# CHAPTER III. CANADA LYNX BIOLOGICAL OPINION

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# A. CONTEXT OF THE PROPOSED ACTION FOR CANADA LYNX

## 1. Background

The proposed action is described in detail in Chapter I of this biological opinion.

This section identifies the action area and describes the relationship of the action area to lynx habitat. Next, this section explains the relationship of the proposed action to existing management, and then describes elements of the Revised Plan for the conservation of Canada lynx and lynx habitat. Finally, this section describes the guidelines and standards that are intended to conserve lynx and lynx habitat, and specific measures proposed to avoid, reduce, or minimize potential adverse effects of forest management activities at the project level. Section B. of this biological opinion describes the status of the Canada lynx and Canada lynx habitat. Section C. describes the baseline condition of the Canada lynx and Canada lynx habitat in the action area. Section D. provides an analysis of the effects of the proposed action on the lynx and lynx habitat, including analysis of effects on designated critical habitat. This is followed by our conclusion, incidental take statement, reinitiation notice, and literature considered in the biological opinion. This opinion will consider the effects of implementation of the proposed framework of the Revised Plan as well as the effects of proposed measures to be implemented at the project level. However, this biological opinion does not provide a detailed analysis for effects of specific projects. Future projects undertaken by the USFS will undergo detailed, site-specific analysis for effects on listed species.

## 2. Action Area and Relationship of the Project Area to Canada Lynx Habitat

As described in Chapter I of this biological opinion, the project area lies within the Northern Rocky Mountain/Cascade region of the contiguous distinct population segment (DPS) of Canada lynx. Lynx habitat within the Northern Rockies Geographic Area was delineated into lynx analysis units (LAUs) for analysis and management purposes. An LAU is intended to provide the fundamental unit for evaluating and monitoring the effects of management activities on lynx and is a delineated area approximating the size of a lynx home range (16,000 to 25,000 acres) with at least 6,400 acres of primary vegetation capable of supporting lynx.

In 2000, 69 LAUs were delineated on the IPNF with the majority of habitat located on the Priest Lake, Sandpoint, and Bonners Ferry Ranger Districts. As the available knowledge of lynx habitat requirements has increased, lynx habitat in North Idaho has been more narrowly defined to include only subalpine fir/Engelmann spruce *(Abies lasiocarpa/Picea engelmannii)* habitats, with the exception of moist cedar-hemlock in limited locations. These habitats on the IPNF are referred to as lynx primary habitat. Lynx secondary habitat is moist grand fir *(Abies grandis)*, and cedar-hemlock *(Thuja plicata-Tsuga heterophylla)* potential vegetation types (where they are not part of primary habitat). In 2008, the USFS updated the available acres of lynx habitat on the IPNF through a best available science review and remapping effort and delineated 35 LAUs (USFS 2013a, Appendix C). Remapping of lynx habitat and LAUs on the IPNF was completed in coordination with the Service (USFWS 2008, entire).

Approximately 891,703 acres (36 percent) of the IPNF is in LAUs and 582,979 acres are considered to be lynx habitat (23 percent). The IPNF also supports 34,687 acres of lynx critical habitat in 2 LAUs. Because resident lynx may make exploratory or breeding movements into new areas, though typically returning to their original home range, and males in particular may travel long distances during these episodes, the action area is the entire Forest (2.5 million acres).

### 3. Relationship of Proposed Action to Existing Management

In 2007, the IPNF amended the 1987 Forest Plan with the Northern Rockies Lynx Management Direction amendment (NRLMD) (USFS 2007, entire). The NRLMD (USFS 2007) amended 18 USFS Forest Plans. The Service prepared a biological opinion on the effects of the amendment on lynx and determined that the NRLMD was not likely to jeopardize lynx (USFWS 2007, p. 75).

At the time (2007) the NRLMD was prepared and the biological opinion was completed, critical habitat had not been designated for lynx. Critical habitat was designated in 2009 (February 25, 2009, 71 FR 8616) and since that time, the NRLMD has been applied to lynx habitat in critical habitat on the IPNF. The exception to the application of the NRLMD on critical habitat is matrix habitat and any critical habitat that is not in an LAU. On the IPNF there are presently 3,434 acres of critical habitat outside LAUs. However, upon further evaluation it has been determined that these areas were erroneously included as critical habitat and clearly do not support the PCE1. Therefore, we do not consider this area to be critical habitat or lynx habitat and it is not further addressed in this biological opinion. Matrix habitat is habitat types that do not support high densities of snowshoe hares but that occurs between patches of boreal forest in close juxtaposition such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range. The NRLMD describes linkage areas as well, which include areas of connectivity between blocks of lynx habitat. Linkage areas are further described as occurring both within and between geographic areas, where basins, valleys or agricultural lands separate blocks of lynx habitat, or where lynx habitat naturally narrows between blocks. The NRLMD does include some measures to address lynx habitat needs in linkage areas and thereby addresses some areas of matrix habitat. The identification and description and use of the term "matrix habitat" however, did not arise until the designation of critical habitat. As stated in the final rule, activities that change vegetation structure or condition in matrix habitat are not considered an adverse effect to lynx critical habitat unless those activities create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat or if they adversely affect adjacent foraging and denning habitat. As just mentioned, impediments to connectivity and movement for lynx are addressed by the NRLMD for both lynx habitat and non-lynx habitat.

The NRLMD includes standards and guidelines intended to "incorporate management direction in land management plans that conserves and promotes recovery of Canada lynx, by reducing or eliminating adverse effects from land management activities on National Forest System lands…" (USFS 2007). As analyzed in our 2007 biological opinion, the NRLMD is intended to avoid or reduce the potential for projects proposed under Forest Plans to adversely affect lynx through a suite of objectives, standards, and guidelines that promote and conserve the habitat conditions needed to produce adequate snowshoe hare (lynx primary prey) densities to sustain lynx home ranges, and thus sustain lynx populations. The opinion concluded that the programmatic

objectives and project-level standards, and guidelines in the amended Forest Plans provide comprehensive conservation direction adequate to reduce adverse effects to lynx from forest management on NFS lands and do not result in jeopardy to the lynx DPS. Because critical habitat for lynx was not designated until 2009, the opinion did not address the effects of Forest Plan direction, as amended by the NRLMD, on lynx critical habitat.

## 4. Proposed Action Description

As described in Chapter I of this biological opinion, the Revised Plan direction is organized by goals, desired conditions, objectives, standards and guidelines, (collectively referred to as elements of the Revised Plan). The Revised Plan Forest-wide direction describes the framework under which lands will be managed for the next 10 to 15 years on the Forest.

The Revised Plan desired conditions for wildlife and vegetation, and standards and guidelines related to wildlife are discussed in Chapter I of this biological opinion and contained in Appendix A of Chapter I. Guidelines and standards are the procedures and requirements (respectively) applied to project and activity decision-making to achieve goals, desired conditions, and objectives. All project-level activities must meet the standards and guidelines. Table III-1 describes the standards and guidelines to be applied at the project level specifically for the conservation of lynx habitat and linkage needs.

**Table III-1. Forest-wide guidelines and standards in the Revised Plan for Canada lynx conservation.**

| Management Need | Element Code | Element Description |
|---|---|---|
| Linkage | FW-GDL-WL-15 | Sets direction for interagency coordination and inclusion on wildlife crossing features in roadway construction and reconstruction. |
| Linkage | FW-GDL-WL-16 | Restricts management activities within one-quarter mile of existing crossing features, and future crossing features. |
| Linkage | FW-GDL-WL-17 | Maintains federal ownership in wildlife linkages identified through interagency coordination. |
| General Habitat | FW-GDL-VEG-03 | Retains CWD and logs to provide a variety of species, sizes and decay classes. |
| General Habitat | FW-GDL-VEG-04 | Generally retains all snags greater than 20” diameter-at-breast height (DBH), and at least the minimum number of snags and live trees (for future snags) that are required. |
| General Habitat | FW-GDL-VEG-05 | Implement the identified prescriptions for snag retention. |
| General Habitat | FW-GDL-VEG-06 | During timber harvest, provides course woody debris from retained snags that fall over or trees felled for safety reasons. |
| General Habitat | FW-STD-WL-01 | Applies the NRLMD. |

The standards and guidelines discussed in Chapter 1 and Table III-1 would be applied forest-wide as well as across the Management Areas (MAs) and Geographic Areas (GAs). Each of the

twelve management area designation has its own prescription for management and allowed uses (see Table I-5 in Chapter I of this biological opinion). The relationship of the MAs to LAUs and lynx critical habitat is provided in Table III-2.

**Table III-2. Distribution of LAU acreages and critical habitat acreages on the IPNF across the designated management areas under the Revised Plan.**

| Management Area | Acres (Percent) of Lynx Habitat in LAU | Acres (Percent) Critical Habitat in LAU |
|---|---|---|
| 1a – Wilderness | 9,509 (1.6) | 0 |
| 1b – Recommended Wilderness | 83,655 (14) | 0 |
| 1c – Wilderness Study Area | 0 | 0 |
| 1e – Primitive Lands | 12,236 (2.1) | 0 |
| 2a – Wild & Scenic Rivers (Wild & Recreational) | 8,497 (1.5) | 0 |
| 2b – Eligible Wild & Scenic Rivers (Wild & Recreational) | 3,559 (0.6) | 0 |
| 3 – Special Areas | 10,948 (2.4) | 3,079 (8.9) |
| 4a – Established & Proposed Research Natural Areas | 4,202 (0.7) | 0 |
| 4b – Experimental Forests | 0 | 0 |
| 5 – Backcountry | 211,776 (38) | 6,826 (19.7) |
| 6 – General Forest | 199,419 (38) | 24,744 (71.4) |
| 7 –Primary Recreation Areas | 0 | 0 |
| **Approximate Total:** | **547,753** | **34,649**[1] |

Geographic areas have desired conditions that are specific to a locale, such as a river basin or valley. The GA desired conditions were developed to refine forest-wide management to better respond to local conditions and situations that may occur within a specific GA. The desired conditions in GAs for listed species would not exert additional effects on the species, rather the desired condition would help the Forest achieve a forest-wide desired condition, objective, standard, or guideline for the species. Refer to Chapter II.A.4 for an explanation of the relationship of GAs to listed species.

The revised plan would incorporate all standards and guidelines contained in the NRLMD (FW-STD-WL-01). Refer to the section below, Relationship of Proposed Action to Existing Management, for an explanation of the NRLMD.

# B. STATUS OF THE SPECIES

This section describes the listing history, life history and habitat requirements, status and distribution of lynx and lynx critical habitat.

## 1. ESA Listing Status

The lynx was added to the list of threatened species on March 24, 2000 (65 FR 16052). We concluded that the single factor threatening the contiguous United States DPS of lynx was the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Land and Resource Management Plans and Bureau of Land Management (i.e., Forest Service and BLM) Land Use Plans. On July 3, 2003, we published a clarification of findings in the Federal Register (68 FR 40076) determining that threatened species designation was appropriate for the lynx.

## 2. Species Description, Life History, Population Dynamics

The lynx is a medium-sized cat with long legs; large, well-furred paws; long tufts on the ears; and a short, black-tipped tail (McCord and Cardoza 1982, p.730). The winter pelage of the lynx is dense and has a grizzled appearance with grayish-brown mixed with buff or pale brown fur on the back, and grayish-white or buff-white fur on the belly, legs, and feet. Summer pelage of the lynx is more reddish to gray-brown (Quinn and Parker 1987, p.684; Koehler and Aubry 1994, p.74). Adult males average 22 pounds in weight and 33.5 inches in length (head to tail), and females average 19 pounds and 32 inches (Quinn and Parker 1987, p.683). The lynx's long legs and large feet make it highly adapted for hunting in deep snow. The life expectancy for lynx is not very well known. The oldest documented lynx was a 16 year old male in Montana (Kolbe and Squires 2006, p.535).Lynx activity patterns are reported to vary by sex, season, and reproductive status (Kolbe and Squires 2007, p.1608). During summer, in Montana, male lynx exhibited a crepuscular activity pattern, whereas females with kittens were active throughout the photoperiod (ibid, p.1608). During winter in Montana, lynx of both sexes were most active during the afternoon and early evening (ibid, p.1608).

Individual lynx maintain large home ranges reported as generally ranging between 12 to 83 square miles (Koehler1990, p.847; Aubry et al. 2000, pp.383-4; Squires and Laurion 2000, p.343; Squires et al. 2004, pp.586-7; Vashon et al. 2005a, pp.7-11). The size of lynx home ranges varies depending on abundance of prey, the animal's gender and age, season, and the density of lynx populations (Koehler 1990, p.849; Poole 1994, p.614.; Slough and Mowat 1996, pp.951, 956; Aubry et al. 2000, p.383.; Mowat et al. 2000, pp.276-280; Vashon et al. 2005a, pp.9-10). When densities of snowshoe hares decline, for example, lynx enlarge their home ranges to obtain sufficient amounts of food to survive and reproduce. Preliminary research supports the hypothesis that lynx home ranges at the southern extent of the species' range are generally large compared to those in the core of their range in Canada (Koehler and Aubry 1994, pp.90-91; Squires and Laurion 2000, p.347). In northwestern Montana, female home ranges average 34 square miles while male's average 83 square miles (Squires et al. 2004, pp.15-16).

Lynx are highly mobile and have a propensity to disperse long distances, particularly when prey becomes scarce (Mowat et al. 2000, p.293). Lynx also make long distance exploratory

movements outside their home ranges (Aubry et al. 2000, p.386; Squires et al. 2001, pp.18-26; Moen et al. 2010). Aubry et al. (2000, p.386) defined exploratory movements as long-distance movements beyond identified home range boundaries, in which the animal returned to its original home range. In Minnesota, exploratory movements were greatest for males during the breeding season in March (Burdett et al. 2007, p.461). Moen et al. (2010) reported lynx making long distance movements in Minnesota at all times of the year. Resident lynx made long distance movements lasting days to a few months into Ontario and back during the pre-denning period (ibid). In Maine, lynx made long distance movements throughout the year from a study area in northwestern Maine into Quebec (distances of 52–403 km [31–242 mi]) and within the state (distances of 142–227 km [85–136 mi]), often returning to reoccupy their home range (Vashon et al. 2012, pp.21-22).

In Montana, Wyoming, and southern British Columbia, exploratory movements during the summer months by resident lynx were documented (Apps 2000, pp.360-361, Squires and Laurion 2000, pp.343-345, Squires and Oakleaf 2005, p.197). Distances of these exploratory movements in Montana ranged from about 15–40 km (9–25 mi), and duration away from the home range was 1 week to several months (Squires and Laurion 2000, pp.344-345). For three consecutive summers (1999-2001), a male lynx traversed a similar path in a northwesterly direction from the animal's home range in the Wyoming Range near Big Piney, Wyoming, as far as the Henry's Lake Mountains, west of West Yellowstone, Montana (Squires and Oakleaf, 2005, p.197). The longest travel distance was a minimum of 728 km (452 miles) during the summer of 2000 (ibid, pp.197-198).

Breeding occurs through March and April in the north (Quinn and Parker 1987, p.684). Kittens are born in May to June in southcentral Yukon (Slough and Mowat 1996, p.954). In a Montana study, lynx kittens were born in late April to mid-May with an average parturition date of May 9 (n=59). Den use ended between late June and late July (Olson et al. 2011, p.459). The male lynx does not help with rearing young (Eisenberg 1986, p.299). Slough and Mowat (1996, p.953) reported yearling females giving birth during periods when hares were abundant; male lynx may be incapable of breeding during their first year (McCord and Cardoza 1982, p.734, Quinn and Parker 1987, p.25865). In northwestern Montana, females stayed at natal dens an average of 21 days, and the time spent at subsequent dens decreased with time since parturition (Olson et al. 2011, p 458). Females stopped caching kittens at dens when kittens were approximately 2 months old (Olson et al. 2011, p.459), when they are mobile enough to travel with their mothers.

In northern study areas during the low phase of the hare cycle, few if any live kittens are born, and few yearling females conceive (Brand and Keith 1979, pp.836-837; Poole 1994, p.615; Slough and Mowat 1996, p.953). However, Mowat et al. (2000, pp.286-287) suggested that in the far north, some lynx recruitment occurs when hares are scarce and this may be important in lynx population maintenance during hare lows.

During periods of hare abundance in the northern taiga, litter size of adult females averages four to five kittens (Mowat et al. 1996, pp.437-438). In Montana, the average litter size in the Seeley Lake study area was 2.3 kittens and 3.2 kittens in the Purcell Mountains (Squires et al. 2006, p.22). Koehler (1990, pp.847-849) suggested that the low number of kittens produced in northcentral Washington was comparable to northern populations during periods of low snowshoe hare abundance. In his study area, two radio-collared females had litters of three and

four kittens in 1986, and one kitten in 1987 (the actual litter size of one of the females in 1987 was not determined) (Koehler 1990, p.847). Of the known-size litters in Washington, one kitten survived the first winter. In Wyoming, one female produced four kittens in 1998, but snow tracking indicated that the kittens were not with the female in November and were presumed dead (Squires and Laurion 2000, p.346). The same female produced two kittens in 1999.

Snowshoe hares are the primary prey of lynx, comprising 35 to 97 percent of the diet throughout the range of the lynx (Quinn and Parker 1987, p.686; Koehler and Aubry 1994, pp.74-75). Other prey species include red squirrel (*Tamiasciurus hudsonicus*), grouse (*Bonasa umbellus*, *Dendragopus* spp., *Lagopus* spp.), flying squirrel (*Glaucomys sabrinus*), ground squirrel (*Spermophilus parryii, S. Richardsonii*), porcupine (*Erethrizon dorsatum*), beaver (*Castor canadensis*), mice (*Peromyscus* spp.), voles (*Microtus* spp.), shrews (*Sorex* spp.), fish, and ungulates as carrion or occasionally as prey (Saunders 1963, pp.386-388; van Zyll de Jong 1966, p.20; Nellis et al. 1972, pp.323-326; Brand et al. 1976, p.424; Brand and Keith 1979, p.834; Koehler 1990, p.847; Staples 1995, pp.37-45, 150). Winter food items in Montana included snowshoe hare (96 percent prey biomass), red squirrel, and grouse (Squires and Ruggiero 2007, p.311). Male lynx will opportunistically kill white tailed deer (*Odocoileus virginianus*) (Fuller 2004, p.397; Squires and Ruggiero 2007, p.312).

During the cycle when hares become scarce, the proportion and importance of other prey species, especially red squirrel, increases in the diet (Brand et al. 1976, pp.422-425; Apps 2000, pp.362-363; Mowat et al. 2000, pp.267-268). However, a diet of red squirrels alone might not be adequate to ensure lynx reproduction and survival of kittens (Koehler 1990, pp.848-849). Most research has focused on the winter diet. Summer diets are poorly understood throughout the range of lynx. Mowat et al. (2000, pp.267-268) reported through their review of the literature that summer diets have less snowshoe hare and more alternate prey species, possibly because of a greater availability of other species.

In northern regions, when hare densities decline, the lower quality diet causes sudden decreases in the productivity of adult female lynx and decreased survival of kittens, which causes the numbers of breeding lynx to level off or decrease (Nellis et al. 1972, pp.326-328; Brand et al. 1976, pp.419-420; Brand and Keith 1979, pp.836-838; Poole 1994, p.615; Slough and Mowat 1996, p.955.; O'Donoghue et al. 1997, pp.158-159). Relative densities of snowshoe hares at southern latitudes are generally lower than those in the north, and differing interpretations of the population dynamics of southern populations (measured from Quebec east to the Maritimes and south within the United States) of snowshoe hare have been proposed (Hodges 2000b, pp.165-173).

The center of North American lynx range is in north-central Canada. Lynx occur in mesic coniferous forests that have cold, snowy winters and provide a prey base of snowshoe hare (Ruggiero et al. 2000b, p.10). These forests are generally described as boreal forests. Boreal forests provide optimal habitat for snowshoe hares. In North America, the distribution of lynx is nearly coincident with that of snowshoe hares (Bittner and Rongstad 1982, p.154; McCord and Cardoza 1982, p.743). Lynx survivorship, productivity, and population dynamics are closely related to snowshoe hare density in all parts of its range. In the extensive boreal forests of Canada, snowshoe hare densities reach peak densities of roughly four to six hares per hectare (or 1.6 to 2.4 per acre) and decline to about 0.1 to 1 per hectare (0.04 to 0.4 per acre) during cyclic

lows (Krebs et al. 1995, pp.1112-1114, Slough and Mowat 1996, p.956, Hodges 2000a, pp.118-121). A minimum density of snowshoe hares (greater than 0.5 hares per hectare or 1.2 hares per acre (Ruggiero et al. 2000b, pp.446-447) distributed across a large landscape is necessary to support survival of lynx kittens and recruitment into and maintenance of a lynx population.

In Canada and Alaska, lynx populations undergo extreme fluctuations in response to the cycling of snowshoe hare, enlarging or dispersing from their home ranges and ceasing the recruitment of young into the population after hare populations decline (Mowat et al. 2000, pp.265-306). In the contiguous United States, the degree to which lynx population fluctuations are influenced by local snowshoe hare population dynamics is unclear. However, lynx populations here are on the periphery of the species range in North America, and are naturally limited by the low availability of snowshoe hares, as suggested by large home range size, high kitten mortality due to starvation, and greater reliance on alternate prey. These characteristics appear to be similar to those exhibited by lynx populations in Canada and Alaska during the low phase of the population cycle (Quinn and Parker 1987, p.687, Koehler 1990, p.849, Aubry et al. 2000, p.389). This is likely due to the inherently patchy distribution of lynx and hare habitat in the contiguous United States and correspondingly lower densities of hares.

Lynx population dynamics may emanate from the core in Canada to the southern periphery in the contiguous United States, as evidenced by a lagged correlation of lynx trap records and observations in the United States (related to cyclic highs in lynx populations in Canada) (McKelvey et al. 2000a, pp.232-242; Mowat et al. 2000, pp.290-294). In Canada, the Hudson Bay Company maintained fairly accurate annual lynx pelt data across the range of lynx, which reflect dramatic population cycles. In the Great Lakes Geographic Area, population dynamics in recent decades appear to be strongly driven by immigration from Canada (McKelvey et al. 2000a, p.238). However, in other areas and time periods it is not known to what extent the correlation is due to immigration from Canada, population responses to the same factors controlling northern populations, or a combination of the two. A lack of accurate historic data limits our understanding of lynx population dynamics in the contiguous United States and precludes drawing definitive conclusions about lynx population trends. Historically, formal surveys designed specifically to detect lynx were rarely conducted. Many reports of lynx (e.g., visual observations, snow tracks) have been collected incidentally to other activities, but cannot be used to infer population trends. Long-term trapping data have been used to estimate population trends for various species. In the United States however, trapping returns are strongly influenced by trapper effort, which varies between years and, therefore, may not accurately reflect population trends. Another important problem to note is that trapping records of many States did not differentiate between bobcats and lynx, referring to both as "lynxcats." Overall, the available data are too incomplete to infer much beyond simple occurrence and distribution of lynx in the contiguous United States (McKelvey et al. 2000a, pp.208-209)

However, lynx populations in the contiguous United States seem to be influenced by lynx population dynamics in Canada (Thiel 1987, pp.91-92; McKelvey et al. 2000b, entire) and many of these populations in Canada are directly interconnected to U.S. populations. Therefore, we assume that retaining connectivity with larger lynx populations in Canada is important to ensuring long-term persistence of lynx populations in the U.S. We assume that, regionally, lynx within the contiguous United States and adjacent Canadian provinces interact as metapopulations

and, therefore, assessments of population viability must be made at this larger scale and not solely based on populations within the contiguous United States.

### 3. Habitat Requirements

The primary factor driving lynx behavior and distribution is the distribution of snowshoe hare, their primary prey. Snowshoe hares prefer boreal forest stands that have a dense horizontal understory to provide food, cover, and security from predators. Snowshoe hares feed on conifers, deciduous trees, and shrubs (Hodges 2000b, pp.181-183). Snowshoe hare density is correlated to understory (horizontal) cover between approximately 3 to 10 feet above the ground or snow level (Hodges 2000b, pp.184-185). Habitats most heavily used by snowshoe hares are stands with shrubs, stands that are densely stocked, and stands at ages where branches have more lateral cover (Hodges 2000b, p.184). Generally, earlier successional forest stages support a greater density of horizontal understory and more abundant snowshoe hares (Buehler and Keith 1982, p.24; Wolfe et al. 1982, pp.665-669; Koehler 1990, pp.847-848; Hodges 2000b, pp.183-195; Homyack et al. 2007, pp.8-11; Griffin 2004, pp.84-88). Mature, multistoried stands also can have adequate dense understory to support abundant snowshoe hares (Hodges 2000a, pp.136-140; Griffin 2004, pp.53-54, Squires et al. 2006, pp.12-16).

Lynx are associated primarily with upper elevation (1,400 – 2,700 m) coniferous forests dominated by one of the following vegetation types: Douglas-fir, spruce-fir, fir-hemlock, and on drier sites, lodgepole pine (Aubry et al. 2000, pp.378-379). In extreme northern Idaho, northeastern Washington, and northwestern Montana, cedar-hemlock habitat types may also be considered primary vegetation. Secondary vegetation that, when interspersed within subalpine forests, may also contribute to lynx habitat, include cool, moist Douglas-fir, grand fir, western larch, and aspen forests. Dry forest types (e.g. ponderosa pine, climax lodgepole pine) do not provide lynx habitat.

In the United States, lynx inhabit conifer and conifer-hardwood habitats that support their primary prey, snowshoe hares. Both timber harvest and natural disturbance processes, including fire, insect infestations, catastrophic wind events, and disease outbreaks, can provide foraging habitat for lynx when resulting understory stem densities and structure provide the forage and cover needs of snowshoe hare (Keith and Surrendi 1971, pp.21-25; Fox 1978, p.370; Conroy et al. 1979, pp.684-689; Wolff 1980, pp.115-128; Parker et al. 1983, p.784; Litvaitis et al. 1985, pp.869-872; Bailey et al. 1986, pp.285-286; Monthey 1986, pp.569-570; Koehler 1990, pp.848-849; Agee 2000, pp.52-58, 64-71). These characteristics also include a dense, multi-layered understory that maximizes cover and browse at both ground level and at varying snow depths throughout the winter (crown cover within the lower 4.5 meters [15 feet] in order to provide cover and food for snowshoe hares to 2 meters (6 feet) high at maximum snow depths). Despite the variety of habitats and settings, good snowshoe hare habitat has a common denominator – dense, horizontal vegetative cover 1 to 3 meters (3 to 10 feet) above the ground or snow level (Hodges 2000b, pp.184-185). Multi-layered forests provide this structure, as well as high levels of cover preferred by lynx.

Snowshoe hares have evolved to survive in areas that receive deep snow (Bittner and Rongstad 1982, p.154). Primary forest types that support snowshoe hare are subalpine fir, Englemann spruce, Douglas fir, and lodgepole pine in the western United States, and spruce/fir, pine, and

deciduous forests in the eastern United States (Hodges 2000b, pp.189-190). Within these habitat types, snowshoe hares prefer stands of conifers with shrub understories that provide forage, cover to escape predators, and protection during extreme weather (Wolfe et al. 1982, pp.665-669; Monthey 1986, pp.569-570; Koehler and Aubry 1994, p.74). Hares' use of habitat is correlated with understory cover (Hodges 2000a, pp.136-140). Early successional forest stages generally have greater understory structure than do mature forests and therefore support higher hare densities (Hodges 2000b, pp.183-195). Mature forests also provide snowshoe hare habitat as openings are created in the canopy when trees succumb to disease, fire, wind, ice, or insects, and the understory develops (Agee et al. 2000, pp.47-58). In northwest Montana, connectivity of dense patches of boreal forests interspersed with open habitat, within the forest matrix benefited snowshoe hares (Ausband and Baty 2005, p.209).

Cover is important to lynx when searching for food (Brand et al. 1976, p.425). Lynx have been observed (via snow tracking) to avoid large openings (Koehler 1990, p.847; Staples 1995, p.63) during daily movements within the home range, seeming to prefer to move through continuous forest, using the highest terrain available such as ridges and saddles (Koehler 1990, p.847; Staples 1995, p.63). Lynx often hunt along edges (Mowat et al. 2000, p.274). Kesterson (1988, as cited by Mowat et al. 2000, p.274) and Staples (1995, p.30) reported that lynx hunted along the edges of mature stands within a burned forest matrix, and Major (1989, as cited by Mowat et al. 2000, p.274) found that lynx hunted along the edge of dense riparian willow stands. In Montana, lynx preferentially foraged in spruce-fir forests with high horizontal cover, abundant hares, and large diameter trees during the winter (Squires et al. 2006, pp.14-15). Lynx tended to avoid sparse, open forest and forest stands dominated by small-diameter trees during the winter.

Lynx use a variety of types of large woody debris, such as downed logs, root wads, and windfalls, to provide denning sites with security and thermal cover for kittens (McCord and Cardoza 1982, pp.743-744; Koehler 1990, pp.847-849; Koehler and Brittell 1990, p.12; Mowat et al. 2000, p.275; Squires and Laurion 2000, pp.346-347; Squires et al. 2006, pp.22-25; Mark McCollough, USFWS, pers. comm. 2007 as cited in USFWS 2007, p.19; Squires et. al. 2008, pp.1501-1502). During the first few months of life, kittens are left alone at these sites when the female lynx hunts. Downed logs and overhead cover provide protection of kittens from predators, such as owls, hawks, and other carnivores during this period. In northwestern Montana, female lynx used one to six dens per breeding season. Distance between dens and frequency of den relocation increased as kittens matured (Olson et al. 2011, p.455).

The age of the forest stand does not seem as important for denning habitat as the amount of horizontal structure available, e.g. downed, woody debris (Mowat et al. 2000, pp.274-275; M. McCollough, pers. comm. 2007, as cited in USFWS 2007, p.19), which provides hiding cover and shelter for kittens. Den sites may be located within older regenerating stands (>20 years since disturbance) or in mature conifer or mixed conifer-deciduous (typically spruce/fir or spruce/birch) forests. In Montana, lynx selected den sites with higher horizontal cover than elsewhere in the animal's home range (Squires et al. 2006, p.24; Squires et al. 2008, p.1502). Seventy-three percent of lynx dens were found in mature, mesic forests. Dens were also located in regenerating mesic forests (18 percent) and boulder fields (7 percent). More recently, Squires et al. (2008, p.1502) found dens in Montana primarily within mature forest stands (80 percent), mid-seral regenerating forests (13 percent), young regenerating stands (5 percent) and thinned stands (2 percent). In Montana, dens were also found in topographically concave or drainage-like

areas away from forest edges (Squires et al. 2008, p.1502). In Washington, lynx used *Pinus contorta* (lodgepole pine), *Picea* spp. (spruce), and *Abies lasiocarpa* (subalpine fir) forests older than 200 years with an abundance of downed woody debris for denning (Koehler 1990, p.847). A den site in Wyoming was located in a mature subalpine fir/ lodgepole pine forest with abundant downed logs and a high amount of horizontal cover (Squires and Laurion 2000, pp. 346-347).

In the northeast United States, lynx dens were found in a several stand types including softwood mid/late regeneration, mature forest mixed regeneration, mature softwood, other regeneration, and hardwood/softwood mid/late regeneration. The structural components of lynx den sites are common features in managed (logged) and unmanaged (spruce budworm damaged areas, wind-throw) stands. Tip-up mounds (root wads) were the most common predictor of den sites in Maine (M. McCullough, pers.comm. 2007, as cited in USFWS 2007, p.19). A key component for suitable lynx denning habitat appears to be horizontal structural.

Denning habitat in or near foraging habitat is likely to be most functional and selected by females. The hunting range of females is restricted at the time of parturition, and their need to feed kittens requires an abundance of prey. Lynx, like other felids, frequently move their kittens until they are old enough to hunt with their mother. Multiple nursery sites are used that provide kittens with overhead cover and protection from predators and the elements. Downed logs and overhead cover throughout the home range provides security when lynx kittens are old enough to travel (Koehler 1990, p.847). In northwestern Montana, female lynx used one to six dens per breeding season. Distance between dens and frequency of den relocation increased as kittens matured (Olson et al. 2011, p. 455). Females stayed at natal dens an average of 21 days, and the time spent at subsequent dens decreased with time since parturition (Olson et al. 2011, p 458). Females stopped caching kittens at dens when kittens were approximately 2 months old (Olson et al. 2011, p.459), when they are mobile enough to travel with their mothers.

Some mammals are more sensitive to disturbance when they bear and rear young. Scientists frequently handle lynx kittens without apparent adverse effects, although in some cases females moved their kittens to new maternal den sites following handling (Mowat et al. 1996, p.443; Olson et al. 2011, p.460). In Montana, four female lynx relocated dens within four days of the scientist's visit to the den, whereas 4 females did not relocate until at least 20 days after the human disturbance (Olson et al. 2011, pp.459-460). However, frequent movement of den sites and kittens is not unusual behavior, as females use on average 3 maternal dens per year (range 1-5) even when human disturbance is not present (Olson et al. 2011, p.459).

### 4. Mortality

Reported causes of lynx mortality vary between studies. The most commonly reported causes include starvation, predation, and human-caused mortalities such as vehicle collisions and trapping or shooting.

#### *Starvation*

Starvation is one of the most commonly reported causes of mortality, which includes adult and juvenile starvation (Quinn and Parker 1987, p.685; Carbyn and Patriquin 1983, p.266; Koehler 1990, p.850, Squires et al. 2006, p.19). Significant lynx mortality due to starvation has been

demonstrated in cyclic populations of the northern taiga, during the first 2 years of hare scarcity (Poole 1994, p.616; Slough and Mowat 1996, p.953). Northern population studies have shown that, during periods of low snowshoe hare numbers, starvation can account for up to two-thirds of all natural lynx deaths. Hunger-related stress, which induces dispersal, may increase the exposure of lynx to other forms of mortality such as trapping and highway collisions (Brand and Keith 1979, p.845; Carbyn and Patriquin 1983, p.265; Ward and Krebs 1985, p.2823; Bailey et al. 1986, pp.283-284).

***Predation***

Predation on lynx by mountain lion (*Puma concolor*), coyote (*Canis latrans*), wolverine (*Gulo gulo*), gray wolf (*Canis lupus*), and other lynx has been confirmed (Berrie 1974, p.17; Koehler et al. 1979, p.442; Poole 1994, p.613; Slough and Mowat 1996, p.953; O'Donoghue et al. 1997, p.156; Apps et al. 2000, p.359; Aubry et al. 2000, p.392; Squires and Laurion 2000, p.346; Squires et al. 2006, p.19). In Montana, 15 lynx mortalities from predation were documented with greater than 90 percent due to mountain lion predation (Squires et al. 2006 as cited *In* ILBT 2013). Observations of predation events are rare; therefore the significance of predation on lynx populations is currently unknown.

***Vehicle Collisions***

Vehicle collisions have caused lynx mortalities in most occupied geographic areas in the U.S. Primarily, these vehicle collisions have occurred on highways with high speed and high traffic volume that pass through lynx habitat, such as I-70, I-80, US 50, US 550 and US 160. Two highway mortalities have been documented in Wisconsin (Thiel 1987, p.93), six highway mortalities have been documented in Minnesota on the edge of lynx range, and twelve highway mortalities have been documented in Canada and Alaska (Staples 1995, p.30; Gibeau and Heur 1996, p.4; T. Clevenger, pers. comm. 1999, as cited by Apps et al. 2000, p.354; Alexander, pers. comm. 1999, as cited by Ruediger et al. 2000, p.11). In addition, 18 translocated lynx were killed on highways in New York (Brocke et al. 1991 as cited *In* ILBT 2013) and 13 translocated lynx were killed on highways in Colorado (Devineau et al. 2010, p.528 as cited *In* ILBT 2013); however Brocke et al. (1990 as cited *In* ILBT 2013) suggests that translocated individuals may be more susceptible to highway mortality than the aforementioned events with resident lynx.

Vehicle collisions resulting in lynx mortalities have also occurred on paved or graveled forest road systems in Minnesota and Maine. In Minnesota, two vehicle collisions resulting in lynx mortality have been documented on graveled forest roads in Minnesota (USFWS 2012 as cited *In* ILBT 2013). In Maine, twelve vehicle collisions have been documented on graveled forest roads (Mark McCollough, USFWS, pers. comm. 2006 as cited by Ruediger et al. 2000, p.11; Vashon et al. 2012); however the forest roads in Maine often have higher speeds and higher traffic volume than most forest road systems in lynx habitat in other geographic areas. Vehicle collisions on forest roads are less likely to occur when compared to highways; however it is important to consider that extensive (>600 km) backtracking studies in Montana have found that lynx do not avoid gravel forest roads (Squires et al. 2010 as cited *In* ILBT 2013) and lynx may use the roadbed on less traveled forest roads for travel and foraging (Koehler and Brittell 1990 as cited *In* ILBT 2013).

### *Trapping and Shooting*

Human-caused mortality can be directly caused by trapping and shooting.

Trapping

State wildlife management agencies regulate the trapping of furbearers. Trapping and snaring of lynx is currently prohibited across the contiguous United States. Incidental trapping or snaring of lynx can occur in areas where regulated trapping for other species, such as wolverine, coyote, fox, fisher, marten, bobcat and wolf, overlaps with lynx habitats (Mech 1973, Carbyn and Patriquin 1983, Squires and Laurion 2000, U.S. Fish and Wildlife Service unpublished data 2011, USFWS 2012, Vashon et al. 2012 as cited *In* ILBT 2013) and involves a variety of traps including foot-holds, body gripping traps, and snares (USFWS 2012 as cited *In* ILBT 2013).

Incidental trapping has been reported in Maine, Minnesota, Montana and Idaho. In Maine from 2000-2012, 59 lynx were reported captured in traps set for other furbearers, of which at least 6 resulted in mortalities (Vashon et al. 2012 as cited *In* ILBT 2013). In Minnesota during the same time period, 22 lynx were reported captured in traps and snares, of which at least 12 resulted in mortalities (USFWS 2012 as cited *In* ILBT 2013). In Montana, 10 lynx were reported trapped, of which at least 4 resulted in mortalities. Two lynx were trapped in Idaho, 1 in 2012 (Beth Waterbury, Idaho Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013) and another in 2013 (Michael Lucid, Idaho Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013), which resulted in 1 mortality.

Injuries and mortalities related to incidental trapping can be minimized through various techniques. Several states including Maine, Minnesota and Montana have implemented special regulations to reduce the likelihood of incidental capture of lynx in traps set for other furbearers.

Shooting

Lynx can be intentionally shot by poachers or mistakenly shot by legal hunters. In the reintroduced population in Colorado, shooting was the cause of 14 known and 5 probable mortalities (Devineau et al. 2010 as cited *In* ILBT 2013). In Maine, 5 lynx have been reported as shot, and in Minnesota, 6 lynx have been reported as shot and killed, which included 2 radiocollared lynx (USFWS 2012 as cited *In* ILBT 2013). In Washington, 1 lynx was accidentally shot in 1999 by a licensed hunter who mistook it for a bobcat (Harriet Allen, Washington Dept. of Fish and Wildlife, pers. comm. 1999), and in Montana, 2 lynx were poached by mountain lion hunters (USFWS 2001 as cited *In* ILBT 2013). In Minnesota Since 2001, 6 lynx are known to have been shot and killed, 2 of which were radio-collared (USFWS 2012 as cited *In* ILBT 2013).

### 5. Interspecific Relationships with Other Carnivores

The two major competition impacts to lynx are likely exploitation (competition for food) and interference (avoidance). Several predators (birds of prey, coyote, gray wolf, mountain lion, bobcat [*Lynx rufus*], and wolverine) consume snowshoe hares and therefore compete at some level with lynx for prey. Lynx have adaptations for surviving in areas that have cold winters with

deep, fluffy snow for extended periods; these adaptations provide lynx a competitive advantage in hunting snowshoe hare over a number of potential competitors, such as bobcats or coyotes (McCord and Cardoza 1982, p.748; Buskirk et al. 2000, pp.86-95; Ruediger et al. 2000, pp.1-11; Ruggiero et al. 2000a, pp.445-450). In one paper, coyotes were theorized to most likely pose local or regionally important exploitation impacts to lynx, and coyotes and bobcats were deemed to possibly impart important interference competition effects on lynx (Buskirk et al. 2000, pp.90-95). Mountain lions have been identified as potential interference competitors, possibly impacting lynx during summer and in areas lacking deep snow in winter, or when high elevation snow packs develop crust in the spring. Long-term snow conditions presumably limit the winter distribution of potential lynx competitors such as bobcats (McCord and Cardoza 1982, p.748) or coyotes. Further, 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.

Concerns regarding the effect of winter recreation on lynx behavior and habitat use remain a focal point for land management agencies. The best available research regarding the preferential use of compacted snow by coyotes and dietary overlap between lynx and coyotes suggests that both factors vary geographically and temporally. Snow conditions in different regions may determine whether or not snowmobile trails influence coyote movements (Bunnell et al. 2006, p.835; Kolbe et al. 2007, pp.1413-1416; Burghardt-Dowd 2010, pp.76-77). In addition to snow conditions, prey availability and geography may influence dietary overlap between lynx and coyotes. For example, one study in Maine found that snowshoe hares comprised 37 percent of coyote winter diet on the Maine coast, not in lynx habitat (Major and Sherborne 1987), and another separate study in western Maine found that snowshoe hare comprised 39% of coyote winter diet, in lynx habitat (Litvaitis and Harrison 1989). However, in two separate studies in Montana and Wyoming, biologists found that coyotes were primarily scavengers in the winter. In the Montana study, snowshoe hare remains were present at only 3% of coyote winter feed sites (Kolbe et al. 2007, pp.1415-1416) and in Wyoming, snowshoe hares remains were found in only 8% of the coyote winter scat samples collected (Burghardt-Dowd 2010, pp.19-20), which is likely due to the availability of carrion, an alternative food resource for coyotes.

Exploitation competition may contribute to lynx starvation and reduced recruitment. During periods of low snowshoe hare numbers, starvation accounted for up to two-thirds of all natural lynx deaths in the Northwest Territories of Canada (Poole 1994, pp.613-614). As described previously, major predators of snowshoe hare include lynx, northern goshawk (*Accipiter gentilis*), great horned owl (*Bubo virginianus*), bobcat, coyote, red fox (*Vulpes vulpes*), fisher (*Martes pennanti*), and mountain lion. In southern portions of snowshoe hare range, predators may limit hare populations to lower densities than in the taiga (Dolbeer and Clark 1975, pp.546-547; Wolff 1980, p.128; Koehler and Aubry 1994, pp.74-75).

Based on only anecdotal evidence, Parker et al. (1983, p.784) discussed competition between bobcats and lynx on Cape Breton Island. Lynx were found to be common over much of the island prior to bobcat colonization. Concurrent with the colonization of the island by bobcats, lynx densities declined and their presence on the island became restricted to the highlands, the one area where bobcats did not become established.

Canada lynx-bobcat hybridization was first officially documented in a wild lynx population in Minnesota; however it was not known at this time whether hybrids could successfully reproduce (Schwartz et al. 2004, pp. 353-354). Homyack et al. (2008, p.507) identified two hybrids that were capable of reproduction through direct observation or placental scars. To date, there has been no evidence of hybridization in the western U.S., perhaps due to elevation differences between lynx and bobcat home ranges during the winter (i.e. lynx breeding season). In 2004, Schwartz et al. (p.354) noted that further research efforts need to be undertaken to describe the extent, rate, and nature of hybridization between these species and to understand the ecological context in which hybridization occurs.

### 6. Status and Distribution

Lynx populations in the contiguous United States occur at the southern periphery of a widely-distributed metapopulation whose core is located in the northern boreal forest of central Canada (McCord and Cardoza 1982, p.729; Quinn and Parker 1987, p.684; McKelvey et al 2000b, p.24). The boreal forest of central Canada is vast and extends into Alaska. Lynx in the contiguous United States are at the southern margins, or periphery, of its range. Here, the southernmost extent of the boreal forest that supports lynx occurs in the Northeast, western Great Lakes, northern and southern Rockies, and northern Cascades (Ruediger et al. 2000, pp.42-47).

The historical and present range of the lynx north of the contiguous United States includes Alaska and that part of Canada that extends from the Yukon and Northwest Territories south across the United States border and east to New Brunswick and Nova Scotia. In the contiguous United States, lynx historically occurred in the Cascades Range of Washington and Oregon; the Rocky Mountain Range in Montana, Wyoming, Idaho, eastern Washington, eastern Oregon, northern Utah, and Colorado; the western Great Lakes Region; and the northeastern United States region from Maine southwest to New York (McCord and Cardoza 1982, p.729). A thorough discussion and interpretation of lynx records through time is found in the USFWS's final rule (March 24, 2000, 65 FR 16052) and clarification of our findings (July 2003; 68 FR 40076).

The distribution of lynx in North America is closely associated with the distribution of North American boreal forest (Agee 2000, p.39). In Canada and Alaska, lynx inhabit the classic boreal forest ecosystem known as the taiga (Quinn and Parker 1987, p.684; Agee 2000, p.41; McKelvey et al. 2000a, p.211). The range of lynx extends south from the classic boreal forest zone into the subalpine forest of the western United States, and the boreal/hardwood forest ecotone in the eastern United States (Agee 2000, pp.43-46; McKelvey et al. 2000a, pp.211-231). Forests with boreal features (Agee 2000, p.40) extend south into the contiguous United States along the Cascade and Rocky Mountain Ranges in the west, the western Great Lakes Region, and along the Appalachian Mountain Range of the northeastern United States. Within these general forest types, lynx are most likely to persist in areas that receive deep snow, to which the lynx is highly adapted (Ruggiero et al. 2000a, pp.445-449). Lynx are rare or absent from the wet coastal forests of Alaska and Canada (Mowat et al. 2000, p.272).

At its southern margins in the contiguous United States, forests with boreal features, or southern boreal forests, become naturally fragmented as they transition into other vegetation types. Southern boreal forest habitat patches are small relative to the extensive northern boreal forest of

Canada and Alaska, which constitutes the majority of lynx range. Many southern boreal forest habitat patches within the contiguous United States cannot support resident populations of lynx and their primary prey species.

The complexities of lynx life-history and population dynamics, combined with a general lack of reliable population data for the contiguous United States, make it difficult to ascertain the past or present population status of lynx in the contiguous United States. It is difficult to determine with certainty whether reports of lynx in many States were (1) animals dispersing from northern populations that were effectively lost because they did not join or establish resident populations, (2) animals that were a part of a resident population that persisted for many generations, or (3) a mixture of both resident and dispersing animals.

The final rule determining threatened status for the lynx in the contiguous United States summarized lynx status and distribution across four regions that are separated from each other by ecological barriers consisting of spans of area lacking lynx habitat (March 24, 2000, 65 FR 16052). These distinct regions are the Northeast, the Great Lakes, the Northern Rocky Mountains/Cascades, and the Southern Rocky Mountains. The recovery outline for the species split these regions into six "core" areas for lynx, with the southern Rocky Mountains area designated as an additional "provisional core" area (USFWS 2005). While these regions are ecologically unique and discrete, the lynx is associated with only the southern boreal forest in each and, with the exception of the Southern Rocky Mountains Region, each area is geographically connected to the much larger population of lynx in Canada.

The following summarizes status and distribution information of the lynx DPS in the contiguous United States:

***Northeast Region (Maine, New Hampshire, Vermont, New York)***

Based on an analysis of cover types and elevation zones containing most of the lynx occurrences, McKelvey et al. (2000a, pp.211-217) determined that, at the broad scale, most lynx occurrence records in the Northeast were found within the "Mixed Forest-Coniferous Forest-Tundra" cover type at elevations ranging from 250 to 750 meters (820 to 2,460 feet). This habitat type in the northeast United States occurs along the northern Appalachian Mountain range from southeastern Quebec, western New Brunswick, and western Maine, south through northern New Hampshire. This habitat type becomes naturally more fragmented and begins to diminish to the south and west, with a disjunct segment running north-south through Vermont, an extensive patch of habitat in the Adirondacks of northern New York, and with a few more distant and isolated patches in Pennsylvania (see Figure 8.23 in McKelvey et al. 2000a, p.249).

In the northeast, information on the presence of lynx was limited at the time of listing in 2000. In 1999, 6 lynx were radio-collared in northern Maine (March 24, 2000; 65 FR 16052). As of 2004, Maine Department of Inland Fisheries and Wildlife had radio-collared 43 lynx (Vashon et al. 2008, p.1492) and documented 34 litters (Vashon et al. 2005b as cited in Vashon et al. 2012, p 19) Records show lynx currently to be distributed throughout northern Maine (November 9, 2005; 70 FR 68294). Lynx in Maine currently have high productivity; 91 percent of available adult females older than 2 years produced litters averaging 3 kittens (Vashon et al. 2012, p.18). This area is the only area in the northeastern region of the lynx's range within the contiguous

United States that currently supports breeding lynx populations and likely acts as a source or provides connectivity for peripheral portions of the lynx's range in the Northeast.

Federal agencies manage a minor amount of lynx habitat in this region. The White Mountain National Forest has amended its Plan to include the LCAS and so addressed in part, on National Forest lands, the major factor threatening the lynx: inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx. The preponderance of lynx habitat in this region occurs on private lands in the State of Maine. This area presently supports the largest population of Canada lynx in the lower 48 states due in part to past timber management practices that created lynx habitat (i.e., vast clearcutting in the 1970s and 1980s). The Maine Forest Practices Act (1989) greatly changed forest practices and replaced clearcutting with various forms of partial harvesting, which produces habitat that supports fewer numbers of snowshoe hares. Hence, we expect lynx numbers to decline from present levels in this region.

***Great Lakes Region (Minnesota, Wisconsin, Michigan)***

The majority of lynx occurrence records in the Great Lakes Region are associated with the "mixed deciduous-coniferous forest" type (McKelvey et al. 2000a, p.248). Within this general forest type, the highest frequency of lynx occurrences were in the *Acer saccharum* (sugar maple), *Tilia spp.* (basswood), *Pinus banksiana* (jack pine), *P. strobus* (white pine), and *P. resinosa* (red pine) forest types (McKelvey et al. 2000a, p.247). These types are found primarily in northeastern Minnesota, northern Wisconsin, and the western portion of Michigan's Upper Peninsula.

Mixed deciduous-coniferous forest covers an extensive area in this region, but much of this area is considered marginal habitat for lynx because it is a transitional forest type at the edge of the snowshoe hare range. Habitat at the edge of hare range supports lower hare densities (Buehler and Keith 1982, pp.24-28) that may not be sufficient to support lynx reproduction. Snow depths within appropriate habitat that allow lynx a competitive advantage over other carnivores (i.e., coyotes) occur only in limited areas in northeastern Minnesota, extreme northern Wisconsin, and Michigan's upper peninsula.

At the time of listing, we were unsure of whether the Great Lakes Region supported resident populations of lynx or if lynx documented in these areas were simply dispersing from Canada (March 24, 2000; 65 FR 16052) (McKelvey et al. 2000b, pp.217-221, 233-235; R. Sando, Minnesota Department of Natural Resources, in litt. 1998, as cited in USFWS 2007, p.27). Since that time, numerous lynx have been verified from northeastern Minnesota through DNA analysis, radio- and GPS-collared animals, and documentation of reproduction (November 9, 2005; 70 FR 68294). Northeastern Minnesota is the only area in the Great Lakes region for which we have evidence of recent lynx reproduction; as such, it likely acts as a source or provides connectivity for more peripheral portions of the lynx's range in this region.

The Forest Service in Minnesota manages a preponderance of lynx habitat in this region. All National Forests in the region have amended or revised their Plans, and so addressed in part, on National Forest lands, the primary factor threatening the lynx: inadequacy of existing regulatory

mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Plans and BLM Plans. These include the Chippewa, Superior, Hiawatha, and Ottawa National Forests. Voyageurs National Park in Minnesota was designated as lynx critical habitat in 2006. This designation will ensure that lynx habitat within the park will be managed to conserve lynx.

The final rule for critical habitat summarizes other private land conservation efforts for lynx in the region (November 9, 2006, 71 FR 66009).

***Northern Rocky Mountain/Cascades Region (Washington, Oregon, Montana, Idaho, Wyoming, Utah)***

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. 2000a, pp.224-232, 246). Most of the lynx occurrences are in the 1,500-2,000 meters (4,920-6,560 feet) elevation class (McKelvey et al. 2000a, pp.243-246). 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. The majority of verified lynx occurrences in the United States and the confirmed presence of resident populations are from this region. The boreal forest of Washington, Montana, and Idaho is contiguous with that in adjacent British Columbia and Alberta, Canada.

Northwestern Montana and the north Cascades in Washington currently have resident lynx populations, and strong evidence exists to support the presence of resident lynx distributed throughout much of the forest types considered lynx habitat in Montana and Washington (November 9, 2005; 70 FR 68294). Resident lynx populations exist in contiguous habitats in Idaho, Montana and northwestern Wyoming in the Greater Yellowstone Area (e.g., Murphy et al. 2004, pp.7-10). Lynx have probably always occurred only intermittently in peripheral areas of Oregon and Utah, although the historical or current presence of resident populations in either of these States has not been confirmed.

The North Cascades, Yellowstone and Glacier National Parks manage substantial amounts of lynx habitat in this region. Lynx occur in all three National Parks. Through National Park Service management, lynx habitat is generally managed in ways that promote natural ecological processes, which benefits lynx. Glacier National Park provides a large expanse of lynx habitat that is contiguous with lynx habitat in Canada. Of the three Parks, Glacier and North Cascades were determined to meet the habitat criteria requirements for critical habitat, and were designated critical habitat in 2006 and retained their critical habitat designation in the 2009 revised designation of critical habitat. This designation will further ensure that lynx habitat within the Parks will be managed to conserve lynx.

The BLM Spokane District in Washington manages lynx habitat. Its Resource Management Plan was modified in 2003 to incorporate the provisions of the Lynx Conservation Assessment Strategy (2000 LCAS) (Ruediger et al. 2000, entire). On November 30, 2006, we completed consultation with the BLM for the revision of their Coeur d'Alene Resource Management Plan in which lynx were addressed. The Cottonwood BLM in southern Idaho recently issued its Resource Management Plan (March 2010) which includes the standards and guidelines in the

2000 LCAS for lynx. The Missoula BLM district has also amended their plan to abide by the standards and guides in the 2000 LCAS.

The Forest Service manages the preponderance of lynx habitat in the Northern Rocky Mountain/Cascades region. Through the Northern Rockies Lynx Management Direction (NRLMD), 18 National Forests addressed in part on National Forest lands, the primary factor threatening the lynx: inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Plans and BLM Plans. These include the Custer, Flathead, Gallatin, Helena, Kootenai, Lewis and Clark, Lolo, Bitterroot, and Beaverhead-Deerlodge National Forests in Montana; the Clearwater, Nez Perce, Idaho Panhandle, Salmon-Challis, and Targhee National Forests in Idaho; the Ashley National Forest in Utah; and the Bridger Teton, Shoshone, and Bighorn National Forests in Wyoming. The Boise, Payette, and Sawtooth National Forests of Idaho have amended or revised their plans to address this factor, as have the Uinta and Wasatch-Cache National Forests in Utah. Region 6 of the Forest Service in Washington intends to address this factor through Forest Plan revision, which has started for the Okanogan-Wenatchee and Colville (all occupied by lynx), and the Malheur, Wallowa-Whitman, Umatilla (unoccupied) National Forests. The Mount Baker National Forest Plan is not yet in revision.

The final rule for critical habitat and the revised designation of critical habitat summarizes other private land conservation efforts for lynx in the region (November 9, 2006, 71 FR 66009; February 25, 2009, 71 FR 8616).

***Southern Rocky Mountains Region (Colorado, southeastern Wyoming)***

Colorado represents the extreme southern edge of the range of the lynx. A majority of the lynx occurrence records in Colorado and southeastern Wyoming were associated with the "Rocky Mountain Conifer Forest" type. The occurrences in the Southern Rockies were generally at higher elevations (8,000-12,000 feet) than were all other occurrences in the West (Ruediger et al. 2000, p.52).

A resident lynx population may have occurred historically in the Southern Rocky Mountains Region, based on a small number of lynx records from Colorado. If this population existed it was extirpated by the early 20th century. In 1999, the Colorado Division of Wildlife (CDOW) began a reintroduction effort that that concluded in 2010. From 1999 to 2006, 218 adult lynx were released; of the released adults 122 mortalities have been documented (Devineau et al. 2010, p.528). Reproduction was documented in the years 2003- 2006, and again in 2009 and 2010 (CDOW 2010, p.2).

The southern boreal forest of Colorado and southeastern Wyoming is isolated from boreal forest in Utah and northwestern Wyoming by the Green River Valley and the Wyoming basin (Findley and Anderson 1956 in McKelvey et al. 2000a, p.230). However, 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. A number of lynx from the reintroduced population in Colorado have recently dispersed great distances, with occurrences located in Kansas, Nevada, South Dakota, Arizona, Idaho, Nebraska, Montana, Wyoming and New Mexico (T. Shenk, pers. comm. 2007, as cited in USFWS 2007,

p.29). Thirty-three different individuals were located in Wyoming, seven in Montana and six in Nebraska. Such information indicates that dispersing lynx are able to traverse long distances across extremely variable terrain.

The Forest Service manages the preponderance of lynx habitat in this region. All National Forests in the region addressed through amending or revising their Plans, on National Forest lands, the primary factor threatening the lynx: inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Plans and BLM Plans. The Forests completed a Final Environmental Impact Statement and Record of Decision for the Southern Rocky Lynx Amendment in 2008. The USFWS prepared a biological assessment for consultation under section 7(a)2 in 2008. The Forests included the Medicine Bow, Routt, Arapaho-Roosevelt, Pike and San Isabel, Rio Grande, White River, Grand Mesa, Uncompahgre, Gunnison, and the San Juan National Forests.

### 7. Recovery Outline

We developed a recovery outline for lynx in the contiguous United States (USFWS 2005, entire). The purpose of the outline is to serve as an interim strategy to guide recovery efforts until a final recovery plan is completed. The outline introduces concepts regarding the relative importance of different geographic areas to the persistence of lynx in the contiguous United States, identifying areas as either core, provisional core, secondary or peripheral based on lynx records over time and evidence of reproduction.

Core areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. Six core areas and one "provisional" core area are identified within the contiguous United States. The provisional core area in the Southern Rockies was identified because it contains a reintroduced population. Reproduction has been documented in this introduced population; however, it is too early to determine whether a self-sustaining lynx population will result.

"Focusing lynx conservation efforts on these core areas will ensure the continued persistence of lynx in the contiguous U.S. by addressing fundamental principles of conservation biology." The recovery outline continues, "At this time, the role of areas outside of **core areas** in sustaining lynx populations in the contiguous United States is unclear. The fluctuating nature of lynx population dynamics and the ability of lynx to disperse long distances have resulted in many individual occurrence records outside of core areas, without accompanying evidence of historic or current presence of lynx populations. Areas classified as **secondary areas** are those with historical records of lynx presence with no record of reproduction; or areas with historical records and no recent surveys to document the presence of lynx and/or reproduction. If future surveys document presence and reproduction in a secondary area, the area could be considered for elevation to core. We hypothesize that secondary areas may contribute to lynx persistence by providing habitat to support lynx during dispersal movements or other periods, allowing animals to then return to core areas. In **peripheral areas** the majority of historical lynx records is sporadic and generally corresponds to periods following cyclic lynx population highs in Canada. There is no evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by lynx. However, some of these peripheral areas may provide habitat enabling the successful dispersal of lynx between populations or subpopulations. At this

time, we simply do not have enough information to clearly define the relative importance of secondary or peripheral areas to the persistence of lynx in the contiguous United States (USFWS 2005).

The recovery outline provides four preliminary recovery objectives, which are accompanied by recovery actions needed to attain objectives. A discussion of how the proposed action relates to the recovery outline can be found later in this biological opinion, in Section D.

> **Objective 1:** Retain adequate habitat of sufficient quality to support the long-term persistence of lynx populations within each of the identified core areas.
>
> **Objective 2:** Ensure that sufficient habitat is available to accommodate the long-term persistence of immigration and emigration between each core area and adjacent populations in Canada or secondary areas in the United States.
>
> **Objective 3:** Ensure that habitat in secondary areas remains available for continued occupancy by lynx.
>
> **Objective 4:** Ensure that threats have been addressed so that lynx populations will persist in the contiguous United States for at least the next 100 years.

All four objectives and the following actions identified in the recovery outline are most relevant to this project.

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

3.0 Monitor lynx use in LAUs, or other appropriate management unit, at least once every ten years to determine distribution and occupancy within the core area.

4.1 Develop and implement long-term management commitments with key Canadian, U.S. Federal, State, Tribal and private forest landowners to conserve habitats facilitating movement between each core area and lynx populations in Canada.

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

5.4 Identify and implement management efforts as necessary to provide lynx habitat in secondary areas. Use the Lynx Conservation Assessment Strategy (Ruediger et al. 2000, pp.75-92) as habitat management guidance in secondary areas.

### 8. Status of Lynx Designated Critical Habitat

The USFWS published a revised designation of critical habitat for the contiguous United States distinct population segment of the Canada lynx. The final rule was published on February 25, 2009 and became effective on March 27, 2009 (74 FR 8616). In total, approximately 39,000 square miles fall within the boundaries of the revised critical habitat designation, in five units in the states of Maine, Minnesota, Montana, Wyoming, Idaho and Washington (Table III-3).

**Table III-3. Critical habitat units designated for lynx (74 FR 8616).**

| Critical Habitat Units | Area Designated ($mi^2$) | Land Ownership |
|---|---|---|
| Unit 1: Maine | 9,497.2 | Private, State, Federal |
| Unit 2: Minnesota | 8,065.1 | Federal, Private, State |
| Unit 3: Northern Rocky Mountains (MT and ID) | 10,101.6 | Federal, Private, State |
| Unit 4: North Cascades | 1,835.9 | Federal, Private |
| Unit 5: Greater Yellowstone Area (MT and WY) | 9,500.5 | Federal, State, Private |
| **TOTAL** | **39,000.3** | |

The five units contain the physical and biological features essential to the conservation of the lynx as they are comprised of the primary constituent element and its components laid out in the appropriate quantity and spatial arrangement. The units are discussed below with information taken from the final rule revising designated critical habitat for lynx (74 FR 8616). Following the discussion of units is a discussion of the primary constituent element and its components. The Service is conducting a review of lynx designated critical habitat and intends to release a new proposed rule for critical habitat later in 2013. As a result of this review, the acres included in some Critical Habitat Units may change. For example, as discussed previously, the 3,434 acres of critical habitat outside LAUs on the IPNF will be removed from designation.

***Critical Habitat Units***

Unit 1 is located in northern Maine in portions of Aroostook, Franklin, Penobscot, Piscataquis, and Somerset Counties. This area was occupied by the lynx at the time of listing and is currently occupied by the species. This area is the one area in the northeastern region of the lynx's range within the contiguous United States that currently supports breeding lynx populations and may serve as a source of lynx, or provide connectivity for more peripheral portions of the lynx's range, in the Northeast. About 10 percent (600,000 acres) of the area of the Northeast lynx critical habitat is enrolled in the Natural Resources Conservation System Healthy Forest Reserve Program. These landowners have developed lynx forest management plans for a 10-year period.

Unit 2 is located in northeastern Minnesota in portions of Cook, Koochiching, Lake, and St. Louis Counties. This area was occupied by the lynx at the time of listing and is currently occupied by the species. Lynx are currently known to be distributed throughout northeastern Minnesota. This area is essential to the conservation of lynx because it is the only area in the Great Lakes region for which there is evidence of recent lynx reproduction. It likely acts as a source or provides connectivity for more peripheral portions of the lynx's range in the region. National Forest land in Unit 2 is managed under Forest Plans that have incorporated management direction similar to the NRLMD, which reduces or eliminates adverse effects on lynx, by reducing adverse effects on habitat important to lynx. Where the NRLMD or similar strategies avoid adverse effects on lynx habitat and snowshoe hare habitat, it would avoid adverse effects on lynx critical habitat.

Unit 3 is located in northwestern Montana, in portions of Flathead, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Missoula, Pondera, Powell, and Teton Counties and in a small portion of northeastern Idaho in Boundary County. This area is approximately 10,000 square miles

(6,465,254 acres), was occupied by the lynx at the time of listing, and is currently occupied by the species. Lynx are known to be widely distributed throughout this unit and breeding has been documented in multiple locations. This area is essential to the conservation of lynx because it appears to support the highest density lynx populations in the Northern Rocky Mountain region of the lynx's range. It likely acts as a source for lynx and provides connectivity to other portions of the lynx's range in the Rocky Mountains, particularly the Yellowstone area. Table III-4 illustrates the preponderance of federal lands, which are primarily National Forest system lands, within Unit 3. National Forest lands in Unit 3 are managed under the NRLMD; BLM lands are generally managed under the 2000 LCAS. Where the NRLMD or similar strategies avoid adverse effects on lynx habitat and snowshoe hare habitat, it would avoid adverse effects on lynx critical habitat.

**Table III-4. Square miles of lynx critical habitat per ownership per State in Unit 3: Montana and Idaho (74 FR 8616).**

| | Federal ($mi^2$) | State ($mi^2$) | Private($mi^2$) | Tribal ($mi^2$) | Other($mi^2$) |
|---|---|---|---|---|---|
| Montana | 11,182 | 372 | 1,985 | 347 | 72 |
| Idaho | 50 | 1 | 0 | 0 | 0 |

Unit 4 is located in north-central Washington in portions of Chelan and Okanogan Counties and includes BLM lands in the Spokane District. This area was occupied by lynx at the time of listing and is currently occupied by the species. This unit supports the highest densities of lynx in Washington. This area is essential to the conservation of lynx because it is the only area in the Cascades region of the lynx's range that is known to support breeding lynx populations. National Forest lands in Unit 4 are managed under the 2006 Conservation Agreement (USFS and USFWS 2006, entire). Where the NRLMD or similar strategies avoid adverse effects on lynx habitat and snowshoe hare habitat, it would avoid adverse effects on lynx critical habitat.

Unit 5 is located in Yellowstone National Park and surrounding lands in southwestern Montana, in portions of Gallatin, Park, Sweetgrass, Stillwater, and Carbon Counties, and in northwestern Wyoming in portions of Park, Teton, Fremont, Sublette, and Lincoln Counties. This area was occupied by the lynx at the time of listing and is currently occupied by the species. The Greater Yellowstone Area is inherently marginal lynx habitat with highly fragmented foraging habitat (snowshoe hare habitat). For this reason lynx home ranges in this unit are likely to be larger and incorporate large areas of non-foraging matrix habitat. National Forest lands in Unit 5 are managed under either the NRLMD (USFS 2007) or the Southern Rockies Lynx Management Direction (USFS 2008), which provides management direction similar to the NRLMD. Where the NRLMD or similar strategies avoid adverse effects on lynx habitat and snowshoe hare habitat, it would avoid adverse effects on lynx critical habitat.

***Primary Constituent Elements of Critical Habitat***

The physical and biological features that are essential to the conservation of the species have been identified within the geographical area occupied by the lynx at the time of listing. These physical and biological features are the primary constituent elements (PCEs) laid out in a specific quantity and spatial arrangement to be essential to the conservation of the species. Based on this

and the current knowledge of the life history, biology and ecology of the species, the PCE for lynx critical habitat is:

1. Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:

    a. Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;

    b. Winter snow conditions that are generally deep and fluffy for extended periods of time;

    c. Sites for denning that have 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.

***Actions That May Affect Proposed Critical Habitat***

The final rule also described three types of Federal actions that may adversely affect critical habitat, and therefore should result in consultation. Briefly, these are:

1. Actions that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx….These activities could significantly reduce the quality of snowshoe hare habitat such that the landscape's ability to produce adequate densities of snowshoe hares to support persistent lynx populations is at least temporarily diminished.

2. Actions that would cause permanent loss or conversion of the boreal forest on a scale proportionate to the large landscape used by lynx….Such activities could eliminate and fragment lynx and snowshoe hare habitat.

3. Actions that would increase traffic volume and speed on roads that divide lynx critical habitat….These activities could reduce connectivity within the boreal landscape for lynx, and could result in increased mortality of lynx.

4. In matrix habitat, activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range, or if they adversely affect adjacent foraging or denning habitat.

## 9. Factors Affecting the Status of Lynx Rangewide

The final rule listing lynx as a threatened species (65 FR 16052; March 24, 2000) concluded that the primary factor threatening the lynx DPS was the inadequacy of existing regulatory mechanisms, specifically, the lack of guidance for conservation of lynx in federal land management plans. The USFS manages the vast majority of lynx habitat in the U.S. The Service concluded that the lack of Forest Plan guidance for conservation of lynx, as evidenced by the fact that, at the time of listing, Forest Plans allowed or directed actions that cumulatively adversely affected lynx, was a significant threat to the contiguous United States DPS of lynx. Our remanded determination in our clarifications of findings of our final rule (July 2003; 68 FR 40076) affirmed the findings in the final rule.

The 2000 LCAS recommended habitat-related standards for federal lands to address potential risk factors to lynx (see list of risk factors in Ruediger et al. 2000, pp.16-72). Most Forests implemented the 2000 LCAS as interim guidance until Forest Plans could be amended to address lynx conservation.

Subsequent to the 2000 LCAS, Forest Plan amendments or revisions have been completed in the Northern Rockies, Southern Rockies, and the Great Lakes regions, where lynx occur, as noted in the *Status and Distribution* section above. These amendments and revisions include objectives, standards, and guidelines intended to avoid or reduce the potential for projects proposed under Forest Plans to adversely affect lynx. Hence, the primary threat to lynx at the time of listing has been addressed in these regions. In the Northeast, the White Mountain National Forest in New Hampshire is using the 2000 LCAS to guide their forest management plan. However, nearly all Canada lynx habitat in the Northeast is on private, industrial forest lands. These lands are managed under Maine Forest Practices Act (1989) the effects of which are discussed above.

Based on a review of all past and recent literature, the following are risk factors potentially affecting lynx (Table III-5). These risk factors have varying effects on lynx, depending upon the nature, location, duration and timing of the activity. Some risk factors present more likelihood of risks to lynx, while others are relatively benign in effects. The Service believes climate change, vegetation management, wildfire management and fragmentation of habitat represent the factors with the greatest potential to influence lynx and snowshoe hare populations. Other risks include, incidental trapping, recreation, mineral and energy development, illegal shooting, illegal shooting, forest /backcountry roads and trails, grazing by livestock. The discussion of risk factors is largely excerpted from the June 2013 draft Revised LCAS currently being prepared by the Interagency Lynx Biological Team (IGBT 2013 pp. 59-75)..

**Table III-5. Risk factors potentially affecting Canada lynx.**

| Risk Factors Affecting Lynx | |
|---|---|
| ● Climate Change<br>● Vegetation Management<br>● Wildland Fire Management<br>● Fragmentation of Habitat | ● Incidental Trapping<br>● Recreation<br>● Mineral and Energy Exploration/Development<br>● Illegal Shooting<br>● Forest/Backcountry Roads and Trails<br>● Grazing by Domestic Livestock |

***Climate Change***

Physical and biological systems on all continents and in most oceans are being affected by climate change, especially by regional temperature increases (Rosenzweig et al. 2007). Climate change is strongly affecting some species and altering many aspects of systems that are related to snow, ice and frozen ground (Hannah and Lovejoy 2003, Root et al. 2003, Harris et al. 2006, Parmesan 2006, Rosenzweig et al. 2007). Inkley et al. (2004) and Rosenzweig et al. (2007) predicted that the ranges of wildlife and native plants in North America will generally move northward or to higher elevations as temperatures increase.

Several possible effects of climate change on lynx can reasonably be anticipated. These include: 1) potential upward shifts in elevation or latitudinal distribution of lynx and their prey; 2) changes in the periodicity or loss of snowshoe hare cycles in the north; 3) reductions in the amount of lynx habitat and associated lynx population size due to changes in precipitation, particularly snow suitability and persistence, and changes in the frequency and pattern of disturbance events (e.g., fire, hurricanes, insect outbreaks); 4) changes in demographic rates, such as survival and reproduction; and 5) changes in predator-prey relationships. In addition, it is possible that interactions between these variables may intensify their effects.

Shifts in Distribution

Arctic and alpine ecosystems are expected to be among the most sensitive to climate warming (Diaz and Millar 2004). Less snowfall, reduced extent of snow cover, accelerated retreat of most mountain glaciers, and earlier spring snowmelt have already been observed across much of the northern latitudes (Gitay et al. 2002). Results from climate change modeling suggest that snow cover in the contiguous United States will be substantially reduced in extent and distribution (McKelvey et al. 2011). From this can be inferred a contraction of the range of lynx. In Maine, for example, it is predicted that once annual snowfall declines below a key threshold of 270 cm/yr (106 in/yr; Hoving et al. 2005), lynx may be displaced by bobcats (Jacobson et al. 2009).

Changes in Periodicity of the Snowshoe Hare Cycle

The 10-year cycle that occurs in northern Canada and Alaska involves an interaction between lynx, hares, and the hares' plant resources (Krebs et al. 1995, 2001*a*). The periodicity of lynx abundance may be triggered by North Atlantic Oscillation (NAO) climate effects (Stenseth et al.

1999), with the strength of the trophic interactions varying with region-specific vegetation (e.g., forest–tundra, boreal conifer–deciduous mixed woods) and winter conditions. NAO-determined winter snow levels may mediate lynx hunting efficiency, the effects of which then cascade down through snowshoe hares to the plants (Stenseth et al. 1999, Krebs et al. 2001*b*).

In Europe, there are indications that population cycles of voles, grouse and insects now are breaking down, with several lines of evidence implicating climate change as the underlying cause (Ims et al. 2008). The geographical borders between cyclic and noncyclic populations are shifting, and the spatial extents of regions that have cycles are shrinking. The collapse of cycles in herbivores with high-amplitude population cycles also would imply collapses of important ecosystem functions such as pulsed flows of resources and disturbances (Schmitz et al. 2003, Ims et al. 2008). A common denominator of cycles that exhibit spatial gradients, such as the more pronounced cycle of snowshoe hares in its northern range of North America, is that the cycles appear to fade as winters become shorter (Ims et al. 2008). The loss of the hare cycle would likely translate into a reduced potential for lynx to expand into new or unoccupied habitat in Canada or the adjoining United States.

Reduction in Lynx Habitat and Population Size

Climate change may reduce the extent of deep snow habitats preferred by lynx. Based on a general circulation model, Kerr and Packer (1998) predicted that lynx would be among the 25 mammal species in Canada likely to undergo significant losses of habitat, with accompanying decreases in population size. McKelvey et al. (2011) estimated that contiguous areas of spring snow cover would become smaller and more isolated throughout the Columbia, Upper Missouri and Upper Colorado Basins, with greatest losses at the southern periphery, which likely is an indicator of the trajectory of lynx habitat. According to Carroll (2007), climate change could result in dwindling of potential lynx habitat in the northern Appalachians to small areas in the Canadian Maritime Provinces.

Forests in the northeast are predicted to significantly change in the next 100 years under every emissions scenario (Prasad et al. 2007). The extent of oak and pine forest types is projected to increase and expand into central and possibly northern Maine (Iverson et al. 2008). Maine and the northeast forest region are predicted to lose much of their spruce-fir and mixed conifer forest, including upland spruce-fir forest and lowland spruce flats (Prasad et al. 2007, Ollinger et al. 2008, Tang and Beckage 2010). Warming climate and selective logging for conifers has already resulted in an increase of the deciduous forest in northern Maine (Seymour 1992), which is contributing to fragmentation of lynx habitat (Simons 2009).

Galatowitsh et al. (2009) estimated that by 2069, average annual temperatures in Minnesota will increase 3° C (5.4° F) with a slight increase (6%) in precipitation. Minnesota forests will experience warmer summers with more frequent and longer droughts. Most simulations for the Great Lakes-St. Lawrence Basin predict reduced precipitation and lower lake levels (Inkley et al. 2004). Similarly, most climate models predict that the northern Rockies and the Greater Yellowstone ecosystem will be warmer and drier, with increased risk of bark beetle epidemics and forest fires in susceptible age classes. The recent mountain pine beetle outbreak in British Columbia, for example, was associated with warmer winters, longer growing season, and fire suppression (Gayton 2008).

An increasing occurrence and persistence of drought, along with associated insect outbreaks and wildfires, could rapidly and dramatically affect the distribution, amount, and composition of lynx habitat. Cohen and Miller (2001) suggested climate change could alter both the nature and extent of wildfire and beetle outbreaks. With warming climate, fire seasons in the western United States will likely be extended and that total area burned may increase (McKenzie et al. 2004). Westerling et al. (2006) predicted that warmer springs could increase the frequency and duration of wildfires which in turn could reduce the resistance of surviving trees to bark beetle attack. Raffa et al. (2008) suggested that increasing temperatures and forest homogeneity likely will result in bark beetle outbreaks that exceed natural disturbance thresholds; this may set the landscape for additional outbreaks since there will be even-aged forests over a larger area.

Westerling et al. (2006) compiled information on large wildfires in the western United States from 1970–2004; large wildfire activity increased suddenly and markedly in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons. The greatest increases occurred in mesic, middle and high elevation forest types (such as lodgepole pine and spruce-fir) in the northern Rocky Mountains. Fire exclusion has had little impact on natural fire regimes of these higher-elevation forest types in this area; rather, climate appears to be the primary driver of forest wildfire risk. Large wildfires were strongly associated with increased spring and summer temperatures and an earlier spring snowmelt.

Changes in Demographic Rates

Incremental changes in climate would affect lynx directly or indirectly through effects on prey abundance. Annual weather patterns are known to affect survival and reproduction of snowshoe hares, which in turn would influence lynx productivity and survival. Reductions in lynx population size and the amount of available habitat possibly could decrease the likelihood of persistence of smaller subpopulations and successful genetic interchange between subpopulations (Gonzalez et al. 2007).

Changes in Predator-Prey Relationships

Climate change is likely to negatively affect lynx habitat and its ability to support lynx and snowshoe hares, although the rates of change and magnitude of effects are difficult to predict. It seems likely that snowshoe hares, which have shorter generation times than lynx, would respond to habitat changes more quickly than would the lynx themselves.

A characteristic of the snowshoe hare is its seasonal pelage coloration, turning white during the winter from a brown coat in the other seasons. This pelage change appears to be triggered by day length (Severaid 1945). A shift in the duration of snow cover could result in a mismatch of the pelage of snowshoe hares with the background color of its environment, increasing its vulnerability to predation. Over time, natural selection pressure could be expected to correct the mismatch.

Reduced snow depth, condition, and persistence may diminish the competitive advantage of lynx relative to bobcats and coyotes. This could also increase the likelihood of habitat overlap with wolves and mountain lions, increasing predation risk to lynx and competition for snowshoe hare prey.

Federal land management agencies have limited ability to alter the trajectory or to ameliorate the effects of climate change. Assessments should be conducted to consider possible ways to assist with adaptation to climate change. Chapter 6 of this document identifies research needs, which include the need for additional work to more accurately predict specific effects of climate change on lynx.

***Vegetation Management***

Stand structure, composition and arrangement are important elements of habitat for snowshoe hares and lynx. Vegetation management practices can have beneficial, neutral, or adverse effects on lynx and snowshoe hare habitat and populations, and the duration of effects varies. Effects of vegetation management on snowshoe hare habitats have been studied across the range of the species (Conroy et al. 1979, Sullivan and Sullivan 1988, Koehler 1990*b*, Thomas et al. 1997, Homyack et al. 2005, Robinson 2006, Griffin and Mills 2007, Berg 2010, Ivan 2011*a*, Lewis et al. 2011, and McCann and Moen 2011). Effects on lynx have been investigated by Koehler (1990*a*), Koehler and Brittell (1990), Fuller et al. (2007), Homyack et al. (2007), Moen et al. (2008), Vashon et al. (2008*b*) and Squires et al. (2010).

Vegetation management occurs across the range of the lynx and can directly affect important habitats and prey. Management activities uninformed by consideration of negative impacts to the species were identified as being of greatest potential concern to lynx conservation (68 FR 40076-40101, July 3, 2003).

Historically, the dominant natural disturbance processes that created early successional stages within the range of the lynx were wind events, fire, and insect and disease outbreaks (Kilgore and Heinselman 1990, Heinselman 1996, Veblen et al. 1998, Agee 2000, Seymour et al. 2002, Lorimer and White 2003). In forests of the Northeast Geographic Area, wind, fire, insects and diseases were predominant natural disturbance agents, while fire, insects and diseases were predominant in the Great Lakes Geographic Area and across the western United States.

After disturbances, forests generally develop through several stages described by Oliver (1980) as “stand initiation”, “stem exclusion”, “understory reinitiation”, and “old growth”. Stand dynamics, particularly within-stand competition for light, nutrients, and space, determine how forests grow and respond to intentional manipulations and natural disturbances (Oliver and Larson 1996). The frequency and severity of disturbances influence which species will dominate in a stand after the disturbance event. During the stand initiation structural stage (SISS), trees that are established and tall enough to protrude above snow cover may provide snowshoe hare and lynx habitat. During the stem exclusion stage, the tree crowns lift and lower branches self-prune, thus growing above the reach of snowshoe hares. As the stand moves into understory reinitiation and old growth structural stages, food and cover may again become available to support snowshoe hares.

Commercial timber management of conifer forests traditionally has been designed to: reduce tree density and promote tree growth (e.g., precommercial thinning), especially in young regenerating forests; improve growth and vigor of mature trees (e.g., commercial thinning, thinning from below); reduce the vulnerability of commercially-valuable trees to insects and disease (e.g., commercial thinning, group selection); and harvest forest products (e.g., regeneration harvest).

Timber management practices may mimic natural disturbance processes but often are not an exact ecological substitute. Some practices, such as use of herbicides to suppress hardwood regeneration, do not have an historical analogue. Timber harvest may differ from natural disturbances by:

- Removing most standing biomass from the site, especially larger size classes of trees, and down logs, which alters microsite conditions and nutrient cycling;

- Creating smaller, more dispersed patches and concentrating harvest at lower elevations in mountainous regions and on more nutrient rich soils, resulting in habitat fragmentation;

- Causing soil disturbance and compaction by heavy equipment, which may result in increased water runoff and slower tree growth at the site; or

- Giving a competitive advantage to commercially-valuable tree species and reducing the structural complexity of the forest through the application of harvest, planting, thinning and herbicide treatments.

Stem density and snowshoe hare density are directly and positively correlated (Conroy et al. 1979, Sullivan and Sullivan 1988, Koehler 1990*b*, Koehler and Brittell 1990, Thomas et al. 1997, Hodges 2000*a*, Mowat et al. 2000, Homyack et al. 2006). Vegetation management that promotes high stem density and dense horizontal cover can increase snowshoe hare densities (Keith and Surrendi 1971, Fox 1978, Conroy et al. 1979, Wolff 1980, Parker et al. 1983, Livaitis et al. 1985, Bailey et al. 1986, Monthey 1986, Koehler 1990*a*, 1990*b*, Fuller et al. 2007, Robinson 2006, Homyack et al. 2007, Scott 2009, McCann and Moen 2011).

Where the objective is to provide snowshoe hare habitat by creating additional early successional forest conditions, management considerations include selecting areas that are capable of, but not currently providing, dense horizontal cover (e.g., stem exclusion structural stage), designing the appropriate size and shape of treatment units, retaining coarse woody debris, and maintaining high stem densities in regenerated forests (Koehler and Brittell 1990, Homyack et al. 2004, Bull et al. 2005, Fuller and Harrison 2005, Ivan 2011*a*).

Precommercial thinning of young, dense regenerating conifers is generally designed to increase the growth of selected trees by removing competing trees of the same species or shrubs/trees of other species (Daniel et al. 1979, Homyack et al. 2005, 2007). Reducing the density of sapling-sized conifers in young regenerating forests to increase the growth of certain selected trees promotes more homogeneous patches and reduces the amount and density of horizontal cover, which is needed to sustain snowshoe hares (Sullivan and Sullivan1988, Hodges 2000*b*, Griffin and Mills 2004, Ausband and Baty 2005, Griffin and Mills 2007, Homyack et al. 2007, Ellsworth 2009). Precommercial thinning has been shown to reduce hare numbers by as much as 2 and 3 fold (Griffin and Mills 2004, Griffin and Mills 2007, Homyack et al. 2007) due to reduced densities of sapling and shrub stems and decreased availability of browse. Griffin and Mills (2007) reported that, if their results were representative, the practice of precommercial thinning could significantly reduce snowshoe hares across the range of lynx.

There are anecdotal examples of precommercially thinned stands that subsequently "filled in" with understory trees. It has been suggested this could be a technique to extend the time that understory trees and low limbs provide the dense horizontal cover that constitutes snowshoe hare habitat. The duration between time of thinning and regrowth to a height providing winter snowshoe hare habitat would likely vary by tree species, each having different regenerative capacities which could be influenced by a variety of local factors (e.g., topographic relief, moisture, and mineral and organic content of the soil; Baumgartner et al. 1984, Koch 1996). Bull et al. (2005) reported that the slash and coarse woody debris remaining after precommercial thinning provided both forage and cover for snowshoe hares up to a year following treatment. However, Homyack et al. (2007) found that snowshoe hare densities were reduced following precommercial thinning for 1–11 years post-thinning. They further suggested that after precommercial thinning, the stands did not regain the structural complexity in the understory that would be needed to support snowshoe hare densities to the level that were present pre-treatment. At this time, no other data are available to quantify the re-establishment of snowshoe hare habitat and over what time period, or the response by snowshoe hares, as compared with sites that were not precommercially thinned, so this remains an unproven management technique. As an alternative to standard precommercial thinning (i.e., complete thinning resulting in a homogeneous patch), Griffin and Mills (2007) suggested retaining at least 20% of the patch in untreated clumps of about ¼ ha (½ ac) which would maintain hare habitat in the short term. However, Lewis et al. (2011) found that landscapes with patches of high quality habitat surrounded by similar vegetation supported more snowshoe hares than did more fragmented landscapes composed of high quality patches in a matrix of poorer quality habitat. Further long-term studies of modified thinning methods are needed.

Uneven-aged management (single tree and small group selection) practices can be employed in stands where there is a poorly developed understory, but have the potential to produce dense horizontal cover for snowshoe hares. Removal of select large trees can create openings in the canopy that mimic gap dynamics and help to maintain and encourage multi-story attributes within the stand.

However, if removal of large trees opens the canopy to the extent that the patch functions as an opening, this may discourage use by lynx (Koehler 1990*a*, von Kienast 2003, Maletzke 2007, Squires et al. 2010). Removal of larger trees from mature multi-story forest stands to reduce competition and increase tree growth or resistance to forest insects may reduce the horizontal cover (e.g., boughs on snow), thus degrading the quality of winter habitat for lynx (Robinson 2006, Koehler et al. 2008, Squires et al. 2010). Similarly, removing understory trees from mature multi-story forest stands reduces the dense horizontal cover selected by snowshoe hares, and thus reduces winter habitat for lynx (Koehler et al. 2008, Squires et al. 2010).

Current favorable habitat conditions for snowshoe hare and lynx in Maine resulted from large-scale salvage cutting following a spruce budworm outbreak in the 1970s and 1980s (Hoving et al. 2004). After salvage harvest of the affected trees, a portion of the area was sprayed with herbicide to reduce deciduous competition (Scott 2009). This created favorable habitat conditions for snowshoe hares and lynx. After the passage of the Maine Forest Practices Act of 1989, various forms of partial harvesting have since replaced clearcutting as the predominant form of forest management in northern Maine. Partial harvested stands result in a wide range of residual stand conditions, but many have lower conifer stem densities and higher hardwood

density than regenerating clearcuts (Robinson 2006). On average, partial harvested stands supported about 50% of the hare densities observed in regenerating clearcuts (Robinson 2006).

Fuels treatments commonly are designed to remove understory biomass and reduce stem density in forests that are outside their historical range of variability, and to clear fuels adjacent to human developments for safety or to protect investments. These types of projects are becoming more common. In the western United States, projects designed to restore forests to a condition more representative of the historical range of variability are generally targeted to drier, lower-elevation forests affected by fire suppression (Hessburg et al. 2005) which are not lynx habitat. Lynx habitats in higher-elevation spruce-fir forests have been less affected by past fire suppression and are mostly within the historical range of variability (Agee 2000). Fuels treatments may be needed to protect human communities and capital improvements by reducing the intensity and rate of spread of a fire, affording control actions with a higher probability of success and providing safer conditions for fire fighters. By removing or reducing the understory and ladder fuels to meet those objectives, dense horizontal cover important to snowshoe hares is reduced and habitat value is diminished for hares and lynx.

Prescribed burning is a technique used to reduce tree stem density and reduce fuels. In the Great Lakes Geographic Area, prescribed burning is used in lynx habitat primarily as a tool to reduce fuels (including from blow-down) and mimic a more natural fire regime in pine forest types. In these instances there is a short-term (10–30 years) impact on snowshoe hare habitat. In the western United States, prescribed fire for ecosystem restoration is most applicable to the dry ponderosa pine and Douglas-fir forests that are not lynx habitat. Because spruce-fir forests are generally composed of thinner barked trees that are easily killed even with light fire, this technique is not used frequently in most lynx habitat.

Biomass removal for energy production targets the removal of dead trees, logging slash and small diameter trees and shrubs. Biomass removal is similar to fuels treatments in reducing cover and habitat for snowshoe hares.

***Wildland Fire Management***

Fire and other natural disturbance processes historically played an important role in maintaining a mosaic of forest successional stages that provides habitat for both snowshoe hare and lynx (Fox 1978, Bailey et al. 1986, Quinn and Thompson 1987, Koehler and Brittell 1990, Poole et al. 1996, Slough and Mowat 1996). The response of snowshoe hare and lynx in their use of habitat after fires follows a somewhat predictable pattern. For the first few years after a burn, there appears to be a negative correlation between lynx use and the amount of area burned (Fox 1978). This short-term effect is likely a response to a reduction of snowshoe hare populations, reduced cover, and possibly also increased competition from coyotes in the now-open habitat (Stephenson 1984, Koehler and Brittell 1990). The mid-term (10–40 years post-fire) effect on vegetation in a burned area is development of small tree and shrub cover sufficient for hare populations to reoccupy the area. The length of time varies depending on tree species, potential vegetation, fire severity, and the presence of re-sprouting broadleaf species. Where broadleaf species are denser, hare re-occupancy occurs more quickly (within 3–12 years). Hare population density again decreases as the conifer tree canopy develops and shades out the understory. Forest

gap processes, such as tree blowdown, insect infestations, and outbreaks of disease, follow a similar pattern (Agee 2000).

Across the range of lynx, vegetation dynamics differ somewhat as a result of the natural fire frequency and intensity. For example, lynx habitat in the northeastern boreal forests had very long fire return intervals of up to 500 years (Agee 2000). The Great Lakes boreal forests tended to have shorter fire return intervals of 50–150 years (Heinselman 1996). In much of the Rocky Mountains, the fire regime was more variable in lynx habitat, with both frequent (35–100 years) stand-replacing or mixed severity fires, and infrequent (200+ years) stand-replacement fires (Hardy et al. 1998). The Cascade Mountains were dominated historically by infrequent (70-150 years) stand-replacing fire regimes (Agee 2000). Disturbance interval and fire severity vary by cover type, with xeric pine types such as lodgepole or jack pine typically experiencing more frequent and more severe fires than mixed conifer types and spruce/fir.

In the Cascades Geographic Area wildfire has been a significant disturbance influence in lynx habitat. Fires burned more than 50% of suitable lynx habitat in Okanogan County since 1994 (Koehler et al. 2008). In 2006, the Tripod Fire in the Meadows burned 600 $km^2$ (20 $mi^2$) of the most contiguous lynx habitat in Washington.

Gayton (2008) reported that recent mountain pine beetle epidemics in British Columbia were the result of a changing climate that contributed to warmer winters and longer growing seasons. Cohen and Miller (2001) and McKenzie et al. (2004) have suggested climate change could affect the extent of bark beetle outbreaks and extent and fire seasons and total area burned in the west.

Land management agencies began effective fire suppression with the advent of aircraft support approximately 70 years ago. Over time, continued fire suppression altered vegetation mosaics and species composition. In jack pine forests of the Great Lakes region, fire suppression changed stand composition and successional pathways (Agee 2000). In the western United Stated, a shift to uncharacteristically severe and intense wildfires has occurred recently in lower-elevation forests (Quigley et al. 1996, Morgan et al. 1998). However, fire suppression in areas with a history of infrequent fires, as is typical of cool moist forest types such as spruce-fir forests, has probably not had much impact (Habeck 1985, Agee 1993, Schoennagel et al. 2004, Whitlock 2004). This is true across much of the boreal forest in the western United States.

The current goals for vegetation management on federal lands in the United States are to restore ecosystem health, ecological processes, and forest structure, composition, and function appropriate to the site (e.g., USDA Forest Service 2010). Westerling et al. (2006) suggested fuel management and ecological restoration practices will likely not reverse current wildfire trends; large increases in wildfires in the western United States since 1970 resulted from increased temperatures and earlier spring snowmelt. Particularly in the western United States, ecosystem restoration is primarily focused in the dry and mesic forest types at lower elevations, rather than in lynx habitat, and includes reestablishing frequent, low intensity fire in those systems. Applying ecosystem restoration across a landscape may reduce the risk of uncharacteristic large, stand-replacing fires occurring in the lower-elevation forest types, and thereby prevent their spread into adjacent lynx habitat.

After large dead trees fall to the ground, they provide cover and may enhance lynx foraging habitat in the short term and potential denning habitat in the longer term, depending on post-disturbance stand conditions. Standing snags also may provide sufficient vertical structure and cover to allow lynx to traverse long distances (>1 km [>0.6 mi]) across burned habitat (Maletzke 2004).

Similar to vegetation management, wildland fire management may diminish, enhance, or sustain the density and distribution of snowshoe hare prey resources and lynx habitat, depending on the design and implementation of programs and actions.

### *Fragmentation of Habitat*

We use the term "fragmentation" to describe human-caused alterations of natural landscape patterns that reduce the total area of habitat, increase the isolation of habitat patches, and impair the ability of wildlife to effectively move between those patches of habitat. Fragmentation may be permanent, for example by converting forest habitat to residential or agricultural purposes, or temporary, for example by creating an opening but allowing trees and shrubs to regrow. Fragmentation of habitat accentuates the viability risk inherent in a small population and increases its vulnerability to local extirpation. The combination of human-caused and natural disturbances may exacerbate fragmentation effects.

Lynx habitat in the contiguous United States is inherently patchier than in the northern boreal forest with its extensive forests, gentle topography and relatively consistent winter snow conditions (Aubry et al. 2000). The pronounced topographic relief in the mountains of the western United States restricts lynx habitat to a relatively narrow elevational band.

A variety of anthropogenic activities can result in increased habitat fragmentation at the home range or broader scale. For example, permanent or temporary removal of forest cover, development of highways and associated infrastructure, and intensive minerals or energy development can fragment lynx habitat.

Within their home ranges, lynx strongly select for habitat patches that enhance their foraging opportunities (Fuller and Harrison 2010, Moen et al. 2008, Vashon et al. 2008*a*, Squires et al. 2010). Analysis of winter movements of lynx in Maine indicated that lynx responded to habitat heterogeneity at a coarse scale within their home ranges, by maximizing their access to snowshoe hare prey (Fuller and Harrison 2010). In Montana, lynx selected homogeneous spruce-fir patches that supported snowshoe hares and avoided recent clear-cuts or other open patches (Squires et al. 2010). Similarly, in Washington, Lewis et al. (2011) reported that landscapes with more contiguous hare habitat or that are surrounded by a mosaic of similar habitat quality supported more snowshoe hares than more fragmented landscapes.

Both lynx and hares are influenced by the spatial arrangement of preferred habitat. In Maine and northern Washington, landscapes where habitat was more contiguous supported more snowshoe hares than landscapes that were more fragmented (Simons 2009, Lewis et al. 2011). Several studies (Koehler 1990*a*, Mowat et al. 2000, von Kienast 2003, Maletzke 2004, Squires and Ruggiero 2007, Squires et al. 2010) have reported that lynx avoid large openings, especially during winter. Mowat et al. (2000) suggested that relatively few snowshoe hares use large

openings, and consequently lynx spend little time hunting in these areas. Koehler (1990*a*) speculated that vegetation management prescriptions that result in distance to cover >100 m (328 ft) may change lynx movement and use patterns until such time as sufficient reestablishment of forest vegetation occurs. Opening size can also influence seedling regeneration and stocking densities (Kreyling et al. 2008).

Fragmentation of the naturally patchy pattern of lynx habitat in the contiguous United States can affect lynx by reducing their prey base and increasing the energetic costs of using habitat within their home ranges. Buskirk et al. (2000) identified direct effects of fragmentation on lynx to include creation of openings that potentially increase access by competing carnivores, increasing the edge between early successional habitat and other habitats, and changes in the structural complexities and amounts of seral forests within the landscape. At some point, landscape-scale fragmentation can make patches of foraging habitat too small and too distant from each other to be effectively accessed by lynx as part of their home range. Maintaining preferred habitat patches for lynx and hares within a mosaic of young to old stands in patterns that are representative of natural ecological processes and disturbance regimes would be conducive to long-term conservation.

Highways typically follow natural features such as rivers, valleys, and mountain passes that may have high value for lynx in providing habitat or connectivity. Various studies have documented lynx crossings of highways. A male lynx in western Wyoming was documented to have successfully crossed several 2-lane highways during exploratory movements (Squires and Oakleaf 2005). In Colorado, lynx successfully and repeatedly crossed major highways, including I-70 (J. Squires, personal communication 2012, Ivan 2011*b*, *c*, 2012). However, in Alberta, Canada, high road densities, human activity, and associated developments appeared to reduce the habitat quality based on decreased occupancy by lynx (Bayne et al. 2008). Apps et al. (2007) found lynx were 13 times less likely to cross the Trans-Canada Highway relative to random expectation, but only 2.2 and 3.1 times less likely to cross Highway 93 and Highway 1A, respectively, compared to random expectation.

Highways pose a risk of direct mortality to lynx and may inhibit lynx movement between previously connected habitats. If lynx avoid crossing highways, this could lead to a loss of effective habitat within a home range and/or reduced interaction within a local population (Apps et al. 2007). Lynx and other carnivores may avoid using habitat adjacent to highways, or become intimidated by highway traffic when attempting to cross (Gibeau and Heuer 1996, Forman and Alexander 1998). As the standard of road increases from gravel to 2-lane or 4-lane highways, traffic volumes and the degree of impact are expected to increase. Four lane highways, such as the interstate highway system, commonly include fences, “Jersey barriers”, and service roads and may run parallel to railroads or power lines that make successful crossing more difficult, or impossible, for wildlife. Alexander et al. (2005) suggested traffic volumes between 3,000 and 5,000 vehicles per day may be the threshold above which successful crossings by carnivores are impeded.

Between 2000 and 2011, 27 lynx were reported to have been killed on roads (both paved and unpaved) in Maine (Vashon et al. 2012), 4 in Minnesota (U. S. Fish and Wildlife Service 2012), 1 in Idaho, and 1 in Montana (Kurt Broderdorp, U.S. Fish and Wildlife Service, personal

communication 2012). Between 1995 and 2011, 15 lynx were reported killed on British Columbia highways (British Columbia Wildlife Accident Reporting System 2012).

Translocated animals may be more vulnerable to highway mortality than resident lynx (Brocke et al. 1990), because they often move extensively after their release and are unfamiliar with their surroundings. In the Adirondack Mountains of New York, an attempt to reintroduce lynx failed and 18 of 37 mortalities of translocated animals were attributed to road kills (Brocke et al. 1990). Over a 7-year period in Colorado, 13 of 102 translocated lynx were killed on highways (Devineau et al. 2010). Traffic volumes on Colorado highways where the 13 lynx mortalities occurred were estimated to range from about 2,300 to >25,000 vehicles per day (K. Broderdorp, personal communication 2012).

Coordination of management across international, federal, state, county, and private land boundaries is essential to minimize fragmentation. Connectivity to source populations in Canada is considered critical to persistence of populations in most parts of the range in the United States (Federal Register Vol. 68 pp. 40076–40101, Squires et al. 2013).

### *Incidental Trapping*

Like most felids, lynx are very vulnerable to trapping and snaring and can be easily overexploited (Mech 1980, Carbyn and Patriquin 1983, Parker et al. 1983, Ward and Krebs 1985, Bailey et al. 1986, Quinn and Thompson 1987, Slough and Mowat 1996). In Canada during a snowshoe hare decline, rates of trapping mortality of lynx were positively related to average pelt value, and appeared to be additive to nontrapping mortality (Brand and Keith 1979).

State wildlife management agencies regulate the trapping of furbearers. Trapping and snaring of lynx is currently prohibited across the contiguous United States. Incidental trapping or snaring of lynx can occur in areas where regulated trapping for other species, such as wolverine, coyote, fox, fisher, marten, bobcat and wolf, overlaps with lynx habitats (Mech 1973, Carbyn and Patriquin 1983, Squires and Laurion 2000, U.S. Fish and Wildlife Service unpublished data 2011, U. S. Fish and Wildlife Service 2012, Vashon et al. 2012).

Lynx that were captured in the United States for research projects have subsequently been killed in traps or snares in Canada (Moen 2009, Vashon et al. 2012). In Maine from 2000-2012, 59 lynx were reported captured in traps set for other furbearers (snares were not legal), of which at least 6 of those were mortalities (Vashon et al. 2012). In Minnesota during the same time period, 22 lynx were reported captured in traps and snares, of which at least 12 were killed (U. S. Fish and Wildlife Service 2012). In Montana, 10 lynx were reported trapped, of which at least 4 died. Two lynx were trapped in Idaho, 1 in 2012 (Beth Waterbury, Idaho Department of Fish and Game, personal communication 2013) and 1 in 2013 (Michael Lucid, Idaho Department of Fish and Game, personal communication 2013), 1 of which died. Lynx were also incidentally trapped and snared in New Brunswick and Nova Scotia where they are a protected species. These figures reflect the reported captures only.

The total number of mortalities due to incidental trapping is unknown. Moen (2008) investigated the proportion of radio-collared animals that were represented in the total number reported to

FWS in Minnesota. In comparison to incidental shooting and vehicle collisions, proportionately fewer mortalities of non-collared lynx were reported due to incidental trapping, suggesting that trap-related mortalities may be under-reported (Moen 2008).

Although many incidentally trapped lynx were reported to have been released, the physical condition of the released animals and the effect on animal fitness are unknown. Depending on environmental conditions and the types of traps used, a substantial portion of lynx caught in foothold traps may experience injuries and foot freezing (Mowat et al. 1994, Nybakk et al. 1996, Kolbe et al. 2003). Some trap-related injuries (e.g., dislocations, fractures, mild freezing) are difficult to detect in lynx in the field (Mowat et al. 1994). Injuries and mortality rates are greatest to lynx incidentally caught in snares and Conibear traps.

Injuries and mortalities related to incidental trapping can be minimized through various techniques. Avoiding areas where lynx are present, avoiding use of suspended flags or sight-attractants near traps, avoiding drag sets and anchoring traps with short chains (Mowat et al. 1994) and multiple swivels, using padded foothold traps or traps with offset jaws (Olsen et al. 1988, Houben et al. 1993, Association of Fish and Wildlife Agencies 2011), employing boxes or other devices to exclude lynx from Conibear traps (U.S. Fish and Wildlife Service 2011), and trapping when temperatures are above -8° C (18° F; Mowat et al. 1994) are recommended. Daily checking of traps can minimize freezing injuries and starvation. Several states including Maine, Minnesota and Montana have implemented special regulations to reduce the likelihood of incidental capture of lynx in traps set for other furbearers.

State wildlife agencies have effectively used trapper outreach such as training, DVDs, and mailings, as a tool to avoid or minimize incidental take of lynx. Some states also have protocols to quickly respond to lynx in traps (e.g., 24-hour hotline) and have trained personnel ready to evaluate trapped lynx and assist with release or rehabilitation.

No conservation measures to address incidental trapping are included in this document because trapping is regulated by the states.

### *Recreation*

Cordell et al. (2009) compared the results of national recreation surveys conducted during 1982–1983, 1994–1995, 1999–2001, and 2005–2009. In terms of both the number of people and percentage of population, participation in outdoor recreation has continued to grow in the United States. Over the years, walking outdoors has been the most popular activity, with 194 million participants currently. Activities gaining more than 50 million participants between 1982–83 and 2005–09 were viewing or photographing wild birds (an increase of 287%), attending outdoor sports events (an increase of 74%), and day hiking (an increase of 210%). Downhill skiing increased by 4.4% to 14.8 million participants, and snowmobiling increased by 3.5% to 8.7 million participants. Cross-country skiing declined by about 5.8% over the same period. Social trends may have cycles that are influenced by economic conditions, technology changes, population growth, cultural evolution, and other factors, making it difficult to project future trends.

Our understanding of the effects of outdoor recreation on lynx and their habitat is incomplete. The effects, if any, may depend on the type of activity and the context within which it occurs. Mechanisms through which recreational activities could impact lynx may include loss of habitat, reductions in habitat availability due to disturbance, or changes in competition for snowshoe hare prey.

Habitat Loss

Construction or expansion of developed areas such as large ski areas and 4- season resorts, as well as smaller recreational sites like nordic ski huts or campgrounds, may directly remove forest cover. Such removal in lynx habitat could decrease prey availability, affect lynx movement within home ranges, or result in a more fragmented landscape.

Disturbance

Few studies have examined how lynx react to human presence. Some anecdotal information suggests that lynx are quite tolerant of humans, although given differences in individuals and contexts, a variety of behavioral responses to human presence may be expected (Staples 1995, Mowat et al. 2000). Preliminary information from winter recreation studies in Colorado indicates that some recreation uses are compatible, but lynx may avoid some developed ski areas (J. Squires, personal communication 2012).

Some wildlife species have been found to be more sensitive to disturbance when bearing and rearing young than in other times of the year. Olson et al. (2011) reported they approached 8 dens of females; half of the females moved their dens within 4 days, while the other half did not move dens for at least 20 days following disturbance. Olson et al. (2011) noted that lynx dens were located in more remote areas and unlikely to be disturbed by humans. Frequent movement of kittens from natal dens to one or more maternal dens is normal behavior exhibited by lynx even in the absence of human disturbance (J. Squires, personal communication 2012).

Changes in Competition for Snowshoe Hare Prey

Packed trails created by snowmobiles, cross-country skiers, snowshoe hares, and other predators might serve as travel routes for potential competitors and predators of lynx, especially coyotes (Bider 1962, Ozoga and Harger 1966, Murray and Boutin 1991, Koehler and Aubry 1994, Murray et al. 1995, and Buskirk et al. 2000*a*). Unique morphological differences between coyotes and lynx would appear to spatially segregate these species by snow conditions (Murray and Boutin 1991, Litvaitis 1992), with coyotes at a disadvantage in deep, soft snow due to their high foot-load (the ratio of body mass to foot area; Murray et al. 1994). Buskirk et al. (2000*a*) hypothesized that the natural spatial segregation of lynx and coyotes in winter could break down where human modifications to the environment allow coyotes to access deep snow areas.

The strength of this hypothesis rests on 2 primary assumptions: a) that the presence of compacted snow resulting from certain recreational activities leads to increased coyote use of or access to lynx habitat; and b) that such increased use or access reduces prey availability to lynx or increases interference interactions. Some studies suggest that coyotes select for snow conditions that are shallower, more supportive, and characterized by low sinking depth (Murray and Boutin

1991, Thibault and Ouellet 2005). Coyote use of more supportive snow may reduce the relatively high energetic cost of travel in and avoidance of deep snow conditions (Crete and Lariviere 2003).

Studies of coyote use of compacted snowmobile trails have yielded variable results. In Montana, Kolbe et al. (2007) snow-tracked coyotes and found that although they did use snowmobile trails, they did not travel closer to these trails than randomly expected. Rather, coyotes adapted to deep snow conditions by selectively using habitats with shallower and more supportive snow (Bunnell et al. 2006, Kolbe et al. 2007), corroborating observations made by others (Murray and Boutin 1991, Crete and Lariviere 2003, Thibault and Ouellet 2005, Burghardt-Dowd 2010). Further, coyotes in the Kolbe et al. (2007) study did not use compacted roads any more than uncompacted roads, suggesting that coyotes may have used roads because they provide a "cleared travel corridor" whether they are compacted or not.

In contrast, the distribution of coyotes in Utah and Wyoming appeared to be influenced by proximity to compacted snowmobile trails in deep, powdery snow areas (Bunnell et al. 2006, Burghardt-Dowd 2010). Bunnell et al. (2006) observed more coyote activity along trails compacted by snowmobiles than those that were not. Burghardt-Dowd (2010) applied methods used by Kolbe et al. (2007) in western Wyoming and similarly found that coyotes selected shallower snow when off compacted trails than randomly expected. However, coyotes in her study area also traveled closer to compacted snowmobile trails than would be expected. The seemingly contradictory results from Kolbe et al. (2007) and Burghardt-Dowd (2010) might be attributable to differences in snow penetrability between the 2 geographic areas. Average snow penetrability measured using the same method was higher in northwestern Wyoming (Burghardt-Dowd 2010) than in Montana (Kolbe et al. 2007), making coyote movement in the absence of artificially compacted snow potentially more energetically costly in Wyoming. Based on these studies, it appears that snow column density and the number of freeze/thaw events in different regions may influence coyote movements and habitat selection (Burghardt-Dowd 2010). That is, snow penetrability in the region may determine whether or not snowmobile trails influence coyote movement patterns in lynx habitats (Bunnell et al. 2006, Kolbe et al. 2007, Burghardt-Dowd 2010).

Regarding the second assumption, if snow compaction assists coyote movement during winter, does this result in reduced prey for lynx? Coyotes are found throughout the majority of the boreal forest ecosystem (Bekoff and Gese 2003) including areas inhabited by lynx (O'Donoghue et al. 2001, Kolbe et al. 2007, Burghardt-Dowd 2010). Unlike lynx, coyotes demonstrate strong prey- and habitat-switching abilities (Buskirk 2000). In the Yukon, coyote and lynx winter diets overlapped most during a peak in hare densities and least during periods of low hare densities (O'Donoghue et al. 2001).

In Maine, hares represented 37% of the winter diet of coyotes in a study on the Maine eastern coast (Major and Sherburne 1987), outside of lynx habitat. Litvaitis and Harrison (1989) reported that snowshoe hares comprised 39% of the winter diet of coyotes in a western Maine study in lynx habitat. However, there is no indication that lynx were present in this study area at the time of the study, making it difficult to infer whether or not competition between coyotes and lynx might have occurred.

In Montana, coyotes primarily scavenged ungulate carrion, and killed snowshoe hares at only 3 of 88 documented feeding sites (Kolbe et al. 2007). Dowd and Gese (2012) analyzed 470 coyote scats and 24 lynx scats (from 5 individual lynx) in northwestern Wyoming and reported that coyotes scavenged primarily on mule deer or elk (*Cervus elaphus*) carrion in winter; only 3.5% of scats contained remains of snowshoe hares during winter. As expected, lynx preyed mostly on snowshoe hares in winter, with 85% of prey items consisting of snowshoe hares. Thus in both Montana and Wyoming, there was not a significant dietary overlap during winter between these species. In Wyoming, the potential for competition between lynx and coyotes would be most likely to occur during the fall when coyotes appear to increase predation on snowshoe hares (Burghardt-Dowd 2010).

Existing information suggests that some low level of competition for prey could occur naturally between lynx and coyotes. However, this is apt to vary spatially or temporally depending on overall prey availability and composition. Research that could conclusively demonstrate and quantify the effects of competition would be challenging due to numerous confounding factors.

Likely Effects of Specific Winter Recreational Activities on Lynx.

**Ski Areas and Four-Season Resorts.** More than 50 ski areas exist throughout the range of the lynx in the contiguous United States. Most ski areas are located on north-facing slopes, where ample snow conditions provide for extended ski/snowboard recreational seasons. In the western states, many of these landscapes feature spruce-fir forests. While ski resorts occupy a small proportion of the landscape, spruce-fir forests provide important stable habitat for snowshoe hares and lynx at the southern extent of their range. In winter, alpine and Nordic skiing and snowboarding are the primary uses. Most of these resorts offer year-round recreation, with summer activities typically including hiking and mountain biking.

Ski resort development may fragment the forested landscape. One ski run is often separated from the next only by small inter-trail forest islands. Ski runs often are intermixed with other open areas such as open or gladed bowls, rock outcrops or barren tundra ridges. Ski resorts that are built or expanded in lynx habitat may impact lynx by removing forest cover, reducing the snowshoe hare prey base, and creating or increasing human disturbance in or near linkage areas.

There is limited information on lynx behavior and habitat use in and around ski areas. Lynx have been known to incorporate smaller ski resorts within their home ranges, but may not utilize the large resorts. Preliminary information from an ongoing study in Colorado suggests that some recreation use may be compatible, but lynx may avoid some areas with concentrated recreation use. In some areas, lynx habitat may be limited and concentrated in the ski area development footprint (J. Squires, personal communication 2012).

**Snowmobile Warming Huts and Nordic Ski Huts**. Most backcountry ski hut sites are primitive in nature. Some facilities may have utilities, summer road access, and on-site storage for grooming equipment and fuel. Use by snowmobile clubs and the general public is often focused or concentrated around these sites. Many have developed trail systems that loop around the site or provide access to other remote areas.

These facilities are generally located along designated cross-country ski and snowmobile routes. Users compact the snow along the route to/from the huts and in the immediate vicinity. Off-trail travel has the potential to create larger areas of compacted snow. However, as indicated above, this local snow compaction is short term and not likely to change the competitive interactions between lynx and coyotes.

**Developed Campgrounds.** Typically these are single-season summer facilities that might provide limited winter use, and generally supply such amenities as water and holding tanks for sewage disposal. Access could be further facilitated through the plowing of roads. When located in lynx habitat, the effects might be similar to those described for Nordic ski huts and snowmobile huts.

***Minerals and Energy Exploration and Development***

Leasable Minerals

Activities associated with exploration and development of leasable minerals could affect lynx habitat by changing or eliminating the native vegetation and contributing to habitat fragmentation. Development of a high density of wells, as is typical of coal-bed methane development (e.g., 1 well per 2–4 ha [5–10 ac]), could affect lynx by directly removing habitat. The development of associated roads, power lines and pipelines to facilitate exploration and development could also result in a loss of lynx habitat and contribute to fragmentation of habitat. In some areas, for example in the Wyoming Range, extensive oil and gas development is occurring within lynx habitat.

Locatable Minerals

Only a fraction of the historical number of mines is operating today; those that continue to operate do so with more stringent environmental protection measures. However, in some parts of the United States, minerals exploration and new development appear to be on the rise. Activities associated with exploration and development of locatable minerals could affect lynx habitat by changing or eliminating the native vegetation, and by contributing to habitat fragmentation. Amount of impact can be variable depending on the size of the associated mining operation or development. Locatable minerals are extracted through both open pit and sub-surface mines with potential habitat alteration ranging from tens to thousands of hectares. In some instances, such as larger mining operations, land exchanges are conducted to consolidate private ownership of the surface above a deposit prior to mine development. Depending on lands exchanged this could retain lynx habitat in public ownership, but could still result in a net loss of habitat. Development of road and railroad access to facilitate exploration and development could also directly impact lynx habitat, contribute to fragmentation, facilitate increased competition as a result of snow-compacted routes, and result in direct mortality. Despite these potential impacts, mining exploration and development is generally anticipated to affect only a small portion of lynx habitat in the contiguous United States.

Salable Minerals

In general, salable minerals are found close to the surface. During exploration activities, equipment is moved to the site and a number of test pits are dug or holes drilled to determine the quality of material. If desired minerals are found in suitable quantity, then vegetation is removed and materials are excavated. Areas developed for salable minerals can vary in size from a single truck load to tens of acres. Impacts to lynx could include the potential alteration or removal of lynx habitat, increased fragmentation, and/or the potential for human-caused mortality from road development.

Wind Energy

Wind energy development and associated transmission lines in lynx habitat is increasing across the nation. Facilities are located on ridge tops or other areas exposed to consistent wind. The construction of wind facilities including access roads may result in loss of lynx habitat and increased fragmentation from permanent forest clearings. Noise and human activity associated with operation of wind facilities would likely continue through the life of the project, which may exceed 20 years.

Utility Corridors

Utility corridors contain developments such as overhead or buried power lines and gas pipelines, and often are located within or adjacent to existing road rights-of-way. Utility corridors potentially could have short or long term impacts to lynx habitats, depending on location, type, vegetation clearing standards, and frequency of maintenance. Utility corridors that are extensively cleared of vegetation and maintained in a low structure condition, likely equate to a permanent habitat loss. When associated with highways and railroads, utility corridors may further widen the right-of-way. Utility corridors may facilitate human access into previously remote areas.

### *Illegal Shooting*

Lynx can be mistakenly shot by legal hunters or illegally killed by poachers. The actual magnitude of shooting mortality is unknown. In Canada, incidents were reported by Saunders (1963*b*), Parker et al. (1983), and Slough and Mowat (1996). In Maine, 5 lynx were reported shot (Vashon et al. 2012). In Minnesota, 1 of 17 radio-collared lynx that are known to have died was shot (Moen 2008); a total of 6 lynx were reported shot over about a 10-year period in that state (U. S. Fish and Wildlife Service 2012). Two lynx were reported poached by lion hunters in Montana, and 1 lynx was reported shot in Washington (U.S. Fish and Wildlife Service 2001). In the first 10 years of the reintroduction project in Colorado, Devineau et al. (2011) reported that 14 of 102 (14%) of lynx mortalities were attributable to illegal shooting, with another 5 that were probably shot.

No conservation measures were developed to address illegal shooting. Misidentification errors can be reduced by disseminating information about where lynx occur and providing education to hunters about the characteristics that can be used to distinguish lynx from bobcats. This is being done by state wildlife agencies.

### *Forest/Backcountry Roads and Trails*

This section addresses transportation and distribution systems on public lands. Forest and backcountry roads are typically low-speed (<72kmh [<45 mph]), single or double-lane gravel or paved roads. Extensive (>600 km) backtracking studies found that lynx did not avoid gravel forest roads (Squires et al. 2010). Trails are typically narrow routes with a native surface; there is no information to suggest that trails have negative impacts on lynx.

Construction of roads results in a small reduction of lynx habitat by removing forest cover. In some instances, vegetation along less-traveled roads provides good snowshoe hare habitat, and lynx may use the roadbed for travel and foraging (Koehler and Brittell 1990). Similar to McKelvey et al. (2000*d*), Squires et al. (2010) concluded that forest roads with low vehicular or snowmobile traffic had little effect on lynx seasonal resource-selection patterns in Montana. In Maine, Fuller et al. (2007) documented lynx traveling on roads (unplowed during winter), but determined that roads and their associated edges were selected against within home ranges. Lynx may have exhibited negative selection for road edges because these areas were associated with the lowest density of conifer saplings and hare abundance compared to all other stand types.

Squires et al. (2008) reported that lynx denned farther from all roads compared to random expectation. Lynx occupy dens in early May when many forest roads are still impassable by wheeled vehicles due to persistent snowdrifts and wet, muddy roads; snowmobiles no longer used the roads because of intermittent and unpredictable availability of sufficient snow (Squires et al. 2008). They concluded that lynx did not avoid the subset of roads that were open to wheeled vehicle travel. Rather, the observed avoidance of roads was more a function of the correlation of roads and landscape pattern; fewer roads were located in denning habitat and higher road density occurred along forest edges and in managed stands, which lynx avoided (Squires et al. 2010).

In Minnesota, Moen et al. (2010*b*) found that lynx selected for roads during long-distance movements. Roads may not have been essential to these movements, but lynx appeared to benefit energetically from the use of these linear features.

There have been no documented mortalities on low-use forest roads in Washington; however, several have occurred in Maine and Minnesota. The private forest roads in Maine have a higher traffic volume and faster speeds than many National Forest road systems in lynx habitat. Twelve of 27 lynx mortalities on roads in Maine between 2000 and 2011 occurred on forest roads (Vashon et al. 2012). In Minnesota, between 2000 and 2011, 2 lynx were killed on backcountry railroads, and 2 on unpaved forest roads (U. S. Fish and Wildlife Service 2012). Backcountry roads also provide human access into lynx habitat where incidental trapping or illegal shooting can occur.

### *Grazing by Domestic Livestock*

Grazing by domestic sheep, goats and cattle is common in the western United States. There is little scientific information available about dietary overlap with, or competition between, livestock and snowshoe hares, or the response of snowshoe hares to livestock grazing. If there

were significant forage competition, this could have an indirect impact on lynx by reducing its prey base.

The summer diet of snowshoe hares is dominated by herbaceous food including forbs, grasses, and leaves of shrubs. The winter diet is restricted to woody browse, including smaller-diameter twigs, branches, small stems and evergreen needles of shrubs and trees (Adams 1959, Wolff 1978, Koehler 1990*a*, Hodges 2000*a*). The habitats used by snowshoe hare that are most likely to be affected by livestock grazing are riparian willow and aspen communities.

High-elevation riparian areas dominated by willows have been shown to provide important summer and fall habitat for lynx in Colorado (Shenk 2008). Berg and Gese (2010) found in Wyoming that hare use during the summer in small patches of forest surrounded by non-forest vegetation containing willow. Overbrowsing by domestic livestock or wild ungulates that altered the structure or composition of the native plant community could negatively affect snowshoe hare habitat.

Overall, grazing or browsing by domestic livestock on federal lands is unlikely to reduce the snowshoe hare prey base or have a substantial effect on lynx. Grazing/browsing could have some localized effects on high elevation willow communities or aspen stands if not managed appropriately.

### 10. Implementation of the NRLMD on National Forest Lands in the Northern Rockies

As previously stated, in the Northern Rockies region of the lynx DPS, the NRLMD amended 18 USFS Forest Plans to address the "lack of guidance for conservation of lynx in federal land management Plans." The NRLMD includes standards and guidelines intended to avoid or reduce the potential for projects proposed under Forest Plans to adversely affect lynx. A suite of standards and guidelines in the NRLMD promote and conserve the habitat conditions needed to produce adequate snowshoe hare (lynx primary prey) densities to sustain lynx home ranges, and thus sustain lynx populations. The NRLMD is intended to address the major threats to lynx and the inadequacy of existing regulatory mechanisms in the Northern Rockies region in order to reduce adverse effects and avoid jeopardy through its implementation.

In support of this biological opinion, we reviewed the latest publications and information providing the best available science on the status and factors influencing lynx and snowshoe hare populations in the Northern Rocky Mountains region. Based on our updated review of the literature, we conclude that the provisions of the NRLMD continue to address the major risks to lynx on the KNF. This will be demonstrated in our analysis of effects in Section D.

The primary issues addressed in the NRLMD included winter snowshoe hare habitat in multistoried forests, wildland fire risk, and the nature of management direction applied to grazing, mineral development, roads, and over-the-snow recreation. In addition to the vegetation management direction the NRLMD identifies standards and guidelines specific to four other categories of risk factors including: 1) all management practices and activities; 2) livestock management; 3) human use (i.e. special uses, recreation, road, highways, mineral and energy development); and 4) linkage areas. A detailed description of the objectives, standards, and guideline of the NRLMD is provided in Section C.3 below.

### 11. Analysis of the Species and Critical Habitat Likely to be Affected

Lynx are a wide-ranging species requiring large, interconnected areas of suitable habitat. Habitat connectivity within geographic areas and with Canada may be important for long-term lynx population viability and maintenance of the contiguous United States DPS. Lynx habitat occurs in a relatively patchy distribution across broad areas of the west. Certain areas include expanses of more contiguous and higher quality lynx habitat that appear more important to supporting viable resident lynx populations (e.g. core areas and critical habitat).

A key factor in sustaining lynx populations in the DPS is USFS management of snowshoe hare (their primary prey) habitat. Lynx on IPNF lands may be affected by management activities that reduce or degrade essential habitat elements used by lynx for denning, foraging (snowshoe hare habitat and hunting habitat), and recruitment, or that increase habitat fragmentation and lynx mortality. The biological assessment for the Revised Plan determined that the proposed action would likely result in adverse effects to individual lynx over the life of the plan. This biological opinion evaluates these Revised Plan effects within the action area on the lynx population DPS.

Critical habitat has been designated for Canada lynx within the action area, which lies in the critical habitat Unit 3. The conservation role of lynx critical habitat is to support viable core area populations. A key factor then in USFS management is providing boreal forest landscapes supporting a mosaic of differing successional forest for the production of snowshoe hare (the lynx primary prey). The biological assessment for the Revised Plan determined that the proposed action would likely result in project-level adverse effects on designated critical habitat for Canada lynx. This biological opinion evaluates the effects of the Revised Plan within the action area on the conservation role of lynx critical habitat Unit 3.

## C. ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The “action area” includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action [50 CFR §402.02]. The action area does not necessarily include all areas potentially frequented by far-ranging, or migrant, species (USFWS and NMFS 1998, pp 4-15 to 4-19).

The “action area” includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action [50 CFR §402.02]. The action area does not necessarily include all areas potentially frequented by far-ranging, or migrant, species (USFWS and NMFS 1998, pp. 4-15 to 4-19).

The action area is the entire Forest (2.5 million acres). To reiterate, mapped lynx habitat is found on 35 LAUs, across 891,701 acres on the Forest. Of the total acres in the LAUs, 582,981 acres is

lynx boreal forest habitat type . The remainder is non-lynx habitat (scree slopes, cliffs, lakes, or warm and dry site habitat types dominated by ponderosa pine, Douglas-fir and Grand fir habitat types). There is also approximately 34,650 acres of designated critical habitat for lynx in two LAUs: American-Canuck and Deerskin.

As discussed earlier in the *Status of the Species Section*, resident lynx may make exploratory or breeding movements into new areas, but typically return to their original home range. Males may travel long distances during these episodes. However, lynx habitat supports the densities of snowshoe hares needed to sustain resident lynx and reproduction. Boreal forest is limited in areas outside LAUs, and is much more fragmented in distribution, occurring in smaller patches, than in LAUs. It is unlikely that the amount and distribution of boreal forest patches outside LAUs support the high snowshoe hare densities required by resident lynx.

### 1. Status of the Species within the Action Area

Lynx population numbers are unknown for the IPNF. A three-year lynx survey conducted on the St. Joe Ranger District and snow-tracking surveys on the Priest Lake and Coeur d'Alene Ranger Districts of the IPNF did not result in any observation of lynx tracks or signs. Subsequent fisher surveys by the Coeur d'Alene Tribe did result in the detection of lynx on two occasions (Albrecht and Heusser 2009 as cited in USFS 2013a, p. 18). Recent forest carnivore research on the Priest, Bonners Ferry, and Sandpoint Ranger Districts resulted in three (3) confirmed sightings of lynx in the Selkirks and Purcells (Idaho Fish and Game (IDFG) et al. 2011 as cited in USFS 2013a, p. 18, Lucid and Allen pers. comm. 2012 as cited in USFS 2013a, p. 18). In 2012, a female lynx was trapped and killed in the Purcell Mountains by a bobcat trapper who mistook it for a bobcat. Lynx are known to occur to the east of the IPNF on the Kootenai National Forest (KNF), based on historic and recent trapping records. Hence, some lynx centered on the KNF may have home ranges that overlap portions of the IPNF.

As discussed above in Section B, lynx habitat on IPNF lands in the action area are currently managed in accordance with the NRLMD. The NRLMD biological opinion (USFWS 2007, p. 75) concluded that the programmatic objectives and project-level standards and guidelines in the amended Forest Plans provide comprehensive conservation direction adequate to reduce adverse effects to lynx from forest management on national forest lands and do not result in jeopardy to the lynx DPS. The elements of the NRLMD addressing the risk factors for lynx are described in detail below (Section B.3).

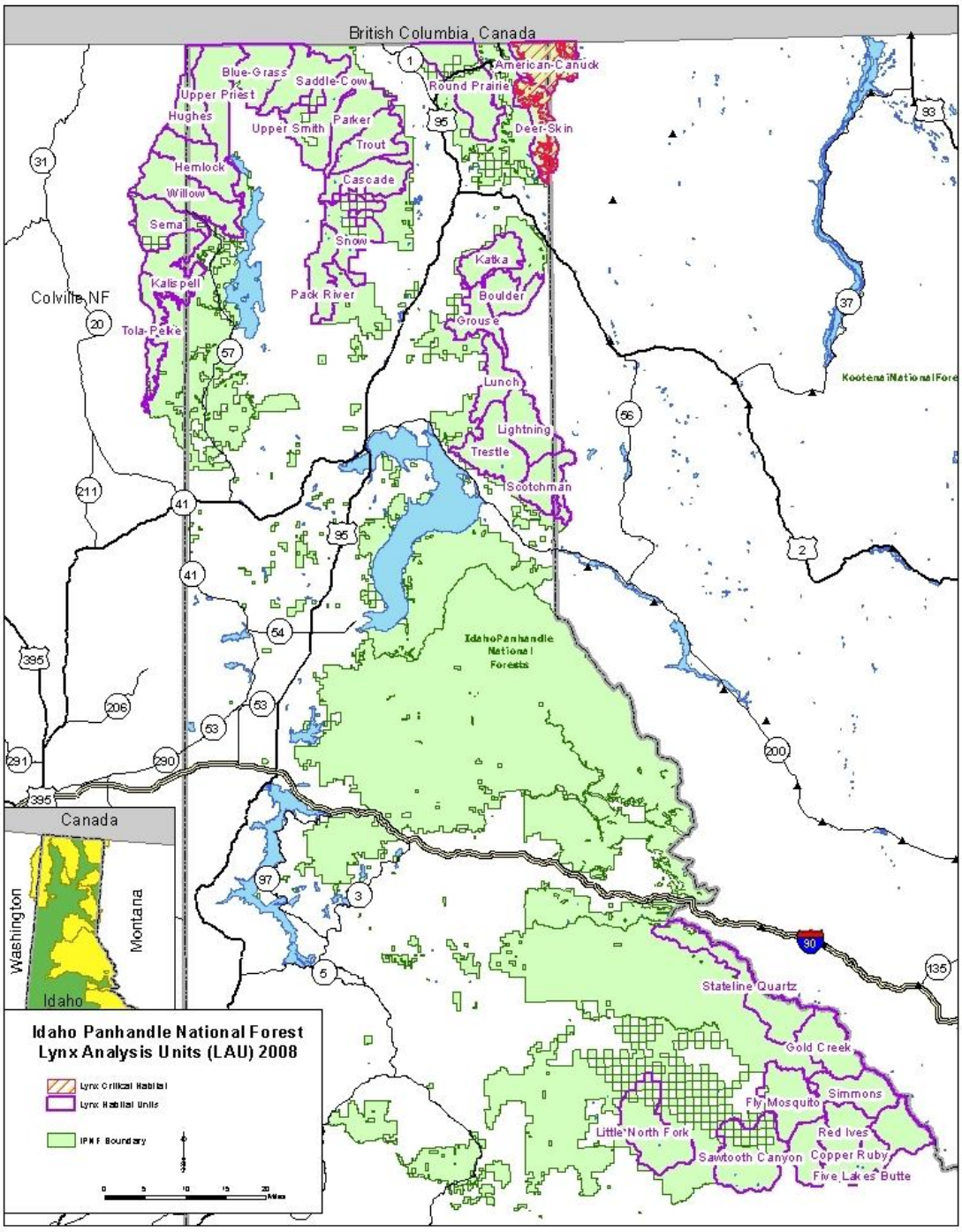



**Figure III-1. Location of LAUs on the IPNF.**

## 2. Factors Affecting Canada Lynx within the Action Area

The IPNF identified past/ongoing actions and key stressors for lynx in its biological assessment (USFS 2013a, pp.23-24, 34-40). The NRLMD and 2013 LCAS address similar risk factors as those listed in the IPNF BA, as well as: connectivity, landscape patterns, denning habitat, and habitat conversion.

As previously stated, the risk factors identified for lynx (Table III-5) have varying effects on lynx, depending upon the nature, location, duration, and timing of the activity (USFWS 2007, p.36). On NFS lands, some factors present more likelihood of risks to lynx and others are relatively benign in effects. Many were addressed through implementation of the NRLMD (see Section B.9 above). The status of the risk factors relevant to the action area is summarized below.

- Climate Change
- Vegetation Management
- Wildland Fire Management
- Fragmentation of Habitat – including the importance of linkage areas
- Incidental Trapping/Shooting
- Recreation
- Mineral and Energy Exploration and Development
- Forest/Backcountry Roads and Trails
- Grazing by Domestic Livestock

### *Climate Change*

Section B.9 provides a comprehensive overview of what we know about the status of climate change in northern boreal forests and the range of anticipated effects on lynx. We address climate change and its impacts in the action area in a limited fashion because the Federal land management agencies, such as the USFS, have limited ability to alter the trajectory or reduce the effects of climate change within the action area. The subsequent effects analysis will describe the provisions of the Revised Plan aimed at addressing the anticipated effects of climate change on the IPNF as a whole. This discussion is found in the analysis of effects of vegetation management and wildland fire management.

### *Vegetation Management*

The primary factors driving lynx populations, behavior, and distribution is the abundance and distribution of their primary prey: snowshoe hare. As discussed in Section B.9, stand structure, composition and arrangement are important elements of habitat for snowshoe hares and lynx. Stem density and snowshoe hare density are directly and positively correlated. Therefore, vegetation management activities that reduce stem densities, overstory vegetative layers, and/or horizontal structure can result in negative effects on both snowshoe hare use of affected stands and therefore lynx.

The vegetation management objectives of the NRLMD (VEG O1, O2, O3 and O4) were designed to improve the quality of lynx habitat by improving conditions for prey:

> 1) VEG O1 - manage vegetation to mimic or approximate natural succession and disturbance processes while maintaining habitat components necessary for the conservation of lynx;
>
> 2) VEG O2 - provide a mosaic of habitat conditions through time that support dense horizontal cover and high densities of snowshoe hare, and provide winter snowshoe hare habitat in both the SISS and in the mature, multi-story conifer vegetation;
>
> 3) VEG O3 - conduct fire use activities to restore ecological processes and maintain or improve lynx habitat; and
>
> 4) VEG O4 - focus vegetation management in areas that have potential to improve winter snowshoe hare habitat but presently have poorly developed understories that lack dense horizontal cover.

These objectives are attained through application of the vegetation management standards: VEG S1, S2, S5 and S6. These standards were crafted to ensure that enough habitat within each LAU would be available to provide lynx with sufficient snowshoe hare prey and lynx foraging (hunting) habitat conditions. Briefly, the standards require:

- VEG S1 - If more than 30 percent of the lynx habitat in an LAU is currently in a SISS that does not yet provide winter snowshoe hare habitat no additional habitat may be regenerated by vegetation management projects
- VEG S2 - Timber management projects shall not regenerate more than 15 percent of lynx habitat on NFS or BLM lands in an LAU in a ten-year period
- VEG S5 - Pre-commercial thinning projects that reduce snowshoe hare habitat may occur from the SISS until the stands no longer provide winter snowshoe hare habitat only in limited locations or under limited circumstances
- VEG S6 - Vegetation management projects that reduce snowshoe hare habitat in multi-story mature or late successional forests may occur only in limited locations or under limited circumstances.

Since 2007, the NRLMD vegetative standards have limited or influenced vegetation management on IPNF lynx habitat such that a mosaic of vegetative successional stages required by lynx and its primary prey – the snowshoe hare - are maintained and promoted over time. These key standards maintain the quality of lynx habitat by improving conditions for prey. When applied at the project level, adverse effects on lynx are mostly avoided or minimized. In our NRLMD biological opinion, we concluded that this direction would conserve the most important components of lynx habitat: a mosaic of early, mature and late successional staged forests, with high levels of horizontal cover and structure (USFWS 2007, p.43).

The NRLMD also included guidelines for vegetation management. Guidelines were intended to be implemented in most cases, whereas a standard is a required action. The NRLMD guidelines

would be adhered to except where compelling reasons, such as the protection of other species at risk or public safety, are an issue (USFWS 2007, p. 8). The USFS confirms that the NRLMD guidelines have been implemented at the project level and any exceptions were noted and explained in annual reporting to the USFWS (L. Allen8/19/2013 pers. comm.). The vegetation guidelines include:

- VEG G1 - Vegetation management projects should be planned to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available
- VEG G4 - Prescribed fire activities should not create permanent travel routes that facilitate snow compaction. Constructing permanent firebreaks on ridges or saddles should be avoided
- VEG G5 - Habitat for alternate prey species, primarily red squirrel, should be provided in each LAU
- VEG G11 - Denning habitat should be distributed in each LAU.

These standards and guidelines work together to maintain the quality of lynx habitat by improving conditions for prey. When applied at the project level, adverse effects on lynx are mostly avoided, or minimized. In our NRLMD biological opinion, we concluded that this direction would conserve the most important components of lynx habitat: a mosaic of early, mature and late successional staged forests, with high levels of horizontal cover and structure (USFWS 2007, p.43).

Table III-6 summarizes the current condition of IPNF LAUs in regards to VEG S1 and VEG S2, including effects from timber harvest, prescribed fire, and wildland fires. Table III-6 displays the percentage of habitat in a) the SISS, that is, snowshoe hare habitat in early successional stages - - and the percentage of the LAUs in SISS (not to exceed 30 percent) VEG S1; and b) how commercial timber harvest and fuels management have contributed to the acres of SISS over the last 10 years (2002-2011) - VEG S2. In accordance with VEG S1, no LAUs exceed 30 percent in SISS, and therefore no 3 adjacent LAUs exceed 30 percent in SISS (column 3). Lastly, in accordance with VEG S2, the Forest has not regenerated more than 15 percent of any LAU over the past 10 years (column 4).

Table III-6. Status of lynx habitat on the IPNF by LAU and conditions related to the NRLMD standards VEG S1 and VEG S2**.**

| Lynx Analysis Unit (LAU) | Lynx Habitat in LAU (Acres) | VEG S1 –Acres (Percent) in SISS Habitat[1] | VEG S2 – Acres (Percent) Changed to SISS on NFS Lands Over Past 10 Years by Regeneration Harvests[2] |
|---|---|---|---|
| **American-Canuck[3]** | **20,710** | **1,034 (4.9)** | **183 (0.9)** |
| Blue-Grass | 18,253 | 225 (1.2) | 102 (0.6) |
| Boulder | 14,221 | 95 (0.7) | 0 |
| Cascade | 15,529 | 208 (1.3) | 88 (0.6) |
| Copper-Ruby | 10,777 | 0 | 0 |
| **Deer-Skin[3]** | **13,976** | **28 (0.2)** | **0** |

| Lynx Analysis Unit (LAU) | Lynx Habitat in LAU (Acres) | VEG S1 –Acres (Percent) in SISS Habitat[1] | VEG S2 – Acres (Percent) Changed to SISS on NFS Lands Over Past 10 Years by Regeneration Harvests[2] |
|---|---|---|---|
| Five Lakes Butte | 12,040 | 0 | 0 |
| Fly Mosquito | 14,496 | 244 (1.7) | 45 (0.3) |
| Grouse | 16,053 | 174 (1.1) | 0 |
| Gold Creek | 12,320 | 5 (<.1) | 0 |
| Hemlock | 27,159 | 952 (3.5) | 0 |
| Hughes | 19,634 | 820 (4.2) | 0 |
| Kalispell | 22,394 | 55 (0.2) | 0 |
| Katka | 9,762 | 77 (0.8) | 0 |
| Lightning | 16,002 | 503 (3.1) | 0 |
| Little North Fork | 19,863 | 145 (0.7) | 0 |
| Lunch | 14,738 | 157 (1.1) | 0 |
| Pack River | 10,507 | 36 (0.3) | 0 |
| Parker | 15,778 | 17 (0.1) | 0 |
| Red Ives | 14,070 | 54 (0.4) | 0 |
| Round-Prairie | 14,062 | 663 (4.7) | 276 (1.9) |
| Saddle-Cow | 16,614 | 147 (0.9) | 106 (0.6) |
| Sawtooth Canyon | 11,867 | 158 (1.3) | 0 |
| Scotchman | 10,186 | 3 (<.1) | 0 |
| Sema | 19,163 | 18 (<.1) | 0 |
| Simmons | 15,573 | 558 (3.6) | 0 |
| Snow | 15,207 | 0 | 0 |
| St. Joe Headwaters | 15,099 | 901 (5.9) | 0 |
| Stateline Quartz | 16,959 | 638 (3.8) | 494 (2.9) |
| Tola-Pelke | 13,802 | 124 (0.9) | 0 |
| Trestle | 18,125 | 96 (0.5) | 0 |
| Trout | 17,953 | 129 (0.7) | 0 |
| Upper Priest | 30,109 | 2,309 (7.7) | 0 |
| Upper Smith | 17,434 | 592 (3.4) | 0 |
| Willow | 32,546 | 48 (0.2) | 0 |
| **Totals** | **582,979** | **11,213** | **1,294** |

1. Lynx habitat in a SISS not yet providing winter snowshoe hare habitat (typically less than 16 years after treatment). Includes habitat affected by vegetation management, prescribed fire, and wildland fires.
2. Regeneration harvest includes clearcutting, shelterwood, seed-tree, single-tree, and group selection.
3. Bold font indicates presence of critical habitat. American-Canuck includes 20,710 acres of critical habitat and Deerskin includes 13,977 acres.

Exemptions and Exceptions to the Vegetation Management Standards

The NRLMD authorized exemptions from standards VEG S1, S2, S5, and S6 for fuels management within the wildland-urban interface (WUI). Also, exceptions listed in VEG S5 and S6 allow for precommercial thinning to protect structures, for research, and to promote the conservation of tree species such as whitebark pine and aspen. The exemptions and exceptions would allow actions that may have adverse effects on lynx by reducing the horizontal structure of natural forest succession phases and or affecting the mosaics of the forested landscape in localized areas.

Specifically, on the IPNF, the total acreage that could be affected by exemptions and exceptions were updated in 2008 and is limited to no more than 34,978 acres for fuels management in the WUI and 17,120 acres for precommercial thinning projects for resource benefits such as research, defensible space, and white pine/whitebark pine/aspen treatments (USFS 2013a, pp.28-29); in total this represents 9 percent of mapped lynx habitat on the IPNF. Since implementation of the NRLMD in 2007, the IPNF has conducted three precommerical thinning projects under the exceptions of the NRLMD, affecting a total of about 717 acres (USFS 2013a, p 30). An additional 1,294 acres have been subject to regeneration harvest with 12 acres resulting in adverse effects on lynx or lynx habitat; however this grand total includes acres counted prior to remapping of lynx habitat in 2008, so some of those original counted acres may not have been lynx habitat (L. Allen 08/19/2013 pers. comm.). Additionally, the IPNF has completed 1,342 planned prescribed burns covering 46,977 acres Forest-wide, with 144 of these operations burning approximately 4,330 acres within LAUs.

To date, it appears that the level of adverse effects related to vegetation management on the IPNF is substantially lower than anticipated in the ROD and the biological opinion for the NRLMD.

We conclude that the environmental baseline as affected by vegetation management under the existing Forest Plan is in good condition. Implementation of the NRLMD on the IPNF has maintained the mosaic of habitats required by lynx and its primary prey, the snowshoe hare. As evidenced in Table III-6, all LAUs are in compliance with the NRLMD. Further, the IPNF reports that guidelines have been implemented for all projects in lynx habitat since 2007. Additionally, the acres of adverse effects on lynx habitat (i.e., snowshoe hare habitat) on the IPNF are well below those anticipated in the ROD and biological opinion for the NRLMD as well as those indicated in the 2008 update. Therefore, we conclude that vegetative conditions on the IPNF fully support female home ranges for the production of lynx.

***Wildland Fire Management***

As described in Section B.9, fire and other natural disturbance processes historically played an important role in maintaining a mosaic of forest successional stages that provides habitat for both snowshoe hare and lynx. The use of fire to restore ecological processes to maintain/improve lynx and snowshoe hare habitat is supported by the NRLMD vegetation objectives VEG O1 – O3.

The USFS Terrestrial BA (USFS 2013a, p. 30) reports that since the Canada lynx was listed in 2000, 1,681 wildfire events have burned approximately 24,640 acres across the Forest. Approximately 13,180 acres burned within LAUs.

Based on the IPNF compliance with the NRLMD and the rate of wildfires in lynx habitat, it appears that the environmental baseline as affected by wildfires under the existing Forest Plan is in good condition. That is, fires contribute to the mosaic of successional stages that provides habitat for both lynx and snowshoe hare but have not contributed to an over-abundance of early SISS.

***Fragmentation of Habitat***

Fragmentation of the naturally patchy pattern of lynx habitat in the contiguous United States can affect lynx by reducing their prey base and increasing the energetic costs of using habitat within their home ranges. A variety of anthropogenic activities such as highways and major developments and associated infrastructure contribute to fragmentation. Highways also pose a risk of direct mortality and may inhibit lynx movement between previously connected habitats. Further, connectivity to source populations in Canada is considered critical to persistence of populations in most parts of the range in the United States (68 FR40076–40101).

The NRLMD recognizes the importance of linkage and addresses it through objectives, standards, and guidelines All O1, All S1, LINK O1, LINK S1, and All G1, which are identified below:

- ALL O1 - Maintain or restore lynx habitat connectivity in and between LAUs, and in linkage areas

- ALL S1 - New or expanded permanent development and vegetation management projects must maintain habitat connectivity in an LAU and/or linkage area

- LINK O1 - In areas of intermingled land ownership, work with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions to reduce the potential of adverse impacts on lynx and lynx habitat

- LINK S1 - When Highway or forest highway construction or reconstruction is proposed in linkage areas, identify potential highway crossings

- ALL G1 - Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses, or overpasses

Coarse, landscape-level lynx linkage areas have been identified (Claar et al. 2003, p. 236-238; USFS 2007) and are intended to assist in land use planning in order to maintain connectivity where it exists and allow for movement of animals between blocks of habitat that are otherwise separated by intervening non-habitat areas such as basins, valleys and agricultural lands, or where habitat naturally narrows due to topographic features. There are eight identified lynx

linkage areas (Claar et al. 2003, p. 236-238, USFS 2007) on the IPNF. All eight of these are located on private lands (and non-lynx habitat) in valley bottoms and transect interstate or state highways (i.e. Interstate 90 (I-90), State Route 95 (SR 95), SR 200, and SR 2). Figure III-2 shows the location of lynx linkage areas on the IPNF.

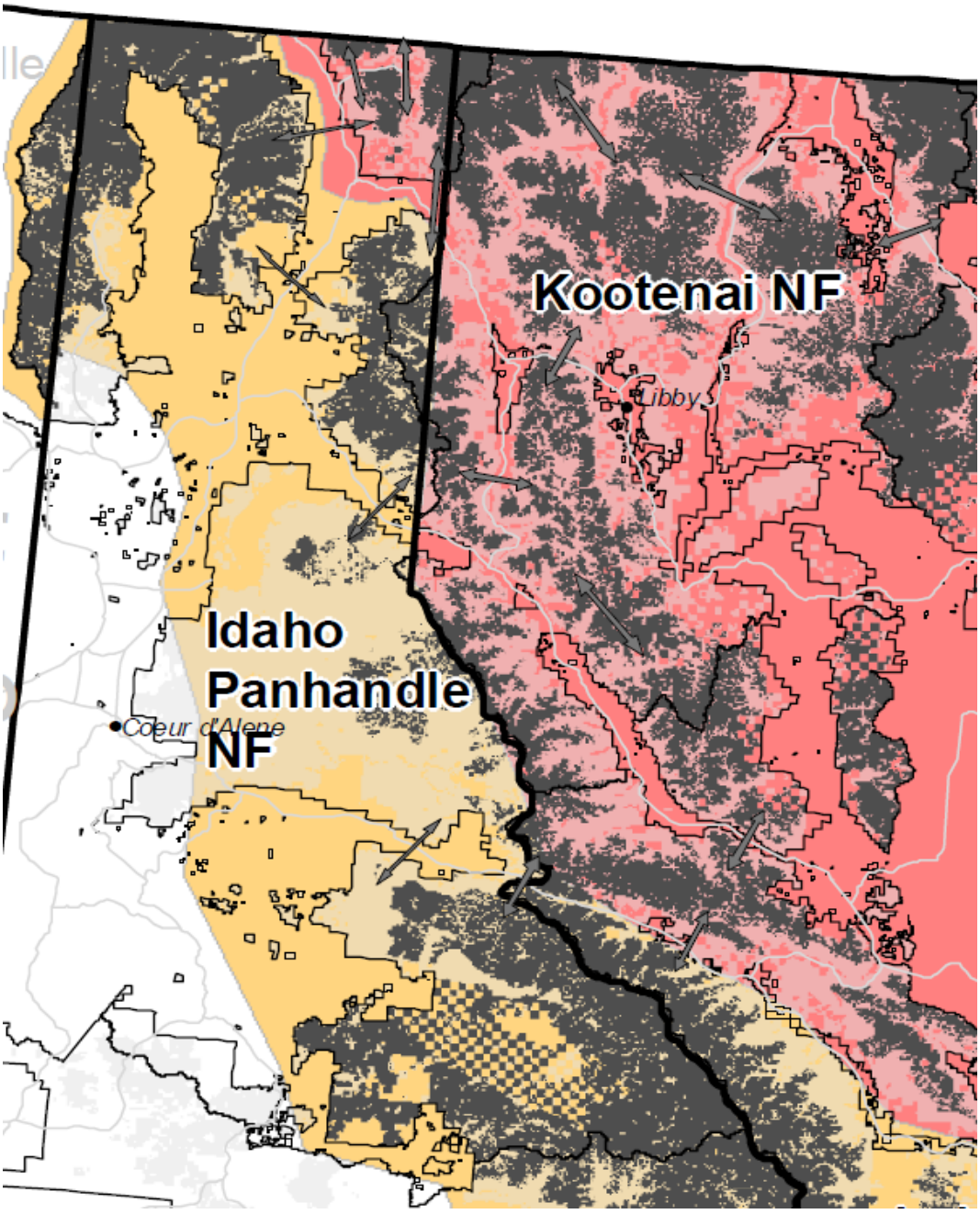



**Figure III-2. Location of linkage areas on the IPNF (source: Figure 1 in USFS 2007). Grey arrows depict locations of linkage areas.**

### *Incidental Trapping and Illegal Shooting*

As discussed in Section B.9, two lynx were trapped in Idaho, 1 in 2012 (Beth Waterbury, Idaho Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013) and another in 2013 (Michael Lucid, Idaho Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013), which resulted in 1 mortality. We are not aware of shooting mortality for lynx in Idaho or the action area. These risks appear to contribute limited mortality within the action area. Trapping and hunting is authorized and administered by agencies other than the USFS; therefore, we do not further address incidental trapping and illegal shooting in this biological opinion.

### *Recreation*

Our understanding of the effects of outdoor recreation on lynx and their habitat is incomplete. Recreational developments may remove forest cover or result in direct habitat loss or fragmentation. Human presence may disturb or displace lynx. Packed trails created by snowmobiles, cross-country skiers, snowshoe hares, and other predators might serve as travel routes for potential competitors and predators of lynx, especially coyotes.

NRLMD objectives, standards and guidelines address the most serious consequences of recreational development, requiring new or expanding permanent developments to maintain or where possible, promote habitat connectivity within LAUs and linkage areas (All O1, All S1, LINK O1, LINK S1, and All G1).

Anecdotal information suggests that lynx are quite tolerant of humans, although individuals may behave differently in response to human presence. The NRLMD does not address the potential for human disturbance on lynx. Roads provide human access into wildlife habitats. NRLMD guideline HU G9 indirectly limits the potential for human disturbance of lynx from roads. Specifically, the guideline states:

- HU G9 - On new roads built for projects, public motorized use should be restricted. Effective closures should be provided in road designs. When the project is over, these roads should be reclaimed or decommissioned, if not needed for other management objectives

Additionally, the 2011 Access Amendment limits road densities in grizzly bear BMUs and maintains the baseline linear miles of open and total permanent roads in BORZ. These commitments similarly limit human access into lynx habitat, thereby reducing opportunities for human disturbance of lynx.

The evidence supporting a risk to lynx from compacted snow routes (e.g. snowmobile trails and tracks) is limited. However, the NRLMD includes guidelines HU G12/HU G11 which state:

- HU G12 - Winter access for non-recreation special uses and mineral and energy exploration and development, should be limited to designated routes or designated over-the-snow routes

- HU G11 - Designated over-the-snow routes or designated play areas should not expand outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat. This may be calculated on an LAU basis, or on a combination of immediately adjacent LAUs. This does not apply inside permitted ski area boundaries, to winter logging, to rerouting trails for public safety, to accessing private inholdings, or to access regulated by Guideline HU G12. Use the same analysis boundaries for all actions subject to this guideline.

The IPNF currently has 190 recreation Special Use Permits and agreements (USFS 2011, p. 289). None of these involve winter recreation, with the exception of Lookout Ski area, which is not located in lynx habitat.

Table III-7 summarizes existing motorized and recreational access within LAUs on the IPNF. With the advancement in snowmobile technology and increase in winter recreation on the Forest, there has been an increase in snowmobile use throughout lynx habitat (USFS 2013a, p.29). Many areas of lynx habitat on the Forest have limited accessibility for snowmobiling off-route due to tree densities and topography (ibid, p. 30). Within lynx habitat within LAUs on the IPNF there are approximately 123 miles of groomed over-snow motorized routes (Table III-7). There are no designated snowmobile play areas on the IPNF, although it is likely that some areas in LAUs receive concentrated use. There are six Challenge Cost-Share agreements that permit winter grooming of snowmobile trails on the IPNF, and five of these are located in lynx habitat. Recent efforts to complete MVUM on the IPNF closed overland motorized travel and resulted in a reduction of motorized routes available throughout the action area (USFS 2011b as cited in USFS 2013a, p.30).

Winter access to lynx habitat is also restricted within the LAUs in the Selkirk Mountains (including all or portions of Pack River, Snow, Cascade, Trout, Upper Smith, Saddle Cow, Blue-Grass, Upper Priest, Hughes, Hemlock, Willow, Sema and Kalispel), which are closed in winter due to a 2007 federal court order to protect woodland caribou (see Chapter IV. woodland caribou, for details). All or portions of other LAUs on the North Zone are closed due to management direction (USFS pers. comm. 8/19/2013).

Scientific evidence to date indicates that recreational activities provide a low risk of effects to lynx (IGBT 2013). Given the guidelines of the NRLMD and existing limitations on roads and snowmobile use on the IPNF, we conclude that the environmental baseline as affected by recreational use of the IPNF is in good condition.

***Mining Proposals***

As described in Section B.9, activities associated with exploration and development of leasable minerals, locatable minerals, and mineral materials could affect lynx habitat by changing or eliminating the native vegetation and contributing to habitat fragmentation. Large-scale mining operations could result in additional habitat loss and fragmentation from site development and distribution facilities.

The effects of mining developments (habitat loss, roads, and human access) are addressed by the NRLMD guidelines HU G4, HU G5, HU G6, HU G9, and HU G12. Briefly, the guidelines state:

- HU G4 - For mineral and energy development sites and facilities, remote monitoring should be encouraged to reduce snow compaction

- HU G5 - For mineral and energy development sites and facilities that are closed, a reclamation plan that restores lynx habitat should be developed

- HU G6 - Methods to avoid or reduce effects on lynx should be used in lynx habitat when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development

- HU G9 - On new roads built for projects, public motorized use should be restricted. Effective closures should be provided in road designs. When the project is over, these roads should be reclaimed or decommissioned, if not needed for other management objectives

- HU G12 - Winter access for non-recreation special uses and mineral and energy exploration and development, should be limited to designated routes or designated over-the-snow routes.

There are currently 1,232 Plans of Operations for various small scale locatable minerals (e.g., gold, silver, copper) operations Forest-wide on the IPNF. Of these, 13 are located in lynx habitat. Before approval, or before these types of mining activities can occur, a NOI is typically submitted by a proponent to the ranger district where the proposed operations would occur. The district ranger determines whether a more detailed Plan of Operations is required, based on whether such operations will likely cause significant disturbance of surface resources, including habitats of listed species. The IPNF annually receives around 100 of these NOIs per year. The majority of on-going activities are related to maintenance of existing facilities. Most locatable mineral operations are less than five acres in size. Potential for future mineral discovery is considered "low" (USFS 2013a, p. 31).

There are approximately 434 identified mineral material (e.g., gravel, rock, sand) pits within the IPNF and of these 23 sites are within lynx habitat. Sites typically range from less than one to five acres in size. There are no active mineral leases located on the IPNF at this time.

Overall, existing mining proposals on the IPNF have not contributed to measurable habitat loss or fragmentation of lynx habitat in the action area.

***Forest/Backcountry Roads and Trails***

As described in Section B.9, construction of roads results in a small reduction of lynx habitat by removing forest cover. In some instances, vegetation along less-traveled roads provides good snowshoe hare habitat, and lynx may use the roadbed for travel and foraging. In general, forest

roads with low vehicular or snowmobile traffic appear to have little effect on lynx seasonal resource-selection patterns in areas similar to the action area.

Since 2007, effects of roads on lynx on IPNF lands in lynx habitat have been addressed through implementation of NRLMD guidelines All G1 and HU G6 though G9. These guidelines state:

- ALL G1 - Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses, or overpasses
- HU G6 - Methods to avoid or reduce effects on lynx should be used in lynx habitat when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development
- HU G7 - New permanent roads should not be built on ridge-tops and saddles, or in areas identified as important for lynx habitat connectivity. New permanent roads and trails should be situated away from forested stringers
- HU G8 - Cutting brush along low-speed, low-traffic-volume roads should be done to the minimum level necessary to provide for public safety
- HU G9 - On new roads built for projects, public motorized use should be restricted. Effective closures should be provided in road designs. When the project is over, these roads should be reclaimed or decommissioned, if not needed for other management objectives.

Table III-7 summarizes existing motorized access within LAUs on the IPNF. Recent efforts to complete Motorized Vehicle User Maps (MVUM) on the IPNF closed overland motorized travel and resulted in a reduction of motorized routes available throughout the action area (USFS 2011b as cited in USFS 2013a, p. 30).

**Table III-7. Current motorized access within Canada lynx habitat on the IPNF.**

| Type of Allowed Access | Lynx Habitat | |
|---|---|---|
| | Primary & Secondary | Critical Habitat |
| Wheeled Motorized Access Routes (miles) | 531 | 62 |
| Highways (miles) | 0 | 0 |
| Over-Snow Motorized Use (acres) [1] | 249,727 | 34,649 |
| Designated Over-Snow Play Areas (acres) | 0 | 0 |
| Groomed and Designated Over-Snow Routes (miles) | 123 | 6 |

[1] Many of these areas have limited accessibility for snowmobiling off-route due to tree densities and topography (USFS 2011b as cited in USFS 2013a, p. 30).

Approximately 56 percent of the lynx habitat in LAUs is also within the recovery zones for grizzly bear on the Forest (USFS 2013a, p.25). Under the Grizzly Bear Access Amendment, there will be lower levels of wheeled motorized vehicle access and an increase in the amount of core (secure) habitat in BMUs.

Based on the information above, we conclude that the environmental baseline, as it relates to backcountry roads or trails, is not contributing substantive negative effects on lynx in the action area.

***Livestock Grazing***

As described in Section B.9, overall, grazing or browsing by domestic livestock on federal lands is unlikely to reduce the snowshoe hare prey base or have a substantial effect on lynx. Grazing/browsing could have some localized effects on high elevation willow communities or aspen stands if not managed appropriately.

Grazing allotments in LAUs are managed in accordance with the NRLMD grazing objective GRAZ O1 and through guidelines GRAZ G1 through G4:

- GRAZ O1 - Manage livestock grazing to be compatible with improving or maintaining lynx habitat
- GRAZ G1 - In fire- and harvest-created openings, livestock grazing should be managed so impacts do not prevent shrubs and trees from regenerating
- GRAZ G2 - In aspen stands, livestock grazing should be managed to contribute to the long-term health and sustainability of aspen
- GRAZ G3 - In riparian areas and willow carrs, livestock grazing should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages, similar to conditions that would have occurred under historic disturbance regimes
- GRAZ G4 - In shrub-steppe habitats, livestock grazing should be managed in the elevation ranges of forested lynx habitat in LAUs, to contribute to maintaining or achieving a preponderance of mid- or late-seral stages, similar to conditions that would have occurred under historic disturbance regimes.

Currently, there are three active cattle grazing allotments on the IPNF that contain a cumulative total of 10,177 acres of lynx habitat in three LAUs within the action area. Given the limited likelihood of adverse effects on lynx from grazing and the relatively few acres of lynx habitat in grazing allotments, we conclude that the environmental baseline as affected by livestock grazing is in good condition.

## 3. Status of Critical Habitat in the Action Area

This section analyzes the environmental baseline conditions for critical habitat in the action area. Our analysis describes the environmental baseline of critical habitat in terms of the current Forest Plan direction in lynx habitat, most importantly, the direction in the NRLMD that affects critical habitat for lynx.

### *Critical Habitat in the Action Area*

For the purposes of this biological opinion, we defined the action area to include all lynx critical habitat on the IPNF. The action area is within Unit 3 of designated lynx critical habitat and contains the physical and biological features essential for the conservation of the species, including the primary constituent element (PCE1) and its four components. Our final rule determined that the conservation role of lynx critical habitat is to support viable lynx populations within core areas.

The action area includes approximately 34,650 acres of designated critical habitat for lynx in critical habitat Unit 3. This represents less than 1 percent of the designated critical habitat in Unit 3 and just 6 percent of all lynx habitat on the IPNF. Critical habitat on the IPNF is located north of U.S. Highway 2 and east of the Moyie River in the extreme northeast corner of the Forest in 2 LAUs: American-Canuck and Deerskin.

### *Factors Affecting Critical Habitat in the Action Area*

Since the NRLMD was amended to the Forest Plan in 2007, the Forest manages all mapped lynx habitat in LAUs, including mapped lynx habitat designated as critical habitat, in accordance with the NRLMD. In other words, the NRLMD direction applies to mapped lynx habitat designated as critical habitat within the action area and addresses each of the habitat types, habitat components, and habitat conditions detailed and described in the lynx critical habitat PCE1 (Table III-8).

Matrix habitat is characterized as hardwood forest, dry forest, non-forest or other habitat types that do not support snowshoe hares and is used by lynx for travel within its home range. For matrix habitat within the critical habitat component of an LAU, the linkage objectives, standards, and guidelines would apply to any matrix habitat identified as linkage areas. Otherwise, projects in matrix habitat should undergo site-specific analysis and consultation at the time they are proposed. Hence, the NRLMD is likely not applied to all matrix habitat.

**Table III-8. The components of the lynx critical habitat primary constituent element (PCE1) and the NRLMD features that address the PCE1.**

| PCE | PCE Description | Associated NRLMD Objective, Standard and/or Guideline |
|---|---|---|
| 1. | ***Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:*** | VEG O1, VEG O2, VEG O3, VEG O4 |
| a | Presence of snowshoe hares and their preferred habitat conditions, including dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface; | VEG O1, VEG O2, VEG O3, VEG O4; VEG S1, VEG S2, VEG S5 and VEG S6; VEG G1, VEG G4, VEG G5 and VEG G10; GRAZ G1, GRAZ G2, GRAZ G3, and GRAZ G4; HU G1, HU G2, HU G8 |
| b | Winter snow conditions that are generally deep and fluffy for extended periods of time; | VEG G4; HU G4, HU G11, and HU G12 |
| c | Sites for denning that have abundant coarse woody debris (downed trees and root wads); | VEG O1; VEG G11; HU G1 |
| d | Matrix habitat (e.g., hardwood forest, dry forest, non-forest or 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. | ALL S1; GRAZ G4; HU G3 and HU G7; LINK S1 and LINK G2 |

The following risk factors for critical habitat are addressed for the action area: vegetation management, wildland fire management, linkage area management, recreational access and developments, mining and energy developments, forest/backcountry roads and trails, and livestock grazing.

Vegetation Management Actions That May Affect PCE, PCE1a and PCE1c

Under the NRLMD, vegetation management in lynx habitat and in critical habitat is limited by the vegetation standards (VEG S1, S2, S5, and S6) such that a mosaic of vegetative successional stages required by lynx and its primary prey – the snowshoe hare - are maintained and promoted over time. These key standards maintain the quality of lynx habitat by improving conditions for prey. When applied at the project level, adverse effects on lynx (and specifically, PCE1a, PCE1b, and PCE1c) are mostly avoided or minimized. In our NRLMD biological opinion, we

concluded that this direction would conserve the most important components of lynx habitat: a mosaic of early, mature and late successional staged forests, with high levels of horizontal cover and structure (USFWS 2007, p.43). The exception to the application of the NRLMD vegetation management standards includes the matrix component of critical habitat. However, the vegetative standard ALL S1, which requires vegetation management projects to maintain habitat connectivity in an LAU or linkage area, does apply where linkage areas overlap with matrix habitat.

Table III-6 summarizes the current condition of lynx habitat (and critical habitat) in IPNF LAUs in regards to the PCE). On the IPNF, there are no LAUs that exceed the 30 percent requirement, and the Forest has not regenerated more than 15 percent of any LAU over the past 10 years. Further, since 2007, critical habitat that is in early successional stages has been managed to provide optimal snowshoe hare habitat over time by VEG S5; VEG S6 conserves multistoried snowshoe hare habitat and supports the habitat components and conditions that provide lynx denning habitat (PCE1a and PCE1c). These standards combined conserve the PCE, PCE1a and PCE1c. No prescribed fires have burned in critical habitat. Both LAUs supporting critical habitat (American-Canuck and Deerskin) are in compliance with the NRLMD.

Under the NRLMD, exceptions and exemptions to VEG S1, S2, S5 and S6 are allowed to protect the WUI and other specific forest resources. Since 2007, 2,011 acres of mapped lynx habitat have been treated, but the IPNF has not treated any acres of WUI in lynx critical habitat using these exceptions or exemptions.

This information indicates that the overall baseline condition of lynx critical habitat, in regards to vegetation that supports snowshoe hare and lynx identified in the PCE1, PCE1a, and PCE1c, is in good condition on the IPNF. Since 2007, NRLMD direction has conserved both existing snowshoe hare habitat and also protected successional stages to ensure a mosaic of habitat that will continue, over time, to support snowshoe hares year-round as described in the PC1E, PCE1a and PCE1c (Table III-8).

Wildfire Management Activities That May Affect PCE1, PCE1a, PCE1c, PCE1d

As described in Section B.9, fire and other natural disturbance processes historically played an important role in maintaining a mosaic of forest successional stages (PCE1) that provides habitat for both snowshoe hare and lynx. The USFS Terrestrial BA (USFS 2012a, p. 30) reports that since the Canada lynx was listed in 2000, 1,681 wildfire events have burned approximately 24,640 acres across the IPNF. Approximately 1,585 acres of this occurred in critical habitat in the American-Canuck LAU. Based on this rate of wildfires in lynx habitat, it appears that the environmental baseline for critical habitat as affected by fires under the existing Forest Plan is in good condition. That is, fires contribute to the mosaic of successional stages that provides habitat for both lynx and snowshoe hare but have not contributed to an over-abundance of early SISS.

Linkage Areas Management That May Affect PCE1, PCE1a, PCE1d

Lynx habitat is a natural mosaic of successional stages. Linkage is necessary to ensure the full suite of boreal forest landscapes supporting differing successional forest stages – PCE1, and habitat conditions for foraging - PCE1a, and denning - PCE1c are available within home rages. PCE1d is in and of itself primarily areas for lynx movement between habitats.

Of the eight identified linkage areas on the IPNF (Claar et al. 2003, p. 236-238, USDA 2007), none are located in critical habitat, although one provides potential linkage from critical habitat southward to other primary lynx habitat.

Since 2007, linkage areas in critical habitat including those in matrix habitat on the IPNF have been managed under the NRLMD objectives, standards, and guidelines ALL O1, ALL S1, LINK O1, LINK S1, and ALL G1. Primary among these is standard ALL S1, which requires that new or expanded developments and vegetation management projects maintain habitat connectivity in an LAU or linkage area. This conserves the function of the PCE1, specifically PCE1a, PCE1c, and PCE1d by ensuring the mosaic of structural stages are available and accessible within a lynx home range.

Thus, under the existing baseline condition, we expect that linkage areas in critical habitat and the affected PCE1, PCE1a, and PCE1d are in good condition.

Recreation Activities That May Affect PCE1, PCE1a, PCE1d

With respect to critical habitat, the concern is recreational developments and associated infrastructure that result in significant loss or fragmentation of lynx habitat affecting the ability of the PCE1, specifically PCE1, PCE1a, and PCE1d to function.

Since 2007, lynx and snowshoe hare habitat in the action area has been managed under the NRLMD, which addresses the most serious consequences of recreational development and potential effects from snow compaction resulting from over-the-snow motorized use. ALL S1 conserves PCE1, PCE1a, and PCE1d by ensuring connectivity areas in an LAU or linkage area are conserved when recreational developments are proposed. This helps maintain the function of the PCE1 by ensuring a mosaic of structural stages are available and accessible within a lynx home range and further conserves the integrity of PCE1d to function as movement and connectivity areas.

Additionally, there is limited evidence that compacted snow routes introduce competition from predators into lynx habitat, which some have theorized would reduce snowshoe hare abundance and so could affect PCE1a. In any case, under snow compaction is limited by HU G11 which serves to limit expansion outside the baseline areas and consolidate use, thereby conserving the PCE1a by limiting predator introduction that would reduce snowshoe hare abundance.

The IPNF currently has 190 recreation Special Use Permits and agreements (USDA Forest Service 2011, page 289). None of these involve winter recreation, except Lookout Ski area. The ski area is not located in lynx critical habitat. None of the six Challenge Cost-Share agreements that permit winter grooming of snowmobile trails on the IPNF are located in lynx critical habitat.

Mining Proposals that May Affect PCE1, PCE1a, and PCE1d

With respect to critical habitat, mining proposals and associated roads may result in direct loss, conversion, or fragmentation of boreal forests (PCE1) or preferred snowshoe hare habitats (PCE1a). Mining developments could also further fragment important linkage habitat or movement corridors (PCE1d).

Under the NRLMD, mining proposals in lynx critical habitat are limited by the guidelines HU G4, HU G5, HU G6, HU G9, and HU G12 as detailed above. Guidelines HU G6 and HU G9 specifically conserve the PCE1 and PCE1a by limiting loss and fragmentation of boreal forest landscapes and preferred habitat conditions of snowshoe hare. Further, NRLMD standard ALL S1, applies in both lynx habitat and linkage areas and states that new or expanded permanent developments or vegetation management projects must maintain habitat connectivity in an LAU and/or linkage area. This protects the PCE1d matrix habitat from modification by mining developments and associated roads.

There are currently 1,232 Plans of Operations for locatable minerals on the IPNF. Of these, one is located in critical habitat. The majority of on-going activities are related to maintenance of existing facilities. Most locatable mineral operations are less than five acres in size. Potential for future mineral discovery is considered "low" (USFS 2013a, p.31).

There are approximately 434 identified mineral material pits within the IPNF including five inactive pits located in designated critical habitat. Sites typically range from less than one to five acres in size.

There are no leasable minerals located on the IPNF at this time.

Based on the guidelines of the NRLMD and lack of effects from existing mining proposals, we conclude that baseline condition as affected by mining proposals is not contributing to adverse effects on lynx critical habitat.

Forest/Backcountry Roads and Trails That May Affect PCE1, PCE1a, PCE1d

As summarized in Section B.9, the presence of forest/backcountry roads does not appear to affect lynx habitat use or selection (ILBT 2013). There are no road density prescriptions recommended for LAUs. Road density standards in the existing plan for both big game and grizzly bears have constrained road densities in the action area on a landscape scale. The baseline condition as affected by forest/backcountry roads does not appear to be contributing to adverse effects on lynx critical habitat.

Livestock Grazing That May Affect PCE 1a and PCE1d

There are no cattle grazing allotments in lynx designated critical habitat on the IPNF. Hence, the environmental baseline for critical habitat is not affected by this potential risk factor.

# D. EFFECTS OF THE ACTION

"Effects of the action" refers to 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 that action, and that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are 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 action under consideration. [50 CFR §402.02]

## 1. Factors to be Considered

This section considers the effects to lynx and lynx habitat from implementation of the Revised Plan direction as guided by the Revised Plan elements (goals, objectives, desired condition, standards, and guidelines). This analysis also addresses how the specific elements (not targeted for lynx) for the conservation of caribou and caribou habitat incidentally moderate the effects on lynx of the Revised Plan. The Revised Plan also implements the previously consulted-on Grizzly Bear Access Amendment; the effects of this grizzly bear amendment on lynx are also considered.

As is typical of USFS Land and Resource Management Plans, this Revised Plan does not prescribe site-specific actions and so, this biological opinion does not provide an analysis of specific projects. Rather, the analysis is a broad-scale examination of the types of activities conducted under the Revised Plan that could potentially result in effects on Canada lynx, lynx habitat, and designated critical habitat. Because of the broad-scale analysis, the KNF is responsible for section 7 consultation on all future projects (conducted under the Revised Plan) that may affect the Canada lynx or its habitat or designated critical habitat even if those projects are consistent with the Revised Plan.

Our analysis will be used to determine the potential for the Revised Plan direction to jeopardize the affected population of lynx. In our analysis of effects of the Revised Plan, we will discuss the effects of the Revised Plan and implementation of the MAs relative to LAUs, which are the units of analysis commonly used to describe effects on lynx (see Section A.1).

Notably, the Revised Plan incorporates the NRLMD. The analysis contained in our biological opinion on the effects of NRLMD on lynx (USFWS 2007, entire) was considered in this analysis and updated where appropriate. Relevant sections of the NRLMD are cited by page number in our analysis below; our analysis is updated with recent science where appropriate. In this biological opinion we analyze the effects of the Revised Plan as it implements the NRLMD. As previously discussed (Section A.3), we determined that implementation of the NRLMD was not likely to jeopardize the continued existence of the Canada lynx (USFWS 2007, pp 75-78).

## 2. Analyses for Effects of the Action on Lynx

The following sections analyze the direct and indirect effects of implementing elements of the Revised Plan on lynx. The effects will be discussed by risk factors as described in Section B.9. The risk factors will be discussed under the following, often overlapping categories, similar to our discussion in the Environmental Baseline section:

1. Vegetation Management
2. Wildland Fire Management – including the importance of linkage areas
3. Fragmentation of Habitat
4. Recreation
5. Mineral and Energy Exploration and Development
6. Forest/Backcountry Roads and Trails
7. Grazing by Domestic Livestock

For each category of effect, we begin with a general summary of what the science currently tells us about the potential impacts on lynx and lynx habitat. This is followed by an analysis of the specific effects of the proposed action on lynx and lynx habitat.

### *Effects of Vegetation Management on Lynx Under the Revised Plan*

Vegetation management includes timber harvest, planting, thinning, prescribed fires, and mechanical fuel treatment.

General Effects of Vegetation Management on Lynx

Timber harvest and associated forest management can be benign, beneficial, or detrimental to lynx depending on harvest methods, spatial and temporal specifications, and the inherent vegetation potential of the site (65 FR 16052-16086, March 24, 2000, p. 16071). Even-aged harvest, for example, removes or alters stand structure, and temporarily eliminates snowshoe hare forage/cover and lynx cover until the site is regenerated to forest cover. In addition, this type of treatment reduces potential denning habitat by removing large trees and down logs from the site and reduces prey habitat (i.e. red squirrel) with the removal of large trees.

However, even-aged management, or regeneration harvest, can be a tool for creating high quality snowshoe hare habitat in the future, especially where natural regeneration would be expected to respond and provide dense young vegetation.

Uneven-aged management, such as single tree selection or group selection, results in varying effects to snowshoe hare, red squirrel and lynx, depending on the number of stems removed, canopy cover, harvest system and post-sale treatments. Removal of dense horizontal structure through timber harvest is typically detrimental to snowshoe hare habitat. However, where dense understory is lacking, removal of trees (overstory) allows light to penetrate the forest floor and so can stimulate pockets of dense regeneration and the development of horizontal cover preferred by hares.

Silvicultural thinning can reduce an area's carrying capacity for snowshoe hares by reducing dense horizontal structure within forest stand understories (Homyack et al. 2007, pp. 10-11). In northwestern Montana, Ausband and Baty (2005, p. 209) found that within individual forest stands, hares had a significant affinity for dense, unthinned sapling patches. Research conducted in northwestern Montana found that precommercial thinning decreased snowshoe hare abundance, compared to both control and thinned stands where 80 percent of the entire stand was thinned but 20 percent of the total stand was retained with saplings uncut (Griffin and Mills 2007, p. 560). Declines were prominent in the second winter after treatment. In addition, estimated survival rates of snowshoe hares decreased as individuals spent proportionately more time in open young and open mature forest stand structure types (Griffin and Mills 2007, pp.561-562).

Vegetation treatments focused on fuel reduction have the potential to reduce the quality of lynx habitat by simplifying stand structure and/or reducing stem densities below levels that provide suitable forage and cover conditions for snowshoe hares. These activities have the potential to reduce the affected area's carrying capacity for snowshoe hares. Fuel reduction projects or salvage of dead and dying trees can result in the removal of coarse woody material and may reduce the areas potential use as denning habitat for lynx.

Prescribed fire for resource benefit in lynx habitat could result in temporary reductions in foraging habitat for lynx and snowshoe hare habitat, and remove existing coarse woody debris and/or affect its recruitment for denning habitat. These effects on lynx habitat would be temporary, as succession would be set back or restarted. Some recovering stands would produce dense regenerating growth, providing high quality snowshoe hare habitat after approximately 10 to 30 years, which in turn would benefit lynx.

The primary factors driving lynx populations, behavior, and distribution is the abundance and distribution of their primary prey: snowshoe hare. Older forested stands provide high quality winter habitat when they provide multi-story structure that provides forage and horizontal cover, for both lynx and snowshoe hare (Murray et al. 1994, pp.1446-1450; Squires et al. 2010). Regenerating forests providing dense sapling stands that protrude above the snow also provide important snowshoe hare habitat in Montana. Winter is the most constraining season for lynx in terms of resource use (Squires et al. 2010).

In summer, lynx broaden their habitat use to include younger forest stands with an abundance of shrub cover that supports snowshoe hares (Squires et al. 2010, pp.1654-1655). Dense, young sapling stands (more than 2,000 trees per acre) can also provide habitat for concentrations of hares in western Montana (Griffin 2004, pp.84-88). Lynx also require cover when searching for food (Brand et al. 1976, p.425). Lynx have been observed (via snow tracking) to avoid large openings (Koehler 1990, p.847; Staples 1995, p.63) during daily movements within the home range. Hence, mature stands, along with stands in an early successional stage and intervening successional stages, provide the landscape mosaic of habitat conditions needed for snowshoe hare production and lynx foraging (hunting) habitat, and thus for recovery and survival of lynx.

The primary negative effects of vegetation management on lynx in the action area include reduction in amount or quality of snowshoe hare foraging habitat, which can lead to reductions in

the abundance and/or distribution of snowshoe hares: the primary prey of lynx. Additionally, vegetation management may convert forest stand dominance groups that support snowshoe hare to dominance groups that do not; may change too much habitat at one time to early successional stage stands (thereby reducing the availability of snowshoe hare habitat); may affect availability of denning habitat; and may have negative or positive effects on landscape patterns (i.e., the mosaic of stand types and age classes used by snowshoe hare and lynx) and connectivity.

Climate may exacerbate effects of vegetation management in lynx habitat. As described in Section B.9, an increasing occurrence and persistence of drought, along with associated insect outbreaks and wildfires, could rapidly and dramatically affect the distribution, amount, and composition of lynx habitat. Cohen and Miller (2001) suggested climate change could alter both the nature and extent of wildfire and beetle outbreaks. With warming climate, fire seasons in the western United States will likely be extended and that total area burned may increase (McKenzie et al. 2004).

Effects of Vegetation Management within the Action Area

***Snowshoe Hare Habitat*** – Under the Revised Plan, no mapped lynx habitat is within the lands identified as suitable for timber production – that is, the land base used for determining allowable sale quantity and vegetation management for timber production. That is, no timber stands targeted to provide commercial timber products on a regulated basis with planned, scheduled entries are in mapped lynx habitat. The acres of lynx habitat where timber harvest (removal of trees for wood fiber utilization and other multiple-use purposes) would be allowed are reduced under the Revised Plan in mapped lynx habitat by approximately 20,641 acres compared to the existing plan (Tables III-9 and III-10). Hence, approximately 76 percent of lynx habitat on the forest would be subject to timber harvest. The Revised Plan applies the NRLMD vegetation management standards and guidelines: VEG S1, S2, S5 and S6, VEG G10 and G11. Timber harvest, thinning, and salvage harvest in lynx habitat would be subject to the standards of the NRLMD: VEG S1, VEG S2, VEG S5, and VEG S6**,** and guidelines: VEG G1, VEG G4, VEG G5, and VEG G11. These standards and guidelines were crafted to avoid or limit adverse effects to lynx by ensuring that habitat within each LAU would provide lynx with sufficient snowshoe hare prey (i.e. snow shoe hare habitat) and lynx foraging (i.e. hunting) habitat conditions. Briefly, the standards require:

- If more than 30 percent of the lynx habitat in an LAU is currently in a SISS that does not yet provide winter snowshoe hare habitat no additional habitat may be regenerated by vegetation management projects (VEG S1).
- Timber management projects shall not regenerate more than 15 percent of lynx habitat on NFS or BLM lands in an LAU in a ten-year period (VEG S2).
- Pre-commercial thinning projects that reduce snowshoe hare habitat may occur from the SISS until the stands no longer provide winter snowshoe hare habitat only in limited locations or under limited circumstances (VEG S5).

- Vegetation management projects, including prescribed fire, that reduce snowshoe hare habitat in multi-story mature or late successional forests may occur only in limited locations or under limited circumstances (VEG S6).
- Vegetation management projects should be planned to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available (VEG G1).
- Prescribed fire activities should not create permanent travel routes that facilitate snow compaction. Constructing permanent firebreaks on ridges or saddles should be avoided (VEG G4).
- Habitat for alternate prey species, primarily red squirrel, should be provided in each LAU (VEG G5).
- Denning habitat should be distributed in each LAU (VEG G11).

Since 2007, the Forest has burned 4,330 acres within LAU boundaries through prescribed fires (USFS 2013a, p. 30), but not all those acres were necessarily lynx habitat. Regardless, this amounts to less than one-half percent of LAU acres affected by prescribed fire since 2007. At the project level, the Revised Plan implements NRLMD standard VEG S6 which applies to all proposals for prescribed fire in lynx habitat. This standard prohibits vegetation management projects (including prescribed fire) that reduce snowshoe hare habitat in multi-story mature or late successional forests except for treatment around administrative sites, for research studies, or for incidental removal during salvage. This standard would greatly limit the acreage of lynx habitat that could be affected by prescribed fires.

The standards and guidelines of NRLMD implemented under the Revised Plan work together to maintain the quality of lynx habitat by improving conditions for prey. If applied at the project level, adverse effects on lynx are mostly avoided, or minimized. In our NRLMD biological opinion, we concluded that this direction would conserve the most important components of lynx habitat: a mosaic of early, mature and late successional staged forests, with high levels of horizontal cover and structure (USFWS 2007, p.43).

As seen in Table III-6, all LAUs are currently in compliance with the standards VEGS1 and VEGS2. The Forest reports that since implementation of the NRLMD it has treated 1,294 acres of mapped lynx habitat through regeneration harvest and 717 acres through precommercial thinning. The IPNF does not propose exceeding the acres originally authorized under the NRLMD for the life of the Revised Plan. As we previously determined, the NRLMD objectives, standards, and guidelines (implemented under the Revised Plan) are expected to continue to work together to maintain the quality of lynx habitat on the Forest by improving conditions for lynx prey (USFWS 2007, p.43).

Additionally, the Revised Plan would incorporate desired conditions for wildlife FW-DC-WL-02 and 03 that are consistent with maintaining the quality of lynx habitat on the Forest. These will trend the Forest toward large remote areas with limited disturbance and toward recovery of threatened and endangered species. Revised Plan vegetative desired conditions FW-DC-VEG-03 through 06 are not specific to lynx but complement the objectives, standards and guidelines of the NRLMD by addressing coarse woody debris and snag retention, which contributes to horizontal cover for snowshoe hares and den sites for lynx.

As we previously stated (USFWS 2007, p. 43), and as updated by the analysis provided above, overall, where the NRLMD standards and guidelines and Revised Plan desired conditions are applied to vegetation management projects, we anticipate few projects, if any, would have adverse effects on lynx. Collectively, application of the NRLMD and Revised Plan is expected to avoid adverse effects to lynx and promote the survival and recovery of lynx populations. Areas exempt from these standards are discussed below.

*Exemptions and Exceptions to Vegetation Standards for Fuels Management and Precommercial Thinning*

The NRLMD includes exemptions from standards VEG S1, S2, S5, and S6 to allow for fuels management within the WUI. Also, exceptions listed in VEG S5 and S6 would allow some precommercial thinning to protect structures, for research, and to promote the conservation of tree species such as whitebark pine and aspen. These exemptions and exceptions allow actions that may have adverse effects on lynx by reducing the horizontal structure of natural forest succession phases, and/or affecting the mosaics of the forested landscape in localized areas. These exemptions and exceptions are brought forward into the Revised Plan. Specifically, the NRLMD authorized the total area that *could* be affected by the exemptions at 34,978 acres (about 6 percent of lynx habitat on the Forest) and the total area that *could* be affected by the exceptions at 17,120 acres (about 3 percent of lynx habitat on the Forest).

Since implementation of the NRLMD, the Forest has treated 1,294 acres in the WUI; only 12 acres of which applied to the exemptions. Therefore, under the remaining allowance for exemptions and exceptions in the Revised Plan, up to 34,966 acres of lynx habitat could be treated in ways that adversely affect lynx by exemptions for fuels management in the WUI. Similarly, the Forest has thinned 717 acres under the exception to date; under the Revised Plan up to 16,403 acres of lynx habitat could be treated in ways that adversely affect lynx by exceptions for precommercial thinning.

As analyzed in the NRLMD biological opinion (2007, pp. 43-44), the exemptions from VEG S1 for fuels management would affect the forest mosaic by allowing more than 30 percent of lynx habitat within an LAU to be in SISS. The exemption from VEG S2 would allow more than 15 percent of an LAU to be converted from suitable to SISS within a decade. Where the exemptions from VEG S1 or S2 are used within the WUI, there would likely be adverse effects to lynx by reducing the quality and productivity of lynx and snowshoe hare habitat for at least 10 to 15 years, depending up on the location, until treated stands regenerate to provide winter snowshoe hare habitat. Notably, these stands may be treated again to retain them as fuel breaks, and not allowed to regenerate extending the length of time they remain in early seral conditions. For more discussion see USFWS 2007, pp. 43-44.

The exemption from VEG S5 for fuels management would reduce natural levels of horizontal structure in early successional phases by allowing precommercial thinning during the SISS, prior to when the stand no longer provides winter snowshoe hare habitat. Thinning dense stands of young trees could adversely affect lynx by reducing the carrying capacity of these stands to produce snowshoe hares. Similarly, the exemption for fuels management from VEG S6 would

likewise allow management actions that reduce the horizontal cover and thus the quality of snowshoe hare habitat in older, multi-layered stands.

The exceptions to VEG S5 and S6 for thinning projects to protect structures from wild fire or conserve other vegetation communities such as whitebark pine and aspen could affect up to 12,687 acres. These projects could adversely affect lynx by reducing the carrying capacity of these stands to produce snowshoe hares.

Fuels management projects are proposed to occur wherever necessary, both inside and outside the WUI. The Forest Service anticipates that the majority of these projects would occur within the WUI but would need flexibility in some cases. Outside the WUI, standards VEG S1, S2, S5, and S6, and guidelines VEG G5, G10 and G11 apply to fuels management projects and so would avoid or significantly reduce the potential for adverse effects on lynx and snowshoe hare habitat, as described in the following NRLMD language:

- Standard VEG S1 applies to all vegetation and fuel treatment projects outside the wildland urban interface as defined by Healthy Forest Restoration Act (HFRA).
- Standard VEG S2 applies to all timber management projects, outside the wildland urban interface as defined by HFRA.
- Standard VEG S5 applies to precommercial thinning projects that use precommercial thinning to achieve objectives, outside the wildland urban interface as defined by HFRA.
- Standard VEG S6 applies to all vegetation and fuel treatment projects outside the wildland urban interface as defined by HFRA.

The following language immediately follows in each of the above standards to limit the acreage treated by exceptions for fuels management:

- VEG G10 - Cumulative total of fuel treatment projects within the WUI that do not meet the vegetation standards shall not exceed six percent of mapped lynx habitat per Forest in the amendment area. For fuels treatment within the WUI, follow guideline.
- VEG G10 - Fuel treatment projects in the WUI as defined in HFRA should be designed considering standards VEG S1, S2, S5 and S6 to promote lynx conservation

Overall, these measures would work together to avoid adverse effects on about 91 percent of lynx habitat and snowshoe hare habitat on the IPNF, and would maintain the landscape mosaic of habitat conditions needed for snowshoe hare production and lynx foraging. The Revised Plan would allow some adverse effects on snowshoe hare/lynx foraging habitat: 34,004 acres for fuels treatments in the WUI, and 16,403 acres for precommercial thinning projects. Thirty-six percent of lynx habitat could be subject to timber harvest, but the Revised Plan would apply desired conditions for vegetation and wildlife and the NRLMD objectives, standards, and guidelines to projects in lynx habitat. Since 2007, the Forest has treated substantially fewer acres than anticipated (and authorized) under the NRLMD and does not propose exceeding the acres reauthorized under the 2008 NRLMD lynx remapping effort for the life of the Revised Plan. Therefore, we anticipate limited impairment of lynx ability to feed, breed, and shelter as a result of the Revised Plan effects on lynx and snowshoe hare foraging habitat. We do not expect the level of adverse effects on individual lynx as a result of vegetation management, including fuels management, would rise to levels with substantial negative effects on the population.

**Lynx Denning Habitat**

Timber harvest, thinning, and salvage harvest may remove existing coarse woody debris and/or affect its recruitment. Denning habitat is used for parturition and rearing of young. The common component of denning habitat is large amounts of coarse woody debris (CWD) (Koehler 1990, p.847; Squires et al. 2008, p.1502) and horizontal cover provided by low growing canopies of subalpine fir and Engelmann spruce trees (Squires et al. 2008, p.1502). Squires et al. (2008, p.1502) found that lynx selected den sites with higher horizontal cover and log volumes compared to the forests immediately surrounding dens. Hence, the retention of CWD, snags and snag recruits during timber and salvage harvest is important for the ability of the stand to support lynx denning habitat. Based on the recent findings of Squires et al. (2008, pp.1501-1505) denning habitat is found in a variety of forest conditions, and suitable den site attributes occur in small pockets scattered across the landscape at relatively high densities; lynx den site availability is not limiting for lynx. Although actual den site opportunities (e.g. large woody debris or jackstraw piles) do not appear to be a limiting factor, den locations must be in or adjacent to foraging habitat for denning habitat to be functional (ILGT 2013, p.22).

On the whole, the best information suggests that Forest Service management conducted under the existing Forest Plan and NRLMD provides adequate denning habitat across lynx habitat on the IPNF. The Revised Plan would continue these practices and implement guideline VEG G11 of the NRLMD, which states that denning habitat should be distributed in each LAU in the form of pockets of large amounts of large woody debris, either down logs or root wads, or large piles of small wind thrown trees ("jack-strawed" piles). If denning habitat appears to be lacking in the LAU, then projects should be designed to retain some coarse woody debris, piles, or residual trees to provide denning habitat in the future. The Revised Plan also includes additional guidelines, FW-GDL-VEG-03 through 06, which retain downed wood, snags, and snag recruits during vegetation management activities.

Because denning habitat is not limiting on the Forest and the Revised Plan implements guideline VEG G11 of the NRLMD and guidelines FW-GDL-VEG-03 through 06, the Revised Plan is expected to adequately maintain levels of coarse woody debris, snags, and snag recruits to contribute to lynx denning habitat for the life of the plan.

**Landscape Patterns and Connectivity**

As discussed earlier, lynx use a variety of forest age and structure classes within dynamic forest ecosystems. Snowshoe hares generally reach highest abundance in younger seral stages, although mid- to late-seral, multistoried forests provide lynx foraging and denning habitat and produce both snowshoe hares and red squirrels. Multistoried forests provide important snowshoe hare habitat during the winter months, providing forage and thermal and hiding cover. This mosaic of habitats provides not only for the production of snowshoe hare habitats but also for the connectivity of habitats required to support snowshoe hares and lynx. The spatial and temporal interspersion of habitat is influenced both by natural disturbance events, such as wind and wildland fire, and by vegetation management activities, including timber harvest.

The Revised Plan would implement the four vegetation management objectives of the NRLMD , described above. These four objectives would improve the quality of lynx habitat by improving conditions for prey and are attained through application of the NRLMD vegetation management standards and guidelines (described above): VEG S1, S2, S5, S6 and G10 and G11.

Incorporating NRLMD standard ALL S1 would address the impacts to lynx from loss of connectivity within lynx habitat on the Forest. This standard requires that new or expanded permanent developments and vegetation management projects in a LAU or linkage area maintain habitat connectivity. Thus, under this standard, Forest Service actions will not be permitted to degrade connectivity in lynx habitat or in linkage areas. This is complemented by the numerous desired conditions within the Revised Plan for large, remote areas with limited disturbance that contribute to wildlife movement (FW-DC-WL-02; MA1a,b,c,e-DC-WL-01; MA5-DC-WL-01). Additional, site-specific desired conditions in GAs would facilitate habitat connectivity including:

> GA-DC-WL-CDA-03. The integrity of the Idaho/Montana divide as a corridor is retained to allow wildlife movement between the Salmon and Selway/Bitterroot Wilderness areas and potential source populations in Canada.
>
> GA-DC-WL-LK-01. National Forest System lands contribute habitat conditions for wildlife movement between the Yaak and the Selkirk Mountain range and between the Cabinet and the Selkirk mountain ranges.
>
> GA-DC-WL-PO-01. Habitat conditions are retained for wildlife movement along the divide between Idaho and Montana from the Kootenai River south to Scotchman Peaks and across the Clark Fork River and for wildlife movement between the Cabinet-Yaak ecosystem and the Selkirk Ecosystem.
>
> GA-DC-WL-PR-01. NFS lands provide habitat conditions for wildlife movement, especially woodland caribou, throughout the Selkirk recovery zone.
>
> GA-DC-WL-SJ-02. Use of the area for wildlife movement along the Idaho/Montana divide between the Salmon and Selway/Bitterroot Wilderness Areas is retained.

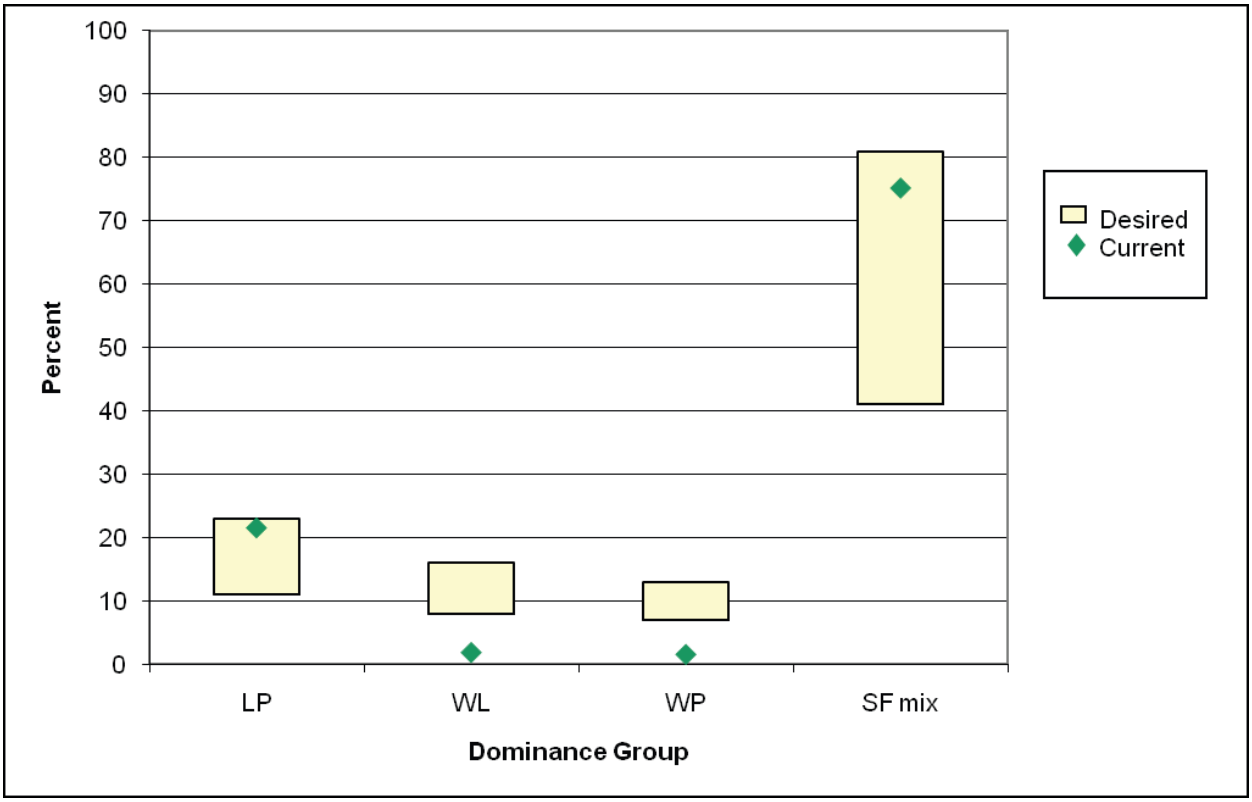
The four vegetation management objectives of the NRLMD and standard ALL S1 combined with the desired conditions for wildlife movement under the Revised Plan would promote forested landscape patterns and connectivity that maintain or restore lynx habitat. This positive effect would occur in lynx habitat except where the fuel and vegetation management exceptions apply (discussed previously).

## Habitat Conversion

Forest management activities can result in conversion of species composition in forested stands. For example, silvicultural prescriptions might be designed to change species composition to restore stands affected by past fire suppression activities.

The desired condition for forest vegetation under the Revised Plan describes the desired forest composition (i.e., dominance group), structure, and pattern for each biophysical (ecological) setting on the Forest, of which there are three: warm/moist; warm/dry; and subalpine. The subalpine biophysical setting occurs over approximately 24 percent of the IPNF forested lands and occupies the higher elevations of the Forest. This setting ranges from the cool and moist lower subalpine sites, up to the cold and dry high elevation sites that have more open forests, and occur between forest and alpine tundra (USFS 2012b, p. 81). Canada lynx habitat primarily occurs in the subalpine biophysical setting with a limited amount of habitat overlapping into the warm/moist biophysical setting.

Within the subalpine biophysical setting, the desire for the landscape includes a variety of patch sizes, with residual structural diversity and heterogeneity both within and between patches. The Forest reports that in some locations in this subalpine setting, there are existing homogenous patches of extensive lodgepole pine dominated forests in the medium and large size classes (ibid). These forests are very susceptible to large bark beetle outbreaks and/or wildfires. The desired condition is that the pattern of these areas be diversified; the desire is that the pattern of successional stages is such that fire, insect or diseases do not dominate the landscape at any one time. The desired condition for the composition of the forest communities, is described based on the most dominant tree species for the four dominance groups within the subalpine setting (lodgepole pine, western larch, white pine, and spruce/fir mix) (Figure III-3 [USFS 2011a, Figure 14, p. 19]). This Figure illustrates the percentage of the subalpine setting within each of these four dominance groups compared to the desired range of conditions.




DF = Douglas-fir; LP = lodgepole pine; WL = western larch; WP = white pine; and SF mix = subalpine fir mix

**Figure III-3. Desired and current forest composition by dominance group in the subalpine biophysical setting.**

For the IPNF, the most abundant dominance group in this setting is the subalpine fir mix, which occupies over 75 percent of the forested acres. Intermediate abundance levels are in the lodgepole pine, the western larch, and the white pine dominance groups. Notable, there are currently few acres of white pine.

In addition to depicting the current condition, Figure III-3 illustrates the desired amount for each of the dominance groups. The desired ranges that are illustrated in the figure represent an approximation of the historic range of conditions for forest composition. Under the Revised Plan, the desired condition is for management actions (taking several decades or even centuries) to shift the forest composition from its current condition, to the desired ranges that are depicted in the figure for each of the dominance groups. In a comparison of the current and desired conditions, it is apparent that the desire is to increase the amount of western larch and white pine dominance groups and potentially reduce the lodgepole pine and spruce-fir mix: though both are within the desired range at this time.

The desired condition under the Revised Plan as shown above appears to trend the Forest composition toward a slight decrease in the percentage of subalpine fir mix dominance group (where most lynx habitat occurs). However, the Forest indicates that little timber harvest occurs in the subalpine fir mix dominance group because subalpine fir is not a very commercially viable product, access is difficult and expensive, and the harvest season for this timber type is short (L. Allen 08/19/2013 pers. comm.). Some white bark pine restoration is planned at higher elevations but these sites typically do not provide snowshoe hare habitat because they are sparsely forested (L. Allen 03/19/2013 pers. comm.). Further, all projects in lynx habitat must comply with the NRLMD standards VEG S1, S2, and S6, which limits timber harvest in lynx habitat in LAUs. Lastly, as presented by the Forest, the subalpine fir dominance group is expected to expand under the Revised Plan (USFS 2011b, p.87, Table 15). Therefore, we do not anticipate that conversion of dominance groups (vegetation types) will occur at a scale that would impair the ability of lynx to feed, breed, or shelter in the action area.

Under the Revised Plan, prescribed fire for resource benefit in lynx habitat would be allowed in 99 percent of lynx habitat (Table III-9). This could result in temporary reductions in foraging habitat for lynx and snowshoe hare habitat, and removal of existing coarse woody debris and/or effect on woody debris recruitment for denning habitat. These effects on lynx habitat would be temporary, as succession would be set back or restarted. Some recovering stands would produce dense regenerating growth, providing high quality snowshoe hare habitat after approximately 10 to 30 years, which in turn would benefit lynx. At the project level, NRLMD standard Veg S6 would apply to all proposals for prescribed fire in lynx habitat. This standard prohibits vegetation management projects (including prescribed fire) that reduce snowshoe hare habitat in multi-story mature or late successional forests except for treatment around administrative sites, for research studies, or for incidental removal during salvage. This standard would greatly limit the number of prescribed fires that could occur in lynx habitat; retaining the inherent (natural) potential of these older, mature stands to eventually succumb to natural wildfires over the very long-term.

**Table III-9. Acres of lynx habitat by allowable uses and activities under the existing Plan and the Revised Plan.** The magnitude of *actual* use and activity is further regulated by the 2007 NRLMD standards as well as other management direction and available budgets.

| Allowable Uses Under Forest Plan Management Area Direction | Existing Forest Plan | | Proposed Action | |
|---|---|---|---|---|
| | Lynx Habitat Acres (% of Total)[1] | Critical Habitat Acres (% of all CH)[1] | Lynx Habitat Acres (% of Total)[1] | Critical Habitat Acres (% of all CH)[1] |
| Timber Harvest | 431,160 (79) | 33,917 (98) | 419,692 (77) | 24,744 (71) |
| Timber Production | 114,276 (21) | 23,009 (66) | 0 | 0 |
| Commercial Use – Special Forest Products & Firewood | 547,755 (100) | 34,649 (100) | 411,195 (75) | 31,570 (91) |
| Personal Use – Special Forest Products & Firewood | 547,755 (100) | 34,649 (100) | 429,747 (78) | 34,649 (100) |
| Planned Fire Ignition | 547,571 (99) | 33,916 (98) | 547,393 (99) | 33,916 (98) |
| Natural, Unplanned Fire Ignitions to meet Resource Objectives | 88,798 (16) | 0 | 532,603 (97) | 31,570 (91) |
| Grazing | 444,021 (81) | 34,649 (100) | 411,195 (75) | 31,570 (91) |
| Wheeled Motor Vehicle | 459,567 (83) | 34,649 (100) | 427,294 (78) | 31,570 (91) |
| Over-the-snow Motor Vehicle | 489,260 (89) | 34,649 (100) | 439,530 (80) | 31,570 (91) |
| Road Construction (permanent or temporary) | 386,540 (71) | 36,649 (100) | 427,294 (78) | 24,744 (71) |
| Minerals – Leasable | 277,307 (51) | 16,081 (46) | 522,145 (95) | 31,570 (91) |
| Minerals – Materials | 445,874 (81) | 33,916 (98) | 522,145 (95) | 24,744 (71) |

[1]Total acres of non-critical potential lynx habitat≈548,294; total acres of critical habitat≈34,687 (*from* Table 7 on page 22)

**Table III-10. Summary of changes in acres of lynx habitat and critical habitat affected by allowable uses under the existing plan and Revised Plan.**

| Allowable Uses | Lynx Habitat | | | Critical Habitat | | |
|---|---|---|---|---|---|---|
| | Existing Plan | Proposed Action | Difference | Existing Plan | Proposed Action | Difference |
| Timber Harvest | 431,160 | 419,692 | -11,468 | 33,917 | 24,744 | -9,173 |
| Timber Production | 114,276 | 0 | -114,276 | 23,009 | 0 | -23,009 |
| Commercial Use | 547,755 | 411,195 | 136,560 | 34,649 | 31,570 | -3,079 |
| Personal Use | 547,755 | 429,747 | 181,992 | 34,649 | 34,649 | 0 |
| Planned Fire Ignition | 547,571 | 547,393 | -178 | 33,916 | 33,916 | 0 |
| Natural, Unplanned Fire | 88,798 | 532,603 | +443,805 | 0 | 31,570 | +31,570 |
| Grazing | 444,021 | 411,195 | -32,826 | 34,649 | 31,570 | -3,079 |
| Wheeled Motor Vehicle | 459,567 | 427,294 | -32,273 | 34,649 | 31,570 | -3,079 |
| Over-the-snow Motor Vehicle[4] | 489,260 | 439,530 | -49,730 | 34,649 | 31,570 | -3,079 |
| Road Construction | 386,540 | 427,294 | +40,754 | 36,649 | 24,744 | -11,905 |
| Minerals – Leasable | 277,307 | 522,145 | +244,838 | 16,081 | 31,570 | +15,489 |
| Minerals – Materials | 490,120 | 522,145 | +32,025 | 33,916 | 24,744 | 9,172 |

### *Effects of Wildland Fire Management on Lynx Under the Revised Plan*

Fire management includes fire suppression, wildland fire use, and prescribed fire. Mechanical treatment of fuels is addressed above under Vegetation Management.

General Effects of Wildland Fire Management on Lynx

In the western United States, fire historically played an important role in maintaining the mosaic of forest successional stages that provide habitat for both snowshoe hare and lynx (Fox 1978, entire; Bailey et al. 1986, pp.285-286; Quinn and Parker 1987, p.687; Koehler and Brittell 1990, p.12; Slough and Mowat 1996 as cited in USFWS 2007, p.11). The response by vegetation, snowshoe hare populations, and lynx in their use of habitat after fires is similar to that of timber harvest. For the first few years after a burn, there appears to be a negative correlation between lynx use and the amount of area burned (Fox 1978, p.362). This short-term effect is likely a response to a reduction of snowshoe hare populations and reduced cover (Stephenson 1984, pp.6-9, Koehler and Brittell 1990, p.13). The mid-term (15 to 40 years post-fire) effect on vegetation in a burned area is development of small tree and shrub cover sufficient for hare populations to reoccupy an area. The length of time varies depending on tree species, habitat type, fire severity and the presence of re-sprouting broadleaf species. Where broadleaf plant species are denser, hare re-occupancy occurs more quickly (within 3–12 years). Hare population density again decreases where the conifer tree canopy develops and shades out the understory. Forest gap processes, such as tree blowdown, insect infestations, and outbreaks of disease, produce similar effects as fire (Agee 2000 as cited in ILBT 2013, pp. 65-66).

As discussed in Section B.9, fire suppression altered vegetation mosaics and species composition in the western U.S., with a resulting shift to uncharacteristically severe and intense wildfires in lower-elevation forests (Quigley et al. 1996, Morgan et al. 1998). While these areas do not typically support snowshoe hares or lynx, fires in low-elevations indirectly affect lynx habitat by increasing the risk of fires moving into higher elevation lynx habitat (USFS 2013a, p. 41).

Effects of Wildland Fire Management on Lynx in the Action Area

**Fire Suppression** – It is generally acknowledged that in the Northern Rocky Mountains fire suppression has altered historic vegetative patterns. This effect has been most pronounced within vegetation communities that have fire regimes that are of low intensity or of mixed severity. Many of these are drier community types and are not considered lynx habitat. Some research indicates that spruce-fir habitats (lynx habitat) appear to have been little or less affected by fire suppression because the fire regimes within this type tend to be high intensity, stand replacing events occurring at low frequencies (i.e. every 100 years or more) (Agee 2000 as cited in USFWS 2007, p. 11).

Under the Revised Plan, fire plays an increased role in helping to trend the vegetation towards the desired conditions while serving other important ecosystem functions. The acres of lynx habitat where natural ignitions will be allowed will increase significantly (444,000 acres) (Table10s III-9 and III). With the Revised Plan emphasis on the use of fire to trend vegetation towards the desired condition including: FW-DC-FIRE-03; MA1abce-DC-VEG-01, MA1abc-

DC-FIRE-01, MA1abcde-GDL-FIRE-01 and 02, MA2a-DC-FIRE-01,02,03, MA2b-DC-FIRE-01, MA2bc-DC-VEG-01, MA2ab-GDL-FIRE-01 through 03, MA5-DC-VEG-01, MA5-DC-FIRE-01, and MA5-GDL-FIRE-0, we expect that fire suppression will occur in more limited circumstances to project life, property, and key resources. However, undesirable wildfires will continue to be suppressed where necessary to protect life, property and key resources as stated in FW-DC-FIRE-03.

We do not anticipate direct adverse effects on lynx from fire suppression activities, because lynx would leave an area on their own in advance of an approaching fire and therefore be out of the area associated with fire suppression activities. If suppression activities were to take place prior to an approaching fire, there may be an overall increase in human activity in a particular area. However, at this point, we do not anticipate adverse effects because to date, anecdotal evidence suggests that lynx are tolerant of human presence (Staples 1995, pp.116-121; Mowat et al. 2000, pp.280-281). However, indirect effects may occur to vegetation communities from fire suppression. Fire suppression in some forest types has increased the risk of a large-scale disturbance (fire) in one event under extreme conditions. We anticipate these effects to primarily occur in the lower-elevation forests that are not lynx habitat, but they may move into adjacent lynx habitat. We expect this risk to be reduced over time with implementation of desired conditions for fire under the Revised Plan.

**Wildland Fires** – The Revised Plan has more flexibility to use wildland fire to trend vegetation toward desired conditions but would be consistent with the NRLMD. The acres of lynx habitat where natural ignitions will be allowed will increase significantly (444,000 acres) (Tables III-9 and III-10). The use of fire to restore ecological processes and maintain/improve lynx habitat is supported in the NRLMD objectives VEG O1 through O3.

Similar to vegetation management, wildland fire may diminish, enhance, or sustain the density and distribution of snowshoe hare prey resources and lynx habitat depending on the design and implementation of programs and actions. As described above under *General Effects of Wildland Fire Management on Lynx*, in the short-term, wildland fires in lynx habitat would primarily result in adverse effects on lynx due to the initial reduction in cover and subsequent loss of snowshoe hare habitat. Hence, given the timeframe of the Revised Plan (10 to 15 years), most wildland fires in lynx habitat would potentially result in adverse effects on snowshoe hare habitat and lynx habitat. The effects on lynx and lynx habitat under the Revised Plan would be temporary, as described above and most likely to be felt at a local level depending on the location, extent, and landscape context of the event.

Since 2000 approximately 13,180 acres within LAUs has burned as a result of wildfires on the Forest (USFS 2013a, p.30), and not all of the affected acres were lynx habitat. This demonstrates that in the recent past, the acreage within the LAUs affected by wildland fire is low (1.5 percent of lynx habitat affected by wildfire since 2000).

The effects of future wildland fires are difficult to discern. Based on data from the past 10 years, limited acres of lynx habitat (2 percent) have been affected. We recognize that this trend may not continue in light of anticipated trends in climatic effects. Where more than 30 percent of an LAU is in SISS habitat due to a wildland fires, NRLMD Standard VEG S2, would prohibit

further vegetation management actions that produce additional SISS habitat. Further, this prohibition would apply even in WUIs, to prevent more than three adjacent LAUs from having greater than 30 percent SISS.

Therefore, we anticipate that unplanned fires would likely result in short-term adverse effects on lynx from temporary reductions in foraging habitat for snowshoe hare and lynx and may remove coarse woody debris and affect its future recruitment for denning habitat. However, because fire historically played an important role in maintaining the mosaic of forest successional stages that provide habitat for both snowshoe hare and lynx (see General Effects of Wildland Fire Management on Lynx), the desired condition for wildland fire under the Revised Plan would likely benefit lynx and their prey populations over the long-term. Hence, we do not anticipate substantial adverse effects on the lynx at the population level.

***Effects of Linkage of Lynx Habitat Under the Revised Plan***

General Effects on Linkage

Maintaining linkage with lynx populations in Canada and between mountain ranges is important for lynx in the Northern Rocky Mountains Geographic Area and for populations farther south in the Rocky Mountains (Ruediger et al. 2000, pp.55-57). It is likely that the Northern Rocky Mountains Geographic Area and the Southern Rocky Mountains Geographic Area of Colorado and southern Wyoming are poorly connected due to intervening desert and grassland habitats, although lynx reintroduced into Colorado have successfully travelled to the Northern Rockies.

Potential impediments to lynx dispersal include highways and areas of human settlement (Apps 2000, pp.361-362; Ruediger et al. 2000, pp.31-32). Lynx use a variety of habitats for dispersal and are known to travel great distances to use suitable habitat patches (Ruggiero et al. 2000b, pp.450-451). When dispersing, lynx have been documented to cross large, early-successional stage stands or very large openings, which would otherwise be avoided if located within breeding territories (Ruggiero et al. 2000b, pp.450-451). Although empirical data are limited, tracking of radio-collared lynx indicate they have crossed divided interstate and secondary highways. However, it is not yet understood how major highways and high levels of associated development may impact population connectivity. Private land development, especially along road corridors in mountain valleys, may fragment habitat and impede movement of lynx (Ruediger et al. 2000, pp.31-32). Private land development on non-NFS lands is addressed in Cumulative Effects below.

Effects on Linkage in the Action Area

Broad-scale lynx linkage areas have been identified and are intended to assist in land use planning in order to maintain connectivity and allow for movement of animals between blocks of habitat that are otherwise separated by intervening non-habitat areas such as basins, valleys and agricultural lands, or where habitat naturally narrows due to topographic features. There are eight identified lynx linkage areas (Claar et al. 2003, p. 235-238, USFS 2007) on the IPNF. All eight

of these are located on private lands (and non-lynx habitat) in valley bottoms and transect interstate or state highways (i.e. Interstate 90 (I-90), State Route 95 (SR 95), SR 200, and SR 2). Figure III-2 shows the location of lynx linkage areas on the IPNF. Recognizing that linkage of habitat major highways within the IPNF and between the IPNF and Canada is important, the Revised Plan incorporates the NRLMD standard LINK S1: When highways or forest highway construction or reconstruction is proposed in linkage areas, identify potential highway crossings; and ALL S1: New or expanded permanent development and vegetation management projects must maintain habitat connectivity in an LAU and/or linkage area; and guideline ALL G1: methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses, or overpasses. These guidelines and standards address the most serious consequence of developments, highways, and vegetation management relative to linkage by requiring new or expanding permanent developments and vegetation management projects to maintain or where possible, promote habitat connectivity within LAUs and linkage areas.

The Revised Plan builds on these standards and guidelines through its desired condition that states that forest management contributes to wildlife movement within and between national forest parcels. Specifically, FW-DC-WL-18, states that movement between those parcels separated by other ownerships is facilitated by management of the NFS portions of linkage areas identified through interagency coordination. Federal ownership is consolidated at these approach areas to highway and road crossings to facilitate wildlife movement. The direction in the Proposed Action was developed to address the importance of linkage needs of wildlife. The Revised Plan also acknowledges the role of other agencies in facilitating linkage. To that end, the Revised Plan guidelines support the development of future crossing structures (above or below ground culverts or passages where animals can cross high volume roads without risk of being struck by a vehicle) on highways or railroads within or adjacent to Forest lands. The development of crossing structures is dependent on future interagency coordination and collaboration with the public, primarily because the highways and railroads that may be barriers for wildlife are not under the jurisdiction of the IPNF. However, the IPNF may manage lands near future crossing structures and have thus identified the need to manage lands near those features to maintain the effectiveness of those features. Specifically, guidelines FW-GDL-WL-15 through 17 require that IPNF coordinate with others on the development of crossing structures when major highways are reconstructed, and that they manage lands near those features to maintain the effectiveness of the structure.

Under the Revised Plan, the following desired conditions would ensure that habitat conditions contribute to wildlife movement within and across the Forest: FW-DC-WL-07; MA1abce-DC-WL-01; MA3-DC-WL-01; and MA5-DC-WL-01. Desired conditions in GAs would also facilitate linkage and wildlife movements, specifically on the Idaho/Montana (GA-DC-WL-CDA-03); along the divide between Idaho and Montana from the Kootenai River south to Scotchman Peaks and across the Clark Fork River and for wildlife movement between the Cabinet-Yaak ecosystem and the Selkirk Ecosystem (GA-DC-WL-PO-01); throughout the Selkirk recovery zone (GA-DC-WL-PR-01); on the divide between Idaho and Washington, from the Canadian border south (GA-DC-WL-PR-03); between the Yaak and the Selkirk Mountain range and between the Cabinet and the Selkirk mountain ranges (GA-DC-WL-LK-01) and along the Idaho/Montana divide between the Salmon and Selway/Bitterroot Wilderness Areas (GA-

DC-WL-SJ-02). These areas include linkage areas identified in the NRLMD. Many of these areas either overlap lynx habitat within LAUs or would connect LAUs. This direction would also support lynx movement to habitat on adjacent Forests and into Canada.

Hence, we do not anticipate adverse effects on linkages and movement areas for lynx under the Revised Plan.

### *Effects of Recreation on Lynx Under the Revised Plan*

The potential effects of recreation on lynx reproduction, behavior, habitat use and populations have not thoroughly been investigated. Anecdotal evidence suggests that lynx are tolerant of human presence; however, this has not been rigorously tested (Staples 1995, pp.116-121; Mowat et al. 2000, pp.280-281). This section addresses the effects of developed and dispersed recreation, over-snow motorized use, and collection of forest products on lynx.

### *Effects of Developed Recreation on Lynx Under the Revised Plan*

General Effects of Developed Recreation on Lynx

Developed recreation facilities offer recreation experiences, protect resources, or otherwise manage concentrations of visitor use. These facilities range from a complete campground with water systems, toilets, and fully developed sites; to a simple bulletin board or parking barrier at a parking lot. They may be developed by the Forest Service or private parties. Privately developed or managed facilities are approved by the Forest Service and are permitted under a special use authorization or partnership agreement. Redesign and reconstruction of developed sites has been ongoing with primary changes focused on updating campgrounds for RV use, improving accessibility, and improving services such as potable water and sanitation. Developed recreation can result in direct loss of lynx habitat and further loss of habitat or fragmentation from associated development of the surrounding area.

Effects of Developed Recreation on Lynx in the Action Area

There are 81 managed recreation sites on the IPNF (USFS 2013b, p. 287). Under the Revised Plan, 16 developed recreation sites would be managed under MA7 (Primary Recreation Areas). MA7 encompasses about 14,200 acres and includes lands associated with 4th of July, Canfield Mountain, English Point, and Lookout on the Coeur d'Alene River District; Priest Lake on the Priest Lake District; and Sam Owen on the Sandpoint District. The desired condition in MA7 is to maintain and improve these recreation sites (MA7-DC-AR-01).

Developed recreation sites outside of MA7 will continue to be managed for recreation use and improved where necessary and budgets allow. The desired condition across the Forest (FW-DC-AR-01) is to provide quality, well-maintained recreation facilities at key locations to accommodate concentrations of use, enhance the visitor's experience, and protect the natural resources of the area.

Some of the developed recreation facilities are outdated and will be upgraded as funding becomes available (USFS 2013b, p. 298). The Forest stated in its Final EIS (ibid) that needs for

additional facilities are overshadowed by a shortfall in maintenance and rehabilitation funds for existing facilities and the high cost of construction. The current trend for use of available funds to upgrade the larger developed recreation sites that receive high levels of use is expected to continue under the Revised Plan.

Given the desired condition for recreation opportunities under the Revised Plan, improvements or development of recreation sites on the IPNF may occur, and; therefore, individual lynx may be affected by developed recreation through habitat avoidance, but more likely through habitat alteration or loss. Anecdotal evidence suggests that lynx are tolerant of human presence; however, this has not been rigorously tested (Staples 1995, pp.116-121; Mowat et al. 2000, pp.280-281). Human-created disturbance near existing developed recreation sites is fairly predictable and if disturbance occurred at levels affecting lynx or their dens, it is unlikely that lynx would den near such established sites at all. The likelihood of construction of new or expanded recreation sites affecting a lynx den is extremely low. Lynx are rare, den sites are rare and are typically not re-used year to year, multiple den sites are used each year, and denning habitat is not limited in the action area (Squires et al. 2008, 2010). If human activities or presence near den sites disturbed lynx, it is unlikely that a lynx would select a site near a construction site or a new or existing developed area. We expect the likelihood of developed recreation disturbing a lynx den site to be so unlikely as to be discountable.

Under the Revised Plan existing recreation special uses would continue and new ones would be authorized. However, options for additional recreation special uses would be affected by the MA allocations as well as the Grizzly Bear Access Amendment and Revised Plan elements (i.e., FW-GDL-WL-01, 02, 03) that limit types of access and seasonal closures during sensitive periods; such as mating, calving, and when animals emerge from dens.

The Revised Plan retains the NRLMD objectives, standards, and guidelines that address the most serious consequence of recreational development, requiring new or expanding permanent developments to maintain or where possible, promote habitat connectivity within LAUs and linkage areas (All O1, All S1, LINK O1, LINK S1, and All G1). If ski areas are expanded or proposed, they would be required to incorporate the NRLMD guidelines that reduce impacts within the proposed development itself, including: HU G1, HU G2, and HU G3. Additionally, the Revised Plan desired conditions trend the forest toward large remote areas with low disturbance to accommodate species with large home ranges (FW-DC-WL-02), and toward recovery of threatened and endangered species including the availability of foraging, denning, rearing, and security habitat (FW-DC-WL-03).

With the application of NRLMD objectives standards and guidelines (listed above) Revised Plan desired conditions for wildlife (FW-DC-WL-02, 03) and guidelines (FW-WL-GDL-15 through 17), the existing lack of funding for expansion of facilities (USFS 2011b, p. 298), and lynx tolerance of human activities, we do not anticipate adverse effects of developed recreation sites on lynx. Future proposals resulting in adverse effects despite compliance with the Revised Plan (e.g. significant habitat loss) would be addressed at the project level.

### *Effects of Non-winter Dispersed Recreation on Lynx Under the Revised Plan*

General Effects of Non-winter Dispersed Recreation on Lynx

As discussed in the NRLMD Biological Opinion (USFWS 2007, p. 52), due to the apparent low susceptibility of lynx to displacement by humans, this activity presents low risk of adverse effects except possibly for disturbance near den sites. Research by Squires et al. (2008, pp.1501-1505) finds that denning habitat is found in a variety of forest conditions, and lynx den site availability is generally not limiting for lynx. Therefore, the likelihood that lynx denning would conflict with dispersed recreation is low. Further, as described in the NRLMD Biological Opinion (USFWS 2007, p. 52) dispersed recreation often occurs along hiking trails through forested areas and well-used, if not designated camp sites. Human-created disturbance near such areas is fairly predictable and if disturbance occurred at levels affecting lynx or their dens, it is unlikely that lynx would den near such established sites at all. Further, lynx could move their kittens to an alternate site and/or would likely avoid denning in these areas in following years. Den sites are typically not re-used year to year and denning habitat is not limited in the action area (Squires et al. 2008, p.1505), lynx den sites are not easily detected in forests and unlikely to be noticed by recreationists. Lynx are rare, as such their den sites are rare.

Effects of Non-winter Dispersed Recreation on Lynx in the Action Area

The number of miles of roads and trails available for wheeled motor vehicle use is the same from the existing plan to the Revised Plan since there are no proposed changes to their current designated status for use (USFS 2013b, p. 296). The number of acres available for cross-country wheeled motor vehicle use is also the same between the existing plan and the Revised Plan since there are no proposed changes to the areas currently designated for that use. The difference where wheeled motor vehicle use may be allowed (where roads or trails exist and could be designated for such use) effects where potential dispersed use could occur. Under the Revised Plan, this area would be reduced by 5 percent (USFS 2013b, p. 296).

Under the Revised Plan, dispersed recreation opportunities would continue to be available with some improvements made to concentrated use areas. Project level standards would apply the NRLMD (FW-STD-WL-01). Specifically, objective All O1 and standard All S1 would ensure connectivity in recreation projects. Hence, conditions are expected to be maintained relative to dispersed recreation as analyzed in the NRLMD biological opinion (USFWS 2007). Measures incorporated in the Revised Plan that may further reduce effects of dispersed recreation on lynx include the desired condition to trend the forest toward recovery of threatened and endangered species including the availability of foraging, denning, rearing, and security habitat (FW-DC-WL-03) and reduced disturbance around denning habitat for listed species (FW-DC-WL-01). Hence, the likelihood that dispersed recreation on or off trails would occur in proximity of a den site, and/or that the dispersed recreation activities occurring would actually disturb a lynx den site or in other ways adversely affect lynx is so low as to be discountable.

### *Effects of Dispersed Winter Recreation on Lynx Under the Revised Plan*

General Effects of Dispersed Winter Recreation on Lynx

Snowmobiling, cross-country skiing, and snowshoeing are popular activities within higher elevation environments. Concerns regarding the effect of winter recreation on lynx behavior and habitat use remain a focal point for land management agencies. Compacted trails created by snowmobiles, cross country skiers, and snowshoes may increase access to lynx winter habitat for competitors and predators, particularly coyotes. Disparate conclusions from previous studies suggest that compacted snow and dietary overlap between coyotes and lynx may vary spatially and temporally. For example, Kolbe et al. (2007, entire) backtracked coyotes in Montana and found that coyotes did use snowmobile trails, however, they did not travel closer to these trails than randomly expected. Instead, coyotes adapted to deep snow conditions by selectively using habitats with shallower and more supportive snow (Kolbe et al. 2007, p.1414; Bunnell et al. 2006, p.836). Kolbe et al. (2007, p.1414) found no difference between coyotes' use of compacted and uncompacted roads. This suggested that coyotes may be selecting for open travel corridors instead of snow conditions. However, a more recent study in Wyoming using similar methods to Kolbe et al. (2007, pp.1410-1412) found that coyotes traveled on or near compacted trails more than random expectation (Burghardt-Dowd 2010, pp.64-66). Results from this study indicated that average snow penetrability was higher in northwestern Wyoming than in western Montana, making coyote movement in non-compacted snow potentially more energetically costly to coyotes in Wyoming (ibid, pp.76-77).

In addition to snow conditions, prey availability and geography may influence dietary overlap between lynx and coyotes. Kolbe et al. (2007, pp.1415-1416) found that coyotes in Montana were primarily scavengers, with snowshoe hares comprising only 3% of coyote winter feed sites. Similarly, Burghardt-Dowd (2010, pp.19-20) found coyotes in Wyoming to be primarily scavengers, with 8% of sampled coyote scats containing snowshoe hare remains. In both Montana and Wyoming, lynx preyed primarily on snowshoe hares in the winter with 96% and 85% of lynx prey biomass consisting of snowshoe hares, respectively (Squires and Ruggiero 2007, p.311; Burghardt-Dowd 2010, p.20). In both regions, there was no significant dietary overlap between lynx and coyotes in the winter; however, the potential for dietary overlap between lynx and coyotes would most likely occur during the fall when coyotes appear to increase predation on snowshoe hares (Burghardt-Dowd 2010, pp.20-21).

The best available research regarding the preferential use of compacted snow by coyotes and dietary overlap between lynx and coyotes suggests that both factors vary geographically and temporally. Snow conditions in different regions may determine whether or not snowmobile trails influence coyote movements (Bunnell et al. 2006, p.835; Kolbe et al. 2007, pp.1413-1416; Burghardt-Dowd 2010, pp.76-77). Also, the potential for snow-compacting recreational activities to reduce available prey for lynx may depend on local prey abundance or the presence of alternative prey.

Effects of Dispersed Winter Recreation on Lynx in the Action Area

Under the Proposed Action, the acres of lynx habitat where over-snow motorized access will be allowed will be reduced by almost 52,800 in mapped lynx habitat (Tables III-9 and III-10). Stated another way, 80 percent of lynx habitat is open to over-snow motorized access (Table III-9); however, given the density of trees in favored lynx habitats, not all acres are accessible. There is a current court ordered closure for woodland caribou—that includes all LAUs in the Selkirk Mountains. Under the Revised Plan, this will be lifted once winter travel planning is complete. Future winter travel planning will incorporate the Proposed Action MA direction when developing a winter travel plan (snowmobiling is not allowed in MA1a,b, MA4a, portions of MA2a and MA2b, and 3 of 4 designations of MA3). This would reduce the likelihood of negative affects to Canada lynx from over-the-snow winter access (USFS 2013a, p. 39).

Under the Revised Plan, the guidelines of the NRLMD would be retained such that winter recreation designated over-the-snow routes would not expand outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat (HU G12/HU G11). Under the Revised Plan, elements GA-DC-WL-PR-04 and GA-DC-WL-PO-03 provide direction for undisturbed wintering areas for woodland caribou in the Selkirk area and the Selkirk Mountain range. These desired conditions may have a beneficial effect on lynx residing in the Selkirk Mountains (including all or portions of these LAUs: Pack River, Snow, Cascade, Trout, Upper Smith, Saddle Cow, Blue-Grass, Upper Priest, Hughes, Hemlock, Willow, Sema and Kalispel), which are closed in winter due to a 2007 federal court order to protect woodland caribou (see Chapter IV. woodland caribou, for details). Additionally, the Revised Plan (FW-STD-WL-04) would prohibit grooming of snowmobile routes in grizzly core habitat after April 1 of each year and (FW-GDL-WL-04) minimize or avoid disturbance from over-snow vehicle use during the winter period of December 1 to April 30 in areas occupied by caribou. These measures would benefit lynx where habitat overlaps.

Implementation of the Revised Plan (including the guidelines of the NRLMD) would maintain sufficient habitat effectiveness for lynx by limiting expansion of compacted snow routes, by addressing potential effects on lynx during future winter travel planning, and by prohibiting grooming in grizzly bear core habitat after April 1 of each year and minimizing disturbance from snowmobiles in occupied caribou habitat during the winter period.

The status of the science regarding effects of snow compaction on lynx has not changed since our assessment of the effects of winter dispersed recreation on lynx in the NRLMD biological opinion (USFWS 2007, p. 55). That is, there is no indication that compacted snow routes increase competition from other species to levels that adversely impact lynx populations, and under the proposed action, the amount of areas affected by snow compacted routes within the action area would decrease. Thus, winter dispersed recreation may adversely affect individual lynx in some specific cases; however, as a whole, we do not expect substantial impairment of the ability of lynx to feed, breed, or shelter as a result of winter dispersed recreation.

### *Effects of Collection of Forest Products on Lynx Under the Revised Plan*

General Effects of Collection of Forest Products on Lynx

Collection of forest products includes personal and commercial firewood collection, limited personal use permits for such items as rocks and trees, and all other unpermitted use of forest products such as huckleberry or mushroom collection. Collection of such items would not likely degrade lynx habitat or snowshoe hare habitat features. An exception would be collection of Christmas trees, boughs, and posts and poles in lynx habitat (essentially a form of thinning). The removal of these forest products can potentially reduce the quality of lynx habitat. Generally, the collection of forest products occurs in close proximity to roads and the density of people engaged in this activity diminishes with increasing distance from a road or trail (USFS 2013a, p.40). Potential effects are more likely to be in line with those expected for dispersed recreation.

Effects of Collection of Forest Products on Lynx in the Action Area

The acres of lynx habitat where commercial and personal collection of other forest products will be allowed are reduced or remain the same in mapped lynx habitat (Tables III-9 and III-10). Forest-wide desired conditions would trend the forest toward providing remote areas for species with large home ranges, recovering Federally-listed species, facilitating denning and habitat use through low levels of disturbance, and managing motorized access to promote recovery (FW-DC-WL-01 through 05). These conditions benefit lynx by reducing the risk of displacement and other human effects. The activities associated with the collection of forest products are typically small in scale, disturbance impacts would be temporary and of low impact on individual lynx, and effects are minimized on a project basis by limiting the amount and distribution of the product to be removed (USFS 2013a, p.62). Therefore, we do not anticipate adverse effects on lynx from human presence associated with the collection of forest products.

In its NRLMD ROD, the USFS (2007, p. 12) clarified that under Standard VEG S5, which prohibits thinning that would change the characteristics of the habitat. The Revised Plan would implement NRLMD Standard VEG S5 which prohibits thinning that would change the characteristics of the habitat. Therefore, effects from these activities would likely be insignificant or discountable to lynx habitat and lynx.

### *Effects of Mineral and Energy Exploration and Development on Lynx Under the Revised Plan*

General Effects of Mineral and Energy Exploration and Development on Lynx

Generally, the impacts of mining and energy development on lynx, result from the habitat loss and fragmentation.

Effects of Mineral and Energy Exploration and Development (Specifically Mining Proposals) on Lynx in the Action Area

There are no major mining operations on the IPNF at this time. Known oil and gas deposits on the IPNF, and geothermal energy potential is very low. The Forest reports little commercial interest in leasing for such resources is anticipated under the Revised Plan (USFS 2013a, p. 40).

As reported by the IPNF, even though the acres of lynx habitat where leasable mineral activities will be allowed is increased under the Proposed Action this is not expected to have any effect on lynx vegetation. The Forest also clarifies that a leasable analysis was completed for the existing plan and areas were identified where no leasing could take place. However, because the potential is so low for the IPNF, the Proposed Action did not complete such an analysis. Hence, on paper there appears to be an increase in mineral leasing capability when in reality this is not the case (ibid). The acres of lynx habitat where mining of locatable and materials will be allowed will be increased by 22,853 acres in lynx habitat (Tables III-9 and III-10). Under the Revised Plan, future development of locatable minerals is expected to be very limited within the action area (ibid). Therefore, the USFWS concludes, the risk to lynx and lynx habitat due to all mining activities is expected to be very low.

However, future mining activities could occur in lynx habitat under the Revised Plan. The effects of mining developments (habitat loss, roads, and human access) under the Revised Plan would be addressed by the NRLMD guidelines HU G4, HU G5, HU G6, HU G9, and HU G12 addressing monitoring snow compaction; reducing impacts on lynx and lynx habitat; providing connectivity on high speed roads; closing roads after project completion; and limiting winter access to designated routes, respectively (USFWS 2007, p. 56). Effects of mining would further be addressed through project level analysis and mitigation. Mining proposals often require extensive mitigation programs (USFS 2012; USFS 2003), which may include restrictions on the placement of facilities, the timing of activities, or even the purchase of mitigation lands to offset impacts on NFS lands. Although the Grizzly Bear Access Amendment (implemented through FW-STD-WL-02) would not preclude the development of future mining operations, it would likely influence mitigation and project design due to limitations on open and total roads and the need to maintain secure habitat in grizzly bear BMUs (60 percent of lynx habitat overlaps grizzly bear BMUs).

Any mining proposal on the Forest would be considered in terms of Forest-wide desired conditions that trend the forest toward providing remote areas for species with large home ranges, recovering Federally-listed species, facilitating denning and habitat use through low levels of disturbance, and managing motorized access to promote recovery (FW-DC-WL-01 through 03). At the project level, the Revised Plan Forest-wide guidelines and standards would address potential effects of mining proposals on connectivity and linkage areas (FW-GDL-WL-15 through 17) and access management (FW-STD-WL-02).

With the application of the NRLMD guidelines and Revised Plan desired conditions, standards, and guidelines, and the low likelihood of future mining proposals under the Revised Plan these activities are expected to result in no or only minor adverse effects to lynx depending upon the scale of development and potential loss of habitat. Therefore, mining proposals in the action area are not expected to impair lynx ability to feed, breed, or shelter. Adverse effects from individual projects would be addressed at the project level.

### *Effects of Forest/Backcountry Roads and Trails on Lynx Under the Revised Plan*

General Effects of Forest/Backcountry Roads and Trails on Lynx

In general, construction and reconstruction of forest roads are not considered a primary threat to resident lynx populations in and of themselves (65 FR March 23, 2000 and USFWS 2007, p. 50). Construction of roads results in a small reduction of lynx habitat by removing forest cover. In some instances, vegetation along less-traveled roads provides good snowshoe hare habitat, and lynx may use the roadbed for travel and foraging (Koehler and Brittell 1990). McKelvey et al. (2000c, pp.317-320, 334) demonstrated that lynx show no preference or avoidance of unpaved forest roads and the existing road density does not appear to affect lynx habitat selection (McKelvey et al. 2000c, pp.317-320, 334). Hence, forest roads and trails likely do not represent an impediment to lynx movements. Preliminary information suggests that lynx do not avoid roads (Ruggiero et al. 2000b, pp.450-451), except at high traffic volumes (Apps 2000, pp.366-367). Limited information is available on the magnitude of lynx mortality on forest roads. Vehicle speeds on forest roads in the mountainous west are relatively slow in comparison to highways or other public roads due to topography, substrate and road conditions. Thus, the potential for lynx mortality or injury due to collisions with vehicles is probably low on forest roads in the west. Further research directed at investigating the effects of road density on lynx is needed. Roads and trails can also fragment habitat; these effects are addressed under Effects on Linkage (below).

Access via roads may increase the mortality risk to lynx from incidental trapping when lynx is not the target species (Koehler and Aubry 1994, pp.76-77) and from incidental shooting. A lynx was trapped in Idaho in 2011 (ILBT 2013, p. 33). The actual magnitude of shooting mortality is unknown, but incidents were reported by Saunders (1963b, pp.394-395), Mech (1973, pp.151-152), Parker et al. (1983, p.771) and Slough and Mowat (1996, p.950). We are unaware of any reports of mortality of lynx due to hunters or poachers in Idaho.

Effects of Forest/Backcountry Roads and Trails on Lynx in the Action Area

The Revised Plan does not make site-specific decisions about travel routes. Actual cross-country travel is still managed according to the Motor Vehicle Use Map, which primarily restricts travel to designated routes.

The areas where wheeled motorized access is allowed will be reduced by 35,352 acres in mapped lynx habitat . Areas of allowable road construction will be increased by 28,849 acres mapped lynx habitat. Additionally, the Revised Plan would implement the guidelines of the NRLMD that reduce the potential effects of roads on lynx:

- Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses or overpasses (ALL G1).
- Methods to avoid or reduce effects to lynx should be used in lynx habitat when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds

and volumes, or a foreseeable contribution to increases in human activity or development (HU G6).

- New permanent roads should not be built on ridge-tops and saddles, or in areas identified as important for lynx habitat connectivity. New permanent roads and trails should be situated away from forested stringers (HU G7).
- Cutting brush along low-speed, low-traffic-volume roads should be done to the minimum level necessary to provide for public safety (HU G8)
- On new roads built for projects, public motorized use should be restricted. Effective closures should be provided in road designs. When the project is over, these roads should be reclaimed or decommissioned, if not needed for other management objectives (HU G9).

Under the Revised Plan, 22 percent of lynx habitat in LAUs would be restricted from motorized access as well as new temporary or permanent road construction (Table III-9). Further, new road construction would be limited in MA 5, comprising an additional 38 percent of lynx habitat as described in guideline MA5-GDL-AR-03, although new trails would be allowed. Notably, the Revised Plan also implements the Grizzly Bear Access Amendment (FW-STD-WL-02**)**. Although this was developed to reduce road related impacts to grizzly bears, it would also benefit lynx by reducing levels of wheeled motorized vehicle access where grizzly bear BMUs overlap with lynx habitat. Approximately 60 percent of lynx habitat is within grizzly bear BMUs on the Forest (USFS 2013a, p.25). With implementation of the NRLMD guidelines for roads and the Revised Plan desired conditions for large, remote areas with low levels of disturbance including: FW-DC-WL-02; MA1abce-DC-WL-01; MA3-DC-WL-01; GA-DC-WL-PR-02, and the Access Amendment standard FW-STD-WL-02, we do not anticipate adverse effects on lynx from roads and trails under the Revised Plan.

### *Effects of Grazing by Domestic Livestock on Lynx Under the Revised Plan*

General Effects of Grazing by Domestic Livestock on Lynx

Snowshoe hare densities and overwinter survival appear to be positively correlated with understory density (Adams 1959, pp.153, 168, Wolff 1980, p.117-118, Litvaitis et al. 1985, pp.871-872). Livestock may compete with snowshoe hares for forage resources (Ruediger et al. 2000, pp.26-27). Browsing or grazing also could impact plant communities that connect patches of lynx habitat within a home range. Throughout the Rocky Mountains and other regions of the west, grazing and browsing by domestic livestock and wild ungulates has been identified as a factor in the decline or loss of aspen as a seral species in subalpine forests (Gruell and Loope, pp.24-26; Bartos et al. 1994, p.83; Shepperd and Fairweather 1994, pp.345-347; Barnett and Stohlgren 2001, pp.576-579). Heavy grazing by domestic livestock that inhibited aspen regeneration and survival thus could impact snowshoe hare habitat, indirectly affecting lynx. Conversely, appropriate grazing management can rejuvenate and increase forage and browse in key habitats such as riparian areas. We found no evidence that grazing was a factor threatening lynx, therefore, grazing was not addressed in the final listing rule (March 24, 2000; 65 FR 16052). There is no existing research that provides evidence of lynx being adversely affected by grazing within the Northern Rockies/Cascade Mountains Region or elsewhere, or of lynx movements within home ranges being impeded by grazing practices (USFWS 2007, p.57).

Effects of Grazing by Domestic Livestock on Lynx in the Action Area

The desired condition for grazing under the Revised Plan, FW-DC-GRZ-01, is that grazing occurs at sustainable levels while protecting resources. The acres of Canada lynx habitat where livestock grazing will be allowed are decreased under the Revised Plan (Table III-9). Under the Revised Plan, grazing allotments would continue to be permitted within suitable areas; however, the number of allotments and associated AUMs is expected to remain the same over the next 10-15 years (USFS 2013a, p. 40).

There are three cattle grazing allotments covering 10,177 acres of lynx habitat in three LAUs within the action area, which represents approximately less than 2 percent of lynx habitat on the IPNF.

The NRLMD requires that the Forest: manage livestock grazing to allow regeneration in fire- and harvest-created openings (GRAZ G1); contribute to the long-term health and sustainability of aspen (GRAZ G2); maintain or achieve a preponderance of mid- or late-seral stages, similar to conditions that would have occurred under historic disturbance regimes in riparian areas and willow carrs (GRAZ G3); and contribute to maintaining or achieving a preponderance of mid- or late-seral stages, similar to conditions that would have occurred under historic disturbance regimes in shrub-steppe habitats (GRAZ G4).

As previously analyzed in the NRLMD biological opinion (USFWS 2007, p.57), the guidelines for grazing management practices that provide for the regeneration of trees, shrubs and aspen clones in lynx habitat would adequately minimize the potential for adverse effects of grazing to lynx, and may improve the habitat over baseline conditions. These measures address the primary risk to snowshoe hare populations and hence lynx; that is, localized effects on high elevation willow communities or aspen stands (IGBT 2013). With the application of these measures, application of INFISH in Riparian Habitat Conservation Areas (which limits timber harvest in riparian habitats supporting native fisheries), and the maintenance of existing levels of grazing on the Forest, the Revised Plan would reduce the likelihood that grazing would impact lynx prey habitat abundance in riparian areas or multistory foraging areas under the Revised Plan. Therefore, we do not anticipate adverse effects on snowshoe hare populations or lynx as a result of grazing. Therefore, no effects or discountable effects to lynx as a result of grazing

### 3. Analysis of Effects on Critical Habitat

***Factors to be Considered for Critical Habitat***

Lynx critical habitat on the IPNF lies within Critical Habitat Unit 3. Critical habitat on the IPNF is a subset of the total mapped lynx habitat and so is mostly addressed under the NRLMD, carried forward in the Revised Plan. The NRLMD includes standards and guidelines intended to avoid or reduce the potential for projects proposed under Forest Plans to adversely affect lynx. The primary focus of standards and guidelines in the NRLMD is to conserve and promote the *habitat* conditions needed to produce adequate snowshoe hare (lynx primary prey) at densities adequate to sustain lynx home ranges, and thus sustain lynx populations. The NRLMD addresses the habitat types, habitat components, and habitat conditions detailed and described in

the lynx critical habitat PCE (outlined in Section C.5 and Table III-8). One exception is "deep, fluffy snow" conditions (over which the FS has limited control), which is driven by broad climatic conditions now affected by the onset of global warming. Snow-compacting activities (that the FS can regulate) may affect snow condition on the ground, but only at site specific scales and not the overall deep snow condition of the area. An additional exception to the provisions of the NRLMD as discussed in detail in Section C.5, is some matrix habitat. If matrix habitat is not specifically mapped as lynx habitat or included in a linkage area, it is not subject to the NRLMD and effects on the area are addressed at the project level.

***Effects of the Revised Plan on Critical Habitat***

Values to remember throughout this analysis of critical habitat are presented in Table III-11. The following sections analyze the effects of implementing the Revised Plan on the PCE1, PCE1a, PCE1b, PCE1c, and PCE1d.

**Table III-11. List of acreages of habitat in LAUs, lynx habitat, and critical habitat on the IPNF.**

| **Lynx Habitat on the IPNF** | **Acres** |
|---|---|
| Acres in LAUs | 891,701 |
| Acres of mapped lynx habitat in LAUs | 582,981 |
| Acres of Critical Habitat | 34,687 |
| Acres of lynx habitat in the WUI | 102,290 |
| Acres of critical habitat in the WUI | 14,662 |

Effects on PCE (1) Boreal forest landscapes supporting a mosaic of differing successional forest stages:

The primary effect of forest management on the PCE1 is vegetation management that alters the mosaic of differing successional boreal forest stages. Fire historically played an important role in maintaining the mosaic of forest successional stages that provide habitat for both snowshoe hare and lynx. Vegetation management in addition to or in replace of natural fires can serve a similar role to fire.

The Revised Plan implements the NRLMD (FW-WL-STD-01). In doing so, it carries forward four objectives for vegetation management: VEG O1, O2, O3 and O4. These objectives speak directly to conserving the broad PCE1.

- VEG O1 directs the Forest to approximate the natural succession and disturbance processes while maintaining habitat components needed for the conservation of lynx.

- VEG O2 provides a mosaic of differing successional forest stages that support dense horizontal cover, through time, that conserves and supports high densities of snowshoe hares.
- VEG O3 supports the use of fire to restore ecological processes to improve lynx habitat.
- VEG O4 addresses successional changes at a smaller scale, focusing management actions in areas with potential to improve snowshoe hare habitat but presently lacking dense understories.

Additionally, the Revised Plan incorporates desired conditions that support the PCE1 by maintaining the quality of lynx habitat on the Forest. The Desired Conditions are based on historical conditions and natural disturbance processes, so lynx would have approximately the types and amounts of habitats they would have had historically under natural disturbance processes (USFS 2013a, p. 43) and create habitats that are more resilient to large-scale disturbance (ibid, p. 44). Element FW-DC-WL-03 would trend the Forest toward recovery of threatened and endangered species. Hence, we expect this desired condition further supports the Objectives of the NRLMD. Element FW-DC-FIRE-03 directs the Forest to increase its use of wildland fire (both prescribed fire and where appropriate, wildfire), in many areas across the Forest. In this element, fire plays an increased role in helping to trend the vegetation towards the desired conditions while serving other important ecosystem functions. However, undesirable wildfires continue to be suppressed where necessary to protect life, property and key resources. This desired condition for fire under the Revised Plan would likely benefit lynx and their prey populations over the long-term because fire historically played an important role in maintaining the mosaic of forest successional stages that provide habitat for both snowshoe hare and lynx (Fox 1978, entire; Bailey et al. 1986, pp.285-286; Quinn and Parker 1987, p.687; Koehler and Brittell 1990, p.12; Slough and Mowat 1996 as cited in USFWS 2007, p.11).

We conclude that the Revised Plan, including the NRLMD objectives (with implementing standards and guidelines) provide clear direction that speaks to the conservation of the most important component of lynx critical habitat: the PCE1 - a mosaic of early, mature and late successional staged forests, with high levels of horizontal cover and structure.

Effects on PCE 1a Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow.

The primary factors driving lynx populations, behavior, and distribution is the abundance and distribution of their primary prey: snowshoe hare (PCE1a).

Snowshoe hares prefer boreal forest stands that have a dense horizontal understory to provide food, cover, and security from predators. Snowshoe hares feed on conifers, deciduous trees, and shrubs (Hodges 2000b, pp.181-183). Snowshoe hare density is correlated to understory (horizontal) cover between approximately 3 to 10 feet above the ground or snow level (Hodges 2000b, pp.184-185). These include:

- stands with shrubs, stands that are densely stocked, and stands at ages where branches have more lateral cover (Hodges 2000b, p.184).

- earlier successional forest stages supporting a greater density of horizontal understory and more abundant snowshoe hares (Buehler and Keith 1982, p.24; Wolfe et al. 1982, pp.665-669; Koehler 1990, pp.847-848; Hodges 2000b, pp.183-195; Homyack et al. 2007, pp.8-11 Griffin 2004, pp.84-88).
- mature, multistoried stands with adequate dense understory to support abundant snowshoe hares (Hodges 2000a, pp.136-140; Griffin 2004, pp.53-54, Squires et al. 2006, pp.12-16).

The primary source of negative effects from forest management on the PCE1a is vegetation management that reduces the amount or quality of the preferred habitat conditions for snowshoe hare, which can lead to a reduction in the abundance and/or distribution of snowshoe hares.

The Revised Plan carries forward the four vegetation management standards VEG S1, S2, S5, S6 and four guidelines VEG G1, G4, G5, G10 that implement the four vegetation management objectives (described in the section immediately above). Implementation of the NRLMD under the Revised Plan directly supports PCE1a by conserving multi-storied snowshoe hare habitat, conserving dense regenerating stands for snowshoe hare habitat, and creating conditions that would regenerate snowshoe hare habitat in stands where it is currently lacking. The standards set percentages for maximum treatment of lynx habitat within LAUs targeted to regenerate forests in both amount of habitat (VEG S1) and timeframe (VEG S2). The standards further define the limits of where hare habitat can be removed for pre-commercial thinning projects VEG S5). The standards VEG S5 and VEG S6 prohibit reductions in snowshoe hare habitat in young, stand initiation phase forest, as well as multi-storied forests. Prescribed burning in lynx habitat is allowed but is limited by VEG S6, which prohibits vegetation management projects (including prescribed fire) that reduce snowshoe hare habitat in multi-story mature or late successional forests except for treatment around administrative sites, for research studies, or for incidental removal during salvage. Combined, these standards promote and conserve the habitat conditions needed to produce adequate snowshoe hare densities to sustain lynx home ranges, and thus sustain lynx populations and therefore addresses the PCE1a.

The NRLMD guidelines provide additional direction within the LAUs that supports PCE1a including 1) planning vegetation management projects such that they recruit a high density of conifers, hardwoods, and shrubs if normally scarce (VEG G1) and directing harvest in mesic, monotypic, lodgepole stands that lack understory (VEG G1), 2) avoiding permanent fire breaks on ridges or saddles to preserve connectivity and ensuring prescribed fire does not create permanent travel routes that facilitate snow compaction (VEG G4), and providing habitat for alternative prey [red squirrels] in each LAU (VEG G5). Additionally, the one NRLMD objective for grazing (GRAZ O1) directs that grazing be compatible with improving or maintaining lynx habitat. Additionally, four grazing guidelines (GRAZ G1, G2, G3, and G4) implement the objective for grazing. They direct that grazing should not prevent shrub and tree regeneration in fire- and harvest-created openings, and that grazing should contribute to sustainability of aspen and to mid-or late-seral willow, riparian and shrub-steppe areas.

The following human use guidelines relate to maintaining/providing snowshoe hare habitat in LAUs:

- HU G1 - When developing or expanding ski areas, provisions should be made for adequately sized inter-trail islands that include coarse woody debris, so winter snowshoe hare habitat is maintained.
- HU G2 - When developing or expanding ski areas, foraging (i.e., snowshoe hares) should be provided consistent with the ski area's operational needs, especially where lynx habitat occurs as narrow bands of coniferous forest across mountain slopes.
- HU G3 - Recreation developments and operations should be planned in ways that both provide for lynx movement and maintain the effectiveness of lynx habitat

The forest-wide desired vegetative conditions maintain the quality of lynx habitat on the Forest by providing the approximate types and amounts of habitats lynx would have had historically under natural disturbance processes (USFS 2013a, p. 43) and creating habitats that are more resilient to large-scale disturbance (ibid, p. 44). Additionally, though not specific to lynx, the desired conditions FW-DC-VEG-07 and 08 and guidelines FW-GDL-WL-03 through 06 address coarse woody debris and snag retention, which contributes to horizontal cover for snowshoe hares. The Revised Plan forest-wide desired conditions for wildlife (FW-DC-WL-02 and 03) are also consistent with maintaining quality lynx habitat on the Forest by trending the Forest toward large remote areas with limited disturbance and recovering threatened and endangered species.

Overall, elements of the Revised Plan, including these NRLMD objectives, standards, and guidelines would maintain the broad PCE1, a landscape mosaic of habitat conditions needed for snowshoe hare production and lynx foraging and clearly conserves, supports, and promotes the habitat conditions of PCE 1a, supporting high snowshoe hare densities, which in turn support lynx.

Exemptions and Exceptions to the NRLMD Vegetation Standards

The Revised Plan would allow some adverse effects on snowshoe hare/lynx foraging habitat as authorized under the NRLMD. Exemptions from standards VEG S1, S2, S5, and S6 to allow for fuels management within the WUI and exceptions listed in VEG S5 and S6 to allow some precommercial thinning could result in adverse effects to PCE1a.

Specifically, the NRLMD authorized the total area that *could* be affected by the exemptions from VEG S1, S2, S5, and S6 at 34,978 acres (about 6 percent of mapped lynx habitat on the Forest) and the total area that *could* be affected by the exceptions to VEG S5 and VEG S6 at 17,120 acres (about 3 percent of mapped lynx habitat on the Forest). Since implementation of the NRLMD, the Forest has treated 921 acres in the WUI (of which none of the acres are within critical habitat); 12 of these acres may have resulted in adverse effects on lynx. Additionally, the forest has precommecially thinned 717 acres. Therefore, under the remaining allowance for exemptions and exceptions in the Revised Plan, up to 51,369 acres of mapped lynx habitat could be treated in ways that may adversely affect the PCE when it occurs within critical habitat (34,966 acres + 16,403 acres = 51,369 acres). Approximately 42 percent (14,662 acres) of critical habitat occurs in the WUI. If all critical habitat acres in the WUI are treated under the Revised Plan, it would likely result in adverse effects, through a reduction in the quality or quantity of existing lynx habitat at the LAUs scale. However, it is unlikely that the Forest would treat all critical habitat in the WUI, because VEG G10 applies to all fuels management projects

and requires at least some consideration of the standards VEG S1, S2, S5 and S6 in designing fuel reductions treatments. This requires consideration of the status of the affected LAU relative to the standards, i.e., the percent of an LAU already in SISS, the amount of SISS in adjacent LAUs, and the amount of multistoried forest in an LAU when designing projects in the WUI. A concentration of adverse effects in the two LAUs supporting critical habitat would likely affect the Forest's ability to comply with VEG S1 and S2.

Exemptions from VEG S1 for fuels management would affect the forest mosaic by allowing more than 30 percent of mapped lynx habitat within an LAU to be in a SISS. The extent of effects would be limited because no three adjacent LAUs can exceed 30 percent in a SISS condition. This limits the extent of effects on the forest mosaic and the preferred habitat of snowshoe hares. Further, as demonstrated in Table III-7, currently all LAUs on the IPNF, including those supporting lynx critical habitat and those that do not, are in compliance with the standards of the NRLMD, despite the implementation of exemptions and exceptions. Hence, we do not anticipate a concentration of adverse effects on PCE1a of critical habitat in the action area.

The exemption to the vegetation standards for fuels management could allow more than 15 percent of an LAU to be converted from suitable habitat (supporting snowshoe hares) to SISS (not snowshoe hare habitat) within a decade (VEG S1). Where exemptions from VEG S2 are used within the WUI, there would likely be adverse effects to the PCE1a by reducing the quality and productivity of snowshoe hare habitat for at least 10 to 15 years, depending upon location, until treated stands regenerate to provide winter snowshoe hare habitat. Further, depending upon the fuel loading, location and funding, these stands may be treated again to retain them as fuel breaks and not allowed to regenerate, extending the length of time they remain in early seral conditions. This is most likely in those areas closest to communities or structures (generally < .25 miles); in most other cases, the Forest Service would consider moving the openings around to reduce fire size and intensity (Joan Dickerson, U.S. Forest Service, pers. comm. 2007 as cited *In* USFWS 2007, p. 43). These openings would be allowed to regenerate.

The exemption from VEG S5 for fuel management would reduce natural levels of horizontal structure in early successional phases by allowing precommercial thinning during SISS, prior to when the stand no longer provides winter snowshoe hare habitat. It is well documented that such thinning in hare habitat results in a corresponding decrease in the abundance of snowshoe hares (USFWS 2007, p. 43), thereby affecting the PCE1a's ability to support high densities of snowshoe hares. Similarly, the exemption for fuel management from VEG S6 would likewise allow management actions that would reduce the horizontal cover and thus quality of snowshoe hare habitat in older, multi-layered stands.

Thus, exemptions in either VEG S5 or S6 may reduce the capacity of the PCE1a to support sufficient high densities of snowshoe hares to support lynx reproduction and/or occupancy. The impact would depend upon the size of the treated area as well as the inherent capacity of the site to produce snowshoe hares. Overall, the exemptions from VEG S5 and S6 are limited to areas within the WUI where 42 percent of critical habitat is found. However for the reasons explained above as well as the fact that some proportion of this area is likely matrix habitat and would not

suffer adverse effects from fuels management, we do not anticipate adverse effects in all lynx critical habitat in the WUI in the action area.

Implementing the NRLMD under the Revised Plan would also allow exceptions to VEG S5 and S6 for thinning projects that would protect structures from wildfire or to conserve other vegetation communities such as whitebark pine and aspen. The amount of precommercial thinning that could be affected resulting in a reduction in ability of the PCE1a to produce snowshoe hares is anticipated to be 16,403 acres and is expected to be dispersed across the mapped lynx habitat in LAUs on the IPNF. Hence, a concentration of effects is not anticipated in the two LAUs providing critical habitat.

To date, acres treated in mapped lynx habitat have been significantly lower than anticipated (and authorized) under the NRLMD. The Forest does not anticipate exceeding the acre allowance for using exemptions and exceptions that was re-authorized under the NRLMD through the re-mapping effort in 2008 for the life of the Revised Plan (51,369 acres remain: 34,966 acres + 16,403 acres = 51,369 acres). Additionally, VEG G10 applies to all fuels management projects and requires at least some consideration of the standards (VEG S1, S2, S5 and S6) in designing fuel reductions treatments. That means the Forest is required to consider the status of an LAU relative to the standards, i.e., the percent of an LAU already in SISS, the amount of SISS in adjacent LAUs, and the amount of multistoried forest in an LAU when designing projects in the WUI. Thus, the level of adverse effects on the PCE1a in the action area, is not expected to rise to levels that would affect the critical habitat ability to support viable core area populations – the conservation role of critical habitat on the IPNF.

Other Effects on PCE1a

The Revised Plan desired condition is to allow fire (planned and unplanned ignitions) to play a more natural role over time (FW-DC-FIRE-03). Wildfires are unpredictable and can be difficult to control. Wildfires may affect several LAUs, reverting large acreage of forest back to early successional stages, initially creating conditions that lack cover for lynx and are relatively devoid of forage for snowshoe hares and thus adversely affecting the PCE1a. However as detailed above in Section D.2 *Effects of Wildfire Management on Lynx Under the Revised Plan*, wildfire in lynx habitat (boreal forest types with cool, moist habitat) typically leaves patches of unburned areas, and fire severity varies across the landscape. Wildfire also rejuvenates lynx and snowshoe hare habitat by creating early successional habitat that will eventually regenerate to support high densities of hares, and adds dead and downed timber for denning and additional horizontal cover. Thus, wildfire effects in lynx habitat are typically beneficial. Further, under the Revised Plan, VEG S1 would limit the Forest's ability to conduct additional actions that create additional SISS habitat in an LAU that has been substantially affected by fire if more than 30 percent of the LAU is already in SISS. Additionally, VEG S1 ensures that vegetation management projects do not result in more than 3 adjacent LAUs exceeding 30 percent of an LAU in a SISS. These provisions limit the concentration of effects in critical habitat in any one LAU. Thus, Revised Plan direction for wildland fire use is not likely to have adverse effects on PCE1a of lynx critical habitat.

Effects on PCE 1b Winter snow conditions that are generally deep and fluffy for extended periods of time

The physical and biological features of critical habitat for lynx include snow conditions for which lynx are highly specialized that give lynx a competitive advantage over potential competitors (74 FR 36 8638,2009). Forest management does not influence snow depth and conditions, which are dependent upon broad regional factors, such as geography, precipitation, temperature, and also topography and elevation. Thus, we do not expect the Revised Plan to result in adverse effects to PCE1b.

Further, earlier in this biological opinion we detailed the best available research regarding the preferential use of compacted snow by coyotes and dietary overlap between lynx and coyotes. To date, this research suggests that both factors vary geographically and temporally. Snow conditions in different regions may determine whether or not snowmobile trails influence coyote movements (Bunnell et al. 2006, p.835; Kolbe et al. 2007, pp.1413-1416; Burghardt-Dowd 2010, pp.76-77). Also, the potential for snow-compacting recreational activities to reduce available prey (PCE1a) may depend on local prey abundance or the presence of alternative prey.

We expect that snow compaction activities may have localized effects on predator-prey dynamics, but that snow compaction does not affect the overall snow condition (PCE1b) for the action area or critical habitat unit. The Revised Plan contains direction to reduce snow compaction, albeit at relatively local scales. Human-use objective HU O1 maintains the lynx's natural competitive advantage over other predators in deep snow, by discouraging the expansion of snow-compacting activities in lynx habitat. Vegetation guideline VEG G4 prescribed fire activities from creating permanent travel routes that facilitate snow compaction. There are three human use guidelines: HU G4, HU G11, HU G12 that limit snow compaction, stating that monitoring should be conducted remotely for mineral and energy development to reduce snow compaction, designated over-the snow routes should not expand past the baseline (as described in 2007), and winter access for non-recreational uses should occur on designated routes to limit snow compaction, respectively.

Further, the Revised Plan would reduce the acres where over-snow motorized use is allowed by nearly 50,000 acres across the Forest and 3,100 acres in critical habitat. Again, not all the available acres would be accessible because of forested conditions and topography. Once fully implemented, this condition further minimizes opportunities for snow compaction across the Forest.

The status of the science regarding effects of snow compaction on lynx has not changed since our assessment of the effects of winter dispersed recreation on lynx in the NRLMD biological opinion (USFWS 2007, p. 55). That is, there is no indication that compacted snow routes increase competition from other species to levels that adversely impact lynx populations, and under the proposed action the amount of areas affected by snow compacted routes within the action area would decrease. Hence, to the extent the Forest can conserve and promote deep, fluffy snow conditions (PCE1b) relative to winter snow recreation, we conclude that the Revised Plan direction would not have adverse effects on PCE1b.

Effects on PCE 1c Sites for denning that have abundant coarse woody debris, such as downed trees and root wads

Denning habitat is used for parturition and rearing of young. The common component of denning habitat is large amounts of coarse woody debris (CWD) (Koehler 1990, p.847; Squires et al. 2008, p.1502) and horizontal cover provided by low growing canopies of subalpine fir and Engelmann spruce trees (Squires et al. 2008, p.1502). Squires et al. (2008, p.1502) found that lynx selected den sites with higher horizontal cover and log volumes compared to the forests immediately surrounding dens.

The primary effects of forest management on lynx denning habitat include timber harvest, thinning, and salvage harvest that removes existing coarse woody debris and/or affect its recruitment or removes vegetative layers. Hence, the retention of CWD, snags and snag recruits during timber and salvage harvest is important for the ability of the stand to support lynx denning habitat as are limitations on activities that affect the development of multiple vegetation layers. Based on the recent findings of Squires et al. (2008, pp.1501-1505) denning habitat is found in a variety of forest conditions, and suitable den site attributes occur in small pockets scattered across the landscape at relatively high densities; lynx den site availability is not limiting for lynx. Although den site availability is not limiting on the fine scale, surrounding forest area and environ-level habitat features are also important factors to consider when defining lynx denning habitat.

The NLRMD objectives provide not only a mosaic of differing successional forest stages identified as the PCE1 but also conditions that support dense horizontal cover and maintain the habitat components needed for the conservation of lynx, including denning habitat (PCE1c). The NRLMD standards ensure these objectives are achieved across the landscape and additional guidelines apply at the local scale. Under the NRLMD, guideline (VEG G11) directs that projects should be designed to provide coarse woody debris (downed logs, root wads, jack-straw piles) if denning habitat is not well distributed throughout each LAU. One human use guideline (HU G1) provides for retention of coarse woody debris on trails in ski resorts as winter snowshoe hare habitat.

Forest-wide the Revised Plan desired conditions that are not specific to lynx but complement the objectives, standards, and guidelines of the NRLMD include (FW-DC-VEG-07 and 08) addressing coarse woody debris and snag retention, which contributes to horizontal cover for snowshoe hares and den sites for lynx (PCE1c). At the project-level, guidelines FW-GDL-VEG-03 through 06, which retain downed wood, snags, and snag recruits during vegetation management activities further support the retention of habitat components needed by lynx at the local scale to support the PCE1c.

At a local scale, under the Revised Plan, timber harvest, thinning, prescribed fire, and salvage harvest may remove or affect the recruitment of the components that comprise lynx denning habitat including coarse woody debris, snags, and horizontal cover. We conclude that the Revised Plan supports PCE1c on the IPNF through implementation of the NRLMD objectives, standards, and guidelines and Revised Plan guidelines FW-GDL-VEG-03 through 06 and that denning habitat would be available at the large landscape scale required by lynx. We anticipate

no adverse effects on PCE1c in the action area, as a result of Revised Plan direction. This direction would retain the structure needed for sites for denning that have abundant coarse woody debris, such as downed trees and root wads, across critical habitat.

Effects on PCE 1d Matrix habitat 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.

Matrix habitat is hardwood forest, dry forest, non-forest or other habitat types that do not support snowshoe hares and is used by lynx for travel within its home range. Cover is important to lynx when searching for food (Brand et al. 1976, p.425). Lynx have been observed (via snow tracking) to avoid large openings (Koehler 1990, p.847; Staples 1995, p.63) during daily movements within the home range, seeming to prefer to move through continuous forest, using the highest terrain available such as ridges and saddles (Koehler 1990, p.847; Staples 1995, p.63). Lynx often hunt along edges (Mowat et al. 2000, p.274). Kesterson (1988, as cited by Mowat et al. 2000, p.274) and Staples (1995, p.30) reported that lynx hunted along the edges of mature stands within a burned forest matrix, and Major (1989, as cited by Mowat et al. 2000, p.274) found that lynx hunted along the edge of dense riparian willow stands. In Montana, lynx preferentially foraged in spruce-fir forests with high horizontal cover, abundant hares, and large diameter trees during the winter (Squires et al. 2006, pp.14-15). Lynx tended to avoid sparse, open forest and forest stands dominated by small-diameter trees during the winter.

Under the Revised Plan, matrix habitat would be subject to timber harvest, fire/fuels management, recreational use, grazing, and developments. In the Final Rule designating critical habitat, we describe the function of matrix habitat as maintaining the ability for lynx to move through it to access other habitat types in a home range (74 FR 8616-8662, p. 8620). We state that activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range, or if they adversely affect adjacent foraging or denning habitat.

Hence, maintaining connectivity and limiting developments that would create a barrier to lynx movement in matrix habitat would sufficiently address the habitat needs for lynx in matrix habitat. The Revised Plan implements the NRLMD including standards and guidelines in LAUs and linkage areas:

- Standard ALL S1- New or expanded permanent developments and vegetation management projects must maintain habitat connectivity.
- Guideline ALL G1 - Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses or overpasses.

Within linkage areas, the NRLMD implements the following:

- Standard LINK S1 - When highway or forest highway construction or reconstruction is proposed in linkage areas, identify potential highway crossings.

- Standard LINK G2 - Livestock grazing in shrub- steppe habitats should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages, similar to conditions that would have occurred under historic disturbance regimes.
- Guideline LINK G1 - NFS lands should be retained in public ownership.

These NRLMD standards and guidelines help maintain the matrix habitat needed by lynx for traveling through habitat patches within a home range. Forest-wide (i.e., inside and outside LAUs), the Revised Plan builds on these standards and guidelines through its desired condition that states that forest management contributes to wildlife movement within and between national forest parcels. Specifically, FW-DC-WL-17 states that 1). movement between those parcels separated by other ownerships is facilitated by management of the NFS portions of linkage areas identified through interagency coordination and 2). Federal ownership is consolidated at these approach areas to highway and road crossings to facilitate wildlife movement.

The Revised Plan guidelines support the development of future crossing structures (above or below ground culverts or passages where animals can cross high volume roads without risk of being struck by a vehicle) on highways or railroads within or adjacent to Forest lands. Specifically, these forest-wide guidelines FW-GDL-WL-15 through 17 apply inside and outside LAUs and require that IPNF coordinate with others on the development of crossing structures when major highways are reconstructed, and that they manage lands near those features to maintain the effectiveness of the structure. These elements of the Revised Plan address potential barriers to lynx movement.

Also, under the Revised Plan, matrix habitat would be managed according to the elements for vegetation, which apply broadly, including areas that do not support high levels of snowshoe hares. The goal of the Revised Plan vegetative elements is for forest, grassland, shrubland, and riparian plant communities trending toward the desired range for composition, structure, patterns and processes. The ecological integrity of these communities is high and they exhibit resiliency to natural and man-caused disturbances, including climate change. These conditions would maintain the PCE1d. The desired conditions within the Revised Plan for large, remote areas with limited disturbance that contribute to wildlife movement (FW-DC-WL-02; MA1a,b,c,e-DC-WL-01; MA3-DC-WL-01; MA5-DC-WL-01; GA-DC-WL-CDA-03, GA-DC-WL-LK-01, GA-DC-WL-PO-01, GA-DC-WL-PR-01, GA-DC-WL-PR-03 – described in the Revised Plan, USFS 2011a) further support the role of matrix habitat (PCE1d).

We conclude that the Revised Plan desired conditions would have no adverse effects on PCE1d, and that general plan direction supports the maintenance of PCE1d as movement areas on the IPNF.

### 4. Implications of Effects to Recovery

The action area is located within the Northwestern Montana/Northeastern Idaho core area (USFWS 2005). The recovery outline is clear in its emphasis on the need to manage lynx habitat within core to support recovery of lynx in the DPS. The recovery outline focuses lynx conservation efforts in core areas to ensure the continued persistence of lynx in the contiguous U.S. Our critical habitat rule supports this premise in general, while further refining the key

landscapes needed for recovery as the Recovery Outline "core areas" with evidence of breeding populations (74 FR 8616-8702, p. 8640). The objectives of the recovery outline are still relevant to meeting the recovery needs of lynx. Below, we analyze the extent to which the proposed action addresses the four recovery objectives:

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

To summarize, we conclude that the proposed action fulfills this objective and adequately manages lynx habitat in the core area to support lynx recovery. The proposed action would support the long-term persistence of lynx populations in the IPNF.

In support of Objective 1, the Revised Plan includes the following direction for all core area:

- The Revised Plan incorporates the NRLMD, including the vegetation management objectives VEG O1, O2, O3, and O4 that support this recovery objective, as detailed earlier.
- The Revised Plan would maintain a mosaic of early to late forest successional stages necessary to support snow shoe hare and lynx. No more than 30 percent of lynx habitat within an LAU would be in stand initiation structural phase, and no more than 15 percent of lynx habitat in any LAU could be changed (harvested) to this stage per decade (VEG S1 and S2) (LAUs provide the basic scale within which to measure lynx habitat quality and moderate the impacts of Forest management.)
- The Revised Plan would preclude a reduction in snowshoe hare/winter forage habitat in either SISS (early successional stages) or in older, mature multistoried stands (VEG S5 and S6) in at least 94 percent of lynx habitat within the action area.
- Where fuels treatment actions are planned, VEG S1, S2, S5, and S6 will be considered in designing treatments to reduce adverse effects to lynx (VEG G10).
- Exemptions to standards that avoid adverse effects to lynx habitat are limited to fuel reduction treatments within the WUI and would affect no more than six percent of lynx habitat within the core area.
- Exceptions to standards that avoid adverse effects to lynx habitat are limited to only those circumstances listed under VEG S5 and S6.
- Vegetation guidelines FW-GDL-VEG-03 through 06 under the Revised Plan support the vegetation standards and guidelines in the NRLMD.
- Approximately 56 percent of all lynx habitat within the LAUs on the IPNF is in wilderness and backcountry status, where natural ecological processes are expected to predominate.

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

To the extent of IPNF authority and management, the Revised Plan meets this objective in part by providing and conserving core area lynx habitat directly adjacent to and continuous with lynx

habitat in Canada. Such habitat should accommodate both immigration of lynx from Canada, and emigration from core areas to secondary areas or Canada.

In the action area, the Revised Plan includes NRLMD objectives to use federal jurisdiction to actively maintain or restore lynx habitat connectivity in and between linkage areas and LAUs, either through federal land management or conservation easements, land exchanges, or other cooperative efforts with private land owners (All O1, Link O1). The Revised Plan also incorporates the NRLMD standard requiring new or expanded developments and vegetation management projects to maintain habitat connectivity within LAUs and linkage areas (ALL S1).

The Revised Plan desired condition is that forest management contributes to wildlife movement within and between national forest parcels. Specifically, FW-DC-WL-18, states that movement between those parcels separated by other ownerships is facilitated by management of the NFS portions of linkage areas identified through interagency coordination and Federal ownership is consolidated at these approach areas to highway and road crossings to facilitate wildlife movement.

The Revised Plan also includes guidelines (FW-GDL-WL-15 through 17) requiring that IPNF coordinate with others on the development of crossing structures when major highways are reconstructed, and that they manage lands near those features to maintain the effectiveness of the structure. Under the Revised Plan, the desired conditions in MAs and GAs would facilitate linkage and connectivity (MA1a,b,c-DC-WL-01, MA3-DC-WL-01, MA5-DC-WL-01, GA-DC-WL-CDA-03, GA-DC-WL-LK-03, GA-DC-WL-PO-01, GA-DC-WL-PR-03, and GA-DC-WL-SJ-02 and include the following areas: Mallard Larkin's, Northwest Peaks, Idaho/Montana divide, between Yaak and the Selkirk Mountain range, between the Cabinet and the Selkirk mountain ranges, across the Clark Fork River, between the CYE and SE, and between the Salmon and Selway/Bitterroot Wilderness Areas. Many of these areas either overlap lynx habitat within LAUs or would connect LAUs. This direction would also support lynx movement to habitat on adjacent Forests and into Canada. Hence, the Revised Plan meets the recovery objective of accommodated long-term connectivity across these areas.

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

The remapping of lynx habitat on the IPNF identified secondary vegetation in which the NRLMD is applied. Therefore, this objective is being met.

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

Although the Revised Plan does not apply for 100 years and thus cannot directly fulfill this objective, it would allow lynx populations to persist on lands within core areas in the action area within the foreseeable future. Continued implementation of the NRLMD through implementation of the Revised Plan addresses the threat to the DPS, inadequate regulatory measures, within the IPNF by limiting, reducing or avoiding the major adverse impacts of federal land management

on lynx, as well as several other potential impacts or influences that do not rise to the level of a threat to the DPS.

## E. SUMMARY OF LYNX AND CRITICAL HABITAT RESPONSE TO THE PROPOSED ACTION

### 1. Lynx Response to the Proposed Action

The final rule listing lynx as a threatened species (March 24, 2000; 65 FR 16052) concluded that the primary factor threatening the lynx DPS is the inadequacy of existing regulatory mechanisms, specifically, the lack of guidance for conservation of lynx in federal land management Plans. The NRLMD addresses this threat and the biological opinion (USFWS 2007) concluded that the programmatic and project-level objectives, standards, and guidelines in the amended Forest Plans provide comprehensive conservation direction adequate to reduce adverse effects to lynx from Forest management and to preclude jeopardy to the lynx DPS. The Revised Plan incorporates the continued implementation of the NRLMD on the IPNF, and upon review of the Revised Plan in its entirety, our conclusions remain the same as in 2007 (USFWS 2007): most actions in lynx habitat that are in compliance with the NRLMD would avoid or substantially reduce adverse effects on lynx in the action area.

Conservation of snowshoe hares and their habitat is of prime importance to sustaining lynx populations. Forest management under the Revised Plan has the potential to reduce the quality and quantity of snowshoe hare habitat.

The NRLMD vegetation objectives, standards and guidelines conserve snowshoe hare habitat, and avoid or minimize the effects on lynx and most lynx habitat in the action area. Exemptions and exceptions to the standards that allow adverse effects on snowshoe hare habitat are limited, and the Forest estimates that no more than 34,966 acres and 16,403 acres of lynx habitat, will be treated through the exemptions and exceptions to standards, respectively as authorized under the NRLMD and 2008 remapping effort and brought forward through the Revised Plan. Combined, no more than 9 percent of lynx habitat on the IPNF could be treated in ways that adversely affect lynx, or snowshoe hare, or lynx habitat. These acreages are well below the levels anticipated in our 2007 no jeopardy opinion. Our conclusion remains the same (USFWS 2007, pp.67-68): management under the NRLMD would provide for the recovery of lynx in these areas (including the IPNF).

Further, Table III-7 illustrates that all LAUs are in compliance with the terms of the landscape level standards VEG S1 and S2. All LAUs contain less than 30 percent in the stand initiation structural stage, and less than 15 percent of lynx habitat in each LAU has been converted to stand initiation structural stage over the past decade. This indicates that the overall baseline condition of lynx habitat, in regards to vegetation, is within acceptable ranges of age classes on the IPNF. The Revised Plan also trends vegetation towards historical conditions and returns natural disturbance to the landscape. We anticipate that this trend will, over time, contribute to the mosaic of structural stages required by lynx and its primary prey, the snowshoe hare.

Thus, we expect that lynx that live within the action area will respond favorably to the management under the Revised Plan and that implementation of the Revised Plan and the NRLMD will provide for the recovery of lynx in the action area.

### 2. Critical Habitat Response to the Proposed Action

Conservation of snowshoe hares and their habitat is of prime importance to sustaining lynx populations. Forest management actions have the potential to alter boreal forest landscapes that support a mosaic of differing successional forest stages (PCE); affect the quality and quantity of snowshoe hare habitat (PCE1a); affect lynx denning habitat (PCE1c); and affect matrix habitat (PCE1d). Overall, the Revised Plan avoids or minimizes most adverse effects on critical lynx habitat and supports the PCE.

Approximately 6 percent of the lynx habitat on the IPNF is designated critical habitat. The Revised Plan, which includes direction for use of wildland fires and implements the objectives, standards, and guidelines of the NRLMD, would maintain the PCE1, boreal forest landscapes supporting a mosaic of differing successional stages. The Revised Plan, incorporating the NRLMD, would maintain the habitat mosaic, structure, and components that support lynx and their primary prey, the snowshoe hare, on IPNF lands.

Further, the Revised Plan provides strong direction to conserve the PCE 1a. As demonstrated in Section D.3. *Analysis for Effects on Critical Habitat*, the Revised Plan elements implementing the management standards and guidelines of the NRLMD clearly conserve, support, and promote the habitat conditions of PCE1a, which support high snowshoe hare densities, which in turn support lynx.

The IPNF supports 34,687 acres of critical habitat. Approximately 42 percent of critical habitat on the IPNF is within the WUI and as such may be subject to adverse effects for fuels management projects in mapped lynx habitat. However, for the reasons described in Section D.3 we conclude that there is unlikely to be a concentration of effects on PCE1a in critical habitat under the Revised Plan

The NRLMD vegetation objectives, standards and guidelines conserve snowshoe hare habitat, and avoid or minimize the effects on lynx habitat and critical habitat. Thus, the Revised Plan allows critical habitat for lynx within the action area to fulfill its conservation and recovery role. We expect that critical habitat will respond favorably to Forest management under the Revised Plan. The affected critical habitat would remain functional and retain the current ability for the PCE1 to be functionally established. Although some projects may have adverse effects on PCE1a, over the life of the plan, adverse effects are limited such that the PCE1 will fulfill its conservation role to support viable core area lynx populations.

# F. 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 biological 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 ESA. Past and present impacts of non-Federal actions are part of the "environmental baseline," as are the impacts of Federal activities that have undergone section 7 consultation. This analysis addresses the potential cumulative effects on lynx, lynx habitat, and critical habitat in the action area.

## 1. Cumulative Effects on Lynx and Lynx Habitat

There are approximately 370,000 acres of private, state, and corporate timber lands inholdings within the IPNF boundary representing 15 percent of the action area. In terms of the LAUs, approximately 26,450 acres of private, state and corporate timber lands (non-NFS lands) occur within the LAU boundaries on the IPNF; however, it is unknown how much of the acreages in these other ownerships is capable of supporting lynx habitat. Non-NFS lands represent 3 percent of the total acreage in the LAUs. Timber harvest, development, prescribed fires, and fuels management on non-NFS lands may impact the distribution, amount, and quality of lynx habitat and may impact connectivity between NFS lands in the action area. Climate change, recreational uses, and trapping for non-lynx species may also contribute to cumulative effects on lynx.

Cumulative adverse effects on lynx from actions on private, state, and corporate timber lands would occur from disruption of linkage areas and reduction of snowshoe hare foraging habitat. Timber management on these lands may also not adequately retain coarse woody debris, snags, and snag recruits in lynx habitat. Effects from timber harvest would likely be temporary, as vegetation in treated areas regenerates over time. Some snowshoe hare habitat may be permanently lost to development on private lands. Not all lands would be developed or used in ways that have negative impacts on lynx habitat. Overall, negative effects on these lands would be limited to just 3 percent of all the lands in the LAUs in the action area (26,450 acres of non-federal/891,701 acres total lynx habitat) and effects would be moderated by habitat availability on adjacent NFS lands. This level of cumulative effect is not expected to result in substantial negative effects on the.

Recreation is likely to increase on all land ownership types, if for no other reason than human population growth. Recreational developments on non-NFS lands may contribute to adverse cumulative effects on connectivity and linkage of lynx habitat. The severity of this cumulative effect is limited by the acres of non-NFS lands in the action area (15 percent); a lower percentage of this amount comprises lynx habitat. As we have reported in Section B.9, anecdotal evidence indicates lynx are tolerant of humans; this is not considered an important source of cumulative effects.

It is not legal to trap or hunt lynx in Idaho but trapping for other species is permitted. Two lynx were trapped in Idaho, 1 in 2012 (Beth Waterbury, Idaho Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013) and another in 2013 (Michael Lucid, Idaho

Department of Fish and Game, personal communication 2013 as cited *In* ILBT 2013), which resulted in 1 mortality. Incidental trapping of lynx while trapping for other species likely contributes to cumulative lynx mortality in the action area in years when it occurs, but is not expected to result in substantial negative effects on the population.

The action area is predominantly NFS lands (86 percent). Much of the private lands in the action area occur at lower elevations which is not lynx habitat. We conclude that these factors and the existing conservation efforts on lynx habitat on non-NFS lands reduce adverse effects such that there would not be a substantial effect on the numbers, reproduction, or distribution of lynx.

### 2. Cumulative Effects on Lynx Critical Habitat

There are no state, private, or corporate-owned lands containing lynx critical habitat in the action area. Hence, no cumulative effects to critical habitat would occur.

## G. CONCLUSION

### 1. Conclusion for Lynx

After reviewing the current status of the Canada lynx, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is the Service's biological opinion that the effects of the proposed Revised Plan are not likely to jeopardize the continued existence of the Canada lynx.

Regulations implementing section 7 of the Act define "jeopardize the continued existence of" as: "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

The best information suggests that implementation of the Revised Plan would not appreciably reduce the likelihood of survival and recovery of Canada lynx. Our conclusion is based on the literature and information referenced in this document, meetings and discussions with IPNF, discussions with Canada lynx experts, the information in the draft EIS (2011b), and information in our files. The *Effects of the Action* section analyzed and summarized key factors in detail.

We find that although adverse effects are likely to some individual lynx, the proposed action is expected to support and sustain lynx populations within the action area, the IPNF, and so is not reasonably expected to reduce appreciably the likelihood of both the survival and recovery of lynx populations in the wild. The Revised Plan elements include measures to maintain the habitat mosaic, structure, and components required to support lynx and their primary prey, the snowshoe hare. Further, in this biological opinion, we determined that the Revised Plan is compatible with our understanding of recovery needs for lynx. As analyzed in this opinion, the proposed action addresses, in whole or in part, each of the objectives in the recovery outline for lynx at the core area and critical habitat scales.

The following are key findings, which are discussed in detail in the preceding sections of this biological opinion.

The status of the Canada lynx DPS is considered:

- The NRLMD BO (USFWS 2007, p.75) concluded that the programmatic and project-level objectives, standards, and guidelines in the amended Forest Plans provide comprehensive conservation direction adequate to reduce adverse effects to lynx from Forest management and to preclude jeopardy to the lynx DPS. Similar Forest Plan amendments or revisions have been completed in the Southern Rockies and the Great Lakes regions, where lynx occur. Hence, the primary threat to lynx at the time of listing has been addressed in these regions.

- Since 2007, the National Forests have managed lynx habitat under the NRLMD or similar strategies. This management has benefited lynx habitat during that time. Most adverse effects on lynx or lynx habitat have been limited to vegetation management projects such as precommercial thinning or timber harvest as exempted under the NRLMD biological opinion (USFWS 2007).

- We have determined that the proposed action, which incorporates the NRLMD, is compatible with recovery needs for lynx as described in USFWS (2005). As analyzed in this opinion (Section D.4 *Analysis of Effects on Critical Habitat*), the proposed action addresses, in whole or in part, the relevant objectives for Federal land managers as described in the recovery outline for lynx.

- Since 2007, exemptions and exceptions employed in projects under the NRLMD resulting in adverse effects on lynx, lynx habitat, or snowshoe hare habitat are well below the level anticipated in our 2007 no jeopardy opinion (USFS 2012). Thus, since 2007, adverse effects to lynx under implementation of NRLMD are less than we had anticipated in our biological opinion. Further, the IPNF does not propose to exceed the acres of adverse effects anticipated in 2007, even over the 15 year life of the Revised Plan.

The risk factors for lynx for vegetation management in the action area are addressed:

- The Revised Plan implements the NRLMD, which conserves snowshoe hare and lynx habitat on at least 91 percent of lynx habitat within the action area, the IPNF.

- The Revised Plan would allow adverse effects to lynx described under the NRLMD, primarily from the following: 1) fuels management projects that are exempted from vegetative management standards inside WUI in up to six percent of occupied lynx habitat; and 2) exceptions to vegetative standards for some pre-commercial thinning projects that are conducted for fuels treatment or other resource benefits (e.g., whitebark pine restoration). To date, under these exemptions and exceptions, the Forest has treated

substantially fewer acres than anticipated (and authorized) under the NRLMD and does not anticipate exceeding the acres reauthorized through the 2008 lynx habitat remapping exercise for the life of the Revised Plan.

- Since 2007, all projects on the IPNF have complied with the direction in the NRLMD. Under the NRLMD, the Forest has conducted vegetation management on a few thousand acres in lynx habitat; however, adverse effects were limited to::

    - 12 acres of lynx habitat within the WUI with adverse effects on lynx, and
    - 717 acres of precommercial thinning in lynx habitat for resource protection with adverse effects on lynx.

    All LAUs currently have less than 30 percent in SISS, and less than 15 percent of lynx habitat in each LAU has been changed to stand initiation structural stage over the past decade (in accordance with vegetation standards VEG S1 and VEG S2). The relatively low total acres treated within the WUIs (far below the six percent anticipated in the NRLMD biological opinion) and the current condition of lynx habitat related to landscape standards VEG S1 and VEG S2, indicate that the overall baseline condition of lynx habitat in regards to vegetation is in good condition on the IPNF.

- Approximately 77 percent of lynx habitat could be subject to timber harvest (419,692 acres). All of these acres would be subject to NRLMD standards VEG S1, S2, S5 and S6, which limit the amount of habitat that can be regenerated in an LAU by area and time-frame; prohibit pre-commercial thinning unless certain conditions are met; and prohibit reduction of multi-story mature or late successional forests. Further, the NLRMD guidelines would apply, which further limit effects on lynx from vegetation management projects by requiring projects be planned to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available (VEG G1); providing habitat for alternate prey species, primarily red squirrel, in each LAU (VEG G5) and providing denning habitat distributed in each LAU (VEG G11).

- Prescribed fire is allowed in lynx habitat is limited by NRLMD standard VEG S6. This standard prohibits vegetation management projects (including prescribed fire) that reduce snowshoe hare habitat in multi-story mature or late successional forests except for treatment around administrative sites, for research studies, or for incidental removal during salvage. This standard would greatly limit the number of prescribed fires that could occur in lynx habitat. Further, at the project level, NRLMD guideline VEG G4 would limit prescribed fire activities such that permanent travel routes that facilitate snow compaction are not created and constructing permanent firebreaks on ridges or saddles are avoided.

The Revised Plan maintains other key elements of lynx habitat including denning, forest pattern, connectivity and linkage of habitat for lynx.

- The Revised Plan would promote forested landscape patterns and connectivity that maintain or restore lynx habitat. This positive effect would occur in 91 percent of lynx habitat where adverse effects are avoided and by the forest trends towards desired conditions that maintain large remote areas with low levels of disturbance and that maintain connectivity and movement for wildlife.

- The desired condition under the Revised Plan is that forest management contributes to wildlife movement within and between national forest parcels; movement between those parcels separated by other ownerships is facilitated by management of the NFS portions of linkage areas identified through interagency coordination; and federal ownership is consolidated at these approach areas to highway and road crossings to facilitate wildlife movement (FW-DC-WL-18). Wildlife linkage and habitat connectivity would be achieved at the project or site-specific level through guidelines FW-GDL-WL-15 through 17, which direct the forest to: include wildlife crossing features in the construction or reconstruction of highways that cross National Forest lands, or high use Forest roads where necessary to contribute to connectivity of wildlife populations; limit management activities within one-quarter mile of existing and future crossing features to ensure use by wildlife; and maintain federal ownership in linkage areas identified through interagency coordination.

- Based on the recent findings of Squires et al. (2008, pp.1501-1505) denning habitat is found in a variety of forest conditions, and suitable den site attributes occur in small pockets scattered across the landscape at relatively high densities; lynx den site availability is not limiting for lynx. Further, the Revised Plan desired conditions FW-DC-VEG-07 and 08, and at the project level, guidelines, FW-GDL-VEG-03 through 06 would maintain levels of coarse woody debris, snags, and snag recruits to contribute to lynx denning habitat. Lastly, when denning habitat is lacking, NRLMD guideline VEG G11 requires that denning habitat be distributed in an LAU. Other activities on the Forest are expected to result in no or limited effects on lynx.

- Effects on lynx from developed recreation are expected to remain low under the Revised Plan. Application of the NRLMD addresses effects of developed recreation on connectivity and linkage as well as measures to reduce site-specific impacts. The Revised Plan desired conditions for wildlife habitat further reduce the likelihood of effects.

- The likelihood that dispersed recreation on or off trails would occur in proximity of a den site, and/or that the dispersed recreation activities occurring would actually disturb a lynx den site or in other ways adversely affect lynx is so low as to be discountable.

- There is no indication that compacted snow routes increase competition from other species to levels that adversely impact lynx populations, and under the proposed action, the amount of areas affected by snow compacted routes within the action area would

decrease. Where snow compaction activities occur, NRLMD guidelines habitat (HU G12/HU G11) apply.

- Anecdotal reports indicate that lynx appear tolerant of human presence. About 12 percent of lynx habitat in LAUs occurs in nonmotorized areas (providing limited human access), and 60 percent of LAU acreage is in grizzly bear BMUs (limiting roads and access for people). Therefore, we expect that the Revised Plan would avoid or minimize adverse effects on lynx from human disturbance. These same factors along with Revised Plan incorporation of the NRLMD guidelines ALL G1 and HU G6 through G9 that reduce the potential effects of forest roads on lynx and lynx habitat would similarly minimize or avoid adverse effects on lynx from roads..

- To date, existing and proposed mines have not resulted in adverse effects on lynx. The effects of mining developments (habitat loss, roads, and human access) are addressed in the Revised Plan by the NRLMD guidelines HU G4, HU G5, HU G6, HU G9, and HU G12 addressing snow compaction from monitoring activities; reducing impacts on lynx and lynx habitat; avoiding or minimizing effects on lynx when upgrading roads; closing roads after project completion; and limiting winter access to designated routes, respectively.

- The NRLMD guidelines (Graz G1, G2, G3, G4) for grazing management practices that provide for the regeneration of trees, shrubs and aspen clones in lynx habitat should avoid the potential for adverse effects of grazing to lynx, and may improve the habitat over baseline conditions.

We find that the Revised Plan would allow some action that would result in adverse effects to some individual lynx. The proposed action overall promotes the conservation and recovery of lynx and their habitat through ongoing implementation of the NRLMD, the desired conditions and guidelines of the Revised Plan for connectivity and linkage, desired conditions and use of fire to trend vegetative conditions towards those under which lynx would have evolved that would improve the resilience and resistance of the fire to large, catastrophic fires, disease and insect outbreaks, and climate change. These conditions would similarly maintain the habitat mosaic, structure, and components required to support lynx and their primary prey, the snowshoe hare. We have examined the impacts of the proposed action on individuals and on the lynx within the Northern Rockies, the region affected by the proposal. We conclude that the proposed action would not appreciably reduce the numbers or distribution of lynx on the IPNF, nor the Northern Rocky Mountains Region of the DPS. Thus, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of lynx in the wild.

### 2. Conclusion for Lynx Critical Habitat

After reviewing the current status of designated lynx critical habitat, the environmental baseline for the action area, the effects of the action and the cumulative effects, it is the Service's biological opinion that the effects of the Revised Plan are not likely to result in the destruction or adverse modification of lynx critical habitat. This biological opinion does not rely on the

regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The Lynx Critical Habitat Final Rule (74 FR 8644) explains that "The key factor related to the adverse modification determination is whether, with implementation of the proposed action, the affected critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established) to serve the intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical and biological features to an extent that appreciably reduces the conservation value of critical habitat for lynx. Generally, the conservation role of lynx critical habitat units is to support viable core area populations."

The proposed action has components that will adversely affect lynx critical habitat via reductions in lynx/snowshoe hare habitat, i.e. reductions in the quantity and quality of PCE1a. However, the proposed action would conserve adequate amounts of snowshoe hare habitat needed to sustain lynx in the LAUs, and would retain the ability for the critical habitat to function. When added to the status of the critical habitat unit, the effects of the project are such that the conservation role of the lynx critical habitat unit (3) will continue to support their intended conservation role for lynx.

The rationale for our determination of no destruction or adverse modification of critical habitat is based on the body of literature and information referenced in this document, meetings and discussions with IPNF, discussions with lynx experts, information in our files, and the information in the Draft EIS (USFS 2011b). Section D. *The Effects of the Action* analyzed and summarized key factors in detail. Our analysis of the effects on lynx in this biological opinion, and in the opinion on the NRLMD, are also germane to our conclusions because they specifically analyze the effects of the Revised Plan management strategy (the NRLMD) on lynx habitat.

The following are key details or findings, which are discussed in detail in the preceding sections of this biological opinion.

The status of Critical Habitat Unit 3 is considered:

- This biological opinion demonstrates how the NRLMD conserves the critical habitat PCE1. Most of the lands in this Unit are NFS lands and since 2007, most National Forests have managed lynx habitat in Unit 3 under the NRLMD or similar strategies. Similarly, most National Forests have managed lynx critical habitat under the NRLMD or similar strategies since its designation in 2009.

The effects on critical habitat in the action area are avoided or reduced:

- The analysis in this biological opinion reveals that NRLMD does address the habitat types, habitat components, and habitat conditions detailed and described in the lynx critical habitat PCE1.

- The Revised Plan would have no adverse effects on PCE1.b deep fluffy snow and includes commitments to reduce the potential effects of snow compaction at the localized, ground level in the action area.
- The Revised Plan would not adversely affect PCE1.c: sites for denning, and contains commitments to ensure adequate denning sites are provided in the action area.
- For those areas of the project that provide lynx habitat but not snowshoe hare habitat or are located in matrix habitat (PCE 1.d), we do not anticipate adverse effects as a result of implementation of the Revised Plan because desired conditions would trend the forest toward those conditions under which lynx would have evolved and that would improve the resilience and resistance of the Forest to large, catastrophic fires, disease and insect outbreaks, and climate change. These conditions would similarly maintain the habitat mosaic, structure, and components required to support lynx and their primary prey, the snowshoe hare.
- Project-related activities would adversely affect lynx critical habitat PCE1.a; however, these adverse effects are limited under the Revised Plan through the NRLMD.
- While adverse effects within designated lynx critical habitat is expected, specifically related to the exemptions and exceptions for vegetation treatments in the WUI and precommercial thinning for resource benefit, considering the amount and status of critical habitat in the action area, Unit 3 would continue to produce adequate densities of snowshoe hares to support persistent lynx populations, the conservation role of critical habitat.
- LAUs in the action area with inclusions of state, private, or corporate timber lands affected by vegetation management, including the reduction of foraging habitat, would continue to support snowshoe hares and lynx through the commitments of the NRLMD on Federal lands. Forest actions would not degrade snowshoe hare and lynx habitat, as measured by standards VEG S1, S2, S5 and S6.

- Although adverse effects on critical habitat would occur through project implementation, the total effect on lynx critical habitat within critical habitat Unit 3 would not appreciably reduce the conservation value of critical habitat for lynx. The actions that might adversely affect critical habitat may occur on a subset of 51,369 acres (which is the total exemptions and exceptions) of Critical Habitat Unit 3 over the 15-year Plan; these lands comprise less than 1 percent of the critical habitat acres in Unit 3 (6,465,254 acres). Further, the Revised Plan and NRLMD would apply standards and guidelines to these lands to ensure the PCE1 would maintain its conservation role to support viable populations of lynx in core areas.

The Revised Plan would result in critical habitat conditions that would continue to produce adequate densities of snowshoe hares and adequate levels of cover to support persistent lynx populations across Unit 3. We conclude the Revised Plan will not alter the physical and biological features of critical habitat to an extent that appreciably reduces the conservation value of critical habitat for lynx. The proposed action would not directly or indirectly alter critical habitat in Unit 3 to the extent that the conservation role for the species (i.e. to support viable core area lynx populations) would be diminished; the critical habitat units would retain their current

ability for the PCE1 to be functionally established (74 FR 8644). Therefore, the proposed action is not likely to adversely modify critical habitat.

# H. INCIDENTAL TAKE STATEMENT INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA 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 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 as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it 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 ESA provided that such taking is in compliance with the terms and conditions of an incidental take statement.

In general, an incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize the impacts of the take and sets forth terms and conditions which must be complied with in order to implement the reasonable and prudent measures.

## 1. Amount or Extent or Incidental Take

This biological opinion considered the effects to lynx from implementation of the Revised Plan direction as guided by the Revised Plan elements (goals, objectives, desired condition, standards, and guidelines). It includes specific elements for the conservation of lynx and lynx habitat, but does not authorize specific actions.

The Revised Plan contained sufficient specificity through its suite of elements to permit an adequate analysis of the effects of the types of projects and activities on lynx allowed under the Revised Plan and to make a determination that the extent of adverse effects on lynx as a result of the Revised Plan does not rise to levels that are likely to jeopardize lynx.

In this biological opinion, we documented how the proposed action reduces the potential for adverse effects and incidental take to occur as a result of Forest management. However, the potential remains for specific projects and activities to result in adverse effects and incidental take of lynx. The mere potential for future take from these actions is not a legitimate basis for providing an exemption for take. The IPNF is responsible for section 7 consultation on all future projects (conducted under the Revised Plan) that may affect the lynx or its habitat, even if those projects are consistent with Revised Plan. This subsequent consultation, on specific actions developed pursuant to the Revised Plan, will identify and analyze effects on lynx, determine if an

exemption from the section 9 take prohibitions is necessary and serve as the basis for enumerating such incidental take. If so, the Service will provide Reasonable and Prudent Measures and Terms and Conditions, as appropriate, to minimize the impacts of the taking on the lynx in accordance with 50 CFR 402.14(i).

The exception to this deferral of the enumeration of take to subsequent consultation is the incidental take associated with fuels management in the WUI and limited vegetation management projects conducted for "resource benefits". We anticipate that most of the take associated with implementation of the proposed action would occur through vegetation management when projects are conducted in lynx habitat under the exemptions and exceptions to the vegetation standards VEG S1, S2, S5 and S6 of the NRLMD, as described and analyzed in this biological opinion. We anticipate this take in the form of harm, as the exemptions and exceptions allow modification of lynx habitat that would result in decreased production and density of snowshoe hares, their primary prey. As a result, we anticipate that some, but not all, adult female lynx within home ranges affected by such projects would fail to complete a pregnancy or would be less successful in finding adequate food resources needed to ensure maximum survival potential for kittens. Thus, we expect significant reproductive impairment and kitten survival to be affected.

The Service anticipates that incidental take of lynx will be difficult to quantify and detect for the following reasons:

- Lynx are wide-ranging, not easily detected in the wild.
- Although we have a general understanding of where lynx population centers are within the action area, the distribution of individual lynx across the IPNF or at smaller scales within the action area is not known.
- We lack information to accurately predict the number of snowshoe hares and alternate prey needed for the survival of adult lynx or kittens.
- Snowshoe hare populations exhibit population cycles in Canada and although not well understood, populations likely fluctuate in the United States as well. This variation could cloud our ability to demonstrate a direct cause and effect relationship. It may be difficult in many cases to determine whether mortality or injury of lynx is attributable to incidental take of lynx as a result of the proposed action, or whether it was natural mortality or injury of lynx due to natural declines in snowshoe hares.
- We lack information to predict with precision the densities of hares in various habitat and forest stands, before and after specific treatments, especially in relationship to the host of naturally occurring environmental variables that may affect hare densities.
- Thus, we lack information to predict with precision the densities of hares in various habitat and forest stands within the home range of individual females, before and after specific treatments.
- Discovery or detection of lynx injury or mortality attributed to habitat alteration is very unlikely.

In addition to the difficulties outlined above, monitoring lynx is difficult and very expensive. For example, because individual lynx are sparsely distributed over tens of square

miles often in snowy terrain, specialized equipment is necessary to safely access their habitat for capturing and collaring. Also, in order to capture and collar enough lynx for an adequate sample size for scientifically valid trends, hundreds of square miles of this habitat must be surveyed and monitored over multiple years. These circumstances would drive the yearly cost of monitoring into hundreds of thousands of dollars and require a commitment of several biologists to the monitoring for several years. For these reasons, direct monitoring is not practical or reasonable. In cases such as these Service policy, as stated in the Endangered Species Consultation Handbook (March 1998) (Handbook), is to provide some detectable measure of effect, such as the relative occurrence of the species or a surrogate species in the local community, or amount of habitat used by the species, to serve as a measure for take. Take also may be expressed as a change in habitat characteristics affecting the species, such as water quality or flow (Handbook, p 4-47 to 4-48).

Because of the difficulty of estimating the precise number of lynx that would experience take in the manner described above, we have developed a surrogate measure to estimate the amount of anticipated take. Here we will use the number of acres of snowshoe hare habitat treated through the exceptions and exemptions of vegetation management standards as a surrogate measure of the anticipated incidental take of lynx.

Similar to what was described in the 2007 NRLMD biological opinion, because the IPNF has provided explicit estimates on the number of acres of snowshoe hare habitat that may be impacted by the proposed vegetation management, we are able to accurately assess take from these activities. The Forest provided explicit estimates of the number of acres that could treated through (a) fuels treatment projects within the WUI conducted under the exemptions from vegetation standards VEG S1, S2, S5 and S6, and (b) precommercial thinning projects for "resource benefit" (detailed earlier in this biological opinion) allowed under exceptions to VEG S5 and S6. Projects conducted under the exceptions and exemptions would reduce the quality of habitat that produces snowshoe hares. We have determined that many, but likely not all, of the projects conducted under the exemptions or exceptions would significantly reduce the capacity of affected snowshoe hare habitat to produce hares, and so would result in take in the form of harm. Therefore, we are using the number of acres treated under these exemptions and exceptions under the proposed action as a detectable surrogate for the number of lynx taken in the form of harm, through significant degradation or modification of habitat. This approach is consistent with Service policy (Handbook, p 4-47 to 4-48), which endorses the use of acres of species' habitat destroyed or disturbed as a reasonable surrogate measure for the number of a species harmed.

The IPNF has proposed to incorporate the NRLMD, using the 2007 projections for acres of WUI to be treated for fuel reduction under exemptions and additional acres of pre-commercial thinning for other resource benefits under exceptions. In 2007, the NRLMD decision projected the number of acres on the IPNF that may need to be treated using (a) exemptions to the vegetation standards for fuels treatment to protect life and property in the WUI: 34,978 acres; and (b) exceptions to the vegetation standards for other resource benefits: 17,120 acres, over a period of 10 years (Appendix D, Table 1, USFWS 2007). These treatments may reduce snowshoe hare numbers in LAUs to levels that have adverse effects on lynx. Since 2007, the IPNF has treated 921 acres with 12 of those acres under (a) and 717 acres under (b). Including

the acres already treated since 2007, the IPNF anticipates treating no more than the total numbers of acres identified in 2007, over the life of the Revised Plan.

In this biological opinion, we analyzed the effects of treating the total number of acres projected for the proposed action under the exceptions and exemptions to vegetation standards. This number of acres was the uppermost estimate projected as being necessary for fuels reduction in the WUI to protect human safety and property, or for other resource benefits. Thus, we are using that total number of acres that could potentially be treated under these exemptions and exceptions as our anticipated amount of incidental take. The acres treated under exemptions and exceptions on the IPNF since 2007 are well below those anticipated in our 2007 biological opinion. Further, of the 921 acres treated through fuel reduction projects, not all treatments resulted in adverse effects to lynx; about 909 acres were treated without causing adverse effects on lynx. However, we do not expect, but cannot rule out that: 1) the total number of acres identified above would be treated over the life of the plan, or that 2) all treatments in the WUI or for other resource benefit would result in adverse effects on lynx. Therefore, this opinion analyzed the greatest level of adverse effects on lynx allowed under the proposed action.

This biological opinion anticipates the following amounts of take in the form of harm (modification of habitat that will significantly reduce the snowshoe hare prey base for lynx, resulting in significant impairment of lynx breeding (i.e. reproduction) and feeding): treatment of up to 34,966 acres of lynx habitat over the life of the Revised Plan due to fuels management in the WUI, and no more than 16,403 acres of lynx habitat due to pre-commercial thinning for vegetation management for other resource benefits. Because the exemptions and exceptions are limited to a total of no more than about 9 percent of lynx habitat on the IPNF (51,369 acres exemption/exception, divided by approximately 582,981 acres lynx habitat), the decrease in prey base would translate to a low amount of impairment of reproduction and feeding during some years. Specifically, we anticipate that some adult female lynx within home ranges affected by such projects may fail to complete a pregnancy or would be less successful in finding adequate food resources needed to ensure maximum survival potential for kittens. Thus, we expect significant reproductive impairment and kitten survival to be affected.

Stated another way, the anticipated incidental take of lynx under the Revised Plan from fuels treatment and precommercial thinning for vegetation management for resource benefit would be exceeded if:

At any time during the course of the action (i.e. beginning on the date of the signed ROD for this proposed action to 15 years later, or during the life of the Revised Plan, whichever comes first) the level of take anticipated in this incidental take statement would be exceeded if:

- more than 34,966 acres of lynx habitat in the WUI is treated under the exemptions from VEG S1, S2, S5 or S6 for fuel treatment projects; or
- more than 16,403 acres on the IPNF is treated under the exceptions to VEG S5 and S6 for other resource benefits.

**Effect of Take**

In this biological opinion, we determined that this level of anticipated take is not likely to result in jeopardy to the species. To give perspective on what these impacts on habitat mean to lynx, the average lynx territory in the action area is 53,375 acres for males and 21,745 acres for females (Squires et al. 2004, pp.15-16). The proposed action limits adverse effects on lynx (through reductions in snowshoe hare habitat) to projects conducted in the WUI and for resource benefits, which would affect no more than 9 percent (51,369 acres) of lynx habitat on the Forest. Therefore, the number of individual lynx home ranges that would be affected would be low, or if the acres treated were widely distributed, the acres treated within any one home range would be low. In areas treated through exemptions and exceptions, the level of reduction in snowshoe hare prey base and its specific impact on female lynx will vary. This variation is caused by differences in the scale of the project, site specific snowshoe hare habitat conditions within the project area, and the existing prey base, as well as the habits of the individual lynx. Without the details on the actual project site and the variations mentioned, the Service has made assumptions regarding the condition and distribution of the habitat that leads to an overestimate of the amount and quality habitat impacted. Our assumptions therefore lead to an overestimate of the effect and the associated level of take, because not all treated acres would intersect with snowshoe hare and lynx habitat in a way that represents harm to the lynx. To confirm this overestimate, since 2007, of 1638 acres (921 acres + 717 acres) treated through exemptions on the IPNF, 909 acres were treated in a manner that caused no adverse effects on lynx.

**Reasonable and Prudent Measures**

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of lynx:

**RPM #1**: The Forest shall minimize harm of lynx from fuels management by ensuring that the acres impacted are not concentrated in a geographic area or several adjacent LAUs.

**RPM #2**: The Forest shall minimize harm of lynx from pre-commercial thinning and other vegetation management projects by ensuring that female lynx home ranges, as represented by LAUs, either retain sufficient foraging habitat (when sufficient foraging habitat already exists in an LAU) or does not substantially reduce foraging habitat (when sufficient foraging habitat does not already exist in an LAU).

**RPM #3:** The Forest shall monitor and report the progress of the action and the impact on the species.

These reasonable and prudent measures, with their implementing terms and conditions (below), are designed to minimize the impact of incidental take that might otherwise result from the proposed action, and to ensure that the level of take exempted in this incidental take statement is not exceeded.

## 2. Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions implement reasonable and prudent measure #1:

The Forest Service shall ensure that fuels management projects conducted under the exemptions from standards VEG S1, S2, S5 and S6 on the IPNF:

1. Do not occur in greater than 34,966 acres in the WUI.
2. Do not result in more than 3 adjacent LAUs not meeting the VEG S1 standard of no more than 30 percent of an LAU be in SISS.

The following term and conditions implement reasonable and prudent measure #2:

The Forest Service shall ensure that vegetation management projects conducted under exceptions to VEG S5 and S6 on the IPNF:

3. Do not occur in greater than 16,403 acres.
4. In lynx habitat on the IPNF, precommercial thinning and vegetation management projects allowed per the exceptions listed under VEG S5 and S6, shall not occur in any LAU exceeding VEG S1, except for protection of structures.

The following term and conditions implement reasonable and prudent measure #3:

5. In support of the monitoring and reporting requirements of the NRLMD, the IPNF shall provide to the Service and the Forest Service Northern Region (Region 1) Office in Missoula, summaries of the reporting requirements listed below. The summaries shall document the following information related to fuel treatment and vegetation management projects occurring in lynx habitat:

a. Individual vegetation management projects conducted in lynx habitat under the exemptions and exceptions to the vegetation standards VEG S1, S2, S5 and S6 of the NRLMD may reduce the quality or quantity of snowshoe hare habitat, but not all will result in a detectable, measurable effect to lynx (i.e. may affect, but not likely to adversely affect). This type of project may occur many times over the life of the proposed action. The acres impacted by these projects will be reported and the total aggregated to ensure that over the life of the revised Forest Plan, the number of acres impacted does not exceed the acres projected to be treated and the effects analyzed in our biological opinion.

For the projects that are likely to result in detectable and measurable effects to lynx (and our biological opinion's analysis found may rise to the level of take) the acreages will also be tracked and aggregated to ensure that they do not exceed the number of acres used as a surrogate for take of lynx. This approach to tracking and monitoring ensures that the

proposed action is implemented as proposed and is consistent with our analysis. In addition, given the long timespan of the proposed action, this process provides information that can help determine whether consultation reinitiation ever becomes necessary.

Thus report as follows:

The BA prepared for each proposed project shall include a report of the acres to be treated under the exemptions and/or exceptions from the vegetation management standards VEG S1, S2, S5, and S6. The report shall also include the total acres treated likewise on the Forest as a whole, to date. This total shall include the acres in the proposed project, other projects that have signed decisions (including those that have been completed), and those projects that have completed section 7 consultations.

b. In addition, each BA shall report whether or not the project met any applicable Revised Plan guidelines for lynx. If guidelines were not met, provide rationale as to why they could not be met.
c. To ensure that term and condition 2 is met, report in each project level biological assessment, any two, adjacent LAUs that have more than 30 percent of lynx habitat in SISS, either because of natural events, vegetation management or fuel treatment projects, or any combination of these or other causes.
d. To ensure that term and condition 4 is met, report on the IPNF by LAU, of lynx habitat treated through precommercial thinning or other vegetation management projects as allowed in VEG S5 and S6; record the type of activity, acres, location and whether or not standard VEG S1 was adhered to.
e. The IPNF shall report this project level monitoring information, at the time the project decision is signed, to the designated Forest Service office with responsibility for maintaining an accurate accounting of reports. This data will be used in the annual report as required under the 2007 NRLMD biological opinion.

## I. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA 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 plans, or to develop information.

1. The Forest Service should ensure to the extent possible, that unoccupied habitat continues to facilitate and allow dispersal of lynx into the future. Therefore in linkage zones in unoccupied lynx habitat or for projects that may affect such linkage zones, apply the following direction from the proposed action:

   - Maintain or restore lynx habitat connectivity in linkage areas (All O1).
   - New or expanded permanent developments and vegetation management projects must maintain habitat connectivity in linkage areas (All S1).

- □ Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal lands (All G1).
- □ In areas of intermingled land ownership, work with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions to reduce the potential of adverse impacts on lynx and lynx habitat (LINK O1).
- □ When highway or forest highway construction or reconstruction is proposed in linkage areas, identify potential highway crossings (LINK S1).
- □ National Forest Service lands should be retained in public ownership (LINK G1).

2. The Service commends the Forest Service for initiating and implementing important efforts to increase our understanding of lynx and lynx habitat with completion of the Science Report, lynx habitat mapping, and linkage zone identification, and assuming leadership roles on both the Lynx Biology Team and Lynx Steering Committee. We recommend that you continue to be a leader in these arenas, in coordination/cooperation with other federal, State, or private entities.

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

## J. REINITIATION NOTICE

This concludes formal consultation on the IPNF Revised Plan and its effects on Canada lynx and its critical habitat. 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 (not applicable to critical habitat); (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.

As detailed in the incidental take statement in this biological opinion, at any time during the course of the action (i.e. beginning on the date of the signed ROD for this proposed action to exactly 15 years later, or during the life of the Revised Plan, whichever comes first) the level of take anticipated in this incidental take statement would be exceeded if:

- more than 34,966 acres of lynx habitat in the WUI on the IPNF is treated under the exemptions from VEG S1, S2, S5 or S6 for fuel treatment projects; or
- more than 16,403 acres of lynx habitat on the IPNF is treated under the exceptions to VEG S5 and S6 for other resource benefits.

## K. CITATIONS AND PERSONS CONTACTED

Adams, L. 1959. An analysis of a population of snowshoe hares in northwestern Montana. Ecological. Monographs 29:141-170.

Agee, J.K. 2000. Disturbance ecology of North American boreal forests and associated northern/mixed subalpine forests. Chapter 3. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Allen, L. 08/21/2013. Personal communication. Comments and clarifications from to draft Revised Plan biological opinion. Prepared by Lydia Allen, IPNF Wildlife Program Manager. for Kathleen Ports, USFWS Contractor,

Allen, L. 03/19/2013. Personal communication. Email correspondence between Lydia Allen, IPNF Wildlife Program Manager, and Kathleen Ports, USFWS Contractor, regarding Forest actions that convert stand cover types, specifically as it relates to actions in lynx habitat.

Apps, C.D. 2000. Space-use, diet, demographics, and topographic associations of lynx in the southern Canadian Rocky Mountains: a study. Chapter 12. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Aubry, K.B., G. Koehler, and J.R. Squires. 2000. Ecology of Canada lynx in southern boreal forests. Chapter 13. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Ausband, D.E. and G.R. Baty. 2005. Effects of precommercial thinning on snowshoe hare habitat use during winter in low-elevation montane forests. Canadian Journal of Forest Research 35:206-210.

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.

Barnett, D.T. and T.J. Stohlgren. 2001. Aspen persistence near the National Elk Refuge and Gros Ventre Valley elk feedgrounds of Wyoming, USA. Landscape Ecology 16: 569-580.

Bartos, D.L., J.K. Brown, and G.D. Booth. Twelve years biomass response in aspen communities following fire. Journal of Range Management 47:79-83.

Berrie, P.M. 1974. Ecology and status of the lynx in interior Alaska. Pages 4-41 in R.L. Eaton, editor. The world's cats. Volume 1. World Wildlife Safari, Winston, Oregon.

Bittner, S.L., and O.J. Rongstad. 1982. Snowshoe hare and allies. In J.A. Chapman ,and G.A. Feldhamer, editors. Wild mammals of North America biology, management and economics. Johns Hopkins University Press, Baltimore, Maryland.

Brand, C.J., and L.B. Keith. 1979. Lynx demography during a snowshoe hare decline in Alberta. Journal of Wildlife Management 43:827-849.

Brand, C.J., L.B. Keith, and C.A. Fischer. 1976. Lynx responses to changing snowshoe hare densities in central Alberta. Journal of Wildlife Management 40:416-428.

Brocke, R.H., K.A. Gustafson, A.R. Major. 1990. Restoration of lynx in New York: biopolitical lessons. Trans. N.A. Wildl. and Nat. Res. Conf. 55:590-598.

Buehler, D.A., and L.B. Keith. 1982. Snowshoe hare distribution and habitat use in Wisconsin. Canadian Field Naturalist 96:19-29.

Bunnel, K.D., J.T. Flinders, and M.L. Wolfe. 2006. Potential impacts of coyotes and snowmobiles on lynx conservation in the Intermountain West. Wildlife Society Bulletin 34(3):828-838.

Burdett, C. L., R. A. Moen, G. J. Niemi, and L. D. Mech. 2007. Defining space use and movements of Canada lynx with Global Positioning System telemetry. Journal of Mammalogy 88: 457–467.

Burghardt-Dowd, J. L. 2010. Coyote diet and movements in relation to winter recreation in northwestern Wyoming: Implications for lynx conservation. Thesis, Utah State University, Ogden, USA.

Buskirk, S.W., L.F. Ruggiero, C.J. Krebs. 2000. Habitat fragmentation and interspecific competition: implications for lynx conservation. Chapter 4. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical 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, movement, and social organization of lynx (*Lynx canadensis)* in Riding Mountain National Park, Manitoba. Canadian Field Naturalist 97:262-267.

CDOW. 2010. Wildlife Research Report July 2009 to June 2010. Prepared by. T.M. Shenk Colorado Department of Wildlife. Obtained from agency website at: http://wildlife.state.co.us/SiteCollectionDocuments/DOW/Research/Mammals/Publications/2009-10AnnualReportLynxConservation.pdf

Claar, J., R. Naney, N. Warren, and B. Ruediger. 2003. Wildlife linkage areas: an integrated approach for Canada lynx. Pages 234–239 *in* Proceedings of the International Conference on Wildlife Ecology and Transportation, Lake Placid, New York, USA.

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

Devineau, O., T. M. Shenk, G. C. White, P. F. Doherty, Jr., P. M. Lukacs, and R. H. Kahn. 2010. Evaluating the Canada Lynx reintroduction programme in Colorado: patterns in mortality. Journal of Applied Ecology 47:524–531.

Dolbeer, R.A., and W.R. Clark. 1975. Population ecology of snowshoe hares in the central Rocky Mountains. Journal of Wildlife Management 39:535-549.

Eisenberg, J.F. 1986. Life history strategy of the Felidae: variations on a common theme. Pages 293-303 in S.D. Miller and D.D. Everett. Cats of the world: biology, conservation, and management. National Wildlife Federation, Washington, D.C.

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

Fuller, A. K. 2004. Canada lynx predation on white-tailed deer. Northeastern Naturalist 11(4):395–398.

Gibeau, M., and K. Heuer. 1996. Effects of transportation corridors on large carnivores in the Bow River Valley, Alberta. Pages 67-79 in Proceedings of the Florida Department of Transportation/Federal Highway Administration Transportation-Related Wildlife Mortality Seminar. Orlando, Florida.

Griffin, P.C. 2004. Landscape ecology of snowshoe hares in Montana. PhD dissertation, University of Montana, Missoula.

Griffin, P. C., and L. S. Mills. 2007. Precommercial thinning reduces snowshoe hare abundance in the short term. Journal of Wildlife Management 71:559–564.

Gruell, G.E, and L.L. Loope. 1974. Relationships among aspen, fire, and ungulate browsing in Jackson Hole, Wyoming. Aspen Bibliography. Paper 5239. http://digitalcommons.usu.edu/aspen_bib/5239.

Hodges, K.E. 2000a. The ecology of snowshoe hares in northern boreal forests. Chapter 6. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Hodges, K.E. 2000b. Ecology of snowshoe hares in southern boreal and montane forests. Chapter 7. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

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* × *L. rufus*) hybrids at the southern periphery of lynx range in Maine, Minnesota and New Brunswick. The American Midland Naturalist 159:504–508.

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.

ILBT. Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-13-XX, Missoula, MT. 116 pp.

Keith, L.B. and D.C. Surrendi. 1971. Effects of fire on a snowshoe hare population. J. Wildl. Manage. 35:16-26.

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

Koehler, G.M., and K.B. Aubry. 1994. Chapter 4: Lynx. Pages 74-98 in American Marten, Fisher, Lynx, and Wolverine in the Western United States, L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, W.J. Zielinski, editors. U.S. Forest Service, General Technical Report 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.

Koehler, G.M., J.D. Brittell, and H.S. Hash. 1979. Lynx movements and habitat use in Montana. Canadian Field Naturalist 93:441-442.

Kolbe, J. A. and J. R. Squires. 2006. A longevity record for Canada lynx in western Montana. Western North American Naturalist 66(4):535-536.

Kolbe, J. A. and J. R. Squires. 2007. Circadian activity patterns of Canada lynx in western Montana. Journal of Wildlife Management 71:1607–1611.

Kolbe, J., J. Squires, D. Pletscher, and L. Ruggerio. 2007. The effect of snowmobile trails on coyote movements within lynx home ranges. Journal of Wildlife Management 71(5):1409-1418.

Krebs, C.J., S. Boutin, R Boonstra, A. R. E. Sinclair, J. N. M. Smith, M. R. T. Dale, K. Martin, and R. Turkington. 1995. Impact of Food and Predation on the Snowshoe Hare Cycle. Science. 269(5227):1112-1115.

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

Major, A.R. 1989. Lynx (*Lynx canadensis canadensis)* (Kerr), predation patterns and habitat use in the Yukon Territory, Canada. Unpublished M.S. Thesis, State University of New York, Syracuse.

McCord, C.M., and J.E. Cardoza. 1982. Bobcat and lynx. In J.A. Chapman and G.A. Feldhamer, editors. Wild mammals of North America biology, management and economics. Johns Hopkins University Press, Baltimore, Maryland.

McKelvey, K.S., K.B. Aubry, Y.K. Ortega. 2000a. History and distribution of lynx in the contiguous United States. Chapter 8. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

McKelvey, K.S., S.W. Buskirk, C.J. Krebs. 2000b. Theoretical insights into the population viability of lynx. Chapter 2. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

McKelvey, K.S., Y.K. Ortega, G. Koehler, K. Aubry, and D. Brittell. 2000c. Canada lynx habitat and topographic use patterns in north central Washington: a reanalysis. Chapter 10. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

McKelvey, K. S., J. P. Copeland, M. K. Schwartz, J. S. Littell, K. B. Aubry, J. R. Squires, S. A. Parks, M. M. Elsner, and G. S. Mauger. 2011. Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors. Ecological Applications 21(8):2882-2897.

McKenzie, D., Z. Gedalof, D.L. Peterson, and P. Mote. 2004. Climatic change, wildfire and conservation. Conservation Biology 18(4):890-902.

Mech, L.D. 1973. Canadian lynx invasion of Minnesota. Biological Conservation 5:151-152.

Moen, R., L. Terwilliger, A.R. Dohmen, and S.C. Catton 2010. Habitat and road use by lynx on long-distance movements. Natural Resources Research Institute, University of Minnesota Duluth technical report NRRI/TR-2010-02.

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

Mowat, G., S. Boutin, and B.G. Slough. 1996. Using placental scars to estimate litter size and pregnancy rate in lynx. Journal of Wildlife Management 60:430-440.

Mowat, G., K.G. Poole, and M. O'Donoghue. 2000. Ecology of lynx in northern Canada and Alaska. Chapter 9. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Murphy, K., T. Potter, J. Halfpenny, K. Gunther, T. Jones, P. Lundberg. 2004. Final report: the presence and distribution of Canada lynx (*Lynx Canadensis*) in Yellowstone National Park. Unpublished report Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

Murray, D.L., S. Boutin, and M. O'Donoghue. 1994. Winter habitat selection by lynx and coyotes in relation to snowshoe hare abundance. Canadian Journal of Zoology 72:1444-1451.

Nellis, C.H., S.P. Wetmore, and L.B. Keith. 1972. Lynx-prey interactions in central Alberta. Journal of Wildlife Management 36:320-329.

O'Donoghue, M., S. Boutin, C.J. Krebs, and E.J. Hofer. 1997. Numerical responses of coyotes and lynx to the snowshoe hare cycle. Oikos 80:150-162.

Olson, L. E., J. R. Squires, N. J. DeCesare and J. A. Kolbe. 2011. Den use and activity patterns in female Canada lynx (*Lynx canadensis*) in the Northern Rocky Mountains. Northwest Science 85:455–462.

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

Poole, K.G. 1994. Characteristics of an unharvested lynx population during a snowshoe hare decline. Journal of Wildlife Management 58:608-618.

Quinn, N.W.S., and G. Parker. 1987. Lynx. In M. Novak, J.A. Barber, M.E. Obbard, B. Malloch, editors. Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources.

Ruediger, B., S. Mighton, B. Naney, T. Rinaldi, F. Wahl, N. Warren, D. Wenger, A. Williamson, L. Lewis, B. Holt, G. Patton, A. Vandehey, and S. Gniadek. 2000. Canada Lynx Conservation Assessment and Strategy. Unpublished interagency document prepared for the U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management and National Park Service. Missoula, Montana.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires. 2000a. The scientific basis for lynx conservation: qualified insights. Chapter 16. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires. 2000b. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical editors. Ecology and conservation of lynx in the United States. University Press of Colorado, Boulder.

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

Schmitz, O.J., E. Post, C.E. Burns, and K.M. Johnston. 2003. Ecosystem responses to global climate change: moving beyond color mapping. BioScience 53:1199–1205.

Schwartz, M. K., K. L. Pilgrim, K. S. McKelvey, E. L. Linquist, J. J. Claar, S. Loch, L. F. Ruggiero. 2004. Hybridization between Canada lynx and bobcats: genetic results and management implications. Conservation Genetics 5:349–355.

Shepperd, W.D and M.L. Fairweather. 1994. Impact of large ungulates in restoration of aspen communities in a southwestern ponderosa pine ecosystem. P.344-347. In: Covington, W.S., and L.F. DeBano, (eds.), Sustainable ecological systems: Implementing an ecological approach to land management. USDA Forest Service General Technical Report RM-247. Fort Collins, Colorado.

Slough, B.G., and G. Mowat. 1996. Population dynamics of lynx in a refuge and interactions between harvested and unharvested populations. Journal of Wildlife Management 60:946-961.

Squires, J.R., and T. Laurion. 2000. Lynx home range and movements in Montana and Wyoming: preliminary results. Chapter 11. In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, technical 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.

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

Squires, J. R. and R. Oakleaf. 2005. Movements of a male Canada lynx crossing the Greater Yellowstone Area, including highways. Northwest Science 79:196-201.

Squires, J.R., L.F. Ruggiero, and J.A. Kolbe. 2004. Ecology of lynx in western Montana, including Seeley Lake, progress report - January 2003-September 2004. Unpubl. report. U.S. Forest Service, Rocky Mountain Research Station, Missoula, Montana.

Squires, J.R., L.F. Ruggiero, J.A. Kolbe, and N.J. DeCesare. 2006. Lynx ecology in the intermountain west. Unpubl. report. U.S. Forest Service, Rocky Mountain Research Station, Missoula, Montana. Available at: http://www.rmrs.nau.edu/publications/Lynx_Research_Program_Summary7_19_06_Final/Lynx_Research_Program_Summary7_19_06_Final.pdf

Squires, J.R., N.J. DeCesare, J.A. Kolbe, and L.F. Ruggiero. 2008. Hierarchical den selection of Canada lynxin western Montana. Journal of Wildlife Management 72:1497-1506.

Squires, J. R., N. J. DeCesare, J. A. Kolbe, and . F. Ruggiero. 2010. Seasonal resource selection of Canada lynx in managed forests of the Northern Rocky Mountains. Journal of Wildlife Management 74:1648–1660.

Staples, W.R. 1995. Lynx and coyote diet and habitat relationships during a low hare population on the Kenai peninsula, Alaska. Unpublished M.S. Thesis, University of Alaska, Fairbanks.

Stephenson, R. O. 1984. The relationship of fire history to furbearer populations and harvest. Final Report, Federal Aid in Wildlife Restoration, Project W-22-2, Job 7.13R Alaska Dept. of Fish and Game, Juneau, USA.

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

USFS. 2007. Record of Decision for the Northern Rockies Lynx Management Direction. U.S. Department of Agriculture, U.S. Forest Service, National Forests in Montana, and parts of Idaho, Wyoming, and Utah. March 2007.

USFS. 2008. Southern Rockies lynx management direction record of decision. U.S.D.A. Forest Service, Rocky Mountain Region, Golden, Colorado. 78pp

USFS. 2009. Designation of Section 386 Energy Corridors on National Forest System Land in 10 Western States: ROD. 79 pp.

USFS. 2011a. Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones. Record of Decision. Kootenai, Lolo, and Idaho Panhandle National Forests Lincoln, Sanders, Bonner, Boundary, and Pend Oreille Counties Montana, Idaho, and Washington. November 2011.

USFS. 2011b. Draft Environmental Impact Statement for the Draft Land Management Plan: Kootenai National Forest. U.S. Department of Agriculture. Forest Service. December 2011.

USFS. 2011c. Draft Land Management Plan: Kootenai National Forest. U.S. Department of Agriculture. Forest Service. December 2011.

USFS. 2012. NRLMD reporting year 2011. Report to the U.S. Fish and Wildlife Service regarding acres of adverse effects from treatments authorized under the NRLMD for years 2007 through 2011 for National Forests in the Northern Region. Prepared by Kristi Swisher, U.S. Forest Service, Region 1, Missoula, Montana.

USFS and USFWS. 2006. Amended Canada lynx conservation agreement between the U.S. Forest Service and the U.S. Fish and Wildlife Service. U.S. Forest Service Agreement 00-MU-11015600-013. Denver, Colorado.

USFWS. 2005. Recovery Outline: Contiguous United States Distinct Population Segment of Canada lynx. U. S. Department of Interior, U.S. Fish and Wildlife Service, Helena, Montana, USA.

USFWS. 2007. Biological Opinion for the Northern Rockies Lynx Management Direction (NRLMD). U. S. Department of Interior ,U.S. Fish and Wildlife Service. Montana Field Office, Helena, MT.

USFWS and NMFS. 1998. Consultation Handbook. Procedures for conducting consultation and conference activities under section 7 of the ESA. U.S. Department of Interior, U.S Fish and Wildlife Service and U.S. Department of Commerce, National Marine Fisheries Service, Washington, D.C.

van Zyll de Jong, C.G. 1966. Food habits of the lynx in Alberta and the Mackenzie District, North West Territories. Canadian Field Naturalist 80:18-23.

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

Vashon, J.H., J.F Organ, W.J. Jakubas, A.D. Vashon, G.J. Matula Jr., C.R. McLaughlin, and S.M. Crowley. 2005b. Reproduction and mortality of Canada lynx (*Lynx canadensis*) in

northern Maine. Unpubl. report, Maine Department of Inland Fisheries and Wildlife, Bangor.

Vashon, J., S. McLellan, S. Crowley, A. Meehan, and K. Laustsen. 2012. Canada lynx assessment. Maine Department of Inland Fish and Wildlife, Research and Assessment Section, Bangor, ME.

Ward, R., and C.J. Krebs. 1985. Behavioural responses of lynx to declining snowshoe hare abundance. Canadian Journal of Zoology 63:2817-2824.

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

Wolff, J.O. 1980. The role of habitat patchiness in the population dynamics of snowshoe hares. Ecological Monographs 5.