Alaska Department of Fish and Game
Division of Wildlife Conservation
Federal Aid in Wildlife Restoration
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1 July 1988-30 June 1989

MUSKOX

Compiled and edited by
Sid O. Morgan, Publications Technician
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STATE OF ALASKA
Steve Cowper, Governor

DEPARTMENT OF FISH AND GAME
Don W. Collinsworth, Commissioner

DIVISION OF WILDLIFE CONSERVATION
W. Lewis Pamplin, Jr., Director
W. Bruce Dinneford, Acting Planning Chief

Additional copies of this report, or reports on other species covered in this series may be obtained from:

Publications Technician
ADF&G, Wildlife Conservation
P.O. Box 3-2000
Juneau, AK 99802
(907) 465-4190

TABLE OF CONTENTS

STATEWIDE HARVEST AND POPULATION STATUS

Muskox populations are found in Alaska on (1) Nunivak and Nelson Islands and on the adjacent mainland (Unit 18), (2) the Seward Peninsula (Unit 22), (3) the northwest coast near Point Hope (Unit 23), and (4) the eastern Arctic Slope (Subunits 26B and 26C). All herds (except the one on Nunivak Island) are the result of transplants between 1967 and 1970 from Nunivak Island. The animals found on the Yukon-Kuskokwim mainland are the result of emigration from Nelson Island.

The lichen range on Nunivak Island is critically overgrazed, because of the presence of 6,000 reindeer and only 600 muskoxen on the island. Consequently, the muskox population objective for Nunivak is to reduce the herd to about 550 animals. Because this herd is characterized by high production and low natural mortality, we need to reduce it by increasing the harvest. The cow harvest should remain the same, but an increased number of bulls should be taken until the population reaches 550.

The Nelson Island herd is dynamic; a considerable proportion of the population has emigrated to the mainland areas of Unit 18. Presently the objective is to maintain the herd at 250 animals. Recently there were over 200 muskoxen present on this island. The large difference from the previous year's population (120) is because of movement back to the island from the mainland and not because of reproductive performance. Thirty-six were harvested during the reporting period, equalling the harvest for the previous year.

The Seward Peninsula population has grown at an average annual rate of 19% since 1970, and the population continues to serve as an important center for expanding into unoccupied habitat. Management objectives are still being developed for this herd. Recent population surveys showed that a direct count of 461 animals agreed very closely to a population estimate of 480 ($\pm$ 132 at 95%) based on a mark-recapture census of collared animals. Muskoxen densities in this area averaged 1/32 mi^2.

The primary objective for muskoxen in Unit 23 is to maintain a healthy and viable population. The herd was stable during the past year, but calf production appears good (5-22%); the estimated population is at 123 animals. The Seward Peninsula (Unit 22) now supports over 4 times as many muskoxen as northern Unit 23; several factors are suspected for this disparity, including (1) differences in predation rates, (2) range nutritive quantity and quality, (3) climate, (4) human-induced mortality, and (5) dispersal.

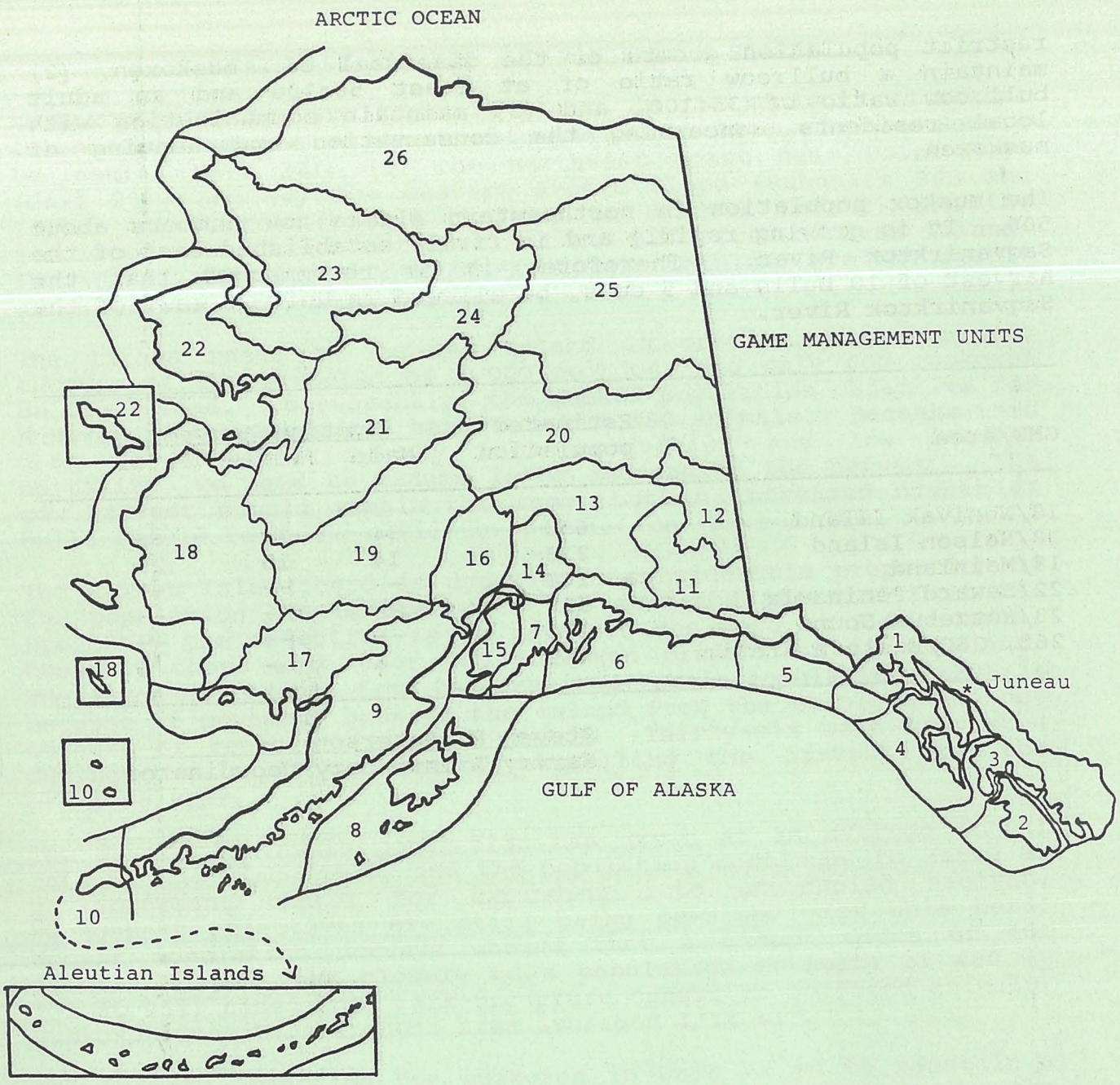
The muskox population in Unit 26 continued to expand and disperse. Our overall objective for the unit is to determine the limits of muskox distribution by 1990 and estimate total herd size by 1992. Specific management objectives for Subunit 26B and 26C are to (1) manage the harvest so that it does not appreciably

restrict population growth or the 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 communication with local residents concerning the conservation and hunting of muskoxen.

The muskox population in northeastern Alaska now numbers about 500. It is growing rapidly and is firmly established east of the Sagvanirktok River. Therefore, it is recommended that the harvest of 10 bulls and 5 cows, be allowed in Unit 26 east of the Sagvanirktok River.

GMU/area	Estimated population	Hunting harvest		
		Male	Female	Total
18/Nunivak Island	650	34	34	68
18/Nelson Island	213+	14	15	29
18/Mainland	ca. 100	--	--	--
22/Seward Peninsula	527	--	--	--
23/Kotzebue Sound	123	--	--	--
26B, 26C/Eastern Arctic	489	6	--	6

Steven R. Peterson
Survey & Inventory Coordinator


ARCTIC OCEAN
26
23
25
24
22
GAME MANAGEMENT UNITS
22
21
20
13
12
18
19
16
14
11
7
1
15
6
5
17
18
Juneau
9
4
3
GULF OF ALASKA
10
8
2
10
Aleutian Islands

STUDY AREA

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Thirty-one muskoxen were introduced from Greenland to Nunivak Island in Unit 18 during 1935 and 1936 as a first step towards reintroducing the species to Alaska. The Nunivak Island muskox population grew slowly until approximately 1958, when they began a period of rapid growth. The first hunting season was opened in 1975; the population has since fluctuated between 500 and 750 muskoxen, exhibiting considerable reproductive potential under heavy harvest regimes. A decade of mild winter weather, low natural mortality, and absence of predators have fostered the growth of the muskox population. The Nunivak Island muskox population remained healthy and productive in 1989, declining slightly from 1988 under a harvest strategy designed to reduce the population.

During 1967 and 1968, 23 subadult muskoxen were transplanted from Nunivak Island to Nelson Island, 20 miles across Etolin Strait. The muskox population on Nelson Island exhibited an annual growth rate averaging 22% between 1968 and 1981. The first hunting season was opened in 1981, when the population approached the management goal of 200-250 muskoxen. The population remained stable through 1986, providing emigrations to the mainland and stable harvests. When last censused in December 1988, the population was estimated at 213 muskoxen.

As many as 100 muskoxen may now reside on the mainland of the Yukon-Kuskokwim Delta, having originally emigrated from Nelson Island. Muskoxen are widely distributed at low densities in small herds from the mouth of the Kuskokwim to the mouth of the Yukon River; they are rapidly expanding their range north and east.

POPULATION OBJECTIVES

To maintain the posthunting, precalving population at 500-550 muskoxen on Nunivak Island.

To maintain a posthunting, precalving population of at least 250 muskoxen on Nelson Island.

To increase the dispersed, low-density population of approximately 100 muskoxen on the mainland to at least several thousand, thereby allowing colonization of suitable upland tundra habitats in the Andreafsky and Kilbuck Mountains.

METHODS

A ground census providing information on sex and age composition of the Nunivak Island muskox population was conducted from 16 to 19 March 1989 by Department and U.S. Fish and Wildlife Service (USFWS) staff. Snow machines 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 13 March 1989. A USFWS aircraft accompanied by a Department observer surveyed the entire island.

An aerial survey of the Nelson Island muskox population was conducted by Department staff on 6 December 1988. The island was completely surveyed during a 3-hour flight.

Five mainland muskoxen in 2 herds north and southwest of Bethel were radio-collared by Department and USFWS staff on 30 and 31 March 1989. Periodic telemetry flights were conducted throughout the spring and summer of 1989 to relocate these animals. Reports were received from other other sources (e.g., local residents and commercial pilots) concerning the distribution of additional mainland muskoxen during the reporting period.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

Results of a census conducted in the spring of 1989 indicate that the posthunting, precalving Nunivak Island muskox population numbered at least 577 (Hinkes 1989). I estimate that the postcalving population numbered approximately 650 muskoxen during the summer of 1989. Sixty-seven groups and 577 muskoxen were observed during the aerial census, and 53 groups and 478 muskoxen were located during the ground census.

The 1989 posthunting, precalving population size for Nunivak Island (577) decreased slightly from that for 1988 (609) and is similar to the 1987 estimate (587). Since harvests were initiated in 1975, the population has ranged in size from 500 to 750 muskoxen.

Results of a survey conducted in December 1988 indicate that the precalving, prehunting population on Nelson Island was at least 213 muskoxen, a substantial increase from the summer 1988 postcalving estimate of 150, suggesting that as many as 75

muskoxen returned to Nelson Island in late fall 1988 after leaving in the spring. Apparently, a proportion of the population either moved to and from the island in response to changes in snow and ice conditions and forage availability or were missed in the survey.

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. While sustaining annual harvests during this period, the herd provided a nucleus for emigrations to the mainland.

Fluctuations in the size of the Nelson Island muskox population are influenced by snow and ice conditions on the island and adjacent mainland. Because muskoxen have difficulty feeding through deep or hardened snow, they frequently emigrate to the mainland to locate better foraging conditions. In addition, harassment from snow machines has been suggested as another possible reason for such movements. The Nelson Island population is not always confined to the island, because the animals can cross frozen tidal inlets to the mainland from November to May.

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 it numbers approximately 100, compared with 40 in 1984. The mainland herd are descendents of the 23 muskoxen introduced to Nelson Island in 1967 and 1968. Muskoxen have been sighted on the mainland of Unit 18 for over 15 years; these populations have been characterized by a rapid increase in numbers and range. Plotted topographical distribution of mainland muskox sightings indicates they exhibit a general habitat preference for upland tundra. The rate of expansion and long-range movements demonstrated by them is remarkable.

Population Composition:

Composition data for Nunivak Island muskoxen are available from the 1989 ground census conducted from 16 to 19 March 1989. We classified 71% (412) of the 478 muskoxen observed in 53 groups, ranging in size from 1 to 29. Sixty-seven groups were observed during the aerial census. We enumerated 108 3-year-old and older cows in the portion of the population classified, a marked decrease from the 145 observed in 1988. It is possible the distribution of muskoxen by sex/age category was not uniform throughout the island, and more females may have been in the interior of the island where the ground survey had been more cursory.

The proportion of adult males in the population has increased during the last 6 years, while the proportion of adult females and yearlings has decreased. This is the intentional result of heavy cow harvests designed to reduce the productivity of the population; however, an additional effect of this strategy is a

surplus of bulls. Census data indicate that 139 4-year-old and older bulls were present in 1989, compared with 108 reproductive-age females (3-years-old and older).

Distribution and Movements:

The greatest concentrations of Nunivak Island muskoxen observed during the 1989 census were found along the southwestern coast from Cape Mendenhall to Nash Harbor. Few muskoxen were found in northeastern Nunivak Island, resulting perhaps from hunting pressure from Mekoryuk; however, muskoxen tend to concentrate on wind-blown, Elymus-covered dunes in southern Nunivak Island after late-winter snow has accumulated elsewhere on the island.

During the December 1988 census, Nelson Island muskoxen were concentrated primarily on the cliffs above Cape Vancouver and on the hills northeast of Tununak; some individuals and small herds were also scattered on the hills in the central portion of the island and on the escarpment above Nightmute. Although snow cover was complete, it was not deep. Unlike the April 1988 survey, no muskoxen were observed on the mainland near Nelson Island. During late winter, muskoxen usually concentrate above the cliffs at Cape Vancouver and on wind-swept hills northeast of Tununak. Few muskoxen are found in the central portion of the island where snow depths may be quite deep. If the lowland tundra on the mainland loses its snow cover in spring before Nelson Island does, muskoxen may move across frozen inlets to the mainland. Although some of these muskoxen remain on the mainland, others may return to Nelson Island.

Local residents, pilots, and biologists have reported numerous sightings of mainland muskoxen during the last 15 years. These reports continued throughout 1988-89. The range of mainland muskoxen extends southeast to the mouth of the Kuskokwim River, northeast to Lower Kalskag, and northwest to the Andreafsky Mountains. Expansion of range north of the Yukon River in several of mainland herds was also reported for the first time. A lone bull with a red ear tag was observed by local residents near the village of Saint Marys in September 1988. A commercial pilot observed an ear-tagged solitary bull, presumably the same animal, in the Andreafsky Mountains north of Mountain Village in February 1989. Another group of 9 muskoxen was reportedly seen during February 1989 in the same area. Department staff placed a red ear tag on a bull in a herd on the mainland southwest of Bethel in 1984, and we suspect this may either be the same one or a marked animal from the Seward Peninsula.

In the area south of the Yukon River between Bethel and Saint Marys in March 1989, ADF&G and USFWS staff radio-collared 3 muskoxen (2 bulls and 1 cow) from a herd of nine. Three short yearlings were present in this herd. These 3 animals have since been relocated south of the Yukon River in a range extending westward to Pilot Station and eastward to Russian Mission and the Johnson River. Most notably, by August 1989 the radio-collared

cow had moved 90 miles east to Arhymot Lake near the Portage Mountains at Lower Kalskag near the border of Unit 18 and Subunit 19A.

In March 1989 staff also radio-collared 2 muskoxen from another herd of 12 southwest of Bethel. This herd, monitored since 1984, has remained relatively stationary near Dall Lake, producing calves annually (5 in 1989). The ear-tagged bull observed north of the Yukon River in 1988-89 may once have been part of this herd; however, it has not been located since 1985-86.

Mortality

Season and Bag Limit:

The fall and spring hunting seasons for bulls on Nunivak Island are from 1 to 30 September and 15 February to 15 March, respectively, for both resident and nonresident hunters. The fall and spring hunting seasons for cows on Nunivak Island are from 1 to 30 September and 1 February to 15 March, respectively, for both resident and nonresident hunters. There is no subsistence hunting season for muskoxen in Unit 18. The bag limit is 1 bull by drawing permit only or 1 cow by registration permit only. Five and 30 permits are issued for the fall and spring bull seasons, respectively. Thirty-five registration permits for cows are issued on a first-come, first-served basis.

The hunting season for bulls and cows on Nelson Island are from 1 February to 15 March. The bag limit is 1 muskox by registration permit only. Fifteen bull and 15 cow permits are issued on a first-come, first-served basis. There is no open season for muskoxen for the remainder of Unit 18.

Human-induced Mortality:

Five drawing permits for bulls and 5 registration permits for cows were available to hunters during September 1988. The 5 drawing permittees were notified by mid-July of their eligibility to hunt bull muskoxen in September 1988. Only 2 permittees elected to hunt, and both harvested bull muskoxen during the September season.

Five registration permits for cows were available on a first-come, first-serve basis in Mekoryuk on 30 August 1988. All 5 permittees harvested cow muskoxen during the September season.

Thirty persons were drawn to hunt bull muskoxen on Nunivak Island. A waiting list of 191 alternate permittees indicated the continuing popularity of this spring bull hunt. Because some successful permit applicants chose not to hunt, an additional 23 persons from the alternate list were contacted. All 30 persons with drawing permits who hunted were successful. Mekoryuk High School staff took an additional bull by permit; one cow hunter

from Mekoryuk shot a bull by mistake and notified ADF&G staff. The total 1989 bull harvest for the spring hunt was 32 muskoxen.

Seventeen registration permits for the spring 1989 cow hunt were available on 29 January on a first-come, first-serve basis in Mekoryuk. On the same day, an additional 8 permits were available in Bethel, three in Anchorage, and two in Fairbanks. All 17 cow permits available at Mekoryuk were issued to local residents; 10 people remained on the waiting list. One person on the Mekoryuk waiting list later received a permit.

Eight permits were issued in Bethel; 2 people remained on the waiting list. Applicants spent the night inside the office building waiting for their permits. Extremely cold weather in Fairbanks diminished public interest in waiting in line for permits, although both permits were eventually issued. One hunter chose not to hunt, and the unutilized permit was transferred to Mekoryuk. Three cow permits were issued in Anchorage; one hunter remained on the waiting list. All 3 hunters from Anchorage were successful in obtaining cow muskoxen during spring 1989. Hunters harvested 68 muskoxen (34 bulls and 34 cows) during the fall 1988 and spring 1989 seasons on Nunivak Island.

Thirty registration permits for Nelson Island muskoxen (15 bulls and 15 cows) were issued at the Chefornak City office on 21 January 1989; no one remained on the waiting list. The hunters who were issued permits attended a bilingual orientation on the identification of the age and sex classes of muskoxen. One bull hunter cancelled his hunt late in the season. The total harvest for Nelson Island in 1989 was 14 bulls and 15 cows.

Harvest Chronology. Cow muskoxen on Nunivak Island and both bull and cow muskoxen on Nelson Island were particularly susceptible to harvesting during periods of moderate weather that occurred between winter storms. Most hunters on Nelson and Nunivak Islands took their muskoxen during 2 periods of moderate weather in late February and mid-March 1989. Bull hunters on Nunivak Island took their animals at relatively regular intervals throughout the 15 February to 15 March season. Bulls hunters on Nunivak Island usually hunt with guides/outfitters, and their hunts are normally scheduled well in advance of the season.

Hunter Residency and Success. Most drawing permittees (70%) were residents of Anchorage and Southcentral Alaska. Residents of Fairbanks and Interior Alaska held 16% of the drawing permits, and the remainder were held by residents of Valdez and Bethel (2 each). No nonresidents harvested muskoxen in Unit 18 during the reporting period.

Three of the 5 fall registration permits for cows were issued to Mekoryuk residents. The other 2 permits were issued to residents of Southcentral Alaska.

All 17 cow permits available at Mekoryuk for the spring 1989 hunt were issued to local residents. All 8 permits available at Bethel were issued to Bethel residents. Both permit holders who obtained registration permits at Fairbanks were from that area. The 3 permits available at Anchorage were issued to Anchorage area residents.

Of the 30 registration permits available at Chefornak, 27 were issued to Nelson Island residents, two were issued to Kipnuk residents, and one was issued to a Bethel resident. Among Nelson Island residents, Toksook Bay residents received 10 permits, Chefornak nine, Nightmute six, and Tununak two.

The success rate for all muskox hunters entering the field was 100%. Most cow muskox hunters on Nunivak Island and both bull and cow hunters on Nelson Island were able to complete their hunt in 1 day. Nunivak Island bull hunters, who were usually guided or supplied by outfitters, took 2-3 days to complete their hunts, because they were more selective of animals to be taken.

Transport Methods. Boats were used for the fall hunt on Nunivak Island. Snow machines were used for late-winter hunts on Nunivak and Nelson Islands.

Natural Mortality:

Little quantitative information is available concerning the natural mortality of muskoxen in Unit 18. No large predators, such as bears and wolves, are found on Nunivak Island, and they are rare on nonexistent on Nelson Island and the Delta lowlands. In March 1989, hunters on Nunivak Island found 3 muskoxen frozen to the ground after a thaw, rain, and rapid plunge in the temperature occurred. Their long guard hair had become wet in the rain and had frozen to the ground while they were bedded down overnight. These muskoxen may have died had not the animals been freed by the hunters. During March 1989, hunters on Nelson Island reported taking muskoxen with large patches of hair missing, presumably after the partially frozen-in animals managed to liberate themselves. Other Nelson Island muskox calves were observed limping, apparently having injured their hoofs and legs on ice. Most other reported natural mortalities are the results of accidents such as falling off cliffs, breaking through ice over streams, or strandings 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 to be in very good condition. There are no reindeer currently on Nelson Island, but several muskoxen harvested there in recent years have had less body fat than normal, and fetuses have been smaller than expected. Muskoxen on Nelson Island may have had difficulty foraging in the winter of 1989 because of ice-covered vegetation. Concerns about the

status of the range on Nelson Island are partially alleviated by the potential for emigration. Large areas of upland tundra on the mainland in Unit 18, particularly in the Andreafsky and Kilbuck Mountains, appear capable of supporting several thousand muskoxen.

Game Board Actions and Emergency Orders

In 1984 at the recommendation of ADF&G staff, the Board of Game increased the Nunivak Island harvest quota to 50 cows and 35 bulls from 45 cows and 30 bulls. The harvest was increased to reduce the herd to the management guideline of 500-550 animals. This quota was maintained through 1986, when the Board of Game lowered the harvest to 35 bulls and 35 cows, again at the request of ADF&G staff. At that time (1986), I believed the Nunivak herd had been reduced to management guidelines and the growth rate stabilized. Because changes in muskox seasons and bag limits will now only be considered every 3 years, the Board of Game in the spring of 1989 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, I recommend that the Department issue 35 cow and 45 bull permits on Nunivak. This quota should allow the population to edge closer to the management guideline of 500-550 and help correct the imbalance in the sex ratio of the population.

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, while those for adult females and yearlings have decreased. This is a result of heavy cow harvests designed to reduce the productivity and bring the population within the management guideline of 500-550 muskoxen. An additional effect of this strategy is a surplus of bulls. The Board of Game has authorized an increase in the harvest to 45 bulls beginning in the fall of 1989. The harvest of cows should be maintained at 35 per year. Harvest of bulls and cows should be reduced when the posthunting, precalving population reaches 550. Transplants could also be conducted to remove surplus muskoxen.

Fluctuations in the observed size of the Nelson Island population are influenced by snow and ice conditions 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 to May. The actual Nelson Island muskox population count has varied from 120 in April 1988 to 213 in December 1988. The difference in the counts is due to movement to and from the mainland, not reproductive performance. Recently the Nelson Island muskox population has provided a source for emigration to the mainland and stable harvests. No changes in harvest levels are recommended.

Mainland muskoxen in Unit 18 have increased in range and numbers in recent years; as many as 100 muskoxen now reside there. Muskoxen are widely distributed at low densities from the mouth of the Kuskokwim River to the mouth of the Yukon River, and they are rapidly expanding their range north and east. A radio-collared cow muskox approached the Subunit 19A border near Lower Kalskag on the Kuskokwim River in 1989. The growth of the mainland population is the result of continued emigration from Nelson Island as well as reproduction 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 informational and educational program explaining the benefits of a larger muskox population on the mainland of Unit 18 should be prepared for the benefit of local residents.

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 Refuge, Bethel, AK 99559. 7pp and appendices.

PREPARED BY:

Samuel Patten, Jr.
Wildlife Biologist III

SUBMITTED BY:

Steven Machida
Survey-Inventory Coordinator

STUDY AREA

GAME MANAGEMENT UNIT: 22 (23,000 mi^2)
23 (17,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Seward Peninsula

BACKGROUND

Thirty-six and 35 muskoxen were reintroduced to the Seward Peninsula in 1970 and 1981, respectively. These transplanted muskoxen were obtained from the Nunivak Island population, which were originally derived from East Greenland stock. Muskoxen soon occupied most of the Seward Peninsula, and annual population growth has exceeded 20% in some years. The Seward Peninsula population serves as an important center for expansion into surrounding areas unoccupied by muskoxen.

POPULATION OBJECTIVES

To reestablish muskoxen as a native species in Alaska (Executive Order 5095).

METHODS

Radiotelemetry continues to provide the basis for the muskox survey-inventory and research programs on the Seward Peninsula. The relatively low density of muskoxen and limited staff time and funds make the use of radiotelemetry the only practical means to monitor changes in herd status. The gregarious nature of muskoxen makes radiotelemetry more cost-effective than it would be for monitoring more solitary-oriented species.

Six male and 9 female muskoxen were radio-collared during the reporting period. Ground darting for collaring using fixed-wing aircraft for transportation and a trained herding dog (Smith 1987), rather than helicopter darting, reduced the cost of maintaining a pool of instrumented muskoxen.

Reports of muskox sightings from the public provide a valuable source of information on distribution of muskoxen on the Seward Peninsula. We solicit these reports through word of mouth, posters, newspaper articles, and radio spots. Public interest in muskoxen is high, and most of the people providing these reports feel they are assisting the program to reestablish muskoxen in Alaska. Contact with these people is an avenue for transferring information on muskox biology and management and a viable way for the Department and public to work together toward a common goal.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

The Seward Peninsula muskox population was censused in 1983, 1984, 1985, and 1988 (Table 1). The aerial photocensus conducted in April 1988, resulting in a minimum count of 527 muskoxen, provided an accurate estimate of the population size, as did the counts in 1984 and 1985. The 1983 count probably underestimated actual population size by 10 to 15 (Smith 1986).

Population Composition:

No meaningful composition data was collected during the reporting period. As discussed in a previous report (Smith 1988), an unbiased measure of recruitment assist efforts in assessing population trend and would enhance the validity of the existing population simulation model (SEWOX1). Obtaining these data will require increased survey-inventory efforts.

Distribution and Movements:

Muskoxen continue to expand into new areas following the pattern described by Smith (1989). Muskoxen were observed in the vicinity of the Yukon River and the Nulato Hills; marked ones were seen on the Selawik Flats and near Saint Marys on the lower Yukon River.

The area around Nome (Subunit 22C), has achieved a notable increase in resident muskoxen as a result of immigration and natural increase. At least 59 animals were in Subunit 22C in the spring and summer of 1989, providing unmatched opportunities for viewing muskoxen from the State's highway system.

Mortality

Season and Bag Limit:

There is no open season.

Natural Mortality:

The late winter of 1988-89 set new low-temperature records for the Seward Peninsula. Minus 54°F was recorded in Nome in January, the lowest since weather records began in 1898. Additionally, snow cover was deep and hard, and it persisted longer in the spring of 1989 than most Seward Peninsula residents could remember from previous years. Snow cover was nearly complete by the second week in June, and a substantial amount of snow persisted throughout the summer. No meaningful measure of natural mortality was obtained, although similar conditions in previous years on the Seward Peninsula, Nunivak Island, and

elsewhere have resulted in increased adult mortality and reduced calf survival the following spring.

Habitat

Muskoxen have demonstrated the ability to exploit a much broader range of habitats than was thought possible 20 years ago. Habitat is essentially unlimited at this time, and muskoxen can be expected to greatly expand their distribution in the future.

CONCLUSIONS AND RECOMMENDATIONS

The Seward Peninsula muskox population may be the largest in Alaska. Because of limited staff time, less survey-inventory work was carried out in 1988-89 than in previous years. Methods to efficiently monitor the population have been developed as a result of research conducted since 1982 on the Seward Peninsula. I recommend that a population photocensus be carried out in April 1990 and at 2-year intervals thereafter. In addition, we need to (1) maintain a pool of radio-collared muskoxen sufficient for the census and (2) monitor distribution.

ACKNOWLEDGEMENTS

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LITERATURE CITED

Smith, T. E. 1986. Muskoxen Survey-Inventory Progress Report, Seward Peninsula 1984-85. Pages 12-20 in B. Townsend, ed. Annual Rep. of Survey-Inventory Activities. Part X. Muskoxen Vol. XVI. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-4.

_____. 1987. Status and dispersal of an Introduced muskox population on the Seward Peninsula. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Final Rep. Job 16.1R. Proj. W-22-3, W-22-4 and W-22-5.

_____. 1988. Muskox survey-inventory progress report, Seward Peninsula, 1987-88. Pages 11-17 in S. O. Morgan, ed. Annual report of survey-inventory activities. Part X. Vol. XIX. Alaska Dep. Fish and Game. Fed Aid in Wildl. Rest. Prog. Rep. Proj. W-23-1. 1989.

_____. 1989. The Role of bulls in pioneering new habitats in an expanding muskox population on the Seward Peninsula. Can. J. Zool. 67(5):1096-1101.

PREPARED BY:

Timothy E. Smith
Wildlife Biologist II

SUBMITTED BY:

Steven Machida
Survey-Inventory Coordinator

Table 1. Active radio collars, estimated population size, and percentage of radio-collared muskoxen at time of April census, 1983-88.

Year	Active radios	Population census	% Radio-collared animals
1983	7	175	4
1984	14	225	6
1985	16	271	6
1988	31	527	6

STUDY AREA

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

GEOGRAPHICAL DESCRIPTION: Kotzebue Sound and western Brooks Range

BACKGROUND

In 1970, 36 muskoxen were transplanted from Nunivak Island to Cape Thompson. An additional 34 Nunivak Island muskoxen were transplanted to Cape Thompson in 1977. These muskoxen were the first to inhabit northern Unit 23 since their extirpation during the mid-1800's.

Since the initial transplants, growth of the muskox population has been slow in northern Unit 23. In June 1981, 76 muskoxen were counted in the northern portion of Unit 23; in 1985, 100 muskoxen in 4 separate groups were counted in the same area. A comprehensive census conducted in northern Unit 23 during May 1988 resulted in a minimum count of 123 muskoxen. Several bulls, traveling alone or in pairs, have been observed in an inland area 225 miles from the original transplant site.

POPULATION OBJECTIVES

To establish and maintain a healthy and viable muskox population in Unit 23.

To implement a muskox hunting season once the population is large enough to accommodate the anticipated harvest demand.

METHODS

Radiotelemetry continues to provide information concerning movements and distribution of muskoxen in northwestern Alaska. There are currently 7 functioning radio collars on muskoxen in the northern portion of Unit 23 (Table 1).

Composition data were also gathered during radiotelemetry surveys. Calves were distinguished from adults when observed from the air (Table 2), but because of the difficulty in distinguishing yearlings from 2-year-olds, all animals older than calves were classified as adults. No efforts were made to distinguish bulls from cows. In addition to telemetry data, observations of muskoxen reported by ADF&G staff and members of the public were recorded and filed in the Kotzebue office.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

The size of the muskox population in Unit 23 appeared to be stable during the reporting period. Verified sightings of muskoxen in the southern portion of the unit suggest that muskoxen from Unit 22 (Seward Peninsula) are emigrating north and inhabiting portions of Unit 23. These additions may result in an upward trend in the overall size of the population; however, observations of calf production indicate that population growth of muskoxen in the northern portion of Unit 23 has remained low.

During a census conducted in May 1988 (Larsen 1989), the minimum number of muskoxen known to inhabit the northern portion of Unit 23 was estimated at 123. In the absence of any subsequent census data, this remains our best estimate of the minimum population size.

Population Composition:

Calves composed 5-22% of the muskoxen observed during radiotelemetry surveys conducted in May and June 1989 (Table 2). Because all radio-collared muskoxen were not relocated on each telemetry flight, direct comparisons of the percentage of calves from one date to another are meaningless. As a means of better determining calf survival during their first few months of life, every effort should be made to locate all radio-collared individuals during each aerial survey and gather composition data from each associated group.

Distribution and Movements:

To better monitor movements and distribution of muskoxen in northwestern Alaska, two cows were radio-collared at Cape Krusenstern during September 1983. In September 1986, 1 of the 2 muskoxen originally collared at Cape Krusenstern was recaptured at Cape Thompson and outfitted with a new radio collar. At the same time, two additional muskoxen were radio-collared at Cape Thompson, two were collared near the Kukpuk River, and one was collared at Rabbit Creek. On 10 May 1989, one female muskoxen was recaptured near Rabbit Creek, and her collar was replaced. At the same time, a lone bull was radio-collared. To date, we are aware of only 1 radio-collared muskoxen that has either died or shed its collar; the collar and possibly the carcass are located near the mouth of Akalolik Creek, approximately 15 miles northeast of Point Hope.

Radio-collared muskoxen were located within 4 to 5 miles of the coast during every radio-tracking flight. The Tahinichok Mountains and Rabbit Creek in the Mulgrave Hills and the Chariot

and Cape Thompson areas were where radio-collared muskoxen were most frequently observed during radiotelemetry flights (Table 3).

Reported observations of uncollared animals indicate that the overall distribution of muskoxen is more extensive than suggested by our telemetry data. Lone bulls were observed as far east as the Anisak River and as far south as Deering. One radio-collared muskox was reportedly seen near Selawik. Because all the collars deployed in Unit 23 were accounted for at the time of this sighting, this collared muskox probably came from the Seward Peninsula. We suspect that the origin of the muskoxen observed south of the Selawik River drainage was the Seward Peninsula.

Mortality

Season and Bag Limit:

There is no open season.

Human-induced Mortality:

Although muskox hunting is currently prohibited in Unit 23, several animals have been killed by humans during the past several years. Human-induced mortality probably has contributed to the slow growth of the population in Unit 23.

During the reporting period, a minimum of 3 bull muskoxen died from gunshot wounds. Two bulls were killed during September 1988 along the Wulik River, and one was killed south of the village of Selawik along the shore of Inland Lake during the summer of 1989. The bulls killed along the Wulik River were gutted, but the carcasses were subsequently abandoned; a grizzly sow with 2 cubs subsequently fed on the carcasses. All meat from the muskox killed near Selawik was reported to have been retrieved for human consumption.

CONCLUSIONS AND RECOMMENDATIONS

The muskoxen population in Unit 23 appears to have remained stable during the reporting period. Growth in the northern portion of the unit is slow; however, continued immigration of muskoxen from the Seward Peninsula will likely increase the overall size of the population.

Additional radio collars should be deployed as a means of determining movement patterns and distribution of muskoxen, which move more than 4 to 5 miles inland from the coast. Whenever possible, lone or paired muskoxen observed far inland should be captured and collared. Because of the observed movements of muskoxen from the Seward Peninsula into Unit 23, radio frequencies of Unit 22 collars should also be programmed into telemetry receivers prior to muskox radio-tracking flights.

An individual, possibly a graduate student, should be hired to investigate reasons for the slow growth of the herd in the northern portion of the unit. No regulatory changes are recommended at this time.

LITERATURE CITED

Larsen, D. N. 1989. Unit 23 Muskoxen Survey-Inventory Progress Report. Pages 18-22 in S. O. Morgan, ed. Annual Report of Survey-Inventory Activities. Vol. XIX. Part X. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-23-1. Job 16.0. Juneau.

PREPARED BY:

Douglas N. Larsen
Wildlife Biologist III

SUBMITTED BY:

Steven Machida
Survey-Inventory Coordinator

Table 1. Ages, capture dates, and capture locations of radio-collared muskoxen in Unit 23, September 1983-May 1989.

ID No.	Sex	Capture date	Estimated age[a] (time of capture)	Capture location
001	F	9/16/83		Cape Krusenstern
		9/12/86		Cape Thompson
002	F	9/16/83		Cape Krusenstern
003	F	9/12/86		Cape Thompson
004	F	9/12/86		Cape Thompson
005	F	9/12/86	7	Rabbit Creek
		5/10/89		Rabbit Creek
006	F	9/12/86		Kukpuk River
007[b]	F	9/12/86	6	Kukpuk River
008	M	5/10/89	7	Rabbit Creek

[a] Ages estimated by T. Smith, ADF&G Nome
[b] Mortality or shed collar prior to April 1987

Table 2. Numbers of adult and calf muskoxen observed during radio-tracking flights, Unit 23, May-June 1989.

Date	Adults	Calves	Total	% Calves
05/08/89	19	1	20	5
05/12/89	46	4	50	8
05/18/89	12	0	12	0
06/12/89	21	6	27	22
06/30/89	48	6	54	11

Table 3. Locations of radio-collared muskoxen and associated group members, Unit 23, May-June 1989.

ID No.	Date	Location	Adults	Calves	Total
001, 004	05/12/89	Cape Thompson	24	2	26
	06/30/89	Cape Thompson	33	3	36
002, 006	06/30/89	Cape Thompson	33	3	36[a]
003	05/08/89	Tahinichok Mtns	9	1	10
	05/12/89	Tahinichok Mtns	11	2	13
	05/18/89	Tahinichok Mtns	--	-	--
	06/12/89	Tahinichok Mtns	10	5	15
	06/30/89	Tahinichok Mtns	6	1	7
005	05/08/89	Tahinichok Mtns	10	0	10
	05/12/89	Tahinichok Mtns	10	0	10
	05/18/89	Tahinichok Mtns	10	0	10
	06/12/89	Tahinichok Mtns	10	1	11
	06/30/89	Tahinichok Mtns	9	2	11
008	05/12/89	Rabbit Creek	1	0	1
	05/18/89	Rabbit Creek	2	0	2[b]
	06/12/89	Rabbit Creek	1	0	1
	06/30/89	Tahinichok Mtns	9	2	11[c]

[a] Together with numbers 001 and 004.
[b] Together with an uncollared adult bull.
[c] Together with number 005.

STUDY AREA

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

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 between the Sagavanirktok River and the Canadian Border. A small number of bulls have been hunted in Subunit 26C since 1983.

MANAGEMENT GOALS

To reestablish muskoxen throughout their historic range in Alaska.

To provide the opportunity to view, photograph, and enjoy muskoxen.

To provide subsistence and recreational hunting opportunities for muskoxen.

MANAGEMENT OBJECTIVES

To manage harvest so that it does not appreciably restrict population growth or the dispersal of muskoxen.

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

To maintain direct communication with local residents of Nuiqsut, Kaktovik, and Barrow concerning management decisions relating to the reintroduction, conservation, and hunting of muskoxen.

METHODS

Precalving muskoxen surveys were flown with a Cessna 185 aircraft during the 1st week of April 1989 east of the Sagavanirktok River by biologists of the U.S. Fish and Wildlife Service (USFWS). During the last week of April ADF&G staff surveyed the area between the Colville and Anaktuvuk Rivers and the Sagavanirktok River in a DeHavilland Beaver aircraft. A postcalving count was not conducted in the summer of 1988.

Composition counts were done by USFWS biologists in Subunit 26C during the 1st week of July 1988. Groups of muskoxen were located from the air by helicopter and then classified from the ground as young bulls, adult bulls, cows, calves, and yearlings. Mandatory hunt reports for the spring 1988 permit hunt were analyzed.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

During precalving aerial surveys of Subunits 26B and 26C, biologists from USFWS and ADF&G counted 489 muskoxen in 1989, compared with 410 in 1988, representing an increase of 19% (Table 1). There are also about 75 muskoxen in the adjacent northern Yukon Territory that were not counted (P. Reynolds, pers. commun.). From 1979 to 1989 the population in Alaska increased at an average annual rate of 16%. The population in Subunit 26C appears to be stabilizing at 350-400 animals; most of its production is lost to emigration into Subunit 26B and Canada.

Population Composition:

During composition surveys in July 1988, 371 muskoxen were counted, approximately 76% of the known population (Table 2). Calf:cow and bull:cow ratios returned to the high levels existing between 1983 and 1985. Possible explanations for the low calf:cow and bull:cow ratios are biased sampling, decreased natality of cows, and increased mortality of calves and bulls. Severe winter weather could have been a contributing factor, especially in 1986 (K. Whitten, pers. commun.).

Distribution and Movements:

The distribution of muskoxen in northeastern Alaska was reviewed last year (Golden 1989). During April 1989 there were probably about 75 muskoxen in the northern Yukon Territory, 350 within the Arctic National Wildlife Refuge (ANWR), and 125 west of ANWR. For the first time a mixed-sex group of 13 wintered about 40 miles southeast of the village of Nuiqsut. Radio-telemetry studies conducted since 1982 have demonstrated that muskoxen are highly mobile and not necessarily faithful to seasonal ranges or areas of occupancy. The entire population in northeastern Alaska and adjacent Yukon Territory must be considered a single, interbreeding population (P. Reynolds, pers. commun.).

Mortality

Season and Bag Limit:

The open seasons in Subunit 26C for resident and nonresident hunters within Arctic National Wildlife Refuge are 15 August to 15 September and 1 to 31 March. The bag limit is 1 bull by registration permit only. Ten permits will be issued: 5 at Kaktovik and 5 at Fairbanks on a first-come, first-served basis. There are no open seasons for the remainder of Unit 26.

Human-induced Mortality:

From 1983 to 1988, 26 bulls were harvested; most of this harvest occurred in the Sadlerochit River area. In 1989 hunters harvested 6 bulls, killing 3 cows accidentally (Table 3); again, most were taken in the Sadlerochit area. Only a small illegal harvest has been documented in the past 5 years; moreover, the small annual harvest of 10 bulls represents less than 3% of the known population and should have no significant effect on future growth and dispersal.

Hunter Residency and Success. Kaktovik residents took 4 legal bull muskoxen during the 1988-89 season, and residents living outside Kaktovik harvested 2 bulls (Table 4). One local and 3 nonlocal residents were unsuccessful, resulting in 60% hunter success. All hunters in 1988-89 were residents of Alaska.

Permit Hunts. Ten registration permits were issued on a first-come, first-served basis (5 in Kaktovik and 5 in Fairbanks) for hunt No. 1007. All permits issued in Kaktovik went to residents of that community, and the other 5 permits issued went to Fairbanks residents. Hunters issued permits in Kaktovik were allowed to take bulls anywhere in Subunit 26C. Those hunters issued permits in Fairbanks were allowed to hunt in 2 zones: 3 permits for the area west of Marsh Creek and 2 permits east of the Jago River.

Harvest Chronology. The muskoxen hunt was held in March until this regulatory period, when a fall hunt was added to spread harvest pressure. Two muskoxen were taken in September by nonlocals, and four were taken in March by local residents.

Transport Methods. Hunters have used either airplanes or snowmachines to hunt muskoxen during the last 5 years. Generally, most local residents have used snowmachines and most nonlocals have used aircraft. Some local residents have provided snowmachines for nonlocals to use, but guiding muskoxen hunters has not been as common in Kaktovik as it has been on Nunivak Island.

Natural Mortality:

Natural mortality of muskoxen in the eastern Arctic is low. Of 13 nonhunting mortalities observed between 1984 and 1986, nine were associated with predation or scavenging, three were among old or malnourished muskoxen, and one was due to unknown causes (Garner and Reynolds 1986, Whitten 1986).

Between 1983 and 1985, yearling and calf mortality rates were estimated to be 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 during the winter of 1988-89 contributed to higher overwinter mortality and caused animals to be thin in the spring (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; they were briefly reviewed last year (Golden 1989). Results of a recently completed study on muskox habitat in northeastern Alaska also became available during this reporting period (O'Brien 1988).

Game Board Actions and Emergency Orders

The muskoxen hunt was instituted (for Subunit 26C) by the Board of Game in 1983 as a recreational drawing-permit hunt; the season was 1-31 March. From 1983 through 1985, only Alaskan residents could apply for drawing permits.

In 1986 in response to the Madison decision, the drawing permit was changed to a registration permit, and all permits were issued in Kaktovik on a first-come, first-served basis. Also in 1986, the tag fee was reduced from $500 to $25 for Alaskan residents. Beginning in 1987, nonresidents were also eligible for registration permits, but all permits were still issued in Kaktovik. This created difficulties and dissatisfaction for nonlocal hunters.

To provide broader availability of permits and better distribution of hunting pressure in addition to the 1-31 March season, the Board of Game changed the regulations in 1989 to establish a fall season from 15 August through 15 September, increased the harvest limit to 10 bulls, and required 5 permits to be issued in Kaktovik and 5 to be issued in Fairbanks. The hunt was still administered by registration permit on a first-come, first-served basis.

CONCLUSIONS AND RECOMMENDATIONS

The ADF&G is in the process of developing a statewide muskoxen policy and a management plan for muskoxen in the eastern Arctic Slope. These documents will consider the interests of the public and all state and federal agencies involved in managing muskoxen and their habitat. The objectives in this report reflect recent population growth trends, public interest in muskox hunting, and ADF&G's intention to encourage the continued expansion and dispersal of the Arctic Slope muskoxen herd.

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 as well as dispersal of bulls and some mixed groups to the east and west. The latter may reflect social pressure stimulated by higher muskoxen density in Subunit 26C, but it is unlikely that the population has reached carrying capacity. I expect the herd in Subunit 26C to continue to be 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 those in Subunit 26C.

The muskoxen population in northeastern Alaska now numbers about 500. It is growing rapidly and is firmly established east of the Sagavanirktok River. Therefore, I recommend the harvest of 10 bulls and 5 cows in Unit 26 east of the Sagvanirktok River (for FY 1991).

The management objectives for growth and dispersal of muskoxen in Subunits 26B and C are being met, and I recommend that these management strategies be continued; however, more data are needed to determine the distribution and total number of muskoxen across the eastern Arctic. This is especially important because of our interest in herd growth, the desire to expand hunting opportunities, and because of the potential impacts of oil and gas development on the establishment of new muskoxen herds on the coastal plain. Biologists from USFWS acquired most of the information used in this report, but they are limited to investigations within or close to ANWR. I recommend that ADF&G allocate muskoxen survey and inventory funds for FY 90 to permit greater cooperative work with USFWS in Subunit 26C and to expand aerial surveys outside ANWR in Subunit 26B.

LITERATURE CITED

Garner, G. W., and P. E. Reynolds, 1986. Muskoxen. Pages 250-279 in Final report baseline study of the fish, wildlife, and their habitats. Vol. I. Arctic Natl. Wildl. Refuge Coastal Plain Resource Assessment, U.S. Fish and Wildl. Serv., Region 7, Anchorage, Alaska.

Golden, H. N. 1989. Unit 26 B and C muskoxen survey and inventory report. Pages 23-37 in S. O. Morgan, ed. Annual report of survey inventory activities Vol. XIX. Part X. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-23-1. Juneau. 36pp.

Gunn, A. 1982. Muskox. Pages 1021-1035 in J. A. Chapman and G. A. Feldhammer, eds. Wild mammals of North America. Johns Hopkins Univ. Press, Baltimore, Maryland.

O'Brien, C. M. 1988. Characterization of muskox habitat in northeastern Alaska. M. S. Thesis. Univ. of Alaska, Fairbanks. 114pp.

Whitten, K. R. 1986. Muskoxen survey-inventory report. Pages 14-16 in B. Townsend, ed. Annual report of survey-inventory activities. Vol. XVII. Part X. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-5. Juneau. 16pp.

PREPARED BY:
Howard N. Golden
Wildlife Biologist III

SUBMITTED BY:
Christian A. Smith
Management Coordinator

REVIEWED BY:
Patrick Valkenburg
Wildlife Biologist II

Table 1. Muskoxen population size, based on precalving (spring) and postcalving (summer-fall) aerial surveys, Subunits 26B and 26C, 1979-89.[a]

Year	Subunit 26B		Subunit 26C		Total	
	Pre-calving	Post-calving	Pre-calving	Post-calving	Pre-calving	Post-calving
1979	0	--	112	--	112	--
1980	0	--	148	--	148	--
1981	0	--	186	--	186	--
1982	0	--	219	--	219	--
1983	0	--	257	--	257	--
1984	8	6	293	377	301	383
1985	5	10	347	466	352	476
1986	9	68	399	360	408	428
1987	65	--	320	--	385	--
1988	55	--	355	--	410	--
1989	130	--	359	--	489	--

[a] Postcalving surveys were not conducted in 1987 and 1988 due to poor weather, and 1989 surveys will be reported next year. Data source: P. E. Reynolds, U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks; and ADF&G survey data.

Table 2. Muskoxen population composition Subunit 26C, summers 1984-88.[a]

Year	Bulls: 100 cows[b]	Ad bulls: 100 cows[c]	Yrlgs: 100 cows[d]	Calves: 100 cows[d]	Yrlg % in herd	Calf % in herd	Total
1984	88	69	51	75	14	21	341
1985	66	54	48	75	15	23	419
1986	50	34	42	39	17	15	360
1987	49	28	32	48	12	19	339
1988	62	42	51	71	16	23	371

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

[b] Bulls and cows ≥2 years old.

[c] Cows are ≥4 years old.

[d] Cows are ≥3 years old.

Table 3. Annual muskoxen harvest and other known mortality, Subunits 26B and 26C, 1984-89.

Year	Hunter kill			Other known mortality			
	Reported harvest of bulls	Estimated illegal harvest[a]	Total	Bulls	Cows	Calves	Total
1984	5		5	1	1	1	3
1985	4		4		4		4
1986	3	1	4	1	4	1	6
1987	5		5				
1988	5		5				
1989	6	3	9				

[a] Includes 1 bull in 1986 and 3 cows in 1989.

Table 4. Muskoxen hunter residency[a] and success for permit hunt no. 1007, Subunit 26C, 1984-89.

Year	Permits issued	Successful				Unsuccessful			
		Local[b] res.	Non-local res.	Non-res.	Total	Local res.	Non-local res.	Non-res.	Total
1984	5	0	5	-	5	0	0	-	0
1985	5	0	4	-	4	0	1	-	1
1986	5	2	1	-	3	2	0	-	2
1987	5	3	1	1	5	0	0	0	0
1988	5	2	3	0	5	0	0	0	0
1988[c]	10	4	2	0	6	1	3	0	4

[a] Only residents of Alaska were allowed to hunt muskoxen before 1987.

[b] Local is resident of Kaktovik, Alaska.

[c] In 1988 there was also a fall season.

Federal Aid Project
funded by your purchase of
hunting equipment