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MUSKOX

Susan M. Abbott, Editor



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Study 16.0
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Walter J. Hickel, Governor

DEPARTMENT OF FISH AND GAME
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DIVISION OF WILDLIFE CONSERVATION
David G. Kelleyhouse, Director
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Cover illustration by Barbara Bradford.

TABLE OF CONTENTS

<u>Game Management Unit</u>	<u>Page</u>
Unit 18 - Yukon-Kuskokwim Delta	1
Unit 22 - Seward Peninsula and Nulato Hills draining into Norton Sound	16
Unit 23 - Northern Kotzebue Sound and the Western Brooks Range	21
Subunits 26B and 26C - Central and Eastern Arctic Slope	32

LOCATION

Game Management Unit: 18 (41,159 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 re-introduce muskoxen in Alaska. Thirty-one muskoxen were introduced from Greenland to Nunivak Island in Unit 18 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 was opened in 1975, and the population has since fluctuated between 750 and 500 animals, exhibiting considerable reproductive potential even under heavy harvest regimes. The Nunivak muskox population remained healthy and productive in 1991 and 1992, declining slowly since 1989 under a harvest strategy designed to reduce the population size.

During 1967-68, 23 subadult muskoxen were transplanted from Nunivak Island to Nelson Island, 20 miles across Etolin Strait. The muskox population on Nelson Island has exhibited an average annual growth rate of 22% between 1968 and 1981. The first hunting season was opened in 1981 when the population approached the management goal of 200 to 250 animals. The population has since remained stable providing emigration to the mainland and stable harvests. When the last census was completed on 14 March 1992, the pre-hunt population was estimated at 214 muskoxen.

More than 100 muskoxen now reside on the mainland of the Yukon-Kuskokwim Delta, having originally emigrated from Nelson Island. Mainland muskoxen are now widely distributed at low densities in small herds from the mouth of the Kuskokwim River to the Andreafsky Mountains, and are slowly expanding their range north and east. Sightings have been documented by local residents, aircraft pilots, and by agency biologists conducting surveys of other species.

MANAGEMENT DIRECTION

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

1. Maintain a post-hunt population size of approximately 200 muskoxen on Nelson Island, and approximately 500 on Nunivak Island.

- 1a. Conduct aerial and ground surveys in cooperation with the FWS on Nunivak Island to estimate population size and composition.
- 1b. Conduct aerial surveys on Nelson Island with helicopters and fixed-wing aircraft to estimate population size and composition.
- 1c. Issue drawing and registration permits for hunting muskoxen on both Nunivak and Nelson Island.
2. Determine the distribution and dispersal of muskoxen onto the mainland.
 - 2a. Maintain up to 5 radio-collared muskoxen on the mainland to monitor population status and dispersal.
3. Finalize work on a cooperative muskox management plan for Nunivak Island.
 - 3a. Participate in an interagency effort to finalize a reindeer-muskox management plan for Nunivak Island, and to see that the goals and objectives are being carried out by all parties.

METHODS

A ground census of the Nunivak Island muskox population was completed on 22-26 March 1992 by Alaska Department of Fish and Game (ADF&G), U.S. Fish and Wildlife Service (FWS), and Bering Sea Reindeer Products (BSRP) staff. Snowmachines were used to traverse the perimeter of the island and 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. We plotted all observations on 1:63,360 scale topographical maps. An aerial census providing information on overall numbers and distribution of muskoxen was completed in April 1992. Two USFWS aircraft accompanied by observers from the village of Mekoryuk surveyed all but the interior portion of the island.

An aerial census of the Nelson Island muskox population was conducted by ADF&G staff on 14 March 1992. The island was completely surveyed during a 4.0 hour flight in a Robinson R22 helicopter.

The number of permits were increased on Nunivak Island to decrease the herd gradually. This reduction was agreed upon by the ADF&G, USFWS, Bering Sea Reindeer Association, and the residents of Mekoryuk. As in past years, the number of permits issued for Nelson Island remained the same. Hunter orientations were given to ensure that hunters harvested only animals of the proper sex, and that they understood the regulations and permit requirements. Village representatives at Toksook Bay (Nelson Island) and

Mekoryuk (Nunivak Island) administered hunter checkouts to obtain sex and age information and harvest locations.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: Results of a census conducted in spring 1992 indicate that the post-hunt, pre-calving Nunivak Island population numbered at least 437 animals. I estimate that the post-calving population numbered approximately 500 muskoxen during summer 1992. We observed 49 groups and 407 muskoxen during ground composition counts conducted in spring 1992. The aerial census conducted a few days after the ground count yielded 30 additional animals. We were unable to cover 1 interior portion of the island.

The 1992 post-hunt, pre-calving population size for Nunivak Island of 437 animals decreased dramatically from the 568 found during the 1991 census. Since 1975 when harvests began, the population has ranged from 500 to 750 muskoxen.

Results of the survey conducted during March 1992 indicate that the pre-calving, pre-hunt population on Nelson Island was at least 214 muskoxen, a slight decrease from the February 1991 aerial survey. We found approximately half of the Nelson Island muskox herd wintering on the steep escarpments of Cape Vancouver between the villages of Toksook Bay and Tununak. These muskox are 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. The herd has provided a nucleus for emigration to the mainland while sustaining annual harvests during this period. The herd size remained stabilized for the last 10 years, even with harvest rates approaching 15% (Table 2 and 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 during November through May. These movements between the island and mainland may explain some of the annual fluctuations observed in the Nelson Island herd.

Mainland muskoxen are descendants of the 23 muskoxen introduced to Nelson Island during 1967-68. Muskoxen have been sighted on the mainland of Unit 18 for 18 years. Although comprehensive surveys for determining the size of the mainland population have never been conducted, periodic sightings by ADF&G and USFWS staff, and the public indicate that the mainland population numbers approximately 100 to 150 animals. This population was estimated to number 40 animals in 1984. We attribute low productivity and high mortality observed among the mainland animals to low densities of breeding age animals and excessive harvests by hunters.

Population Composition: Composition data for the Nunivak Island herd is available from the 1992 ground census conducted during 22-26 March 1992. We classified 407 of the 437 muskoxen observed in 49 groups, ranging in size from 1 to 29 animals (Table 5). We counted 117 adult males (4+), 68 adult females (4+), 45 (3-year old) males, 45 (3 year-old) females, 27 (2 year-old) males, 26 (2 year-old) females, 60 yearlings, and 19 unclassified. We extrapolated the 19 unclassified animals into the various age and sex classifications.

The proportion of adult males in the population has increased during the previous 6 years, and the proportion of adult females and yearlings has decreased (Table 5). However, adult female numbers increased between 1989 and 1990, possibly because of higher than normal survival of all female age classes. Also, many of the unclassified animals during the 1989 count may have been predominantly females older than 3 or 4 years old. Extrapolated 1992 composition data indicate that 122 4-year-old and older bulls were present in 1992, compared to 72 4-year-old and older females. However, if 3-year old cows are reproductive, then the total number of reproductive age cows would be 119 animals (Table 5).

The pre-hunt composition of the Nelson Island muskoxen was 53 adult males, 45 adult females, 20 3-year-old males, 24 3-year-old females, 14 2-year-old males, 16 2-year-old females, and 42 yearlings (Table 1).

Distribution and Movements: The largest concentrations of Nunivak Island muskoxen observed during the 1992 census were found along the southwestern coast from Cape Mendenhall to Cape Mohican. Few muskoxen were found on 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 of southern Nunivak after late winter snow accumulates on the remainder of the island.

At the time of the March 1992 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. Snowcover was complete and about 16 inches deep. We also observed a herd of 12 muskoxen just off the northeast edge of Nelson Island along the shore of Baird Inlet. We found about half the Nelson Island herd on the cliffs of Cape Vancouver and the cliffs north of Tununak.

Few muskoxen are found in the central portion of Nelson Island except during the summer months. Muskox from Nelson Island often move onto the mainland across the shallow frozen inlets to the surrounding lowland tundra. Although some animals 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 ice on larger lakes and inlets.

Local residents, pilots, and agency biologists have reported numerous sightings of mainland muskoxen during the last 18 years. These reports continued throughout 1992. The 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. Four muskoxen were observed on the Mountain Village airstrip during late August 1989, a group of 13 near the Johnson River 43 miles from Bethel towards Chefornek during March 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. A herd of 13 animals remained within 30 miles of Bethel near the villages of Kasigluk, Nunapitchuk, and Atmautluak.

The rate of expansion and long-range movements demonstrated by mainland muskoxen is remarkable. A 4-year-old female muskox that was probably born on Nelson Island was collared as a 3-year-old female on 30 March 1989 near Pilot Station south of the Yukon River. This animal moved approximately 160 miles east to 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 radio-collared 3 muskoxen (2 bulls and 1 cow) from a herd of 9 animals located south of the Yukon River between Bethel and Pilot Station during March 1989. Three yearlings were present in this herd. These 3 collared animals have since died. This herd ranged westward to Pilot Station and eastward to Russian Mission and the upper Johnson River.

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

Mortality

Season and Bag Limit:

All Hunters:

Unit 18,
Nunivak
Island

One bull by drawing
permit only. 10 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

Bull Season:

Sept. 1-Sept. 30
Feb. 15-Mar. 15

Cow Season:

Sept. 1-Sept. 30
Feb. 1-Mar. 15

for cows (5 in the fall
and 30 in the spring) will
be issued on a first-come,
first-serve basis.

Unit 18,
Nelson
Island

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

Feb. 1-Mar. 25

Remainder
of Unit 18

No Open season

Harvest:

Human-induced Mortality. Ten bull drawing permits and 5 cow registration permits were available to hunters each season during September 1990 and 1991. The 10 drawing permittees were notified by mid-July of their eligibility to hunt bull muskox during September. Only 4 drawing permittees during September 1990 and 5 during September 1991 elected to hunt, and all harvested bull muskoxen. During August 1990 and 1991, 5 cow registration permits were available each season on a first-come, first-served basis in Mekoryuk. Only 1 out of the 5 permittees harvested cow muskox during the 1990 and 1991 September seasons.

Thirty-five persons drew permits each year to hunt bull muskoxen on Nunivak Island for spring 1991 and 1992. A waiting list of over 300 alternate permittees generated by this drawing hunt each year indicates the continuing popularity of the Nunivak spring bull hunt. Because some successful permit applicants chose not to hunt, we contacted an additional 30 persons from the alternate list during spring 1992. All 35 persons with drawing permits who hunted were successful. Five additional unused permits from the fall hunt were used for the spring hunt, bringing the spring 1992 harvest quota to 40 bulls. The total bull harvest for the 1991-92 regulatory year was 45 muskoxen.

Seventeen registration permits for the spring 1991 and 1992 cow hunts were available 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 for both years.

During both years, 8 permits were issued in Bethel with 2 hunters remaining on the waiting list. Applicants spent the night inside the office building waiting for their permits. During both years, all 3 permits were issued in Anchorage and both Fairbanks permits were issued as well. All 30 cow permit holders were successful.

Hunters harvested 71 and 76 muskoxen, respectively, (85 bulls and 62 cows) during the 1990-91 and 1991-92 seasons from Nunivak Island (Table 6). Historically, the number of bulls and cows harvested has not been constant, and are intentionally being increased slowly to reduce the herd size.

Thirty registration permits for Nelson Island muskoxen (15 bulls and 15 cows) were issued at the Toksook Community Center during January 1991, and 30 permits were issued during January 1992 at the Tununak Community Center. Thirty-four hunters showed up for the permit issuance in 1991 and 30 in 1992. All hunters attended a bilingual orientation on the identification of the age and sex classes of muskoxen during both years. Six hunters did not go hunting during the 1991 season.

The total harvest for Nelson Island in 1991 was 10 bulls and 14 cows. During the 1992 season, 15 bulls and 15 cows were harvested. An additional bull was shot and abandoned between Tununak and Newtok by snowmachine hunters during the 1991 season. Two cows were similarly shot and abandoned between Tununak and Toksook Bay in 1992. The total human-induced mortality for Nelson Island was 10 cows and 15 bulls in 1991, and 17 cows and 15 bulls in 1992. Historically, Nelson Island harvest goals have remained the same since 1985, allowing a limited harvest of both females and males to stabilize the population (Table 3).

Harvest Chronology: Harvest chronology for cow muskox on Nunivak Island, and for 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 harvested their muskoxen between late February and mid-March when increasing daylight hours and milder weather occur. Bull hunters on Nunivak Island usually hunted with guides or transporters, and their hunts were normally scheduled well in advance of the season.

Hunter Residency and Success: Most drawing permittees were residents of Anchorage and southcentral Alaska. Success rates were 100% for 1991 and 1992.

One of the 5 cow registration permits available each year for fall 1990 and 1991 were issued to Mekoryuk residents. The other permits went to Bethel residents who did not go hunting. We issued all 17 cow muskox permits available at Mekoryuk for spring 1991 and 1992 hunt to local residents. We issued all 8 permits available at Bethel to Bethel residents. Both permit holders who obtained registration permits at Fairbanks were from the Fairbanks area. We issued 3 permits available at Anchorage to Anchorage residents.

Of the 30 registration permits available at Toksook Bay in 1991, all went to Nelson Island residents. Of the permits issued at Tununak in 1992, 25 of the permits went to Nelson Island residents, 4 went to Bethel residents, and 1 to an Anchorage resident (Table 4).

Success rates for Nelson Island hunters for 1991 was 80% and for 1992 was 100%. Success rate for all Nunivak muskox hunters entering the field was 100% during both years. Success rates for Nunivak hunts have consistently remained at 100% 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 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. However, 1 Bethel hunter transported his cow muskox by use of a floatplane. Snowmachines are used for late winter hunts on both Nunivak and Nelson islands.

Natural Mortality

Little quantitative information is available concerning natural mortality among muskoxen in Unit 18. No large predators such as bears and wolves are on Nunivak Island, and are rare or non-existent on Nelson Island and the lowland of the Delta. Most natural mortalities are results of accidents such as falling off cliffs, breaking through ice over lakes and streams, and becoming stranded on drifting sea ice.

Habitat

Assessment: The Nunivak Island lichen range is considered 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 extensively using marginal habitats along the steep marine escarpments to avoid hunters and snowmachine traffic during December through April. Concerns about the status of the range 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 ADF&G the discretionary authority to issue up to 45 bull and 45 cow permits on Nunivak Island. For the 1990-91 regulatory year, the ADF&G staff issued 35 cow and 40 bull permits on Nunivak. During the 1991-92 regulatory year, 35 cow and 45 bull permits were issued. This quota should allow us to maintain the population guideline of 500-550 animals, and help correct the imbalance in the sex ratio of the population.

During its spring 1992 meeting, the board gave the department the discretionary authority to issue up to 30 muskox permits on Nelson Island. The old regulation required that we issue 15 bull and 15 cow permits annually. This should allow us to adjust harvest levels for each sex to compensate for changes in population size and demography.

CONCLUSIONS AND RECOMMENDATIONS

The Nunivak Island herd is characterized by high productivity and low natural mortality. The proportion of adult males in the population has increased during the last 6 years, and the proportion 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 for at least several years. The harvest of bulls and cows should be reduced when the post-hunt, pre-calving population size reaches 500 animals.

Interagency meetings have been held biannually in Bethel and at the village of Mekoryuk to finalize a muskox-reindeer management plan for Nunivak Island. There has been a management plan drafted and comments received in cooperation between 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 6,000 to 8,000 privately owned reindeer that inhabit Nunivak Island. This plan includes ways to reduce the reindeer herd to 3,000 animals or less. The proper management of the reindeer affects the capacity of the island 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 Alaska, and allowing hunting opportunities of muskox have been identified as the 3 major goals for muskox 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. Nelson Island muskoxen are not always confined to the island because the animals can cross frozen tidal inlets to the mainland from November to May. The Nelson Island muskox population has provided a source for emigration to the mainland and stable harvests in recent years. We recommend bulls-only harvests for the 1993 season, and variable harvests until the 1996 season.

Mainland muskoxen in Unit 18 have increased in range and numbers during recent years. As many as 100 to 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, and are expanding their range north and east. No known sightings of muskoxen 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 that hunting remain closed on mainland muskoxen. 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 a cooperative collaring project with the Yukon Delta National Wildlife Refuge and village councils to develop an educational program that encourages local residents to protect this rare and unique species.

Prepared by:

Randall H. Kacyon
Wildlife Biologist III

Submitted by:

Steven Machida
Survey-Inventory Coordinator

Table 1. 1992 Nelson Island muskoxen (pre-hunt) composition.

Sex and Age Class						
4+ year-old		3 year-old		2 year-old		Yearlings
Males	Females	Males	Females	Males	Females	
53	45	20	24	14	16	42

Table 2. Historical Nelson Island muskox herd size, 1973-1992.

Year	Pre-Hunt, Pre-Calving Population size	Post-Hunt, Pre-Calving ^a Population size
1973	44	N/A
1975	66	N/A
1977	132	N/A
1978	107	N/A
1980	167	N/A
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

^a Regulated hunting did not begin until spring 1981.

Table 3. Nelson Island muskox harvests and number of applicants, 1981-92.

Year	<u>No. permits available</u>		<u>No. muskox harvested</u>		No. 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)*	58
1991	15	15	10	14(1)*	34
1992	15	15	15(2)*	15	30

* Added number of muskoxen found dead from wounding.

Table 4. Residency of Nelson Island muskox hunt permittees, 1981-92.

Year	No. permits available	No. Residents of UVNI ^a villages	No. residents of Unit 18 excluding UNVNI villages	Residents outside Unit 18
1981	20	20	0	0
1982	30	30	0	0
1983	25	21	3	1
1984	30	21	9	0
1985	30	25	5	0
1986	30	21	9	0
1987	30	29	1	0
1988	30	27	3	0
1989	30	30	0	0
1990	30	30	0	0
1991	30	30	0	0
1992	30	25	4	1
Total	345 (100%)	309 (89.6%)	34 (9.8%)	2 (0.6%)

^a Villages associated with the United Villages of Nelson Island.

Table 5. Sex and age composition of muskox observed during the spring ground census, Nunivak Island 1976-1992.

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

Table 5. (Continued)

Year		Yearlings		2 Yr.-old		3 Yr.-old		4+ Yr.-old		Unclassified	Total	Percent Yearlings
		M	F	M	F	M	F	M	F			
1986	Count	45	46	43	21	47	52	102	73	58	487	0.19
	Est.	51	52	49	24	53	59	116	83			
1987	Count	39	40	51	48	57	88	93	81	89	586	0.13
	Est.	46	46	60	57	67	104	110	96			
1988	Count	38	39	38	44	43	71	133	74	129	609	0.13
	Est.	48	49	48	56	55	90	169	94			
1989	Count	40	40	19	22	48	57	139	51	161	577	0.14
	Est.	55	55	26	31	67	79	193	71			
1990	Count	35	36	36	42	50	77	156	100	36	568	0.13
	Est.	38	38	38	45	54	82	166	107			
1991	Count	32	32	24	15	43	37	146	86	24	439	0.15
	Est.	34	34	25	16	46	39	154	91			
1992	Count	30	30	27	26	45	45	117	68	19	407	0.15
	Est.	32	32	28	27	47	47	122	72			
											Average	0.16

Table 6. Muskoxen removed from the Nunivak Island population by hunting, 1975-1992.

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
Total	558	466	1	1,025

LOCATION

Game Management Units: 22 (25,230 mi²)

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 re-introduction in spring 1970 when 36 animals were transplanted 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%. An additional 34 muskoxen¹ 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 conducted in 1992 indicated the Seward Peninsula muskox population contained 706 animals. Presumably because of the harsh winters of 1989-90 and 1990-91, growth rates declined slightly averaging 15% annually between 1988 and 1992.

MANAGEMENT DIRECTION

The following management goals form the basis of a management plan 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 take animals from existing herds and re-establish them on 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 the highest priority uses of muskoxen.

Management Goals

Management goals for Unit 22 muskoxen are to:

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

¹The original number of animals transplanted was 37. A 4+ female died shortly after the transplant, and a yearling was transported to Fairbanks, Alaska because of capture myopathy.

- 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 Subunit 22C for viewing, education, and other non-consumptive 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

A muskoxen census was conducted during spring 1992 on the Seward Peninsula west of approximately 163°30' W in Units 22 and 23. The area was apportioned into 5 sample units which were thoroughly surveyed by Supercub aircraft equipped with radio-tracking gear. When muskoxen were located, the survey crew determined whether the group contained any radio-collared animals. A visual count was made, and the number of short yearlings noted. Black and white photos were also taken.

Upon completion of the census, the number of known active radio collars was compared to the number actually found. An additional flight was made to locate missing radio collars and animals. Photos were enlarged, individual muskoxen were counted, and group counts from the photos were compared to visual counts.

During June 1992 muskoxen composition data were obtained by the use of a helicopter and a Supercub aircraft. With the exception of calves and yearlings, individual were sexed and classified as adults, 3-year-olds, and 2-year-olds.

Radio-collared muskoxen provided a basis for conducting survey-inventory work. Ten radio-tracking flights were completed between November 1991 and June 1992 to gather location and composition data on collared muskoxen. These data were obtained from only on those muskoxen residing in the western and northern portions of the Seward Peninsula.

Sightings provided by the public of muskoxen 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 at a substantial rate. A recently developed model of this population indicates the herd may contain over 2,300 animals by the year 2000 if the current rate of increase continues. Reports of muskoxen east of 163°30' W are becoming more commonplace. As the herd increases in size, so will the numbers of animals emigrating eastward.

Population Size: During the census conducted in April 1992, 706 muskoxen were found in 52 individual groups ranging in size from 1 though 69 animals. Location by unit and subunit of the groups and total numbers of animals counted is as follows:

Unit 23, 8 groups (134 animals).
Subunit 22B, 2 groups (3 animals).
Subunit 22C, 6 groups (49 animals).
Subunit 22D, 22 groups (340 animals).
Subunit 22E, 14 groups (180 animals).

Before the census, 20 muskoxen (6 males and 14 females) had active radio-collars. Nineteen radio-collared animals were located. The remaining lone bull was not found.

Population Composition: On 7 June 1993, composition data were gathered for 20 groups of muskoxen distributed throughout the southwest portion of the Seward Peninsula in Subunit 22D, and 353 muskoxen were classified. 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.

Harvest:

Human-Induced Mortality. One adult bull was known to have been illegally killed during summer 1992.

Natural Mortality: Although we obtained no meaningful measure of natural mortality of Seward Peninsula muskoxen during the report period, I believe that the severe winters of 1989 and 1990 had an impact on muskoxen survival, particularly of calves.

CONCLUSIONS AND RECOMMENDATIONS

The Seward Peninsula muskoxen population grew and expanded into new suitable habitat as shown by recent survey data. The unusual severity of the winters of 1989-1990 and 1990-91 was directly reflected in the composition data because the percentages of 2-year-olds and yearlings was lower than expected. The number of animals observed during the survey is considered a minimum population figure because we know that not all Seward Peninsula muskoxen were found. Productivity remains high, and I suspect survival rates continued to be equally high. I estimate no less than 850 muskoxen currently reside on the Seward Peninsula.

During recent years, Seward Peninsula muskoxen have become a high profile species among members of the public. Their success in re-establishing themselves throughout much of the unit's suitable habitat has prompted interest, primarily among local residents, in establishing a hunt.

Efforts are underway to develop a cooperative management plan for Seward Peninsula muskoxen. Cooperators of this plan include the Department (ADF&G), The National Park Service (NPS), the Bureau of Land Management (BLM), and the native corporations of Bering Straits (BSNC) and Northwest Alaska (NANA). Our intention is to submit this plan for approval to the Board of Game and the Federal Subsistence Board at the spring 1994 meetings.

To meet the established goals regarding the future of Seward Peninsula muskoxen, the following management activities are recommended:

1. Maintain a pool of at least 25 collared animals and monitor movements on a regular basis.
2. Conduct surveys and collect composition data at 2-year intervals.

LITERATURE CITED

- Smith, T. E. 1987. Status and dispersal of an introduced musk-ox population on the Seward Peninsula. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Final Report. Job 16.1R Proj. W-22-3, W-22-4 and W-22-5.
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Prepared by:

Robert R. Nelson
Wildlife Biologist III

Submitted by:

Steve Machida
Survey-Inventory Coordinator

LOCATION

Game Management Unit: 23 (43,000 mi²)

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 re-introduced 36 muskoxen from Nunivak Island to Cape Thompson. An additional 34 muskoxen were transplanted to Cape Thompson in 1977.

Of all attempts to re-introduce muskoxen into their historic ranges in Alaska, the Cape Thompson transplant 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 excessive illegal harvests and poor quality winter ranges (Larsen 1989).

MANAGEMENT DIRECTION

The following management goals and objectives are established for muskoxen 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 1994, and at 3 to 5 year intervals thereafter.

METHODS

We used radiotelemetry and opportunistic sightings to collect information on movements and distribution of muskoxen in northwest Alaska. Monitoring efforts have been minimal since 1988. The National Park Service (NPS) and the ADF&G relocated collared muskoxen 2 to 4 times annually from fixed-wing aircraft during this report period. Limited sex and age composition data (adult and calf <12 months old) were recorded when possible. Because all composition data were recorded from fixed-wing aircraft (rather than from ground observation or from a helicopter), sex and age data are incomplete.

During this report period, ADF&G staff captured 2 muskoxen in the Tahinichok Hills and 1 female near the village of Point Hope, and removed radio collars that had flipped over the animals horns and were partially blocking their vision. They used snowmachines or 4-wheelers to access the animals and immobilized them with Carfentinal (4-5 mg) and Xylazine (12-17 mg). Naloxone (600-900 mg), injected by hand syringe, reversed the effects of the drugs.

In April 1992, we conducted an aerial census in Unit 22 and the southern portion of Unit 23. The census area was divided into count areas and searched by fixed-wing aircraft. Known locations of groups containing radio-collared animals were used to verify count area totals. The result of the census was expressed as a minimum count. Methods and results are described in detail in the Unit 22 survey-inventory report for this period.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size: The Cape Lisburne muskoxen population appears stable, and populations in the Unit 23 portion of the Seward Peninsula are increasing. Productivity and natural mortality rates appear low. The Unit 23 population is comprised of approximately 110 to 140 individuals located near Cape Thompson, and 135 to 150 individuals located on the northern Seward Peninsula. During the April 1992 census, observers counted 8 groups of muskoxen totaling 134 individuals in the Unit 23 portion of the Seward Peninsula.

Population Composition: Calf production in Unit 23 appears within the range expected for a stable or increasing population. Increased surveys are needed to collect valid composition data. Calves composed 7% to 22% of the muskoxen observed during radiotelemetry surveys (Table 1). During the 1988 census in the northern portion of Unit 23, we found 14% calves (n=123) in the population. In Unit 22 which has an expanding population, similar radiotelemetry surveys yielded an estimate of 18% calves. This percentage is probably low because most collars were on males.

Distribution and Movements: We relocated collared muskoxen on 64 occasions and observe no changes in range use. For the second time in Unit 23, staff received a report that a collared muskox had flipped the transmitter over its horns, blocking its vision and rubbing the bridge of its nose. We removed the collar from female #003 and collared a male (#014) in the same group. At the end of this report period, we verified that 4 muskoxen had functioning radio collars (Table 3). Two muskoxen collared in 1986 and 1989 have not been relocated during the last 2 years. The batteries on these collars have probably expired.

The number of observations of dispersing individuals, primarily older males, increased during the report period. This may indicate that muskox habitat on the Lisburne Peninsula

is at carrying capacity. If so, it may be unrealistic to expect this population to reach higher densities in the future. Local residents reported seeing individual muskoxen in the upper and middle Kobuk as well as the upper and middle Noatak River drainages. There has been no indication that new, productive herds have become established in these areas. Movements of radio-collared animals from the Seward Peninsula northward suggest that increases in that population may eventually augment muskoxen numbers in northern portions of Unit 23.

Observations of muskoxen during winter have clearly shown that they primarily depend on relatively low, rolling, and windblown hills for winter habitat. Although rolling hills are abundant within Unit 23, most of this terrain does not blow clear of snow. As a result, winter habitat availability may be an important factor currently limiting the growth of muskoxen populations in Unit 23.

Mortality

Season and Bag Limit: There is no open season.

Harvest and Natural Mortality

Eleven muskoxen are known to have died during the report period. Four out of the 11 radio-collared muskoxen died. Local residents and staff reported finding an additional 7 muskox carcasses. The following circumstances surrounded these incidences:

- Local residents found 3 adult females from the Rabbit Creek herd frozen in a stream bed in April 1991. The heads of these animals had been taken but no meat had been salvaged. Cause of death could not be established although a large quantity of blood beneath one of the animals suggested it was shot.
- During fall 1991, Unit 23 residents reported finding a radio-collared female (#005) washed up on a bank of the lower Noatak River. The cause of death could not be determined.
- During June 1992, a staff biologist found that 4 muskoxen (1 adult male, 1 adult female, a young male or adult female, and a 4-6 week old male calf) had been shot 15 miles northwest of Kivalina. Only the head of the adult male and the head and 1 hindquarter of the young male or adult female had been retrieved. The calf and other adult female had not been touched.
- A resident of Kivalina reported finding a radio-collared adult bull muskox (#008) in the Wulik River in late August 1992. The head had been removed and taken to Kivalina. The cause of death was not confirmed, but the animal was reportedly shot.

- During regular radio-tracking surveys, staff confirmed the death of 2 radio-collared animals (male #004 and female #013). The cause of death for both animals is unknown.

High survival rates among radio-collared animals indicates that natural mortality of adult muskoxen is very low. Illegal harvest of muskoxen by local and non-local hunters has been a chronic problem in Unit 23, and appears to be increasing. A public service announcement addressing the illegal killing and waste of muskox was aired on the local radio station during June 1992.

CONCLUSIONS AND RECOMMENDATIONS

The department should establish and maintain direct communication with residents of Point Hope, Kivalina, Noatak, Deering, and Buckland regarding management decisions and conservation of muskoxen. At a public meeting conducted in Point Hope during August 1992, village elders expressed frustration over several aspects of muskoxen management in Unit 23. Their primary complaint was that muskoxen had been re-introduced to this portion of the unit without any input from them. Residents of Point Hope and elsewhere in the unit feel the presence of muskoxen, muskoxen hair, and muskoxen feces scare caribou away from important hunting areas. Point Hope residents attribute the scarcity of caribou in their region over the last 20 years to the re-introduction of muskoxen.

The second complaint of Point Hope residents regarding muskoxen management in Unit 23 was that they are not allowed to legally harvest even a small number of muskoxen for meat. These concerns have intensified over the years and appear to be beyond the point of informed discussion. This will undoubtedly undermine the department's ability to manage muskox in the future, and will probably continue to affect the willingness of Point Hope residents to comply with regulations for other species. This situation highlights the need for public involvement and support throughout wildlife management processes.

Investigations addressing the slow population growth of re-introduced muskox herds in the Cape Thompson area are recommended. Contact should be maintained with other agencies interested in muskox research. The department should participate in defining research needs for muskoxen management in northwest Alaska.

Radio collars should be removed from 4 muskoxen in northwest Unit 23. At this time there are at least 7 major groups of muskoxen in Unit 23 that do not have collared animals in them. Radio collars flipping over the horns of muskoxen continues to be a problem. This generates a poor public image for projects using radiotelemetry. Time and funding could be best used for annual or biannual population censuses.

Opportunistic observations by staff and the public should continue to be solicited, and recorded in a standard data base.

LITERATURE CITED

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Prepared by:

Lee Anne Ayres
Wildlife Biologist II

Submitted by:

Steven Machida
Survey-Inventory Coordinator

Reviewed by:

Jim Dau
Wildlife Biologist III

Table 1. Minimum numbers of adult and calf muskoxen observed during radio tracking flights, Unit 23, 1 July 1990 - 30 June, 1992. Observations include groups of muskoxen without radio collars that were observed during flights.

Date	Adults ^a	Calves	Total	% Calves
09/28/90	73	13	86	15
03/07/91	77	06	83	07
04/19/91	32	08	40	20
06/04/91	97	24	121	20
06/08/92	74	10	84	12
08/24/92	38	06	44	12
06/04/93	123	35	158	22

^a Adult category includes yearlings.

Table 2. Dates and locations of radio-collared muskoxen in Unit 23 located between 1 July 1990 and 30 June 1992.

ID	Date	Location	Adults	Calves	Total	Association (ID#)
001	9/28/90	Cape Thompson	35	8	43	
	3/07/91	Cape Thompson	31	2	33	(006)
	4/19/91	Cape Thompson	-	-	27	
	6/04/91	N. Cape Thompson	29	8	37	(002)
	6/08/92	12 NW Chariot	2	0	2	
	8/24/92	3 N Chariot	14	1	15	(012)
	6/04/93	Nalakachak Creek	24	3	27	
002	6/04/91	N. Cape Thompson	29	8	37	(001)
003	9/28/90	Jade Creek	11	2	13	(005)
	3/07/91	Tachinichok Mts.	4	0	4	
	4/19/91	Tachinichok Mts.	7	2	9	
004	9/28/90	Kukpuk River	15	2	17	(013)
	3/07/91	N. Point Hope	-	-	-	(013)
	6/04/91	Kukpuk River	15	6	21	(013)
	6/08/92	N. Point Hope	-	-	-	(Mortality)
005	9/28/90	Jade Creek	11	2	13	(003)
	3/07/91	Tachinichok Mts.	12	2	14	
	4/19/91	Tachinichok Mts.	1	0	1	
	4/22/91	Tachinichok Mts.	1	0	1	
	6/04/91	Tachinichok Mts.	1	1	2	
	9/04/91	Tachinichok Mts.	1	1	2	
	10/16/91	Noatak River	1	1	2	(Mortality 1992)
006	3/07/91	Cape Thompson	31	2	33	(001)
008	9/28/90	Kivalina River	1	0	1	
	3/07/91	Upper Wulik River	1	0	1	
	4/19/91	Upper Wulik River	1	0	1	
	6/04/91	Wulik River	1	0	1	
	9/04/91	Wulik River	-	-	-	
	6/08/92	Port Site	7	0	7	(014) (Mortality Fall 92)

Table 2. (Continued).

ID	Date	Location	Adults	Calves	Total	Association (ID#)
010	3/07/91	Chariot	22	2	24	(011)
	4/19/91	Chariot	17	4	21	
	6/04/91	Point Hope	18	1	19	
	9/23/91	6 mi E Chariot	4	0	4	
	6/08/92	6 mi E Chariot	29	3	32	(012)
	8/24/92	L.Kivalina River	3	2	5	
	6/04/93	10 mi S Chariot	15	2	17	
011	9/28/90	Chariot	11	1	12	(012)
	3/07/91	Chariot	22	2	24	(010)
	4/19/91	Chariot	6	2	8	(012)
	6/04/91	Chariot	7	2	9	(012)
	8/30/91	20 E. Pt Hope	-	-	-	(012)
012	9/28/90	Chariot	11	1	12	(011)
	3/07/91	Chariot	7	0	7	
	4/19/91	Chariot	6	2	8	(011)
	6/04/91	Chariot	7	2	9	(011)
	8/30/91	20 mi E. Pt Hope	-	-	-	(011)
	9/23/91	Cape Thompson	-	-	32	(013)
	6/08/92	Chariot	29	7	36	(010)
	8/24/92	3 N Chariot	14	1	15	(001)
	6/04/93	Cape Thompson	11	4	15	
013	9/28/90	Kukpuk River	15	2	17	(004)
	3/07/91	N. Point Hope	-	-	-	(004)
	6/04/91	Kukpuk River	15	2	17	(004)
	8/30/91	Kukpuk	-	-	-	
	9/23/91	Cape Thompson	-	-	32	(012)
	6/08/92	Cape Thompson	-	-	-	(Mortality)
014	4/23/91	Rabbit Creek	7	2	9	
	5/10/91	Rabbit Creek	-	-	9	
	6/04/91	Tachinichok Mts.	11	4	15	
	9/04/91	Jade Creek	6	3	9	
	9/23/91	Rabbit Creek	12	2	14	
	6/08/92	Port Site	7	-	7	(008)
	8/24/92	Rabbit Creek	1	-	1	
	6/04/93	Tachinichok Mts.	3	-	3	

Table 2. (Continued).

ID	Date	Location	Adults	Calves	Total	Association (ID#)
Observations of muskox groups (no radio collars)						
	9/28/90	Rabbit Creek	14	2	16	
	5/19/91	Igichuk Hills	3	2	5	
	9/03/91	Krusenstern Lag.	3	2	5	
	9/22/91	Tachinichok Mts.	-	-	38	
	8/24/92	Chariot	20	3	23	
	2/23/93	18 S Kotzebue	9	1	10	
	6/04/93	Tachinichok Mts.	40	12	52	
	6/04/93	Cape Thompson	30	14	44	

Table 3. Ages, capture dates, capture locations, and status of collared muskoxen in Unit 23, September 1983 - June 1992.

ID#	Frequency	Sex	Capture Date	Age	Capture Location	Present Status
01	150.360 148.840	F	9/16/83 9/12/86	-	Cape Krusenstern Cape Thompson	Active 6/93
02	150.250	F	9/16/83	-	Cape Thompson	Expired Battery
03	148.100	F	9/12/86 4/23/91	-	Cape Thompson Rabbit Creek	Collar Removed
04	148.810	M	9/12/86	-	Cape Thompson	Mortality 8/91 On Air 6/93
05	148.070 149.740	F	9/12/86 5/10/89	7	Rabbit Creek Rabbit Creek	Mortality ?/92 Retrieved
06	150.950	F	9/12/86	-	Kukpuk River	Active 3/91 Suspect Battery Expired 6/93
07	150.970	F	9/12/86	6	Kukpuk River	Mortality 4/87 Shed Collar
08	149.820	M	5/10/89	7	Rabbit Creek	Mortality 6/92 Collar Destroyed
09	149.750	M	9/03/89	12	Cape Thompson	Active/Missing Last Heard 5/90
10	149.770	F	9/03/89	6	Cape Thompson	Active 6/93

Table 3. (Continued).

ID#	Frequency	Sex	Capture Date	Age	Capture Location	Present Status
11	149.780	F	9/03/89	10	Cape Thompson	Collar Removed 8/91
12	149.830	F	9/03/89	11	Cape Thompson	Active 6/93
13	149.840	F	9/03/89	3	Cape Thompson	Mortality 9/91 -6/92 On Air 6/93
14	149.810	M	4/23/91	5+	Rabbit Creek	Active 6/93

LOCATION

Game Management Subunits: 26B and 26C (26,000 mi²)
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 500 muskoxen now inhabit the area between the Sagavanirktok River and the Malcolm River in the Yukon Territory. A small number of bulls has been harvested in Subunit 26C since 1983 and in Subunit 26B beginning in 1990.

Management Goals

Management goals for area muskoxen 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

Survey data were gathered by USFWS biologists during this report period. They conducted precalving surveys during early April using a Cessna 185 aircraft. Ground composition counts were conducted in Subunit 26C during early July in some years. 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. A fall post-rut census was usually flown in October. To facilitate locating muskoxen, approximately 20 radio-collared animals are maintained in the population.

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 Subunit 26C remained near 400, while numbers in Subunit 26B increased to about 165 in 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 presently includes approximately 550 muskoxen.

Population Composition: Annual composition data (Table 1) indicate that 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 exceed management objectives.

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

Mortality

Harvest:

Unit 26(B)
One bull by Tier II
permit only; up to two
muskoxen may be taken.
Evidence of sex required

Resident
Open Season
Oct. 1 - Oct. 31
Mar. 1 - Mar. 31

Nonresident
Open Season
No open season

Unit 26(C)
One bull by
federal permit, up
to 11 permits may be
issued.

Oct. 1 - Oct. 31
Mar. 1 - Mar. 31

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 Subunits 26B (hunt no. 1010T) and 26C (hunt no. 1012T) beginning with the 1990-91 season. These regulations allowed Alaska residents to harvest up to 15 bulls. The USFWS took over subsistence management of muskoxen in Subunit 26C beginning with the 1992-93 season, issuing up to 11 permits to Kaktovik residents. This harvest is divided among three areas in the subunit. The state administers a Tier II hunt in Subunit 26B for up to two bulls.

The actual number of permits issued each year has varied, with a maximum of 12 issued for the 1992-93 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 1985-86 to 1991-92 ranged from 4 to 10 (Table 2). No illegal harvest has been recorded since 1988-89, when three cows were accidentally taken. Annual harvest is strongly influenced by the effect of weather on travel conditions during October and March.

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

Hunter Residency and Success. Before the 1990-91 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 1990-91 resulted in all permits being obtained by local residents (Table 3).

Transport Methods and Harvest Chronology. Local hunters rely primarily on snowmachines to hunt muskoxen during March, but two bulls were taken in Subunit 26B by two local hunters using aircraft in fall 1990 (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 appear to be a more important predator 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 appear to contribute to mortality of calves, yearlings, and old adults but these losses are generally minimal.

Habitat

Various studies have focused on the status of muskoxen habitat (O'Brien 1988), and forage apparently is not limiting population growth in Subunits 26B and 26C. Social

factors are probably responsible for the increased emigration from Subunit 26C. Habitat in Subunit 26B is adequate to support a larger population than what currently exists in that area, and snow conditions appear more favorable for muskoxen there than in Subunit 26C (P. Reynolds, pers. commun.).

Nonregulatory Management Problems/Needs

No major nonregulatory problems exist at this point. I recommend that the herd expansion in western Subunit 26B and the northern Yukon Territory adjacent to the Arctic National Wildlife Refuge be monitored.

CONCLUSIONS AND RECOMMENDATIONS

Muskoxen are doing well under the present management regime and are expanding their range westward. Immigration and good reproduction and survival have resulted in a high rate of increase in muskoxen east of the pipeline in Subunit 26B. A small population has also established itself west of the pipeline and will probably expand its range and numbers in the future. The existing conservative harvest strategy should be continued. It will allow continued herd growth while providing continued benefits to local users.

It appears that USFWS will continue basic monitoring of muskoxen numbers, productivity, survival, and movements east of the Sagavanirktok River. The status of muskoxen west of the Sagavanirktok River can probably be monitored most efficiently by recording sightings during other surveys and reports from the public. The USFWS has recorded such observations and will continue to do so. The small number of animals involved indicates that aerial surveys would not be cost-effective at present.

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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Prepared by:

Robert O. Stephenson
Wildlife Biologist III

Submitted by:

Kenton P. Taylor
Management Coordinator

Reviewed by:

Patrick Valkenburg
Wildlife Biologist III

Table 1. Results of summer (postcalving) aerial muskoxen composition counts and estimated population size in Subunit 26B and 26C, 1986-92^a.

Regulatory year	<u>4+ yr adults</u>		<u>3 yr adults</u>		<u>2 yr adults</u>		Total adults	% Yearlings	% Calves	Total muskox observed	Estimated population size
	M	F	M	F	M	F					
1986-87	37	105	16	28	24	23	233	12.4	18.9	339	385 ^b
1987-88	49	80	15	38	23	22	227	16.2	22.6	371	410 ^b
1988-89	32	81	16	31	17	19	196	14.3	15.7	280	489 ^{b,c}
1989-90	42	82	18	19	17	18	196	17.0	15.2	289	470 ^b
1990-91	56	111	21	24	21	21	254	15.3	15.5	367	470 ^d
1991-92	77	150	24	37	21	34	343	11.5	20.4	504	n/a
1992-93	97	167	22	24	22	21	353	15.9	15.9	517	539 ^b

^a Data source: P.E. Reynolds, U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.

^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. Subunit 26B and 26C muskoxen harvest data by permit hunt, 1986-92.

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Illegal	Total harvest
1010T	1986-87	5		100	100	0			5
1012T	1987-88	5		100	100	0			5
1014T	1988-89	10	10	60	67	33		3	9
	1989-90	10		100	100	0			10
	1990-91	11		82	100	0			9 ^a
	1991-92	11		45	100	0		0	5 ^b

^a Two muskoxen taken in Subunit 26B and three in Subunit 26C.

^b All muskoxen taken in Subunit 26C.

Table 3. Subunit 26B and 26C muskoxen hunter residency and success, 1985-92.

Regulatory ^a year	Successful				Unsuccessful				Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Total (%)	
1985-86	2	1	0	3 (60)	2	0	0	2 (40)	5
1986-87	3	1	1	5 (100)	0	0	0	0 (0)	5
1987-88	2	3	0	5 (100)	0	0	0	0 (0)	5
1988-89 ^c	4	2	0	6 (60)	1	3	0	4 (40)	10
1989-90	2	7	1	10 (100)	0	0	0	0 (0)	10
1990-91	9	0	0	9 (82)	2	0	0	2 (18)	11
1991-92	5	0	0	5 (45)	6	0	0	6 (55)	11

^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 1988-89.

Table 4. Subunits 26B and 26C muskoxen harvest chronology by time period, 1986-92.

Regulatory year	Harvest periods				<u>n</u>
	8/15-8/31	9/1-9/15	3/1-3/15	3/16-3/31	
1986-87			3		3
1987-88			3	1	4
1988-89		3	2	3	8
1989-90	4	3	2	1	10
1990-91		3		2	9 ^a
1991-92			3	2	5

^a Date of kill for four muskoxen is unknown.

Table 5. Subunits 26B and 26C muskoxen harvest by transport method, 1986-92.

Regulatory year	Percent of harvest			<u>n</u>
	Airplane	Dog team	Snowmachine	
1986-87	0		3	3
1987-88	2		3	5
1988-89	3		3	8
1989-90	9		1	10
1990-91	2	1	6	9
1991-92			5	5

Federal Aid in Wildlife Restoration

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 then allots the funds back to states through a formula based on each state's area and of paid censehold-s t a t e . ceives 5% enues col-year, the lowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.



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