



Terrestrial Life

Many terrestrial species can be found in the 1002 region due to the abundant food source available on the coastal plain. The forage quantity and quality supports the different species that stay in the area all year round, or come during summer to feed, breed, and raise their young. Migratory species such as the caribou (the Porcupine Caribou Herd PCH in 1002) can be found. Non-migratory species include muskoxen, polar bears, arctic foxes, wolves, wolverines, and other small mammals such as lemmings, voles and shrews.

Vegetation in the area are mainly moist herbaceous/shrub tundra, tussock sedges and wet sedge tundra. The limited precipitation and low temperature in the area limits the variety of plants that can survive there. Mostly, it is vascular species low in height.

The Caribou, as a migratory species, mainly uses the 1002 area as a staging ground. The central southern portion of the 1002 area is a core calving ground for the PCH. It also uses the western portion of 1002 as a post-calving ground, and migrates through the area yearly.

Other species such as the muskoxen and arctic foxes stay in the area year-round. Collectively though, the critical time periods of these species would still be summer from May to October, when the weather is warmer and insects are less abundant, allowing calving and breeding to take place for different species. However, polar bears den there during the winter as well, and disturbance to their dens may lead to abandonment of the dens by mothers, endangering the survival of cubs.

Main concerns for terrestrial species would be noise pollution from exploration, which could be particularly significant for polar bears, and blockades and fragmentation of habitat by pipelines and oil-drilling infrastructure.

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Terrestrial Life - Polar Bears (*Ursis arctos*)



Habitat

Polar bears can be found along the Coastal Plain and on Arctic Ice. Although Polar Bear breeding occurs on ice, once pregnant, the females migrate to the Coastal Plain in order to make dens, give birth to and nurse their young. Arctic Refuge's coastal tundra provides America's only land denning habitat for polar bears, serving primarily the Beaufort Sea population. It's also one of the world's largest polar bear denning sites.

Dangers

- hunted throughout most of their range.
- polar bears of the Beaufort Sea region are exposed to mineral and petroleum
- extraction and related human activities such as shipping, road-building, and seismic testing (Stirling 1990).

Movement

- Polar bears were observed to move more than 4 km/hr for extended periods, but mean hourly rates of movement varied from 0.30-0.96 km/hr.
- Movement rates varied significantly among months: they generally were lowest in spring and late summer and highest in early winter (Amstrup 1995, Amstrup. Geographic displacements from the beginning to the end of each month were smaller for females with cubs of the year than for single females, and larger in November than in April.
- Total annual movements ranged from 1,454-6,203 km. Bears that spent part of the year in dens moved less than others, but non-denning classes of bears did not differ in total annual movement (Amstrup 1995, Amstrup et al. 2000).
- Beaufort Sea polar bears kept their movements within boundaries outside of which they seldom ventured. Annual activity areas ranged from 12,730 km² to 596,800 km². Monthly activity areas ranged from a mean of 344 km² for females with cubs in April to 11,926 km² for females with yearlings in December (Amstrup 1995, Amstrup et al. 2000).

Polar Bear Denning Sites:

Breeding

-Amstrup et al. (2001) and McDonald and Amstrup (2001) suggested that the number of polar bears in the Southern Beaufort Sea population grew at more than 3% per year between 1967 and 1998, reaching an estimated population that could be as high as 2,500 animals.

-Survival of adults, as calculated from life tables, was higher and survival of young lower when the population was large. Survival rates of adult Beaufort Sea polar bears, however, were as high or higher than those measured anywhere else.

-Although numbers of young produced per female when the population was small (<0.40) and when it was large (<0.38) were similar, litters of more than one yearling were more frequent when the population was small.

Death

-In this study hunting explained 85% of the documented deaths of adult female polar bears (Amstrup and Durner 1995). Natural mortalities were not commonly observed among prime age animals (Amstrup and Nielsen 1989), and we still know little about the proximate causes of natural deaths among polar bears.

Critical Time Periods:

In research conducted on the Beaufort Sea Region, it was discovered that in the months of May through August the bears shifted locations to the north and remained there till October.

Sensitivities:

Although hydrocarbons have serious ramifications on all wildlife, polar bears reproduction rates and rapid growth will not be severely altered if oil is to be extracted (Amstrup et al. 1989) as can be seen in prior cases. The available data suggests that polar bears are pretty resilient to environmental disturbances (Amstrup 1993).

Effects of Petroleum on Polar Bears

- Although contact with hydrocarbons can have serious ramifications for polar bears (Amstrup et al. 1989), the polar bear's apparent rapid population growth has spanned the entire history of petroleum development in arctic Alaska (Amstrup 2000, Amstrup et al. 2001, McDonald and Amstrup 2001). This suggests that managed resource development can be compatible with healthy polar bear populations. Also encouraging is the new ability to estimate potential impacts that oil spills may have on polar bears. That ability has major ramifications for assessing risks of a variety of potential developments (Durner et al. 2001b).
- Effects of the increasing human intrusions into the polar bear environment have not been observed at a population level, suggesting that proactive management can assure coexistence of polar bears and human developments.

Endangered?

- Estimated numbers of bears at the close of the study were relatively large. Early estimates suggested the additional loss of as few as 30 bears each year might push the total take from the population to the maximum sustained yield (Amstrup et al 1986, Amstrup and DeMaster 1988). Excess take did precipitate a decline in the 1960s and 1970s. Hence, although populations may now be near historic highs, managers must be alert to possible changes in human activities, including hunting and habitat alterations that could precipitate future declines.
- because polar bears have a low rate of reproduction and a greater success of cubbing in land-based dens, onshore denning habitat is crucial to the survival of the species.

References

(1) <http://www.absc.usgs.gov/1002/section8.htm>

(2) http://www.savealaska.com/sa_anwr.html

(3) Map on polar bear dens and fish habitats: "Distribution of Selected Wildlife on Arctic Refuge Coastal Plain". Conservation GIS Center. February 5, 2003.

http://www.conservationgiscenter.org/maps/html/2000_wildlife.html

Terrestrial Life - Porcupine Caribou (*Rangifer tarandus*)

U.S. Fish and Wildlife Service

General Information

The porcupine caribou herd can be located at many plant communities throughout ANWR. The herd is made up of an estimated 129,000 members and spends winters in the southern portion of the refuge (as well as outside of refuge). The herd migrates twice a year more than 700 miles to ANWR's Coastal Plain. The pregnant cows normally reach the calving areas in the Coastal Plain by early June and give birth. (Hank Lentfer and Carolyn Servid, 2001). Soon afterwards, the rest of the herd joins the cows in their calving ground. About a month afterwards, when the climate gets slightly warmer and mosquitos hatch, the caribou will migrate north seeking relief from these tormenting insects. They will travel along the coast, and to the uplands in Brook's Range. (Kaj Birket-Smith)



Porcupine Caribou Herd

(Photo: <http://www.r7.fws.gov/nwr/arctic/caribou.html>)

Critical Time Periods

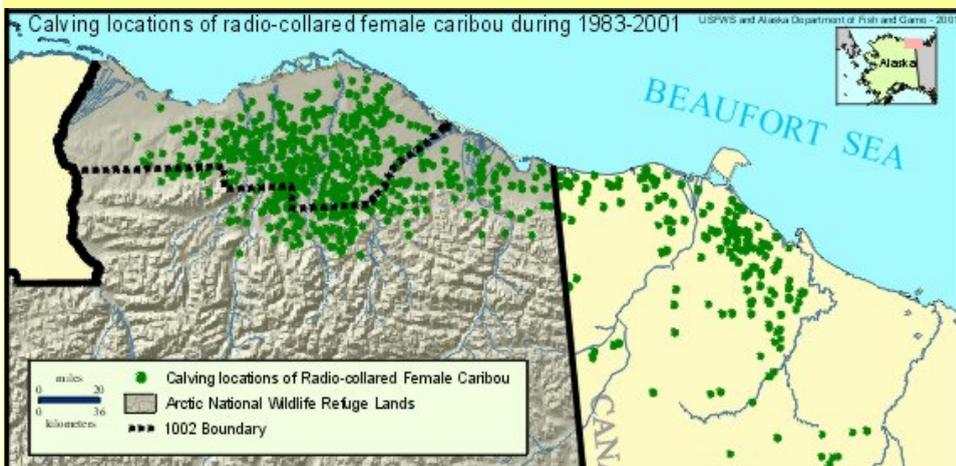
Between the months of August and October insects are less abundant, the caribou still travel in search of nutrition but do not have the need to congregate in areas where swarms of insects can be avoided. (Lentfer and Carolyn Servid, 2001) Therefore, the caribou disperse widely and cover a large area but along parallel paths. By October, the Porcupine caribou herd has moved to the boreal forest. The critical time period for the caribou is when migrations is at its greatest in April and during the first week after the calves are born. The cows are the first to arrive to the Coastal Plain (USGS Fish and Wildlife, 2003) and 1002 region and normally arrive in early June although harsh weather conditions can delay their arrival. The most critical time period is in the calves first week in the world.

The Coastal Plain is vital to the calves' survival for two main reasons:

- 1) fewer brown bears, wolves, and golden eagles live on the coastal plain so newborns have greater chance of survival in their first week until they are strong enough to outrun their predators. (USGS Fish and Wildlife, 2003)
- 2) Coastal Plain provides proper nutrition needed for calving. There is an abundance of plant species and after a long winter, the cows need to have good nutrition

Calving grounds:

the northern foot hills of the Brooks Range and the arctic Coastal Plain from from the Tamarayiak River in Alaska to the Babbage river in Canada. Most often used calving grounds are on the Coastal Plain between the Katakturuk and Kongaut rivers where normally, 50% - 75% of the herds' calves are born.



Calving Locations of Radio Collared Female Caribou
(Map: <http://www.r7.fws.gov/nwr/arctic/caribou.html>)

Proposal

The porcupine caribou herd are a vital part of ANWR's eco-system and therefore must be taken into great consideration when planning the most environmentally efficient way to extract oil . The porcupine' caribou herd's relation to the Coastal Plain is part of an unaltered system which brings new life to the Caribou after a long and harsh winter.

It is vital to take into grave consideration the migratory paths of the Porcupine Caribou Herd before formulating a plan to extract oil. Precautions should be made with utmost carefulness in order to mitigate as much as possible the effects on the herd's migratory paths which have gone undisturbed for centuries.

Suggestion

The fact that this important species is migratory is a major asset in formulating an environmentally efficient method of oil extraction. The oil drilling should occur between the months of October and April when the the caribou are not in the 1002 area.

Caribou's Migratory Paths:

(Map: <http://www.r7.fws.gov/nwr/arctic/caribouyear.html>)

Reference:

1. Hank Lentfer and Carolyn Servid. (2001). *Arctic refuge : a circle of testimony* . Minneapolis, Minn. : Milkweed Editions, 2001.
2. Joe C. Truett and Stephen R. Johnson. (2000). *The natural history of an Arctic oil field : development and the biota*. San Diego, Calif. : Academic, c2000.
3. Kaj Birket-Smith. (1976). *The Caribou Eskimos : material and social life and their cultural position*. New York : AMS Press
4. <http://www.r7.fws.gov/nwr/arctic/wildlife.html>
5. <http://www.absc.usgs.gov/1002/index.htm>

Terrestrial Life - Central Arctic Caribou

General Information

Success in reproduction is mainly related to the females' nutrition and calf production is highly positively correlated to fat content of sexually mature females during the autumn . As researched near the Sagavanirktok River near the petroleum extraction zone, due to the roads built the herd was not able to reach their usual habitats and food supply thus leading to a reduction of female body fat and calf production. (Remon Pelinsky, 1986) The reduced nutrition of the females near the oil production areas reduced the amount of pregnancies one year after another.

Caribou's Migratory Paths

(Map: <http://www.r7.fws.gov/nwr/arctic/caribouyear.html>)

Sensitivities

Evidence from oil extraction in Prudhoe bay has demonstrated its drastic effects on the caribou's habitat. From the 1970s to the 1980's the Central Arctic Caribou made use of the areas of the coastal plane near drilling sites (Remon Pelinsky, 1986) During the calving period, caribou showed increasing avoidance of areas near drilling sites and changed their migratory routes accordingly. Within the main industrial complex, the number of caribou severely decreased by an estimated 78% in Caribou use and 90% in migratory paths. These were only some of the effects Prudhoe Bay drilling had over the past few decades

Proposal: Like all the species in the 1002 region, calving and natural habitat will change. The Central Arctic Caribou's migratory paths and calving productivity will most likely decline as was the case near the Prudhoe bay's drilling sites. With the loss of their preferred habitat, sexually mature females will have less body fat and thus have lower reproduction rates. Exactly how much impact there will be depends on the methods of oil extraction and the amount of roads built and the location of those roads.

Reference:

1. Adamczewski, J. Z., C. C. Gates, R. J. Hudson, and M. A. Price. 1987. *Seasonal changes in body composition of mature female caribou and calves (Rangifer tarandus groenlandicus) on an arctic island with limited winter resources*. Canadian Journal of Zoology 65:1149-1157.
2. Joe C. Truett and Stephen R. Johnson. (2000). *The natural history of an Arctic oil field : development and the biota*. San Diego, Calif. : Academic, c2000.

Terrestrial Life - Muskoxen

Muskoxen (*Ovibos moschatus*) were driven to extinction before the 20th century. They were reintroduced in 1969 and their numbers reached a peak at almost 400 individuals in 1986. Since then, the muskoxen population has declined to around 200 individuals. Reasons for this population decline include emigration, increased predation by grizzly bears, and severe winters. Also, hunting by humans has increased since their reintroduction. (Patricia E. Reynolds, Kenneth J. Wilson, and David R. Klein, 2002)

Muskoxen conserve energy by limiting their movement; they tend to stick to a core area about 50 km² in the winter and 200 km² during the calving and summer seasons. Calving occurs from March to June, so it is especially important for mothers to build up enough reserves during the summer to last the winter and to feed the newborn. Thus, a prolonged winter would have significant negative impacts on calf survival.

Muskoxen depend on riparian cover along river corridors, floodplains, and foothills year-round. During the winter, it seeks out areas of soft shallow snow. Its winter diet consists mainly of low-quality forage such as sedges, grasses, mosses, and forbs. In the spring, it feeds on high quality flowering sedges. Muskoxen tend to be very loyal to a particular spot, returning there year after year. (Patricia E. Reynolds, Kenneth J. Wilson, and David R. Klein, 2002)

Any human activity should stay away from the muskoxen habitats, including adjacent uplands. The areas that muskoxen frequent are places often used for gravel and water extraction for roads and/or platforms. Muskoxen congregate into larger groups in the winter, and large groups of animals are more likely to be disturbed by human activity because they tend to have more sensitive individuals.

Muskoxen groups that have moved west tolerate the Trans-Alaskan pipeline and the Dalton highway, but it is due to the wider area of habitable land available to the animals. Muskoxen remaining in the 1002 coastal plain are in a more geographically constricted habitat, with the Beaufort Sea to the north and the Brooks Range to the south. Eastern muskoxen populations are likely to suffer if human activities displace their territories and there are few alternative habitats available. (Patricia E. Reynolds, Kenneth J. Wilson, and David R. Klein, 2002)

Muskoxen habitats and vegetation in ANWR

As muskoxen populations in the far west have coexisted peacefully with the Trans-Alaskan pipeline, a similar pipeline through the 1002 region should have little impact as well-- if it is built with the same environmental precautions. For example, the Trans-Alaskan pipeline has 579 animal crossings over its 800 mile span.

Helicopters and low-flying aircraft have been noted to cause some herds to stampede and abandon their calves. Some herds have been agitated by 3-D seismic exploration as far as three kilometers away; other herds seem unperturbed as close as 300 m. Generally, noise produced by traffic, etc will have a negative effect on the animals. (Patricia E. Reynolds, Kenneth J. Wilson, and David R. Klein, 2002)

Little data are available on the interaction between muskoxen and human settlement associated with oil development. This is because drilling platforms have been built in regions rarely visited by muskoxen. However, the nature of the muskoxen's normal food source is such that its scavenging among human waste is unlikely. The major concern is the gravel used for the platforms, which would have to be extracted from muskoxen habitats.

Locations of mixed-sex groups of muskoxen seen during winter and summer surveys in the Arctic National Wildlife Refuge, Alaska, USA, 1982-1999

(Map: <http://www.absc.usgs.gov/1002/images/Fig07-06.gif>)

Sources:

Map on muskoxen and vegetation: "Distribution of Selected Wildlife on Arctic Refuge Coastal Plain". Conservation GIS Center. February 5, 2003.

http://www.conservationgiscenter.org/maps/html/2000_wildlife.html and GIS data from USGS

Terrestrial Life - Wolves and Arctic Foxes

Wolves and Wolverines

Wolves primarily den in the foothills and mountains south of the coastal plain in the refuge. Wolverines are infrequently observed but travel in all types of arctic terrain, and females may use snowdrifts along small tundra streams for dens. During spring, wolves roam out to the coastal tundra where they prey on newborn caribou. Population declines or changes in distribution of wolves are results PREDICTED from the increased mortality, decreased prey, harassment, and disturbance in denning areas caused by oil development. The cumulative effects of displacement, avoidance, and reduced food resources could result in long-term changes in wolverine distribution. (2)

The following article is directly quoted from the official website of ANWR:

<http://www.r7.fws.gov/nwr/arctic/wolf.html>

"Wolves have long been a lightning rod for controversy. They evoke passionate feelings in many of us. Some people love them, a few fear them, others prefer that they be shot. On the Arctic Refuge, however, these differences are seldom voiced. Why? The wolf is wild, beautiful, and inspiring. So is the Refuge. The two belong together. People know it and expect it.

Cousin to the dog, the gray wolf is a highly social animal, preferring to live in packs. The pack, dominated by a male/female pair, may include their pups of the year, wolves born the previous year, and other adults.

Gray wolves may be shades of gray, brown, black, or white. Wolves of all these colors roam the Refuge. Some five packs totalling 25 to 30 animals live on the Refuge's north slope east of the Canning River. The wolves are found primarily in the mountains and foothills along major rivers.

The makeup of wolf packs on the Refuge's north slope varies. In summer, many wolves hunt alone or in pairs. Some are "drifters." Others may switch packs or move to new areas, perhaps following the caribou migration. In winter the packs stay together more to hunt.

Gray wolves mate in late February and March. The pairs then move to maternity dens near rivers in the foothills and mountains. About four to seven pups are born in late May or early June. The pups are weaned during the summer, and the dens are abandoned in July or August. By early winter, the pups can travel and hunt with the adult wolves.

Although to date, no dens have been found on the Refuge coastal plain, wolves make frequent trips there from May to July when the Porcupine caribou herd is present. After the caribou leave the coastal plain, the wolves stay in the mountains and foothills hunting caribou, along with Dall sheep and moose. Wolves, however, are opportunistic feeders. They will catch small rodents, birds, and ground squirrels if they can.

Natural relationships between predator and prey still prevail on the Arctic Refuge. Here the wolf's connection to the caribou and the land continues as it has for centuries. Untamed and free, the wolf is a symbol for the Refuge - a truly remarkable place."

Arctic Foxes

From recent studies it has been seen that, "past and current industrial activities on the North Slope have probably increased the availability of shelter and food for the arctic fox" (1, pg. 117). Like bears, these animals too use oil fields for foraging on garbage, or resting. Foraging of these sites is more likely to occur in the winter when food is more scarce than in the summer. It has been observed that "foxes do not avoid human activity" (1) raising their young in the proximity of traveled roads and operating drill rigs. Over the years it is remarked that, "the density and the rate of occupancy of dens and the sizes of litters are greater in oil fields than in adjacent areas" (1). These increasing fox numbers have a negative impact on bird population, which are extensively hunted by these. This can be especially "devastating to colonial birds" or to birds that migrate to the area (1). An increase number of roads, has also allowed foxes to access other bird populations that were before inaccessible to them. Thus, it has been seen that oil exploration in the Alaskan region increases fox population which has an adverse effect on other species, such as birds.

Reference:

1. Environmental Assessment, Redoubt Shoal Unit Development Project, section 3.8.3 .

<http://yosemite.epa.gov/R10/water.nsf/0/9316eb066fa30af088256b4b000a77e6/>

[\\$FILE/Forest%20Oil%20EA%20Section%203A%20Affected%20\(Baseline\)%20Environment.pdf](#)

1. *Protection of the Arctic National Wildlife Refuge: Key to Managing one of the World's Most Biologically Valuable Ecoregions, the Arctic Coastal Tundra*" WWF (2000)

Terrestrial Life - Lemmings and Voles

Lemmings and Voles tend to be more abundant and have less survival issues than muskoxen. In the winter they live in large underground burrows that may be as close as two inches from the permafrost. There are two species of lemmings in the area: the brown lemming (*Lemmus sibiricus*) and the collared lemming (*Dicrostonyx groenlandicus*). The brown lemming prefers wetter environments like damp meadows and river or lake shores, while the collared lemming prefers rockier places. Lemmings live on plants, roots, berries, and lichens, and stored seeds in the winter. (John Whitaker Jr., 1996)

There are two species of voles in the 1002 area: the northern red-backed vole (*Clethrionomys rutilus*) and the singing vole (*Microtus miurus*). The northern red-backed vole feeds on leaves, buds, and twigs. They are active all winter, making the most of their short lives: by the end of the summer, all those born before the last year have died. The singing vole is known for its alarm call, a high pitched trill. Singing voles are colonial, behaving much like prairie dogs. They feed on stored tubers during the long winter season. Burrows of singing voles are often raided by native peoples, who pilfer the stored tubers for their own use. (John Whitaker Jr., 1996)

Because of their numbers lemmings and voles are not likely to be wiped out by human activity in the region. However, they are an important source of food for higher level consumers, including polar bears, wolves, and foxes. Lemming cycles-- population booms and busts every four to five years-- for example, are closely tied to the population cycles of various predators. A sharp drop in their numbers could potentially cause a population decrease in many other, higher-level consumers. (John Whitaker Jr., 1996)

Singing Vole (*Microtus miurus*)

The singing vole is so-named for its high-pitched trill, used to warn members of its social group. It is a food source for the common avian and mammal predators of the area. Singing voles dig burrows with ~1" diameter entrances that may be up to 3' long. This includes a large nest that may be up to 1' long, and a storage chamber for extra food. Burrows are typically only 2" from the surface, and are often raided by Native peoples for the stored tubers.

The singing vole eats lupines, arctic locoweed, horsetail, and sedge. Its range encompasses Alaska, Yukon, and the Northwest Territories. It breeds from May to September. Gestation is 21 days. The singing vole may have up to 3 litters/year, with 4-12 young/litter. (John Whitaker Jr., 1996)

Northern Red-backed Vole (*Clethrionomys rutilus*)

Northern Red-backed voles like to eat green herbaceous plants and underground fungi. They store bulbs, stems, tuber, and nuts in their burrows. Burrow entrances are characterised by pieces of cut vegetation among boulders and logs. Its range encompasses Alaska and northwest Canada. It breeds from late May to early September. Gestation is 17-19 days. Females typically have 2 litters/year, with 4-9/litter. (John Whitaker Jr., 1996)

Brown Lemming (*Lemmus sibiricus*)

Brown lemmings live in surface nests made of woven balls of grass 6-8" wide. They also dig tunnels with chambers 6" diameter. Frequently will a tunnel or nest be abandoned and a new one created. Brown lemmings feed on grasses, sedges, and leafy plants during summer. During the winter months it relies on the bark and twigs of willow and birch. They have very small home ranges, about 3.5 - 6 sq yds. Lemmings mate typically from the spring to fall, though sometimes there is breeding throughout winter as well. There are typically 1-3 litters/yr, with 1-13/litter. Population fluctuates dramatically, peaking every 3-4 years due to winter breeding. Then, the lemmings become nervous and hyperactive, and are prey to the various predators of the area. Brown lemmings inhabit the wet tundra of Alaska, northern Canada, and northern British Columbia, including the ANWR region. (John Whitaker Jr., 1996)

Collared Lemming (*Dicrostonyx groenlandicus*)

Collared lemmings live in surface nests 6-8" wide among rocks and snowdrifts. They dig tunnel systems with resting chambers as deep as the permafrost line. During the summer, collared lemmings feed on grasses, sedges, bearberry, and cotton grass. They also feed on willow twigs and buds year-round. With a range that spans northern and western Alaska as well as northern Canada, collared lemmings are a major food source for arctic carnivores including Arctic foxes, wolves, wolverines, snowy owls, gulls, jaegers, etc. Collared lemmings breed from March to September. A female has several litters a year, with ~7/litter. Gestation is 21 days. (John Whitaker Jr., 1996)

Impacts of Oil Exploration and Drilling

Lemmings and Voles tend to be more abundant and have less survival issues than muskoxen. In the winter they live in large underground burrows that may be as close as two inches from the permafrost. They subsist on willow twigs, sedges, and stored tubers during the long winter season. Burrows of voles are often raided by native peoples, who pilfer the stored tubers for their own use. (John Whitaker Jr., 1996)

Because of their numbers lemmings and voles are not likely to be wiped out by human activity in the region. However, they are an important source of food for higher level consumers, including polar bears, wolves, and foxes. Lemming cycles, for example, are closely tied to the population cycles of various predators. A sharp drop in their numbers could potentially cause a population decrease in many other, higher-level consumers. (John Whitaker Jr., 1996)

Terrestrial Life - Shrews

Overview ("Shrew," Microsoft® Encarta® Online Encyclopedia 2003)

-Shrews are small mouselike mammals, related to the mole, with a long, pointed snout and soft, gray-brown, velvety fur

nocturnal animals that feed primarily on insects and worms but also eat mice equal to their own size, as well as plants and occasionally fish and other aquatic animals.

-Many species have glands from which a fluid with a disagreeable odor is secreted, and some species have a poisonous saliva.

-Members of one subfamily of shrews hunt by means of echolocation, although this sense is relatively crude compared to its development in bats.

Common Characteristics ("Shrew," Microsoft® Encarta® Online Encyclopedia 2003)

-In the United States:

- most common are the long-tailed shrews

- slightly less than 7.5 cm (less than 3 in) long.

- ears are larger than in some other shrews, and the teeth are brown at the tip.

- five to seven young are produced in a litter each spring.

-short-tailed shrews.

- mole shrew, the most common shrew in the eastern United States,

- about 11.4 cm (about 4.5 in) long.

Reference:

1. John Whitaker Jr. (1996). *The National Audubon Society Field Guide to North American Mammals*
2. "Shrew," Microsoft® Encarta® Online Encyclopedia 2003,
http://encarta.msn.com/encyclopedia_761555846/Shrew.html

