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The Lynx

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SPECIES DESCRIPTION AND NATURAL HISTORY

The lynx (*Felis lynx*) is a predator of the Northern Hemisphere's high-latitude and deep-snow boreal forest ecosystem. Traditionally, North American and Eurasian lynx were considered different species, *Lynx canadensis* and *L. lynx*, respectively. However, many authorities now believe the two are subspecies. A third population, the Spanish lynx of the Iberian Peninsula, is considered a separate species, *Felis pardina*, by some and a subspecies, *F. lynx pardina*, by others. Taxonomic and evolutionary relationships still are not clear (Corbet 1978, Nowak and Paradiso 1983).

Physical Characteristics

In North America, lynx measure from two to three and a half feet long and weigh 10 to 40 pounds (Banfield 1974, Saunders 1964). Eurasian lynx are somewhat larger, measuring up to four feet long and weighing up to 70 pounds (Novikov 1962). Males generally are larger than females, and weights and physical dimensions also vary geographically (McCord and Cardoza 1982).

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Coloration varies from yellowish brown to gray, often with a pattern of dark spots. The short tail may have several dark rings and is tipped with black. Long, ruff-like fur on the lower cheeks and tufts of black hairs on the tips of the ears give the lynx a distinctive face. The legs are relatively long and the paws large and densely furred, an adaptation for moving over snow.

Although similar to the bobcat (*F. rufus*), the lynx can be distinguished by its longer legs, larger feet, and longer ear tufts. It lacks the bobcat's more definite markings over the body, and its tail is black-tipped above and below, while the stubby tail of the bobcat is black only on the upperside of the tip (Murie 1963).

Lynx generally are noctural or crepuscular. Highly resistant to cold, they appear to be affected adversely by hot weather. They have poor endurance and usually ambush rather than chase prey (Banfield 1974).

Range

Lynx are found throughout Canada except for the northern regions of Labrador, Quebec, and the Northwest Territories; the arctic archipelago; and the coastal mountains of British Columbia (McCord and Cardoza 1982). They inhabit most of Alaska, except for the coastal regions, but in the contiguous United States the only substantial populations are in northern Washington and Idaho and northwestern Montana, with lower densities extending down the Rocky Mountains into Utah and Colorado (McCord and Cardoza 1982). A few live in northern New England. On occasion, especially during periods of high population levels in Canada, lynx are found in the states of the northern plains and upper Great Lakes (Adams 1963). Lynx densities throughout the range vary widely, with highs and lows occurring in the 10-year population cycle. Density estimates are not available for most areas, but in Alberta lynx numbers changed from 10 to two individuals per 40 square miles during a decline in the snowshoe hare (*Lepus americanus*) population (Brand and Keith 1979).

Lynx also are widely distributed in the forest zone of the Soviet Union, the mountains of central Asia, and throughout western mainland Europe (Novikov 1962). The endangered Spanish lynx formerly occurred throughout the Iberian Peninsula, but now is restricted to scattered mountainous areas and the Guadalquivir Delta (Nowak and Paradiso 1983).

Lynx habitat has been described generally as climax boreal forest with a dense undercover of thickets and windfalls. Advanced successional stages of forests and dense conifer stands often are selected as habitat (Banfield 1974). Habitat quality and food abundance can influence home range size, which normally averages from four to 20

square miles per individual and at times up to 80 square miles (Brand *et al.* 1976, Carbyn and Patriquin 1983, Saunders 1963). Lynx reportedly move three to 18 miles a day. A movement of almost 300 miles was recorded for a young female (Mech 1977).

Reproduction

Mating occurs mainly in February and March, beginning about mid-February in more northerly regions. Females bear a single litter of one to six, usually two or three, young yearly (Saunders 1963). Gestation lasts nine or 10 weeks, and kittens are born mid-May to mid-June.

Lactation can last for five to six months, but some meat is eaten by two- to six-week-old kittens. The young usually remain with their mother until the winter mating season, and siblings may stay together for a while afterward (Nowak and Paradiso 1983).

Diet

Lynx throughout North America and Europe show remarkable consistency in diet. Little doubt exists that this cat is especially adapted to prey on rabbits. The snowshoe hare is the major prey species in North America, the mountain hare (*L. timidus*) is a primary food source in Europe, and the Old World rabbit (*Oryctolagus cuniculus*) is the basic prey of the Spanish lynx. Hares can comprise some 80 percent of the lynx diet. It has been estimated that lynx make a kill every other day and that an individual lynx may eat 170 to 200 hares yearly, plus a few birds and mice. Lynx sometimes cache prey and return later to feed upon them (Saunders 1963).

Grouse, squirrels, and small rodents can be important alternate prey items for all lynx populations. Ungulates in northern Europe and the Soviet Union and ducks on the Iberian Peninsula often make up a large portion of the diet (Borg 1962, Delibes 1980).

In North America, lynx rely on snowshoe hares more during winter than during summer. Their diet varies more when there is no snow cover, probably because of the greater availability of small mammals. However, snowshoe hares still comprise the majority of prey consumed during summer months. In some parts of Europe, lynx change their diet in early winter from one of hares, small mammals, and birds toward a higher proportion of ungulates (Birkeland and Myrberget 1980). Snow conditions can greatly influence hunting success. When the weight-bearing strength of snow is low, lynx will break through, while hare and grouse prey do not (Nellis and Keith 1968). Soft, deep snow also hinders the hunting ability of lynx. Thus in certain years with poor snow conditions, success can be low even if prey densities are high.

Population Cycles

North American lynx population trends probably have been recorded longer than those of any other wildlife species. Fur returns, useful as an index to population growth and decline, were recorded by the Hudson Bay Company for more than two centuries. Several authors have pointed out that fur returns, indicative of the size of the lynx population, fluctuated regularly from extremely high levels to very low levels, about every 10 years. The periods between peaks in population levels vary somewhat, but less than would be expected by chance (Bulmer 1974).

One researcher described the 10-year cycle as follows, "the basic cause of the cycles is the [snowshoe hare] interacting with its vegetable food to produce a predator-prey oscillation. When the rodents decline in numbers, the [lynx] become short of food, prey upon and cause the decrease of the gallinaceous birds of the same region and themselves die of starvation and/or emigrate . . . in large numbers [which] helps to synchronize various regions" (Lack 1954).

The following points about the 10-year cycle also have been made: (1) lynx have followed a 10-year cycle at the continental level for the past 200 years, (2) lynx can remain common in some areas two to three years after the hares decline, though in Alaska, lynx declined immediately after hares declined, (3) lynx fluctuations have been more extreme than those of other furbearers, (4) mass movements of hares, lynx, foxes (*Vulpes vulpes*), martens (*Martes americana*), and other species probably have taken place, and (5) the amplitude of recent lynx cycles has declined markedly as the peaks in the cycle have become lower (Bailey *et al.* 1986, Keith 1963, O'Conner 1984).

SIGNIFICANCE OF THE SPECIES

The lynx has important economic, recreational, scientific, and aesthetic value. Throughout its range it is classified as a furbearer and provides recreational opportunities and economic returns for trappers. More recently, formal seasons have been established in the northwestern United States for hunters who use hounds to pursue and tree lynx. Pelt values can vary considerably with individual quality and demand, but generally provide some of the highest monetary returns of any fur.

In certain instances, lynx may regulate or influence some prey population levels. Declines of arctic hare (*L. arcticus*) and caribou (*Rangifer tarandus*) on Newfoundland have been attributed to lynx predation pressure (Bergerud 1967, 1971). However, it is **generally** believed that lynx do not cause the density of their rabbit prey to

decline, but rather the level of available prey influences the survival, abundance, and reproductive success of the lynx. Nevertheless, when hare numbers are low, lynx may keep the hare population depressed for two or three years before the increase phase begins.

In some high-elevation forests in the Pacific Northwest the presence of the lynx is considered an indicator of ecosystem integrity. In these areas, lynx generally inhabit the timbered ridgetops and slopes where harvests of such species as lodgepole pine (*Pinus contorta*) are being planned.

The scientific value of the lynx is tremendous. The 10-year cycle is among the most intriguing phenomena in nature. Much can be learned about predator-prey relationships, wildlife population dynamics, and the ecology of predators in general and felids in particular from the study of the lynx. Aesthetic values are nebulous and impossible to quantify realistically, but to many people the lynx's secretive nature, periodic abundance and scarcity, and ability to survive in severe winter cold and deep snow make it a symbol of the boreal forest.

HISTORICAL PERSPECTIVE

The range of the lynx in North America before European settlement probably was very similar to what it is today, with the exception of its southern edge. It is possible that lynx range once extended south to cover the northern third of the United States. However, lynx were not often distinguished from bobcats in historical or bounty records, so some confusion exists in regard to the southern extent of the former range. Historical records indicate that lynx were found in low to moderate densities throughout forested sections of Wisconsin, New York, Vermont, New Hampshire, Maine, Nova Scotia, and Newfoundland (Orff 1985). Similar densities were present in the western mountains as far south as Oregon and Colorado. Local lynx populations in other parts of Canada and Alaska probably have experienced declines due to agricultural, industrial, and suburban development, but these declines could be considered relatively minor compared to those caused by habitat loss in the northern United States and southeastern Canada.

However, from 1880 to 1920, a time included in the height of wild-fur trade, successive peaks in the lynx cycle showed continued declines (Todd unpubl. report). Throughout this period each new peak in the lynx harvest was lower than those preceding it. In the late 1880s, about 80,000 lynx were pelted, but by the early 1900s the number had dropped to 20,000 (Todd unpubl. report). This trend continued through 1940.

The available evidence suggests that a major decline in lynx abundance occurred during a period of less than 30 years around the turn of the century, when fur-trade trapping was basically unregulated on the western frontier. Intense exploitation is seen as the primary reason for the lynx decline (Elton and Nicholson 1942, Devos and Matel 1952). Pelt prices remained stable throughout this period, so a lack of economic incentive was not responsible for the smaller fur harvests.

Lynx were considered pests in the early 1900s and attempts were made to control their numbers. Bounties were still offered in some states in the 1960s, but lynx are no longer considered undesirable (Siegler 1971).

CURRENT TRENDS

The lynx had re-occupied much of its former range by the early 1960s. These gains continued into the early 1970s, but data now indicate that the occupied range has shrunk again (Todd unpubl. report).

In the early 1980s, lynx were present in 14 states and all Canadian provinces and territories except Prince Edward Island (Deems and Pursley 1983). Accurate, or even rough estimates, of lynx numbers do not exist because of this cat's secretive nature, generally low densities, and confounding population dynamics. However, the best compendium on the status of the lynx in North America can be found in Jorgensen and Mech (1971). Status reports are included for Alaska, British Columbia, Saskatchewan, Wisconsin, New Hampshire, and the northwestern states. These reports suggest that trapping was not the only factor involved in local declines of lynx populations. They also indicate that, in general, lynx populations are secure in Canada and Alaska, but withdrawing from the heavily human-populated southern fringe of the species' range. State reports from New England, New York, Wisconsin, and Wyoming indicate that lynx are present but in very low densities.

Research in Canada and Alaska indicates that increased trapping pressure and habitat alteration and destruction are still having negative impacts on lynx populations in some areas. This is particularly true for lynx along the southern edge of the range, where densities are low and access to trap lines is high. The implications seem to be that heavy trapping, spurred by large jumps in pelt prices, is largely responsible for the decline in lynx abundance throughout much of the range. Only remote regions in the Yukon and Northwest Territories have shown actual increases in the latest cyclic peaks compared to previous peaks

(Todd unpubl. report). Habitat loss is considered of secondary importance and is probably more critical along the southern edge of the range.

Some researchers believe that intense trapping when lynx are at low levels could be a form of additive mortality, removing adult lynx that normally would survive during the cyclic lows and reproduce when snowshoe hares increase (Brand and Keith 1979). A similar increase in mortality also could occur when adult lynx are isolated in "pockets" of suitable habitat and adequate food supply during low-density years, especially if large numbers of trappers have access to these pockets (Berrie 1974, Todd unpubl. report). Maintaining an adequate breeding stock during low population years is critical to ensure a swift and substantial increase in lynx numbers during the increase phase of the 10-year cycle. If this management objective is not attained, the major long-term impact seems to point toward lynx populations that cycle about a lower mean level and that show markedly reduced population peaks.

Although trapping and poisoning of lynx were once widely practiced in Europe and Russia, regulated hunting and trapping seasons now exist. Scandinavian and Finnish-Russian lynx populations are once again becoming contiguous, possibly because of reduced hunting, better food conditions, and reduced competition from wolves. Reintroduction of lynx has been carried out in parts of Germany, Austria, Switzerland, Italy, and Yugoslavia (Heggberget and Myrberget 1980, Smit and Van Wijngaarden 1976).

The Spanish lynx is classified as endangered and is confined to isolated, mainly mountainous areas in central and southern Spain and Portugal. The total population is estimated at 1,000 to 1,500, but is rapidly declining because of habitat loss, disease, and accidental kills (Delibes 1979).

MANAGEMENT

Lynx management generally focuses on regulating the yearly kill, with trapping and hunting confined to specified seasons during the winter months. In Canada, trappers are required to operate on registered trap lines or areas. In Washington, lynx can be pursued with hounds on a limited basis and both trappers and hunters are required to register lynx pelts with the Department of Game. Currently lynx are subjected to limited harvest in six states and 10 provinces and territories and are receiving total protection in nine states and one province. The lynx is on the endangered species lists of Colorado, New Hampshire, and Wisconsin and is listed in Appendix II of the Convention on Interna-

tional Trade and Endangered Species of Wild Flora and Fauna treaty (Defenders of Wildlife 1984), giving it some protection from the international fur trade.

Many states and provinces currently are monitoring or planning to monitor lynx populations. Private organizations, such as Defenders of Wildlife, urge that the status of the lynx throughout its range be carefully monitored and that management be reevaluated, taking into account the rise in pelt prices (Defenders of Wildlife 1984).

Published accounts on habitat management for lynx are scarce. Research is being conducted in the northwestern states to determine habitat use and to evaluate the impact of timber harvest on lynx distribution on national forest lands.

PROGNOSIS

Research suggests that lynx populations are relatively stable throughout much of the North American range. However, in some regions local populations have declined to levels lower than the apparent normal cyclic lows of the recent past. Many researchers believe that more effective management will have to be developed and applied if exploitation of this species increases. The extreme fluctuations in numbers, coupled with the ease with which the species can be trapped, could contribute to severe local reductions of breeding stock. Although the lynx may be considered safe throughout much of its range, populations levels should be watched closely. Increasing economic value of lynx pelts could influence pressure on local populations (Jorgensen and Mech 1971).

The influence of pelt value on lynx harvests is of critical importance. As recently as the 1984-85 season the price on a prime lynx pelt soared to over $1,000. Average pelt price was $650 (Haefer, Moscow Hide and Fur, pers. comm.). With price tags such as these the incentive is created to sacrifice conservation and long-term economic productivity for short-term economic gain (Todd unpubl. report).

It is possible that local populations, and possibly populations over broad parts of the range, will decline if pelt prices continue to rise and trapping pressure intensifies along with increased habitat loss. Some biologists believe that these trends will continue and, therefore, that the concept of a lynx surplus suitable for trapping will have to be reevaluated (Bailey unpubl. summ.). They also suggest that new management strategies for lynx need to be developed because lynx occur in fluctuating and highly unpredictable environments, cycle over eight to 11 year periods, usually are dependent on hares as their sole source of food, and are highly vulnerable to trapping, especially in accessible areas.

One management strategy that has been suggested is to curtail or cease the taking of lynx for three years during the declining phase of the 10-year cycle (Brand and Keith 1979). During this time, recruitment of kittens into the population is very low or nonexistent. The surviving adults therefore play the extremely important role of restocking the population. Reducing trapping mortality for three or more years during the population phase decline would lessen the population crash. In highly accessible areas with few natural refugia, curtailment of trapping up to five years, followed by quotas or shortened seasons, may be necessary to prevent overexploitation (Bailey *et al.* 1986).

Other factors have been named as possible agents involved in reducing lynx abundance. Habitat loss, severe winters, industrial development, and snowshoe hare population levels have had some localized influence, but only contributed a fraction of the total impact.

It is unlikely that the lynx will be classified as endangered throughout its range in the foreseeable future, but it may become increasingly rare in areas accessible to large numbers of trappers and susceptible to habitat alteration or destruction. What is likely is that increasingly stringent trapping regulations will be needed in some areas to ensure that viable local populations continue to exist at or near carrying capacity. A drastic drop in fur prices could improve the outlook in heavily trapped areas.

RECOMMENDATIONS

Theodore N. Bailey recommended that ideal lynx management should be (1) highly flexible, (2) rapidly responsive to sudden changes in lynx habitat or prey abundance, (3) able to predict the impact of trapping on the entire lynx cycle rather than only on the following year's population, (4) closely tied to snowshoe hare abundance and distribution, (5) able to consider offspring dependence on females by adjusting trapping periods, and (6) able to provide for adequate stocks and distributions of breeding adults during years of low prey abundance (Bailey unpubl. summ.).

Several trapping regulations have been suggested. These include closing the season for three to five years once lynx and hare populations have peaked, shorter and later seasons, quotas and permits based on management areas, untrapped sanctuaries, and perhaps restricting the use of exposed bait, flag, and cubby sets during other furbearer seasons to reduce incidental lynx capture (Bailey *et al.* 1986, Brand and Keith 1979). Continued and improved monitoring of lynx populations throughout the range is essential to developing proper base-line data from which management decisions can be made.

In 1978, several biologists reviewed whether international trade in species listed under Appendix II of CITES was detrimental to the survival of those species (Mech 1978). They recommended that each state review its lynx research and management programs and seek to improve them in order to help ensure continued lynx survival. This directive still can be considered a timely one today.

Virtually every aspect of lynx biology, ecology, and management is in need of further research. The impact of trapping, habitat alteration, and human interference on local population levels and social organization is vital to the management of this species, especially on the southern edge of lynx range where numbers may be declining. Studies designed to remove certain individuals and to manipulate habitat could provide answers about man's influence on lynx populations. Individuals which are taken from a population during removal studies could be introduced into low-density areas, thereby providing information on possible stocking programs. Concurrent studies on lynx and bobcats could help determine whether the species compete for the same resources or if they are ecologically separated by differences in adaptation or habitat preference. Additional basic knowledge of social organization, predator-prey relationships, and habitat preference also is needed.

The challenge of lynx conservation and management is a multifaceted one. Pelt values and the fur harvest, the 10-year cycle, survival, mortality, changing reproductive parameters, and habitat loss all play a part in the population dynamics of this native cat.

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