

Muskoxen in Northern Alaska

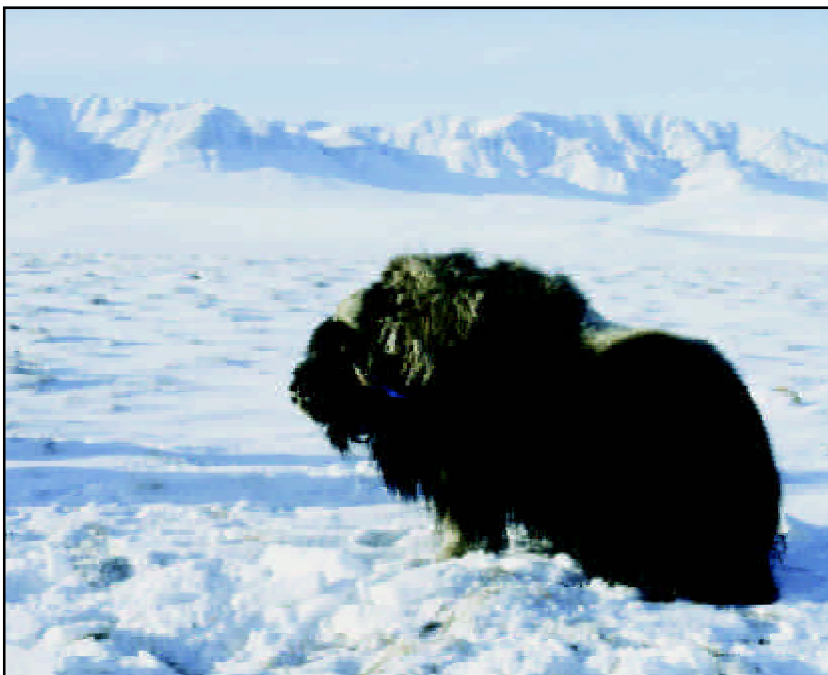
Restoration of an Arctic Animal

This article was prepared by Patricia Reynolds, U.S. Fish and Wildlife Service.

The coastal plain of the Arctic National Wildlife Refuge seems to be devoid of life in mid-winter, when snow, wind, and darkness dominate the landscape. Gone are the countless caribou and birds and insects that animate the coastal plain in summer. Colors are muted into monochromes of black and white. Wolves have moved to the mountains, and grizzly bears are curled in winter dens. But groups of dark-bodied animals move slowly across the frozen tundra foraging on dried sedges. Muskoxen have returned to Arctic Alaska after an absence of over 100 years.

The muskox is misnamed: it is not an ox and does not produce musk. This mammal is a member of the cow family, which includes large ruminating animals with hooves and horns. But muskoxen are more closely related to sheep and goats than to oxen or cattle. Their distinctive odor was likely experienced by the early explorers who encountered and named this animal.

Adult male muskox in late winter, Arctic National Wildlife Refuge, Alaska.



Muskoxen are arctic animals well adapted for life in cold climates. With a large head, short legs, and a stocky body, the muskox loses less heat than a lean, long-legged animal. At a distance, muskoxen appear to be massive, but the animals are relatively small, standing only 4–5 feet tall at the shoulder. However, a mature bull can weigh more than 900 pounds. Females captured in late summer in the Arctic National Wildlife Refuge weighed 300–560 pounds. The muskox has a heavy dark coat of long coarse hair that hangs in a skirt over its white-furred legs. Even its muzzle is covered with hair. In winter a thick layer of fine wool (called quivit) insulates the animal like a down parka. With a large gut and an efficient digestive system, the muskox can survive and maintain body fat on a winter diet of dried sedges that would starve a cow.

Both male and female muskoxen have long curved horns with sharp tips that are used to drive off predators and to discourage less-dominant members of their group from feeding in a favorite spot. Males also have a heavy helmet of horn that covers the forehead and protects the skull during fights for females. When males clash heads, the thick horn boss and the heavy bones of the skull protect the brain from concussion.

History of Muskox Populations

Originating in Asia, muskoxen were in western Europe almost a million years ago and appeared in Alaska in the late Pleistocene 150,000 to 250,000 years ago. As the ice sheets spread, muskoxen moved across Europe into the continental United States. They also expanded eastward into northern Canada and Greenland. Mammoths, bison, horses, and reindeer dominated the ice-age fauna in Europe, Asia, and North America, where several kinds of muskoxen also were present. But musk-



Mixed-sex group of muskoxen in summer, Arctic National Wildlife Refuge.

oxen may have been uncommon animals in the ice-age ecosystem.

About 9000 years ago, as ice sheets contracted and disappeared, muskoxen vanished from Europe. By 2000 years ago, they were gone from Russia. But one species of muskox survived in Arctic regions until recent times in Alaska, Canada, and Greenland.

Decline and Extinction

By the beginning of the 1900s, however, these remaining populations of muskoxen were in trouble. Muskoxen disappeared from northern Alaska by the 1860s and were gone from the rest of Alaska and possibly northwestern Canada by 1900. The extermination of muskoxen in Alaska was likely due to a combination of factors, including climatic conditions that influenced access to food and mortalities from predators and hunters. Humans with dogs were effective hunters of muskoxen, even before the arrival of firearms in Alaska.

Muskox populations in Canada also declined by the early 1900s. Commercial exploitation of the species occurred on a large scale. Between 1860 and 1915, 23,000 muskox hides were taken from the mainland of Canada and traded to the Hudson's Bay Company. Some Arctic explorers supported their expeditions by using muskoxen and caribou for food, clothing, and dogfood. At least 1400 muskoxen were taken from the Arctic islands of northern Canada between 1880 to 1917 by explorers.

Whalers and local hunters took thousands more muskoxen in Canada during these years.

In Greenland, Arctic explorers, whalers, and sealers also killed muskoxen in the early 1900s. Muskoxen were used to support fox trapping and fox farming operations, as well as meteorological and radio stations. A few thousand adult muskoxen were likely killed during efforts to capture calves for zoos. Populations in East Greenland, however, survived in spite of years of exploitation.

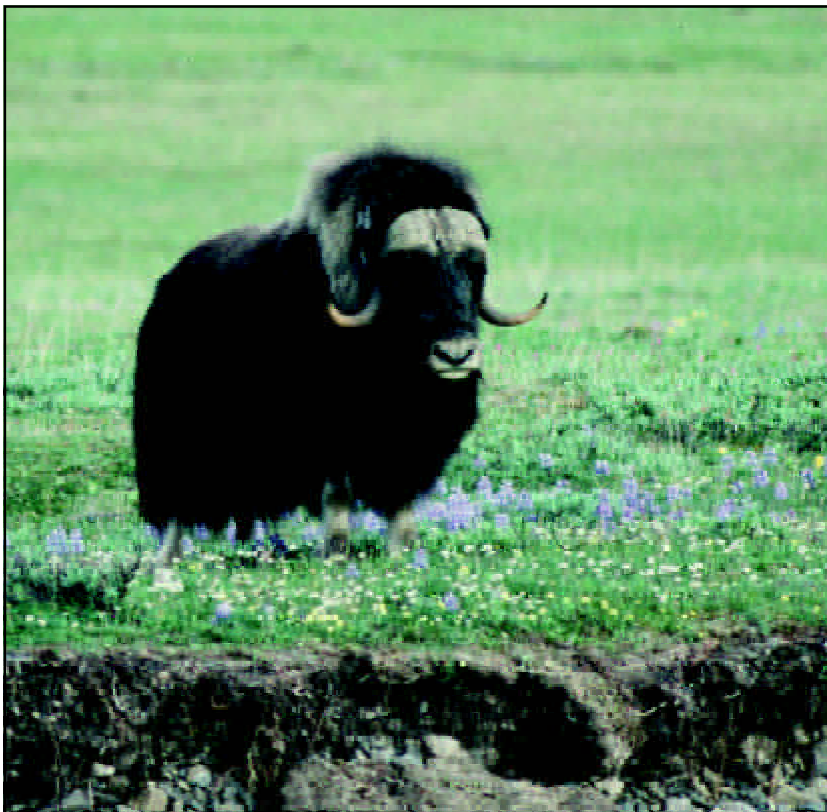
Conservation Actions

The disappearance of muskoxen from Alaska and the decline in numbers of muskoxen in Canada raised concerns that the species might become extinct. In 1917, killing muskoxen and trading muskox parts in Canada became illegal except in some areas where residents needed muskoxen for food. In 1927 the Thelon Game Sanctuary was established to protect remnant populations of muskoxen in Canada.

The United States government, also concerned about the disappearance of muskoxen from Alaska and the decline of the species in Canada, allocated money to acquire muskoxen and re-establish the species in Alaska. In 1930, 36 muskoxen, mostly calves and yearlings, were captured in East Greenland. During the next four months, these animals traveled halfway around the world from Greenland to Norway and New York by ship, across the United States to Seattle by train, up the inside passage to Seward by steamer, and finally to

Fairbanks, Alaska, by train. These well-traveled muskoxen were pastured at the Biological Survey Experiment Station in Fairbanks for five years. In 1935, four muskoxen from Fairbanks were taken to Nunivak Island, 25 miles off the coast of western Alaska. This island had nearly a million acres of grazing land and no large predators. In 1936 the remaining 27 muskoxen from Fairbanks were also moved to Nunivak Island after a journey down the Yukon River to the community of St. Michael in Norton Sound. The final leg of the trip by open barge to Nunivak Island almost ended in disaster when the barge began to take on water. But the animals landed safely and became the source of all wild muskoxen in Alaska today.

Adult male muskox in summer, Arctic National Wildlife Refuge.



Restoration of Vanished Populations

The 31 muskoxen released on Nunivak Island in the 1930s increased to several hundred by the 1960s. The island could only support about 500–600 muskoxen, and surplus animals were used to restore populations in regions of Alaska where they had disappeared. Between 1967 and 1981, 129 muskoxen from Nunivak Island were moved to four locations: Nelson Island east of Nunivak Island, northeastern Alaska near the Arctic National Wildlife Refuge, northwestern Alaska near Point Hope, and western Alaska on the

Seward Peninsula. During the next two decades, muskoxen expanded into nearby areas and recolonized formerly occupied landscapes in Alaska. About 4000 wild muskoxen live in Alaska today, with about half of these animals living on the Seward Peninsula.

In northeastern Alaska, muskoxen returned to areas of former occupation with the release of 51 muskoxen near the community of Kaktovik on Barter Island in 1969 and 13 muskoxen on the Kavik River in 1970. Most of these animals quickly dispersed into the nearby wilderness of the Arctic National Wildlife Refuge, although some animals moved long distances or died. Within a few years, muskoxen were established in three locations in northeastern Alaska.

Muskox Studies

I have studied the population of muskoxen in the Arctic National Wildlife Refuge for the U.S. Fish and Wildlife Service for more than two decades. The studies began in 1981 as part of a larger investigation collecting biological information about the coastal plain of the refuge. Today, studies of muskoxen in northeastern Alaska are part of a long-term monitoring program of refuge resources and cooperative investigations with biologists from other agencies and organizations.

We estimate numbers of muskoxen and trends in animal abundance in the refuge during surveys flown in late March or early April, when the ground is still snow covered and animals are easy to see on the treeless tundra. Calves, subadults, and adult males and females are counted from the ground in late June. Surveys of muskoxen in the Arctic National Wildlife Refuge are coordinated with surveys in adjacent areas flown by colleagues with the Alaska Department of Fish and Game, Parks Canada, and the Yukon Territory Government.

I use radiocollared animals to find out where muskoxen live, how far they move, how long they live, how often females reproduce, and how they behave in social groups. Between 1982 and 2000, we radiocollared 114 muskoxen, mostly adult females. Some of these muskoxen also carried collars that sent a signal to an orbiting satellite. Locations and activity counts were relayed to computers in Fairbanks several times each week. From this information, I defined seasonal use areas, movement rates, and activity patterns. I also cooperated with several graduate students from the University of Alaska Fairbanks who were

studying the habitats of muskoxen in and near the Arctic National Wildlife Refuge.

Social Behavior

Muskoxen are social animals. Females are almost always found in mixed groups of males, females, and young animals. Mixed groups of muskoxen in the Arctic National Wildlife Refuge range in size from 2 to 118 animals and are larger in winter and smaller during the summer breeding season. From October through May, 1982 through 1991, mixed groups had an average size of 20 to 24, compared with an average size of 12 in August.

Many adult males spend the winter in small groups of 2 to 12 bulls. In summer these bull groups dissolve, and most bulls become solitary or are associated with a breeding group. Males without females often linger on the edge of breeding groups and move from group to group. Like wild sheep, one male muskox breeds several females. Large adult males acquire and defend groups of females from July through September. The peak of breeding occurs in August, and displays and fights among males over females are common during this time of year. Males roar, butt and push heads, use odor as a threat display, and tear up the ground with their horns. A dominant male walks stiff-legged, tilting its head toward a rival to “show off” its horns. Bulls face one another, swinging their heads from side to side as they back up slowly for several yards. Then they run toward one another at full gallop, at speeds of 30 miles per hour, and clash head on.

When disturbed or frightened, muskoxen run together and wheel around, shoulder to shoulder, forming a circle or crescent with their horns facing out. Each animal attempts to press its rear flanks against another muskox. Even a solitary animal, when disturbed, will back up against a rock, bank, or snowdrift to protect its hindquarters. If a predator approaches, it is faced with a wall of horns. Adult muskoxen often dart from a defensive formation and attempt to hook the predator with their horns. Muskoxen will also run in a tight group, sometimes for miles, leaving a wide track of trampled snow.

Numbers of Muskoxen in the Arctic National Wildlife Refuge

After their return to northeastern Alaska, the number of muskoxen rapidly increased from about 50 in 1976 to almost 400 in 1986. During this time, calf production and rates of animal survival also were high. By 1987, mixed groups of muskoxen

were moving out of the refuge, as the population expanded into new regions.

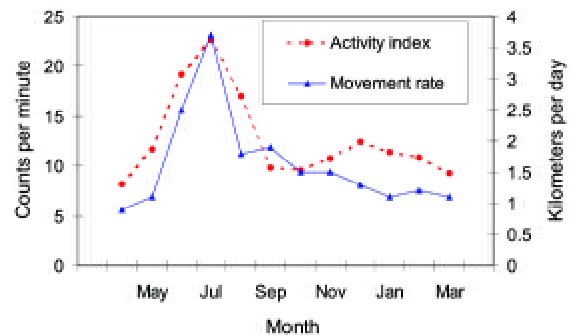
From 1987 to 1998, numbers of muskoxen in the Arctic Refuge were relatively stable at about 325. But from 1999 to 2002, numbers of muskoxen declined sharply. The changes in the abundance of muskoxen in the refuge over time occurred because of changes in births and deaths and shifts in distribution.

Calves

Most muskox calves in the Arctic National Wildlife Refuge are born from mid-April to mid-May. Unlike caribou, which produce calves in early June when high-quality food is available, muskoxen give birth when snow and freezing temperatures are present and green vegetation is not available for several weeks. A female muskox must be fat at the time she gives birth to have enough body reserves to make milk for a calf.

The number of calves varies from year to year because most female muskoxen in northeastern Alaska do not reproduce every year. Marked females in the Arctic National Wildlife Refuge have a calf every two or three years. When deep snow or icing conditions are present or winter conditions are prolonged, fewer calves are seen in June. In such years, muskoxen spend more energy digging and moving through snow, and by the calving season, reproducing females may be in poor condition and newborn calves may not survive.

In the Arctic National Wildlife Refuge the number of muskox calves declined over time. Very few calves were seen in 2000 and 2001 after winters of deep snow. Winter conditions persisted into June 2001, delaying the growing season for at least two weeks. Long winters not only deplete the body reserves of adult muskoxen but also result in a



Seasonal changes in the rates of movement and activity counts of satellite-collared female muskoxen in and near the Arctic National Wildlife Refuge, Alaska, 1986–1992.

shortened growing season, which may prevent females from fattening enough to successfully reproduce the following year. Predation by grizzly bears may also have contributed to the low numbers of calves in 2000 and 2001.

Deaths

The adult muskoxen die from several causes, including winter starvation, predation, hunting, and old age. Twelve (20%) of 61 marked muskoxen dying between 1982 and 2002 were in poor condition and died during winter. Five (8%) likely died of old age. Known-aged female muskoxen in the Arctic National Wildlife Refuge lived a maximum of 19 years. Hunters killed six (10%), and the cause of death was not determined for six marked muskoxen (10%). Grizzly bears likely killed 10 (16%) of the marked muskoxen and were seen feeding on 14 other carcasses (23%). By contrast, wolves and unidentified predators killed or scavenged eight marked muskoxen (13%).

About 3–4% of the estimated numbers of muskoxen in the Arctic National Wildlife Refuge are killed each year by hunters. Hunting of muskoxen was first permitted in 1982. Only residents of the community of Kaktovik have been allowed to hunt muskoxen in the Arctic National Wildlife Refuge since 1992. Hunting is regulated by permits, and most animals killed in the hunt are adult males.

Predation of muskoxen by grizzly bears in northeastern Alaska may be increasing. In 2000 and 2001, 19 muskoxen were killed and 5 were possibly killed or scavenged by bears in and near the Arctic National Wildlife Refuge. Sixteen of these died in multiple kills, events in which two to five muskoxen were killed from one group. Several marked bears were implicated in multiple kills of muskoxen, indicating that bears have become efficient predators of muskoxen in northeastern Alaska. Deep snow in 2000 and 2001 may have contributed to the high incidence of multiple kills in these years.

Preying on muskoxen is not without risk for grizzly bears. At least one marked bear was killed by a muskox, and other bears were badly injured when attacking muskoxen. Radiocollars were ripped off three different bears by muskoxen. These incidents show that muskoxen use their horns to defend themselves against predators.

Shifts in Distribution

As numbers declined in the Arctic National Wildlife Refuge, numbers of muskoxen increased



Adult female muskoxen in winter, Arctic National Wildlife Refuge.

in the Yukon Territory, Canada, east of the refuge, and in north-central Alaska, west of the refuge. Periodic pulses of mixed groups moving out of the refuge into adjacent areas have occurred several times since 1986. Movements of groups containing radiocollared muskoxen indicate that at least several muskoxen left the Arctic National Wildlife Refuge in 2000 and 2001.

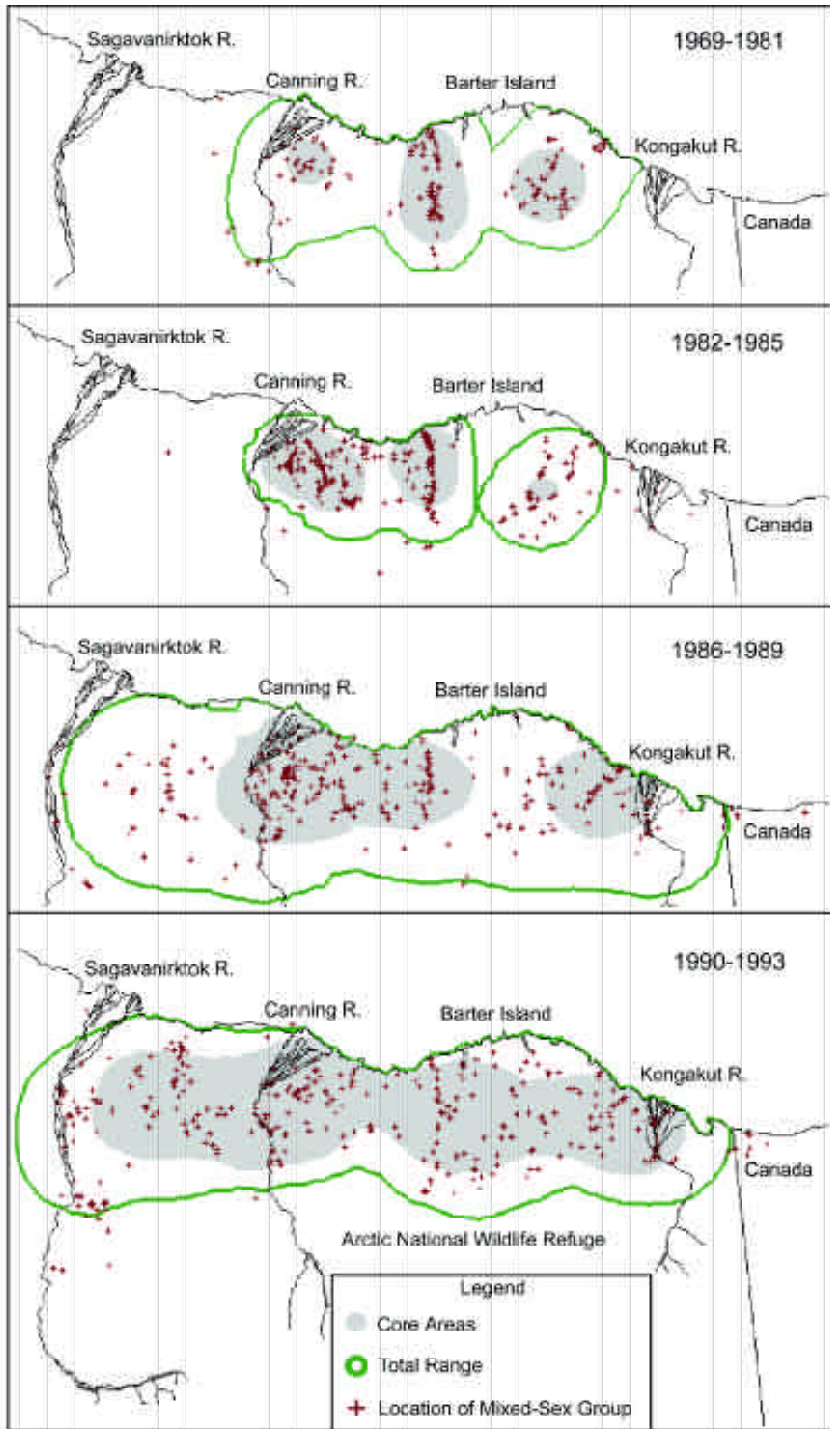
Ice, deep snow, an extended snow season, or a short growing season may limit access to food and force muskoxen to move. Muskoxen may also move long distances in response to predator attacks.

Seasonal Strategies

The lives of muskoxen on the coastal plain in northern Alaska alternate between the abundance of the short summer season and the dark and cold of the Arctic winter lasting eight to nine months. Seasonal shifts in physiology and behavior, as well as physical adaptations, allow muskoxen to live in these conditions year-round.

During the short summer, when green forage is available, muskoxen feed intensively to replenish body reserves lost the previous winter and calving period. The animals need to become fat enough to reproduce and to survive the next long winter. In summer, muskoxen in northern Alaska frequently forage along rivers, eating willows, sedges, and forbs. Muskoxen move longer distances and are more active in summer than in winter.

Throughout the long winter, muskoxen maintain their body condition while foraging on small amounts of poor-quality food. Energy conservation is a key. The warm, quilt-lined coat, the square body, and the short limbs of the muskox reduce heat loss. Muskoxen also slow down in winter, reducing their metabolic rate and food intake and decreasing their movements and activ-



Range expansion of muskoxen in mixed-sex groups in and west of the Arctic National Wildlife Refuge, Alaska, 1969–1993.

ity. Muskoxen generally stay in the same location most of the winter, selecting feeding sites with shallow soft snow on wind-blown ridges or uplands.

But winter conditions can affect muskox populations. In years when icing conditions, deep snow, or a prolonged snow season occur, muskoxen use more energy to dig for food or to move

through snow and may not successfully reproduce or survive. Deep snow or other local conditions may influence rates of predation or cause muskoxen to move to new areas.

Outlook

Muskoxen have been returned to Alaska, and the numbers of muskoxen have increased dramatically in Canada and Greenland since 1900. Populations of muskoxen have been established in northern Russia, Scandinavia, and West Greenland. These trends indicate that muskoxen will continue to exist in northern areas of the world. Muskoxen are an important component of the Arctic environment. They fit into a space not occupied by other animals, with their abilities to conserve energy, to survive on poor-quality food in winter, to defend themselves against predators, and to live year-round in northern climates.

Although numbers of muskoxen in the Arctic National Wildlife Refuge have declined, the total population in northeastern Alaska and northwestern Canada continues to expand. About 600–700 muskoxen now live between the Colville River in Alaska and the Babbage River in Canada in areas where no muskoxen were found 100 years ago. Populations in other regions of Alaska also are stable or increasing. The return of muskoxen to Alaska has restored a key piece to the Arctic ecosystem and adds dimension and diversity to the landscape of the Arctic National Wildlife Refuge.

Suggestions for Further Reading

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- Reynolds, P.E. (1998) Dynamics and range expansion of a reestablished muskox population. *Journal of Wildlife Management*, vol. 62, no. 2, p. 734–744.
- Reynolds, P.E., K.J. Wilson, and D.R. Klein (2002) Muskoxen. In *Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries* (D.C. Douglas, P.E. Reynolds, and E.B. Rhode, ed.). U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR-2002-0001, p. 54–64.