ALASKA DEPARTMENT OF FISH AND GAME

JUNEAU, ALASKA

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ANNUAL REPORT OF SURVEY-INVENTORY ACTIVITIES

PART X. MUSKOXEN

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Federal Aid in Wildlife Restoration

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STATEWIDE HARVEST AND POPULATION STATUS

All muskoxen herds in Alaska were thriving in 1985. The parent herd on Nunivak Island was stable or increasing slightly; an additional season of female harvest should stabilize the herd near the goal population of about 550 head. Herds resulting from transplants from Nunivak are increasing, some at near-maximum rates. The Nelson Island herd is stable as the result of hunting and of animals leaving the island for mainland Unit 18, where a new population may become established. Unit 23 populations are increasing slowly; those in the eastern Arctic and on the Seward Peninsula are growing rapidly.

Population data and hunter harvests are summarized below:

Herd	Estimated population	Trend	Harvest		
			Bulls	Cows	Total
Nunivak Island	547[a]	Stable or slowly increasing	20	49	69
	616[b]		--	--	--
Nelson Island	195[a]	Stable	16	14	30
	225[b]		--	--	--
Seward Peninsula	271[a]	Increasing	--	--	--
Unit 23	96[b]	Stable or slowly increasing	--	--	--
Eastern Arctic	450[b]	Increasing	4	0	4

[a] Early spring 1985, pre-calving.

[b] Summer 1985.

Robert A. Hinman
Deputy Director

MUSKOXEN

SURVEY-INVENTORY PROGRESS REPORT

GAME MANAGEMENT UNIT: 18

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

PERIOD COVERED: 1 July 1984-30 June 1985

Season and Bag Limit

See Hunting Regulations No. 25.

Population Status and Trend

Nunivak Island:

The Nunivak Island muskox population remains healthy and productive. Heavy harvests of cows during 1984-85 have altered the sex ratio of the herd and can be expected to reduce herd productivity; this change is desirable and consistent with management goals.

A post-hunt, pre-calving census in March 1985 enumerated 547 animals compared with 552 in 1984. Blowing snow and extreme wind chill hindered observations during part of the census, and as many as 50-100 muskoxen may have been missed.

Sixty-nine muskoxen were taken in the fall and spring hunting seasons (Table 1) prior to the census; therefore, the pre-hunt, pre-calving population on Nunivak Island in 1985 was at least 616 animals.

Nelson Island:

The Nelson Island muskox population has stabilized at a level consistent with management guidelines (Table 2). A post-season aerial census on 17 April revealed 195 muskoxen in 2 large groups, and 30 muskoxen were harvested in the 1985 spring season. Hence, the pre-hunt, pre-calving population was estimated at 225 animals, which is similar to the 1983 estimate of 230 animals. Emigration to the mainland and hunting account for herd stabilization.

Mainland Muskoxen:

Reports from the public over the past year indicate that Nelson Island muskoxen continue to emigrate to the mainland (Table 3). In April 1985 a herd of 10-14 muskoxen was reported in the

Askinuk Mountains near Scammon Bay. Another herd of 8-12 muskoxen, including a radio-collared animal, was monitored in the area southwest of Bethel during this reporting period. Other muskoxen were reported in 1984-85 on the mainland near Chevak, Newtok, and Chefornak. Illegal harvests of mainland muskoxen occurred near Johnson River villages west of Bethel in May 1985.

Population Composition

Nunivak Island:

No fall aerial surveys were conducted during the reporting period. The 1985 ground census was conducted during March 14-20 by men on snowmachines. Periods of blowing snow hindered census efforts on southwestern Nunivak Island. Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (USFWS) staff classified 547 animals in 45 groups, ranging in size from 1 to 33 animals. Most animals observed were concentrated on southern Nunivak Island near Mount Roberts and in dunes around Cape Mendenhall.

During the census, 150 adult bulls (age 4+ years) and 55 3-year-old bulls were counted on Nunivak Island. I anticipate that the pre-hunt population in spring 1986 will contain approximately 200 adult bulls (4 years or older).

At the time of the census, herds on southeastern Nunivak Island contained a high proportion of bulls, probably as a result of the February-March cow harvest. We did not observe such a high percentage of bulls in herds further west.

The 1985 post-hunt population exhibited a breeding bull (4+ age class) to cow (2, 3, and 4+ age classes) ratio of 46:100. The 1984 breeding bull:cow ratio was 35:100. The proportion of cows in the observed population declined last year in response to harvest quotas established in 1984. I believe that reducing herd productivity is a necessary step toward reaching the interim management goal of stabilizing the post-hunt and pre-calving herd at 500-550 animals. A computer model indicates that this goal can be achieved with 1 additional year of heavy cow harvests (50 cows, 30 bulls). If herd stabilization is a long-term management goal, future harvests (from 1987 on) should remove 35 males and 35 females. The computer model projects that at this level of harvest the population will remain stable at 500-550 animals until the year 2000.

Muskox pregnancy rates also declined on Nunivak Island from 1984 to 1985. Examination of 39 cows taken during the 1985 spring season indicated a minimum pregnancy rate of 74% (70% for 4-year-old and older females, and 61% for 3-year-old cows). This is a decline from the 1984 rate of 77%, and an even greater decline from the 1980-82 average (83%).

The 1985 census enumerated 140 cows 3 years old or older. Assuming that approximately 26% of the 62 unclassified animals were reproductively mature cows, the extrapolated total is 156 reproductively mature cows. If these cows produce 50-70 calves per 100 cows as has been observed in the past, 78-109 calves will be born in 1985. The post-calving, post-hunt population would then be 625-656 animals, in excess of the management guideline for the herd.

Nelson Island:

An aerial census conducted on 19 October 1984 indicated a minimum of 186 muskoxen on Nelson Island. Turbulence near Cape Vancouver prevented aerial counting in that area.

A local resident reported approximately 100 muskoxen on steep slopes near Cape Vancouver in early February 1985 and an additional 30-40 muskoxen on ridges east of Tununak. An aerial census conducted on 19 April by ADF&G and USFWS personnel in ideal weather confirmed the presence of 104 muskoxen around Cape Vancouver. Ninety-one additional muskoxen were counted northeast of Tununak. Thirty muskoxen were harvested in the February-March season (Table 2); thus, the 1985 pre-hunt, pre-calving population numbered at least 225 animals. Harvests over the last 4 years and emigration to the mainland have stabilized the Nelson Island population.

No ground census was conducted during spring 1985.

Mainland Muskoxen:

Reports from the public indicate that Nelson Island muskoxen continue to emigrate to the mainland (Table 3). A resident of Newtok found a muskox carcass in a creek 15 miles east of the village in November 1984. This 4-year-old bull had broken through the ice and subsequently died. The same resident of Newtok observed a herd of 12-15 muskoxen 5 miles northeast of Newtok in December 1983.

A resident of Chevak observed 2 muskoxen in early winter 1984 on the north shore of the Kashunuk River south of Ingrisarak Mountain. He identified one of the muskoxen as a 2-year-old bull. Residents of Marshall reportedly saw a lone muskox on Ingrisarak Mountain (near Chevak) in late winter. Reports of muskoxen near Ingrisarak Mountain substantiate 1984 reports by aircraft pilots who observed muskoxen in the same area. A muskox was illegally taken there in December 1982.

National Guard officials reported 3 muskoxen near Cape Romanzof Air Force Base in the Askinuk Mountains in January 1985. Residents of Scammon Bay reported 10 muskoxen in the Askinuk Mountains in April 1985 within 2 miles of the village. Another

single muskox was seen near Scammon Bay in April. Ten additional muskoxen were reported west of Nunavakpak Lake near Bethel on 9 April. On the same day USFWS observed a herd of 10 muskoxen southwest of Dall Lake. Whether this 3rd group was the same or a different herd remains undetermined. At least 1 herd of 8-12 animals inhabited the upland tundra between Kasigluk, Chefornak, and Tuntutuliak in 1984-85. Aerial and ground surveys indicate that the area between Kasigluk and Tuntutuliak resembles the south end of Nunivak Island. In this open and windswept country, abundant grass tussocks project through the snow in winter. Low willows along watercourses provide another food source for muskoxen in this area. At least 11 muskoxen, including 2 new calves, were present in the herd of mainland muskoxen that were radio-tracked west of Tuntutuliak on 13 July 1985. When this herd was located on 4 January 1985 between Dall Lake and Tuntutuliak it contained 10 animals, at least 2 of which were calves. Snowmachine tracks were abundant in the area. The herd remained in this area throughout summer 1984 and winter 1984-85 but moved 45 miles north to Nunavakpak Lake near villages on the Johnson River by 20 April 1985.

Mortality

Nunivak Island:

Five drawing permits for bulls and 10 registration permits for cows were available for fall 1984 (Hunts 1001 and 1060). Only 2 drawing permits were used. All 10 cow permits were issued on a first-come, first-served basis at Mekoryuk Community Center on 31 August 1984, with no one on a waiting list. All 12 permittees were successful by early September. Kills were made along the coast west to Nash Harbor and southeast to Duchikthluk Bay. Sunny weather and calm seas facilitated boat access to hunting areas. Two-thirds of the hunters obtained their muskox during the 1st 4 days of the season. Most animals were harvested near shoreline. One 3-year-old cow and 7 older cows were taken; no ages were obtained for 2 cows. Both bulls were in the 4+ age class. Five hunters spent 1 day hunting, 2 spent 2 days hunting, 1 spent 3 days, and 4 spent 5 days. Nine registration permittees were residents of Mekoryuk, and 1 was a resident of Eagle River. One drawing permittee was a nonresident, and the other was an Alaska resident.

Twenty-eight persons were drawn under Permit Hunt 1003 to hunt bull muskoxen on Nunivak Island in spring 1985. Three persons cancelled and 7 never responded to certified letters followed by attempted telephone calls. This degree of nonresponse has not previously been observed by those administering the drawing permit hunt for Nunivak Island. All 18 persons receiving drawing permits and purchasing tags, however, were successful in bagging muskoxen.

Forty registration permits for Nunivak Island cows (Spring 1985, Hunt 1061) were available on 31 January. Permit allocation was as follows: Mekoryuk, 21; Bethel, 11; Anchorage, 6; Fairbanks, 2. All Mekoryuk permits were applied for with 4 people remaining on a waiting list. Only 1 person receiving a permit at Mekoryuk failed to hunt but cancelled out in the last days of the season. All Bethel permits were applied for, with 8 people remaining on a waiting list. Two people on the waiting list later received permits from Anchorage. Only 4 permits were issued in Anchorage, and the 2 remaining permits were transferred to Bethel when no further interest was expressed.

Twenty bulls and 49 cows were harvested from Nunivak Island during the 1984-85 reporting period (Table 1). All cows were harvested by resident hunters. Sixteen bulls were taken by Alaska residents, and 4 bulls were taken by nonresidents. Most muskoxen were harvested in spring 1985 in dunes northeast and northwest of Cape Mendenhall. Other muskoxen were taken from various locations on western Nunivak Island, especially near Dahloongamiut Lagoon. One hunter discarded most of the meat and the hide of his bull muskox on pack ice near Nome after becoming lost while returning from Nunivak Island. Nearly out of fuel, the hunter landed and discarded the muskox to reduce weight.

Game Division and USFWS personnel found a dead 3-year-old female muskox near Duchikmiut River on 9 March. The muskox had been dead for several weeks and was apparently pregnant, but cause of death could not be determined. The carcass had been scavenged by foxes. An additional dead adult bull muskox was found by Mekoryuk residents on 9 March on Kimijooksuk Butte. Cause of death was not evident because the animal had been dead for several weeks. Richard Davis, resident of Mekoryuk and USFWS employee, observed a "crippled" 4-year-old female during the week of 4 March 1985 south of Nanwaksjiak Crater.

An old bull, seen on 15 March on the Bangookthleet Dunes at the south end of Nunivak Island, had a swollen and distended lower left front leg and curled hooves. The animal could move about but appeared weakened. A mature cow seen on 19 March on western Nunivak Island had a swollen right hind foot. The hooves were splayed and the animal was lame. There was no evidence of bluetongue, epizootic hemorrhagic disease, contagious ecthyma, Q fever, infectious bovine rhinotracheitis, bovine viral diarrhea, parainfluenza III, or brucellosis in sera collected from muskoxen on Nunivak Island during February 1984. One sample tested positive for leptospirosis.

Ear tags were retrieved from 2 adult muskoxen in 1985. Red ear tag No. 51 was obtained from a bull harvested at Chakawakamiut Dunes on 3 March. Red ear tag No. 62 was taken by a Game Division biologist from a muskox found dead at Cape Mendenhall on 2 June. The muskox was found in a resting position on low dunes;

cause of death was not apparent. It was believed that this animal, although frozen in the snow, had been dead less that 2 weeks. An additional red tag was observed on the right ear of a mature cow on 19 March on the west side of Nunivak Island.

Nelson Island:

Thirty registration permits (for 15 bulls and 15 cows) were available for Nelson Island muskoxen (Hunt 1070) in spring 1985 (Table 2). The hunt was fully subscribed, with 3 people remaining on a waiting list. Permits for Hunt 1070 were issued at the Newtok Public Building on 25 January on a first-come, first-served basis. Fourteen Nelson Island muskox hunters resided in Newtok, 4 in Toksook Bay, 4 in Tununak, 3 in Nightmute, 3 in Bethel, and 2 in Chevak. Nelson Island residents (including Newtok) received 83% of the permits for Hunt 1070 in 1985.

Kill locations on Nelson Island were concentrated near Ukak on the northernmost ridge of the Kaluyut Mountains, the nearest good muskox habitat to Newtok (where most hunters lived). Other kill locations included ridges northeast of Tununak, and a few animals were taken east of Cape Vancouver. Approximately 100 muskoxen inhabiting steep slopes at Cape Vancouver were not accessible to hunters because of rugged terrain.

Eleven of 14 female muskoxen (78%) taken during the Nelson Island spring hunt were pregnant. At least 57% of 3-year-old females were pregnant, and 100% of 4-year-old and older females were pregnant. Twelve 4-year-old or older bulls, three 3-year-old bulls, and 1 2-year-old bull were taken on Nelson Island in 1985.

All Hunt 1070 permit holders (spring 1985) were successful in harvesting muskoxen. Most hunters (73%) spent 1 day or less in the field; 20% spent 2 days, and 6% spent 3. Only 1 violation of permit conditions occurred in 1985; a hunter with a cow permit shot a bull, claiming that the animal charged him. Although this "defense of life or property" claim is unusual for muskoxen, the hunter was not prosecuted. The animal had been shot repeatedly below the horns, and the head was turned over to the Division of Fish and Wildlife Protection.

A license vendor and local official from Chefornak reported to ADF&G that he had salvaged a drowned bull muskox from an inlet near Nelson Island in August 1984. A local resident found an additional dead adult bull east of Tununak in June 1985.

A few brown/grizzly bears have recently been sighted in the Askinuk Mountains and on Nelson Island. Because a bear was believed to have killed a muskox on the Seward Peninsula, loss of some muskoxen to bears is possible if bear numbers increase.

Mainland Muskoxen:

At least 2 yearling muskoxen were illegally taken on the mainland in early May 1985 by hunters from Johnson River villages. The herd from which these animals were taken contained 11-12 muskoxen in July 1984 and 10 in April 1985, 1 of which was radio-collared. Movements of this herd were closely monitored during April 1985 because the muskoxen were within 35 miles of Bethel. In April, we received independent reports from local residents on the movements of this herd, which inhabited tundra ridges between Kasigluk and Tuntutuliak and was easily accessible by snow-machine. Attitudes toward these muskoxen varied markedly from village to village. I made special information and education visits to villages in the area in early May to explain the reasons for not hunting muskoxen until they are more abundant. Some villages left these animals strictly alone, but residents of other villages herded the muskoxen away from their towns. On 1 and 2 May, concerned citizens informed Game Division that muskoxen were being killed. Within a day of these reports we were able to verify the disappearance of at least 2 yearlings by radio-tracking the herd. In a public meeting held to discuss the issue on 9 May, Nunapitchuk villagers stated that muskoxen were foreign to the area; that no hearings had been held to discuss whether local residents wanted muskoxen; and that muskoxen were trampling the tundra, disturbing berry-picking areas, and frightening people. Muskoxen were declared by these villagers to be neither customary nor traditional sources of food for local residents. It should be noted, however, that other reports indicated that muskoxen were being taken and consumed by some of these local residents.

At the Nunapitchuk meeting, Game Division and USFWS biologists attempted to explain the Game Board policy of allowing mainland muskoxen to increase before legalizing hunting. However, residents of Johnson River villages expressed their resistance to allowing mainland muskoxen to increase. They believe muskoxen should be confined to Nelson and Nunivak Islands.

Management Summary and Recommendations

Nunivak Island:

A principal concern of Game Division and USFWS biologists is that the Nunivak Island population may now exceed the long-term carrying capacity of the island. History suggests that Nunivak Island will support no more than 500-550 muskoxen in winters with heavy snow and freeze-thaw cycles that inhibit foraging. The March 1985 post-hunt, pre-calving census enumerated 547 animals, and the 1985 post-calving population was estimated to number 625-656. If the March 1985 census enumerated the entire population, then harvest removal and natural mortality will again reduce the population to a safe size. However, a significant proportion of the herd may not have been counted.

Muskoxen are not well-adapted for foraging through heavy snow and depend upon windswept areas to obtain food. Suitable winter range on Nunivak Island is limited to about 4,000 acres; in some years more than 50% of the population may winter on 3% of the island's surface area. In general, range conditions on Nunivak Island were favorable for muskoxen throughout winter 1984-85. Snowfall was insignificant until late February, and all traditional winter range was available during the time of the 1985 census. Almost all animals appeared to be in excellent condition. Hunters reported that their muskoxen had extensive fat deposits.

If the enumerated post-hunt, pre-calving population reaches or exceeds 600 muskoxen, harvest quotas should be increased to depress the population to the desired level. A computer simulation suggests that 1 more season (1985-86) of heavy cow harvest (50 cows, 30 bulls) followed by an ongoing harvest of 35 bulls and 35 cows will stabilize the herd at 500-550 animals.

Long-term goals for this population must be developed, and existing Department management plans must be updated. Optimum population structure, including numbers of reproductive females, trophy bulls, and young (eligible for transplants) is a function of management priorities. If this herd is to be managed for transplants, the harvest of bulls should be increased, and the proportion of cows increased, in order to increase productivity. However, the future of muskox transplants remains uncertain in a time of declining state revenues. This herd once had the reputation for providing an international-class trophy hunt of bulls with massive horn structure. If nonresident hunting resumes, should we manage this herd for trophy bulls? If so, how should the population be manipulated to maximize production of trophy animals? These and other questions should be addressed by an updated strategic management plan for Nunivak Island muskoxen.

Nelson Island:

The Nelson Island muskox herd has been stabilized by hunting and emigration, at a level consistent with management goals. No changes in seasons or harvest quotas are recommended at this time.

Mainland Muskoxen:

A small herd of 10-14 muskoxen has become established in the Askinuk Mountains within the last year. Aerial and ground surveys of an area inhabited by another herd of mainland muskoxen southwest of Bethel suggest that hundreds of square miles of open, windswept tundra ridges may be available to muskoxen in years with light snow accumulation. A similar expanse exists around the Mud Volcanoes east of Chevak. I believe initial estimates of a mainland carrying capacity of several hundred

muskoxen could be revised sharply upward, perhaps to several thousand muskoxen. However, if mainland muskoxen are to continue to increase in Unit 18, illegal harvest must be stopped. This will require a substantial commitment to information and education as well as enforcement of current regulations.

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Table 1. Nunivak Island muskox harvest, 1983-84 and 1984-85.

Year	Total	Bulls	Cows
1983-84	50	22	28
1984-85	69	20	49

Table 2. Nelson Island post-hunt, pre-calving population and harvest removals, 1981-85.

Year	Population	Ratio of mature[a] bulls to cows	Harvest quota	Harvest
1981	241[b]	0.87	20 cows	20 cows
1982	190	1.24	30 cows	19 cows 8 bulls
1983	205	0.75	25 bulls	25 bulls
1984	176	ND	15 bulls 15 cows	14 bulls 9 cows 1 yearling bull[c]
1985	195	ND	15 bulls 15 cows	16 bulls[d] 14 cows

[a] Includes bulls 4 years old and older and cows 2 years old and older.

[b] Census may have overestimated population by 40-50 animals.

[c] One adult bull and 1 yearling bull were apparently shot but not salvaged during winter 1983-84.

[d] One bull was taken "in defense of life or property" in 1985.

Table 3. Recent muskox sightings on the Unit 18 mainland, December 1983-April 1985.

Muskoxen observed	Location	Date	Comments
12-15	5 mi northeast of Newtok	December 1983	Observed by local resident.
1 bull	15 mi east of Newtok	November 1984	Broke ice on creek and died.
2; 1 was identified as 2-yr-bull	North shore of Kashunuk River south of Ingrisarak	Early winter 1984-85	Observed by Resident of Chevak.
1	Ingrisarak Mtn., near Chevak	Late winter 1984-85	Reported by residents of Marshall.
3	Askinuk Mts. near Cape Romanzof AFB	January 1985	Reported by National Guard.
10	Askinuk Mts. near Scammon Bay	April 1985	Reported by village residents.
1	Askinuk Mts. near Scammon Bay	April 1985	Reported as different sighting by village residents.
10	West of Bethel	9 April 1985	Reported by local official; remained in area until early May.
10	Southwest of Dall Lake towards Chefornak	9 April 1985	Observed by USFWS personnel; may be different group than above.

MUSKOXEN

SURVEY-INVENTORY PROGRESS REPORT

GAME MANAGEMENT UNIT: 22

GEOGRAPHICAL DESCRIPTION: Seward Peninsula

PERIOD COVERED: 1 July 1984-30 June 1985

Season and Bag Limit

See Hunting Regulations No. 25.

Population Status and Trend

The history of the introduction and early growth of the Seward Peninsula muskox population was summarized in the 1983-84 report (Smith 1985a) and will not be reiterated here.

Radiotelemetry continues to provide an invaluable tool for monitoring the size and distribution of the Seward Peninsula muskox population. A photocensus conducted on 4 April 1985, prior to calving, produced a count of 271 animals. Table 1 summarizes available information on size and recruitment for the Seward Peninsula muskox population. The 38% increase from 1983 to 1984, derived from census data (Table 1), appears to be too high with respect to both the reproductive potential of the species as reported in the literature, and observed rates of calf production on the Seward Peninsula. Apparently, 1983 surveys underestimated the population by at least 10-15 animals. Muskox survey results for 1984 and 1985 are believed to more closely approximate the actual population. Improved accuracy of census data can be attributed to our ability to locate a significant proportion of the population by radiotelemetry, and to a better understanding of seasonal population distribution gained through the ongoing Seward Peninsula muskox research project.

The increase from 1984 to 1985 (21%) is higher than that of established muskox populations (16% for Nunivak Island during 1947-68) but is comparable to that observed in the relatively young transplanted populations on Nelson Island (ADFG files) and in the Arctic National Wildlife Refuge (Jingfors and Klein 1982). The increase is also comparable to the rate of increase of a population recovering from a major reduction, as on Banks Island in the Canadian Archipelago (Urquhart, unpubl. data). The reproductive biology of muskoxen is still poorly understood, but it is likely that fecundity of females declines with age as it does in many ungulates that have been studied in more depth. A 2-year-old female transplanted to the Seward Peninsula from Nunivak Island in the original 1970 introduction produced a calf

in 1983. Since no animals presently alive on the Seward Peninsula are older, it is possible that no females are beyond reproductive age. Animals transplanted in 1981 increased the size of the population and are entering their most productive years. Unless natural mortality increases, population growth is expected to remain high.

Muskoxen captured in April 1984 were in poor condition, apparently because of difficult late-winter foraging conditions (Smith et al. 1985b). Nevertheless, 1984-85 calf production and survival were not significantly reduced. In a survey on 10 June 1984, 30 calves were recorded among a sample of 125 muskoxen (25%). The net increment to the population in April 1985 was 21%.

Historical records of muskox sightings by the public and by Department personnel were compiled and entered in the Big Game Data Index File during the reporting period. From 1970 to 1984, 207 sightings were recorded; data are available for all years except 1977 and 1978. Efforts by Department biologists to solicit information from the public varied annually, and the number of sightings recorded in a given year partly reflects that effort. Requests for sighting reports were made via local radio spots, articles in the local newspaper, and public notices.

Throughout the history of the transplanted population, sightings to the east of centers of population concentration have become increasingly frequent. However, substantial eastward movements were noted within the 1st 5 years following the introduction, and the outer limits of distribution observed from 1970 to 1985 were essentially defined by 1974. Subsequent sightings from 1975 to 1985 involved larger numbers of animals and were more frequent in peripheral areas.

The majority of distant sightings occurred in fall. Of 124 significant sightings (those which fall outside the typical range of the population) from 1970 to 1984, 104 (84%) were made between July and October. Eighty-one (65%) were made in August and September. Mean number of animals per significant sighting was 1.6 (n = 172), and single animals accounted for 92 (74%) of the significant sightings. Of 18 significant sightings for which sex and age were reported, 14 were of adult bulls.

Population Composition

Only limited composition data could be obtained from analysis of aerial photographs (Table 2). The number of animals classified was not sufficient for extrapolation to the entire population.

Mortality

Observed mortality of muskoxen on the Seward Peninsula since 1970 is shown in Table 3. Two radio-collared males and 1 unmarked adult male were found dead during the reporting period. One of

these animals was collared on the Kougarok River on 6 June 1984. It remained solitary until October 1984 when it moved near Teller and acquired a harem. It was found dead in November 1984, 51 miles from the point of capture. I attempted to recover the carcass for necropsy, but the animal had died at the edge of a small stream, and I was unable to free it from the ice. Unfortunately, the cause of death could not be determined. It is notable that the animal's death came shortly after its acquisition of a harem. An injury sustained in a rutting battle could have been the cause of death as reported elsewhere by Wilkinson and Shank (1976). Shooting is another possibility because the carcass was found only 4 miles from Teller and 2 miles from Brevig Mission.

Management Summary and Recommendations

The Seward Peninsula muskox population exhibits a steady increase and a conservative but significant rate of range expansion. If growth continues at the current rate the population will double in 4 years. Information is insufficient to estimate the muskox carrying capacity of the Seward Peninsula and surrounding area, but it is probably in the thousands.

Radiotelemetry has proven to be a cost-effective means of monitoring population size. Although radio tracking provides a means for obtaining a wide variety of information essential for sound management, maintenance of a pool of instrumented muskoxen can be justified solely as an aid in censusing the population. If only the herds which included the 16 radio-collared animals were counted, we could predict with 95% confidence (based on statistical analysis) that no more than 55 animals would have been missed in the 1985 census, assuming that radio-collared animals were randomly distributed in the population. However, considerable effort was expended to increase the precision of the estimate by visually locating herds that contained no radio-collared individuals.

Survey conditions in 1985 were ideal, with complete snow cover, restricted range availability due to deep snow, and unlimited visibility. One muskox herd was sighted from 8,500 feet above ground level. It is unlikely that any large bands were missed within the area covered. Aerial photography was used in 1985 and is the method of choice for determining the number of animals in a herd. Groups of more than 30 animals can rarely be counted accurately under normal aerial survey conditions. With several photographs of the same group contrasted against a snow-covered background, exact counts can easily be made.

No radio collars were placed on muskoxen during the reporting period. Table 4 shows the number of radio collars available at the time of the censuses. To maintain the current proportion of instrumented animals, at least 20 active collars will be required for the 1986 census.

In April 1982, the Board of Game authorized an annual harvest of 5 bull muskoxen from the Arctic National Wildlife Refuge, on the assumption that a precalving population of 219 animals could sustain a limited bull harvest and continue to grow. The Seward Peninsula herd now exceeds 271 animals, and a limited harvest is possible. Harvesting muskoxen is consistent with existing management plans, and specific goals and guidelines should be established for the Seward Peninsula to address the issue of consumptive use.

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Table 1. Seward Peninsula precalving muskox population counts and annual increments, 1983-85.

Year	Muskoxen observed	Numerical increase	Annual increment (%)	Percent short yearlings
1983	162	--	--	--
1984	225	63	38	28
1985	271	47	21	17

Table 2. Composition of muskox bands on the Seward Peninsula, as determined by aerial photography, April 1985.

Band No.	4+ years M	4+ years F	4 years M	4 years F	3 years M	3 years F	2 years M	2 years F	Yrlgs (11 mo)	Unid. sex & age	Totals	Marked animal I.D. Nos.
1	4				1						5	
2	1										1	w/reindeer
3									5	15	20	
4	2	10	3		1		2		2	19	39	200,210
												220,410
5										47	47	240,370
6	1									7	8	
7	1										1	
8	3		2						1		6	
9										16	16	
10	1	1	1	1	1					12	17	110
11										42	42	
12	1										1	
13	3		1		1						5	150,140
14									8	25	33	130,190
												390
15										16	16	180
16	2	3		1			1	1	4		12	80
17	1		1								2	440
Totals	20	14	8	2	4		3	1	20	199	271	

Table 3. Observed mortality of muskoxen on the Seward Peninsula, 1970-1984.

Year	Sex and age	Location	Probable cause of death
1970	No mortalities reported	--	--
1971	Yearling female	On beach 50 km east of Nome	Fell through ice
	2-3-year-old female	Foothills between Sinuk & Feather Rivers	Bear kill?
1972	Adult, sex unknown	16 km below Tin City on beach	Drowned
1973	No mortalities reported	--	--
1974	6-year-old male	Near Selawik	Mistaken for bear & shot
1975	No mortalities reported	--	--
1976	No mortalities reported	--	--
1977	No mortalities reported	--	--
1978	No mortalities reported	--	--
1979	No mortalities reported	--	--
1980	No mortalities reported	--	--
1981	Radio-collared adult	3 km from Port Clarence	Fell through ice
	Yearling, sex unknown	Nuluk River	Unknown
	Adult Male	Golden Gate Creek	Unknown
1982	2 adult females radio-collared in 1981	Tagagawik River	Unknown
	1 adult male	Near Teller	Illegal kill
1983	No mortalities reported	--	--

Table 3. Continued.

Year	Sex and age	Location	Probable cause of death
1984	16-year-old male from 1970 transplant	Near Brevig	Unknown
	15-year-old female from 1970 transplant, radio-collar No. 120	Don R.	Unknown
	Adult female	Nuluk R.	Capture mort.
	3-year-old male	Nuluk R.	Capture mort.
	2 adult females	Pinguk R.	Capture mort.
	Adult female	Black Mt.	Capture mort.
	Radio-collared adult male, No. 480	N. of Teller	Unknown
1985	Adult male	Arctic R.	Unknown

Table 4. Active radio collars, estimated population size, and percentage of radio-collared animals at time of April census, 1983-85.

Year	Active radios	Population census	% Radio-collared animals
1983	7	175[a]	4
1984	14	225	6
1985	16	271	6

[a] Corrected for animals missed. See text.

MUSKOXEN

SURVEY-INVENTORY PROGRESS REPORT

GAME MANAGEMENT UNIT: 23

GEOGRAPHICAL DESCRIPTION: Kotzebue Sound

PERIOD COVERED: 1 July 1984-30 June 1985

Season and Bag Limit

See Hunting Regulations No. 25.

Population Status and Trend

The Unit 23 muskox population appears to be stable or slowly increasing. On 19 July 1985, 96 muskoxen were counted in 4 separate groups, for the highest single count on record. Twenty-three of the animals counted (24%) were calves, indicative of high reproductive success.

Population Composition

Thirty-eight muskoxen 1 year old or older, and 13 calves, were counted during an aerial survey conducted on 24 May 1985. However, 96 muskoxen were seen during a survey conducted on 19 July 1985; 73 of these were at least 1 year old, and 23 were calves-of-the-year. Calves composed 25% and 24% of the May and July counts, respectively (Table 1).

During the 19 July census, 2 groups totaling 50 animals were located by radiotelemetry. The other 2 groups, totaling 46 animals, were located by visually searching a combined area of about 100 mi^2. The area searched was chosen on the basis of recent reported sightings of muskoxen. Obviously, a large amount of potential muskox habitat was not searched, some of which is known to support muskoxen during certain times of the year (e.g., Iviangik Mountain). Additionally, reports of 7 muskoxen in the Cape Krusenstern area were received at about the time of the July survey. These sightings were not verified, however, and were not included in the total of 96. These observations suggest that some muskoxen may not have been observed. The actual number of muskoxen in Unit 23 could be substantially higher than 96.

The observed proportion of calves (24%) was as high as those recorded anywhere else in Alaska, even in rapidly expanding populations (Smith 1984). Relatively high mortality, dispersal, and survey methods that underestimate population size are all factors to consider in accounting for the discrepancy between high productivity and low population growth.

Mortality

A bull muskox was killed illegally in late August or early September near Onion Portage on the Kobuk River. No other mortality was documented.

Management Summary and Recommendations

The muskox population in Unit 23 is difficult to monitor because a small number of animals is distributed over a vast area. The 2 radio-collared muskoxen facilitated efficient location of 50 animals in 2 groups during July 1985. Additional radio-collared animals would further improve census results by facilitating location of larger numbers of muskoxen. Radio-collaring additional animals would also improve our ability to monitor reproduction, recruitment, and other population parameters. A radio-collaring project should be initiated during the next report period.

Literature Cited

Smith, T. E. 1984. Status of Muskoxen in Alaska. Pages 15-18 in D. R. Klein, R. G. White, and S. Keller, eds. Proc. First Int. Muskox Symp. Biol. Pap. Univ. Alaska. Spec. Rep. No. 4. Part X, Vol. XV. Proj. W-22-3. Job 16.0. Juneau. 218pp.

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Table 1. Muskoxen observed during 2 surveys in northwest Alaska, spring and summer, 1985.

Date	Location	Muskoxen		
		Adult	Calf	Total
05/24/85	Saligvik Ridge (Kukpuk R.)	23	7	30
	Kemegrak Hills (Kukpuk R.)	15	6	21
07/19/85	Tahinichok Mts. (Rabbit Creek)	10	2	12
	Tinguk Ridge (Pusigrak Lagoon)	24	10	34
	Ilyinak Creek (Kukpuk R.)	19	6	25
	Lower Kukpuk R.	20	5	25

MUSKOXEN

SURVEY-INVENTORY PROGRESS REPORT

GAME MANAGEMENT UNITS: 26B and 26C

GEOGRAPHICAL DESCRIPTION: Central and Eastern Arctic Slope

PERIOD COVERED: 1 July 1984-30 June 1985

Season and Bag Limit

See Hunting Regulations No. 25.

Population Status and Trend

U. S. Fish and Wildlife Service biologists estimated the postcalving muskox population within and adjacent to the Arctic National Wildlife Refuge to be 257 in 1982, 311 in 1983, and 384 in 1984. The mean annual increase rate was 19% from 1974 to 1984. The postcalving population in 1985 was approximately 450.

Population Composition

U. S. Fish and Wildlife Service biologists collected composition data from approximately 89% of the population during July and November 1984. The bull:cow ratio was 92:100 among muskoxen 3 years of age or older; there were 74 calves and 51 yearlings:100 cows 3 years of age or older. Similar counts in June and July 1985 indicated 85 bulls, 98 calves, and 63 yearlings:100 cows 3 years of age or older. The drop in the bull:cow ratio is probably due in part to hunting, but the change resulted primarily from dispersal of older bulls into surrounding areas.

Mortality

Hunters killed 4 bull muskoxen in March 1985, all from the Sadlerochit subpopulation. Additional known mortalities included 2 old females and 2 females in the 3- or 4-year-old age class. The old females were animals transplanted in 1969.

Management Summary and Recommendations

Wild muskoxen were eliminated from Alaska during the 19th century. In 1969 and 1970 muskoxen were reintroduced to northeastern Alaska to reestablish viable populations on historic ranges and to provide for a high-quality recreational hunt. Muskoxen are now well-established within and adjacent to the Arctic National Wildlife Refuge and they are slowly dispersing to

surrounding regions. Encouraging continued dispersal and protecting suitable habitat during petroleum exploration and development are currently the primary management objectives for muskoxen in Subunits 26B and 26C.

Continued dispersal and range expansion would be most rapidly achieved through additional transplants of muskoxen from the Wildlife Refuge to Subunits 26A and 26B. Without such transplants, range expansion will probably continue to be very slow. Muskoxen, especially adult males, have been sighted annually for nearly 10 years along the Dalton Highway, yet no resident groups are known west of the Canning River.

Permits are currently available for taking 5 bull muskoxen in the Refuge each year during March. The population could easily withstand the removal of 10 adult bulls. Eleven of 14 muskoxen shot to date have come from the most accessible Sadlerochit River subpopulation. Extreme cold and windy conditions during most of March sometimes result in hunter congestion in the Sadlerochit area during the last few (usually warmer) days of March. Harvest could be more evenly distributed by extending the season through April or by adding a fall season in October. This would encourage hunters to visit less accessible areas without the risks and discomfort due to extreme weather during March. Total permits should not exceed 10, no females should be shot, and hunting should remain limited to Subunit 26C to protect animals that may disperse into Subunit 26B.

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