wheelers 20%, highway vehicles 4%, boats and off road vehicles 2%, and aircraft and walking 1% of the time during the reporting period.

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 increasing evidence that predation is becoming more common as bears learn to prey on muskoxen and wolf numbers increase on the Seward Peninsula (Persons 2005).

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 the wintering range of the Western Arctic caribou herd are also likely to increase predation on muskoxen (Persons 2005).

HABITAT

Assessment

There were no activities undertaken to directly assess muskox habitat on the Seward Peninsula during the reporting period. However, we collected urine and fecal samples during composition surveys in Unit 22D and 22E for University of Alaska research biologist Dr. Perry Barboza, who proposes to examine carbon and nitrogen metabolites in the excreta to assess body condition of the animals. Eventually, it may be possible to correlate body condition with range quality and detect differences between geographic areas and changes over time.

Enhancement

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

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Seward Peninsula Muskox Cooperators Group

In June 2005 representatives of The Cooperators met in Nome to develop proposals for the Board of Game, communicate to staff how permits should be allocated between state and federal hunts, and address other management concerns related to Seward Peninsula muskoxen.

The group proposed the harvest rate be increased from 3% to 8% in Unit 22C and that hunt boundaries be changed to maximize harvest opportunities and protect wildlife viewing along the Nome road system. The group recommended a continued 5%, bulls only harvest rate in Unit 22B, an up to 8% bulls only harvest rate in Unit 22C, an up to 8% harvest rate in Unit 22D Southwest and Unit 22E, and up to an 8% harvest rate in Unit 23 Southwest. The group proposed a transition from Tier II to a registration hunt in Unit 22E now that the harvestable surplus is greater than the number of Tier II applicants, and recommended registration permits only be available in Unit 22E in Wales and Shishmaref.

The group proposed the Board of Game simplify the state regulatory code and replace codified harvest quotas with harvest rate guidelines. The change would enable the department to maintain the approved harvest rates if the muskoxen population increased without requiring board action. The group also requested that the department issue more permits based on past hunter success rates, and proposed that muskoxen be added to the list of game animals allowed to be taken by proxy. The Cooperators asked that federal regulators develop a designated hunter program for federal muskox hunts.

The group requested the quota in Unit 22B be allocated such that 75% are state permits and 25% federal permits. In Unit 22D The Cooperators asked that 6 permits be allocated to the federal hunt and the remainder to the state hunt. In Units 22E and 23SW The Cooperators recommended permits be allocated such that 2/3 are state and 1/3 federal. The next Cooperators' meeting is scheduled for October 2006.

The only request by The Cooperators that failed to go into regulation or policy was the proxy hunting proposal that would have added muskox to the list of species that may be taken by proxy.

Conflicts with Humans and Wildlife

More Seward Peninsula residents have come to value muskoxen as a subsistence resource since hunting has been allowed and negative attitudes toward muskoxen have decreased. 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 and repeated instances of muskoxen rubbing against grave markers in the Deering cemetery have angered Deering residents. 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 (Persons 2005).

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. It is not uncommon to observe reindeer and muskoxen occupying the same ridge top, and single deer have been observed in the middle of large groups of muskoxen.

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 Cooperators have maintained their commitment to protect viewing opportunities in Unit 22C and along much of the Nome road system (Persons 2005). The Cooperators have worked with staff to create hunt areas and set season dates that promote wildlife viewing opportunities. In areas closest to Nome the hunting season opens January 1 when most wildlife viewing has ended due to inaccessible snowed-in roads. Muskoxen located close to town are protected by a no hunt area that includes the eastern portion of the Penny River drainage, the Snake River drainage, the Nome river drainage, and the western portion of the Flambeau river drainage. Where hunts in Unit 22B and southern Unit 22D are 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.

CONCLUSIONS AND RECOMMENDATIONS

Growth of the Seward Peninsula muskox population continued to slow during this reporting period, averaging 5.5% annually between 2002 and 2005. From introduction in 1970 until 2000, the population grew an average of 14% annually and between 2000 and 2002 annual growth averaged 7%. Throughout the peninsula composition surveys have shown a decrease in yearling/cow ratios since 2002. Although yearling/cow ratios have remained relatively high, above 30 yearlings:100 cows (except in Unit 22C), the number of muskoxen increased significantly only in Units 22B and 22E and remained relatively stable elsewhere. Slowing of the overall population growth rate and the declining yearling/cow ratio suggest densities may be approaching an upper limit.

As population growth slows it is important to determine what factors are limiting growth so we can insure that our management strategy is appropriate. If habitat limitation is a significant factor limiting productivity, The Cooperators may want to reconsider the goal of managing for continued population growth. Other factors could include emigration, limited suitable wintering areas, density-dependent behavioral factors, predation, other natural mortality, weather or snow conditions, human harvest, or disturbance. A combination of factors is likely involved. Since 1996 when caribou began wintering on the Seward Peninsula, wolf numbers have increased and recent observations indicate bear predation is increasing. We know that herd disturbances by people or predators near calving time can cause calf separation and mortality, but we don't know to what degree these factors are limiting growth. If the habitat cannot support increasing numbers of animals increased harvest may be appropriate, but if predation rates increase, we may need to manage human harvest more conservatively.

Range extension to areas east of the Seward Peninsula continued during this reporting period with new observations of muskoxen in the Nulato Hills, Selawik Hills, Kobuk and Yukon river drainages, including sightings of large groups of mixed age and sex.

During this reporting period harvest continued to be below the allowable harvest in State Tier II subsistence hunts and federal subsistence hunts. As a result, The Cooperators proposed and the Board adopted numerous changes intended to increase harvest and hunting opportunity, effective in the 2006 regulatory year. Changes include a transition in Unit 22E from Tier II to a Tier I subsistence registration hunt, an expanded hunt area in Unit 22C, and increased harvest rates in Units 22C, 22B SW and 23SW. It is important to continue to increase hunting opportunities for a wider range of users while still ensuring adequate opportunity for local subsistence hunters.

Actual harvest rates have been low and we do not believe that hunting has significantly affected the size or composition of the population. However as allowable harvest rates increase and measures are taken to increase success rates it will become increasingly important to monitor changes in the population composition, particularly bull:cow ratios.

The Cooperators have never recommended guidelines for minimum bull:cow ratios. This should be a topic of discussion and action at a future meeting. Differing bull:cow ratios may be appropriate depending on the management goals for a particular area. Higher bull:cow ratios may be appropriate adjacent to areas where expansion is desired or in areas managed for trophy hunting, while a lower bull:cow ratio might be adequate in areas managed to maximize harvest. We do not know the optimal bull:cow ratio for maximizing production and it would be valuable

to investigate that question in the literature and in discussions with other muskox managers and researchers.

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 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 area boundaries or timing of hunts, as necessary.

Some local residents continue to be upset by muskoxen occurring near villages and camps and by competition between muskoxen and subsistence users for greens and berries at traditional gathering sites. 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 (Persons 2005).

There have been many biological, regulatory and social changes influencing muskox management since the Seward Peninsula Cooperative Muskox Management Plan was written in 1994. While management through The Cooperators has generally followed the basic goals of the plan, the plan needs to be amended to bring it up to date with current management practices.

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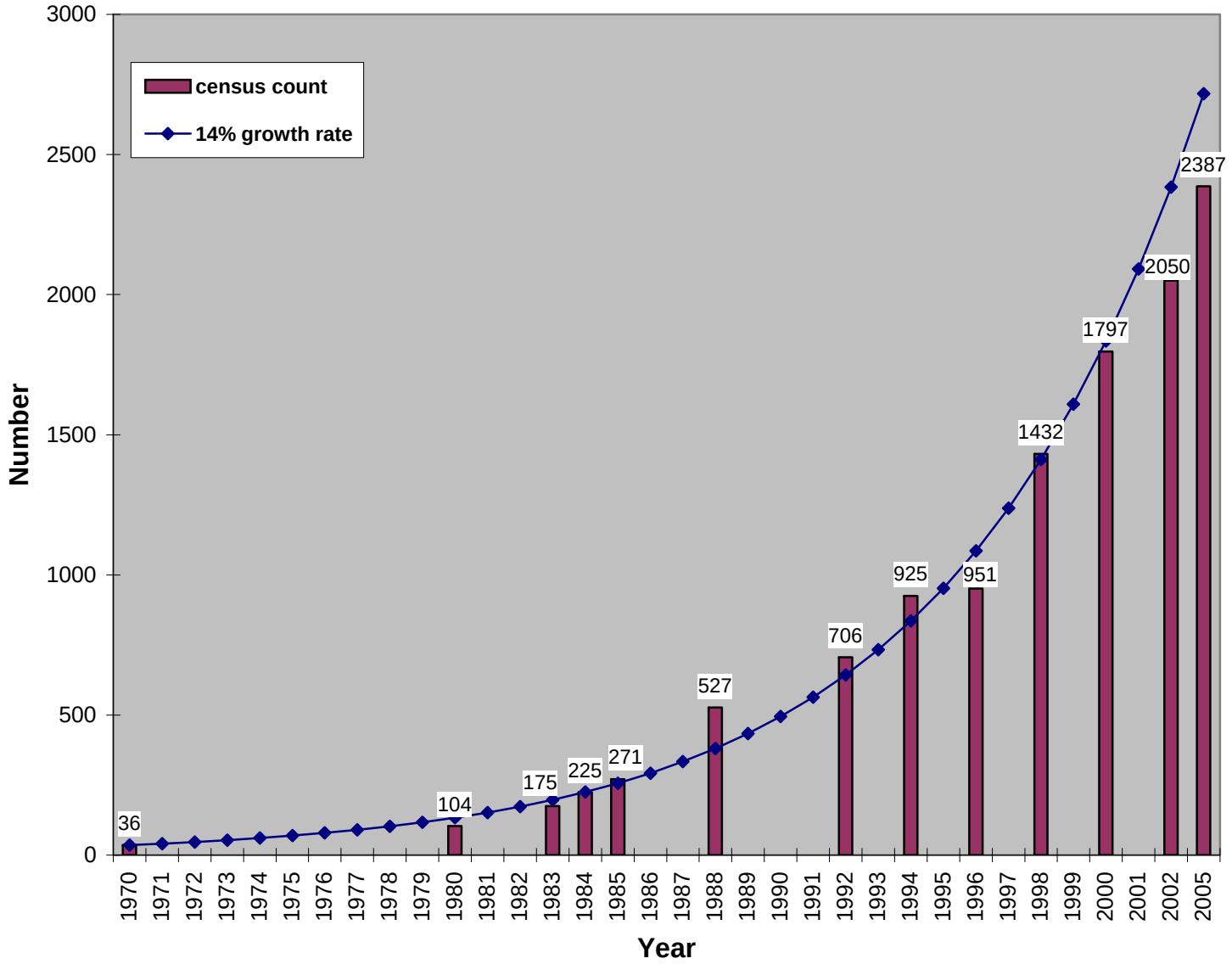

FIGURE 1 Estimated and counted number of Seward Peninsula muskoxen, 1970–2005

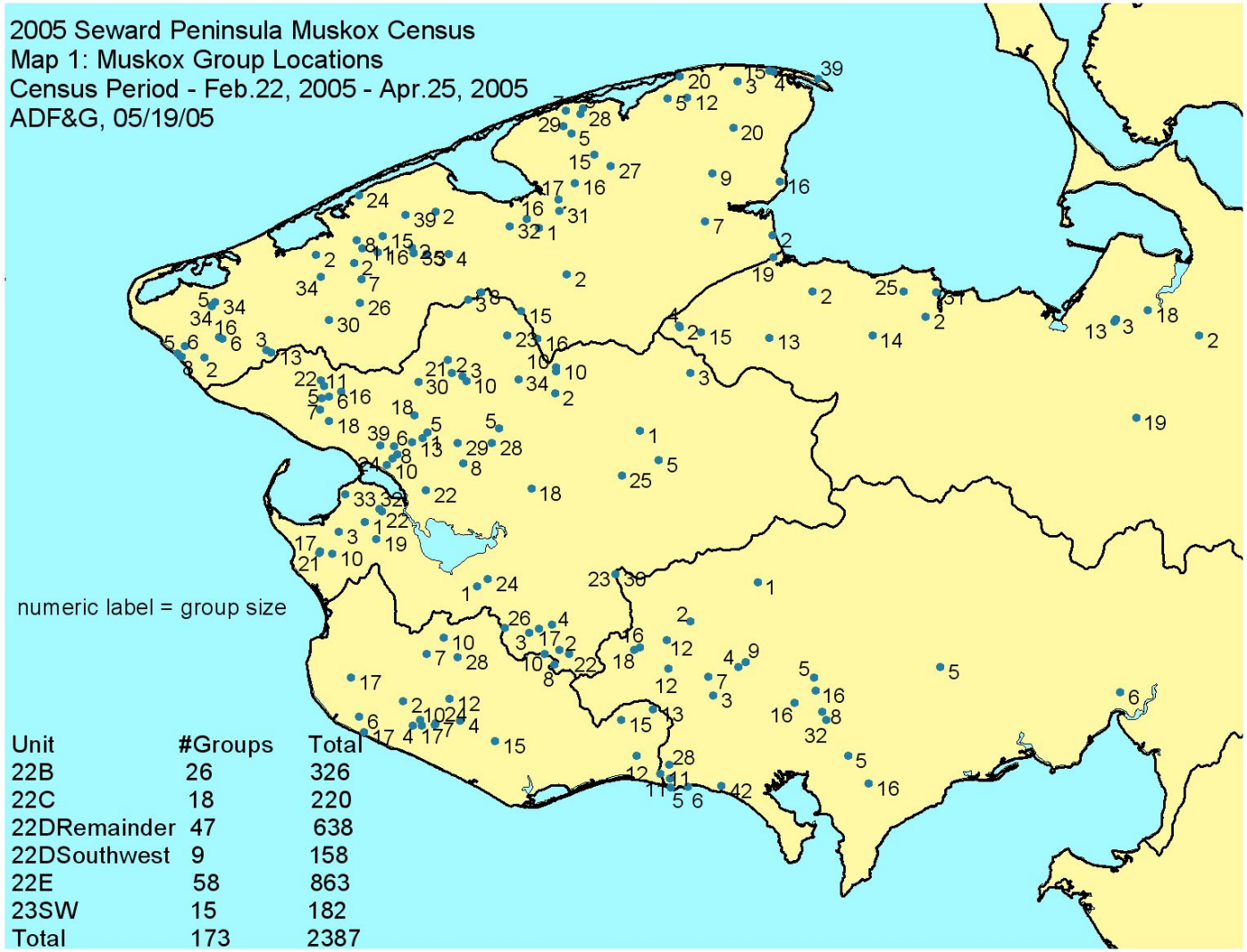

FIGURE 2 Location of Seward Peninsula muskox groups, spring 2005 census

TABLE 1 Seward Peninsula muskox census results, Units 22 and 23 Southwest, spring 2005

Unit	Groups	Adults	Yearlings	Unclassified	Total
22B	26	260	45 (14%)	21	326
22C	18	200	20 (9%)	0	220
22D	56	713	61 (8%)	22	796
22E[1]	62	445	84 (10%)	334	863
23SW	15	133	29 (16%)	20	182
Total	177	1751	239 (10%)	397	2387

TABLE 2 Seward Peninsula muskox census results, Units 22 and 23 Southwest, 1992–2005

	Unit					
Year	22B	22C	22D	22E	23SW	Total
1992	3	49	340	180	134	706
1994	11	79	405	184	246	925
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
2005	326	220	796	863	182	2387

TABLE 3 Age and sex composition of Seward Peninsula muskox groups, 2002–2006

Unit	Year	N	Males ≥4 years old		Females ≥4 years old		Females 3 or 4 years old		Females 3 years old		Males 3 years old		Males 2 years old		Females 2 years old		Yearlings		Unknown		Bull/cow ratio[1]	Yearling/ cow ratio[2]
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
22B	2002	178	39	22%	38	21%	10	6%	19	11%	13	7%	13	7%	13	7%	32	18%	1	1%	58/100	48/100
	2004	236	42	18%	86	36%	0	0%	23	10%	11	5%	16	7%	15	6%	43	18%	0	0%	39/100	39/100
22C	2002	208	49	24%	35	17%	5	2%	30	14%	14	7%	20	10%	16	8%	40	19%	0	0%	70/100	57/100
	2004	217	70	32%	56	26%	0	0%	25	12%	18	8%	10	5%	17	8%	21	10%	0	0%	86/100	26/100
22D	2002	454	70	15%	157	35%	9	2%	49	11%	17	4%	30	7%	33	7%	88	19%	2	0.4%	33/100 [3]	41/100
	2006	516	99	19%	193	37%	0	0%	41	8%	32	6%	28	5%	26	5%	84	16%	13	3%	42/100	36/100
22E	2002	313	57	18%	84	27%	3	1%	29	9%	19	6%	32	10%	32	10%	57	18%	0	0%	49/100 [3]	49/100
	2005	501	83	17%	161	32%	0	0%	69	14%	28	6%	43	9%	34	7%	77	15%	6	1%	36/100	33/100
22SW	2002	170	33	19%	52	31%	0	0%	20	12%	8	5%	15	9%	20	12%	22	13%	0	0%	46/100	31/100

[1] Number of males ≥4 years old/100 cows ≥3 years old

[2] Number of yearlings/100 cows ≥3 years old

[3] In the 2002 composition survey, 59% of the estimated population in Unit 22D was sampled. In Unit 22E 50% of the popluation was sampled. The group selection method used in Units 22D and 22E in the composition survey favored sampling larger groups. We did not sample many of the smaller groups that were likely to be all bulls. Therefore the number of bulls is probably underestimated. These bull/cow ratios should be viewed as a minimum.

TABLE 4 Results of state and federal muskox hunts on the Seward Peninsula, 2004–2005

Harvest Quotas and Harvest for Seward Peninsula Muskox Hunts, 2004-2005

Hunt Area	Muskox Harvest Quota 1	Cow Muskox Harvest Quota	No. of State Permits Issued 2	No. of State Permits Filled Bulls	No. of State Permits Filled Cows	No. of Federal Permits Issued 2	No. of Fed. Permits Filled, Bulls	No. of Fed. Permits Filled, Cows	Total Bull Harvest	Total Cow Harvest	Total Harvest
22B											
TX105	**12**	**0**	**14**	**5**	**1**	**5**	**2**	**0**	**7**	**1**	**8**
Elim	NA	NA	5	0	1	1	0	NA			
Golovin	NA	NA	2	2	NA	1	0	NA			
Koyuk	NA	NA	4	1	NA	2	1	NA			
White Mtn	NA	NA	3	2	NA	1	1	NA			
22C											
TX100	**2**	**0**	**2**	**0**	NA	NA	NA	NA	**0**	**0**	**0**
Unalakleet	NA	NA	1	0	NA	NA	NA	NA			
White Mtn	NA	NA	1	0	NA	NA	NA	NA			
TX101	**4**	**0**	**4**	**4**	NA	NA	NA	NA	**4**	**0**	**4**
Nome	NA	NA	3	3	NA	NA	NA	NA			
Unalakleet	NA	NA	1	1	NA	NA	NA	NA			
22D											
TX102	**31**	**12**	**34**	**13**	**2**	**6**	**1**	**0**	**14**	**2**	**16**
Brevig	NA	NA	8	0	0	4	0	0			
Golovin	NA	NA	1	1	0	0	NA	NA			
Nome	NA	NA	18	12	1	0	NA	NA			
Teller	NA	NA	4	0	0	2	1	0			
White Mtn	NA	NA	3	0	1	0	NA	NA			
TX103	**7**	**3**	**11**	**3**	**0**	NA	NA	NA	**3**	**0**	**3**
Teller	NA	NA	9	1	0	NA	NA	NA			
Nome	NA	NA	1	1	0	NA	NA	NA			
Unalakleet	NA	NA	1	1	0	NA	NA	NA			
22E											
TX104	**51**	**25**	**38**	**14**	**2**	**34**	**11**	**2**	**25**	**4**	**29**
Shishmaref	NA	NA	14	6	2	25	11	2			
Wales	NA	NA	11	5	0	9	0	0			
Nome	NA	NA	2	2	0	NA	NA	NA			
Stebbins	NA	NA	1	1	0	NA	NA	NA			
Drawing	**7**	**0**	**10**	**9**	NA	NA	NA	NA	**9**	**0**	**9**
23SW											
TX106	**10**	**4**	**12**	**3**	**2**	**6**	**2**	**0**	**5**	**2**	**7**
Buckland	NA	NA	6	2	0	5	2	0			
Deering	NA	NA	6	1	2	1	0	0			
									67	**9**	**76**

[1] based on a 5% harvest rate in Units 22B, 22D, and 23SW, on a 3% harvest rate in Unit 22C and an 8% harvest rate in Unit 22E

[2] Based on previous success rates up to 33% additional permits were initially issued in 22B, 22D, 22E and 23SW.

In Februay we issued 3 additional permits for TX105, 2 additional permits for TX102, 1 for TX103, 5 for TX104 and 3 for TX106

TABLE 5 Results of state and federal muskox hunts on the Seward Peninsula, 2005–2006

Harvest Quotas and Harvest for Seward Peninsula Muskox Hunts, 2005-2006

Hunt Area	Muskox Harvest Quota 1	Cow Muskox Harvest Quota	No. of State Permits Issued 2	No. of State Permits Filled Bulls	No. of State Permits Filled Cows	No. of Federal Permits Issued 2	No. of Fed. Permits Filled, Bulls	No. of Fed. Permits Filled, Cows	Total Bull Harvest	Total Cow Harvest	Total Harvest
22B											
TX105	**16**	**0**	**21**	**10**	**0**	**7**	**0**	**0**	**10**	**0**	**10**
Elim	NA	NA	6	0	NA	1	0	NA			
Golovin	NA	NA	6	5	NA	1	0	NA			
Koyuk	NA	NA	4	0	NA	2	0	NA			
Nome	NA	NA	1	1	NA	NA	NA	NA			
Unalakleet	NA	NA	1	1	NA	NA	NA	NA			
White Mtn	NA	NA	3	3	NA	3	0	NA			
22C											
TX100	**2**	**0**	**3**	**1**	NA	NA	NA	NA	**1**	**0**	**1**
Nome	NA	NA	3	1	NA						
TX101	**4**	**0**	**5**	**4**	NA	NA	NA	NA	**4**	**0**	**4**
Nome	NA	NA	4	3	NA	NA	NA	NA			
Kotzebue	NA	NA	1	1	NA	NA	NA	NA			
22D											
TX102	**32**	**13**	**38**	**16**	**7**	**6**	**0**	**0**	**16**	**7**	**23**
Brevig	NA	NA	7	2	1	3	0	0			
Buckland	NA	NA	1	1	0	NA	NA	NA			
Nome	NA	NA	26	13	5	NA	NA	NA			
Teller	NA	NA	3	0	0	3	0	0			
White Mtn	NA	NA	1	0	1	NA	NA	NA			
TX103	**8**	**3**	**12**	**9**	**0**	NA	NA	NA	**9**	**0**	**9**
Teller	NA	NA	4	1	0	NA	NA	NA			
Nome	NA	NA	6	6	0	NA	NA	NA			
Unalakleet	NA	NA	2	2	0	NA	NA	NA			
22E											
TX104	**69**	**35**	**47**	**18**	**9**	**35**	**5**	**2**	**23**	**11**	**34**
Shishmaref	NA	NA	22	9	8	25	5	1			
Wales	NA	NA	12	5	0	10	0	1			
Anchorage	NA	NA	2	0	0	NA	NA	NA			
Big Lake	NA	NA	1	1	0	NA	NA	NA			
Buckland	NA	NA	1	0	0	NA	NA	NA			
Eagle River	NA	NA	1	1	0	NA	NA	NA			
Nome	NA	NA	5	0	1	NA	NA	NA			
Stebbins	NA	NA	2	2	0	NA	NA	NA			
Talkeetna	NA	NA	1	0	0	NA	NA	NA			
Drawing	**7**	**0**	**10**	**7**	**NA**	**NA**	**NA**	**NA**	**7**	**0**	**7**
23SW											
TX106	**9**	**4**	**8**	**0**	**3**	**4**	**0**	**1**	**0**	**4**	**4**
Buckland	NA	NA	5	0	0	2	0	0			
Deering	NA	NA	3	0	3	2	0	1			
									70	**22**	**92**

[1] based on a 5% harvest rate in Units 22B, 22D, and 23SW, on a 3% harvest rate in Unit 22C and an 8% harvest rate in Unit 22E

[2] Based on previous success rates additional permits were issued.

WILDLIFE MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
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Juneau, AK 99811-5526

MUSKOX MANAGEMENT REPORT

From: 1 July 2004
To: 30 June 2006[1]

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 unknown reasons. The north Pacific whaling fleet is often credited with decimating muskoxen in this region. However, muskoxen may have already disappeared from Alaska (but not northwestern Canada) by the time whalers arrived. Although there is ample evidence of several genera of muskox in northwest Alaska from the Pleistocene period (McDonald and Ray 1989), 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. The department released 36 muskoxen on the southwestern portion of the Seward Peninsula near Teller in 1970. In 1981 the department released an additional 35 muskoxen in the same area. Muskox inhabiting Unit 23 Southwest, the 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 and includes information for Units 22 and 23 Southwest. The second translocation effort in Unit 23 occurred at Cape Thompson and this report covers the muskox population that became established in the northwestern part of Unit 23.

In 1970 the department also released 36 muskoxen near Cape Thompson, and in 1977 the department released an additional 34 muskoxen at the same site. Of the 4 translocations of muskoxen to Alaska, the Cape Thompson population has grown the least. Currently, the 'Cape Thompson' muskox population inhabits that portion of Unit 23 from the mouth of the Noatak River to Corwin Bluff within 15–20 miles of the Chukchi Sea.

[1] This report also contains information collected outside the reporting period at the discretion of the reporting biologist.

In addition to the relatively discrete Seward Peninsula and Cape Thompson populations that occupy stable, core ranges, a few muskoxen are also widely scattered throughout the remainder of the unit. Most of these scattered muskoxen occur in small groups of 1-4 individuals, and most are bulls. However, mixed sex-age groups have been observed in the Selawik and Noatak drainages during recent years as well as in the southwestern portion of Unit 26A. Muskoxen in the Noatak drainage and in Unit 26A probably emigrated from the Cape Thompson area while 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 muskoxen 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 muskoxen; 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

The Cape Thompson muskox population has been censused irregularly since 1987, using fixed-wing aircraft. The census area includes that portion of Unit 23 between the mouth of the Noatak River and Corwin Bluff within approximately 20 miles of the Chukchi Sea coast. It also includes the lower 10 miles of the Aggie River. Search efforts have focused on known areas of use and prime muskox habitat along ridgelines and riparian areas; other areas have been searched less intensively. To minimize disturbance, we approach groups of muskoxen at 1000–2000 ft above ground level and repeatedly count them during a gradual, low power, spiral descent. These censuses have provided minimum direct count population counts with no estimates of sightability or confidence intervals.

Population Composition

Composition information was collected each July in 2004, 2005 and 2006 using a helicopter for transportation and ground-based observations of muskox groups. We classified as many muskoxen as possible, sometimes using 1 or 2 fixed-wing planes to help search the area between the Noatak River mouth and Cape Lisburne. The National Park Service paid for all helicopter support and the department contributed 1 staff member to this project. For ratio estimates we defined ‘cow’ as any female $\geq$3 yrs old and ‘bull’ as any male $\geq$4 yrs old.

Distribution and Movements

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

MORTALITY

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

Harvest

Harvest during the 2003–2004 and 2004–2005 regulatory years was monitored through the Tier II hunt report system.

HABITAT

Assessment

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

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

From 1970 to 1998 the Cape Thompson muskox population grew approximately 8% annually (Fig. 1, Table 1). Since 1998, this population has probably been stable. The size of the core range of this population has slowly increased since 1970; however, it has not increased in proportion to population size. Opportunistic observations during 2006 and 2007 of mixed-sex age groups in the vicinity of the upper Kokolik River and Meat Mountain in Unit 26A, and in the middle Noatak River, suggest muskoxen may be emigrating from their core range to new areas.

Population Composition

We located only 54–74% of the entire estimated population during composition surveys in 2004–2006. Because we did not sample the entire population, actual composition may differ somewhat from our results.

We observed 40, 29 and 25 calves:100 cows ($\geq$2 yrs old) in 2004, 2005 and 2006, respectively (Table 2). Bull:cow ratios (all age categories combined but excluding calves and yearlings) for these years were 60, 77 and 67:100. We may underestimate bull:cow ratios because search intensity during composition surveys is low compared to censuses and mature bulls are often alone or in very small groups that could easily be missed. Because we have only 3 years of composition data and because we haven't sampled the entire population in any year, little can be said regarding the survival of individual cohorts. Composition data suggests calf production has

varied substantially among years, and that there is no biologically significant shortage of bulls. Although it is too soon to tell, the decline in calf production combined with observations of mixed sex-age groups emigrating from the core range may suggest this population is beginning to experience density dependent limitations.

Distribution and Movements

The historical distribution and movements of this population have been previously described (Dau 2005). Based on 8 censuses conducted since 1988, the proportion of this population in the southern portion of its range has increased (Fig 2). For example, 24% of the total population was observed within Cape Krusenstern National Monument during the 1988 census while in 2007 this percentage increased to 55% (Fig 3). Several things could be contributing to this change in distribution. Muskoxen in the northern portion of their range may be moving along the coast and either emigrating into Unit 26A or moving southeast toward the Igichuk Hills. Also, since 2003 we have found (occasionally with reports from Cape Lisburne Long Range Radar staff) 13 muskoxen illegally killed and abandoned north of and including Cape Thompson. Many residents of northwest Alaska have long resented the presence of muskoxen in areas they've used to hunt caribou, gather greens and pick berries for generations. Agency staff spend little time in the northern portion of this muskox range so we do not know the magnitude of illegal harvests..

After several years of being almost totally absent from the Tahinichok Mountains, muskoxen resumed using this area in 2004 though to a lesser degree than during the late 1980s. Even so, most muskoxen within Cape Krusenstern National Monument occurred in the Igichuk Hills or along the coast between the mouth of Killikmak Creek and the Noatak River delta.

The strong fidelity muskoxen exhibit for coastal areas is probably attributable to their dependence on high winds to minimize snow depth on exposed ridges during winter. Although snow in these areas is minimal, the quantity and quality of forage appears to be limited. Muskox may be attracted to coastal areas during summer by cooler conditions than occur inland.

Despite their fidelity to the Chukchi Sea coast, for many years bulls in groups numbering 1–6 individuals have been observed scattered throughout the western Brooks Range and its foothills. However, in June 2005 while conducting a sheep survey I observed a mature cow muskox with a newborn calf high in the mountains between the Kugururuk and Avan Rivers. On 12 June 2006 I observed a group of 4 cows and 4 neonates on the southwestern flank of Tupichak Mountain (Unit 26A) that were in the vicinity of 6 bulls scattered along the upper Kokolik River. On 8 July 2006 I observed a group of 7 muskoxen that included 2 cows, 2 calves, a yearling, a mature bull and one of unknown sex/age. This group spent the winter of 2006–2007 within 0.5 mi of the south bank of the Noatak River near the mouth of Nakolik Creek. And, on 24 July 2006 I observed a group of 12 muskoxen near Meat Mountain (Unit 26A) that included 5 cows, 5 calves and at least 1 adult bull. During this reporting period, as in the past, I also observed 10-20 bulls scattered throughout the Noatak River drainage and western Brooks Range well outside the core range. The slight decline in census results from 2005 to 2007 may be attributable to these groups emigrating from the core range.

MORTALITY

Harvest

Season and Bag Limit. Since its inception during the 2000-2001 regulatory year, 6 permits have been issued annually for the Tier II muskox hunt in northwest Unit 23 (TX107), the season has been 1 August–15 March, and the bag limit has been 1 bull.

Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
2004–2005 and 2005-2006		
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

In addition to the state Tier II hunt (TX107), the Federal Subsistence Board established a federal subsistence muskox hunt on Cape Krusenstern National Monument for residents of the monument that went into effect during the 2005–2006 regulatory year. The total annual quota has been 2 bulls with a 1-bull bag limit. The federal season is identical to the Tier II hunt. In 2005–2006 1 bull was taken under this hunt, and in 2006–2007 the quota of 2 bulls was taken (1 by federal proxy permit).

Board of Game Actions and Emergency Orders. Emergency order 05-07-05 closed TX107 in October 2005. In September 2005, state troopers, acting on a tip from a local pilot, located the carcasses of 6 muskoxen (2 bulls, 3 cows and a calf) near Cape Thompson that had been shot and abandoned. In June 2005, we located the freshly bloated carcass of an adult cow that had been shot and left near a 4-wheeler trail along the south bank of the lower Kukpuk River. These illegal kills exceeded the quota of TX107 so the season was closed to prevent further harvests.

Human-Induced Harvest. Few muskox have been harvested under TX107 since this hunt was established (Table 3). Until the 2004–2005 season all permits went to residents of Point Hope, Kivalina or Noatak. Few residents of these communities have applied for a permit recently and

now residents of Kotzebue who have consistently applied since this hunt was established have begun to receive permits.

Permit Hunts. See section above.

Hunter Residency and Success. See section above regarding residence of hunters. Annual success rates for TX107 have ranged from 0–80%. We think most or all hunters who fail to harvest a muskox simply did not hunt.

Harvest Chronology. Since the beginning of this hunt, most harvests have occurred during August–October and February–March.

Transport Methods. Most hunters have accessed the hunting area via snowmachine. Two hunters hunted via boat in 2002–2003, 1 in 2004–2005 and 2 in 2005–2006.

Natural Mortality

Although wolves and brown bears in this area may be learning to take muskox (Dau 2005), losses to predators still appear to be low based on the lack of kills observed by me or reported by the public. Brown bears seem to be a more significant source of mortality on the Seward Peninsula (J. Dau, unpub. observations) and on the North Slope (Reynolds 2003, Reynolds et al. 2002) than in northwestern Unit 23.

Other Mortality

During late August 2006 a seasonal resident of Shesaulik killed a mature bull muskox in defense of life and property after unsuccessfully attempting to chase it out of his dog yard. Unfortunately, he did not salvage the meat. Daily afternoon ambient temperatures were warm so the carcass quickly spoiled and attracted a brown bear. The National Park Service used a helicopter to sling the carcass away from his camp. Although justified in killing the bull, this individual was subsequently cited by the Department of Public Safety for failing to salvage the meat. Given the propensity for muskoxen to travel along beaches during summer and their increasing numbers in the southern portion of their range, human-muskox conflicts between Sealing Point and Shesaulik will likely continue and could become more frequent in the future. At least 2 other muskoxen, both bulls, have been shot and left in the vicinity of Shesaulik over the past 5–6 years.

Illegal harvests have been a source of muskox mortality in northwest Unit 23 since at least the late 1980s. The significance of illegal harvests to the dynamics of this population is unknown.

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 muskoxen 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 muskox management in northwest Alaska (see also 'Other Mortality' section above). Details of these conflicts have been previously reported (Dau 2005).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Two distinct populations of muskox inhabit Unit 23. One population ranges within 15–20 miles of the coast between the mouth of the Noatak River and Corwin Bluff. The other population inhabits the southwestern portion of Unit 23 as part of the Seward Peninsula population. Both populations stem from translocations initiated by the department in 1970. Small groups of bulls are scattered throughout much of the remainder of Unit 23. Additionally, mixed-sex age groups may be becoming established in the southwestern portion of Unit 26A, in the middle Noatak drainage, and in the Selawik drainage.

2. The Cape Thompson population grew approximately 8% annually during 1970-1998 and has essentially been stable since that time. Therefore, the harvest strategy for TX107 should remain conservative with a 6-bull quota.

3. Muskoxen in the northwest portion of Unit 23 exhibited strong fidelity to their core range. This fidelity was most pronounced for large mixed sex/age groups. Even so, more muskoxen now inhabit the southern portion of their range than in previous years.

4. Harvests of muskoxen in the northwest portion of Unit 23 should be cooperatively managed by the department and NPS, as they are on the Seward Peninsula. That would better allow state and federal quotas to be based on the relative abundance of muskoxen on these lands. Currently, although roughly 55% of the total population inhabits Cape Krusenstern, only 25% of the total harvest is allowed to be taken there under the federal hunt. Composition data does not suggest this has affected the sex or age structure of this population. Even so, a cooperative management approach would still probably benefit muskoxen and hunters.

5. Muskoxen use riparian areas during summer and exposed, sparsely vegetated domes and ridges where snow cover is minimal during winter. Muskoxen use body-fat reserves and extremely conservative behavior to survive through winter. Disturbance to muskoxen during winter should be minimized.

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DAU, J. 2007. Unit 23 muskox. Pages 35–48 *in* P. Harper, editor. Muskox management report of survey and inventory activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game. Project 16.0. Juneau, Alaska, USA.

TABLE 1 Muskox census results for the northwest portion of Unit 23, 1988–2007

	May 1988	June 1994	March 1997	June 1997	June 1998	June 1999	June/July 2000	July 2001	Jan. 2004	Feb. 2005	Feb. 2007
Groups	14	19	24	26	39	34	41	37	43	41	40
Individuals[a]	106	215	291	212	322	299	327	236	363	369	347
Calves[b]	17	18		49	65	75	97	23			
Total	123	233	291	261	387	374	424	259	363	369	347
Calves:100 Adults	16	8		23	20	25	30	10			

[a] "Individual" defined as any muskox >2 months old (i.e., excluding calves)

[b] "Calf" defined as any muskox ≤2-3 months old

TABLE 2 Sex and age composition of the Cape Thompson muskox population during July 2004-2006, Game Management Unit 23 (percentage of total observed in parentheses; however, percent of total population classified in parentheses following 'year')[a]

	Males (%)	Females (%)	Unknown (%)	Total (%)
2004 (74%)				
Adults (4+ yrs old)	51 (19)	98 (36)		149 (55)
3-yrs old	4 (1)	10 (4)		14 (5)
2-yrs old	17 (6)	11 (4)		28 (10)
Yearlings			27 (10)	27 (10)
Calves			48 (18)	48 (18)
Unknown age			3 (1)	3 (1)
Total	72 (27)	119 (44)	78 (29)	269
2005 (62%)				
Adults (4+ yrs old)	45 (20)	70 (31)		115 (50)
3-yrs old	11 (5)	16 (7)		27 (12)
2-yrs old	13 (6)	4 (2)		17 (7)
Yearlings			40 (18)	40 (18)
Calves			26 (11)	26 (11)
Unknown age			3 (1)	3 (1)
Total	69 (30)	90 (39)	69 (30)	228
2006 (54%)				
Adults (4+ yrs old)	49 (26)	69 (36)		118 (62)
3-yrs old	4 (2)	15 (8)		19 (10)
2-yrs old	4 (2)	1 (1)		5 (3)
Yearlings			27 (14)	27 (14)
Calves			21 (11)	21 (11)
Unknown age				
Total	57 (30)	85 (45)	48 (25)	190

[a] Composition surveys were paid for by the National Park Service and conducted cooperatively with department staff.

TABLE 3 Harvest data for the Tier II muskox hunt, TX107, 2000-2001 through 2006-2007

					Hunter Residency			
Year	# Permits	# Bulls	# Cows	Total harvest	Point Hope	Kivalina	Noatak	Kotzebue
2000-2001	6	1	0	1	4	2	0	0
2001-2002	6	0	0	0	2	0	4	0
2002-2003	6	4	1	5	1	2	3	0
2003-2004	6	0	0	0	0	0	6	0
2004-2005	6	2	1	3	0	0	3	3
2005-2006[a]	6	0	0	0	0	1	3	2
2006-2007	6	4	0	4	1	1	1	3

[a] Season closed by emergency order

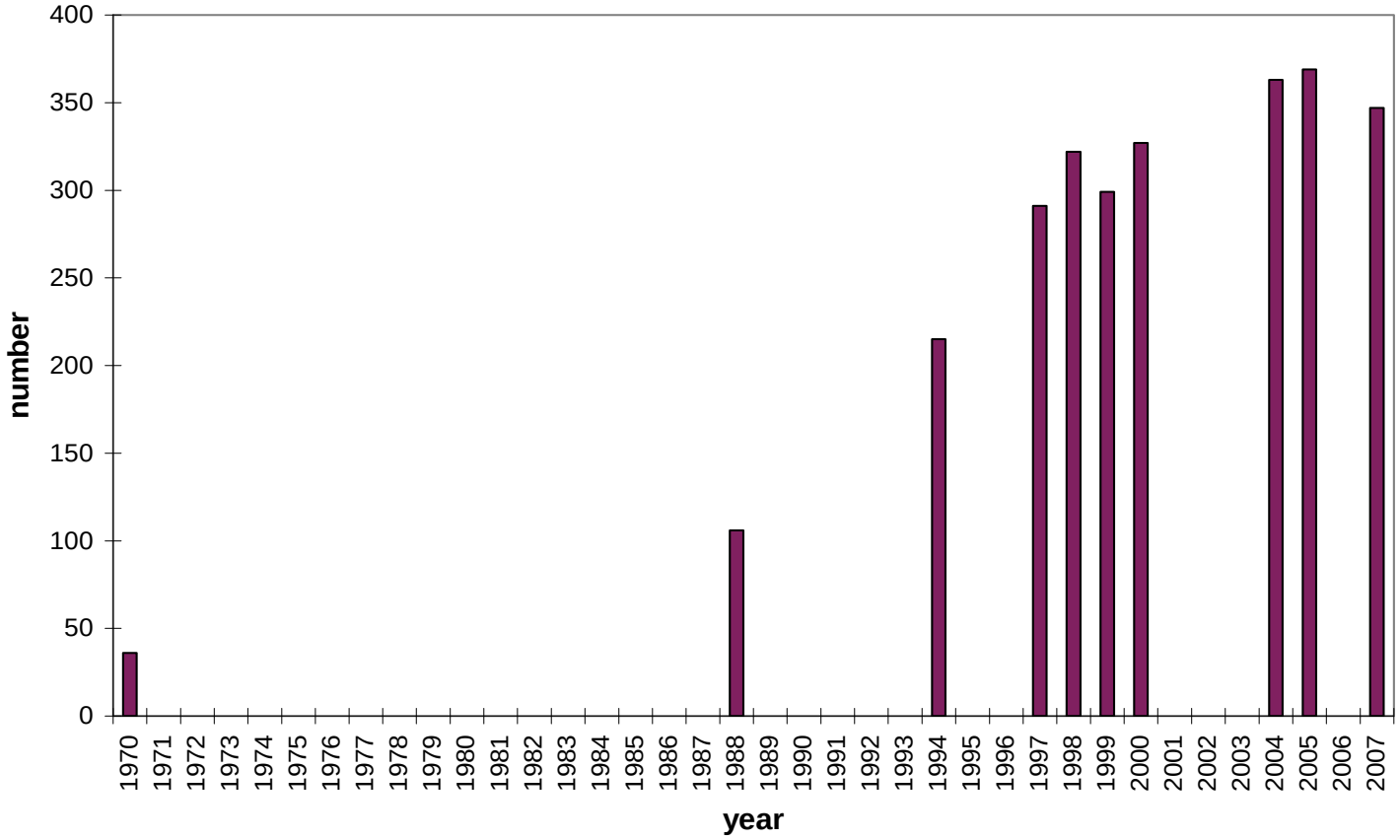

FIGURE 1 Muskox census results in the northwestern portion of Game Management Unit 23 during 1970–2007

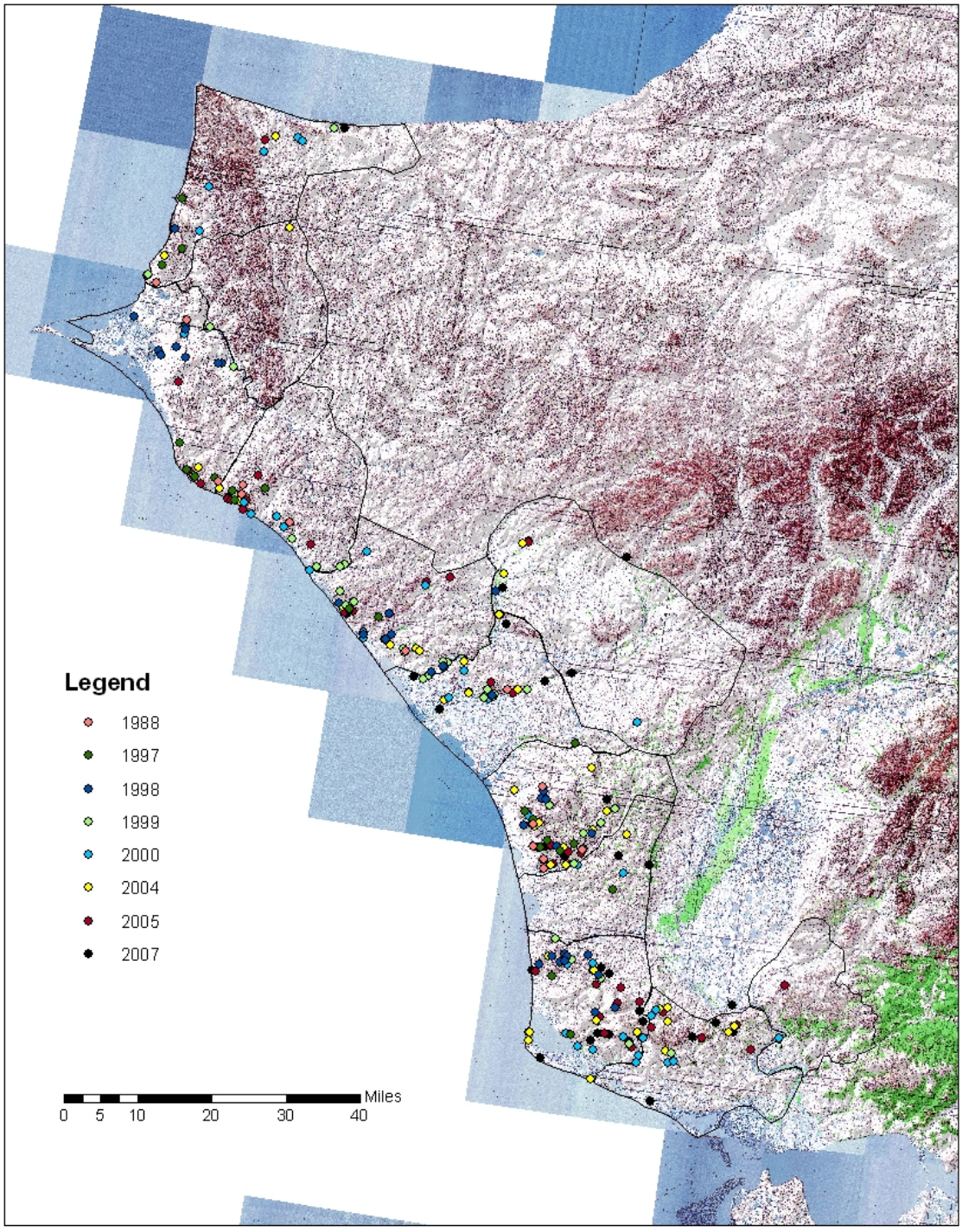

FIGURE 2 Locations of muskox groups observed during population censuses, 1988–2007 (sample units shown as well)

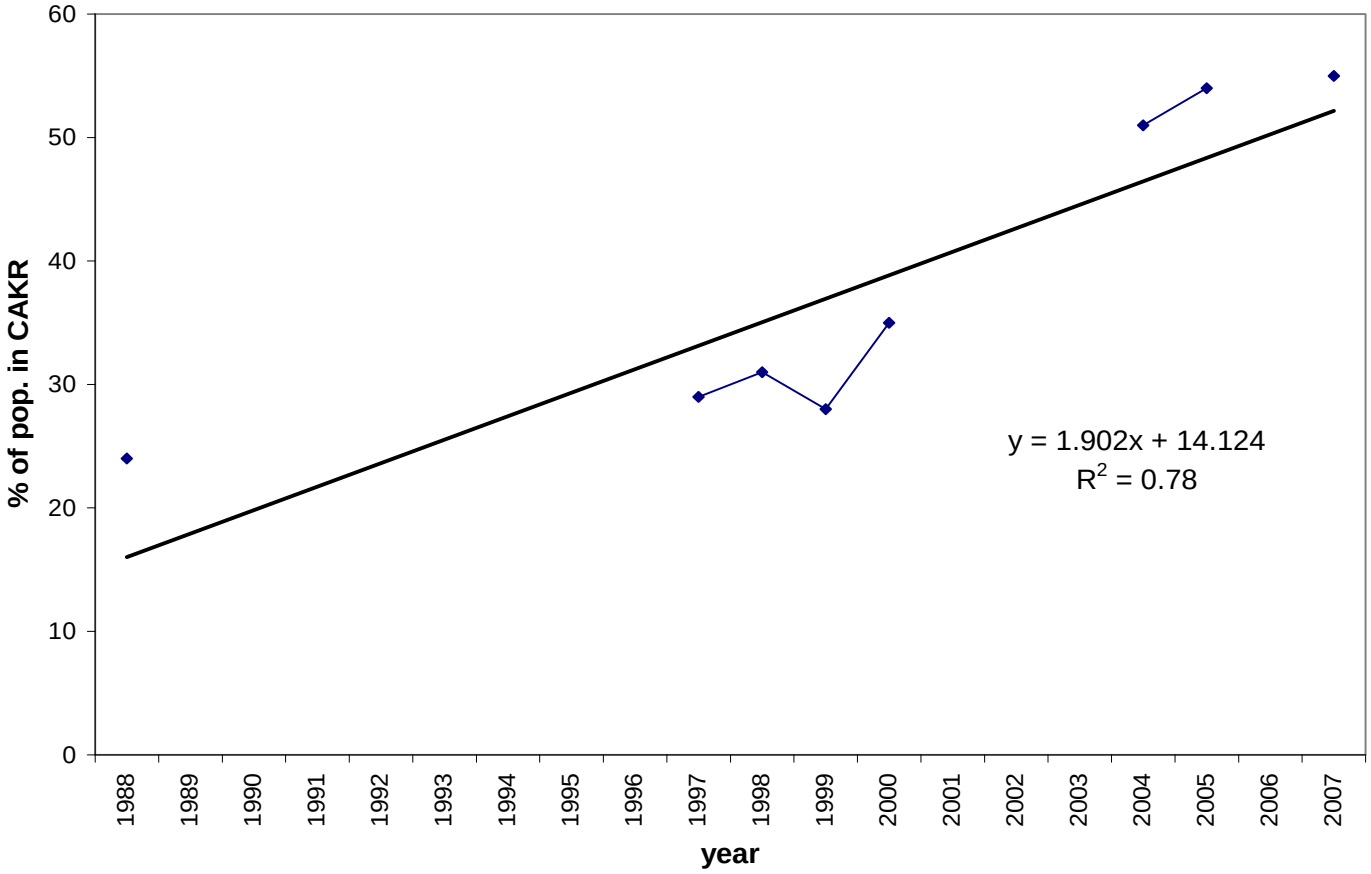

FIGURE 3 The percentage of muskoxen observed within Cape Krusenstern National Monument (CAKR) during population censuses, 1988-2007

WILDLIFE MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO Box 115526
Juneau, AK 99811-5526

MUSKOX MANAGEMENT REPORT

From: 1 July 2004
To: 30 June 2006[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Central and Eastern Arctic Slope

BACKGROUND

Muskox populations in Alaska disappeared in the late 1800s or early 1900s (Lent 1998). The Alaska Department of Fish and Game (ADF&G) reintroduced muskoxen to Nunivak Island during 1935–1936. During 1969 and 1970, 51 animals from Nunivak Island were released on Barter Island and 13 were released at Kavik River on the eastern North Slope. The number of muskoxen in this area (Unit 26C) increased steadily during the 1970s and 1980s, and during the late 1980s and early 1990s expanded eastward into Yukon, Canada, and westward into Unit 26B and eastern Unit 26A. 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 and by 2003 only 29 muskoxen were observed. Muskox numbers in Unit 26B appeared stable to slightly increasing during the 1990s through 2003.

ADF&G first opened a hunting season in Unit 26C in 1982 and in Unit 26B in 1990. Several regulatory scenarios have been in effect since then (Lenart 2003). The "North Slope Muskox Harvest Plan" is the template for managing muskoxen in Unit 26B. Consistent with that plan, in March 1998, the Alaska Board of Game 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. The board 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 were made available in Nuiqsut and Kaktovik, and the season announced by emergency order when snow conditions, weather, or other factors were suitable for hunting muskoxen. A drawing permit hunt (DX112) was also established; 3 permits were issued annually 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. The $25 resident

[1] At the discretion of the reporting biologist, this unit report may contain data collected outside the reporting period.

muskox tag fee was waived for subsistence hunters in Units 26B and 26C. Hunters have harvested small numbers of muskoxen annually in Units 26C and 26B since the seasons opened. Some season and boundary changes were made since 1998 (Lenart 2003).

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, 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 AND ACTIVITIES

1. Maintain a stable population of 500–650 muskoxen in Units 26B and 26C.
   - 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.
   - Administer 3 permit hunts and monitor results of the hunts.

METHODS

POPULATION SIZE AND COMPOSITION

ADF&G and U.S. 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, 206, or a Super Cub. Bright, sunny days provided the best survey conditions. Transects were flown at

approximately 90 mph at 500–1000 ft above ground level, depending on visibility. In addition to flying transects and drainages, we tracked radiocollared females to locate groups of muskoxen.

In Unit 26C, surveys began in 1978 when staff from the Arctic National Wildlife Refuge (ANWR) surveyed major drainages and smaller adjacent tributaries and bluffs. During 2002–2005, refuge staff flew approximately 1400 miles along 50 north–south transects, spaced at 3-mile intervals, across the coastal plain from the Arctic Ocean to the mountains of the Brooks Range, from the Canning River to Canada (Reynolds 2002, 2005; P. Reynolds, FWS, personal communication). ANWR staff flew additional surveys during other times of the year in 2004 and 2005 and results of these surveys can be found in Reynolds (2005).

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. Systematic surveys were not initiated in Unit 26B, west of the Dalton Highway (Unit 26B West), until March 1997. Six-mile wide transects oriented north–south were distributed from 70ºN to 69º15'N. Beginning in April 1999, transects extended farther south to 69ºN, and transects were also flown in the area approximately halfway between the Itkillik and Colville Rivers. In April 2000 and 2003, the 6-mile wide transect method also was applied to Unit 26B East. No surveys were conducted in 2001, but we estimated a minimum population of 258 from a composition count completed in June by excluding calves and including observations of adults not classified. In years 2002, 2004, and 2005, we surveyed only major drainages and smaller adjacent tributaries and bluffs in all of Unit 26B.

In April 2006, we conducted a census across the eastern North Slope in cooperation with ANWR and Gates of the Arctic National Park and Preserve. The survey included the area on the coastal plain east of Judy Creek in eastern Unit 26A, all of Units 26B and 26C, and the western Yukon Territory as far east as the Babbage River. Transects, oriented approximately north–south and spaced 3 miles apart, were flown from the foothills of the Brooks Range mountains to the Arctic Ocean. The easternmost transect extended from 68.910°N, -138.384°W to 69.241°N, -138.503°W in Canada; the westernmost extended from 68.402°N, -149.995°W to 70.429°N, -150.260°W near the Itkillik Hills in Unit 26B. Additional transects beginning at 68.419°N, -150.115°W to 70.434°N, -150.379°W in the Itkillik Hills were flown every 2–6 miles to just west of the Colville River at 69.432°N, -152.110°W to 70.418°N, -152.110°W. We assumed 90–100% coverage for transects that were spaced at 3 miles. The mountains were surveyed by flying suitable muskox habitat along the valleys of major drainages and parts of their tributaries from the Etivuluk River to the Kongakut River. The survey area included approximately 33,000 mi^2 (85,470 km^2).

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. In 2003 and 2005, some groups were classified from an R-44 or R-22 helicopter, but it proved difficult to classify animals from helicopters.

We monitored 3–14 radiocollared adult females each year to locate muskoxen in precalving surveys in April and conducted composition counts in June during 1997 through 2006. In April 1999, ADF&G deployed radio collars on 12 adult (≥3 years old) female muskoxen in 11 groups distributed between the Itkillik River and the Ivishak River in Unit 26B using methods described by

Lenart (1999). Since 1999, adult female muskoxen were captured and radiocollared in June or July by darting them with a CO_2 powered short-range projector pistol. In June the following numbers of radio collars were deployed on muskoxen: 2 in 2001, 1 in 2002, 2 in 2003, 5 in 2004, 2 in 2005, and 4 in 2006.

HARVEST

For Unit 26B we monitored harvest and hunting effort through harvest reports submitted by hunters. Total harvest, residency, success rates, chronology of harvest, and methods of transportation were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 July 2005 through 30 June 2006). We obtained harvest data from FWS for Unit 26C.

We grouped population and harvest data as: 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

Unit 26B and eastern Unit 26A. In Unit 26B and eastern Unit 26A, the number of muskoxen observed during precalving surveys (late March or early April) increased steadily during the early 1990s and fluctuated slightly during the mid 1990s before stabilizing at approximately 250–300 muskoxen from 1999 through 2003 (Table 1). In 2004 and 2005, complete surveys were not conducted, but partial surveys indicated that the population had declined, and may have totaled approximately 200 muskoxen.

In 2005 we observed 186 muskoxen during a survey. Only 62 muskoxen were observed in Unit 26B West, whereas in previous years 92–115 muskoxen were observed (Table 1). Some of the Unit 26B West animals were killed in May 2004 by a flood on the Colville River during breakup. In June 2004 we found 6 dead adult muskoxen on the Colville River at Ocean Point and 7 (2 yearlings, 5 calves) dead on the Colville delta. These groups had been located in April 2004 in groups of 18 and 16, respectively. We do not know if the flood killed other animals in those groups..

During the April 2006 census we observed only 216 muskoxen (including a minimum of 44 yearlings) in 12 groups in Unit 26B and eastern Unit 26A. We observed 67 muskoxen in Unit 26B West, similar to 2005 (62). During the census in 2003, we estimated 302 muskoxen in this area. This indicates that the muskox population in Unit 26B and eastern Unit 26A has declined.

Although the overall number of muskoxen in Unit 26B and eastern Unit 26A decreased since 2003, the number of calves observed in early June was relatively high, indicating good productivity (Table 1). In addition, percent yearlings (proportion of yearlings in the population of muskoxen ≥1-yr old) remained relatively constant (range: 9–16%). during 2000–2005 (excluding 2003). Percent yearlings in 2003 was low (5%), but this was probably related to sampling problems (see Population Composition section below). Thus, some yearling recruitment occurred, and the population

appeared stable to slightly increasing at least until 2003. Muskoxen are long-lived, yet because this population is not increasing, the data suggests that mortality closely tracked or exceeded recruitment during 1999–2006. Some possible causes of mortality include predation by brown bears, drowning, starvation due to being stranded on sea ice, habitat, and weather (See Mortality section below). In addition to possible higher rates of mortality, some distributional changes have probably occurred. Some muskoxen may have emigrated from Unit 26B and eastern Unit 26A and/or moved into the mountains where it is more difficult to locate them.

Unit 26C. The number of muskoxen observed in Unit 26C during precalving surveys was stable or increasing during 1990–1998 (range: 282–332; Table 1). Population counts indicate a decline began in 1999. The decline continued through this reporting period when only 9 muskoxen were observed in Unit 26C in March 2005 and 1 in April 2006 (Table 1). Initially, emigration into Unit 26B and Yukon, Canada, could have caused fewer 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 may have influenced the population, including 1) annual variation in weather affecting female body condition, calf survival, and yearling recruitment (e.g., crust forming on snow and long winters with deep snow making foraging difficult, and late green-up of summer forage, particularly in 2000 and 2001); 2) adults calving in alternate years; 3) brown bears becoming more efficient predators on muskoxen; 4) muskoxen going out onto the coastal ice and not returning; and 5) disease making muskoxen more vulnerable to environmental conditions.

Units 26B and 26C. The combined number of muskoxen observed during precalving surveys in Units 26B and 26C declined considerably; 491–603 were observed during 1995–2000, but only 331 muskoxen were observed in 2003 (Table 1). Complete surveys in Unit 26B were not conducted in 2004 and 2005; but only 217 were observed in 2006. It is likely that the combined population of Unit 26B and 26C is less than 250 muskoxen.

Eastern North Slope including Northwestern Canada. During the April 2006 census, 79 muskoxen were observed in northwest Canada. Therefore, we observed a total of 296 muskoxen on the eastern North Slope and northwest Canada during the 2006 census compared with an estimated population of 700–800 muskoxen during the mid 1990s. Additionally, during summer 2006, biologists observed 2 groups of muskoxen in the Richardson Mountains, Yukon Territory, Canada, totaling 99 animals. (These muskoxen were not located during the April 2006 survey; Reynolds 2006). With these recent observations, we estimated the total population on the North Slope in northeastern Alaska and northwestern Canada at approximately 400 muskoxen. This suggests that the muskox population on the eastern North Slope has declined substantially.

Population Composition

Unit 26B. Although the overall number of muskoxen in Unit 26B decreased by 2006, the number of calves observed in early June was relatively high during 2000–2006, indicating good productivity (Table 1). In Unit 26B, the ratio of calves:100 females >2 years old ranged 36–65:100 during 2000–2006. In 2005 the calf:cow ratio was the highest value observed (65:100) since 1991, and in 2006 it was the lowest value observed (37:100) since 2000. It is possible that the lower value observed in 2006 is a reflection of female muskoxen calving alternate years to replenish reserves rather than some other nutritional limitation. A large proportion of the females calved in 2005. Alternate year calving was observed in the Unit 26C muskox population during the late 1980s and early 1990s (P.

Reynolds, personal communication). During 2000–2006, percent calves in the population was moderately high, ranging 16–26% (Table 1). In 2005, percent calves was 26% and in 2006, it was 12% following the same trend observed in the ratio of calves:100 females >2 years old (Table 1). The number of bulls observed annually probably accounted for the differences in trend observed between percent calves and calves:100 females.

Percent yearling (proportion of 1-yr-old muskoxen in the population per muskoxen ≥1-yr old) was moderate during 2000 through 2002 (range: 12–16%); but was low in 2003 (5%) and 2004 (9%). It was higher in 2005 and 2006 (14 and 15%; Table 1). The low value in 2003 can be attributed to difficulty in locating nursery groups and groups moving frequently, particularly in Unit 26B East. The higher value observed in 2006 is probably a reflection of the high calf:cow ratio observed in 2005. These higher values indicated that some recruitment is occurring.

Ratios of bulls (>3 years):100 cows (>2 years) 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 be because bull groups were more difficult to locate, so counts of bulls were more affected by differences in search effort among years.

We also separately examined composition data from Unit 26B West and Unit 26B East for 1997–2006 (Table 2). In general, percent calves and yearling recruitment during 1997–2006 was slightly more variable in Unit 26B East than in Unit 26B West. Calves:100 cows >2 years old was variable for both Unit 26B West and Unit 26B East. However, no overall trends were observed. We suggest that sample sizes were too small to examine these populations separately. In addition, because distribution is changing, it may be difficult to continue to examine Unit 26B West and Unit 26B East separately.

Unit 26C. In Unit 26C, the ratio of calves:100 females >2 years old was low (≤14:100) during 1999–2001. The percent calves followed a similar trend (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 were 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 when only 47 and 71 muskoxen were classified, respectively. No data were available for 2003–2006 because too few muskoxen were located. Annual bull (>3 years):cow (>2 years) ratios ranged from 40 to 60 during 1997–2001 (Table 1).

Units 26B and 26C. We did not calculate combined composition data from Units 26B and 26C during 2002–2006.

Distribution and Movements

Muskoxen were common along, the Colville, Itkillik, Kuparuk, Sagavanirktok, and Canning Rivers in Unit 26B and the Sadlerochit, Hulahula, Okpilik, Jago, and Aichilik Rivers in Unit 26C. Since 1980, lone bulls and small groups of muskoxen have also been reported south of the Brooks Range in Unit 25A, near Arctic Village. 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. In March 2004 we observed a group of 3 bull muskoxen in the Wind River drainage in Unit 25A. In addition, there was a sighting of a lone bull

near Coldfoot in summer 2004. A mixed group of 15 muskoxen was reported on the Coleen River in 2005 (H. Korth; personal communication). In August 2006, ADF&G staff observed a mixed-sex group of 13 muskoxen on the East Fork Chandalar River and 2 groups of 6 were reported on the Sheenjek and Chandalar Rivers in June 2006 (P. Reynolds, personal communication). We suspect that the animals found on the south side of the Brooks Range originated from the Units 26B and 26C population. In addition, a few bull muskoxen and some small groups have been sighted at the Gisasa, Kateel, and Hogatza Rivers beginning in 1999. 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. However, we suspect that these animals originated from the Seward Peninsula.

Muskoxen tend to form larger groups of 6–60 during winter and remain in one location for a long time. During summer they form smaller groups of 5–20 and move more frequently. Details of long-range movements were noted in spring 1999 within Unit 26B (Lenart 2003). In 2003, one large group of muskoxen (~50) that had wintered near the confluence of the Ribdon and Sagavanirktok Rivers for several years could not be located in June, even though the group had been there in April. Only 9 of these animals were located since then. By April 2004 and 2005, in addition to the 50 missing Ribdon muskoxen, there were approximately 50 less muskoxen than had been observed previously in the Sagwon Bluffs and Ivishak River groups. Some of these animals moved to the Toolik River. Nonetheless, it has been increasingly difficult to locate groups in June and keep track of those groups until the arrival of the helicopter for composition counts. Groups are smaller and move long distances in a short amount of time.

MORTALITY

Harvest

Seasons and Bag Limits. The table below provides a summary of seasons and bag limits for the various muskox hunts in Units 26B and 26C, beginning in RY90. Seasons and bag limits for the Tier II (TX108) hunt in Unit 26B remained the same during RY00–RY05, with a season of 1 August–31 March and a bag limit of 1 muskox. The season was closed for RY06. Seasons and bag limits for the Tier I (RX110) and the drawing (DX112) hunts in Unit 26B remained the same during RY98–RY04. The Tier I hunt season opening was announced by emergency order when conditions were good for traveling and the season closed no later than 31 March with a harvest quota of 4 muskoxen. The DX112 season was 20 September–10 October and 10–30 March with a bag limit of 1 bull muskox. No permits were issued for DX112 and RX110 in RY05. No permits were issued for any of the 3 hunts (TX108, DX112, RX110) in RY06. No permits have been issued in Unit 26C since RY03. All hunts still remain in regulation.

Location/Regulatory year	Permits; Hunt type; Bag limit	Resident Open Season	Nonresident Open Season
Unit 26B			
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 2005–2006	9[a]; Tier II; 1 muskox	1 Aug–31 Mar	No open season

Location/Regulatory year	Permits; Hunt type; Bag limit	Resident Open Season	Nonresident Open Season
2006–2007	0; Tier II; 1 muskox	No open season	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 2004–2005	∞ (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 and No open season
2005–2006 through 2006–2007	0; Tier I; 1 muskox and 0; Drawing; 1 bull	No open season and No open season	No open season and No open season
Unit 26C			
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
2002–2003	2; Federal; 1 bull	15 Sep–31 Mar	No open season
2003–2004 through 2006–2007	0; Federal; 1 bull	No open season	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 August 2002 the Federal Subsistence Board reduced the total muskox harvest in Unit 26C to 2 bulls for the RY02 hunting season. However, if late winter–early spring muskox surveys in subsequent years indicate more muskoxen present in Unit 26C, the number of permits issued can be increased to up to 3% of the estimated muskox population in Unit 26C and will be for bulls only.

During the March 2004 meeting, the Board of Game rescinded several of the regulations related to bow hunting along the Dalton highway that were established in RY02. The North Slope Closed Area was eliminated, along with the requirement that hunters mark their arrows. In addition, limiting the use of licensed highway vehicles in the DHCMA to publicly maintained roads was more clearly defined to allow "no motorized vehicles, except licensed highway vehicles on the following designated roads: 1) Dalton Highway; 2) Bettles Winter Trail during periods when BLM and the City of Bettles announce that the trail is open to winter travel; 3) Galbraith Lake road from the Dalton Highway to the BLM campground at Galbraith Lake, including the gravel pit access road when it is open; 4) Toolik Lake road, excluding the driveway to Toolik Lake Research Facility; 5) the Sagavanirktok River access road 2 miles north of Pump Station 2; 6) any constructed roadway or gravel pit within ¼ mile of the Dalton Highway."

Hunter Harvest. Hunting for muskoxen in the eastern North Slope has been allowed only by permit. The number of permits available and weather conditions such as cold, 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 (Tables 1 and 3). In all of Unit 26B, reported harvest was 0–14 during RY90–RY05 and was <5% of the Unit 26B segment of the population. For RY04 and RY05, harvest was 8 and 4, respectively. During RY95–RY05, harvest in Unit 26B West was 1–5 (≤6%) and in Unit

26B East it was 1–9 (≤6%; Table 3). No permits were issued for hunts in Unit 26B East in RY05. Reported harvest in Unit 26C was 5–15 during RY90 through RY02 (<4%). No permits were issued in Unit 26C since 2002. Restrictions in regulations ensured 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 of Unit 26 (Lenart 1999; 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. Success rates for all years in Unit 26B were high (Table 3). Success rates for Unit 26C were not available, but we suspect success rates were good for all the hunts (>50%). Hunters were predominantly local residents (Tables 4 and 5).

Transport Methods and Harvest Chronology. In most years, hunters relied primarily on snowmachines to hunt muskoxen. However, hunters also used aircraft in some fall hunts during the early 1990s. Hunters using the draw permit primarily used highway vehicles and recently more hunters have used boats in the Tier II hunt (Table 6).

Chronology of harvest depends mostly on weather (e.g., snow, fog, temperature, and rivers freezing). During RY95–RY05, 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 and Other Mortality

We have few data on natural mortality in the eastern Arctic. Brown bears kill both calf and adult muskoxen and have been a more important predator than wolves in Unit 26C (Reynolds et al. 1992). Muskox 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). For example, in RY03 we observed 2 dead and 3 injured muskoxen caused by brown bear predation, and 5 of 11 radiocollared muskoxen were found dead. We suspect that 3 of the 5 mortalities of radiocollared muskoxen were caused by brown bears. In 2006 there were reports of a brown bear chasing a small group of muskoxen that were on the ice off shore near Endicott; 2 calves and 1 adult were killed. Additionally, multiple mortalities of muskoxen suspected to be caused by predation in Unit 26B have been reported since 2000 (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. However, in May 2004, during breakup, the Colville River flooded and killed at least 13 muskoxen in 2 groups (6 adults, 2 yearlings, 5 calves). In early June 2006, 1 adult female muskoxen, 1 yearling female muskoxen, and 1 calf were reported stranded on the ice off Northstar and Endicott and likely died of starvation. The lone adult female was a radiocollared muskoxen.

Some human-caused mortality is capture-related, and some occurs on the Dalton Highway from vehicles hitting muskoxen. Causes of many of the mortalities are unknown. Mortality rate for radiocollared females ranged 0–50% during RY99–RY05 (Table 7).

Disease

Zarnke et al. (2002) tested sera from 104 muskoxen from Alaska for evidence of exposure to malignant catarrhal fever viruses (MCFV) and determined that these muskoxen had a high serum antibody prevalence rate of 96%. However, there was no evidence that muskoxen were experiencing clinical signs of MCFV.

Fifty-six sera collected during 1980–2004 from muskoxen in Units 26B and 26C (ANWR population) were tested for the presence of *Chlamydia.* Four percent of the samples tested positive. The 2 samples that tested positive were collected in 2000, suggesting that this organism may have recently appeared in the population (K. Beckmen, ADF&G, personal communication). However, antibodies to *Chlamydia* were present in other populations of muskoxen in Alaska that are not declining (Nunivak Island, Seward Peninsula, and Cape Thompson), which indicates that the organism is prevalent in these muskox populations (K. Beckmen, personal communication). Sera that tested positive from these 3 populations averaged 22% (n = 41; range: 17–25%).

HABITAT

Various studies of the status of muskox 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. There is some speculation that changes in forage quality and quantity on winter ranges in Unit 26C affected 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). Recently, muskox distribution in Unit 26B has changed, and it is possible some of the redistribution may be influenced by habitat, particularly during the winter. During 1997 through 2003, large groups of muskoxen (i.e., 50–60) wintered in the same location for several years. In 2004 and 2005, distribution was somewhat different, and overall, group sizes were smaller. Perhaps habitat in the earlier locations was overexploited, and muskoxen are currently searching for new wintering areas.

CONCLUSIONS AND RECOMMENDATIONS

The overall population size in Units 26B and 26C declined considerably beginning in 2001, but the population dynamics were different in the 2 units. Abundance of calves, yearlings and adults declined in Unit 26C beginning in 1999. The major factors influencing the decline 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 also most likely involved, and disease may also have played a role (Reynolds 2002). In Unit 26B, abundance of calves and yearlings was stable during 1999–2006, but numbers of muskoxen have declined since 2003. Thus, perhaps mortality rates exceed recruitment or distribution changed substantially. Brown bear predation could be influencing summer movements and group sizes by splitting larger groups into smaller groups and by causing groups to move into the mountains or farther west into Unit 26A to escape predation. Harvest rates of muskoxen were 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. Nonetheless, the population in Unit 26C has almost disappeared in a short time, and some decline has occurred in Unit 26B as well. There is a possibility that muskoxen could become scarce on the eastern North Slope in the future. We recommend increased monitoring of

Units 26A and 26B muskoxen by more frequent radiotracking of more individuals to 1) aid in locating muskoxen during population size and composition surveys, 2) determine distribution and group sizes, 3) document frequency and causes of mortality (e.g., predation, drowning, nutritional stress), 4) investigate the role of weather (e.g., snow depth, freezing events), and 5) assess the possible role of disease. This could provide insight into the reasons for the decline, possible management actions to be taken, and direction for further research.

During the report period (RY04 and RY05), 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 in RY04 and 1 hunt in RY05. However, the population was not stable. In response to declining numbers in Unit 26C, the Federal Subsistence Board reduced the number of permits available for the Unit 26C hunt in RY02 and did not issue permits subsequent years. Members of the North Slope Muskox Working Group and the community of Kaktovik supported these decisions.

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 RY04–RY05.

We met Goal 3 by cooperating with FWS to share information on population data and interpretation of data, and by cooperating in the field to conduct composition counts and surveys. FWS intends to continue monitoring muskox 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. Improvements to the Dalton Highway have increased public use and 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 during RY04–RY05 was <250 muskoxen. 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% of the spring precalving population annually in Unit 26B. The harvest rate was less than 10% annually during RY04–RY05.

REVISED MANAGEMENT OBJECTIVES

We recommend temporarily revising management objectives for the next report period. Research on Unit 26B muskoxen will be implemented for RY06–R07 to collect detailed information concerning distribution, group sizes, movements, and habitat uses; investigate the role of weather; and document frequency and causes of mortality. Results from this project could help identify potential causes of changes of muskox abundance, direct possible management actions that need to be taken, and provide direction for further research.

Results from the research project will also aid us in forming new management objectives after the next reporting period. The temporary revised management objectives and activities for the next reporting period will be as follows:

REVISED MANAGEMENT OBJECTIVES

1. Maintain a stable population of ≥200 muskoxen for 4 to 5 years.
2. Maintain a bull (≥3 yr old):cow (≥2 yr old) ratio of ≥35:100.
   - When objectives 1 and 2 have been met, permits for a bulls-only hunt may be issued. The number of permits to be issued would depend on population size, composition, recruitment, distribution, group size, mortality rates and health of the population.

   In addition, ongoing activities to measure when we meet the above objectives include:
   - Conduct a census during precalving surveys in early April every 2–3 years.
   - Conduct a precalving census across the eastern North Slope every 3–5 years in cooperation with ANWR and Canada.
   - Conduct ground-based composition counts in June to determine herd composition annually.
   - Maintain 15–20 radio collars on adult female muskoxen to assist in locating groups of muskoxen during precalving surveys and composition counts.
   - Administer permit hunts and monitor results of the hunts if a hunt is opened.
   - Test for the presence of potentially population regulating diseases, including: *Chlamydia*, contagious ecthyma, trace mineral deficiencies, lungworm, and stomach worm.

When the first 2 objectives have been met, our third objective and associated activity will be to:

3. Maintain a harvest rate of no more than 3% per year of the spring precalving population in Unit 26B while the population is less than 500 muskoxen.
   - Administer permit hunts and monitor results of the hunts.

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TABLE 1 Units 26B and 26C muskox precalving survey estimates and composition counts, 1990–2006[a]

Location[d]/ Year	Precalving survey 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)[f]		Calves:100 cows>2 yr (number cows >2 yr)		Percent yearling[g] (*n*)		Percent calves (*n*)	
UNIT 26B, eastern 26A												
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)	12	(5)	7	(3)
1997	279[h]	92	123	(107)	49	(23)	34	(47)	22	(24)	13	(16)
1998	207[h]	79	97	(78)	24	(10)	45	(42)	13	(10)	20	(19)
1999	237[h]	96	194	(162)	62	(44)	45	(71)	14	(23)	17	(32)
2000	277[h]	90	172	(131)	35	(24)	60	(68)	13	(17)	24	(41)
2001	258[i]	107[i]	286	(239)	64	(63)	48	(98)	16	(39)	16	(47)
2002	284	102	241	(203)	39	(41)	36	(105)	12	(24)	16	(38)
2003	302[h]	115	172[j]	(144)	94	(55)	48	(58)	5	(7)	16	(28)
2004	198	99	153	(123)	52	(37)	42	(71)	9	(11)	20	(30)
2005	186	62	151	(111)	46	(21)	65	(46)	14	(16)	26	(40)
2006	216[h]	67	175	(153)	37	(21)	37	(56)	15	(23)	12	(21)
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)
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[h]		272	(257)	60	(76)	14	(127)	8	(21)	7	(15)
2000	246[h]		184	(183)	40	(39)	1	(97)	4	(17)	<1	(1)
2001	168[h]		47	(46)	48	(13)	<1	(27)	0	(0)	2	(1)
2002	35[h]		71	(64)							10	(7)
2003	29[h]											
2004	30[h]											
2005	9[h]											

Location[d]/ Year	Precalving survey 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)[f]	Calves:100 cows>2 yr (number cows >2 yr)	Percent yearling[g] (*n*)	Percent calves (*n*)
2006	1[h]						
UNITS 26B, eastern 26A AND 26C							
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	523		356 (314)	38 (63)	25 (165)	11 (34)	12 (42)
2001	426[i]		333 (285)	41 (54)	36 (132)	8 (24)	14 (48)
2002	319		312 (267)				14 (45)
2003	331						
2004	228						
2005	195						
2006	217						

[a] Data source for Unit 26C for all years and for Unit 26B for 1987 through 1997; P. E. Reynolds, U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.

[b] Precalving survey 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 26B surveys occurred east of the Sagavanirktok River until RY96 when the entire subunit from Colville to Canning Rivers was surveyed. Unit 26C surveys encompassed the Canning to Clarence Rivers.

[e] Number of muskoxen observed west of the Dalton Highway in Unit 26B, and including eastern Unit 26A. This number is also included in total number of muskoxen observed.

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

[g] Percent yearling is the proportion of 1-year-olds in the population of muskoxen ≥1 year old.

[h] Censuses were conducted.

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

[j] Some groups of muskoxen were classified from an R-44 or R-22 helicopter. Groups were difficult to locate in Unit 26B East; thus, overall classification of the herd may not be representative.

TABLE 2 Muskox postcalving composition surveys, Units 26B West and 26B East, 1997–2006

	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	14 (4)	38 (10)	10 (3)	30 (10)	25 (24)	17 (14)	14 (13)	35 (37)
1998	9 (3)	4 (1)	25 (8)	61 (13)	15 (10)	20 (9)	17 (11)	38 (27)
1999	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)	13 (11)	22 (25)	68 (37)	22 (39)	19 (28)	13 (22)	36 (61)
2002	12 (13)	16 (14)	20 (22)	44 (50)	21 (28)	9 (10)	12 (16)	29 (55)
2003[d]	24 (24)	10 (6)	25 (26)	87 (30)	46 (31)	2 (1)	3 (2)	9 (23)
2004[e]	21 (17)	8 (6)	11 (9)	22 (41)	24 (20)	6 (5)	25 (21)	58 (36)
2005		23 (10)	28 (21)		21 (15)	13 (6)	26 (19)	65 (29)
2006[e]		18 (6)	15 (11)		14 (14)	26 (17)	10 (10)	26 (38)

[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] We had difficulty locating nursery groups in Unit 26B East. Considered a poor composition count.
[e] In 2004 and 2006, a group of 33 and 17 muskoxen were located in Unit 26B West, but were included in Unit 26B East because these groups originated in Unit 26B East and returned to Unit 26B East.

TABLE 3 Units 26B and 26C muskox harvest data by permit hunt, regulatory years 1996–1997 through 2005–2006

Regulatory year	Hunt/ Area[a]	Unit	Permits available[b]	Returned reports	Total hunters	Successful hunters[c]	Bulls	Cows	Total harvest
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
2002–2003	TX108	26B (West)	9	7	6	5	unk	unk	5
	RX110	26B (East)	2	2	1	1	1	0	1
	DX112	26B (East)	3	3	3	3	3	0	3
	RX113 (F)	26C	2	n/a	n/a	n/a	0	0	0
2003–2004	TX108	26B (West)	9	9	5	2	2	0	2
	RX110	26B (East)	unk[g]	0	0	0	0	0	0
	DX112	26B (East)	3	3	1	1	1	0	1
	RX113 (F)	26C	0	0	0	0	0	0	0
2004–2005	TX108	26B (West)	9	5	4	4	3	1	4
	RX110	26B (East)	4	5	3	1	1	0	1
	DX112	26B (East)	3	3	3	3	3	0	3
	RX113 (F)	26C	0	0	0	0	0	0	0
2005–2006	TX108	26B (West)	9	9	7	4	2	2	4
	RX110	26B (East)	0	0	0	0	0	0	0
	DX112	26B (East)	0	0	0	0	0	0	0
	RX113 (F)	26C	0	0	0	0	0	0	0

[a] Hunt areas: RX = registration; TX = Tier II; DX = drawing; F = federal hunt; 1007, 1013, 113 = Unit 26C; 1010 and 110 = east of Dalton Highway and since RY99 = east of Dalton Highway Management Corridor; 112 = west of Dalton Highway; 1012 = east of Jago River; 1014 = west of Jago River; Hunts RX1013(F) and RX113(F) are not registration hunts—they are 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.

[g] Vendor did not retain overlays.

TABLE 4 Unit 26B East muskox hunter residency and success, regulatory years 1998–1999 through 2005–2006

Hunt[a]/ Regulatory year	Successful			Unsuccessful			Total hunters
	Local[b] resident	Nonlocal resident	Total (%)	Local[b] resident	Nonlocal resident	Total (%)	
RX110							
1998–1999	2	1	3 (60)	1	1	2 (40)	5
1999–2000	0	0	0 (0)	0	0	0 (0)	0
2000–2001	4	2	6 (100)	0	0	0 (0)	6
2001–2002	4	0	4 (100)	0	0	0 (0)	4
2002–2003	1	0	1 (100)	0	0	0 (0)	1
2003–2004	0	0	0 (0)	0	0	0 (0)	0
2004–2005	0	1	1 (33)	0	2	2 (67)	3
2005–2006[c]							
DX112							
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
2002–2003	0	3	3 (100)	0	0	0 (0)	3
2003–2004	0	1	1 (100)	0	0	0 (0)	1
2004–2005	0	3	3 (100)	0	0	0 (0)	3
2005–2006[c]							

[a] RX110 = Tier I registration hunt in Unit 26B, east of the DHCMA; DX112 = drawing hunt in Unit 26B, east of the Dalton Highway.
[b] Local resident is a resident of Unit 26.
[c] No permits were issued.

TABLE 5 Units 26B and 26C muskox hunter residency and success, regulatory years 1986–1987 through 2005–2006

Regulatory year[a]	Successful				Unsuccessful hunters[c]	Total hunters[d]
	Local resident[b]	Nonlocal resident	Nonresident	Total		
1986–1987	3	1	1	5	0	5
1987–1988	3	3	0	6[e]	0	5
1988–1989	4	4	0	8	0	8
1989–1990	2	7	1	10	0	10
1990–1991	10	0	0	10	0	10
1991–1992	5	0	0	5	0	5
1992–1993	10	0	0	10	1	11
1993–1994	9	0	0	9	0	9
1994–1995	9	0	0	9	2	11
1995–1996	12	0	0	12	0	12
1996–1997	18	0	0	18	1	19
1997–1998	13	0	0	13	1	14
1998–1999	14	4	0	18	5	23
1999–2000	9	2	0	11	4	15
2000–2001	15	5	0	20	1	21
2001–2002	9	2	0	11	0	11
2002–2003	6	3	0	9	1	10
2003–2004	2	1	0	3	3	6
2004–2005	4	4	0	8	2	10
2005–2006	4	0	0	4	3	7

[a] Before RY86 only Alaska residents were allowed to hunt muskoxen. In RY90 through RY97 muskox hunting was limited to local residents of Unit 26. In RY98, that portion of Unit 26B, east of the Dalton Highway was opened to include all Alaska residents.
[b] Local is a resident of Unit 26.
[c] Incomplete residency data for "Unsuccessful" hunters because of lack of reporting in Unit 26C.
[d] From hunt reports received.
[e] One illegal muskox.

TABLE 6 Units 26B and 26C muskox harvest by transport method, regulatory years 1986–1987 through 2005–2006

Regulatory year	Harvest by transport method							
	Highway vehicle	Airplane	Dog team/ski	Snowmachine	Boat	Off road vehicle	Unk	Total
1986–1987	0	0	0	3	0	0	0	3
1987–1988	0	2	0	4	0	0	0	6
1988–1989	0	2	0	4	0	0	0	6
1989–1990	0	9	0	1	0	0	0	10
1990–1991	0	1	1	6	0	0	0	8
1991–1992	0	0	0	5	0	0	0	5
1992–1993	0	0	0	10	0	0	0	10
1993–1994	0	1	0	8	0	0	0	9
1994–1995	0	0	0	9	0	0	0	9
1995–1996	0	2	0	10	0	0	0	12
1996–1997	0	0	0	17	1	0	0	18
1997–1998	0	0	0	12	1	0	0	13
1998–1999	1	0	0	15	2	0	0	18
1999–2000	2	0	0	9	0	0	0	11
2000–2001	2	0	0	16	3	0	0	21
2001–2002	2	0	0	7	2	0	0	11
2002–2003	2	1	0	3	3	0	0	9
2003–2004	1	0	0	1	1	0	0	3
2004–2005	3	0	1	0	3	0	1	8
2005–2006	0	0	0	2	1	1	0	4

TABLE 7 Mortality rate for radiocollared female muskox, 1 June through 30 May 1999–2006

Period (1 Jun–30 May)	Number of radiocollared muskoxen	Number of mortalities	Percent mortality
1999–2000	14	3	21
2000–2001	11	1	9
2001–2002	11	3	27
2002–2003	9	1	11
2003–2004	10	5	50
2004–2005	10	0	0
2005–2006	13	1	8

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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