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MUSKOX



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LOCATION

Game Management Unit: 18 (42,000 mi²)

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. Nunivak Island was designated as a National Wildlife Refuge to provide a site for establishing a muskox population which would eventually produce animals for transplants to mainland Alaska. Thirty-one muskoxen from Greenland were introduced to Nunivak Island during 1935-36 as a first step towards re-introducing 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 opened in 1975 and the population has since fluctuated between 500 to 750 animals. The Nunivak muskox population remained healthy and productive in 1990, declining slightly from 1988 under a harvest strategy designed to reduce the population size.

During 1967-68, 23 subadult muskoxen were transplanted 20 miles across Etolin Strait from Nunivak Island to Nelson Island. The muskox population on Nelson Island has since exhibited an annual growth rate averaging 22% between 1968 and 1981. The first hunting season was opened in 1981 when the population size approached the management goal of 200-250 animals. The population has remained stable through 1990 providing emigrants to the mainland and stable harvests. When the last census was taken in February 1990, the size of population was estimated at 239 muskoxen.

As many as 150 muskoxen may now reside on the mainland of the Yukon-Kuskokwim Delta, having originally emigrated from Nelson Island. Muskoxen are now widely distributed at low densities in small herds from the mouth of the Kuskokwim River to the Andraefsky Mountain areas north of the Yukon River, and are rapidly expanding their range north and east. These muskoxen were seen on the mainland soon after their introduction onto Nelson Island. Sightings have been documented by interested local residents aircraft pilots, and biologists conducting field activities.

MANAGEMENT DIRECTION

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

Maintain a post-hunt population size of approximately 200 muskoxen on Nelson Island and approximately 500 on Nunivak Island. Estimate the number, sex, and age composition of muskoxen in all areas. Conduct aerial and ground surveys in cooperation with the U. S. Fish and Wildlife Service (USFWS) on Nunivak Island. Conduct aerial and ground composition surveys on Nelson Island in cooperation with the villages of Toksook Bay and Tununak. Adjust harvest quotas annually for Nunivak and Nelson Island to maintain the desired population level.

Determine the distribution and dispersal of muskoxen on the mainland. Maintain up to 5 radio-collared muskoxen on the mainland to help locate groups. Recorded sightings reported by individual residents of Unit 18, and other agencies and organizations.

Participate in an interagency effort to develop a reindeer-muskox management plan for Nunivak Island. Begin work on a cooperative muskox management plan for Nunivak Island.

METHODS

A ground census providing information on sex and age composition of the Nunivak Island muskox population was completed on 19-22 March 1990 by Department, and USFWS staff, and Bering Sea Reindeer Products (BSRP) representatives. Snowmachines were used to traverse the perimeter of the island and some interior mountains. 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. All observations were plotted on 1:63,360 scale topographical maps. An aerial census providing information on overall numbers and distribution of muskoxen was completed on 30 March 1990. Two USFWS aircraft accompanied by observers from the village of Mekoryuk surveyed the entire island.

An aerial survey of the Nelson Island muskox population was conducted by Department staff on 14 February 1990.

Periodic telemetry flights to monitor the status of 5 mainland radio-collared muskoxen were conducted throughout the summer, fall, and early winter of 1989-90.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: Results of a census and composition survey conducted in spring 1990 indicate that the post-hunt, pre-calving Nunivak Island population numbered at least 568. I estimate that the post-calving population numbered approximately 600 muskoxen in

summer 1990. Seventy-one groups and 568 muskoxen were observed during the ground composition survey. The aerial census conducted a few days later accounted for less animals because inclement weather made it impossible to cover several portions of the island.

The 1990 post-hunt, pre-calving population size of 568 muskoxen on Nunivak Island decreased slightly from the 1988 and 1989 estimates of 609 and 577, respectively. Since 1975 when harvests were initiated, the population has ranged from 500 to 750 muskoxen (Table 1 and 2).

Results of the survey conducted in February 1990 indicated that the pre-calving, pre-hunt population on Nelson Island was at least 239 muskoxen, a slight increase from the December 1988 aerial survey. Approximately half of the Nelson Island population was found on the steep escarpments of Cape Vancouver between the villages of Toksook Bay and Tununak. These muskoxen were apparently using these cliffs as a refuge during winter to avoid snowmachine traffic encountered on the gentler slopes of the island's interior.

The Nelson Island muskox population remained stable in size from 1981 to 1986 at approximately 250 muskoxen during years of light to moderate snow accumulation. Since 1986, the population has fluctuated between 150 to 239 animals. The population has provided a nucleus for emigration to the mainland while sustaining annual harvests. Except for 1987, the population size has remained relatively stable during the last 10 years, even though harvest rates were approaching 15% and emigration onto the mainland was in progress (Table 3).

The Nelson Island population is not always confined to the island because the animals can cross frozen tidal inlets to and from the mainland from November through May. These movements between the island and the mainland may explain some of the annual fluctuations observed for the muskox population.

Although comprehensive surveys for determining the size of the mainland population have never been conducted, periodic sightings by Department and USFWS staff, and the public indicate that the mainland population numbers approximately 100-150 animals. This population was originally estimated at 40 animals in 1984.

Mainland muskoxen are descendants of the 23 muskoxen introduced to Nelson Island in 1967-68. Muskoxen have since been sighted on the mainland of Unit 18 for approximately 16 years. The distribution of mainland muskox sightings indicate the animals have exhibited a decided preference for upland tundra and riparian corridors. The rate of expansion and long-range movements demonstrated by mainland muskoxen are considered remarkable. One unique movement was demonstrated by a 4-year-old female muskox that was radio-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 in August 1989, and was later shot by a hunter on 24 March 1990 near Toksook Bay on Nelson Island.

Population Composition:

Composition data for Nunivak Island muskoxen are available from the 1990 ground census conducted during 19-22 March 1990. We classified 94% (532) of the 568 muskoxen observed in 71 groups, ranging from 1 to 29 animals. We counted 156 4-year-and-older males, 100 4-year-and-older adult females, 50 3-year-old males, 77 3-year-old females, 36 2-year-old males, 42 2-year-old females, 71 yearlings, and 36 unclassified animals. The 1990 ground count is considered one of the best ground composition counts completed since hunting began on Nunivak Island (Table 1).

The aerial survey located 62 groups of muskox ranging in size from 1 to 34 animals; however, only 562 muskoxen were counted (Hinkes 1989). Photographs of the larger groups were not very clear and some animals may have been missed. Therefore, I am relying on the ground count as the final census figure.

The proportion of adult males in the population has increased during the previous 6 years while the proportion of adult females and yearlings has decreased. However, the number of adult cows increased between 1989 and 1990, possibly because of higher than normal survival of all female age classes. In addition, many of the unclassified animals observed during the 1989 count may have been predominantly 3- and 4-years and older females (Table 1). Census data indicate 156 4-year-old and older bulls were present in 1990 in comparison to 100 4-year-old or older females. If 3-year-old cows are considered reproductively active, the overall size of reproductive age cows would be 177 animals. This would make the number of reproductive bulls and cows in the population equal.

Distribution and Movements:

The greatest concentrations of Nunivak Island muskoxen observed during the 1990 census were found along the southwestern coast from Cape Mendenhall to Nash Harbor. Few muskoxen were found in northeastern Nunivak Island, perhaps a result of hunting pressure and snowmachine activity originating from Mekoryuk. Muskoxen tended to concentrate on wind-blown, *Elymus*-covered dunes in southern Nunivak Island after late winter snow accumulated on the remainder of the island.

During the February 1990 census approximately half of the Nelson Island muskox population was concentrated primarily on the cliffs above Cape Vancouver and on the hills northeast of Tununak. In addition, some individual muskoxen and small herds were scattered on hills in the central portion of the island and along escarpments above Nightmute. Snow cover was complete and about 16 inches deep. A small herd of 14 muskoxen was also observed just off the northeast edge of Nelson Island along the shore of Baird Inlet. Few muskoxen were found in the central portion of the island.

Muskoxen from Nelson Island often move onto the mainland across the shallow frozen inlets. Although some of these muskoxen remain on the mainland, others return to Nelson Island. These muskoxen may be susceptible to drowning when they migrate to the mainland in spring and break through the ice on the larger lakes and inlets. This happened to 2 of our radio-collared animals.

Local residents, pilots, and biologists have reported numerous sightings of mainland muskoxen during the last 16 years, and these reports continued throughout 1989-90. The reported range of mainland muskoxen currently extends southeast to the mouth of the Kuskokwim River, northeast to the Portage Lakes-Hills area near Lower Kalskag, and northwest to the Andreafsky Mountains. Four muskoxen were observed on the Mountain Village airstrip during late August 1989, a group of 13 near the Johnson River 43 miles out of Bethel towards Cheforak in March of 1990, and a group of 25 in August 1989 near Scammon Bay. The small herd that was near the upper Johnson River between Lower Kalskag and Paimiut has not been sighted since August 1989.

Department and USFWS staff radio-collared 3 muskoxen (2 bulls and 1 cow) from a herd of 9 south of the Yukon River between Bethel and Pilot Station in March 1989. These 3 animals have since either dropped their radio collars or died. This herd had previously ranged west to Pilot Station and east to Russian Mission and the upper Johnson River.

Staff also radio-collared 2 muskoxen from another herd of 12 southwest of Bethel in March 1989. This herd has been monitored since 1984, and has remained relatively stationary near Dall Lake, producing calves annually (4 in 1990). Both radio-collared animals moved very little and have since drowned. One drowned in Dall Lake and had a calf with it and the other drowned in a slough after falling through the ice.

Mortality

Season and Bag Limit:

Unit 18,
Nunivak Island: One bull by drawing permit only. Ten permits will be issued for the fall season and 35 permits will be issued for the spring season: or 1 cow by registration permit only. 35 permits for cows (5 in the fall and 30 in the spring) will be issued on a first-come, first-served basis.

Bull Season:

1 September - 30 September
15 February - 15 March

Cow Season:

1 September - 30 September
1 February - 15 March

Unit 18, Nelson Island:

1 February - 25 March

One muskox by registration permit only. 15 bull and 15 cow permits will be issued on a first-come, first-served basis.

Remainder of Unit 18

No open season

Harvest

Human Induced Mortality: Ten bull drawing permits and 5 cow registration permits were available to hunters during September 1989. Only 4 drawing permittees elected to hunt and all 4 took bull muskoxen during the September season. Five cow registration permits were available on a first-come, first-serve basis in Mekoryuk on 31 August 1989. Four of the 5 permittees took cow muskoxen during the September season.

Thirty-five persons were drawn to hunt bull muskox on Nunivak Island in spring 1990. A waiting list of over 200 alternate permittees indicates the continuing popularity of the Nunivak Island spring bull hunt. Because some successful permit applicants chose not to hunt, an additional 30 persons from the alternate list were contacted. All 35 drawing permittees who hunted were successful. In addition, 2 permits not filled during the fall hunt were released to 2 permittees who were subsequently successful. The total spring 1990 bull harvest for Nunivak Island was 37 muskoxen.

Seventeen registration permits for the spring 1990 cow hunt were available on 31 January 1990 on a first-come, first-served basis in Mekoryuk. On the same day, an additional 8 permits were available in Bethel, 3 in Anchorage, and 2 in Fairbanks. All 17 cow permits available at Mekoryuk were issued to local residents with 8 people remaining on a waiting list. Eight permits were issued in Bethel with 2 remaining on the waiting list. Applicants spent the night inside the office building waiting for their permits. Only 1 permit was issued in Anchorage out of the 3 available and both permits available at Fairbanks were issued. The remaining 2 permits from Anchorage were issued to the Bethel hunters. Twenty-seven of the 30 cow permittees were successful, and only 2 Mekoryuk hunters were unsuccessful.

Hunters harvested 72 muskoxen (41 bulls and 31 cows) during the fall 1989 and spring 1990 season for Nunivak Island. Historically, the harvest of bulls and cows has varied annually and has slowly been increased in recent years to reduce the herd size (Table 4).

Thirty registration permits for Nelson Island muskoxen (15 bulls and 15 cows) were issued at the Newtok Community Center on 23 January 1990, with no one remaining on the waiting list. Originally, 58 hunters attended a meeting to discuss the permit issuance procedure on 22 January. A bilingual orientation session on the identification of the age and sex classes of muskoxen was conducted immediately after the meeting. One cow hunter from Newtok did not go hunting. The total harvest for Nelson Island in 1990 was

15 bulls and 14 cows. An additional 2 bulls were shot and left unsalvaged between Toksook Bay and Nightmute. The total human-induced mortality for Nelson Island was 17 bulls and 14 cows. Historically, Nelson Island harvest goals have remained the same since 1985, allowing a limited harvest of both females and males (Table 5).

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 moderating weather which occurred between winter storms. Most hunters on Nelson Island, and the cow hunters on Nunivak Island took their muskoxen between late February and mid-March when increasing daylight hours and milder weather occurred. Bull hunters on Nunivak Island who usually hunted with guides/transporters normally scheduled their hunts well in advance of the season and generally took their muskoxen throughout the season.

Hunter Residency and Success: Most drawing permittees (61%) were residents of Anchorage and the surrounding area. Residents of Fairbanks and interior Alaska held 10% of the drawing permits, and the remainder were held by residents of Valdez, Juneau, McGrath (2 each), and Kasilof. Four permits were filled by nonresident hunters.

Four of the 5 cow registration permits available in fall 1989 were issued to Mekoryuk residents. The other permit went to a Bethel resident who did not hunt.

All 17 cow muskox permits available at Mekoryuk for the spring 1990 hunt were issued to local residents. Seven of the 8 permits available at Bethel were issued to Bethel residents, and the remaining permit was issued to a Mekoryuk resident who had flown in the day before to obtain a permit. Both permit holders who obtained registration permits at Fairbanks were from the Fairbanks area. The 3 permits available at Anchorage were issued to 1 Anchorage resident and 2 remaining permits were issued to Bethel hunters after the permits remained unissued in Anchorage for 2 weeks.

Of the 30 registration permits available at Newtok, 37% were issued to Toksook Bay residents, 37% to Newtok residents, 14% to Tununak residents, 6% to Nightmute residents, and 6% to Cheformak residents.

Success rate for all muskox hunters entering the field was 99% since hunting began. It had been 100% up until spring 1990. 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, who were usually hunted with guides or 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. However 1 Anchorage hunter took his bull muskox on foot behind the village. Snowmachines were 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 or wolves are found on Nunivak Island, and are rare or non-existent 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 over lakes and streams, and stranding on drifting sea ice.

Habitat

Assessment: The Nunivak Island lichen range is considered to be critically overgrazed by reindeer, although muskoxen harvested in recent years were reported in very good condition. There are no reindeer on Nelson Island, but several muskoxen harvested there in recent years apparently had less body fat than normal. Muskoxen on Nelson Island may be using marginal habitats along the steep marine escarpments to avoid hunters and snowmachine traffic from December to April. However, concerns about the range status on Nelson Island are partially alleviated by the potential for emigration.

Board of Game Actions and Emergency Orders

In spring 1989 the Board of Game gave the Department the discretionary authority to issue up to 45 bull and 45 cow permits on Nunivak Island. For the 1989-90 regulatory year, Department staff issued 35 cow and 45 bull permits on Nunivak Island. This quota should allow the population to be maintained at the population guideline of 500-550 animals and help correct the imbalance in the sex ratio of the population.

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak Island muskox population is characterized by high productivity and low natural mortality. The proportion of adult males in the population has increased in the last 6 years and that of adult females and yearlings has decreased slightly. The harvest of cows should be maintained at 35 animals per year and the bull harvest at 45 animals per year. The harvest of bulls and cows should be reduced when the post-hunt, pre-calving population size reaches 550 animals. Muskox transplants could also be conducted to remove surplus animals.

Interagency meetings have been held biannually in Bethel and Mekoryuk to begin work on a muskox-reindeer management plan for Nunivak Island. Currently, a cooperative management plan is being drafted by the Department, USFWS, Soil Conservation Service (SCS), BIA, BSRP, Alaska Soil and Water Commission, and NIMA Corporation. Much of the discussions concern the 6,000 to 8,000 privately-owned reindeer that inhabit Nunivak Island. The proper management of these reindeer directly affects the carrying capacity of the habitat for muskoxen. Although muskoxen are still considered a priority

species on Nunivak Island, possible overgrazing of the lichen range by reindeer and erosion of the dune areas by muskoxen has become a concern on this unique refuge. The goals identified for this herd are to: 1) maintain a minimum population of 500 muskoxen, 2) transplant muskoxen to other areas of Alaska, and 3) allow continued hunting opportunities of muskox. This plan also addresses reindeer and includes ways to reduce the reindeer herd to a range carrying capacity of 3,000 animals.

Fluctuations in the observed size of the Nelson Island muskoxen population are influenced by snow and ice conditions, the availability of escape terrain, and forage availability. The Nelson Island population is not always confined to the island because the animals can cross frozen tidal inlets to the mainland from November through May. The Nelson Island muskox population has provided a source for emigration to the mainland and stable harvests in recent years. A ground composition survey should be attempted in late 1991 or early 1992 to determine sex ratios and annual recruitment. Some hunters speculate that on Nelson Island a large proportion of the muskox population is comprised of adult males.

Mainland muskoxen in Unit 18 have increased in range and numbers in recent years. As many as 100 muskoxen may now reside on the mainland of the unit. These muskoxen are widely distributed at low densities from the mouth of the Kuskokwim River to the mouth of the Yukon River, and are expanding their range north and east. No sightings of muskox south of the Kuskokwim River have yet been documented. The growth of the mainland population is the result of continued emigration from Nelson Island and reproduction occurring in a number of mainland herds. Hunting should remain closed on mainland muskoxen for the foreseeable future. Additional mainland muskoxen should be radio-collared 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 conducting planned radio-collaring projects in cooperation with local school districts and village councils as a way to involve more local residents in the project. It is also a way to develop an educational program that encourages Unit 18 residents to protect this rare and unique species.

LITERATURE CITED

Hinkes, M. 1989. A status report of muskox and reindeer populations on Nunivak Island. Progress report: Nunivak Island reindeer/muskox inventory. U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge, Bethel, AK. 99559. 4pp and appendices.

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Table 1. Sex and age composition of muskox during spring ground census, Nunivak Island, 1976-1990 (Post-hunt, Pre-calving).

Year	Yearlings		2 years		3 years		4+ years		Uncl.	Total	% Yrlngs.
	M	F	M	F	M	F	M	F			
1976 count	35	36	37	27	51	64	175	89	40	554	0.13
Estimate ^a	38	38	40	29	55	69	189	96			
1977 count	50	50	32	44	41	72	164	144	53	650	0.15
Estimate ^a	54	54	35	48	45	78	179	157			
1978 count	46	46	19	19	34	88	94	142	11	499	0.18
Estimate ^a	47	48	19	19	35	90	96	145			
1979 count	57	57	35	38	12	43	82	160	45	529	0.22
Estimate ^a	62	62	38	42	13	47	90	175			
1980 count	60	61	64	54	33	42	63	215	9	601	0.20
Estimate ^a	61	61	65	55	34	43	64	218			
1981 count	46	47	35	50	48	58	76	116	20	496	0.19
Estimate ^a	49	49	36	52	48	60	79	121			
1982 count	47	48	34	38	41	79	76	98	46	507	0.19
Estimate ^a	52	52	37	42	48	87	84	108			
1983 count	30	30	28	36	30	53	80	78	119	484	0.12
Estimate ^a	40	40	37	46	40	70	106	104			
1984 count	53	53	21	22	38	91	74	98	102	552	0.19
Estimate ^a	65	65	26	26	47	112	91	120			
1985 count	46	46	29	34	40	46	150	94	62	547	0.17
Estimate ^a	52	52	33	38	45	52	169	106			

Table 1 (continued).

Year	<u>Yearlings</u>		<u>2 years</u>		<u>3 years</u>		<u>4+ years</u>		Uncl.	Total	% Yrlngs.
	M	F	M	F	M	F	M	F			
1986 count	45	46	43	21	47	52	102	73	58	487	0.19
Estimate ^a	51	52	49	25	53	59	116	83			
1987 count	39	40	51	48	57	88	93	81	89	586	0.13
Estimate ^a	46	46	60	57	67	104	110	96			
1988 count	38	39	38	44	43	71	133	74	129	609	0.13
Estimate ^a	48	49	48	56	55	90	169	94			
1989 count	40	40	19	22	48	57	139	51	161	577	0.14
Estimate ^a	55	55	26	31	67	79	193	71			
1990 count	35	36	36	42	50	77	156	100	36	568	0.13
Estimate ^a	38	38	38	46	54	82	166	107			

^a Estimate = estimated composition extrapolated from classified animals.

Table 2. Unit 18 ground muskox composition counts and estimated population size, 1985-89, Nunivak Island.

Regulatory year	4+ yr. <u>adults</u>		3 yr. <u>adults</u>		2 yr. <u>adults</u>		Unk. adults	Total adults	Yearlings (%)	Total muskox observed	Estimated population size
	M	F	M	F	M	F					
1985-86	102	73	47	52	43	21	58	396	19	487	650
1986-87	93	81	57	88	51	48	89	507	13	586	750
1987-88	133	74	43	71	38	44	129	532	13	609	700
1988-89	193	71	67	79	26	31	161	497	14	577	650
1989-90	156	100	50	77	36	42	36	497	12	568	600

Table 3. Nelson Island muskox herd size, 1981-90. GMU 18.

Year	Pre-hunt, Pre-calving estimated herd size
1981	265
1982	217
1983	230
1984	200
1985	225
1986	287
1987	150 ^a
1988	213
1989	No survey
1990	239

^a Poor survey conditions.

Table 4. Muskoxen removed from the Nunivak Island population by hunting, 1975-1990.

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	41	31		72
Total	475	404	1	880

Table 5. Muskoxen removed from the Nelson Island population by hunting, 1981-1990.

Year	Males	Females	Total	Unreported harvest
1981	0	20	20	
1982	8	19	27	
1983	25	0	25	
1984	15	9	24	
1985	16	14	30	
1986	10	14	24	
1987	14	16	30	
1988	15	15	30	
1989	14	15	29	
1990	15	14	29	2 (males)
Total	132	136	268	2

LOCATION

Game Management Unit: 22A, 22B, 22C, 22D, and 22E (23,000 mi²)

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

BACKGROUND

Historical accounts indicate that muskoxen were absent throughout Unit 22 before their re-introduction in spring 1970 when 36 animals were transplanted from Nunivak Island. An additional 35 muskoxen were transplanted from Nunivak Island to the existing population in 1981. Smith (1987) provided a comprehensive discussion of those transplants as well as dispersals which have since occurred throughout the Seward Peninsula and adjacent areas.

MANAGEMENT DIRECTION

The following population goals and objectives have been established for muskox populations in Unit 22.

Re-introduce muskoxen throughout suitable GMU 22 range and provide for their use and enjoyment by members of the public.

Monitor population size, herd growth, and range expansion.

Maintain a pool of radio-collared animals. Monitor movements of radio-collared animals. Conduct an aerial photocensus at 5-year intervals.

Develop a Unit 22 muskoxen management plan in consultation with the public, interested local organizations, and other agencies.

METHODS

Radiotelemetry continued to provide the basis for muskox survey-inventory activities in Unit 22. However, muskox sightings by the public provided valuable information on distribution and migration throughout the Seward Peninsula.

Five additional muskoxen (2 males, 3 females) were radio-collared during the report period. All were captured from the ground using techniques described in Smith (1987).

This method of capture has been proven to significantly reduce the cost of radio-collaring animals.

Seven radio-tracking flights were made to gather relevant data on 31 radio-collared muskoxen during fall 1989. Those data were obtained from only those muskoxen residing in the western and northern portions of the Seward Peninsula. No data were gathered on animals in the eastern portion of the unit.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The most recent census on Seward Peninsula muskoxen was conducted in spring 1988. That aerial photocensus resulted in a minimum count of 527 muskoxen (Smith 1989). At the time, the population was estimated to be increasing at a rate of 25% per year. Assuming this increase rate has remained constant, the population may now exceed 700 animals.

Population Composition: Muskox composition data were not collected during the report period.

Mortality

Season and Bag Limit: No open season.

Natural Mortality: No estimate of natural mortality of Seward Peninsula muskoxen was obtained during the report period. During radio-tracking flights conducted in fall 1989, 3 radio-collared animals (2 males and 1 female) were found dead. Remains from an additional female muskoxen were found in spring 1990. Although the cause of death remains unknown the possibility exists it may have been shot.

CONCLUSIONS AND RECOMMENDATIONS

In recent years, Seward Peninsula muskoxen have become a high profile species. Their success in re-establishing themselves throughout Unit 22 has prompted some discussion, primarily among local residents, about the possibility of a limited hunt. In the very near future, we will probably be asked by the Board of Game to provide biological input into the feasibility of such a hunt. Before we can provide a recommendation based on sound data, we should do the following: 1) conduct a census and derive a current population estimate, 2) conduct annual spring surveys shortly after calving, and 3) develop and implement a muskox management plan.

Many of the radio-collars currently deployed are getting old and will probably fail within the next several years. A pool of at least 25 radio-collared animals needs to be maintained and movement monitored if we are going to be able to make wise management decisions concerning to the future of Seward Peninsula muskoxen.

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LOCATION

Game Management Unit: 23 (43,000 mi²)

Geographical Description: Northern Kotzebue Sound and the Western Brooks Range

BACKGROUND

Historical accounts indicate that muskoxen were found throughout Unit 23 before their disappearance from Alaska in the mid-1800s. Thirty-six muskoxen were transplanted from Nunivak Island to Cape Thompson in northern Unit 23 in 1970 as part of a long-standing plan to re-establish muskoxen throughout their former range in Alaska. In 1977, an additional 34 muskoxen were transplanted from Nunivak Island to the Cape Thompson area.

Although muskox transplants to other regions of Alaska have resulted in highly productive populations, growth in the Cape Thompson population has remained slow. This population was believed to be composed of a minimum of 127-129 muskoxen during 1989-90. Possible causes of the slow growth include inadequate winter habitat, large-scale dispersal, low recruitment, and excessive human-induced mortality.

MANAGEMENT DIRECTION

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

Establish and maintain viable muskox populations in Unit 23. Conduct a muskox census in the western portion of Unit 23 at 3- to 5-year intervals. Maintain a minimum of 10 active radio collars in the Cape Thompson population. Attempts will be made to locate and radio-collar muskoxen that have migrated inland from the coastal groups. Conduct radio-tracking flights to monitor annual movement patterns and distribution. In addition, short yearling recruitment will be assessed from flights conducted during April-May and summer calf survival will be assessed from flights conducted during fall.

Initiate development of a muskox management plan in cooperation with local residents and organizations, and other agencies. The plan will address, among other issues, establishing population goals and whether a hunting season will eventually be established.

METHODS

Radiotelemetry continued to provide the basis for muskox survey-inventory activities conducted in northern Unit 23. Currently, 10 functioning radio collars are deployed on muskoxen in the Cape Thompson population. Telemetry flights were conducted at periodic intervals in fall and spring to determine distribution, herd size, and population composition. Observations of muskoxen reported by the public, and Department and other agency staff were recorded and filed in the Kotzebue office.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The Cape Thompson population size is believed stable at this time. A census conducted in the northern portion of Unit 23 in May 1990 indicated that the population was composed of a minimum of 127-129 muskoxen. A census conducted 2 years earlier in May 1988 indicated that the population size was at least 123 muskoxen (Larsen 1989).

Population Composition: Three radio-tracking survey flights were conducted during fall 1989 and the percentage of calves observed on each flight was 6% and 12%. Two flights were conducted earlier in May 1989 and the percentage of newborn calves observed ranged from 11 to 22% (Table 1). One may conclude from examining the data that some calf mortality may have occurred during summer. However, comparing the spring and fall composition data to estimate calf mortality may not be valid. Movements of animals among different herds and dispersals occurring in summer would affect the percentage of calves observed the following fall, and may mask any mortality that actually occurred.

During May 1990, 2 radio-tracking/survey flights were conducted in the Cape Thompson area, and the percentages of short yearlings observed were 10% and 50%.

Distribution and Movements: Two cow muskoxen were radio-collared at Cape Krusenstern during September 1983 to better monitor the movements and distribution of muskoxen in northern Unit 23. In September 1986, 1 of the radio-collared animals was recaptured and outfitted with a new radio collar. Two additional animals were radio-collared at Cape Thompson, 2 near the Kukpuk River, and 1 at Rabbit Creek as well. In May 1989, 1 radio-collared cow was recaptured at Rabbit Creek, and outfitted with a new radio collar. On 3 September 1989, 5 additional muskoxen (1 bull and 4 cows) were radio-collared near the mouth of Kisimilok Creek between the villages of Kivalina and Point Hope.

During the past 5 years, these radio-collared animals were periodically relocated to obtain information concerning movements and distribution. Groups of muskoxen were most

frequently observed in the Tahinichok Mountains and Rabbit Creek area in the Mulgrave Hills, and in the Chariot and Cape Thompson area to the north. Reported sightings of lone and paired animals further inland from the coast indicate that the overall range of the Cape Thompson population is probably larger than our telemetry data suggest.

Mortality

Season and Bag Limit: There is currently no open season on muskoxen in Unit 23.

Harvest:

Human Induced Mortality: Although the hunting season for muskoxen has remained closed, an unknown number of animals have been killed by hunters each year. In September 1988, 2 bulls were shot near the Wulik River and subsequently abandoned. Unverified reports were received that at least 2 muskoxen were harvested illegally in northern Unit 23 during the 1989-90 report period. We believe that these and other illegal harvests may have contributed to the slow growth rate of the population.

CONCLUSIONS AND RECOMMENDATIONS

The Cape Thompson muskox population in northern Unit 23 apparently has remained stable in size since at least the mid-1980s. Why this population has not grown as have other transplanted muskox populations in Alaska is not known. Suggested causes for the lack of growth include poor winter habitat availability, widespread dispersal, low recruitment, and excessive human-induced mortality.

Additional radio collars should be deployed to monitor habitat use and distribution, sex-age composition, and population size more efficiently. The National Park Service and the Department have developed a proposal to try and determine what factors are limiting muskox populations in Unit 23. The study is proposed to begin in 1993. Additional information and education efforts are recommended to reduce or eliminate the occurrence of any illegal hunting activity. Additional enforcement efforts may be necessary if the problem becomes more severe. Until the population establishes a positive growth rate and population size increases significantly, the hunting season should remain closed. No regulatory changes are recommended at this time.

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Table 1. Numbers of adult and calf muskoxen observed during radio-tracking flights, Unit 23, spring/summer 1989.

Date	Adults	Calves	Total	% Calves
5/08/89	19	1	20	5
5/12/89	46	4	50	8
5/18/89	12	0	12	0
6/12/89	21	6	27	22
6/30/89	48	6	54	11

LOCATION

Game Management Unit: 26B and 26C (26,000 mi²)

Geographical Description: Central and eastern Arctic Slope

BACKGROUND

The history of muskoxen in northeastern Alaska was recently reviewed by Gunn (1982), Garner and Reynolds (1986), and Golden (1989). The population has expanded and dispersed since the reintroduction of 64 animals in 1969 and 1970. There are now at least 500 muskoxen and the population is well established on the north side of the Brooks Range from the Sagavanirktok River east and the Malcolm River in the Yukon. A small number of bulls has been hunted in Subunit 26C since 1983.

MANAGEMENT DIRECTION

Management Goals

Reestablish muskoxen throughout their historic range in Alaska.

Provide the opportunity to view, photograph, and enjoy muskoxen.

Provide opportunities for people to hunt muskoxen.

Management Objectives

Manage harvest below sustained yield to encourage population growth and dispersal of muskoxen.

Maintain a bull:cow ratio of at least 50:100 and an adult bull:cow ratio of 35:100.

Maintain direct communication with local residents of Nuiqsut, Kaktovik, and Barrow about management decisions concerning the reintroduction, conservation, and hunting of muskoxen.

METHODS

Precalving muskoxen surveys were flown east of the Sagavanirktok River in early April 1990 by the U.S. Fish and Wildlife Service (USFWS) biologists using a Cessna 185

aircraft. A postcalving count was not conducted during this report period nor was Subunit 26B west of the Sagavanirktok River surveyed.

USFWS biologists conducted composition counts in Subunit 26C during early July 1990. Groups of muskoxen were located from the air by helicopter and then classified from the ground as young bulls, adult bulls, cows, yearlings, or calves. Mandatory hunt reports for fall 1989 and spring 1990 permit hunts were analyzed.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: USFWS and ADF&G biologists counted 470 muskoxen in 1990; 348 in Subunit 26C and 122 in Subunit 26B (Table 1). An additional 75 muskoxen in the adjacent northern Yukon Territory were not counted (P. Reynolds, pers. commun.). From 1979 to 1989 the muskoxen population in northern Alaska increased at an average annual rate of 16%. The population in Subunit 26C is apparently stabilizing at 350-400 animals, with most recruitment emigrating to Subunit 26B and Canada.

Population Composition: During composition counts in July 1990, 289 muskoxen, approximately 61% of the known population, were located and classified (Table 1). Management objectives of 65 bulls:100 cows and 51 adult bulls:100 cows were met.

Distribution and Movements: The distribution of muskoxen in northeastern Alaska was reviewed by Golden (1989). Approximately 64% of muskoxen from the eastern Arctic population occurred in Subunit 26C within the Arctic National Wildlife Refuge (ANWR), 22% in Subunit 26B, and 14% in northern Yukon Territory. A mixed-sex group of 15-25 has been seen regularly southeast of Nuiqsut for the last 2 years. Radio-telemetry studies conducted by the USFWS since 1982 have demonstrated that muskoxen are highly mobile and not necessarily faithful to seasonal ranges or areas of occupancy. In addition, muskoxen form only temporary associations between individuals. The entire population in northeastern Alaska and adjacent Yukon Territory must be considered a single, interbreeding population (P. Reynolds, pers. commun.).

Mortality

Harvest:

Season and Bag Limit.

<u>Units/Bag Limit</u>	<u>Subsistence Open Seasons</u>	<u>Resident/ Nonresident Open Seasons</u>
Unit 26(C) One bull by registration permit only. Up to 15 permits will be issued.		15 Aug-15 Sept 1 Mar-31 Mar
Remainder of Unit 26	No open season	No open season

Board of Game Actions and Emergency Orders. The Board of Game found that residents of Kaktovik have customary and traditional use of muskoxen. This decision established a subsistence registration permit hunt for residents of Kaktovik to take 1 muskox of either sex. A drawing hunt for bulls was also established for other hunters. Seven registration and 7 drawing permits were to be issued for a fall season of 1-31 October (changed from 15 Aug-15 Sep) and a spring season of 1-31 March. All hunters would be allowed to hunt in Subunits 26B (east of the Sagavanirktok River) and 26C in 1990-91. These changes were to commence in fall 1990, however action on the Board's decision was held in abeyance by the Attorney General following the outcome of the *McDowell vs. Alaska* case. In August 1990, changes in subsistence harvest management throughout Alaska forced the Board of Game to institute a Tier II hunt for muskoxen in Subunits 26B and C beginning with the 1990-91 season. This hunt will allow harvest of 11 bulls within 3 hunt zones: (1) east of the Dalton Highway corridor in Subunit 26B, (2) west of the Jago River in Subunit 26C, and (3) east of the Jago River in Subunit 26C. Only Alaskan residents will be able to participate in this hunt.

Harvest by Hunters. Ten bull muskoxen were taken by hunters with registration permits in Subunit 26C during regulatory year 1989-90 (Table 2). No cows or other illegal animals were killed, an improvement over last year's accidental take of 3 cows. I believe much of the reduction in cow kills was attributed to better hunter orientation, which all hunt applicants were required to attend before going afield.

Permit Hunts. Ten registration permits, 5 in Kaktovik and 5 in Fairbanks, were issued on a first-come, first-served basis for permit hunt 1007 in 1989. Hunters issued permits in Kaktovik were allowed to take bulls anywhere in Subunit 26C. Hunters issued permits in Fairbanks were allowed to hunt bulls in 2 zones, 3 permits for the area west of Marsh Creek and 2 permits east of the Jago River.

This registration system, with permits issued in Kaktovik and Fairbanks, resulted in considerable public dissatisfaction. Lines formed as early as 5 days before permits were issued. Local residents of Subunit 26C were particularly dissatisfied because only 1 person from Kaktovik got a permit. Their response was to submit several game regulation proposals seeking a determination by the Board of Game that residents of Kaktovik have had customary and traditional use of muskoxen, thereby justifying a subsistence hunt.

Hunter Residency and Success. Local hunters included only 1 hunter from Kaktovik and 1 from Nuiqsut. Of the remaining 8 hunters, 7 were nonlocal residents of Alaska and 1 was a nonresident (Table 3). No hunters were local Natives. Hunter success was 100% with the harvest of 10 bulls, including 1 taken by bow and arrow.

Harvest Chronology. Seven of 10 muskoxen were taken during the fall 1989 hunt (Table 4). Over the last 2 years, harvest has been nearly equal between spring and fall hunts, although there was a strong preference for the fall hunting season in 1989.

Transport Methods. Hunters used either airplanes or snowmachines to hunt muskoxen during the last 4 years, although the proportion who used aircraft this year was much higher than other years (Table 5). Generally, most local residents used snowmachines and most nonlocals used aircraft. Some local residents have provided snowmachines for nonlocals to use, but guiding muskoxen hunters has not been as common in Kaktovik as on Nunivak Island.

Natural Mortality. Natural mortality of muskoxen in the eastern Arctic is low. Of 13 nonhunting mortalities observed between 1984 and 1986, 9 were associated with predation or scavenging, 3 were among old or malnourished muskoxen, and 1 was because of unknown causes (Garner and Reynolds 1986, Whitten 1986).

Between 1983 and 1985, yearling and calf mortality rates were estimated as 8% and 15%, respectively (Garner and Reynolds 1986). Extreme winter weather probably accounts for a large proportion of the yearling and calf mortality. Unusually heavy snow in winter 1988-89 contributed to higher overwinter mortality and caused animals to be thin going into summer. Conversely, the relatively mild winter of 1989-90 probably resulted in good yearling survival (P. Reynolds, pers. commun.).

Habitat

Relationships between muskoxen and their habitat have been extensively studied since 1982 by the USFWS and the University of Alaska and were briefly reviewed by Golden (1989). Results of a recently completed study on muskoxen habitat in northeastern Alaska became available in 1989 (O'Brien 1988). There is also an ongoing study through the Cooperative Wildlife Research Unit, University of Alaska, Fairbanks investigating muskoxen winter habitat use.

Nonregulatory Management Problems/Needs

More data are needed to determine the distribution and total number of muskoxen across the eastern Arctic. This is especially important because of our goals relating to herd growth and expanding hunting opportunity, and because of the potential impacts of oil and gas development on the establishment of new muskoxen herds on the coastal plain. USFWS biologists acquired most of the information used in this report, but they are limited to investigations within or close to ANWR. ADF&G should allocate muskoxen survey and inventory funds for FY91 to permit greater cooperative work with USFWS in Subunit 26C and to expand aerial surveys outside ANWR in Subunit 26B.

CONCLUSIONS AND RECOMMENDATIONS

The muskoxen population in Subunit 26C is growing but at a slower rate than in previous years because of lower calf production and/or survival in 1986 and 1987. Dispersal of bulls and some mixed groups to the east and west is also slowing the growth rate in the subunit. This may reflect social pressure stimulated by higher muskoxen density in Subunit 26C, but the population has probably not reached nutritional carrying capacity. The muskoxen population in Subunit 26C is not dense compared to populations on Banks Island and mainland Northwest Territories, Canada, and habitat in ANWR is at least as good (C. Zachel, pers. commun.). I expect the herd in Subunit 26C to continue as a source for emigrants to adjacent areas. The establishment of resident muskoxen in Subunit 26B has occurred only recently. However, the rate of increase of muskoxen in Subunit 26B in the last 3 years indicates that this part of the population could grow as rapidly as did those in Subunit 26C. Expansion westward will probably continue and muskoxen will probably repopulate all of Subunit 26B within 10 years.

The herd management objectives for growth and dispersal of muskoxen in Subunits 26B and C are being met. I recommend that these management strategies be continued and that harvest be limited to less than 20 animals for the next few years.

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