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Division of Wildlife Conservation

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MUSKOX

Mary V Hicks, Editor

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STATE OF ALASKA
Tony Knowles, Governor

DEPARTMENT OF FISH AND GAME
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DIVISION OF WILDLIFE CONSERVATION
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LOCATION

Game Management Unit: 18 (41,159 mi^2)

Geographical Description: Yukon-Kuskokwim Delta

BACKGROUND

Muskoxen were once widely distributed in 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 from 1935 to 1936 as a first step toward reintroducing this species to Alaska. The Nunivak Island population grew slowly until 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. Relatively mild winter weather, low natural mortality, and absence of predators have fostered the growth of the muskox population.

During 1967-68, 23 subadult muskoxen were translocated from Nunivak Island to Nelson Island, 20 miles across Etolin Strait. The Nelson Island muskox population exhibited an annual growth rate averaging 22% between 1968 and 1981. The first hunting season was opened in 1981 when the population approached the management goal of 200-250 animals. For approximately 10 years the population has remained stable, providing emigration to the mainland and stable harvests.

The last census of Nelson Island muskoxen, completed on March 14, 1992, estimated the population at 182 muskoxen and revealed a skewed population structure (too many adult bulls) causing low calf numbers and poor herd growth. Since the population was below the management goal, meetings were held with the United Village of Nelson Island (UNVI) to discuss changes of reductions in annual harvests to promote herd growth. The department reduced cow harvests by offering fewer registration permits to balance the sex ratio and increase the number of mature cows in the population.

More than 150 muskoxen may now reside on the mainland of the Yukon-Kuskokwim Delta, having originally emigrated from Nelson Island. Mainland muskoxen are widely distributed in small herds from the mouth of the Kuskokwim to the Andreafsky Mountain areas north of the Yukon River, slowly expanding their range north and east. Sightings have been documented by local residents, aircraft pilots, and agency biologists during surveys of other species. However, the mainland population appears stable at very low density; it is suspected that illegal hunting has greatly limited the potential growth of the population. We think the population lacks adequate numbers of mature females, needed for good calf production and subsequent population growth.

MANAGEMENT DIRECTION

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

1 Maintain a posthunt population size of approximately 200 muskoxen on Nelson Island and approximately 500 on Nunivak Island.

a Survey populations on Nunivak Island using aerial and ground surveys in cooperation with the FWS to estimate population size and composition.

b Survey populations on Nelson Island with helicopters and fixed-wing aircraft to estimate population size and composition.

c Issue drawing and registration permits for hunter harvest of muskoxen to maintain optimal size, composition, and productivity of the populations on Nunivak and Nelson islands.

d Provide hunter orientation and checkout to ensure that hunters understand permit requirements, do not misidentify the animals they are permitted to harvest, and to obtain sex, age, and location of harvested animals.

2 Determine the distribution and dispersal of muskoxen on the mainland.

Deploy and maintain up to 5 radio collars on mainland muskoxen to monitor population status and dispersal.

3 Finalize a cooperative muskox management plan for Nunivak and Nelson islands.

Participate in an interagency effort to finalize a reindeer-muskox management plan for Nunivak Island and ensure all parties work toward the goals and objectives.

METHODS

A ground census of the Nunivak Island muskox populations was not completed in 1993 due to the lack of adequate snow pack. In April 1993 we used an R22 helicopter leased from Bering Sea Reindeer Products of Mekoryuk to census approximately 1/3 of the island. Poor weather prevented a complete census of the island in 1993. During June 24-26 1994, a helicopter was used for a complete survey of numbers and composition of muskoxen on Nunivak Island. Muskoxen were classified as yearlings, 2-year old males and females, 3-year old males and females, 4-year old and older males and females, or unclassified. We plotted all observations on 1:63,360 scale topographical maps.

An aerial census of the Nelson Island muskox population was completed with a Cessna 185 during March 1993.

RESULTS AND DISCUSSION

Population Status and Trend

The Nunivak Island muskox population remained healthy and productive throughout the reporting period. The population declined slowly since 1989 in response to a harvest strategy designed to reduce the population (Table 6). Emigration and accidental drowning of groups on sea ice continue to cause unpredictable loss of animals, often bringing the total population below the management goal of 500-550 muskoxen.

The Nelson Island muskox population remained stable in size from 1981-1986 at approximately 250 muskoxen during years of light to moderate snow accumulation (Table 2). The herd has provided a nucleus for emigration to the mainland while sustaining high annual harvests during this period. Total numbers have been declining since the 1991-92 regulatory year, following a 10-year period of stability with harvest rates approaching 15% (Table 2). Reduction of harvest rates and selective harvest of bulls was used to reverse the recent decline in numbers. The 1994 population is approximately 65 animals below the management goal of 250. We anticipate the herd should begin growing sometime after the 1995 calving season.

Mainland muskoxen are descendants of the 23 muskoxen introduced to Nelson Island during 1967-68 and have been sighted in Unit 18 for 20 years. The population has increased very slowly from an estimated 40 animals in 1984. Only the large groups near Dall Lake and the Askinuk Mountain area have been producing calves. We attribute low productivity and high mortality among mainland muskoxen to low densities of breeding age animals and excessive illegal harvests by hunters.

Population Size: During a helicopter survey of Nunivak Island muskoxen, completed on June 24-26, 1994, we found 73 groups and a total of 261 adults/subadults and 77 calves (438 total animals, (Table 5). This was a complete survey of the island; however, some small groups of animals may have been missed. The postcalving population was approximately 100 animals below the population management goal of 500-550.

The 1994 Nunivak Island posthunt, precalving population of 361 animals was the lowest since harvest records began in 1975. It also represents a notable decrease from the 1993 population of 437 muskoxen. The decrease was probably caused by emigration of up to 70 animals onto the pack ice where they were lost to drowning. During the winter of 1993-94, residents of Mekoryuk and a herring tender crewmember found several carcasses floating in Etolin Straits. Previously, the precalving population has ranged from 400-750 muskoxen.

On Nelson Island the muskox population continued its decline in numbers which began in 1991. During an aerial survey in March 1993, we found a large proportion of bulls and only 27 calves in the population. We issued 25 bull permits and 5 cow permits during the spring 1994 to reduce the number of males and increase the proportion of females for better recruitment into the population. The census in 1994 indicated the population began to stabilize. In July 1994 we found 187 animals, only a slight decrease from the March 1993 population estimate.

We do not have survey information to estimate the population of mainland muskoxen. Incidental observations suggest the population is widely dispersed and may include 150 animals.

Population Composition: The composition of the Nunivak Island muskoxen population is available from the 1994 helicopter census conducted during 24-25 June 1994. We classified 438 of the 438 muskoxen observed in 73 groups, ranging in size from 1 to 22 animals (Table 7.). We counted 103 adult males (4+-year old), 109 adult females (4+-year old), 28 3-year-old males, 25 3 year-old females, 17 2-year-old males, 23 2-year-old females, 56 yearlings, and 77 calves. The historical Nunivak Island ground counts are summarized in Table 5.

Based on the 1994 census, the proportion of adult males and the proportion of adult females increased during the reporting period. The increase is partly the result of selective harvesting to keep balanced sex ratios, annual recruitment from the 3-year-olds, and few unclassified animals during the census. The younger age groups have similar proportions in each age class for each sex, indicating a uniform population structure that should remain stable throughout the next reporting period.

The posthunt, postcalving composition of the Nelson Island muskox population was 17 adult males (4+-years old), 48 adult females, 7 3-year-old males, 22 3-year-old females, 8 2-year-old males, 12 2-year-old females, 28 yearlings, and 45 calves (Table 1).

We do not have reliable composition information for mainland muskoxen. The slow growth of the population and the absence of calves in many groups suggest a low proportion of adult cows.

Distribution and Movements: During the 1994 census we observed the largest concentrations of Nunivak Island muskoxen along the southwestern coast from Cape Mendenhall to Cape Mohican. Few muskoxen were found in northeastern Nunivak Island, perhaps a result of hunting pressure and snowmachine activity originating from Mekoryuk. Muskoxen, however, tend to concentrate on wind-blown, *Elymus*-covered dunes in southern Nunivak after late winter snow accumulates on the remainder of the island.

At the time of the July 1994 census, Nelson Island muskoxen were concentrated primarily on the cliffs above Cape Vancouver and on the hills northeast of Tununak, although some individuals and small herds were scattered on the hills in the central portion of the island and along the escarpment above Nightmute. We also observed a group of 12 muskoxen just off the northeast edge of Nelson Island along the shore of Baird Inlet. During the winter we found about half the Nelson Island herd on the cliffs of Cape Vancouver and north of Tununak. These areas may be used as refuges to avoid winter snowmachine traffic.

Muskoxen are not confined to Nelson Island and often move to the mainland by crossing frozen tidal inlets during November through May. Although some of these muskoxen remain on the mainland, others return to Nelson Island. The movements between the island and the mainland makes animals susceptible to drowning. It also explains some of the annual fluctuations in the size of the population on Nelson Island.

Local residents, pilots and biologists have reported numerous sightings of mainland muskoxen during the last 20 years. These reports continued throughout 1994. Range of mainland muskoxen extends southeast to the mouth of the Kuskokwim River, northeast to the Portage Lakes-Hills area near Lower Kalskag, and northwest to the Andreafsky Mountains. The animals exhibit a general habitat preference for upland tundra and riparian corridors.

Four muskoxen were observed on the Mountain Village airstrip during late August 1989, a group of 13 near the Johnson River 70 km (43 miles) from Bethel toward Chefornak during March 1990, and a group of 25 in August 1989 through 1994 near Scammon Bay. The small group near the upper Johnson River between Lower Kalskag and Paimiut has not been seen since August 1989. A herd of 13 animals remained within 48 km (30 miles) of Bethel until spring of 1993. After an areawide search, the herd was sighted by an Akiachak resident, who shot 7 of the 13 animals, 4 mature cows and 3 yearlings. An investigation took place and a portion of the illegally taken muskox hides was seized by local FWP officers, and the hunter was cited and prosecuted. This disrespect for wildlife regulations and conservation is not uncommon, and muskox are extremely vulnerable to indiscriminate hunting.

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

Department and USFWS staff radiocollared 5 muskoxen (2 bulls and 3 cows) from herds of 9 and 12 animals south of the Yukon River between Bethel and Pilot Station in March 1989. Six yearlings were in these herds. The collared animals ranged westward to Pilot Station and Dall Lake and eastward to Kalskag and the upper Johnson River. These collared animals died; no additional radiocollars have been deployed during the reporting period. The department and FWS plan to deploy radiocollars on a representative sample of muskoxen on the Yukon/Kuskowkim Delta during the 1995-96 regulatory year. Radiotracking will be used to better understand the population size and movements of mainland muskoxen.

Mortality

Season and Bag limit:

All hunters:		
Unit 18,		
Nunivak Island	Sept. 1-30 Feb. 1-Mar.15	One bull by drawing permit only. Up to 10 permits will be issued for the fall season, and up to 35 permits will be issued for the spring season; or 1 cow by registration permit only.

		35 cow permits (up to 5 in the fall and up to 30 in the spring) will be issued on a first-come, first-serve basis.
Unit 18, Nelson Island	Sept. 1-30 Feb. 1-Mar. 25	One muskox by registration permit only. Up to 30 permits will be issued on a first-come, first-serve basis.
Remainder of Unit 18	No Open season	

Harvest:

Human-Induced Mortality. Hunting of Nunivak Island muskoxen was regulated by drawing permits and registration permits for fall and spring hunts for both years in the reporting period. For the Fall 1992 hunt, 10 bull drawing permits and 5 cow registration permits were available to hunters. This decreased to 5 bull drawing permits and 5 cow registration permits for the Fall 1993 hunt. In each year the successful drawing permittees were notified by mid-July of their eligibility to hunt during the September season. In 1992, 6 of the 10 drawing permittees elected to hunt and took bull muskox. In 1993, 4 of 5 drawing permittees elected to hunt and successfully took bull muskox. The registration for cow permits was in August (each year) on a first-come, first-serve basis in Mekoryuk. No hunting by cow registration permittees occurred in September 1992. All registration permittees took muskox in the Fall 1993 hunt, but 1 permittee misidentified an animal and shot a bull. The meat from the bull was salvaged and donated to needy families in Mekoryuk, but the hides and skull were confiscated by the department.

The Nunivak Island spring hunt permit drawing for bull muskoxen was limited to 35 permits in 1993 and 30 in 1994. A waiting list of over 400 alternate permittees indicates the continuing popularity of the Nunivak spring bull hunt. Four drawing permits not used for the Fall 1992 hunt were added to the Spring 1993 hunt, bringing the total bull permits to 39. All Spring hunters were successful in taking bull muskoxen, yielding a season total of 45 bulls harvested during the 1992-93 regulatory year. One drawing permit not used for the Fall 1993 hunt was added to the Spring 1994 hunt for a total of 31 permittees. All spring hunters were successful in taking bull muskoxen, a season total of 35 bulls harvested during the 1993-94 regulatory year.

The 25 cow registration permits for the spring hunt were available simultaneously on a first-come, first-serve basis in Mekoryuk and Bethel. In Mekoryuk, local residents received 17 permits in 1993 and 14 permits in 1994. In Bethel, applicants received 8 permits in 1993 and 6 permits in 1994. Most of the applicants at Bethel spent the night inside the Bethel Native Corporation building, waiting to receive their permits. All 25 cow permit holders were successful during the 1992-93 season and 24 of 25 were successful during the Spring 1994 hunt.

On Nunivak Island hunters harvested 70 muskoxen (45 bulls and 25 cows) during the 1992-93 season and 58 muskoxen (35 bulls and 23 cows) during the 1993-94 season (Table 6). Historically, harvest of bulls and cows have varied and has been intentionally decreased to allow the herd to slowly reach a stable size of 500-550 animals.

Hunting on Nelson Island was limited to registration permits for varying numbers of bulls and cows in January 1993 and 1994. For the Spring 1993 hunt, 30 bull permits were issued at the Nightmute Community Center where 39 hunters applied for permits (9 applicants did not receive permits). For the Spring 1994 hunt, 25 bull permits and 5 cow permits were issued at the Chefornak High School. In both years all hunters attended a bilingual orientation on the identification of the age and sex classes of muskoxen.

During the 1993 season all permittees harvested the legal limit of 30 bull muskoxen. During the 1994 season the total harvest was 27 muskoxen: 4 hunters with bull permits did not hunt; 21 bulls and 5 cows were harvested, and 1 cow was accidentally shot by a hunter with a permit. For the years 1984-92, the harvest goals remained uniform at 15 bulls and 15 cows in each season. Since 1992 the herd has declined and the number of permits for bulls and cows has changed to help stabilize the population of 250 animals.

Harvest Chronology. Harvest chronology for cow muskox on Nunivak Island and for both bulls and cows on Nelson Island was largely determined by periods of moderate weather occurring between winter storms. Most hunters on Nelson Island, and the cow hunters on Nunivak Island, took their muskoxen between late February and mid March, a period of milder weather and increasing daylight hours. Bull hunters on Nunivak Island usually hunted with guides or transporters, and their hunts are normally scheduled well in advance of the season.

Hunter Residency and Success. Most drawing permittees for Nunivak Island were residents of Anchorage and southcentral Alaska. Success rates were 100% for 1992-93 and 1993-94.

Cow registration permits were mostly issued to local residents at the registration locations. For the Fall 1993 hunt on Nunivak Island, 3 of 5 permits were issued to Mekoryuk residents and the other 2 permittee were from Anchorage and Bethel. For the spring hunts in 1993 and 1994, all the permits available (17 and 14 permits, respectively) were issued to local residents. Similarly, in both years the permits available at Bethel (8 and 6 permits, respectively) were issued to local residents.

The residency of hunters receiving permits for Nelson Island hunts (Table 4) showed more variation than the Nunivak Island hunts. Of the 30 bull registration permits available at Nightmute in 1993, 23 (77%) went to Nelson Island Residents. Of the permits issued in Chefornak in 1994, 22 (73%) went to local residents, 7 (23%) to Bethel residents, 2 (7%) to Anchorage residents, and, for the first time, 2 (7%) were issued to nonresidents. The nonresidents were both from Port Angeles, Washington.

In 1993 Nelson Island hunters' success was 100%, compared with 87% success for 1994 Nelson Island hunters. The success rate for all muskox hunters entering the field was 100% for Nunivak

Island during both years. Most cow muskox hunters on Nunivak Island and both cow and bull hunters on Nelson Island were able to complete their hunt in 1 day. Nunivak Island bull hunters, usually guided or supplied by transporters, took 2-3 days to complete their hunts because they were more selective.

Transport Methods. Boats were used for the fall hunt on Nunivak Island. Snowmachines are used for late winter hunts on both Nunivak and Nelson Islands.

Natural Mortality

Little quantitative information is available concerning natural mortality of muskoxen in Unit 18. No large predators such as bears and wolves are found on Nunivak Island and are rare on Nelson Island and the lowland of the Delta. Most natural mortalities are the results of accidents such as falling off cliffs, breaking through ice on lakes and streams, and stranding on drifting sea ice. It is theorized approximately 70 muskoxen wandered onto the pack ice during winter of 1993-94 and never returned to the main island of Nunivak. These muskoxen probably drowned after drifting out to sea. Four muskoxen carcasses were found floating in Etolin Straits during herring season.

Habitat:

Assessment: The Nunivak Island lichen range is considered to be critically overgrazed by reindeer, although muskoxen harvested in recent years were reported to be in very good condition. Although reindeer are not found on Nelson Island, several muskoxen harvested there in recent years had less body fat than normal. Muskoxen on Nelson Island may be using marginal habitat along the steep marine escarpments to avoid hunters and snowmachine traffic December - April. Concerns about the status of the range on Nelson Island are partially alleviated by the potential for emigration to the mainland.

Board of Game Actions and Emergency Orders. In spring of 1989 the Board of Game gave ADF&G the discretionary power to issue up to 45 bull and 45 cow permits on Nunivak Island. For the 1992-93 regulatory year, department staff issued 25 cow and 45 bull permits on Nunivak. During the 1993-94 regulatory year, we issued 25 cow and 35 bull permits. This quota will allow the population to edge closer to the population guideline of 500-550 animals and help correct the population's sex ratio imbalance.

The Board extended Nunivak Island's bull muskox season by 2 weeks during the reporting period. The season is now February 1 through March 15, rather than February 15 through March 15.

During the spring 1992 meeting, the Board gave the department the discretionary authority to issue up to 30 permits on Nelson Island. The old regulation required we issue 15 bull and 15 cow permits annually. The new regulation allows us to adjust harvest levels for each sex to compensate for changes in population size and composition. This harvest adjustment was implemented during the spring hunt in 1993, when we issued 30 bull-only permits.

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak herd is characterized by high productivity and low natural mortality. The proportion of adult males in the population increased during the last 6 years as the proportion of adult females and yearlings decreased slightly. The harvest of cows should be maintained at 35 animals per year, and the bull harvest at 45 animals per year. Harvest of bulls and cows should be reduced when the posthunt, precalving population is below 550 animals.

Interagency meetings have been held in Bethel and at the village of Mekoryuk to finalize a muskox-reindeer management plan for Nunivak Island. This management plan was finalized on November 9, 1994 in cooperation with the ADF&G, USFWS, Soil Conservation Service (SCS), BIA, BSRP, Alaska Soil and Water Commission, and NIMA corporation. Much of the plan addresses management of the 6000 to 8000 privately owned reindeer that inhabit Nunivak Island. The plan includes ways to reduce the reindeer herd to <3000 animals. The proper management of these reindeer affects the carrying capacity of the habitat to provide space and forage for muskoxen.

Muskoxen are still considered a priority species on Nunivak Island, but possible overgrazing of the lichen range by reindeer and erosion of the dune areas has become a concern on this unique Refuge. Maintenance of a minimum population of 500 muskoxen, transplanting of muskoxen to other areas of the Alaska, and allowing hunting opportunities of muskox have been identified as the 3 goals for muskoxen populations in the plan.

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 always confined to the island because the animals cross frozen tidal inlets to the mainland from November to May. The Nelson Island muskox population has provided stable harvests in recent years and a source for emigration to the mainland. Variable harvest levels are needed to effectively manage the herd in response to emigration and other natural losses. While the population is at or below 250 animals, we recommend harvesting variable numbers of cows and bulls at a rate not exceeding 10% of the population to keep a healthy age and sex structure in the population. Harvest should be increased if the population increases above the management goal of 250 animals.

Mainland muskoxen in Unit 18 have increased in range and numbers in recent years. As many as 150 muskoxen may now reside on the mainland of Unit 18. These muskoxen are widely distributed at low densities from the mouth of the Kuskokwim River to the mouth of the Yukon River, expanding their range north and east. No known sightings of muskox south of the Kuskokwim River have been documented. The growth of the mainland population is the result of continued emigration from Nelson Island and production in a number of mainland herds. We recommend hunting should remain closed on mainland muskoxen. Additional mainland muskoxen should be radiocollared and their movements monitored.

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 collaring project in conjunction with the Yukon Delta National Wildlife Refuge (USFWS) and village councils to develop an educational program that encourages local residents to protect this rare and unique species.

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Table 1. 1994 Nelson Island muskoxen composition, July 1994.

4+ year		3+ year		2+ year			
Males	Females	Males	Females	Males	Females	Yearlings	Calves
17	48	7	22	8	12	28	45

Table 2. Historical Nelson Island muskox herd size.

Year	No Hunting, Precalving[a]	
1973	44	
1975	66	
1977	132	
1978	107	
1980	167	
	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

[a] Hunting began in 1981.

Table 3. Nelson Island muskox harvests and number of applicants.

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

[a] Additive number and sex of muskoxen found dead from wounding.

Table 4. Residency of Nelson Island muskox hunt permittees.

Year	Permits available	Residents of UVNI[a]	Residents of unit excluding UVNI[a]	Residents outside Unit 18	Nonresidents
1981	20	20	0	0	0
1982	30	30	0	0	0
1983	25	21	3	1	0
1984	30	21	9	0	0
1985	30	25	5	0	0
1986	30	21	9	0	0
1987	30	29	1	0	0
1988	30	27	3	0	0
1989	30	30	0	0	0
1990	30	30	0	0	0
1991	30	30	0	0	0
1992	30	25	4	1	0
1993	30	24	4	2	0
1994	30	22	4	2	2
Total	405(100%)	355 (88%)	42 (10%)	8 (2%)	

[a] United Villages of Nelson Island

Table 5. Sex and age composition of muskox during spring ground census, Nunivak Island, 1976-1994 (Posthunt, Precalving[a])

Year		Yearlings M	Yearlings F	2-year+ M	2-year+ F	3-year+ M	3-year+ F	4-year+ M	4-year+ F	Unclassified[d]	Total	Recruitment[e]	Percent yearlings
1976	Count	35	36	37	27	51	64	175	89	40	554		0.13
	Est.[c]	38	38	40	29	55	69	189	96				
1977	Count	50	50	32	44	41	72	164	144	53	650	0.66	0.15
	Est.[c]	54	54	35	48	45	78	179	157				
1978	Count	46	46	19	19	34	88	94	142	11	499	0.40	0.18
	Est.[c]	47	48	19	19	35	90	96	145				
1979	Count	57	57	35	38	12	43	82	160	45	529	0.53	0.22
	Est.[c]	62	62	38	42	13	47	90	175				
1980	Count	60	61	64	54	33	42	63	215	9	601	0.55	0.20
	Est.[c]	61	61	65	55	34	43	64	218				
1981	Count	46	47	35	50	46	58	76	116	20	494	0.38	0.19
	Est.[c]	49	49	36	52	48	60	79	121				
1982	Count	47	48	34	38	44	79	76	98	46	510	0.57	0.19
	Est.[c]	52	52	37	42	48	87	84	108				
1983	Count	30	30	28	35	30	53	80	78	119	483	0.41	0.12
	Est.[c]	40	40	37	46	40	70	106	104				
1984	Count	53	53	21	22	38	91	74	98	102	552	0.75	0.19
	Est.[c]	65	65	26	26	47	112	91	120				
1985	Count	46	46	29	34	40	46	150	94	62	547	0.45	0.17
	Est.[c]	52	52	33	38	45	52	169	106				

Table 5. Continued.

Year		Yearlings M	Yearlings F	2-year+ M	2-year+ F	3-year+ M	3-year+ F	4-year+ M	4-year+ F	Unclassified[d]	Total	Recruitment[e]	Percent yearlings
1986	Count	45	46	43	21	47	52	102	73	58	487	0.65	0.19
	est.[c]	51	52	49	24	53	59	116	83				
1987	Count	39	40	51	48	57	88	93	81	89	586	0.65	0.13
	Est.[c]	46	46	60	57	67	104	110	96				
1988	Count	38	39	38	44	43	71	133	74	129	609	0.49	0.13
	Est.[c]	48	49	48	56	55	90	169	94				
1989	Count	40	40	19	22	48	57	139	51	161	577	0.60	0.14
	Est.[c]	55	55	26	31	67	79	193	71				
1990	Count	35	36	36	42	50	77	156	100	36	568	0.51	0.13
	Est.[c]	38	38	38	45	54	82	166	107				
1991	Count	32	32	24	15	43	37	146	86	24	439	0.36	0.15
	Est.[c]	34	34	25	16	46	39	154	91				
1992	Count	30	30	27	26	45	45	117	68	19	407	0.49	0.15
	Est.[c]	32	32	28	26	47	47	122	72				
1993	Count	17	17	7	13	18	26	45	48	244	435	0.65	0.18
	Est.[c]	39	38	16	30	41	59	103	109				
1994	Count	28	28	17	23	28	25	103	109	0	361[b]	0.33	0.15
	Actual	28	28	17	23	28	25	103	109				
Average											0.52	0.15	

[a] The 1994 composition was done postcalving and posthunting.

[b] Composition was done on June 24-25, 1994 after calving, using a helicopter; there are 77 calves that can be added to the total herd size, bringing total to 438 muskoxen as of June 1994.

[c] Est. = Estimated composition extrapolated from unclassified animals.

[d] Sex and age could not be determined during survey.

[e] Number of yearlings/number of breeding age females from previous year.

Table 6. Muskoxen removed from the Nunivak Island population by hunting, 1975-1994.

Year	Males	Females	Unknown	Total
1975	10	0		10
1976	68	3		71
1977	58	2		60
1978	40	0		40
1979	24	0		24
1980	10	11		21
1981	12	50		62
1982	13	49	1	63
1983	24	35		59
1984	22	36		58
1985	19	42		61
1986	31	43		74
1987	32	34		66
1988	35	35		70
1989	36	33		69
1990	39	31		70
1991	40	31		71
1992	45	31		76
1993	45 +2[1]	25 +1[2]		73
1994	34 +1[3]	23		58
Total	640	515	1	1156

[1] Two adult bulls found dead.
[2] One 2.5 year old cow killed accidentally.
[3] One mature bull taken by mistake by a cow hunter. Note: Harvest was reduced during the 1993-94 season in response to population.

Table 7. Nunivak Island muskox composition and census data, June 24-25, 1994.

Group No.	4+ year M	4+ year F	3+ year M	3+ year F	2+ year M	2+ year F	Yearling	Calves	Total	Latitude	Longitude
1	2	3	3			1			9	60 21.42	166 08.10
2	3								3	60 20.21	166 22.57
3	1								1	60 20.21	166 20.47
4	1								1	60 17.74	166 27.59
5	1								1	60 18.11	166 29.56
6	1	4	2	2	1	1	1	3	15	60 17.53	166 16.50
7	1								1	60 20.39	166 20.16
8	3	2		1				2	8	60 16.15	166 41.57
9	4	3				1	2	2	12	60 13.31	166 47.19
10		3		1			1	2	7	60 09.34	166 49.20
11		2	2	2				3	9	60 08.41	166 31.91
12	1								1	60 10.09	166 48.70
13		2		1				2	5	60 10.10	166 49.85
14	2								2	60 12.09	166 51.75
15	1	2	1		1	1	2	2	10	60 11.06	167 07.05
16	1								1	60 09.09	166 48.85
17	1								1	60 12.97	167 00.59
18	1								1	60 12.69	167 00.57
19	2	4					1	3	10	60 05.95	167 06.57
20	2								2	60 03.50	167 01.03
21	1	2	1			1	2		7	60 11.06	167 07.05
22		4		1	1			4	10	60 11.19	167 08.55
23	1								1	60 13.35	167 17.10
24	2	5	1	2		2	3	3	18	60 12.36	167 26.21
25		2	1		1		3	1	8	60 08.72	167 11.94
26	1	4					2	3	10	60 08.72	167 10.00
27	2	4					2	1	9	60 06.19	167 13.38
28		2					4	2	8	60 08.99	167 09.34
29	1	4			1	1	1	4	12	60 08.30	167 10.22
30	4	3	1	1	2	1	6	2	20	60 07.82	167 09.71
31	1	3	1	1			1	3	10	60 03.70	167 08.24
32		1	1					1	3	60 04.21	167 07.40

Table 7. Continued.

Group No.	4+ year M	4+ year F	3+ year M	3+ year F	2+ year M	2+ year F	Yearling	Calves	Total	Latitude	Longitude
33	1	4					3	3	11	60 02.99	167 14.00
34	2	2	1			1	1	2	9	60 03.00	167 13.99
35		3	1	1		1		3	9	60 02.48	167 07.09
36	1								1	60 00.45	167 07.39
37	1	2					2	2	7	60 00.48	167 07.45
38	3	4	1	1				4	13	60 02.69	167 07.06
39		2		1	1			3	7	60 03.50	167 01.03
40	1								1	59 58.72	167 56.87
41	1								1	60 01.40	166 56.20
42	1								1	59 58.16	166 56.65
43	1								1	59 57.40	166 53.53
44	2	3		1	1	1	4	1	13	59 58.11	166 45.76
45	1								1	59 53.00	166 41.71
46	1								1	59 54.57	166 39.00
47	1								1	59 53.70	166 38.05
48	4								4	59 51.71	166 36.50
49	1								1	59 51.53	166 32.41
50	1								1	59 51.30	166 30.51
51	1								1	59 51.22	166 30.10
52	1								1	59 58.10	166 20.90
53	2	1		2	1		1		7	59 58.84	166 20.90
54	1	5		1		1	2	2	12	59 57.84	166 22.40
55	1	3		1	1	1	2	3	12	59 56.68	166 15.63
56	2								2	59 56.70	166 15.65
57	4								4	59 46.54	166 12.24
58	4								4	59 53.79	166 08.76
59	1								1	59 47.28	166 10.50
60	2	3	2	1	1	2		1	12	59 51.94	166 02.52
61	1	1	2		1	2	1		8	59 55.30	165 58.33
62	1	1	1			1	1		5	59 58.90	165 49.80
63	1								1	59 56.90	165 47.20
64	3	2					1	2	8	59 55.32	165 43.14

Table 7. Continued.

Group No.	4+ year M	4+ year F	3+ year M	3+ year F	2+ year M	2+ year F	Yearling	Calves	Total	Latitude	Longitude
65	3								3	59 56.39	165 44.10
66	4	3	3		2	2	6	2	22	60 00.00	165 44.20
67	2	2	2	1	1	1	1		10	60 00.83	165 42.88
68	2								2	60 01.62	165 43.50
69	1	2		1				2	6	60 11.71	165 52.29
70		3	1	2	1	1		1	9	60 11.67	165 49.45
71	1								1	60 11.44	166 00.25
72		4						3	7	60 15.58	166 01.30
73	1								1	60 07.00	166 10.93
Total	103	109	28	25	17	23	56	77	438		

LOCATION

Game Management Units: 22 (25,230 mi^2)

Geographical Description: Seward Peninsula and that portion of the Nulato Hills draining west into Norton Sound.

BACKGROUND

Historical accounts indicate muskoxen were absent from Unit 22 before their reintroduction during spring 1970 when 36 animals were translocated from the Nunivak Island herd to the southern portion of the Seward Peninsula. By 1980 the population had increased to 104 muskoxen yielding an average annual growth rate of 11% (Table 1). An additional 34 muskoxen from the Nunivak Island herd were transplanted to the existing population in 1981. From 1983 to 1988 the population grew rapidly, and muskoxen were found throughout the northern and western portion of the Seward Peninsula. Annual growth rates during that period averaged 17%. A census completed during 1992 indicated the Seward Peninsula muskox population had grown to 706 animals. Another census completed during spring 1994 yielded a population count of 925 muskoxen.

MANAGEMENT DIRECTION

The following management goals form the basis of a management plan developed for Seward Peninsula muskoxen and follow the guidelines of the Alaska Muskox Management Policy (AMMP). Under the terms of the AMMP, the highest priority for managing muskoxen in Alaska is to promote reestablishment of animals from existing herds onto their former range. As stated in the AMMP, the highest priority for management of muskox populations on the Seward Peninsula is to allow for continued dispersal and range expansion onto suitable vacant habitats. Viewing, hunting, and aesthetic enjoyment are considered the highest priority uses of muskoxen.

1 Allow for continued increase in the size and distribution of the Seward Peninsula muskox population.

2 Provide for a limited harvest in a manner consistent with existing state and federal laws and regulations and the other goals and management objectives of this plan.

3 Manage muskoxen along the Nome road systems of Unit 22C for viewing, education, and other nonconsumptive uses.

4 Work with local reindeer herding interests to minimize any conflicts which may occur between reindeer and muskoxen.

5 Protect and maintain the habitat and other components of the ecosystem upon which muskoxen depend.

6 Encourage cooperation and sharing of information among agencies and users of the resource in developing and carrying out management and research programs.

METHODS

Department staff in cooperation with the US Bureau of Land Management (BLM) and the National Park Service (NPS) completed a muskox census in Units 22C, 22D, 22E, the western portion of Unit 22B, and that portion of Unit 23 on the Seward Peninsula. The area was apportioned into sample units which were thoroughly searched by survey aircraft outfitted with radiotelemetry equipment. When muskoxen were located, the survey crew made a visual count and determined whether the group contained any radiocollared animals.

During June 1992 we completed a muskox composition survey using a helicopter; a Supercub aircraft was used to locate groups for the helicopter crew. With the exception of calves and yearlings, individuals were sexed and classified as adults, 3-year-olds, and 2-year-olds.

Radiocollared muskoxen continued to provide a basis for completing survey-inventory work. Nine radiotracking flights were completed during the reporting period to gather location data on collared muskoxen.

Sightings of muskoxen by the public continued to provide a valuable source of information on distribution and migration of muskoxen throughout the Seward Peninsula.

RESULTS AND DISCUSSION

Population Status and Trend:

The Seward Peninsula muskox population continued to increase in size during the reporting period. Reports of muskoxen seen in the eastern Seward Peninsula are becoming more commonplace. As the herd increases in size, the numbers of animals emigrating eastward should increase as well.

Population Size: During the census completed during April 1994, 925 muskoxen were found in 75 groups ranging in size from 1 though 57 animals (Table 1). Location by unit and subunit of the groups and total numbers of animals counted is as follows:

Subunit 22B, 4 groups (11 animals).
Subunit 22C, 7 groups (79 animals).
Subunit 22D, 38 groups (405 animals).
Subunit 22E, 12 groups (184 animals).
Unit 23, 14 groups (246 animals).

Before the census, 11 muskoxen were instrumented with active radio collars. All 11 radiocollared animals were located during the census.

Population Composition: On June 7, 1992 we gathered composition data for 20 groups of muskoxen distributed throughout the southwest portion of the Seward Peninsula in Unit 22D, and classified 353 muskoxen. Percent calves was calculated at 23%, the number of calves per 100 adult females (>3 years) was 64, and the number of adult bulls (>4 years) per 100 adult females was 33. The percentage of yearlings was 11% and the number of 2-year-olds was 9%.

Mortality

Season and Bag Limit: No open season.

Natural Mortality: Although we did not collect data on natural mortality of Seward Peninsula muskoxen during the reporting period, we believe that natural mortality rates among adults are normally low. However, unusually severe winters characterized by heavy snow cover can adversely affect survival rates, particularly among calves (Nelson 1994).

CONCLUSIONS AND RECOMMENDATIONS

The Seward Peninsula muskoxen population continued to grow, encompassing new suitable habitat. The number of animals observed during a census is considered a minimum population estimate because we know all muskoxen were not found. Productivity remained high, and I suspect survival rates also remained high. We believe the postcalving population of muskoxen on the Seward Peninsula may have exceeded 1000 muskoxen at the end of the reporting period.

During recent years Seward Peninsula muskoxen have become a high profile species among the public. Their success in reestablishing themselves throughout much of the suitable habitat on the Seward Peninsula has prompted interest, primarily among local residents, in establishing a hunt. Department staff recognized the need for a management plan with realistic population management goals in place before a hunt could be established.

Efforts to develop a cooperative management plan for Seward Peninsula muskoxen began during 1992. Cooperators in this planning process included the Department, the NPS, the BLM, and the native corporations of Bering Straits (BSNC), Kawerak and Northwest Alaska (NANA). We anticipate the planning process will be completed by late 1994, and a hunt will be proposed to the Alaska Board of Game during early 1995.

In order to meet the population management goals which will be established by the plan, the following management activities are recommended:

1 Maintain a pool of at least 25 collared animals and regularly monitor movements.

2 Conduct surveys and collect composition data at 2-year intervals.

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Table 1. Population size and growth rate for the Seward Peninsula muskox population, 1970-1994.

Year	Population[b] size estimate	Average annual rate of growth (percent)[a]	Percent collared
1970	36		--
		11	
1980	104		--
		--	
1983	175		4
		29	
1984	225		6
		20	
1985	271		6
		25	
1988	527		6
		8	
1992	706		3
		14	
1994	925		1

[a] Because the muskox population size at the time of the 1981 translocation is unknown, the average annual growth rate between 1980 and 1983 could not be accurately calculated.

[b] The estimate for 1970 refers to the size of the original transplant. The estimate for 1980 is based on aerial surveys of known herds located near Nuluk and Black Mountain. The estimates for 1983 through 1994 are based on aerial surveys completed in Units 22C, 22D, 22E, Unit 22B west of the Niukluk River, and that portion of Unit 23 on the Seward Peninsula.

LOCATION

Game Management Unit: 23 (43,000 mi^2)

Geographical Description: Kotzebue Sound and western Brooks Range

BACKGROUND

Muskoxen are indigenous to northwest Alaska; however, these populations were extirpated during the mid-1800s. In 1970 the department reintroduced 36 muskoxen from Nunivak Island to Cape Thompson. An additional 34 muskoxen were translocated to Cape Thompson in 1977. Muskoxen from the Seward Peninsula transplant (36 and 35 muskox in 1970 and 1981, respectively) have increased in number and moved into southern portions of Unit 23. Of all attempts to reintroduce muskox into their historic ranges in Alaska, the Cape Thompson translocation has been the least successful. The estimated annual average rate of increase for muskoxen from the Cape Thompson transplant has been 6 to 8% since 1977. This is low compared to 19% for muskoxen on the Seward Peninsula from 1970-1991 (Smith 1989). The slow growth of this herd has been attributed to limited winter habitat and excessive illegal harvests.

POPULATION AND MANAGEMENT OBJECTIVES

The following management goals and objectives have been established for muskox populations in Unit 23:

1 To allow for population growth and dispersal of muskoxen into their historic range in Unit 23.

2 To estimate the number of muskoxen in Unit 23 by 1996 and at 3- to 5-year intervals thereafter.

METHODS

In the spring of 1994 we conducted 2 muskoxen censuses. The first census was in April and June 1994 and included the Igichuk Hills, Tachinichok Mountains, Lisburne Hills, and all other hills northwest of the Kivilina River within approximately 15 miles of the coast (Dau and Ayres, 1994). The second census, also in April 1994, covered that portion of Unit 23 on the Seward Peninsula. This census was in conjunction with an extensive Unit 22 muskox census. Complete methods and results of this census are described in the Unit 22 survey and inventory report for this period. For both censuses, search effort focused primarily on potential muskox habitat. Search areas included geographic features such as ridges or drainages. Throughout the reporting period we continued to

use radiotelemetry and opportunistic sightings to collect information on movements and distribution of muskoxen.

Extensive public meetings were held to develop and finalize a Seward Peninsula Muskox Management Plan which included southern portions of Unit 23. Early planning stages for a similar effort for the Cape Thompson herd in northern units 23 and 26A were initiated.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: We estimate 460 to 500 muskoxen inhabit Unit 23. In the northern area of Unit 23 we observed 196 adult and yearling muskoxen and 48 calves during the spring 1994 census (April 20 and June 6-7). The Cape Thompson (Lisburne Hills and Tahinichok Mountains) muskox population was stable from 1988 to 1992 and then grew rapidly in 1993 and 1994 (Table 1). Survival of calves during their first year was better in the Lisburne Hills than in the Tahinichok Mountains during 1993 and 1994 (Table 2). Even during 1993 and 1994 when calf production for these populations appeared high, it was still well below the 48 calves:100 adults observed during June 1992 on the Seward Peninsula (ADF&G unpubl. data).

In April of 1994 we counted 246 adults and yearling muskoxen in 14 groups in the southern portion of Unit 23 on the Seward Peninsula. The last count of this area was in March of 1992 when 8 groups were observed, totaling 134 adults and yearlings. Many groups are found on the boundary of Unit 22 and 23. The increase from 1992 to 1994 was attributed primarily to movements rather than increased productivity. Muskoxen in this area may be increasing at a similar rate as those on the rest of the Seward Peninsula.

Distribution and Movements: We relocated radiocollared muskoxen north of Kotzebue in the spring and fall of 1993. Four radio collars were still functioning on 3 cows and 1 bull. Radio-collared muskoxen (both bulls and cows) from the Cape Thompson transplant continue to show high site fidelity. There seems to be a seasonal shift of habitat types used by muskox in the Tachinichok Mountains. In late May through the summer and early fall, muskoxen inhabit riparian habitat; they move to alpine areas in late fall through winter and early spring. Some muskoxen in the Tachinichok Mountains also move seasonally. Each year 3 to 5 muskoxen are reported in the Igichuk Hills, approximately 20 miles south. In June 1993 5 adults and 2 calves were observed on the western edge of the Igichuk Hills along the coast. We believe these muskoxen are from a herd in the Tahinichok Mountains. Opportunistic surveys and heavy local travel in the Igichuk Hills during winter indicate muskoxen are not present there year-round.

Sightings of widely scattered muskoxen outside their recognized ranges have been common since at least 1988. Groups of 1-3 individuals have been reported from at least 6 locations in the middle and upper Noatak drainage, Kokolik Lake, Pitmegea River, Eagle Creek, the Wulik and Kivilina Rivers, at least 4 locations in the Kobuk drainage between Kiana and the Ambler River, Baldwin Peninsula, headwaters of the Tagagawik River, and Squirrel River. Muskoxen along the Kobuk

and Tagagawik Rivers and Baldwin Peninsula probably came from established populations on the Seward Peninsula. The other muskoxen scattered in these northern areas probably originated from the Tahinichok Mountains and Lisburne Hills populations. With 2 exceptions, these scattered muskoxen have all been males when sex has been identified. The exceptions were a group of 9 muskoxen (bulls, cows, and at least 1 calf) observed 1 mile offshore (west) of the middle of the Baldwin Peninsula during February 1993, and a group of 3 muskoxen (1 large bull, a 3-year-old bull, and an adult female) at the headwaters of the Tagagawik River during May 1993. The number of muskoxen scattered throughout Unit 23 off the core muskox ranges probably ranges from 6-20 annually.

Mortality

Season and Bag Limit:
There is no open season.

Harvest and Natural Mortality: Although muskoxen have been taken illegally in this area, the total number is probably less than 6-10 each year, and in some years probably no illegal harvest occurs. In fall 1992 a radiocollared bull (149.820) was shot and left along the lower Kivilina River. No meat was salvaged and the head had been removed. No other reports of illegal harvests were received during this reporting period.

Numerous conversations with long-term local residents, guides, and transporters indicate adult muskoxen mortality has typically been low in Unit 23. Our telemetry data support such reports. A local pilot reported observing a sow grizzly with cubs catch and kill a cow or yearling muskox near Cape Thompson in spring of 1993. Another local pilot reported finding a 2-month-old calf killed by a Golden eagle near the lower Kukpuk River in June 93. Wolves probably also kill muskoxen in this portion of Unit 23, and some old muskoxen undoubtedly starve each year. Nevertheless, natural mortality appears to have been low since at least 1988.

Management Plans: There are 2 management plans for muskox in Unit 23. Muskox population management in the southern portion of the unit is addressed in the Seward Peninsula Cooperative Muskox Management Plan. Cooperators for this plan include: ADF&G, National Park Service (NPS), Soil Conservation Service, Alaska Department of Natural Resources, U.S. Bureau of Land Management (BLM), Reindeer Herders Association, Bering Straits Native Corporation, and Northwest Alaska Native Association. The final draft was published January 24, 1994. The plan's major recommendations are to allow for continued natural increase in size and distribution of muskoxen and provide limited hunting in 22E and 22D when the population (including Unit 23) is above 950. The harvest will be limited to 3% of the population and limited to bulls. Areas will also be managed for muskoxen viewing opportunities (22B and 22C). Although the plan recommended no changes in management of muskoxen in Unit 23, both the State and Federal Boards have included that portion of Unit 23 west of and including the Buckland drainage in the hunt area.

The second management plan, the Western Arctic Cooperative Muskox Management Plan, addresses muskox originating from the Cape Thompson transplant in Unit 23 and 26A.

Cooperators on this plan are ADF&G, North Slope Borough Department of Wildlife Management, BLM, NPS, the villages of Barrow, Atkasuq, Wainwright, Point Lay, Point Hope, Kivilina, and Noatak. The first draft of this plan was completed March 1994. Major issues include interactions between caribou and muskox, illegal harvest, and the potential for legal harvest.

CONCLUSIONS AND RECOMMENDATIONS

Given the fidelity of most muskoxen to core areas in Unit 23, radio collars are unnecessary for conducting accurate censuses when good survey conditions exist. Additionally, the small sample size of radiocollared muskoxen has been inadequate to quantitatively estimate adult mortality. Therefore, benefits of the radio collars no longer justify their expense in terms of money, time, and risk to muskox. Radiotelemetry work on muskoxen in northwestern Unit 23 should be discontinued until management or research objectives are identified that could be best addressed through telemetry. If possible, the radio collars still on muskoxen should be removed. Time and money allocated to telemetry work should be reallocated to conducting censuses annually or biennially.

In the past, most muskoxen censuses in Units 22 and 23 have been conducted during February-April when snow cover is complete. During the 1994 Cape Thompson census, muskoxen sightability or in June was comparable to that in April. The advantages of June censuses are 24-hour daylight, ability to estimate initial calf production, and fewer conflicts with other S&I activities.

During the development of muskox management plans, 2 topics were identified that required additional information. The interaction between caribou (or reindeer) and muskox was one such topic. Some people feel that muskoxen may displace caribou from portions of their range. Most published scientific reports indicate that when competition occurs, caribou ultimately prevail. However, this does not mean the concerns of local residents are ill-founded. Formal studies have not focused on interactions on winter range, included year-round observations, or been conducted in northwestern Alaska. A research project located in northwest Alaska to investigate competition between reindeer or caribou and muskoxen that would incorporate local knowledge would contribute to wildlife management and may be necessary before residents of northwestern Alaska will support a muskox management program.

Another topic requiring additional information was allowing for dispersal of muskoxen into their "historic range." Both the Seward Peninsula and the GMU 23/26A muskox management plan identified population expansion as their primary goals. In order to evaluate this, managers and the public will need to define and identify potential muskoxen habitat.

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Table 1. Game Management Unit 23 muskox census data for muskoxen in the Tahinichok Mountains and Lisburne Hills, Alaska, 1988 to 1994.

	Adult Bulls[a]	Cows[b]	Yearlings[c]	Calves[d]	Total Adults[e]
Tachinichok Mountains					
1988[f]			4	26	
1993[g]		1	12	43	
1994[h]	33	19	8	13	60
Lisburne Hills					
1988[f]			13	80	
1993[g]		14	23	80	
1994	27	83	26	35	136
Total					
1988[f]			17	106	
1993[g]		15	35	123	
1994[h]	60	102	34	48	196

a "Adult bull" defined as bulls >3 yr. old.
b "Cow" defined as females >2 yr old and bulls <3 yr. old.
c "Yearling" defined as muskox >12 and <24 months old.
d "Calf" defined as muskox < 12 months old.
e "Adult" defined as muskox >12 months old (i.e., adult bulls, cows and yearlings).
f Bulls and yearlings were not identified during the 1988 census. Census conducted May 17-19.
g This was not a complete census but rather an opportunistic count made over roughly 75% of the census area during a routine radio tracking flight on June 4; therefore, this is a minimum count.
h Calves were counted during the flight made on 7 June; bulls, "cows", and yearlings were counted during the flight made on 20 April. Only 49 of the 60 (82%) adult muskoxen found in the Tahinichok Mountains on 20 April were located on 7 June; therefore, the number of calves in this area is a minimum count.

Table 2. Game Management Unit 23 composition data for muskoxen in the Tahinichok Mountains and Lisburne Hills, Alaska, 1988 to 1994.

	Tahinichok Mountains		Lisburne Hills		Total	
	Ca[a] 100 Ad[b] & Ylg[c]	Ylg:100 Ad	Ca:100 Ad & Ylg	Ylg:100 AD	Ca:100 Ad & Ylg	Ylg:100 Ad
1988[d]	15	--	16	--	16	--
1993[e]	28	2	29	21	28	14
1994[f]	27	15	26	24	26	21

[a] "Calf: defined as muskox <12 months old.
[b] "Adult" defined as muskox >24 months old.
[c] "Ylg: defined as muskox >12 and < 24 months old.
[d] Yearlings were not identified during the 1988 census. Census conducted May 17-19.
[e] This was not a complete census: these ratios were determined from a minimum count made on 4 June 1993.
[f] The calf:100 adult and yearling ratio for the Tahinichok Mountains was based on a partial count (13 calves, 49 adults) of the entire population conducted on 7 June 1994.

LOCATION

Game Management Unit: 26B and 26C (26,000 mi^2)

Geographical Description: Central and Eastern Arctic Slope

BACKGROUND

Muskoxen were extirpated from northeastern Alaska by the turn of the century but were reintroduced in 1969 and 1970 when 64 animals were released. The history and current status of muskoxen have been reviewed by Gunn (1982), Garner and Reynolds (1986), and Golden (1989). The number of muskoxen has increased steadily and at least 600 muskoxen now inhabit the area between the Itkillik River in Alaska and the Malcolm River in the Yukon Territory. A small number of bulls have been harvested in Unit 26C since 1983 and in Unit 26B beginning in 1990.

MANAGEMENT DIRECTION

Management Goals

Management goals for area muskox are to: 1) reestablish muskoxen throughout their historic range in Alaska; 2) provide the opportunity to view, photograph, and enjoy muskoxen; and 3) provide opportunities for people to hunt muskoxen.

Management Objectives

Management objectives for area muskoxen are to: 1) manage harvest below sustained yield to encourage population growth and dispersal of muskoxen; 2) maintain a bull:cow ratio of at least 50:100 and an adult bull:cow ratio of 35:100; and 3) maintain direct communication with local residents of Nuiqsut, Kaktovik, and Barrow about management decisions concerning the reintroduction, conservation, and hunting of muskoxen.

METHODS

FWS biologists gathered survey data during this report period (Reynolds 1992). They conducted precalving surveys during early April using a Cessna 185 aircraft. Ground composition counts were conducted in Unit 26C during early July in some years. Groups of muskoxen were located by helicopter and then classified from the ground as adult bulls, adult cows, yearlings, or calves. A fall postrut census was usually flown in October. To facilitate locating muskoxen, approximately 20 radiocollared animals are maintained in the population. Population estimates are based on spring (precalving) surveys.

Mandatory hunt reports for fall and spring hunts were analyzed to provide information on muskoxen taken in permit hunts.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: During the last few years the number of muskoxen in Unit 26C remained near 400, while numbers in Unit 26B increased to about 165 by April 1992. The total population has grown an average of 6% per year, which is less than the average rate of 16% observed between 1979 and 1989 (Golden 1991, Reynolds 1992). The population includes approximately 600 muskoxen.

Population Composition: Annual composition data (Table 1) indicate calf production and yearling recruitment are high but variable. The overall bull:cow ratio is about 66:100, with 58 adult bulls:100 adult cows. These ratios meet management objectives.

Distribution and Movements: Most muskoxen in northeastern Alaska are in Unit 26C. Approximately 30% of the population now is in Unit 26B, and this proportion will probably increase. Muskoxen continued to extend to the adjacent Yukon Territory, although the number of muskoxen using this area is not precisely known. As the population in Unit 26C has increased, dispersal to the east and west has been a major factor influencing muskoxen distribution and growth of local populations. Temporary movements also occur between areas (Reynolds 1992).

Mortality

Harvest:

Units and Bag Limits	Resident Open Seasons	Nonresident Open Seasons
Unit 26(B) 1 bull by Tier II permit only; up to 2 muskoxen may be taken. Evidence of sex required	1 Oct-31 Oct 1 Mar-31 Mar	No open season
Unit 26C 1 bull by federal permit, up to 10 permits may be issued.	1 Oct-15 Nov 1 Mar-31 Mar	No open season

Board of Game Actions and Emergency Orders. In August 1990 changes in subsistence harvest management throughout Alaska caused the Board of Game to institute Tier II hunts for muskoxen in Units 26B (hunt no. 1010T) and 26C (hunt no. 1012T) beginning with the 1990-1991 season. These regulations allowed Alaska residents to harvest up to 15 bulls. The FWS took over subsistence management of muskoxen in Unit 26C beginning with the 1992-1993 season, issuing up to 10 permits to Kaktovik residents. This harvest is divided among 3 areas in the subunit. The state administers a Tier II hunt in Unit 26B for up to 2 bulls. The fall season in Unit 26C was extended to include the first 2 weeks of November for the 1994-1995 season.

The actual number of permits issued each year has varied, with a maximum of 12 issued for the 1992-1993 season. This conservative approach is necessary because Kaktovik residents hunt in a small part of the total range.

Hunter/Trapper Harvest. The annual harvest of muskoxen from 1985-1986 to 1991-1992 ranged from 4 to 10 (Table 2). No illegal harvest has been recorded since 1992-1993, when 1 muskox was illegally killed. Annual harvest is strongly influenced by the effect of weather on travel conditions in October and March.

Permit Hunts. Table 2 details the number of permits issued and hunter success. Hunting for muskoxen in the eastern Arctic is allowed only under permit.

Hunter Residency and Success. Before the 1990-1991 regulatory year, muskoxen were hunted under a registration permit system in which nonlocal residents and nonresidents participated, taking a significant number of muskoxen. Establishing a Tier II hunt in 1990-1991 resulted in local residents' receiving all permits (Table 3).

Transport Methods and Harvest Chronology. Local hunters rely primarily on snowmachines to hunt muskoxen during March, but 2 bulls were taken in Unit 26B by 2 local hunters using aircraft in fall 1990 and another was taken in March 1994 (Tables 4 and 5). When nonlocals were allowed to hunt, they preferred to hunt in August and used aircraft for transport.

Natural Mortality: Natural mortality of adults, calves, and yearlings in the eastern Arctic is low. Brown bears have taken both calf and adult muskoxen and seem more important predators than wolves (Reynolds et al. 1992). Mortality among cow muskoxen averaged 11% annually (Reynolds 1992). Average survival of calves (83%) and yearlings (81%) from 1987 to 1991 was high. Late winter storms contribute to mortality of calves, yearlings, and old adults but these losses are generally minimal.

Habitat

Studies have focused on the status of muskoxen habitat (O'Brien 1988), and forage apparently is not limiting population growth in Units 26B and 26C. Social factors are probably responsible for the increased emigration from Unit 26C. Habitat in Unit 26B is adequate to support a larger population than what currently exists in that area, and snow conditions are more favorable for muskoxen there than in Unit 26C (P. Reynolds, pers. commun.).

Nonregulatory Management Problems/Needs

Some concern has been expressed by North Slope residents concerning possible interactions between muskoxen and caribou. This controversy arose in northern Canada a few years ago but has generally subsided. Biological evidence indicates these species are quite compatible. Efforts to explore perceived problems and exchange information with local residents are reducing the level of concern and should be continued. Both muskoxen and the Porcupine Caribou Herd, which inhabit Units 26B and 26C, continue to thrive.

No major nonregulatory problems are apparent at this point. I recommend we monitor herd expansion in western Unit 26B and the northern Yukon Territory adjacent to the Arctic National Wildlife Refuge.

CONCLUSIONS AND RECOMMENDATIONS

Muskoxen have been doing well under the present management strategy and continue to expand their range westward. Immigration and good reproduction and survival have resulted in a high rate of increase in muskoxen east of the pipeline in Unit 26B. Muskoxen are well established west of the pipeline and continue to expand their range and numbers to the west. The existing conservative harvest strategy should be continued. It will allow herd growth while providing continued benefits to local users. Given the continued herd growth and range expansion, the number of permits to harvest muskoxen in Units 26B and 26C should be increased to the fully authorized number of 15 bulls. Present hunting regulations restrict the Unit 26B Tier II muskox hunt to the area east of the Dalton Highway Corridor Management Area. Sufficient numbers of muskoxen inhabit Unit 26B west of the corridor to safely allow for harvest. The number of Tier II muskox permits for Unit 26B should be increased to a total of 5, and those 5 divided between the areas east and west of the corridor.

FWS will continue basic monitoring of muskoxen numbers, productivity, survival, and movements east of the Sagavanirktok River. The numbers of muskoxen west of the Sagavanirktok River have reached a level warranting accurate population and distribution information by periodic surveys. The opening of the Dalton Highway for public use will likely result in increased interest in muskoxen in this area by both the hunting and nonhunting public. Better population information will provide a basis for decisions regarding continued use of this resource.

The department should consider what long-term course of action needs to be taken regarding muskoxen management on the North Slope. As the population continues to increase in both numbers and range, there will probably be growing interest in providing more hunting opportunity. The concerns of some North slope residents about negative interactions between muskoxen and caribou may also increase. Some effort should be directed at determining the relationships between muskoxen and caribou and addressing concerns of local residents. Given the growing muskoxen population, continued range expansion, and concerns of the public, the department should consider developing a management plan for muskoxen on the North Slope.

This management plan should be developed in cooperation with appropriate agencies, affected landowners, and interested publics.

Frequent changes in recent permitting procedures, resulting from legal decisions, have created confusion among resource users and have excluded nonlocal Alaska residents and nonresidents. Maintaining a stable, equitable system and making permit applications and information available in a timely fashion will help reduce confusion and resentment.

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Table 1. Results of summer (postcalving) aerial muskoxen composition counts and estimated population size in Units 26B (east of the Sagavanirktok River) and 26C, 1986-1994[a].

Regulatory year	4+ yr adults M	4+ yr adults F	3 yr adults M	3 yr adults F	2 yr adults M	2 yr adults F	Total adults	% Yearlings	% Calves	Total muskox observed	Estimated population size
1986-1987	37	105	16	28	24	23	233	12.4	18.9	339	385[b]
1987-1988	49	80	15	38	23	22	227	16.2	22.6	371	410[b]
1988-1989	32	81	16	31	17	19	196	14.3	15.7	280	489[b,c]
1989-1990	42	82	18	19	17	18	196	17.0	15.2	289	470[b]
1990-1991	56	111	21	24	21	21	254	15.3	15.5	367	470[d]
1991-1992	77	150	24	37	21	34	343	11.5	20.4	504	n/a
1992-1993	97	167	22	24	22	21	353	15.9	15.9	517	539[b]
1993-1994	83	157	21	37	38	29	365	11.4	20.4	535	607[b]

[a] Data source: PE Reynolds, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks. Postcalving counts may occur in late June or early July but are listed in the regulatory year beginning on 1 July.

[b] Data from precalving (spring) aerial surveys.

[c] Includes 12 muskoxen seen during ADF&G surveys.

[d] Data from postcalving (summer-fall) aerial surveys.

Table 2. Units 26B and 26C muskoxen harvest data by permit hunt, 1986-1994.

Hunt no. /area	Regulatory year	Permits issued	% did not hunt	% successful hunters	Bulls (%)	Cows (%)	Unk	Illegal	Total harvest
1010T	1986-1987	5		100	100	0			5
1012T	1987-1988	5		100	100	0			5
1014T	1988-1989	10	10	60	67	33		3	9
	1989-1990	10		100	100	0			10
	1990-1991	11		82	100	0			9[a]
	1991-1992	11		45	100	0		0	5[b]
	1992-1993	9		89	100	0		1	8
	1993-1994	12	8	66	100	0		0	8

[a] Two muskoxen taken in Unit 26B and 3 in Unit 26C.
[b] All muskoxen taken in Unit 26C.

Table 3. Unit 26B and 26C muskoxen hunter residency and success, 1985-1994.

Regulatory[a] year	Successful				Unsuccessful				Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	
1985-1986	2	1	0	3 (60)	2	0	0	2 (40)	5
1986-1987	3	1	1	5 (100)	0	0	0	0 (0)	5
1987-1988	2	3	0	5 (100)	0	0	0	0 (0)	5
1988-1989[c]	4	2	0	6 (60)	1	3	0	4 (40)	10
1989-1990	2	7	1	10 (100)	0	0	0	0 (0)	10
1990-1991	9	0	0	9 (82)	2	0	0	2 (18)	11
1991-1992	5	0	0	5 (45)	6	0	0	6 (55)	11
1992-1993	8	0	0		1	0	0	1 (11)	9
1993-1994	8	0	0	8 (66)	4	0	0	4 (33)	12

[a] Before 1987 only Alaska residents were allowed to hunt muskoxen. In 1990 muskoxen hunting on the North Slope was administered under a Tier II hunt limited to local residents.

[b] Local is a resident of Kaktovik, Nuiqsut, and Umiat.

[c] A fall season was added in 1988-1989.

Table 4. Units 26B and 26C muskoxen harvest chronology by time period, 1986-1994.

Regulatory year	Harvest periods				*n*
	8/15-8/31	9/1-9/15	3/1-3/15	3/16-3/31	
1986-1987			3		3
1987-1988			3	1	4
1988-1989		3	2	3	8
1989-1990	4	3	2	1	10
1990-1991		3		2	9[a]
1991-1992			3	2	5
1992-1993					8
1993-1994					8

[a] Date of kill for 4 muskoxen is unknown.

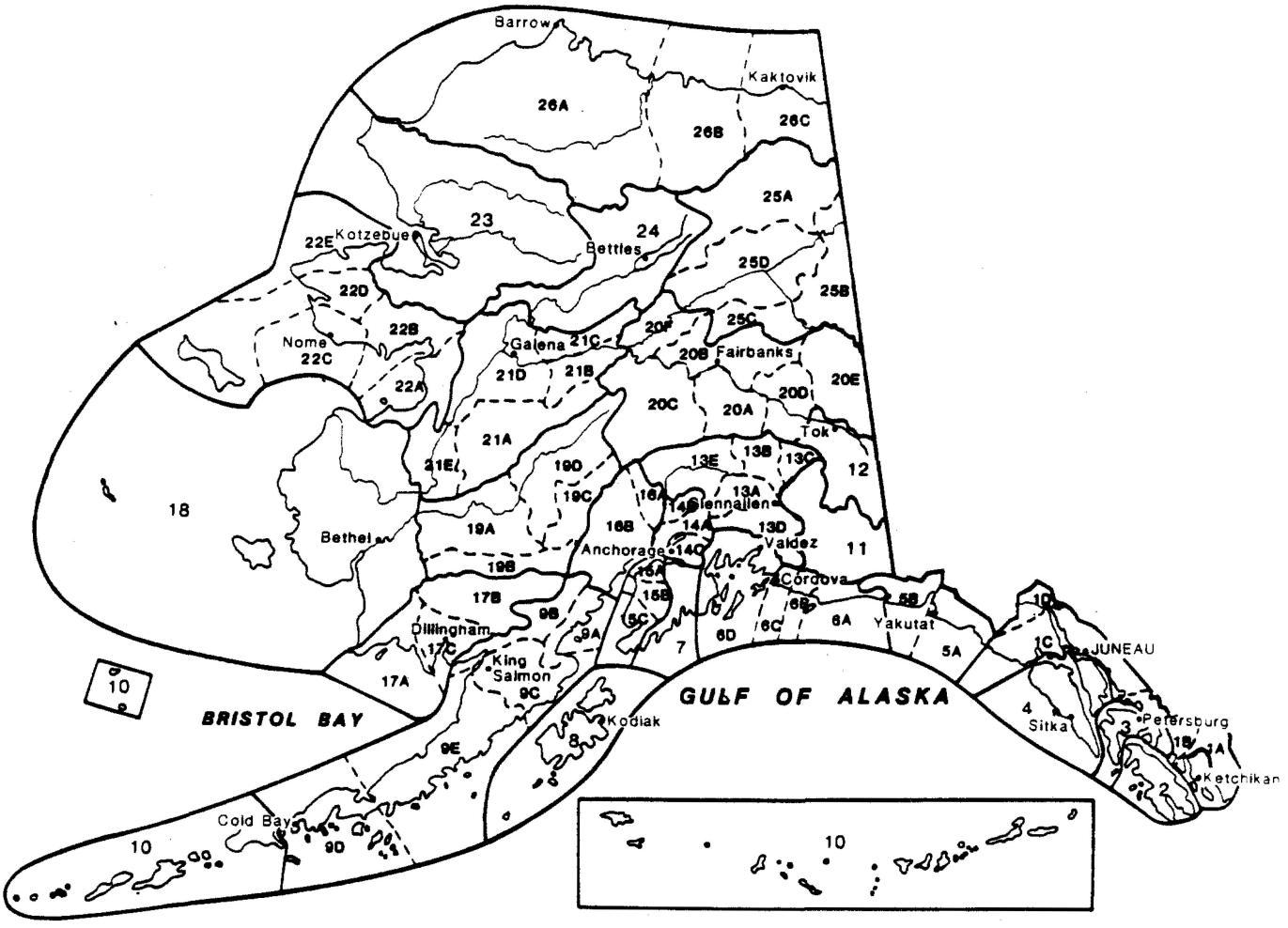
Table 5. Units 26B and 26C muskoxen harvest by transport method, 1986-1994.

Regulatory year	Percent of harvest			*n*
	Airplane	Dog team	Snowmachine	
1986-1987	0	0	100	3
1987-1988	40	0	60	5
1988-1989	38	0	38	8
1989-1990	90	0	10	10
1990-1991	22	11	67	9
1991-1992	0	0	100	5
1992-1993	0	0	100	8
1993-1994	12	0	88	8

NOTES

NOTES

Alaska's Game Management Units



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

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