BIOLOGICAL OPINION
HARDROCK MINERALS PROSPECTING PERMITS

U.S. FOREST SERVICE

March 22, 2012
U.S. FISH AND WILDLIFE SERVICE
TWIN CITIES FIELD OFFICE
BLOOMINGTON, MINNESOTA

Table of Contents

Introduction and Consultation History 1

Gray Wolf 1

Concurrence – Canada Lynx Critical Habitat 1

BIOLOGICAL OPINION 4
1. Description of the Proposed Action 4
1.1. Description of the Action Area 4

2. Status of the Species 6
2.1. Canada lynx 6
2.1.1. Species Description 7
2.1.2. Life History 8
2.1.3. Status and Distribution 12

3. Analysis of the Species Likely to be Affected 17

4. Environmental Baseline 17
4.1. Status of the Species in the Action Area 17
4.1.1. Canada lynx 17
4.2. Factors Affecting Species in the Action Area 20
4.2.1. Canada lynx 20

5. Effects of the Proposed Action 22
5.1. Effects of Interrelated or Interdependent Actions 22
5.2. Cumulative Effects 33

6. Conclusion 34

INCIDENTAL TAKE STATEMENT 35
1. Amount or Extent of Take Anticipated 35
2. Effect of the Take 35
3. Reasonable and Prudent Measures 36
4. Terms and Conditions 36
5. Reporting Requirements 37

CONSERVATION RECOMMENDATIONS 38

REINITIATION – CLOSING STATEMENT 39

Appendix 1. How to identify Canada lynx. 40

Introduction and Consultation History

This document transmits the Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the proposed Hardrock Minerals Prospecting permits in the Superior National Forest in all Ranger Districts, Cook, Lake, Koochiching and St. Louis Counties, Minnesota, and its effects on Canada lynx (*Lynx canadensis*) and its critical habitat in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended. Your December 21, 2011, request for formal consultation was received on December 22, 2011. The Forest Service requested concurrence with a "may affect but not likely to adversely affect" determination for Canada lynx critical habitat and a "likely to adversely affect" determination for Canada lynx in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended. As discussed in detail below, we concur that this action is not likely to adversely affect designated Canada lynx critical habitat, but that the action is expected to result in some adverse effects to Canada lynx.

The Opinion is based on information provided in the December 21, 2011, Biological Assessment (USDA Forest Service 2011a), the Addendum to the Biological Assessment (USDA Forest Service 2012), the draft Environmental Impact Statement (USDA Forest Service 2011b), and other sources of information. Early communication on this proposed action between the Service and Superior National Forest (SNF) began on December 21, 2010, and continued until the BA was submitted. A draft biological opinion was submitted to the Forest Service for its review on March 5, 2012. Additional conversations between the two agencies are documented in electronic mail messages and telephone calls. A complete administrative record of this consultation is on file at the Service's Twin Cities Field Office.

Gray Wolf

The Superior National Forest found that the proposed action may affect and is likely to adversely affect gray wolf (*Canis lupis*) and may affect but will not adversely affect gray wolf critical habitat.

The Gray wolf (*Canis lupus*) and Gray wolf critical habitat were removed from the Endangered Species list effective January 27, 2012.

Concurrence – Canada Lynx Critical Habitat

The Superior National Forest found that the proposed action may affect but is not likely to adversely affect designated Canada lynx (*Lynx canadensis*) critical habitat. Critical habitat for lynx is defined as boreal forest landscapes

supporting a mosaic of differing successional forest stages and containing the following primary constituent elements (PCEs):

a) Presence of snowshoe hares and their preferred habitat conditions, including dense understories of young trees or shrubs tall enough to protrude above the snow;
b) Winter snow conditions that are generally deep and fluffy for extended periods of time;
c) Sites for denning having abundant coarse, woody debris, such as downed trees and root wads; and
d) Matrix habitat (*e.g.,* hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range. The important aspect of matrix habitat for lynx is that these habitats retain the ability to allow unimpeded movement of lynx through them as lynx travel between patches of boreal forest.

We concur that the proposed project is not is not likely to adversely affect critical habitat for the Canada lynx. Our concurrence is based on the project's compliance with provisions set forth in the Superior National Forest Management Plan (Forest Plan) that were adapted from the Lynx Conservation Assessment and Strategy. The programmatic Forest Plan Biological Assessment (USDA 2011; USDA Forest Service 2011c) addressed the effects of the proposed project to the lynx PCEs; the Hardrock Minerals Prospecting Permits Project Biological Assessment tiers to the Forest Plan Biological Assessment.

The Hardrock Minerals Prospecting Permits Project Biological Assessment (BA) addressed the effects of Alternative 4 of the proposed project to the lynx PCEs. Specifically, the proposed project will not result in significant denning habitat loss. Denning habitat in patches over five acres will remain well above 10 percent in all Lynx Analysis Units (LAU) (PCE c). Denning habitat in patches over five acres ranges from 28.2 percent to 74.7 percent on Superior National Forest land in all Lynx Analysis Units (LAU), which is well above the 10 percent Forest Plan guideline (PCE c). The amount of unsuitable habitat for snowshoe hare is below 30 percent in each LAU (PCE a, b, c, d). Management activities on National Forest lands will not change more than 15 percent of the lynx habitat within each LAU to an unsuitable condition within a 10-year period (PCE a, c, d). This standard may be exceeded in LAU 2 and LAU 4, however it is improbable since LAUs 2 and 4 are in areas of low mineral interest and are unlikely to have permit requests in the near future. Future permit applications in LAUs 2 and 4 would be analyzed to determine if this standard will be met at that time. Miles of temporary roads in any year of the 20-year life of the proposed project will remain below 95 percent of the those predicted by the Forest Plan (USDA 2004). Alternative 4 may increase snow compaction on temporary roads

during operations; however, snow compacting activities would be short-term (PCE b). Temporary road use would be greatest during years two through eight of this proposed project and may last longer than typical temporary roads in the Forest. However, all temporary roads will be effectively closed after project completion (PCE b). Road and snow-compacted trail density (PCE a, c, d) will not change under the proposed project.

BIOLOGICAL OPINION

1. Description of the Proposed Action

Alternative 4 of the Hardrock Minerals Prospecting Permits Draft Environmental Impact Statement (EIS) proposes to issue permits for 33 federal hardrock mineral prospecting permit applications and to approve 21 associated operating plans. Project activities include geophysical surveys; drilling; landing construction, use, closure and decommissioning; and temporary road creation, closure and decommissioning.

Minerals exploration under a permit and extension can occur within a six-year timeframe; however, this timeframe can be extended to 15 years. Since permit applications would be accepted for five years, the total duration of the minerals exploration action is estimated to be 20 years. The estimated duration of the geophysical surveys, drilling, and the construction, use and decommissioning of temporary roads, landings and sumps is 20 years.

The analysis timeframe in the Biological Assessment is 30 years. Although prospecting permits will be operable for 20 years, an additional 10-year period was analyzed to account for habitat disturbance and subsequent re-growth following cessation of operations.

Within the project area, there are approximately 1,184,760 acres of federal surface ownership. Of those, there are 470,341 acres with federal surface rights with adjoining subsurface rights, which are spread throughout most of the Forest's 46 Lynx Analysis Units (LAUs). The area of each LAU in the project area varies from 17 acres in LAU 44 to 29,475 acres in LAU 32. The portion of any given LAU within the project area ranges from 0.7 to 87.6 percent. Only LAU 6 is unaffected by the proposed project.

There will be no change in Operation Maintenance Level (OML) 1 through OML 5 road mileage. Traffic volume is expected to increase on portions of State Highway 1, State Highways 1/169, Forest Road 424/St. Louis County Road 623 and Forest Road 377. Winter use of OML 1 and OML 2 roads will increase with this project. Between 523 and 860 miles of temporary roads will be in use at any one time over the duration of the project across all effected LAUs.

1.1. Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the proposed Federal action. The project area includes all National Forest Service lands managed by the Superior National Forest, except for lands within the Boundary Waters Canoe Area Wilderness (BWCAW), Mining Protection Areas (USDA 2004, pp. 2-9), and eligible Wild River Segments (USDA 2004, pp. 3-19). The area of potential permitting and drilling only includes those lands

within the project area that are under Forest Service surface ownership and Federal mineral ownership.

The action was divided into two categories: 1) current mineral prospecting permits and their associated operating plans and 2) future mineral prospecting permits and their associated operating plans. LAUs were divided into four categories based on the interest levels of high, moderate, low and very low. Data on LAUs with very low mineral exploration interest were not presented in the BA because the likelihood of effects is considered to be discountable.

The analysis area for direct and indirect effects is the ten LAUs (LAU 9, 10, 11, 12, 13, 16, 18, 19, 24 and 25) with overlapping areas of high mineral interest with current prospecting permits and includes their associated operating plans (Figure 1). Traffic volume in LAUs 7, 9, 10, 11, 18, 19 and 20 were also considered due to the expected traffic increase within those areas (Figure 2).

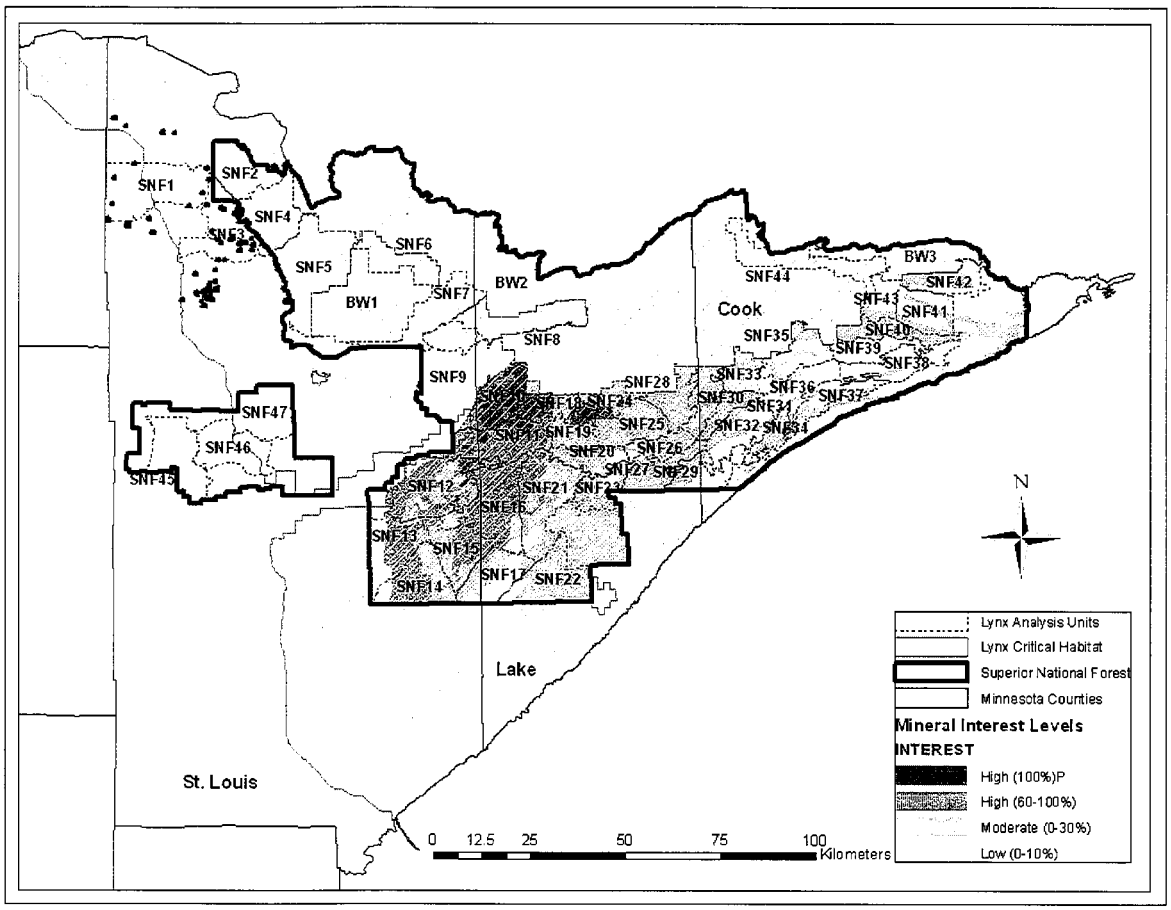

Figure 1. Areas of high, moderate and low mineral interest, Canada lynx critical habitat and Lynx Analysis Units (LAU) on the Superior National Forest, Minnesota.

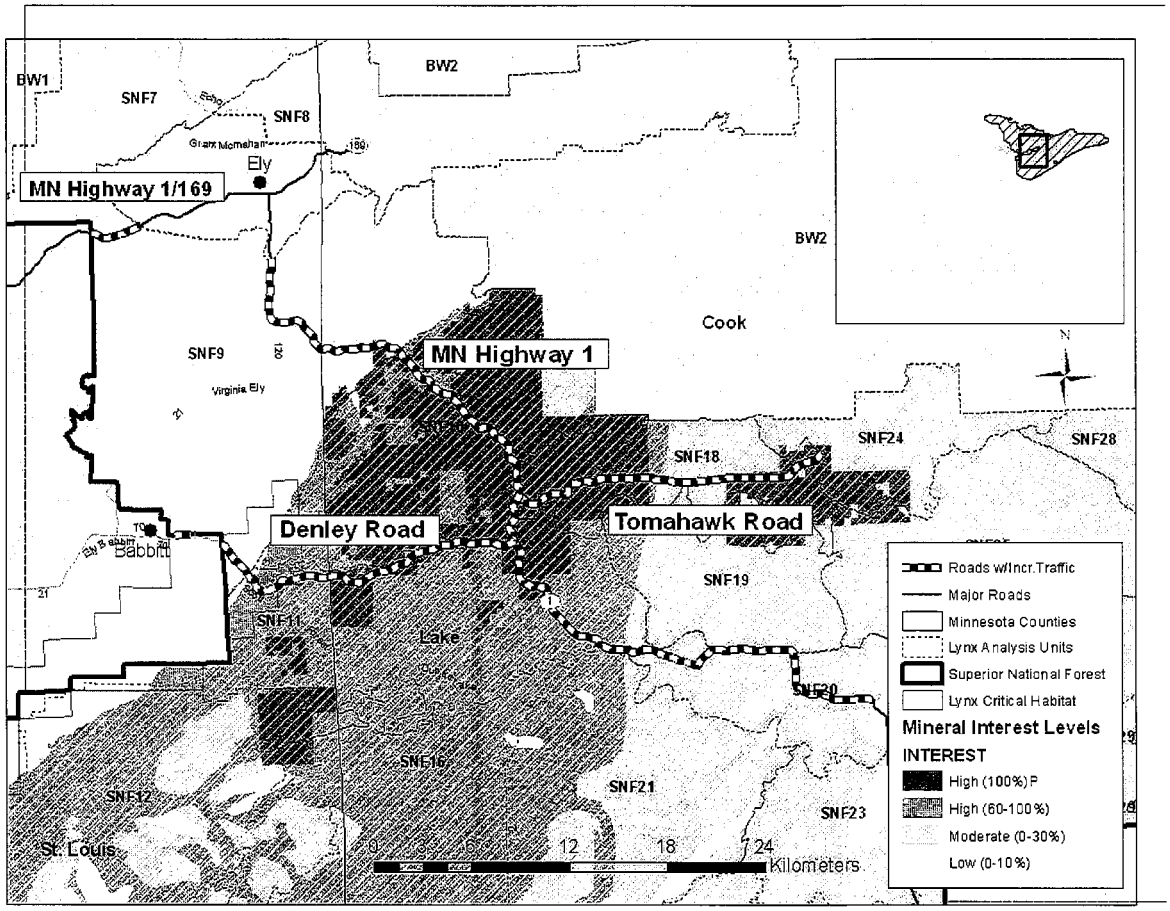

Figure 2. Roads that may see an increase in traffic due to the proposed Hardrock Minerals Prospecting Permits Project on the Superior National Forest, Minnesota; 2 miles of State Highway 1/169, 39 miles of State Highway 1, 12 miles of Forest Road 377 (Tomahawk Road) and 16 miles of Forest Road 424/St. Louis County Road 623 (Denley Road).

2. Status of the Species

2.1. Canada lynx

The Canada lynx in the contiguous U.S. were listed as threatened effective April 23, 2000 [65 Federal Register (FR) 16052, March 24, 2000]. The Service identified one distinct population segment (DPS) in the lower 48 states. On July 3, 2003, the Service published its Notice of Remanded Determination of Status for the Contiguous United States Distinct Population Segment of the Canada Lynx (68 Federal Register FR 40076, July 3, 2003) in which it clarified its findings in the 2000 final listing rule and reaffirmed the listing of the lynx DPS as threatened.

In 2006, the Service designated 1,841 square miles of critical habitat for the Canada lynx within the boundaries of Voyagers National Park in Minnesota, Glacier National Park in Montana, and North Cascades National Park in Washington. In February 2008, the Service proposed to revise the critical habitat designation after questions were raised about the integrity of the scientific information used and whether the decision made was consistent with appropriate legal standards. The U.S. Fish and Wildlife Service announced a revised critical habitat designation for the Canada lynx, which was published in the Federal Register on February 25, 2009. The revised critical habitat rule became effective on March 27, 2009.

An interagency Canada lynx coordination effort was initiated in March 1998 in response to the emerging awareness of the uncertain status of Canada lynx populations and habitat in the contiguous United States and the onset of the listing process. The Service, Forest Service, Bureau of Land Management, and National Park Service have participated in this effort. As a result of those efforts, three products important to the conservation of Canada lynx on federally managed lands were produced: The Scientific Basis for Lynx Conservation (Ruggiero et al. 1999); the Lynx Conservation Assessment and Strategy (LCAS, Ruediger et al. 2000); and Lynx Conservation Agreements (CA) among the Service and various land management agencies (see U.S. Forest Service and USFWS 2000). The CA promotes the conservation of Canada lynx and its habitat on federal lands and identifies actions the federal agencies agree to take to reduce or eliminate potential adverse effects or risks to Canada lynx and its habitat. The LCAS was produced in 1999 to provide a consistent and effective approach to conservation of Canada lynx on federal lands and was used as a basis for assessing the effects of the Forest Plan on Canada lynx.

New information has become available since the LCAS was written. Kolbe et al. (2007) and Bunnell et al. (2006) published information on the effects of snowmobiling on lynx, and Squires and Ruggiero (2007) and Squires (2010) documented the importance of multilayered stands as snowshoe hare habitat. Ongoing research in Minnesota and Maine has resulted in information that contributes to our understanding of lynx and snowshoe hares (e.g., Fuller et al. 2007; Homyack et al. 2007; Hoving et al. 2005; Moen et al. 2008a; Moen et al. 2010).

2.1.1. Species Description

The lynx is a medium-sized cat with long legs; large, well-furred paws; long tufts on the ears; and a short tail whose tip is entirely surrounded by black; the tips of bobcat tails are black only on the upper side (McCord & Cardoza. 1982). The lynx's long legs and large, well-furred paws make it highly adapted for hunting in deep snow. Adult males average 10 kilograms (22 pounds) in weight

and 85 centimeters (33.5 inches) in length (head to tail), and females average 8.5 kilograms (19 pounds) and 82 centimeters (32 inches, Quinn & Parker 1987).

2.1.2. Life History

Lynx evidently require large areas containing boreal forest[1] habitat. In the northeastern U.S., lynx were most likely to occur in areas containing suitable habitat that were greater than 40 miles^2 (Hoving 2001). The requirement for large areas also is demonstrated by home ranges that encompass many square miles. The size of lynx home ranges varies with sex, age, abundance of prey, season, and the density of lynx populations (Aubry et al. 2000; Hatler 1988; Koehler 1990; Mowat et al. 2000; Poole 1994; Slough & Mowat 1996). Generally, it is believed that larger home ranges, such as have been documented in some areas in the southern extent of the species' range in the west, are a response to lower-density snowshoe hare populations (Apps 2000; Koehler & Aubry 1994; Squires & Laurion 2000).

Long-distance movements (greater than 60 miles) are characteristic of lynx (Moen et al. 2010; Mowat et al. 2000). Lynx disperse primarily when snowshoe hare populations decline (Koehler & Aubry 1994; O'Donoghue 1997; Poole 1997; Ward & Krebs 1985). Subadult lynx also disperse even when prey is abundant (Poole 1997), presumably as an innate response to establish home ranges. Lynx also make exploratory movements outside their home ranges (Moen et al. 2010). Lynx are capable of moving extremely long distances (greater than 300 miles) (Brainerd 1985; Mech 1977; Mowat et al. 2000; Poole 1997).

Recent studies of Minnesota lynx show that male home ranges varied between 11 and 201 mi^2, and female home ranges varied between 2 and 37 mi^2 (Burdett 2007). Home ranges varied during the breeding season; males tended to expand the size of their home ranges, presumably to search for females; females tended to contract their home ranges as the birthing period approached (Burdett 2007). A study of radio-collared lynx in Minnesota documented approximately 40 percent of male and female lynx making long distance movements outside of their home range between Ontario, Canada and Minnesota (Moen et al. 2010). Of those lynx that made long-distance movements, females tended to move 62-124 miles (100-200km) and did not return to their original home range, while males moved 31-49 miles (50-80km) back and forth between Ontario and Minnesota (Moen et al. 2010). While topographic features may influence lynx in mountainous western states, lynx in Minnesota tended to move in nearly straight paths (Moen et al. 2010).

Snow conditions also determine the distribution of lynx (Ruggiero et al. 1999). Lynx are morphologically and physiologically adapted for hunting snowshoe

[1] The term "boreal forest" broadly encompasses most of the vegetative descriptions of this transitional forest type that makes up lynx habitat in the contiguous U.S. (Agee 2000).

hares and surviving in areas that have cold winters with deep, fluffy snow for extended periods. These adaptations provide lynx a competitive advantage over potential competitors, such as bobcats (*Lynx rufus*) or coyotes (*Canis latrans*) (Buskirk et al. 2000; McCord & Cardoza. 1982; Ruediger et al. 2000; Ruggiero et al. 1999). Bobcats and coyotes have a higher foot load (more weight per surface area of foot), which causes them to sink into the snow more than lynx. Therefore, bobcats and coyotes cannot efficiently hunt in fluffy or deep snow and are at a competitive disadvantage to lynx. Long-term snow conditions presumably limit the winter distribution of potential lynx competitors such as bobcats (McCord & Cardoza. 1982) or coyotes.

Canada lynx prey primarily on snowshoe hares, especially in the winter when they comprise 35-97 percent of the diet (Koehler & Aubry 1994). Lynx may modify hunting behavior and switch to alternate prey when hare densities are low (O'Donoghue et al. 1998a; O'Donoghue et al. 1998b). Other prey species include red squirrel (*Tamiasciurus hudsonicus*), other small rodents, small carnivores, and birds, including ruffed grouse (Moen et al. 2004). Recent research indicates that the red squirrel is not an important prey species for lynx in northeastern Minnesota (Burdett 2007; Hanson & Moen 2008), similar to lynx in Montana (Squires & Ruggiero 2007). The same study (Squires & Ruggiero 2007) found that red squirrels comprised only two percent of the winter diet of lynx in Montana. In Minnesota, Hanson and Moen (2008) found that snowshoe hare remains were found in 76 percent of the lynx scat in their study, while no evidence of red squirrels remains were detected.

Snowshoe hares have evolved to survive in areas that receive deep snow (Koehler & Aubry 1994) and prefer conifer habitats with dense shrub understories that provide food, abundant cover to escape predators, and thermal protection during extreme weather (Fuller & Heisey 1986; Hodges & Sinclair 2005; Koehler & Aubry 1994; Monthey 1986; Pietz & Tester 1983; Wirsing et al. 2002; Wolfe et al. 1982). Early successional forest stages generally have greater understory structure than do mature forests and therefore support higher hare densities (Newbury & Simon 2005; Pietz & Tester 1983). It may take several years, however, for conditions to become suitable for hares after disturbances, such as clearcuts and fire. Such areas may not be optimal until 15-30 years after the initial disturbance, during what may be described as the sapling/large shrub stage – before the onset of self-thinning (Buskirk et al. 2000; Hoving et al. 2004; Koehler & Brittell 1990; Monthey 1986; Thompson et al. 1989). In central Labrador, for example, hare densities peaked 30 years after clearcuts – hare densities in 30 year-old clearcuts were 37 times higher than in recent clearcuts (Newbury & Simon 2005). Potvin et al. (2005) found that hare densities would likely peak no sooner than 15 years after clearcuts in southwestern Quebec and that optimal conditions took longer to develop in some boreal forest types (e.g., black spruce, *Picea mariana*). Peak densities may develop sooner in more southern forests (Newbury & Simon 2005; Potvin et al. 2005).

In the northeastern U.S., lynx were most likely to occur in areas containing suitable habitat that were greater than 100 square kilometers (km^2) (Hoving 2001). Studies in the southern portion of the species' range have found average home ranges of 151 km^2 and 72 km^2 for males and females, respectively (Aubry et al. 2000). Home range size is likely inversely related to density of snowshoe hare (Apps 2000; Koehler & Aubry 1994; Poole 1994; Squires & Laurion 2000).

Lynx use coarse woody debris, such as downed logs, root wads, and windfalls, to provide denning sites with security and thermal cover for kittens (Koehler 1990; Koehler & Brittell 1990; McCord & Cardoza. 1982; Moen et al. 2008a; Mowat et al. 2000; Squires et al. 2008; Squires & Laurion 2000). Mowat et al. (2000) summarized lynx selection of den sites in northern Canada and Alaska: "....female lynx appear to select den sites in a number of forest types in the North. Lynx do not appear constrained to select specific stand types; rather, the feature that was consistently chosen was the structure at the site itself. Wind-felled trees were the most common form of protection selected by female lynx, although other structures such as roots and dense live vegetation were also used." In Maine, 17 den sites have been located in a variety of stand types, including 10 to 20 year-old clear-cut and adjacent residual stands (J. Organ, U.S. Fish and Wildlife Service, in litt. 1999; G. Matula, Maine Department Inland Fisheries and Wildlife, in litt. 2003). Maine den sites are characterized by regenerating hardwoods and softwoods, dense understory, and abundant coarse woody debris (J. Organ, in litt. 1999, 2003). In Washington, lynx denned in lodgepole pine (*Pinus contorta*), spruce (*Picea* spp.), and subalpine fir (*Abies lasiocarpa*) forests older than 200 years with an abundance of downed woody debris (Koehler 1990). A den site in Wyoming was located in a mature subalpine fir/lodgepole pine forest with abundant downed logs and dense understory (Squires & Laurion 2000). Downed logs and overhead cover must be available throughout the home range of females with kittens to provide alternative den and nursery sites and security when lynx kittens are old enough to travel (Bailey 1974). Den sites found recently in Minnesota were primarily found in low-lying areas with dense vertical and horizontal cover (Moen et al. 2008a). Moen et al. (2008a) found that all den sites studied in Minnesota were associated with a downed tree, with disturbance area varying from 20 m^2 (> 50ft^2) to more than 1 hectare (2.5 acres). Lynx den sites consistently had lower stem density than the surrounding area, with greater than 80 percent of tree stems being coniferous species. Lowland conifer and upland conifer types made up greater than 70 percent of the area within 100m of den sites and the percentage of those cover types decreased with greater distance from the den sites. These findings are consistent with Forest Service definitions for suitable denning habitat.

Lynx breed in spring, and females give birth in late May to early June to litters of up to five kittens; hare densities are correlated positively with litter size, and age at first breeding is lower when hare populations are high. During the low phase of the hare cycle, few if any kittens are born (Brand & Keith 1979; Poole

1994; Slough & Mowat 1996). Litter sizes may be smaller in the southern lynx range due to lower peak hare densities (Koehler 1990; Squires & Laurion 2000). A lynx den found in Minnesota near Superior National Forest in 2004, however, contained five kittens. Therefore, although mean litter sizes may be smaller on the southern edge of the species' range, large litter sizes do occur. Kittens wean at about 12 weeks after birth and stay with females during their first winter when they may hunt cooperatively (Quinn & Parker 1987); family units break up at the onset of breeding, about mid-March (Quinn & Parker 1987).

The most commonly reported causes of lynx mortality include starvation of kittens (Koehler 1990; Quinn & Parker 1987) and human-caused mortality (Bailey et al. 1986; Ward & Krebs 1985). Significant lynx mortality due to starvation (up to two-thirds of deaths) has been demonstrated in cyclic populations of the northern taiga during the first 2 years of hare scarcity (Poole 1994; Slough & Mowat 1996). Where trapping of lynx occurs legally, mortality of adults may be almost entirely human-caused during hare population lows (Poole 1994). Lynx are also killed by automobiles, disease, and other mammal species, although the significance of these factors to lynx populations is uncertain (Bailey et al. 1986; Brand & Keith 1979; Carbyn & Patriquin 1983; Shenk 2009; Ward & Krebs 1985). During a lynx irruption in Minnesota in 1971-1974 when the state allowed take by trappers, 96 percent of 128 mortalities were caused by trapping or shooting, whereas 4 percent were killed by cars (Henderson 1977). Of the 118 lynx that have died of known or suspected causes in Colorado since the state began reintroducing the species in 1999, approximately 29.7 percent were human-induced, either through collisions with vehicles or by shooting, 18.6 percent died of starvation or disease/illness and 37.3 percent of the deaths were from unknown causes (Shenk 2009).

Linear features such as roads may benefit lynx from an energetic perspective, but may also have negative effects if they increase human exposure and the chance of incidental mortality (Moen et al. 2010). Of the 42 lynx mortalities recorded in Minnesota since 2000, 13 died after being trapped, six died as a result of collisions with cars, 14 died of unknown causes, six were shot, two died after collisions with trains, and one was likely predated (U.S. Fish and Wildlife Service, unpubl. data). Although there is no longer legal harvest in Minnesota, lynx that travel long distances into Canada are susceptible to legal harvest there (Moen et al. 2010). Four of the thirteen trapped Minnesota lynx were taken as legal harvest in Canada. Two collared lynx died of unknown causes in Canada.

Buskirk et al. (2000) suggested that when other hare predators, particularly coyotes (*Canis latrans*), can access lynx winter hunting areas via compacted snow they may compete for prey sufficiently to affect local lynx populations, and study results support that theory (Bunnell et al. 2006). Buskirk et al. (2000) also suggested that direct killing by coyotes, bobcats, and mountain lions (*Puma concolor*) could affect lynx numbers where these competitors' ranges overlap

substantially with lynx; in addition, Quinn and Parker (1987) stated that "(G)ray wolves (*Canis lupus*) will kill lynx that they catch in the open." Bobcat home ranges often exhibit elevational or latitudinal separation from those of Canada lynx, which are better adapted to deep snow. The paws of lynx support twice as much weight on snow as bobcats (Quinn & Parker 1987). Bobcats are thought to displace Canada lynx where both felids are locally sympatric. Canada lynx occasionally may kill bobcats (Giddings et al. 1998)2, although the opposite also has been reported.

Hybridization of lynx with bobcats has been confirmed in Maine, Minnesota, and New Brunswick with DNA analysis (Homyack et al. 2008; Schwartz et al. 2004). The hybrid animals had external physical characteristics of both species (Homyack et al. 2008). The Superior National Forest maintains a database to document the genetically confirmed Canada lynx within Minnesota, which includes samples from the Forest's survey and monitoring program and other studies (Catton & Loch 2011). Of the 656 samples in the database, 124 are individual lynx genotypes (56 males, 67 females and one undetermined) and 17 are individual hybrids (11 unique genotypes; three females and eight males) (Catton & Loch 2011). Lynx were detected in more than 10 counties. However, the majority of the lynx were detected in St. Louis, Lake and Cook Counties, where most of the data collection effort has been focused (Catton & Loch 2011).

2.1.3. Status and Distribution

Canada lynx range is associated closely with the distribution of North American boreal forest inhabited by snowshoe hares (Agee 2000). It extends from Alaska, the Yukon Territories, and Northwest Territories south across the United States border in the Cascades Range and northern Rocky Mountains, through the central Canada provinces and down into the western Great Lakes region, and east to New Brunswick and Nova Scotia, Canada, and south into the northeastern United States from Maine to New York (McCord & Cardoza. 1982; Quinn & Thompson 1987).

Within the transitional boreal forest within the contiguous United States there are core areas for Canada lynx in Maine, Minnesota, Montana, Washington and likely Idaho (68 Federal Register 40076-40101, July 3, 2003). More generally, these core areas are contained within the Northeast, Great Lakes, Southern Rocky Mountains, and Northern Rocky Mountains/Cascades regions. Status of Canada lynx in the Minnesota/Great Lakes region is summarized below. Outside of Minnesota in the Great Lakes region, lynx may also occur in Wisconsin and Michigan, but there is no current evidence of reproduction there and suitable

2 Giddings, B., W. Melquist, B. Oakleaf, and B. Bates. 1998. An assessment of lynx in the northern Rocky Mountains: a response to the U.S. Fish and Wildlife Service's request for information concerning the proposed rule to list the contiguous U.S. population of lynx as a threatened species. Montana Fish, Wildlife, and Parks, Helena.

habitat is limited and disjunct from occupied habitat in Minnesota and Canada (68 Federal Register 40076-40101, July 3, 2003).

2.1.3.1. Minnesota/Western Great Lakes Region

In Minnesota, recent and historical lynx records are primarily in the northeastern part of the state, especially in the Northern Superior Uplands Ecological Section. Historically, this area was dominated by red pine (*Pinus resinosa*) and white pine (*P. strobus*) mixed with aspen (*Populus spp.*), paper birch (*Betula papyrifera*), spruce, balsam fir (*A. balsamifera*) and jack pine (*P. banksiana*) (Minnesota Department of Natural Resources [Minnesota DNR] http://www.dnr.state.mn.us/ecs/212L/index.html, accessed July 29, 2011). Unlike elsewhere within the Great Lakes and Northeast regions, most lynx habitat in northeastern Minnesota is on public lands, particularly the Superior National Forest. Mixed deciduous-boreal forest suitable for lynx habitat encompasses most of the Superior National Forest, which has been mapped into Lynx Analysis Units to promote lynx management under the SNF Land and Resource Management Plan (USDA 2004).

Harvest and bounty records for Minnesota, which are available since 1930, indicate approximate 10-year population cycles, with highs in 1940, 1952, 1962, and 1973 (Henderson 1977; McKevley et al. in Ruggiero et al. 1999). Lynx abundance in Minnesota appears to be directly related to population levels in nearby Canada (Mech 1980). Based on trapping records, lynx abundance in Minnesota appears to lag fluctuations in Manitoba, Ontario, and Saskatchewan by about three years (McKelvey et al. in Ruggiero et al. 1999). During a 47-year period (1930–1976) before cessation of legal harvest, the Minnesota lynx harvest ranged from 0 to 400 per year (Henderson 1977) and lynx were captured in the state through periods presumed to represent both population highs and lows.

In the 1990s, there were only five verified records of lynx in Minnesota (M. Don Carlos, Minnesota Department of Natural Resources, in litt. 1994; S. Loch, pers. comm. 2006). Beginning in about 2000, Minnesota lynx numbers evidently began to rebound. Genetic analyses of scat and hair samples collected primarily along lynx snow trails and tissue samples from dead specimens and live captured lynx have confirmed presence of the 124 unique lynx genotypes (56 males, 67 females and one undetermined) and 17 individual lynx-bobcat hybrids (11 unique genotypes; three females and eight males) in Minnesota since 2000 (Catton & Loch 2011). Lynx were detected in more than 10 counties. However, the majority of the lynx were detected in St. Louis, Lake and Cook Counties, where most of the data collection has been focused (Catton & Loch 2011). This number represents only a subset of the actual number of lynx that have been present in the state since 2000, which is unknown.

Lynx researchers have confirmed at least nine lynx dens in Minnesota by following the activities of radio-collared females in the years 2004-2006 (R. Moen, Natural Resources Research Institute, Duluth, MN, pers. comm. 2006). Moen et al. (2008a) located kittens every year in which females were radio-collared, totaling 33 kittens from 10 litters from 2004 through 2007.

Snowshoe hare harvest in Minnesota (the only available long-term index to hare abundance in the state) shows a very inconsistent pattern from 1941-2000. Hare abundance, as indicated by harvest, peaked in the early 1940s and 1950s along with lynx harvest, but not in the early 1950s or 1960s. In contrast, hare harvest was double any previous year from 1977-1980, yet lynx did not increase. Based on surveys in northern Minnesota, snowshoe hare numbers are currently high (Erb 2009).

Canada lynx may not be legally trapped in Minnesota, where they are a protected species, but at least 17 lynx have been captured incidentally in recent years by trappers in pursuit of other species – nine of these lynx died as a result (U.S. Fish and Wildlife Service (USFWS), Bloomington, Minnesota, unpubl. data).

In previous biological opinions for federal actions that are ongoing in Minnesota, the Service anticipated various levels of take. These anticipated levels of take are described below, along with the actual recorded take that may be ascribed to each action. The Service monitors all known take and mortality of lynx in Minnesota in cooperation with the Forest Service.

• 2004 - Up to two lynx per year, but no more than 20 in total, over the 15 years after the approval of the Revised Land and Resource Management Plans, Chippewa and Superior National Forests. These plans were approved in July 2004. Thus, the Service has anticipated that this take would occur between July 2004 and July 2019. Thus far, only one incidental take may be ascribed to the Forest Service's implementations of these plans – a lynx was killed by an automobile in April 2005 on the Superior National Forest.

• 2005 - Trunk Highway 371 North, Federal Highway Administration – One over a 30-year period (2005-2035). Thus far, no take may be ascribed to this action. 2005 - Trunk Highway 1, Federal Highway Administration – Up to three lynx, over a 30-year period (2005-2035). Thus far, no take may be ascribed to this action.

• 2005 - Trunk Highway 53, Federal Highway Administration - Three lynx over the life of the project, a period of approximately 30 years from the start of project construction. Thus far, no take may be ascribed to this action.

• 2006 - Clean Water Act permit for the discharge of dredged or fill material into navigable waters by Northshore Mine, U.S. Army Corps of Engineers – One

lynx during the ten year project period (2006-2015). Thus far, no take may be ascribed to this action.

• 2007 – Paving of Forest Road (Denley Road), in St. Louis and Lake Counties, Minnesota, Superior National Forest - One lynx killed by a vehicle as frequently as once every 10 years, on the 10.4 miles of FR 424 to be reconstructed. Thus far, no take may be ascribed to this action.

• 2007 - Mittal Steel, Minorca Mine Inc. East Reserve Project, U.S. Army Corps of Engineers - One lynx killed by a vehicle once every 16 years in the action area. Thus far, no take may be ascribed to this action. Collectively, we anticipate that these actions would result in the take of approximately three lynx per year within their combined action areas in Minnesota. In addition, during the approximately seven years during which the Service has collected lynx mortality data in Minnesota it has recorded the deaths of 24 lynx due to human causes (one of these was anticipated by a biological opinion).

• 2009 – Mesabi Nugget, U.S. Environmental Protection Agency – One lynx killed by a vehicle during the 30-year project period. Thus far, no take may be ascribed to this action.

• 2011 – Continued Implementation of the Revised Superior National Forest Land and Resource Management Plan, U.S. Forest Service –One lynx per year over the life of the Forest Plan of ten years. Thus far, no take may be ascribed to the continued implementation of the Superior National Forest Plan.

Collectively, we anticipate that these actions would result in the take of approximately three lynx per year within their combined actions areas.

2.1.3.2. Northeast

As it did historically, the boreal forest of the Northeast currently exists primarily in Maine where habitat is currently optimal and a resident, breeding population of lynx occurs. Maine's lynx population is directly connected to substantive lynx populations and habitat in southeastern Quebec and New Brunswick, Canada. Lynx numbers in Maine apparently increased between 1999 and 2003, coinciding with regeneration of forest clearcut in the 1970's and 1980's and high numbers of lynx in nearby Quebec (Hoving et al. 2004). The potential exists for lynx to occur in New Hampshire because of its direct connectivity with Maine, and we presume they currently occur there. Lynx in Vermont have always existed solely as dispersers. Lynx occurring in New York since 1900 have been dispersers.

2.1.3.3. Northern Rocky Mountains/Cascades

In this region, the majority of lynx occurrences are associated at a broad scale with the "Rocky Mountain Conifer Forest." Within this type, most of the occurrences are in moist Douglas fir (*Pseudotsuga menziesii*) and western spruce/fir forests (McKelvey et al. in Ruggiero et al. 1999). Most of the lynx occurrences are in the 1,500-2,000 meters (4,920-6,560 feet) elevation class (McKelvey et al. in Ruggiero et al. 1999). These habitats are found in the Rocky Mountains of Montana, Idaho, eastern Washington, and Utah, the Wallowa Mountains and Blue Mountains of southeast Washington and northeastern Oregon, and the Cascade Mountains in Washington and Oregon. A substantial proportion of the verified lynx occurrences in the United States and confirmed breeding are from this region. The boreal forest of Washington, Montana, and Idaho is contiguous with that in adjacent British Columbia and Alberta, Canada.

The Northern Rocky Mountains/Cascades Region supports the most viable resident lynx populations in the contiguous United States, while recognizing that, at best, lynx in the contiguous United States are naturally rare. Strong evidence exists to support the presence of resident lynx populations distributed throughout much of the forest types considered lynx habitat in Montana and Washington. Resident lynx populations probably exist in contiguous habitats in Idaho and northwestern Wyoming. Lynx have probably always occurred intermittently in Oregon and Utah, although the historical or current presence of resident populations in either of these States has not been confirmed.

2.1.3.4. Southern Rocky Mountains

It is unclear whether lynx in this region historically occurred as a resident population or if historic records were of periodic dispersers. If a resident lynx population occurred historically in the Southern Rocky Mountains, then this native population has been lost. Isolation from potential source populations may have led to the extirpation of lynx in this region. Although habitats in the Southern Rockies are far from source populations and more isolated, it is still possible that dispersers could arrive in the Southern Rocky Mountains during highs in the population cycle.

From 1999 through 2006, the Colorado Division of Wildlife (CDOW) reintroduced 218 lynx from Canada and Alaska into southwestern Colorado (Shenk 2009). No lynx were released in 2007, 2008 or 2009. As of August 2009, CDOW was tracking 37 of the released animals and had confirmed 118 mortalities (Shenk 2009). Reproduction was first documented in 2003 when six dens and a total of 16 kittens were found in southwestern Colorado. A total of 42 dens were found during 2003-2009 surveys. No dens were found in 2007 or 2008. All of the dens have been scattered throughout the high elevation areas of Colorado, except one den which was found in southeastern Wyoming in 2004 (Shenk 2006, 2009).

3. Analysis of the Species Likely to be Affected

The Superior National Forest has concluded that the proposed action may affect and is likely to adversely affect Canada lynx. We concur with that determination.

4. Environmental Baseline

The environmental baseline is defined as the impacts from federal, state or private actions and other human or natural activities in the action area, the anticipated impacts from all federal projects in the action area that have already undergone formal or early section 7 consultation, and the impacts of state or private actions that are contemporaneous with the consultation in process.

4.1. Status of the Species in the Action Area

4.1.1. Canada lynx

As was true historically, northeastern Minnesota supports a substantial amount of boreal forest (roughly estimated at 4,800 miles^2) (Great Lakes Ecological Assessment, in litt., undated). In Minnesota, the deepest snows occur in the northeast corner of the state (Minnesota DNR, http://climate.umn.edu/doc/snowmap.htm). Unlike elsewhere within the Great Lakes and northeast regions, most lynx habitat in northeastern Minnesota is on public lands, particularly on the Superior National Forest.

Lynx persist throughout the proposed action area. The Superior National Forest maintains a database to document the genetically confirmed Canada lynx within Minnesota, which includes samples from the Forest's survey and monitoring program and other studies (Catton & Loch 2011). Of the 656 samples in the database, 124 are individual lynx genotypes (56 males, 67 females and one undetermined) and 17 are individual hybrids (11 unique genotypes; three females and eight males) (Catton & Loch 2011). Lynx were detected in more than 10 counties. However, the majority of the lynx were detected in St. Louis, Lake and Cook Counties, where most of the data collection effort has been focused (Catton & Loch 2011). The Minnesota Department of Natural Resources (DNR) summarized all reports of Canada lynx observations in Minnesota reported to the DNR since the species received federal threatened status in March 2000 through November 11, 2006 (Figure 3). Over that time, the DNR received 426 reports; 63 (15 percent) reports have been verified as lynx.

It is difficult to estimate the abundance of highly mobile species that are rare and present at low densities. Assuming that about 25 percent of northeast Minnesota is suitable lynx habitat, coupled with assumptions about residence time and detectability, Moen et al. (2008b) estimated the number of lynx that

might be resident in northeastern Minnesota at a given time at between 190 and 250 individuals. Recent research supports the hypothesis that lynx can persist without immigration, based on reproductive rates of females, movement rates and the distribution of potential denning habitat in northeastern Minnesota (Moen et al. 2008a; Moen et al. 2004; Moen et al. 2008b).

Snowshoe hare harvest in Minnesota (the only available long-term index to hare abundance in the state) shows a very inconsistent pattern from 1941 - 2000. Hare abundance, as indicated by harvest, peaked in the early 1940s and 1950s along with lynx harvest but not in the early 1950s or 1960s. In contrast, hare harvest was double any previous year from 1977 - 1980, yet lynx did not increase. Hares remained at relatively low densities through the 1990s (S. Loch, in litt. 2003). Based on surveys in northern Minnesota, snowshoe hare numbers are currently high (Erb 2009).

Unlike other Great Lakes and northeast regions of lynx range in the Unites States, most lynx habitat in northeastern Minnesota is on public lands, particularly the Superior and Chippewa National Forests. Mixed deciduous-boreal forest suitable for lynx habitat encompasses most of the Forests, which have been mapped into LAUs to promote lynx management under the LCAS. Currently, the majority of LAUs provide much more than minimum requirements for suitable habitat (Table 1). Approximately 62 percent of land in LAUs on the Superior National Forest is owned by the Forest Service; the remainder is owned by state, county, and private landowners (USDA Forest Service 2011c). Recent observations of lynx on or near the Chippewa (Moen et al. 2006) and Superior National Forests (Moen et al. 2008a; Moen et al. 2008b; Moen et al. 2010) indicate that lynx are present on these Forests at this time. The Superior National Forest has designated critical habitat; the Chippewa Forest does not.

Table 1. Current (2010) condition of LAUs on the Superior National Forest (Forest Service 2011). Percentages indicate the extent of suitable prey and denning habitat and unsuitable lynx habitat for all LAUs.

	Average LAU Size (acres)	Snowshoe Hare Habitat (acres)	Lynx Denning Habitat (acres)	Unsuitable Habitat (acres)
Superior National Forest	42,910	789,963 (61.6%)	549,507 (48.3%)	29,600 (2.2%)

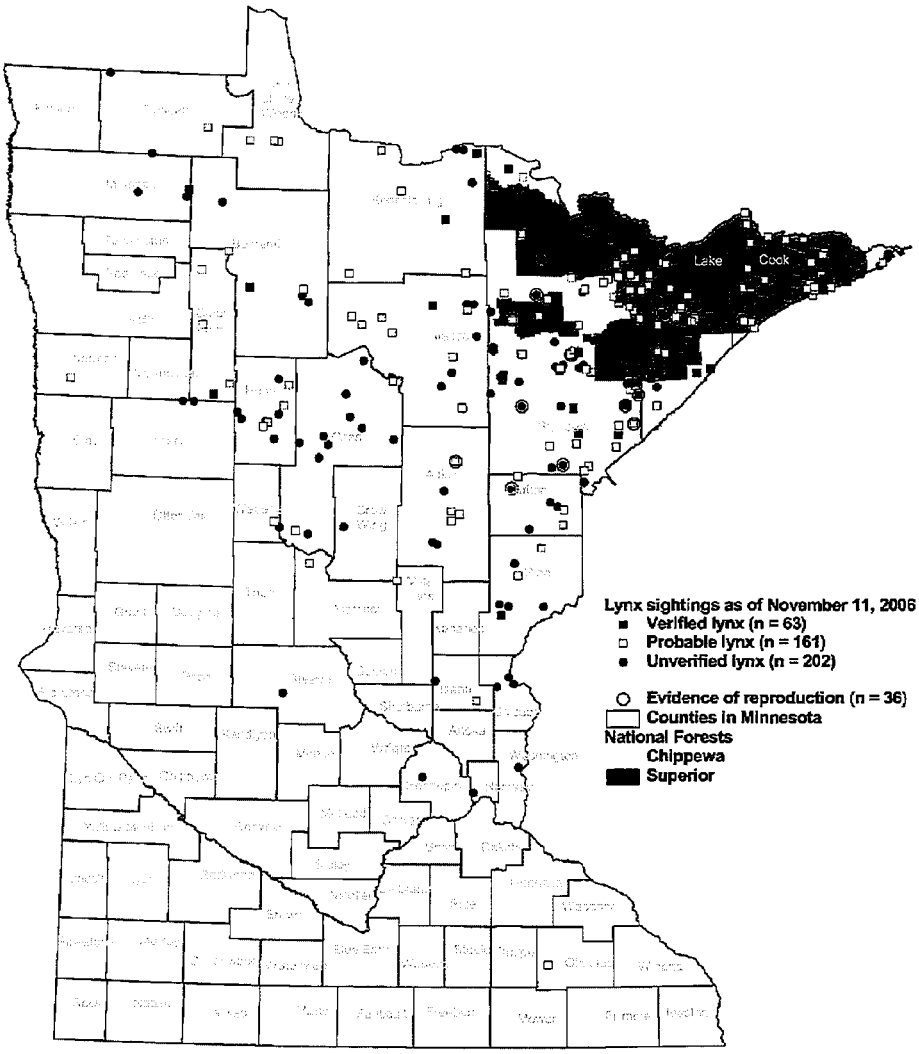

Figure 3. Lynx records in the Minnesota Department of Natural Resources' (MNDNR) database collected between March 2000 and November 11, 2006. MNDNR no longer maintains this database. MNDNR used the following criteria to determine whether to describe a record as "verified": a photo showing distinguishing characteristics was provided; conclusive behavioral observations were provided (e.g., lynx demonstrate curiosity and little fear of humans while bobcats are very secretive and elusive); DNA analysis of a tissue sample confirmed the identification; the observer is a known expert or otherwise has considerable experience with lynx; a detailed description of physical characteristics (e.g. very big feet, long hind legs, flat face, black tip of tail, etc.) was provided.

4.2. Factors Affecting Species in the Action Area

4.2.1. Canada lynx

In the LCAS, the Lynx Biology Team identified potential risk factors to lynx that are within the authority and jurisdiction of the federal land management agencies. Because effects to lynx are closely tied to habitat, most of the identified risks to lynx are also potential risks to lynx critical habitat. These risk factors include management of timber, wildland or prescribed fire, recreation, roads and trails, grazing and other human developments such as agriculture. Risk factors that have recently become more pervasive include climate change, oil and gas leasing, mining exploration and other mining activities. Roads, railroads, utility corridors, land ownership patterns and developments may affect lynx movements. Risks of direct lynx mortality may come from trapping, shooting, predator control, vehicle collisions and competition or predation as influenced by human activities. Other large-scale risk factors to lynx and lynx critical habitat are fragmentation and degradation of lynx habitat – for example, from non-native invasive plant species invasions, climate change or changes in land ownership. Each of these potential risk factors may occur in the action area except livestock grazing; predator control is unlikely. Timber management, wildland fire, recreational use, roads and trails and developments on private land inholdings are most likely to affect lynx in this area.

Road access to Canada lynx habitat increases the likelihood of human-related adverse effects, simply by increasing the number of humans present in the area. Human-related causes were confirmed for five of 11 lynx deaths in Minnesota among radio- and GPS-collared lynx in a recent study (trapping (2), automobile (1), shooting (1) and train (1) [Moen et al. 2008]). Of the remaining six, four died of unknown causes with suspected human involvement (Moen et al. 2008). Six additional lynx deaths have been confirmed in Minnesota due to collisions with vehicles on roads since the species was listed as threatened in 2000 (USFWS, Twin Cities Field Office, Bloomington, MN, unpubl. data). These deaths have occurred on a wide variety of roads with average daily traffic volume ranging from 19 to 19400 vehicles per day (USFWS, Twin Cities Field Office, Bloomington, MN, unpubl. data). There have been three documented lynx road mortalities on the Superior National Forest between 2001 and 2011. These mortalities took place on the Cook County Highway 12 (Gunflint Trail), Forest Road 172 and MN Trunk Highway 61 (USFWS, Twin Cities Field Office, Bloomington, MN, unpubl. data). In Maine, 22 lynx were struck and killed by vehicles between 2000 and 2009. Approximately 16 of these deaths occurred on logging roads and sixoccurred on state paved highways. Most mortality on logging roads were on 2-lane dirt haul roads that are open to the public and used frequently by the public (Mark McCollough, USFWS, Maine Field Office, Orono, ME, pers. comm. 2009). In Colorado, nine lynx deaths due to vehicle collisions have been recorded since 1999 (five other lynx from Colorado were

killed in adjacent states, K. Broderdorp et al., USFWS, *in litt.* 2006, Shenk, *in litt.* 2008). As in Minnesota, estimated traffic volumes vary widely among roadkill locations, from 480 to 27,600 vehicles per day.

Lynx populations characteristically fluctuate during approximately 10-year cycles in response to changes in numbers of their primary prey, snowshoe hare. Hare numbers may have begun to decline in Minnesota in 2004 (Erb & Benson 2004). In addition, lynx numbers in Minnesota may peak three years after harvest levels in nearby Canadian provinces. Lynx harvest in Manitoba and Ontario may have reached a peak during the winter of 2002-2003 (McKelvey et al. 2006). Thus, reduced prey densities and reduced movement of lynx from Canada may soon affect lynx densities in the action area. This would likely be followed, however, by a cyclic increase in about ten years.

Roads are a factor in human-caused lynx mortality where they provide access to areas where lynx occur, increasing the risk of negative interactions between people and lynx. Throughout the Forest outside the BWCAW, high and low standard roads bisect many areas that provide potential or suitable lynx habitat. Paved roads have been a mortality factor in lynx translocation efforts within historical lynx range. Other than translocated animals, there has been one documented occurrence of highway mortality in Wisconsin (Thiel 1985). In Minnesota since 2000, there have been three apparent highway mortalities (U.S. Fish and Wildlife Service, unpubl. data). Two additional mortalities have occurred on secondary roads and one death has occurred on a Superior National Forest road (U.S. Fish and Wildlife Service, unpubl. data). Two other mortalities documented in Minnesota can be attributed to railroads (U.S. Fish and Wildlife Service, unpubl. data).

The draft Hard Rock Prospecting Project EIS proposes the potential to add up to a maximum of 860 miles of temporary SUP roads over its 20-year implementation (USDA Forest Service 2011b). Temporary roads in mineral exploration projects may stay open for more years (1-15 years) than those predicted by the Forest Plan EIS for resource management (1-5 years). If these sites are left accessible to the public, then human-lynx conflicts may increase. Furthermore, intersections of new roads, closed temporary roads and/or roads open to the public are likely to become parking areas, which would indirectly increase public access. Further, these corridors increase potential competition through increased snow compaction. Effective road closures may reduce the potential effects to lynx and lynx critical habitat.

Single, rare mortality events could be significant when lynx numbers are low. In Minnesota, lynx trapping is no longer legal, though lynx are vulnerable to legal trapping for other mammals. Since 2000, there have been at least 19 documented incidents of trapped lynx in Minnesota, and of these at least nine are known to have died (U.S. Fish and Wildlife Service, unpubl. data). Additionally, six lynx have been documented as shot and killed in Minnesota; two of these mortalities

were within the Superior National Forest proclamation (U.S. Fish and Wildlife Service, unpubl. data). Four lynx that were radio-collared in Minnesota have been legally trapped and killed in Canada since 2000 and two died of unknown causes (U.S. Fish and Wildlife Service, unpubl. data).

The Superior National Forest is currently implementing the 2004 Forest Plan, which has direction based on the LCAS and Canada Lynx Conservation Agreement (CA) between the Forest Service and the Service (2000), for all forest activities that occur within LAUs. Thus, the aforementioned risk factors are being minimized and managed to promote the conservation of lynx within the Superior National Forest.

There are areas within designated critical habitat which were not mapped as LAU areas. Approximately 73,976 acres of Superior National Forest lands are outside LAUs but within designated critical habitat (USDA 2011). These areas were not included in the LAU development, primarily because of the mixed ownership patterns (USDA 2000). For actions that occur on Forest land that is not part of a LAU, the Forest still follows Forest Plan direction; however, there is no clear way to measure lynx indicator thresholds.

5. Effects of the Proposed Action

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the actions, that will be added to the environmental baseline" (50 CFR §402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Direct effects result from the agency action, including the effects of interrelated and interdependent actions. Indirect effects are caused by or result from the agency action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the immediate footprint of the project area, but would occur within the action area as defined.

5.1. Effects of Interrelated or Interdependent Actions

Interrelated actions are those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the proposed action. We could identify no actions that are interrelated or interdependent to the proposed project.

We considered the notion that future mining activities may occur following minerals prospecting. Under 50 CFR §402.14(k), an opportunity for incremental review exists when an activity is "authorized by a statute that allows the agency to take incremental steps toward the completion of the action." We understand that no extraction or development activity may occur prior to additional future

Forest Service action, predicated by any necessary additional Section 7 consultation.

5.1.1. Canada lynx

Geophysical Exploration

Up to 96 ground disturbing geophysical surveys may occur over the 20 years of operations (one per propecting permit). Surveys are likely completed in a grid with geophysical baselines up to 2 miles long with one mile perpendicular cross wing or grid lines spaced along the baseline at 500 to 1000 foot intervals. Each proposal may include up to twenty-two miles of cleared lines, three to six feet wide, for a maximum of 16 acres. This amounts to a maximum of 1,536 acres of vegetation clearing over the 20-year duration of the project, with an average of 76.8 acres per year. Most of the vegetation clearing would occur between years one and seven of the proposed project. Vegetation typically grows into the cut lines within 2 years (USDA Forest Service 2011a). The geophysical surveys may affect the shrub and herbaceous layers for several years, but would not change the forest canopy structure. This disturbance is not expected to appreciably change the habitat types and ages in the Forest (USDA Forest Service 2011a). Most LAUs currently have well below 30 percent unsuitable habitat under all ownerships, which is in compliance with Forest Plan Guidance (G-WL-3). Only LAU 24 comes close to the 30 percent limit, with 29.3 percent unsuitable habitat, due to the effects of the recent Pagami Creek Fire (USDA Forest Service 2011a). The amount of unsuitable habitat is not expected to change significantly in the foreseeable future.

Currently, each LAU provides well over 10 percent suitable denning habitat in patches over 5 acres, which is in compliance with Forest Plan guidance (G-WL-4). Denning habitat is well distributed across the project area (USDA Forest Service 2011a). Lynx habitat connectivity, measured by upland forest greater than four years old and lowland forest greater than nine years old, is above 60 percent (USDA Forest Service 2011a) and therefore in compliance with Forest Plan objectives (O-WL-11).

All LAUs containing current permit applications in the project area are in compliance with Forest Plan standard (S-WL-1), which states that management activities on NFS lands shall not change more than 15 percent of lynx habitat on NFS lands within an LAU to an unsuitable condition within a 10 year period (USDA Forest Service 2011a). All LAUs containing future permit applications, except LAU 2 and LAU 4, meet this standard; however it is unlikely that the amount of unsuitable habitat in LAU 2 and 4 will increase with this project since they are in areas of low mineral interest (USDA Forest Service 2011a).

Because the ground disturbance proposed with this project is in compliance with provisions set forth in the Forest Plan that were adapted from the Lynx Conservation Assessment and Strategy we conclude that the geophysical survey

ground disturbance will not significantly alter lynx or snowshoe hare habitat availability. Therefore, habitat loss due to ground disturbing geophysical surveys is unlikely to adversely affect Canada lynx in the project area.

Drilling

The operating plan near Bogberry Lake has the most concentrated pattern of drill sites proposed in the current operating plans, with 38 preliminary and definition drill sites arranged across three square miles. It is unlikely that a higher concentration of drill sites would occur with the proposed project. The concentration of drill sites at Bogberry Lake was applied across the project area to determine the maximum area of habitat that may be affected in high or moderate mineral interest areas.

Each drill pad will affect 0.23 acres. Thirty-eight drill pads multiplied by 0.23 acres equals 8.72 acres of habitat. Divide 8.72 acres by three square miles (1920 acres) to get 0.0045 acres, or 0.45 percent (round up to 0.5 percent) of disturbance per square mile. Therefore, it was estimated that a maximum of 0.5 percent of existing habitat for any given square mile of the proposed project would be disturbed (USDA Forest Service 2011a). LAUs with low mineral interest would have fewer acres of disturbance, but the same disturbance level was applied to all LAUs for the Forest BA effects analysis (USDA Forest Service 2011a).

The Forest estimated that drill pad disturbance will average 1.9 to 15.4 acres per year for 20 years. The total disturbance for 192 operating plans would amount to an average disturbance of 38.4 to 307.2 acres over the 20 life of the project (USDA Forest Service 2011b, p. 40).

The drilling activities of the proposed project will not result in significant denning habitat loss. Denning habitat in patches over five acres ranges from 28.2 percent to 74.7 percent on Superior National Forest land in all Lynx Analysis Units (LAU), which is well above the ten percent Forest Plan guideline G-WL-4 (USDA 2004). Denning habitat will remain above ten percent in all LAUs.

The amount of unsuitable habitat for snowshoe hare is below 30 percent in each LAU and management activities on National Forest lands will not change more than 15 percent of the lynx habitat within each LAU to an unsuitable condition within a 10-year period. This standard (S-WL-1) may be exceeded in LAU 2 and LAU 4. However, it is improbable since LAUs 2 and 4 are in areas of low mineral interest and are unlikely to have permit requests in the near future. Future permit applications in LAUs 2 and 4 would be analyzed to determine if this standard will be met at that time.

Because the drilling proposed with this project is in compliance with provisions set forth in the Forest Plan that were adapted from the Lynx Conservation

Assessment and Strategy, we conclude that the drilling will not significantly alter lynx or snowshoe hare habitat availability. Therefore, habitat loss due to drilling activities is unlikely to adversely affect Canada lynx in the project area.

Temporary Roads

Between 523 and 860 miles of temporary roads will be in use at any one time over the duration of the project across all effected LAUs. Over the 20-year life of the project, an estimated 480 miles of pre-existing old temporary road beds will be used and 384 miles of new temporary roads will be created. Temporary road use in any year of the 20-year life of the proposed project will remain below 95 percent of the miles of temporary roads predicted by the Forest Plan (USDA 2004).

The proposed project may increase snow compaction on temporary roads during operations; however, snow compacting activities would be short term. Temporary road use would be greatest during years 2 through 8 of this proposed project and may last longer than typical temporary roads in the Forest. All temporary roads will be effectively closed after project completion, however. Road and snow-compacted trail density will not change under the proposed project.

Because the temporary road use proposed with this project is in compliance with provisions set forth in the Forest Plan that were adapted from the Lynx Conservation Assessment and Strategy, we conclude that the use of temporary roads will not significantly increase snow compaction over the long term. Therefore, snow compaction due to temporary road usage is unlikely to adversely affect Canada lynx in the project area.

Increased Traffic Volume

The proposed action will increase the likelihood of direct mortality by vehicle collision on the existing roads throughout seven LAUs (LAU 7, 9, 10, 11, 18, 19 and 20) in the Superior National Forest, except in the Boundary Waters Canoe Area Wilderness (BWCAW). Daily traffic volume would vary by year and by road (Forest Service BA 2011). The highest traffic volume is expected four years after the Environmental Impact Statement decision date. Daily traffic volume is likely to be highest in any year during dry conditions and the summer season.

Some of the traffic from drilling rigs will be similar to traffic associated with logging activities and will consist of one to several heavy commercial vehicles that remain stationary in one location during operations. Daily traffic to drill sites is estimated to include ten trips to transport fuel, supplies, water, employees and drill cores (Wirz 2012). The Forest estimated that up to ten drill sites will be active at any one time during the 20-year life of the project (Forest Service DEIS, p. 38). This would equate to an increase of 100 vehicles per day dispersed throughout 2 to 10 LAUs (LAU 7, 9, 10, 11, 18, 19 and 20) at any one

time. Many of these vehicles would congregate on main arterial connecting roads and highways as they head towards Ely, Babbitt or other destinations. Traffic volume will most likely increase near areas of high mineral interest.

State Trunk Highway 1, State Trunk Highway 1/169, St. Louis County Highway 623/ Forest Road 424 and Forest Road 377, which serve the Tomahawk area and lands south of Birch Lake, are likely to be used by the proposed project vehicles because of their proximity to high mineral interest areas (USDA Forest Service 2011a, 2012). The Forest estimated that all (100 percent) of the traffic to Virginia, Minnesota, would move on Highway 1 south of Ely, Minnesota, and that 75 percent of that traffic would travel to and from Virginia on Highway 1/169. Most of the remaining traffic from Highway 1 would travel west to Virginia through Babbitt via Forest Road 424/ St. Louis County Highway 623. Forest Road 377 may also receive increased traffic from the proposed project (M. Grover, pers. comm., January 20, 2012).

Surveys completed between 1995 and 2000 show that the two main Forest Roads serving the high mineral interest areas (FR 424 and 377) have relatively low daily traffic volumes (USFS 2011b). Denley Road (Forest Road 424) and Tomahawk Road (Forest Road 377) had average daily traffic volume of 119 and 42 vehicles per day, respectively. Daily traffic volume fluctuated by year. For instance, the range of daily traffic volume on Tomahawk Road ranged from 21 vehicles per day in 1998 to 65 vehicles per day 1996. Minnesota Department of Transportation (MN DOT) data from 2010 gives an average of 119 vehicles per day on Forest Road 424 (M. Grover, pers. comm. January 20, 2012).

Twelve miles of Forest Road 377 are likely to see an increase in traffic from the proposed project. An increase of 25 vehicles per day of Forest Road 377 would increase traffic volume to 67 vehicles per day on the 12-mile stretch (Table 2).

Similarly, 16 miles of Forest Road424/St. Louis County Highway 623 are likely to see increased traffic from the proposed project (M. Grover, pers. comm., January 20, 2012). Based on the average traffic volume estimations, an additional 25 vehicles per day would increase traffic to 144 vehicles per day. However, traffic projections for Forest Road 424 due to recent improvements to Denley Road are estimated to increase traffic to about 400 vehicles/day (U.S. Fish and Wildlife Service 2006). We have already consulted on the traffic increase that may occur with the Denley Road, project (U.S. Fish and Wildlife Service 2006), however, the Forest believes an increase to 400 vehicles a day is unlikely since there are no definitive plans to pave the road in the foreseeable future (M. Grover, pers. comm. February 3, 2012). For the purpose of this analysis, and to avoid duplicating take estimates, we will use the MN DOT 2010 data (119 vehicles/day, Table 2).

Daily traffic volume data for MN Trunk Highway 1 (recorded 0.1 mile north of the Tomahawk Road) shows 395 vehicles per day (MN DOT 2010). The 2004

Biological Evaluation for Highway 1 reconstruction enumerated 420 vehicles per day (MN DOT 2004). The traffic reporting station closest to the high mineral interest north of Silver Bay shows less than 300 vehicles per day for the months of December through April, which gradually increases to a maximum of approximately 600 vehicles per day in August (MN DOT 2011). The 39-mile stretch of Highway 1 south of Ely, Minnesota, which is most likely to see an increased traffic from the proposed project, has an average of 578 vehicles per day. Since it was estimated that all (100 percent) of the traffic to Virginia, Minnesota, would move on Highway 1 south of Ely, Minnesota, an increase in traffic volume by 100 vehicles per day will bring that average to 678 vehicles per day on the 39-mile stretch of road (Table 3).

Two miles of Highway 1/169, west of Ely, Minnesota, are likely to see increased traffic from the proposed project. This two-mile stretch averages 2,635 vehicles per day (M. Grover, pers. comm., January 20, 2012). An increase in 75 vehicles per day would increase the traffic volume to 2,710 vehicles per day (Table 3).

Numerous assumptions would have to be made to estimate the number of lynx that would likely be hit by vehicles as a result of the traffic on existing roads. Road mortalities of gray wolves have been extensively studied in Wisconsin (Kohn et al. 2000). For lynx, we do not have a study like that (Kohn et al. 2000) on which to base an estimate of the quantitative impact. Therefore, we will assume that lynx are equally susceptible to being taken by vehicles as are wolves and that the factors considered for wolves will also determine the likely number of lynx taken, although we will use a different basis for estimating lynx density in the action area.

To estimate the number and frequency of lynx-vehicle collisions as a result of the mine-related traffic on the existing roads, we will use the results of a study of wolves in Wisconsin (i.e., Kohn et al. 2000). In that study, three wolves were confirmed dead from automobile collisions in a 44-mile length of U.S. Highway 53 during a seven-year study period (Kohn et al. 2000)– i.e., approximately 0.01 wolf/mile/year. Even intensive studies, such as this one, may not document all road-related mortality within the study area (Clarke et al. 1998). In the Wisconsin study (Kohn et al. 2000), the likelihood of detecting wolf-automobile collisions during the winter was probably high because a biologist drove the road every day looking for signs of wolves crossing the road, but the likelihood of detecting incidents during summer was probably low (E. Anderson, University of Wisconsin – Stevens Point, pers. comm. 11/29/06). We will extrapolate that Kohn et al. (2000) documented 50 percent of the wolf mortalities due to automobile collision on Highway 53 during their study – i.e., that actual mortality was 0.02 wolf/mile/year.

Traffic volume on Highway 53 was 4700 vehicles/day (Kohn et al. 2000), whereas traffic volume on Forest Road 424/St. Louis County Highway 623 will be 144 vehicles/day and Forest Road 377 will be 67 vehicles/day (USDA Forest

Service 2011a). To estimate the frequency of lynx deaths due to automobile collisions on Forest Road 424/St. Louis County Highway 623 and Forest Road 377, we will utilize the following assumptions:

1. The probability of death due to automobile collision is likely to be proportional to traffic volume;
2. Traffic volume on Forest Road 424/St. Louis County Highway 623 will be 144 vehicles/day and Forest Road 377 will be 67 vehicles/day;
3. Posted speed limits will approximate those on Highway 53 during the study described above; and,
4. The likelihood of lynx mortality can be expected to be directly proportional to lynx density in the vicinity of the roads, which will approximate those summarized by Moen et al. (2006), approximately 0.3 lynx per sq. km.

To estimate lynx density in the project area, we assumed that there are approximately 1.3 females per male home range, based on weighted mean home ranges of 87 sq. km for males and 68 sq. km for females [studies summarized by Moen et al. (2006)] and assuming continuous and non-overlapping home ranges among males and females, respectively.[3] Therefore, we assume that there are 2.3 lynx per 87 sq. km (i.e., 1 male and 1.3 females in each male home range) – approximately 0.03 lynx/sq. km (0.01158 lynx/mi). Although data are insufficient to estimate lynx density in the action area, this is likely a reasonable estimate. Lynx densities in the southern boreal forest (e.g., Minnesota) are similar to those found in the taiga (the core of lynx range) during times of hare scarcity (i.e., "less than 3 lynx/100 km^2," Mowat et al. 2000). For example, a well-studied population in Washington maintained a density of 0.02-0.026/km^2 during a 7-year study period (Aubry et al. 2000).

We would predict greater densities in the action area if we assumed some degree of overlap among female home ranges, as has been demonstrated (Carbyn & Patriquin 1983; Mech 1980). It is unclear, however, what degree of overlap is likely to occur in the action area and even in regions where some lynx home ranges overlap there are likely some areas not included within any lynx's home range (i.e., unoccupied habitat). Therefore, our assumption of continuous home ranges would somewhat offset the negative influence on the predicted density resulting from our assumption of non-overlapping home ranges.

Anticipated take is based on Wisconsin study mortality rate of 0.02 wolves/mi/yr (Kohn et al. 2000). This mortality rate was divided by the proportional difference in daily traffic volume (e.g., 4700 vehicles from WI study/ 67 vehicles for Forest Road 377 = 70.15, Table 2) and then multiplied by 1.93 (0.02 lynx per sq. mi. for action area/0.006 wolves per sq mi for WI study) to account for higher densities of wolves in the action area (NE Minnesota) than

[3] We could have used the home ranges found thus far for lynx in Minnesota, but the sample size is relatively low (i.e., two females – Moen et al. 2006).

in the Wisconsin study. This gave us the mortality rate for each portion of road effected by the proposed project (e.g. for Forest Road 377, 0.0006 lynx/mi/year). Multiply mortality rate by number of miles of road expected to be used in any year of the proposed project to get the estimated number of lynx taken per year (e.g. for Forest Road 377; 0.007 lynx/year). We did this calculation separately for each Forest road segment to be affected by the increased traffic (16 miles of Forest Road 424/St. Louis County Road 623, and 12 miles of Forest Road 377 [Table 2]).

Based on the above assumptions regarding traffic volume, susceptibility to vehicle collisions, traffic speeds, lynx densities, and current likelihood of vehicle collisions, we estimate that the proposed action will result in less than one lynx taken by a vehicle on both Forest road segments every year. Specific take estimates for Forest Road 424/St. Louis County Road 623 and Forest Road 377 were 0.019 lynx per year and 0.007 lynx per year, respectively. This equates to one lynx every 51.8 years on Forest Road 424/St. Louis County Road 623 and one lynx every 151.4 years on Forest Road 377. The expected life of the project is approximately 20 years, which gives an estimate of less than one lynx per Forest road segment (0.378 lynx/20 yrs. on Forest Road 424, 0.132 lynx/20 yrs. on Forest Road 377) taken during that time period. Since these estimates are well below one lynx over the life of the project, we have determined that the take on Forest Road 424/St. Louis County Road 623 and Forest Road 377 due to the proposed project will have a negligible impact on the species.

Since most of the traffic volume on State Highway 1 and Highway 1/169 cannot be attributed to this proposed project, we calculated the likelihoods of lynx mortality on each road using both the baseline average traffic volumes and the projected traffic volumes (i.e., baseline averages plus the estimated increase in traffic with the proposed project). We then compared our results to determine if the increase of traffic will significantly increase the likelihood of lynx take on each road segment. We defined a significant increase in lynx take as one lynx over the 20 year life of the project for each segment of road.

Traffic volume on Highway 53 was 4700 vehicles/day (Kohn et al. 2000), whereas traffic volume on State Highway 1 will increase from 578 vehicles/day to 678 vehicles/day and traffic volume on State Highway 1/169 will increase from 2635 vehicles/day to 2710 vehicles/day (USDA Forest Service 2011a). To estimate the frequency of lynx deaths due to automobile collisions on State Highway 1 and State Highway 1/169, we will utilize the following assumptions:

1. The probability of death due to automobile collision is likely to be proportional to traffic volume;
2. Baseline traffic volume on State Highway 1 is 578 vehicles/day and 2635 vehicles/day on State Highway 1/169;

3. Traffic volume on State Highway 1 will increase by 100 vehicles/day, to 678 vehicles/day and traffic volume on State Highway 1/169 will increase by 75 vehicles/day, to 2710 vehicles/day;
4. Posted speed limits will approximate those on Highway 53 during the study described above; and,
5. The likelihood of lynx mortality can be expected to be directly proportional to lynx density in the vicinity of the roads, which will approximate those summarized by Moen et al. (2006), approximately 0.3 lynx per sq. km.

Using the same rationale and formulas as above, we calculated the baseline mortality rate for each State Highway segment to be affected by the increased traffic: 39 miles of State Highway 1, two miles of State Highways 1/169, and 12 miles of Forest Road 377 (Table 3). We then calculated the mortality rates based on the expected increase in traffic volume (Table 3).

The estimated mortality rate using the baseline traffic volume of 578 vehicles/day for State Highway 1 is 0.0047 lynx/mi./day. Multiply the mortality rate by the 39 of miles of road expected to be used in any year of the proposed project to get an estimated 0.185 lynx taken per year. This equates to 3.70 lynx over the 20-year life of the project for the 39 mile stretch of Highway 1. To see if that estimate would increase significantly with the proposed increase in traffic, we made the same calculations using the projected increased traffic volume. An increase in traffic volume of 100 vehicles/day for State Highway 1, would increase the traffic volume to 678 vehicles/day, which would increase the mortality rate to 0.0056 lynx/mi./day. Multiply the mortality rate by 39 miles of road to get an estimated 0.217 lynx taken per year. This equates to 4.34 lynx over the 20-year life of the project for the 39 mile stretch of Highway 1. Therefore, the likelihood of lynx take per year increased by 3.2 percent per year (0.217-0.185 = 0.032 lynx/yr.). Subtract the number of lynx estimated to be taken over the life of the project of baseline traffic from the proposed traffic, to get an estimated difference of approximately one lynx (4.34 - 3.70 = 0.64 lynx/20yr., rounded up to one). Therefore, the proposed increase in traffic volume on the 39 mile stretch of Highway 1 would increase the likelihood of take by one lynx over the life of the project. The probability of lynx getting hit by vehicles on the roads within the project area will likely vary in proportion to lynx density throughout their 10-year fluctuating population cycle.

Similarly, we calculated the baseline and projected mortality rates on the two miles of State Highway 1/169 likely to see an increase in traffic due to the proposed project. The baseline traffic volume of 2635 vehicles/day for State Highway 1/169 gives a mortality rate of 0.0216 lynx/mi./day. If we multiply the mortality rate by the two of miles of road expected to be used in any year of the proposed project we get an estimated 0.043 lynx taken per year. This equates to 0.866 lynx over the 20-year life of the project for the two-mile stretch of State Highway 1/169. To see if that estimate would increase significantly with the

proposed increase in traffic, we made the same calculations using the projected increased traffic volume. An increase in traffic volume of 75 vehicles/day for State Highway 1/169 would increase the traffic volume to 2710 vehicles/day, which would increase the mortality rate to 0.0223 lynx/mi./day. Multiply the mortality rate by two miles of road to get an estimated 0.045 lynx taken per year. This equates to 0.890 lynx over the 20-year life of the project for the two-mile stretch of State Highway 1/169. The likelihood of lynx take per year increased by 0.2 percent per year (0.045-0.043 = 0.002 lynx/yr.). Subtract the number of lynx estimated to be taken over the life of the project of baseline traffic from the proposed traffic, to get an estimated difference of less than one lynx (0.890-0.866 = 0.024 lynx/20 years). Therefore, the proposed increase in traffic volume on the two mile stretch of State Highway 1/169 would not significantly increase the likelihood of take over the life of the project.

Based on the above assumptions regarding traffic volume, susceptibility to vehicle collisions, traffic speeds, lynx densities, and current likelihood of vehicle collisions, we estimate that the proposed action will result in approximately one lynx taken over the 20-year life of the project.

Data are currently insufficient to accurately estimate lynx densities in Minnesota, but the assumptions used above to arrive at an estimate of one dead lynx every 20 years also allow us to estimate the proportional impact to the lynx population. To estimate lynx density at 0.03/km^2 (0.01158/mi^2) in the action area, we assumed that lynx home ranges were continuous and non-overlapping within sexes – that is, female home ranges did not overlap with other female home ranges and were continuous across the landscape – we assumed the same for males. Lynx Analysis Units (LAU) and the Boundary Waters Lynx Refugium (BWLR) cover approximately 12,700 km^2 and represent the approximate area occupied by lynx in and around the Superior National Forest. For the purposes of this analysis, we will assume that this is the approximate area occupied by lynx in Minnesota. There are areas within LAUs that are unsuitable for lynx, but lynx also occur in Minnesota beyond the area contained within LAUs and the BWLR (including the action area), therefore, this may be a fair approximation of total lynx range in Minnesota. If lynx occur throughout the area contained within LAUs and the BWLR at a density of 0.03/km^2, then there are approximately 381 lynx in this area. One lynx would represent a 0.26 percent of the lynx population in Minnesota. If one lynx is killed every 20 years, this would represent an approximate loss of 0.26 percent of the lynx population in the state. As stated above, lynx abundance likely varies greatly over an approximately 10-year cycle. Therefore, the loss of one lynx would affect have a greater proportional effect during low phases of the cycle. Low lynx densities during this period, however, would also proportionately lower the likelihood of a lynx getting hit by a vehicle on the project area roads. Thus, the loss of one lynx during the 20-year life of this project is not likely to have an appreciable effect on the Canada lynx.

Table 2: Estimated lynx road mortality by Forest Road segment for the Hardrock Minerals Prospecting Permits. Average traffic volume, expected increase in traffic volume, traffic volume estimated with the proposed project, traffic volume proportional to the Wisconsin wolf study (Kohn et al. 2000), mortality rate, length of each road segment likely to be effected by the proposed project, estimated road mortalities (take) per year, estimated take over the 20-year life of the project and the estimated time for one lynx to be taken per road.

Road Name	Traffic Volume (vehicles/day)	Expected Increase in Traffic Volume (vehicles/day)	Traffic Volume (vehicles/day)	Proportional Traffic Volume (vehicles/day)	Mortality Rate (lynx/mi/yr.)	Road Segment Length (mi.)	Estimated Take (lynx/yr.)	Est. Take over Life of Project (20yrs.)	Est. Time to Take One Lynx (yrs.)
FR 424/ Hwy 623	119	25	144	32.64	0.001183	16	0.019	0.378	52.8
FR 377	42	25	67	70.15	0.000550	12	0.007	0.132	151.4

Table 3: Estimated lynx mortality on State Highways 1 and 1/169 using both the baseline traffic volumes and the projected project traffic volumes. Average traffic volume, expected increase in traffic volume, traffic volume estimated with the proposed project, traffic volume proportional to the Wisconsin wolf study (Kohn et al. 2000), mortality rate, length of each road segment likely to be effected by the proposed project, estimated road mortalities (take) per year, estimated take over the 20-year life of the project and the estimated time for one lynx to be taken per road segment are given. Baseline and projected traffic results were compared to determine if the increase of traffic will significantly increase the likelihood of lynx take on each road segment.

Road Name	Traffic Volume (vehicles/day)	Expected Increase in Traffic Volume (vehicles/day)	Proportional Traffic Volume (vehicles/day)	Mortality Rate (lynx/mi/yr.)	Road Segment Length (mi.)	Est. Take (lynx/yr.)	Est. Take over the Life of the Project (20 yrs.)	Est. Time to Take One Lynx (yrs.)
Hwy 1 - Baseline	578	N/A	8.13	0.004747	39	0.185	3.703	5.4
Hwy 1 - Projected	678	100	6.93	0.005568	39	0.217	4.343	4.6
Hwy 1/ Hwy169 - Baseline	2635	N/A	1.78	0.021649	2	0.043	0.866	23.1
Hwy 1/ Hwy169 - Projected	2710	75	1.73	0.022257	2	0.045	0.890	22.5

5.2. Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

There are several mining projects pending in the Mesabi Iron Range in Minnesota, but each will require separate consultation pursuant to section 7 of the Act.

Lynx inhabit areas on the Superior National Forest and other adjacent ownerships including private, state, county and tribal administration. Within the proclamation boundary of the Superior National Forest, non-federal landowners hold approximately 40 percent of land. Vegetation management on non-National Forest lands may not consider the needs of the lynx or its primary prey species. Lynx in this part of their range may also be limited by non-habitat factors such as illegal take by hunters and trappers, collision with vehicles, low population size, hybridization with bobcats, and competition with other predators.

State, county, and private land timber harvest, related road construction activities, and fire management are not regulated and would not necessarily provide the same level of protection and conservation for threatened and endangered species and their habitats as the Forest Plan does for the Forests' administered lands. Human disturbance and loss of suitable habitat could result from timber harvest, fire management, mining activities and snow-compacting activities. Recreational activities associated with state, county, and private lands will continue in the action area, and are reasonably certain to increase over the life of the Forest Plan as human population increases in northern Minnesota.

Vegetation and fire management, winter recreation and human developments will continue to occur on non-federal lands. These activities are occurring at approximately the same levels on non-federal land as on Forest Service land, and these levels are expected to remain relatively steady in the future. More detailed analysis will occur at smaller geographic scales in context with actions or programs carried out under the Forest Plan as the Forest Service considers actions and habitat on all ownerships within LAUs affected by specific projects.

6. Conclusion

After reviewing the current status of Canada lynx, the environmental baseline for the action area, the effects of the proposed Hardrock Minerals prospecting permits and an increase in truck traffic in Lake, Cook, St. Louis and Koochiching countiesin Minnesota and the cumulative effects, it is the Service's Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Contiguous United States Distinct Population of the endangered Canada lynx.

As detailed above, the proposed action would cause an approximate 0.26 percent decrease in the number of lynx in Minnesota, approximately once every 20 years. Populations of lynx in the contiguous United States also occur in portions of Colorado, Idaho, Maine, Montana, and Washington. Therefore, the estimated proportional impacts to Canada lynx in the Contiguous United States would be less than that anticipated for the species in Minnesota alone. This level of impact would not result in an appreciable effect on the survival and recovery of Canada lynx in the Contiguous United States.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Superior National Forest so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Superior National Forest has a continuing duty to regulate the activity covered by the incidental take statement. If the Superior National Forest (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Superior National Forest must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

1. Amount or Extent of Take Anticipated

In the attached biological opinion, we described the anticipated incidental take in terms of one lynx killed by a vehicle every 20 years in the action area.

2. Effect of the Take

In the attached biological opinion, we concluded that the anticipated incidental take would not jeopardize the continued existence of the Contiguous United States Distinct Population Segment of Canada Lynx.

3. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize take of Canada lynx.

1. Implement measures to reduce the likelihood of vehicle collisions with lynx (see Part 4 Terms and Conditions, below).
2. Document and report to the Service annually any known lynx mortality within the project area within the Superior National Forest proclamation boundaries in Minnesota due to vehicle collisions.

4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

RPM 1: Implement measures to reduce the likelihood of vehicle collisions with lynx.

Term and Condition #1: Place "Caution!! Entering Wildlife Crossing Area" or similar signs along the stretches of Forest Road 424 and Forest Road 377 identified in the attached Biological Assessment in any areas where lynx crossing may be most likely.[4] Signs may be removed when the traffic volume returns to relatively normal levels (i.e., after year 9 of project implementation). Similar signs may be placed along the stretches of State Highway 1 and State Highway 1/169 identified in the attached Biological Opinion where lynx crossing may be likely and where the Forest has jurisdiction. The signs should adhere to Forest Service sign guidelines.

Term and Condition #2: For each permit issued and its associated operating plans, the Forest Service will, to the fullest extent practicable, provide prospecting permit employees and subcontractors who will drive on the roads with information to allow them to identify Canada lynx. This information shall be retained in all vehicles that will be driven in association with the prospecting permits. Before removing or handling specimens, contact FWS Law Enforcement and the nearest MN DNR Conservation Officer. On Forest Service land, also contact a Superior National Forest law enforcement officer. Contact numbers for reporting lynx mortality will be included on the information sheet. The information on the following website could be used for this purpose:

> lynx - http://www.nrri.umn.edu/lynx/information/bobcat.html (see Appendix 1)

---

4 Kohn et al. (2000) suggested that such signs would "have to be obvious and unique to catch and hold motorists' attention." They also recommended erecting "smaller, "reminder signs" at well-used crossing sites to keep motorists alert."

RPM 2: Document and report to the Service annually any known lynx mortality within the project area in the Superior National Forest proclamation boundaries in Minnesota.

Term and Condition #1. Mortality reports should be provided to the Service by December 31 of each calendar year the Revised Forest Plans are implemented. Reports should include, to the extent known, the cause of mortality, location, and sex of lynx. This report can be in conjunction with reporting for other concurrent projects on the Superior National Forest.

Term and Condition #2. Rather than establishing a discrete field monitoring effort to document lynx mortality, contribute to the currently established reporting system maintained by the U.S. Fish and Wildlife Service. The Forest Service should coordinate with partners in state, tribal, county, municipal law enforcement, wildlife management agencies, lynx researchers, and the public to collect information necessary for this reporting system. Information voluntarily provided by these agencies, researchers, and others and compiled by the U.S. Fish and Wildlife Service would fulfill the requirements of the reasonable and prudent measure.

The Service concludes that no more than one Canada lynx will be incidentally taken every 20 years as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Superior National Forest must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

5. Reporting Requirements

Any vehicle collisions with lynx must be reported within 72 hours to U.S. Fish and Wildlife Service, Twin Cities Field Office, Bloomington, Minnesota (612/725-3548). These reports shall include all known information regarding the incident, including the species involved, date of incident, fate of the animal (e.g., dead), location of the carcass, geographic coordinates of the accident location, sex of the animal, and approximate age (i.e., adult, juvenile, yearling). To ensure that any incident will be reported, each employee who will drive on roads identified in this incidental take statement shall be provided information to allow them to identify Canada lynx, as discussed above. This information shall be retained in all vehicles that will be driven on in association with the proposed Hardrock Minerals Prospecting permits.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act, directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery programs, or to develop information.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1. Report any sightings of Canada lynx to the Service at (612) 725-3548. If possible, provide the date and location (geographic coordinates if available).

2. When developing reclamation plans, coordinate with the Service to identify opportunities to provide high-quality lynx habitat. Restore natural plant communities wherever practicable.

3. Remove and reclaim any roads as soon as they become unnecessary for ongoing activities.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation for the potential effects of the proposed Hardrock Minerals Prospecting Permits Project in Cook, Koochiching, Lake and St. Louis, counties, Minnesota, on the Contiguous United States Distinct Population Segment of Canada Lynx. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Appendix 1. How to identify Canada lynx.

©NRRI

Lynx or Bobcat?

The following information is adapted from the website, http://oden.nrri.umn.edu/lynx/information/bobcat.html.

Canada lynx (*Lynx canadensis*) and bobcats (*Lynx rufus*) are medium-sized (2-3 times larger than a large house cat, smaller than a mountain lion) cats that are similar in appearance. There are several physical characteristics to distinguish between Canada lynx and bobcat:

The black tail, ear tufts, and large feet characteristic of Canada lynx are shown clearly in the photo above.

> Tail: A lynx's tail has a black tip all around, with the appearance of being dipped in a bottle of ink. A bobcat's tail is striped with black bands towards the end and has a black tip.
>
> Ears: Lynx have longer ear tufts than bobcats.
>
> Feet: Lynx have much larger feet than bobcats.

While not a physical characteristic, a lynx is more likely to provide humans with a "good" view, often remaining in an area for a period of time while people watch it. Bobcats are more secretive and elusive than lynx.

Contact numbers for reporting lynx mortality (1) FWS Law Enforcement at [redacted] or cell phone [redacted]; (2) USDA Forest Service Special Agent at [redacted] (3) MN DNR Conservation Officer Supervisor at [redacted]

LITERATURE CITED

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, and S. W. Buskirk, editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Apps, C. D. 2000. Space-use, diet, demographics, and topographic associations of lynx in the southern Canadian Rocky Mountains: a study. Pages 351-372 in K. B. A. in L.F. Ruggiero, and S.W. Buskirk, editor. Ecology and conservation of lynx in the 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 471-474 in L. F. Ruggiero, K. B. Aubry, and S. W. Buskirk, editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Bailey, T. N. 1974. Social organization in a bobcat population. Journal of Wildlife Management 38.

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

Brainerd, S. M. 1985. Reproductive ecology of bobcats and lynx in western Montana. Page 85. University of Montana, Missoula, Montana.

Brand, C. J., and L. B. Keith. 1979. Lynx demography during a snowshoe hare decline in Alberta. Journal of Wildlife Management 53:827-849.

Bunnell, K. D., J. T. Flinders, and M. L. Wolfe. 2006. Potential impacts of coyotes and snowmobiles on lynx conservation in the intermountain West. Wildl. Soc. Bull. 34:828-838.

Burdett, C. L. 2007. Hierarchical structure of Canada lynx space use and habitat selection in Northeastern Minnesota. Page 142. University of Minnesota.

Buskirk, S. W., L. F. Ruggiero, and C. J. Krebs. 2000. Habitat fragmentation and interspecific competition: implications for lynx conservation in L. F. Ruggiero, K. B. Aubry, and S. W. Buskirk, editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Carbyn, L. N., and D. Patriquin. 1983. Observations on home range sizes, movements and social organization of Lynx, Lynx canadensis , in Riding Mountain National Park, Manitoba. Canadian field-naturalist. Ottawa ON 97:262-267.

Catton, T., and S. Loch. 2011. Summary of the Superior National Forest's 2011 Canada lynx (Lynx canadensis) DNA database. Pages 1-2. USDA Forest Service, Ely, MN.

Danby, R. K., and D. S. Hik. 2007. Variability, contingency, and rapid change in recent subarctic alpine tree line dynamics. Journal of Ecology 95:352-363.

Erb, J. 2009. Furbearer Winter Track Survey Summary, 2008. Page 7. Minnesota Department of Natural Resources, Grand Rapids, MN.
Erb, J., and S. Benson. 2004. Distribution and abundance of wolves in Minnesota, 2003-2004. Page 5. Minnesota Department of Natural Resources.
Fuller, A. J., D. J. Harrison, and A. D. Vashon. 2007. Winter Habitat Selection by Canada Lynx in Maine: Prey Abundance or Accessibility. Journal of Wildlife Management 71:1980-1986.
Fuller, T. K., and D. M. Heisey. 1986. Density-related changes in winter distribution of snowshoe hares in northcentral Minnesota. Journal of Wildlife Management 50:261-264.
Hanson, K., and R. Moen. 2008. Diet of Canada Lynx in Minnesota Estimated from Scat Analysis. Department of Biology University of Minnesota Duluth. Page 14. NRRI Technical Report No. NRRI/TR-2008/13. NRRI, Duluth, MN.
Hatler, D. F. 1988. A lynx management strategy for British Columbia. Prepared for British Columbia Ministry of Environment, Victoria.
Henderson, C. 1977. Minnesota 1977 Canada lynx status report. Page 23. Report by the Minnesota Department of Natural Resources. Minnesota Department of Natural Resources, St. Paul, MN.
Hodges, K. E., and A. R. E. Sinclair. 2005. Browse site selection by snowshoe hares: effects of food supply and predation risk. Canadian Journal of Zoology 83:280-292.
Homyack, J. A., D. J. Harrison, and W. B. Krohn. 2007. Effects of Precommercial Thinning on Snowshoe Hares in Maine. Journal of Wildlife Management 71:4-13.
Homyack, J. A., J. H. Vashon, C. Libby, E. L. Lindquist, S. Loch, D. F. McAlpine, K. L. Pilgrim, and M. K. Schwartz. 2008. Canada Lynx-bobcat (Lynx canadensis 3 L. rufus) hybrids at the southern periphery of Lynx range in Maine, Minnesota and New Brunswick. American Midland Naturalist 159:504-508.
Hoving, C. L. 2001. Historical occurrence and habitat ecology of Canada lynx (Lynx canadensis) in eastern North America. Page 200. Wildlife Ecology. University of Maine, Orono, ME.
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 [Wildl. Biol.]. 10:285-294.
Hoving, C. L., D. J. Harrison, W. B. Krohn, R. A. Joseph, and M. O'Brien. 2005. Broad-scale predictors of Canada lynx occurrence in eastern North America. Journal of Wildlife Management 69:739-751.
Koehler, G. M. 1990. Population and habitat characteristics of lynx and snowshoe hares in north central Washington. Can. J. Zool./J. Can. Zool. 68:845-851.
Koehler, G. M., and K. B. Aubry. 1994. Chapter 4: Lynx. Pages 74-98 in L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski,

editors. American Marten, Fisher, Lynx, and Wolverine in the Western United States. U.S. Forest Service, Gen. Tech. Rpt. RM- 251.
Koehler, G. M., and J. D. Brittell. 1990. Managing spruce-fir habitat for lynx and snowshoe hares. Journal of Forestry 88:10-14.
Kohn, B. E., J. L. Frair, D. E. Unger, T. M. Gehring, D. P. Shelley, E. M. Anderson, and P. W. Keenlance. 2000. Impacts of the US Highway 53 expansion project on wolves in northwestern Wisconsin. Page 55. Wisconsin Department of Natural Resources, Rhinelander, WI.
Kolbe, J. A., and J. R. Squires. 2007. Activity Patterns of Canada Lynx in Western Montana. Journal of Wildlife Management 71:1607-1611.
McCord, C. M., and J. E. Cardoza. 1982. Bobcat and lynx. Pages 728-766 in J. A. Chapman, and G. A. Feldhamer, editors. Wild Mammals of North America. John Hopkins Univ. Press, Baltimore, Maryland.
McKelvey, K. S., J. V. Kienast, K. B. Aubry, G. M. Koehler, B. T. Maletzke, J. R. Squires, E. L. Lindquist, S. Loch, and M. K. Schwartz. 2006. DNA Analysis of Hair and Scat Collected Along Snow Tracks to Document the Presence of Canada Lynx. Wildlife Society Bulletin:451-455.
Mech, L. D. 1977. Record movement of Canadian lynx. Journal of Mammalogy 58:676-677.
Mech, L. D. 1980. Age, sex, reproduction, and spatial organization of lynxes colonizing northeastern Minnesota. J. Mammal. 61:261-267.
Moen, R., C. L. Burdett, and G. J. Niemi. 2008a. Movement and habitat use of Canada lynx during denning in Minnesota. Journal of Wildlife Management 72:1507-1513.
Moen, R., G. Niemi, C. Burdett, and L. D. Mech. 2004. Canada Lynx in the Great Lakes Region 2004 Annual Report. Page 29. U.S. Forest Service, Duluth, MN.
Moen, R., G. Niemi, and C. L. Burdett. 2008b. Canada lynx in the Great Lakes Region. Page 48. Center for Water and Environment, Natural Resources Research Institute, University of Minnesota, Duluth, MN.
Moen, R., G. Niemi, C. L. Burdett, and L. D. Mech. 2006. Canada lynx in the Great Lakes region: 2005 annual report to USDA Forest Service and MN Cooperative Fish and Wildlife Research Unit and Minnesota Department of Natural Resources. Page 28. Natural Resources Research Institute, Duluth, MN.
Moen, R., L. Terwilliger, A. Dohmen, and S. Catton. 2010. Habitat and road use by Canada lynx making long-distance movements. Page 29. NRRI Technical Report No. NRRI/TR-2010-02 Release 1.0. Center for Water and Environment, Natural Resources Research Institute, University of Minnesota, Duluth, MN.
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, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires,

editors. Ecology and conservation of lynx in the United States. RMRS-GTR-30WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
Newbury, T. L., and N. P. P. Simon. 2005. The effects of clearcutting on snowshoe hare (Lepus americanus) relative abundance in central Labrador. Forest Ecology and Management 210:131-142.
O'Donoghue, M. 1997. Responses of coyotes and lynx to the snowshoe hare cycle. Page 180. Zoology. University of British Columbia, Vancouver, B.C.
O'Donoghue, M., S. Boutin, C. J. Krebs, D. L. Murray, and E. J. Hofer. 1998a. Behavioural responses of coyotes and lynx to the snowshoe hare cycle. Oikos 82:169-183.
O'Donoghue, M., S. Boutin, C. J. Krebs, G. Zuleta, D. L. Murray, and E. J. Hofer. 1998b. Functional responses of coyotes and lynx to the snowshoe hare cycle. Ecology 79:1193-1208.
Pietz, P. J., and J. R. Tester. 1983. Habitat selection by snowshoe hares in north central Minnesota. Journal of Wildlife Management 47:686-696.
Poole, K. G. 1994. Characteristics of an unharvested lynx population during a snowshoe hare decline. Journal of Wildlife Management 58:608-618.
Poole, K. G. 1997. Dispersal patterns of lynx in Northwest Territories. Journal of Wildlife Management 61:497-505.
Potvin, M. J., T. D. Drummer, J. A. Vucetich, D. E. Beyer, R. O. Peterson, and J. H. Hammill. 2005. Monitoring and Habitat Analysis for Wolves in Upper Michigan. Journal of Wildlife Management 69:1660-1669.
Quinn, N., W.S., and G. Parker. 1987. Lynx. Pages 683-694 in M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, editors. Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resources, Toronto, ON.
Quinn, N. S., and J. E. Thompson. 1987. Dynamics of an exploited Canada lynx population in Ontario. Journal of Wildlife Management 51:297-305.
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. Williamson. 2000. Canada lynx conservation assessment and strategy, 2nd edition. Page 142pp. Forest Service Publication #R1-00-53. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service, Missoula, MT.
Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires. 1999. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder, CO.
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 5:349-355.
Shenk, T. M. 2006. Post release monitoring of lynx (*Lynx canadensis*) reintroduced to Colorado. Page 45. Colorado Division of Wildlife, Fort Collins, CO.

Shenk, T. M. 2009. Post release monitoring of lynx (Lynx canadensis) reintroduced to Colorado. Page 55. Widlife Research Report. Colorado Division of Wildlife.
Slough, B. G., and G. Mowat. 1996. Lynx population dynamics in an untrapped refugium. Journal of Wildlife Management 60:946-961.
Squires, J. R., N. J. Decesare, J. A. Kolbe, and L. F. Ruggiero. 2008. Hierarchical den selection of Canada lynx in Western Montana. Journal of Wildlife Management 72:1497-1506.
Squires, J. R., N. J. Decesare, J. A. Kolbe, and L. F. Ruggiero. 2010. Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains. Journal of Wildlife Management 74:1648-1660.
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, and S. W. Buskirk, editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.
Squires, J. R., and L. F. Ruggiero. 2007. Winter prey selection of Canada lynx in Northwestern Montana. Journal of Wildlife Management 71:310-315.
Thiel, R. P. 1985. The relationship between road densities and wolf habitat suitability in Wisconsin. American Midland Naturalist 113:404-407.
Thompson, I. D., I. J. Davidson, S. O'Donnell, and F. Brazeau. 1989. Use of track transects to measure the relative occurrence of some boreal mammals in uncut forest and regeneration stands. Canadian Journal of Zoology/Revue Canadien de Zoologie 67:1816-1823.
U.S. Fish and Wildlife Service. 2006. Biological Opinion: Forest Road 424 (Denley Road) Reconstruction. Page 38. U. S. Fish & Wildlife Service, Bloomington, MN.
U.S. Fish and Wildlife Service. 2011. Biological Opinion - Superior National Forest Plan Reinitiation. Pages 1-82, Bloomington, MN.
USDA. 2004. Forest Plan Revision. Superior National Forest. U.S. Forest Service, Duluth, MN.
USDA. 2011. Federally Listed Threatened and Endangered Species Programmatic Biological Assessment (BA) for the Revised Forest Plan: Superior National Forest. Page 171pp. in A. Dohmen, and M. Shedd, editors. USDA-Forest Service - Region 9. Superior National Forests, Duluth, Minnesota.
USDA Forest Service. 2011a. Biological Assessment for the Federal Hardrock Minerals Prospecting Permits. Pages 1-52. Superior National Forest, Duluth, MN.
USDA Forest Service. 2011b. Draft Environmental Impact Statement Federal Hardrock Mineral Prospecting Permits. Page 297. Superior National Forest, Duluth, MN.
USDA Forest Service. 2011c. Programmatic Biological Assessment for Federally Listed Species. Pages 1-171. Superior National Forest, Duluth, MN.

USDA Forest Service. 2012. Addendum to the Federal Hardrock Prospecting Permits Biological Assessment. Pages 1-5. Superior National Forest, Duluth, MN.

Ward, R. M. P., and C. J. Krebs. 1985. Behavioural responses of lynx to declining snowshoe hare abundance. Can. J. Zool. 63:2817-2824.

Wirsing, A. J., T. D. Steury, and D. L. Murray. 2002. A demographic analysis of a southern snowshoe hare population in a fragmented habitat: evaluating the refugium model. Canadian Journal of Zoology/Revue Canadienne de Zoologie [Can. J. Zool./Rev. Can. Zool.]. 80:169-177.

Wolfe, M. L., N. V. Debyle, C. S. Winchell, and T. R. McCabe. 1982. Snowshoe hare cover relationships in northern Utah. Journal of Wildlife Management 49:662-670.