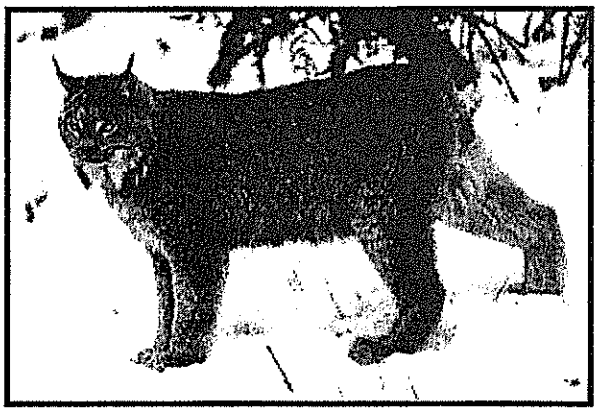
# RECOVERY OUTLINE
## Contiguous United States Distinct Population Segment of the Canada Lynx



**Common Name:** Canada lynx
**Scientific Name:** *Lynx canadensis*

**Listing Status:** Threatened
**Date Listed:** March 24, 2000

**Lead Region:** U.S. Fish and Wildlife Service, Region 6. Cooperating regions are Regions 1, 3 and 5.

**Lead Field Office:** Montana Field Office
100 N. Park Avenue, Suite 320
Helena, Montana 59601
Telephone: 406-449-5225

**Lead Biologist:** Lori Nordstrom, Montana Field Office
Telephone 406-449-5225, ext. 208; lori_nordstrom@fws.gov

**Purpose of the Recovery Outline:** This document serves as an interim strategy to guide recovery efforts and inform the critical habitat designation process for the contiguous United States population of the Canada lynx until a draft recovery plan has been completed. Recovery outlines are intended primarily for internal U.S. Fish and Wildlife Service (Service) use; formal public participation will be invited upon release of the draft recovery plan. We will consider any new information or comments that members of the public may wish to offer regarding this outline during the recovery planning process. For more information on Federal recovery efforts for the contiguous United States population of the Canada lynx, or to provide additional comments, interested parties may contact the lead biologist for this species, Lori Nordstrom, at the above address, telephone, or e-mail.

**Scope of Recovery and Available Information:** The scope of this recovery effort is the contiguous United States distinct population segment of the Canada lynx (U.S. Department of the Interior [USDI] 2000, 2003). This outline provides a general overview of the available information on the contiguous United States lynx distinct population segment, and provides preliminary recovery objectives and actions based on our understanding of current and historical lynx occurrence and lynx population dynamics in the contiguous United States Because of the gaps in our knowledge of this species, for this recovery outline we made some assumptions regarding lynx population dynamics and the relative importance of different geographic areas to the persistence of lynx in the contiguous United States. We recognize the uncertainties of this information and identified the assumptions we made.

## OVERVIEW

**Species Description and Life History:** Canada lynx are medium-sized cats, generally measuring 75-90 centimeters long (30-35 inches) and weighing 8-10.5 kilograms (18-23 pounds) (Quinn and Parker 1987). They have large feet adapted to walking on snow, long legs, tufts on the ears, and black-tipped tails. They are highly adapted for hunting snowshoe hare, the primary prey, in the snows of the boreal forest.

Lynx in the contiguous United States are at the southern margins of a widely-distributed range across Canada and Alaska. The center of the North American range is in north-central Canada. Lynx occur in mesic coniferous forests that have cold, snowy winters and provide a prey base of snowshoe hare (Ruggiero et al. 2000). These forests are generally described as boreal forests. In North America, the distribution of lynx is nearly coincident with that of snowshoe hares (Bittner and Rongstad 1982; McCord and Cardoza 1982). Lynx survivorship, productivity and population dynamics are closely related to snowshoe hare density in all parts of its range. A minimum density of snowshoe hares (greater than 0.5 hare per hectare (1.2 hares per acre) [Ruggiero et al. 2000]) distributed across a large landscape is necessary to support survival of lynx kittens and recruitment into and maintenance of a lynx population.

In the United States, lynx inhabit conifer and conifer-hardwood habitats that support their primary prey, snowshoe hares. Both timber harvest and natural disturbance processes, including fire, insect infestations, catastrophic wind events, and disease outbreaks, can provide foraging habitat for lynx when resulting understory stem densities and structure provide the forage and cover needs of snowshoe hare (Keith and Surrendi 1971; Fox 1978; Conroy et al. 1979; Wolff 1980; Parker et al. 1983; Litvaitis et al. 1985; Bailey et al. 1986; Monthey 1986; Koehler 1990, 1991; Agee 2000). These characteristics include a dense, multi-layered understory that maximizes cover and browse at both ground level and at varying snow depths throughout the winter (crown cover within the lower 4.5 meters (15 feet) in order to provide cover and food for snowshoe hares to 2 meters (6 feet) high at maximum snow depths). Despite the variety of habitats and settings, good snowshoe hare habitat has a common denominator – dense, horizontal vegetative cover 1-3 meters (3-10 feet) above the ground or snow level (Hodges 2000).

In northern Canada, lynx populations fluctuate in response to the cycling of snowshoe hare (Mowat et al. 2000). Although snowshoe hare populations in the southern portion of the range in the contiguous United States may fluctuate, they do not show strong, regular population cycles as in the north (Hodges 2000). In the contiguous United States, the degree to which regional local lynx population fluctuations are influenced by local snowshoe hare population dynamics is unclear.

The southernmost extent of the boreal forest that supports lynx occurs in the contiguous United States in the Northeast, western Great Lakes, northern and southern Rockies, and northern Cascades (Ruediger et al. 2000). Here the boreal forest transitions into other vegetation communities and becomes more patchily distributed. As a result, the southern boreal forests generally support lower snowshoe hare densities, hare populations do not appear to be as highly cyclic as snowshoe hares further north, and lynx densities are lower compared to the northern boreal forest.

Individual lynx maintain large home ranges (reported as generally ranging between 31-216 kilometers$^2$ (km$^2$) (12-83 miles$^2$ (mi$^2$)) (Koehler 1990; Aubry et al. 2000; Squires and Laurion 2000; Vashon et al. 2005). Thus, a lynx population can only persist in a large boreal forested landscape that contains appropriate forest types, snow depths and high snowshoe hare densities. In the Northeast, lynx were most likely to occur in areas that support deep snow (greater than 268 centimeters [106 inches] annual snowfall) associated with regenerating boreal forests in landscapes 100 km$^2$ (40 mi$^2$) or greater in area (Hoving 2001; Hoving et al. 2004). We assume areas with smaller patches of boreal forest are unlikely to provide a sufficient amount of habitat suitable to support a lynx population.

Lynx are highly mobile and have a propensity to disperse long distances, particularly when prey becomes scarce (Mowat et al. 2000). Lynx also make long distance exploratory movements outside their home ranges (Aubry et al. 2000; Squires et al. 2001; Moen et al. 2004). Areas or habitats used by lynx during dispersal or exploratory movements are poorly understood at this time. Dispersing lynx may colonize suitable but unoccupied habitats, augment existing resident populations, or disperse to unsuitable or marginal habitats where they cannot survive. Numerous lynx mortality records exist from anomalous habitats or habitats where no records support evidence (either current or historical) of a reproducing population (McKelvey et al. 2000a). Many of these records correspond to post-population peaks in Canada, with some lag time for immigration (McKelvey et al. 2000a). We find no evidence of lynx populations becoming established in such areas.

Lynx populations in the contiguous United States seem to be influenced by lynx population dynamics in Canada (Thiel 1987; McKelvey et al. 2000a, c). Many of these populations in Canada are directly interconnected United States populations, and are likely a source of emigration into contiguous United States lynx populations. Therefore, we assume that retaining connectivity with larger lynx populations in Canada is important to ensuring long-term persistence of lynx populations in the United States. We assume that, regionally, lynx within the contiguous United States and adjacent Canadian provinces interact as metapopulations and, therefore, assessments of population viability must be made at this larger scale and not solely based on populations within the contiguous United States.

## PRELIMINARY RECOVERY ASSESSMENT

The historical and current range of the lynx in the contiguous United States is within the southern extensions of the boreal forest in the Northeast, Great Lakes, Rocky Mountains, and Cascade Mountains. The lynx is listed in the14 States that support boreal forest types and contain verified records of lynx occurrence--Colorado, Idaho, Maine, Michigan, Minnesota, New Hampshire, New York, Oregon, Montana, Utah, Vermont, Washington, Wisconsin, and Wyoming.

Based on our examination of historical and recent evidence, lynx habitat and occurrence within the contiguous United States can be categorized as--1) core areas, 2) secondary areas, and 3) peripheral areas. The areas with the strongest long-term evidence of the persistence of lynx populations within the contiguous United States are defined as **"core areas."** Core areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. Six core areas and one "provisional" core area are identified within the contiguous

United States. The provisional core area in the Southern Rockies was identified because it contains a reintroduced population[1]. Reproduction has been documented in this introduced population; however, it is too early to determine whether a self-sustaining lynx population will result. Focusing lynx conservation efforts on these core areas will ensure the continued persistence of lynx in the contiguous United States by addressing fundamental principles of conservation biology:

1) representation by conserving the breadth of ecological settings of the distinct population segment;

2) redundancy by retaining a sufficient number of populations to provide a margin of safety to withstand catastrophic events; and

3) resiliency by maintaining sufficient numbers of animals in each population to withstand randomly occurring events and prey population dynamics.

At this time, the role of areas outside of these core areas in sustaining lynx populations in the contiguous United States is unclear. The fluctuating nature of lynx population dynamics and the ability of lynx to disperse long distances have resulted in many individual occurrence records outside of core areas, without accompanying evidence of historic or current presence of lynx populations. Areas classified as "secondary areas" are those with historical records of lynx presence with no record of reproduction; or areas with historical records and no recent surveys to document the presence of lynx and/or reproduction. If future surveys document presence and reproduction in a secondary area, the area could be considered for elevation to core. We hypothesize that secondary areas may contribute to lynx persistence by providing habitat to support lynx during dispersal movements or other periods, allowing animals to then return to "core areas." In "**peripheral areas**" the majority of historical lynx records is sporadic and generally corresponds to periods following cyclic lynx population highs in Canada. There is no evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by lynx. However, some of these peripheral areas may provide habitat enabling the successful dispersal of lynx between populations or subpopulations. At this time, we simply do not have enough information to clearly define the relative importance of secondary or peripheral areas to the persistence of lynx in the contiguous United States.

[1] Since 1999, 204 lynx from Canada and Alaska have been released into Colorado. In 2003, 6 litters were documented with a total of 16 kittens; in 2004, 14 litters were documented with a total of 39 kittens (T. Shenk, Colorado Division of Wildlife, pers. comm. 2005).

I. **CORE AREA CRITERIA** To meet the definition of a core area for lynx, the area must meet all of the following conditions (Table 1):

- Has verified evidence (e.g., McKelvey et al. 2000a; Hoving et al. 2003) of long-term historical and current presence of lynx populations. Lynx occurrences within the core area are persistent over time despite the cyclic or fluctuating nature of lynx and snowshoe hare populations that may periodically result in reduced populations or suspected local extirpation of lynx. This is normal unless populations do not show a positive response when snowshoe hare populations increase.
- Has recent (within the past 20 years) evidence of reproduction. Reproduction or recruitment into the lynx population may not occur every year because of natural cyclic or fluctuating populations that are tied to snowshoe hare population levels.
- Contains boreal forest vegetation types of the quality and quantity to support both lynx and snowshoe hare life needs.
  - Large or numerous patches of habitat supporting average snowshoe hare densities over time of at least 0.5 hare per hectare (1.2 hares per acre) (Ruggiero et al. 2000); the best available information suggests that this is the minimum density necessary to support survival of lynx kittens and recruitment into and maintenance of a lynx population.
  - Contains a minimum of 1,250 $km^2$ (483 $mi^2$) of boreal forest habitat as part of a larger landscape for conservation (can include boreal forest habitat directly adjacent in Canada). This is the minimum size considered necessary to support a minimum lynx population of at least 25 adults based on information from the North Cascades in Washington (1 lynx per 50 $km^2$) (Brittell et al. 1989; Koehler 1990; McKelvey et al. 2000b). Habitat patches must be sufficiently large and connected to enable movement within and between patches within a core area.
- Snow conditions are generally fluffy and/or deep enough to favor the competitive advantage of lynx.

❖ **CORE AREAS (Figure 1)**

♦ **NORTHEAST**

* Northern Maine/northern New Hampshire

♦ **GREAT LAKES**

* Northeastern Minnesota

♦ **NORTHERN ROCKIES/CASCADES**

* Northwestern Montana/northeastern Idaho
* Northern Cascades (Washington)
* Kettle/Wedge (Washington)
* Greater Yellowstone Area (portions of Wyoming, Montana, Idaho)

- **PROVISIONAL CORE AREA (Figure 1)**
  - **SOUTHERN ROCKIES**
    - Entire (Colorado and southern Wyoming)

## II. SECONDARY AREA CRITERIA (Table 1)

- Compared to core areas, secondary areas have fewer and more sporadic current and historical records of lynx and, as a result, historical lynx abundance has been relatively low. Reproduction has not been documented. Some of the secondary areas have not been surveyed following any survey protocol; as a result the current status of lynx occupancy in some secondary areas is not known.
- Quality and quantity of lynx habitat (including snowshoe hare densities and snow conditions) is less clear. Information is currently lacking to understand why historical lynx abundance in these areas appears to be less than in core areas. Compared to core areas, habitat in secondary areas may be patchier, drier, and/or more maritime resulting in snow or habitat conditions that are not favorable to lynx. Another explanation may be that lynx populations were extirpated because of changes in vegetation structure that resulted in poor prey populations or some disturbance, such as past trapping, and the area has not been recolonized by lynx.
- As new information becomes available, some areas currently classified as secondary may be elevated to core status.

- **SECONDARY AREAS (Figure 1)**
  - **NORTHEAST**
    - None
  - **GREAT LAKES**
    - Northern Minnesota/northwestern Wisconsin (portions)
  - **NORTHERN ROCKIES/CASCADES**
    - Southwest Montana
    - Northern/central Idaho(north of the Salmon River)
    - Northern Chelan County (Washington)
    - Salmo Priest (Washington)
    - Little Pend Oreille (Washington)
  - **SOUTHERN ROCKIES**
    - None

## III. PERIPHERAL AREA CRITERIA (Table 1)

- Areas that contain few verified historical or recent records of lynx; records are sporadic and usually associated with periods when there were unprecedented cyclic population highs in Canada, such as the early to mid 1960s and/or 1970s. There may be large gaps in time, e.g., from 1920s to 1960s, with no records of lynx.
- Quality and quantity of habitat to support adequate snowshoe hare or lynx populations are questionable. Habitat may occur in small patches and is not well-connected to larger patches of high quality habitat.
- May sustain short-term survival during lynx dispersal.

❖ **PERIPHERAL AREAS (Figure 1)**

♦ NORTHEAST

* Vermont
* New York
* Eastern Maine
* Central New Hampshire

♦ GREAT LAKES

* Northeastern Wisconsin
* Michigan

♦ NORTHERN ROCKIES/CASCADES

* Utah
* Big Horn Mountains (Wyoming)
* Northeast Oregon/southeast Washington
* Southern Cascades (Washington)
* Vulcan/Tunk (Washington)
* Snowy Mountains and Highwood Mountains (Montana)

♦ SOUTHERN ROCKIES

* None

**Land Ownership Pattern:** Coarse estimates of the amount of lynx habitat and land ownership in the different regions of the contiguous United States can be found in our 2003 Clarification of the Final Rule (USDI 2003). Outside of the Northeast, lynx habitat occurs primarily on a federally-owned land base, predominantly U.S. Forest Service (FS). In the Northeast, nearly all the lynx habitat is privately-owned, most of which is commercial forest in Maine.

## SUMMARY OF LISTING FACTORS

### A) The present or threatened destruction, modification or curtailment of habitat or range.

In all regions within the range of lynx in the contiguous United States, timber harvest, recreation and their related activities are the predominant land use affecting lynx habitat. The final rule stated that timber harvest and associated forest management can be benign, beneficial, or detrimental to lynx depending on harvest methods, spatial and temporal specifications, and the inherent vegetation potential of the site (USDI 2000, 2003).

The primary factor that caused the lynx to be listed was the lack of guidance for conservation of lynx and snowshoe hare habitat in National Forest Land and Resource Plans and Bureau of Land Management (BLM) Land Use Plans given that a substantial amount of lynx habitat in the contiguous United States is federally managed (USDI 2000). This lack of guidance allowed the continued degradation of lynx habitat on Federal lands through timber management and other Federal activities. The remanded final rule[2] found that timber harvest and/or fire suppression may have had regional or local impacts but we believe that they are not currently at a level threatening the contiguous United States lynx distinct population segment, as a result of conservation agreements[3] between the FS, BLM, and Service. The FS and BLM have curtailed pre-commercial thinning, thought to be detrimental to snowshoe hare and thus lynx, since the signing of a Lynx Conservation Agreement with the Service and the programmatic biological opinion on FS and BLM land management plans. Both the Conservation Agreement and programmatic biological opinion require that the information and recommendations in the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000), which was based on the current state of knowledge, be considered for project planning and used as the basis for effects determinations.

Except for lynx habitat management plans on some private and State lands in Washington, in the remainder of the contiguous United States range there are no management plans that specifically address lynx conservation.

NORTHERN ROCKIES/CASCADES AND SOUTHERN ROCKIES

The remanded final rule (USDI 2003) concluded that some timber harvest activities, such as pre-commercial thinning, may reduce the quality of snowshoe hare habitat in local areas on non-Federal lands in the Northern Rocky Mountains/Cascades and Southern Rocky Mountains, and thus may negatively affect lynx or lynx habitat at local scales. Alternatively, timber harvest regimes in lynx habitat that create a dense understory provide good snowshoe hare and lynx conditions. Furthermore, lynx habitat on National Forest and BLM lands is currently managed to conserve lynx since the signing of a Lynx Conservation Agreement and the programmatic

[2] A 2002 court order directed the Service to reconsider the status of the Canada lynx under the Endangered Species Act. The remanded final rule reaffirmed the decision to list as threatened in the contiguous United States.

[3] Both conservation agreements expired in December 2004. The Forest Service agreement has been revised (May 2005), resulting in changes from the original conservation agreement.

biological opinion on FS and BLM land management plans, both of which require that the information and recommendations in the Lynx Conservation Assessment and Strategy be considered for project planning and used as the basis for effects determinations.

The remanded final rule (USDI 2003) found that fire suppression has had only limited effects on lynx habitat in the Northern Rocky Mountains/Cascades and Southern Rocky Mountains; however, it may affect lynx habitat quality at some local scales, particularly on non-Federal lands. Fire suppression and reduction of heavy fuels has the potential to affect snowshoe hare habitat. Because the highest priorities for fuels treatment projects are in low elevation forests with low-intensity-high frequency fire regimes (which are not lynx habitat) and for wildland-urban interface areas, the overall effects on lynx habitat are anticipated to be limited.

GREAT LAKES

Timber harvest and fire suppression on non-Federal lands may cause local impacts to lynx and snowshoe hare habitat in the Great Lakes Region. Since the lynx was listed, lynx habitat on National Forest lands is managed to conserve lynx and National Forest Plans on the Superior and Chippewa National Forests have been revised to provide for the conservation of lynx.

NORTHEAST

Timber harvest and associated activities on non-Federal lands exert the most influence on lynx habitat in the Northeast and have created the favorable conditions that currently exist for lynx and snowshoe hares (Homyack 2003) in northern Maine. As a result of the Standards (Maine Department of Conservation 1999) that implement the Maine Forest Practices Act, as amended (Maine Department of Conservation 2004) harvest management in Maine has shifted away from clearcutting and now favors partial cutting, which, in some situations, may result in less favorable conditions for snowshoe hare and lynx.

**B) Overutilization for commercial, recreational, scientific, or educational purposes.**

We found that in the contiguous United States, lynx populations occur at naturally low densities. This is expected because of limited habitat and limited availability of their primary prey, snowshoe hares. At southern latitudes, low snowshoe hare densities are likely a result of the naturally patchy, transitional boreal habitat. Such habitat prevents hare populations from achieving high densities similar to those in the extensive northern boreal forest. The final rule (USDI 2000) and remanded final rule (USDI 2003) found that despite concerns that overtrapping had severely depressed the United States populations of lynx, low numbers of lynx in the contiguous United States compared to northern Canada occur not as a result of historical overtrapping within the United States, but because lynx and their prey are naturally limited by the amount of habitat, topography, and climate. Precautions taken by States to restrict lynx trapping since the 1980s likely prevented and continue to prevent the overharvest of resident lynx.

Legal trapping, snaring, and hunting for bobcat, coyote, wolverine, and other furbearers create a potential for incidental capture or shooting of lynx. Lynx persist throughout their range despite the incidental catch that presumably has occurred throughout the past, probably at higher levels than presently. Although we are concerned about the mortality of lynx that are incidentally

captured, we have no information to indicate that the loss of these individuals has negatively affected the overall ability of lynx in the contiguous United States to persist. We recognize that individuals may be lost, which could affect small, local populations.

Lynx trapping in Canada, where lynx are a legally harvested furbearer, may affect rates of lynx immigration into the contiguous United States Immigration of lynx into the contiguous United States is believed important to sustaining persistent lynx populations in core areas adjacent to Canada, therefore, contiguous United States lynx populations might be negatively affected if trapping reduces the numbers of emigrating lynx.

**C) Disease or predation.**

Disease or predation is not known to be a factor threatening lynx at a population level.

**D) Inadequacy of existing regulatory mechanisms.**

As a result of Federal, State, and Tribal regulations and plans that conserve lynx, in particular the Forest Service and BLM Lynx Conservation Agreements and the revision of some Forest Plans, the threats to lynx from the inadequacy of existing regulatory mechanisms have been reduced since the lynx was listed. However, establishment of consistent guidance that provides adequate regulatory mechanisms over the longer term is needed throughout the range of the lynx. Similarly, plans to conserve lynx habitat and provide long-term conservation of lynx in the Northeast are currently lacking. The Maine Forest Practices Act has significantly changed silvicultural practices from clearcutting to partial harvesting, which may not create conditions that are beneficial to lynx and snowshoe hares (Hoving et al. 2004).

**E) Other natural or manmade factors affecting the species' continued existence.**

Lynx move between boreal habitats in Canada and the contiguous United States. Immigration of lynx from Canada plays a vital role in sustaining lynx in the contiguous United States (McKelvey et al. 2000c). It is essential that landscape connectivity between lynx habitats and populations in Canada and the contiguous United States be maintained. Lynx movements may be negatively influenced by high traffic volume on roads that bisect suitable lynx habitat, such as in the Southern Rockies. At this time there is no evidence that, if competition exists between lynx and potential competitors such as coyotes and bobcats, it exerts a population-level impact on lynx. The theory that compacted snow trails and roads that are maintained for winter recreation and forest management facilitate competition by giving other species, particularly coyotes, access to lynx winter habitat has neither been proven or disproven at this time.

The ranges of lynx and bobcat naturally interface within the contiguous United States. The range of bobcats is limited by snow conditions that provide a competitive advantage to lynx. In 2003, lynx-bobcat hybridization was first documented in Minnesota and has since been documented elsewhere in the Great Lakes and the Northeast (Schwartz et al. 2004). Whether lynx-bobcat hybridization has implications for lynx conservation is unknown at this time.

Scientific evidence has demonstrated that globally the climate has been warming as evidenced by changes in the amount of snow cover, among other indicators (Intergovernmental Panel on Climate Change 2001). Continued warming temperatures are likely to negatively affect the cold climatic conditions that create and maintain the boreal forest ecosystem for which lynx are highly adapted. As a result, we anticipate that continued warming trends may eventually cause the boreal forests in the contiguous United States to recede north and/or recede to higher, colder elevations, which would likely result in adverse effects to the contiguous United States population of lynx.

**Conservation Efforts:** The FS and BLM signed 4-year Conservation Agreements with the Service in 2000. The FS agreement has been revised and renewed (FS and Service 2005). The BLM agreement has not been renewed although the agency continues to work within the agreement. Under the agreements, lynx habitat was mapped on all National Forest and BLM lands across the contiguous United States and section 7 consultation occurs on these lands. Determinations of project effects on lynx are based on the most current science, including the Lynx Conservation Assessment and Strategy. National Forest Land and Resource Plans and BLM Land Use Plans have been revised or amended, or are in the process of revision or amendment, to address lynx conservation needs. In the Northeast, there are no land management plans to address lynx conservation at this time.

Research on lynx and snowshoe hare ecology, habitat requirements, population demographics and factors influencing lynx populations continues in Colorado, Maine, Minnesota, Montana, Washington, and Wyoming. The State of Colorado is continuing its intensive effort to augment or reestablish resident lynx populations in the Southern Rocky Mountains (>http://wildlife.state.co.us/species_cons/lynx.asp<). Results of a 3-year effort to document lynx distribution in the United States through the National Lynx Survey are being prepared for publication (K. McKelvey, Rocky Mountain Research Station, pers. comm. 2005). The Washington Department of Fish and Wildlife has adopted a Lynx Recovery Plan given that the lynx is a classified by the Washington Fish and Wildlife Commission as threatened (Stinson 2001).

## PRELIMINARY RECOVERY STRATEGY

**Recovery Priority Number:** 15, on a scale of 1C (highest) to 18 (lowest) (USDI 1983a, b). This ranking is based on a low degree of threat, a high potential for recovery, and a taxonomic classification as a distinct population segment under the Endangered Species Act (16 U.S.C. 1531, et seq.).

**Recovery Goal:** The goal of this recovery effort is to address threats to the lynx so that protection of this species under the Endangered Species Act is no longer required, and delisting is warranted.

**Preliminary Recovery Objectives and Actions:** Recovery of the lynx will be achieved when conditions have been attained that will allow lynx populations to persist long-term within each of the identified core areas. Here we present our preliminary recovery objectives and measures for calculating progress toward the recovery goal of delisting the lynx, as well as the recommended

recovery actions to attain that goal, with the understanding that all are subject to change as new information is gathered. More specific recovery objectives, delisting criteria, and actions will be developed in the course of the formal recovery planning process and as additional data become available for analysis. Note that the development of demographic criteria for delisting is not possible at this time (see "Additional Recovery Considerations," below). We present our recommended preliminary recovery actions here to encourage the immediate implementation of such actions, rather than waiting on the release of the draft recovery plan, to make positive progress toward recovery of the lynx.

**Objective 1:** Retain adequate habitat of sufficient quality to support the long-term persistence of lynx populations within each of the identified core areas.

**Objective 2:** Ensure that sufficient habitat is available to accommodate the long-term persistence of immigration and emigration between each core area and adjacent populations in Canada or secondary areas in the United States.

**Objective 3:** Ensure that habitat in secondary areas remains available for continued occupancy by lynx.

**Objective 4:** Ensure that threats have been addressed so that lynx populations will persist in the contiguous United States for at least the next 100 years.

**Recovery Actions Needed to Attain Objectives**

1. **Establish management commitments in core areas** that will provide for adequate quality and quantity of habitat such that there is a reasonable expectation that persistent lynx populations can be supported in each of the core areas for at least the next 100 years.

    1.1. On major Federal land ownerships within each core area, establish and implement long-term guidance whose adequacy to conserve lynx has been verified in a biological opinion.

    1.2. On non-Federal lands in the core areas, develop and implement best management practices and long-term management agreements for lynx with key State, private and/or Tribal forest managers.

2. **Maintain baseline inventories of lynx habitat in each core area,** monitoring changes in structure and the distribution of habitat components.

3. **Monitor lynx use in lynx analysis units[4] or other appropriate management unit** at least once every 10 years to determine distribution and occupancy within the core area.

[4] As defined in Ruediger et al. (2000), a lynx analysis unit is a project analysis unit upon which direct, indirect, and cumulative effects analyses are performed. The size of a lynx analysis unit approximates the area used by an individual lynx, about 65 to 129 square kilometers (25 to 50 square miles).

4. **Identify habitat facilitating movement between each core area and lynx populations in Canada.**

   4.1. Develop and implement long-term management commitments with key Canadian, United States Federal, State, Tribal, and private forest landowners to conserve these habitats.

   4.2. Develop agreements with appropriate Canadian wildlife authorities to survey lynx populations in Provinces adjacent to core areas and closely monitor the effects of lynx harvest to ensure lynx populations in southern Canada persist.

5. **Ensure that habitat in secondary areas remains available for occupancy by lynx.**

   5.1. Conduct surveys to determine whether any of the unsurveyed secondary areas support lynx populations that have not been recently documented. Based on results, adjust core and secondary area designations as appropriate.

   5.2. Conduct research to determine the role of secondary areas in ensuring the persistence of lynx in both the contiguous United States and individual core areas. Based on results, adjust recovery objectives and criteria as appropriate.

   5.3. In secondary areas, monitor amount and condition of habitat and conduct surveys (at least once every 10 years during population peaks) to document occurrence of lynx.

   5.4. Identify and implement management efforts as necessary to provide lynx habitat in secondary areas. Use the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000) as habitat management guidance in secondary areas.

   5.5. Determine whether dispersal occurs between core areas and secondary areas and develop and implement management agreements with key landowners to conserve these habitats if necessary.

6. **Identify population and habitat limiting factors for lynx in the contiguous United States.**

   6.1. Continue and complete studies necessary to gather basic information on the ecological requirements, distribution, population size and trends in each of the core areas and as possible for secondary areas.

   6.2. Identify the risk to lynx populations posed by forest management techniques and human-induced mortality from factors such as roads, trapping and hunting. Address these factors as necessary to ensure the long-term persistence of lynx populations in core areas.

6.3. Continue and complete studies to assess the role of potential competitors (bobcat, coyotes) and predators (fisher, mountain lions) in limiting persistence of lynx populations in core areas; if determined to be limiting factors address as necessary.

6.4. Research the role hybrization between lynx and bobcats may have in limiting the persistence of lynx populations in core areas; if determined to be a limiting factor address as appropriate.

6.5. Monitor the effects of climate change on boreal forest habitat in each of the core areas. Modify the delineation of core areas and adjust management strategies if necessary.

7. **Develop a post-delisting monitoring plan** that will be in place and ready for implementation prior to delisting to ensure the continuing effectiveness of the recommended recovery actions and allow for adaptive management, as necessary.

**Additional Recovery Considerations:** This recovery outline provides preliminary recovery objectives for the contiguous United States distinct population segment of the Canada lynx. At the present time, there are inadequate methods available to develop lynx population estimates for each of the six core areas. Without methods to assess population size or trends, it is not yet possible to develop demographic criteria for delisting the species. The cyclic or fluctuating nature of lynx populations provides an additional element of uncertainty in assessing population trends. As a result, the Service has concluded that it is not practicable at this time to establish demographic criteria for delisting the species.

The delineation of demographic recovery criteria would be facilitated by the development of regional population viability models for each of the core areas (and adjacent lynx populations in Canada, if appropriate) to better understand the population sizes needed for long-term persistence. Modeling also can provide insights into how the cyclic or fluctuating nature of lynx populations and threats affect long-term persistence.

Further uncertainty in recovery and persistence of lynx in the contiguous United States lies in the potential effects of global climate change. Continued warming trends may eventually have a profound effect on the winter conditions that create the habitats for which lynx are highly adapted, and could result in a substantial reduction or even elimination of lynx habitats from the contiguous United States.

**Federal Recovery Plan Coordination and Preparation:** The Service does not anticipate appointing a formal Recovery Team to develop a recovery plan. Comments and suggestions regarding this outline will be considered in preparing a draft recovery plan. The public will be invited to comment on the draft recovery plan at the time it is released. A final recovery plan will be made available to all interested parties.

Given staff and budget limitations, the Service intends to begin formal recovery planning for the lynx in early 2007, after the final lynx critical habitat designation is complete (due November 2006). We anticipate a draft recovery plan would be available for public review in January 2008.

There will be a 60-day public comment period. Based on this timeframe, a final recovery plan would be available in June 2009. This timeframe may be affected by ongoing litigation over the listing.

**Stakeholder Involvement:** Stakeholders will be involved during the process of plan development. Stakeholders may include but are not limited to: States, U.S. Department of Agriculture Forest Service, Tribes, Bureau of Land Management, National Park Service, U.S. Department of Agriculture Animal Plant Health Inspection Service–Wildlife Services, researchers, timber industry, trappers, environmental groups, Canadian wildlife and land managers, recreational interests and other members of the general public. At the local or regional level, stakeholders will be able to participate in lynx conservation efforts.

Prepared by:

Lori Nordstrom, U.S. Fish and Wildlife Service, Montana
Anne Hecht, U.S. Fish and Wildlife Service, Massachusetts
Mark McCollough, U.S. Fish and Wildlife Service, Maine
Bob Naney, U.S. Forest Service, Washington
Joel Trick, U.S. Fish and Wildlife Service, Wisconsin
Nancy Warren, U.S. Forest Service, Colorado
Michele Zwartjes, U.S. Fish and Wildlife Service, Oregon

**Approval:**

ACTING Deputy Sharon R Rose

Regional Director, U.S. Fish and Wildlife Service, Denver, Colorado

9/14/05

Date

**References**


Agee, J.K. 2000. Disturbance ecology of North American boreal forests and associated northern mixed/subalpine forests. Pages 39-82 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Aubry, K.B., G.M. Koehler, and J.R. Squires. 2000. Ecology of Canada lynx in southern boreal forests. Pages 373-396 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Bailey, T.N., E.E. Bangs, M.F. Portner, J.C. Malloy, and R.J. McAvinchey. 1986. An apparent overexploited lynx population on the Kenai Peninsula, Alaska. Journal of Wildlife Management 50:279-290.

Bittner, S.L., and O.J. Rongstad. 1982. Snowshoe hare and allies *in* J.A. Chapman and G.A. Feldhamer (eds.). Wild mammals of North America: biology, management and economics. Johns Hopkins University Press, Baltimore, Maryland.

Brittell, J.D., R.J. Poelker, S.J. Sweeney, and G.M. Koehler. 1989. Native cats of Washington. Washington Department of Wildlife, Olympia.

Conroy, M.L., L.W. Gysel, and G.R. Dudderar. 1979. Habitat components of clear-cut areas for snowshoe hares in Michigan. Journal of Wildlife Management 43:680-690.

Fox, J.F. 1978. Forest fires and the snowshoe hare-Canada lynx cycle. Oecologia 31:349-374.

Hodges, K.E. 2000. Ecology of snowshoe hares in southern boreal and montane forests. Pages 163-206 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Homyack, J.A. 2003. Effects of precommercial thinning on snowshoe hares, small mammals, and forest structure in northern Maine. M.S. Thesis, University of Maine, Orono.

Hoving, C.L. 2001. Historical occurrence and habitat ecology of Canada lynx (*Lynx canadensis*) in eastern North America. M.S. Thesis, University of Maine, Orono.

Hoving, C.L., D.J. Harrison, W.B. Krohn, W.J. Jakubas, and M.A. McCollough. 2004. Canada lynx, *Lynx canadensis*, habitat and forest succession in northern Maine, USA. Wildlife Biology 10:285-294.

Hoving, C.L., R.A. Joseph, and W.B. Krohn. 2003. Recent and historical distribution of Canada lynx in Maine and the northeast. Northeastern Naturalist 10:363-382.

Intergovernmental Panel on Climate Change. 2001. Climate change 2001: Synthesis report summary for policy makers. Intergovernmental Panel on Climate Change Plenary XVIII, United Kingdom. Available online at >http://www.grida.no/climate/ipcc_tar/vol4/english/pdf/spm.pdf<. Accessed May 10, 2005.

Keith, L.B., and D.C. Surrendi. 1971. Effects of fire on a snowshoe hare population. Journal of Wildlife Management 35:16-26.

Koehler, G.M. 1990. Population and habitat characteristics of lynx and snowshoe hares in north-central Washington. Canadian Journal of Zoology 68:845-851.

Litvaitis, J.A., J.A. Sherburne, and J.A. Bissonette. 1985. Influence of understory characteristics on snowshoe hare habitat use and density. Journal of Wildlife Management 49:866-873.

Maine Department of Conservation. 1999. Maine Forest Service Chapter 20 forest regeneration and clearcutting standards 04-058. Maine Department of Conservation, Augusta.

Maine Department of Conservation. 2004. Maine Forest Practices Act, revised to include changes through July 1, 2004; Title 12 Part 11 Chapter 805 Subchapter 3-A. Maine Department of Conservation, Augusta.

McCord, C.M., and J.E. Cardoza. 1982. Bobcat and lynx *in* J.A. Chapman and G.A. Feldhamer (eds.). Wild mammals of North America: biology, management and economics. Johns Hopkins University Press, Baltimore, Maryland.

McKelvey, K. 2005. Pers. Comm. Scientist, Rocky Mountain Research Station, U.S. Department of Agriculture Forest Service, Missoula, Montana.

McKelvey, K.S., K.B. Aubry, J.K. Agee, S.W. Buskirk, L.F. Ruggiero, and G.M. Koehler. 2000a. Lynx conservation in an ecosystem management context. Pages 419-442 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

McKelvey, K.S., K.B. Aubry, and Y.K. Ortega. 2000b. History and distribution of lynx in the contiguous United States. Pages 207-264 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

McKelvey, K.S., S.W. Buskirk, and C.J. Krebs. 2000c. Theoretical insights into the population viability of lynx. Pages 21-38 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Moen, R., G. Niemi, C.L. Burdett, and L.D. Mech. 2004. Canada lynx in the Great Lakes region, 2004 annual report to USDA Forest Service and Minnesota Cooperative Fish and Wildlife Research Unit. Natural Resources Research Institute Technical Report No. NRRI/TR-2004-33.

Monthey, R.W. 1986. Responses of snowshoe hares, *Lepus americanus*, to timber harvesting in northern Maine. Canadian Field-Naturalist 100:568-570.

Mowat, G., K.G. Poole, and M. O'Donoghue. 2000. Ecology of lynx in northern Canada and Alaska. Pages 265-306 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Parker, G.R., J.W. Maxwell, L.D. Morton, and G.E.J. Smith. 1983. The ecology of the lynx (*Lynx canadensis*) on Cape Breton Island. Canadian Journal of Zoology 61:770-786.

Quinn, N.W.S., and G. Parker. 1987. Lynx. Pages 683-694 *in* M. Novak, J.A. Barber, M.E. Obbard, B. Malloch (eds.). Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources, Toronto, Ontario.

Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williams. 2000. Canada lynx conservation assessment and strategy, second edition. U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, U.S. National Park Service. Forest Service Publication #R1-00-53, Missoula, Montana.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires. 2000. The scientific basis for lynx conservation: qualified insights. Pages 443-454 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Saunders, J.K. 1963. Food habits of the lynx in Newfoundland. Journal of Wildlife Management 27:384-390.

Schwartz, M.K., K.L. Pilgrim, K.S. McKelvey, E.L. Lindquist, J.J. Claar, S. Loch, and L.F. Ruggiero. 2004. Hybridization between Canada lynx and bobcats: genetic results and management implications. Conservation Genetics 5:349-356.

Shenk, T. 2005. Pers. Comm. Researcher, Colorado Division of Wildlife, Denver, Colorado.

Squires, J.R., and T. Laurion. 2000. Lynx home range and movements in Montana and Wyoming: preliminary results. Pages 337-350 *in* L.F. Ruggiero, K.B Aubry, S.W. Buskirk, et al. Ecology and conservation of lynx in the contiguous United States. University Press of Colorado, Boulder.

Squires, J.R., S. Tomson, L.F. Ruggiero, and B. Oakleaf. 2001. Distribution of lynx and other forest carnivores in the Wyoming Range, southcentral Wyoming, progress report: winters 2000 and 2001. Unpublished report, U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station, Missoula, Montana.

Stinson, D.W. 2001. Washington state recovery plan for the lynx. Washington Department of Fish and Wildlife, Olympia.

Thiel, R.P. 1987. The status of Canada lynx in Wisconsin, 1865-1980. Wisconsin Academy of Sciences, Arts and Letters 75:90-96.

U.S. Department of the Interior. 1983a. Endangered and threatened species listing and recovery priority guidelines. Fish and Wildlife Service. Federal Register 48:43098-43105.

U.S. Department of the Interior. 1983b. Endangered and threatened species listing and recovery priority guidelines correction. Fish and Wildlife Service. Federal Register 48:51985.

U.S. Department of the Interior. 2000. Endangered and threatened wildlife and plants; determination of threatened status for the contiguous United States distinct population segment of the Canada lynx and related rule; final rule. Fish and Wildlife Service. Federal Register 65:16052-16086.

U.S. Department of the Interior. 2003. Endangered and threatened wildlife and plants; Notice of remanded determination of status for the contiguous United States distinct population segment of the Canada lynx; clarification of findings; final rule. Fish and Wildlife Service. Federal Register 68:400076-400096.

U.S. Forest Service and U.S. Fish and Wildlife Service. 2005. Canada lynx conservation agreement U.S. Forest Service and U.S. Fish and Wildlife Service. USFS agreement number 00-MU-11015600-013.

Vashon, J.H., A.L. Meehan, W.J. Jakubas, J. F. Organ, A.D. Vashon, C.R. McLaughlin, and G.J. Matula, Jr. 2005. Preliminary diurnal home range and habitat use by Canada lynx (*Lynx canadensis*) in northern Maine. Unpubl. report, Maine Department of Inland Fisheries and Wildlife, Bangor.

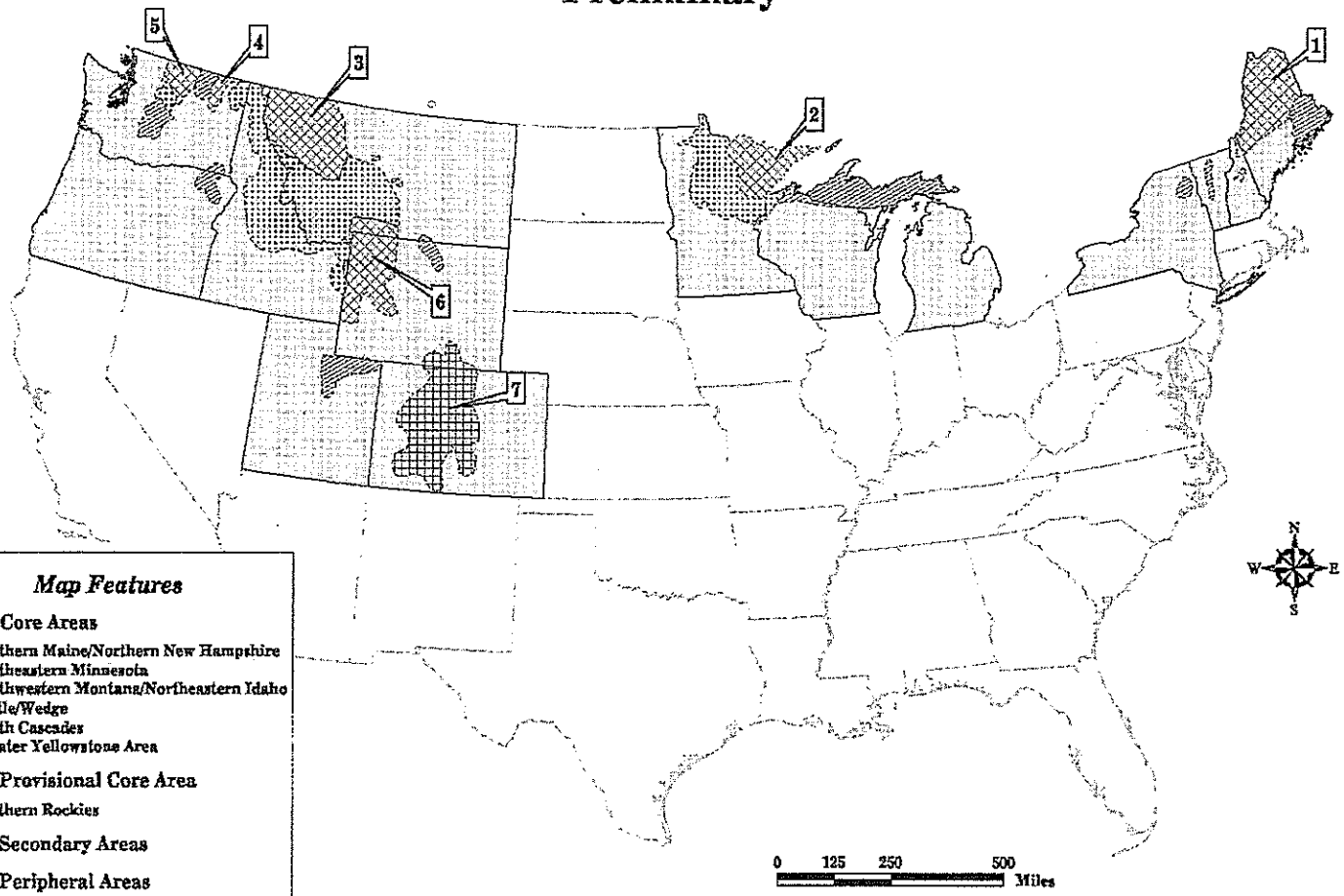
Wolff, J.O. 1980. The role of habitat patchiness in the population dynamics of snowshoe hares. Ecological Monographs 50:111-130.

## TABLE 1. PRELIMINARY LYNX RECOVERY AREA ASSESSMENT SUMMARY

| | ROLE IN RECOVERY | CRITERIA | IDENTIFIED AREAS |
|---|---|---|---|
| CORE | Ensure the continued persistence of lynx in the contiguous United States by providing:<br>1) representation by conserving the breadth of ecological settings of the DPS;<br>2) redundancy by retaining a sufficient number of populations to provide a margin of safety to withstand catastrophic events;<br>3) resiliency by maintaining sufficient numbers of animals in each population to withstand randomly occurring events and prey population dynamics. | 1. Verified evidence of long-term historical and current presence of lynx populations.<br>2. Recent (within the past 20 years) evidence of reproduction.<br>3. Average snowshoe hare densities over time are at least 0.5 hares/ha.<br>4. Contains a minimum of 1,250km$^2$ (483mi$^2$) of boreal forest habitat (can include boreal forest habitat directly adjacent in Canada). Habitat patches must be sufficiently large and connected to enable movement within and between patches within a core area.<br>5. Snow conditions favor the competitive advantage of lynx. | **Northeast** - Northern Maine/northern New Hampshire<br>**Great Lakes** - Northeastern Minnesota<br>**Northern Rockies/Cascades**<br>- Northwestern Montana/northeastern Idaho<br>- North Cascades (WA)<br>- Kettle/Wedge (WA)<br>- Greater Yellowstone Area (WY, ID, MT)<br><br>**Provisional Core Area:** Southern Rockies - Entire (CO and WY) |
| SECONDARY | Unclear: possibly unable to sustain lynx populations or actions may have caused local extirpation without recolonizition. May enable successful dispersal of lynx between populations or subpopulations. | 1. Fewer and more sporadic current and historical records of lynx and relatively low historical abundance.<br>2. Surveys lacking in some areas to identify whether lynx populations may be present<br>3. Reproduction not documented.<br>4. Reason for relatively few lynx records in secondary areas unclear at this time. | **Northeast** - None<br>**Great Lakes** – Northern Minnesota/northwestern Wisconsin<br>**Northern Rockies/Cascades**<br>- Southwest Montana<br>- Northern/central Idaho<br>- Northern Chelan County (WA)<br>- Salmo Priest (WA)<br>- Little Pend Oreille (WA)<br>**Southern Rockies** – None |
| PERIPHERAL | Unclear: May enable successful dispersal of lynx between populations or subpopulations. | 1. Few historic or recent verified records of lynx<br>2. Habitat in small patches not well-connected to larger patches of high quality habitat. | **Northeast**<br>- Vermont<br>- New York<br>- Eastern Maine<br>-Central New Hampshire<br>**Great Lakes**<br>- Northeastern Wisconsin;<br>- Michigan<br>**Northern Rockies/Cascades**<br>- Utah<br>- Big Horn Mountains (WY)<br>- Northeast Oregon/southeast Washington<br>- Southern Cascades (WA)<br>- Vulcan/Tunk (WA)<br>- Snowy Mountains (MT)<br>- Highwood Mountains (MT)<br>**Southern Rockies** - None |

# Figure 1: Canada Lynx Recovery Areas

## Preliminary




***Map Features***

Core Areas

1. Northern Maine/Northern New Hampshire
2. Northeastern Minnesota
3. Northwestern Montana/Northeastern Idaho
4. Kettle/Wedge
5. North Cascades
6. Greater Yellowstone Area

Provisional Core Area

7. Southern Rockies

Secondary Areas

Peripheral Areas

States Where Listed

State Boundaries

Map compiled by USFWS, Bismarck, ND, June 14, 2006. All features are for representative purposes only and may not depict the actual size, shape and/or boundary.