

SPECIES PROFILE

Canada Lynx

Lynx canadensis

Federal Listing: Threatened

State Listing: Endangered

Global Rank: G5

State Rank: S1

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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

Lynx occupy various habitats in the boreal forests and their southern extensions (Anderson and Lovallo 2003). In eastern forests, dominant vegetation includes spruce (*Picea* spp.) and balsam fir (*Abies balsamea*). Snowshoe hare (*Lepus americanus*) are important prey for lynx, and young or subalpine stands may be preferred because they contain more hare than do mature stands (Anderson and Lovallo 2003). Though data on competition and predation are equivocal, lynx may avoid bobcat (*Lynx rufus*) and coyote (*Canis latrans*) by seeking deep snow, to which lynx are morphologically adapted (long legs and large feet, Parker et al. 1983).

1.2 Justification

Lynx have been listed as endangered in New Hampshire since 1980. The United States Fish and Wildlife Service (USFWS) listed all lynx populations in the lower 48 states as threatened in 2000.

1.3 Protection and Regulatory Status

Lynx trapping and hunting seasons in New Hampshire have been closed since 1971. Lynx are also protected under federal endangered species legislation (USFWS 2000).

1.4 Population and Habitat Distribution

Although there are no records of lynx reproducing in New Hampshire (McKelvey et al. 2000), lynx were frequently encountered in Coos and northern Carroll and Grafton counties (Siegler 1971, Silver 1974, Hoving et al. 2003). Lynx are more common toward the north, particularly in Quebec and New Brunswick. Large-scale timber harvests for agriculture and suburban developments north of the St. Lawrence Seaway combined with intensive lynx harvests and land clearing south of the Seaway may have resulted in isolation of lynx in northern New England (Litvaitis et al. 1991). Recent evidence indicates that core lynx populations in the Gaspé Peninsula may be the source for satellite populations in northwestern Maine and northern New Hampshire (Carroll 2005). Few lynx have been captured or killed in New Hampshire in recent years. In 1966 and 1992, adult lynx were killed after collisions with vehicles in Lee and west of Concord on Interstate 89, respectively (Litvaitis 1994).

1.5 Town Distribution Map

Recent observations are quite limited (figure 1). No conclusions can be drawn from this limited dataset.

1.6 Habitat Map

We relied extensively on the recent habitat modeling efforts by Hoving et al. (2005). Initial estimates of lynx habitat were obtained from the model developed by Hoving et al. (2005) in conjunction with information on land cover obtained from the New Hampshire Land Cover Assessment 2001 database from Complex Systems Research Center of the University of New Hampshire (Justice et al. 2002). This digital raster dataset was classified from 1990-1999 Landsat



FIGURE 1. Location of incidental observations of lynx during 1990-2004 (from NHDRED).

Thematic Mapper imagery into 23 classes with a cell size of 30 meters. Overall classification accuracy at this level was assessed at 82.2%. Mean annual snowfall from 1971 to 2000 was obtained from Spatial Climate Analysis Service at Oregon State University. This dataset uses the PRISM modeling system to estimate annual snowfall for each 2 x 2 km pixel based on data from over 7,000 weather stations nationwide and digital elevation models. Suitable lynx habitat in New Hampshire was estimated combining all cells that had a probability of occurrence of > 0.5.

Because lynx are dependent on snowshoe hares (Quinn and Parker 1987, Anderson and Lovallo 2003), a layer was added that included habitats known to support abundant hare populations. Specifically added were high elevation spruce (*Picea* spp.), fir (*Abies balsamea*) stands, and recent clearcuts

that were in areas where annual snowfall was >250 mm [estimated snowfall threshold that limits bobcats in New Hampshire (Litvaitis et al. 2005)]. Both of these habitats are characterized by dense understory vegetation and contain an abundance of snowshoe hare. Information on high elevation spruce-fir stands was provided by New Hampshire Fish and Game (J. Oehler, personal communication). The clearcut dataset was provided by Complex Systems at UNH. Cuts had a minimum size of 1.2 ha, residual basal area of < 2 m²/ha, and were harvested within 10-15 years (D. Justice, personal communication). Overall accuracy of the clearcut layer was 92%. Supporting this addition, Fuller and Harrison (2005) found that lynx showed a strong selection for mid-successional spruce-fir stands (~3.3 – 4.3 m tall) that were 11-22 years old in north-western Maine. Hoving et al. (2004) also reported an association of lynx with regenerating stands.

Model Results

The total area estimated to be suitable for lynx [>50% probability of occurrence according to model developed by Hoving et al. (2005)] was 5,187 km² (figure 2). Because land cover and snowfall information were different from the sources used by Hoving et al. (2005), mapped habitats for this study are slightly different. Regional predicted habitat from Hoving et al. (2005) is shown in Figure 3.

According to Hoving (2001), the 2 variables in the habitat model probably do not directly influence lynx distributions. Annual snowfall is likely functioning as a surrogate variable for mean snow depth. This feature may influence foraging success and affect the distribution of possible competitors of lynx. The negative relationship with lynx presence and the abundance of deciduous forests is less obvious. In comparison to conifer stands, deciduous forests may represent habitats that support fewer snowshoe hares (e.g., Litvaitis et al. 1985) and red squirrels (*Tamiasciurus hudsonicus*) (Obbard 1987), an important secondary prey of lynx (O'Donoghue et al. 1998b). As a result, lynx may not be able to meet prey needs in areas dominated by deciduous forests.

Although this model performed well on a regional scale [correctly classified 94% of a reserved dataset (Hoving et al. 2005)], it is not certain that it adequately described habitats on a more restricted basis (e.g., northern New Hampshire). As indicated, neither of the 2 variables directly affects carrying ca-

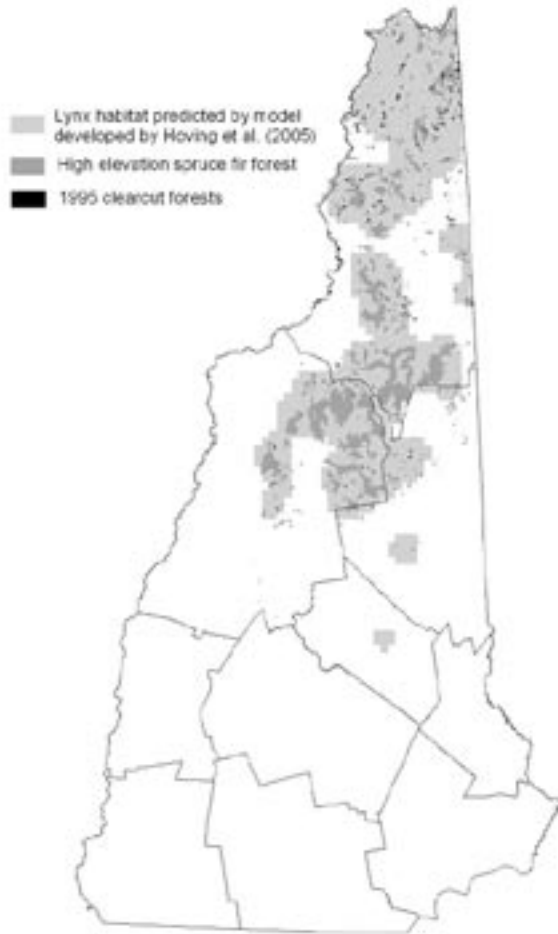


FIGURE 2. Lynx habitat in New northern New Hampshire predicted by the model developed by Hoving et al. (2005). High elevation spruce-fir stands and recent clearcuts also are included because these habitats support dense populations of snowshoe hares. Clearcuts (> 1.2 ha with < 2 m² residual basal area) were only included if they had an average annual snowfall of > 250 mm.

capacity or suitability at a landscape scale. To increase understanding of lynx requirements at landscape and stand scales, a modeling effort by Steury and Murray (2004) was used to examine the prey requirements of translocated lynx. If dispersing lynx that colonize habitats in New Hampshire are assumed to have prey requirements that are comparable to translocated individuals, this study may provide additional insight.

Populations of snowshoe hare in northern New Hampshire are not cyclic (Murray 2000). Under such circumstances, Steury and Murray (2004) indicated that 1.5 hares/ha are needed for positive population growth among translocated lynx. Litvaitis et al. (1985) found that habitats capable of supporting that



FIGURE 3. Regional lynx habitat predicted by Hoving et al. (2005).

density of hare are characterized by very dense understory vegetation [$>50,000$ stem cover units/ ha. Such vegetation is found in regenerating clearcuts, high elevation conifer stands, and some shrub-dominated wetlands. Therefore, the inclusion of recent clearcuts and high elevation spruce-fir stands may provide a more realistic representation of important habitats for lynx, albeit a minimum estimate. Combined, these enriched prey habitats represent only 888 km² [17% of the total lynx habitat predicted by the Hoving et al. (2005) model]. Although northern populations of lynx are known to exploit alternative prey (especially red squirrels) when cyclic populations of hare crash (e.g., O'Donoghue et al. 1998b), lynx demography is directly dependent on snowshoe hare abundance (Brand and Keith 1979, O'Donoghue et al. 1997). Therefore, the modest abundance of high-density hare habitat supports the notion that New Hampshire does not contain sufficient habitat to support a viable, stand-alone population of lynx. Long-term persistence of lynx in New Hampshire is probably dependent on immigrants (Litvaitis et al. 1991, Carroll 2005), and the State likely represents the southern limit of lynx in eastern North America.

1.7 Sources of Information

Published investigations, summary papers (Quinn and Parker 1987, Anderson and Lovallo 2003), and unpublished reports (e.g., Carroll 2005, Fuller and Harrison 2005) were used.

1.8 Extent and Quality of Data

Although no information exists on the habitat needs of lynx in New Hampshire, substantial interest in this species has resulted in a number of investigations in regions with comparable habitat.

1.9 Distribution Research

1. Developing protocols to provide a comprehensive monitoring of lynx populations should be considered. However, based on the limited habitat for lynx in New Hampshire, such a protocol should be developed to address multiple species (e.g., forest carnivores).
2. Any effort to understand the demography of lynx in New Hampshire should be placed in a regional context that considers lynx populations in Maine, New Brunswick, and Quebec.

ELEMENT 2: SPECIES HABITAT CONDITION

2.1 Scale

Based on the large home range of lynx (circa 100 km²), it may be most appropriate to group suitable habitats using the ecological sections defined by Spurduto and Nichols (2004). Over 95% of the lynx habitat estimated by the model proposed by Hoving et al. (2005) was in the White Mountain Ecosection and 99% of suitable clearcuts and high elevation spruce-fir stands occur in this ecosection.

2.2 Relative Health of Populations

There is no evidence that a population of lynx currently resides in New Hampshire.

2.3 Population Management Status

Other than protected status, there are no efforts under way to manage lynx in New Hampshire. The status of lynx in New Hampshire will largely be determined by the ability of lynx emigrating from northern source populations to reach the State. Specifically, habitat continuity along the suspected dispersal corridor (figure 4) should be maintained.

2.4 Relative Quality of Habitat Patches

It is suspected that the highest quality lynx habitat is associated with high elevation spruce-fir stands (figure 3).

2.5 Habitat Patch Protection Status

Approximately 89% of high elevation spruce-fir stands occur on public lands.

2.6 Habitat Management Status

Management options within the State are restricted to providing quality habitat for snowshoe hare. However, given the reduction in even-aged timber management in recent decades and increased tendency for modifications in silviculture practices [e.g., use of pre-commercial thinning; see Homyack (2003)], it is likely that the abundance of habitats that support high density populations of snowshoe hare will decline.

In 2000, the USFWS and USFS developed a lynx conservation agreement that requires the USFS to promote the conservation of lynx habitat on national forests within the historic range of lynx (USFS Agreement 00-MU-11015600-013). Application of even-aged timber management on the White Mountain National Forest could enhance prey abundance for lynx. However, all management alternatives considered in the revised White Mountain National Forest Plan do not include an increase in the amount of forest that will be under even-aged management. In fact, the most liberal application of even-aged management that is being considered would not replace the hare habitat that is being lost to succession.

2.7 Sources of Information

Historical data on abundance of lynx were obtained from Silver (1974). Recent observations were obtained from the Natural Heritage Bureau Element Occurrence database.

2.8 Extent and Quality of Data

As indicated previously, there is no information on stand or patch-specific features that affect habitat use and fitness of lynx in New Hampshire.

2.9 Condition Assessment Research

An inventory and monitoring protocol would provide information on lynx demographics and habitat (including patch-level) preferences. Potentially, this inventory could be associated with USFS National Forest Inventory and could link habitat and land-use changes to changes in lynx demographics (Zielinski et al. 2000). An inventory and monitoring program could be designed using a variety of platforms (e.g., snow tracks, scooted panels, or remotely-triggered cameras) and gather information on a number of mesocarnivores (e.g., bobcats, fishers, and pine marten), making it cost attractive (Zielinski and Kucera 1995).

ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

3.1.1 Unsustainable Forestry Operations

(A) Exposure Pathway

Timber harvest programs are moving away from even-aged management and thus are reducing local populations of snowshoe hare.

(B) Evidence

A recent shift in New England from conifer clear cutting to pre-commercial thinning will enhance growth of young trees but will reduce carrying capacity of a young stand for snowshoe hares (Homyack 2003).

3.1.2 Scarcity (Hybridization)

(A) Exposure Pathway:

Lynx colonizing New Hampshire will likely encounter low-density bobcat populations in northern counties (Litvaitis et al. 2005). Under these conditions, hybridization is possible because neither species may encounter conspecifics.

(B) Evidence:

Hybridization between bobcats and lynx has been detected in northern Minnesota where both species are at relatively low densities (Schwartz et al. 2004).

3.1.4 Unregulated Take

(A) Exposure Pathway

Leghold traps can capture lynx

(B) Evidence

No direct evidence; speculation.

3.2 Sources of Information

Published papers, as well as summary reports by Ruediger et al. (2000) and Carroll (2005) were used.

3.3 Extent and Quality of Data

Recent research efforts have increased our understanding of factors limiting the density of lynx populations.

3.4 Threat Assessment Research

It is difficult to conduct research in New Hampshire because lynx may be extirpated.

ELEMENT 4: CONSERVATION ACTIONS

Any effort seems tenuous based on the current abundance of lynx (extirpated)

ELEMENT 5: REFERENCES

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ELEMENT 6 : LIST OF FIGURES

Figure 1. Location of incidental observations of lynx during 1990-2004 (from NHDRED).

Figure 2. Lynx habitat in New northern New Hampshire predicted by the model developed by Hoving et al. (2005). High elevation spruce-fir stands and recent clearcuts also are included because these habitats support dense populations of snowshoe hares. Clearcuts (> 1.2 ha with < 2 m² residual basal area) were only included if they had an average annual snowfall of > 250 mm.

Figure 3. Regional lynx habitat predicted by Hoving et al. (2005).

Distribution of Canada Lynx in New Hampshire

Distribution
■ Known



0 10 20 40 Miles

Known = verified observations as reported in the NH
Natural Heritage Bureau's Element Occurrence
Database

