Nez Perce–Clearwater National Forests
Forest Plan Assessment

5.0 Threatened, Endangered, Proposed, and Candidate Species

June 2014

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5.0 Threatened, Endangered, Proposed, and Candidate Species

5.1 WILDLIFE

5.1.1 *Canada Lynx*

5.1.1.1 Distribution

Lynx (*Lynx canadensis)* currently are found throughout Alaska and Canada (except arctic islands), south through the Rocky Mountains, northern Great Lakes region, and northern New England. Lynx historically occurred in 16 states represented by 5 ecologically distinct regions: Cascade Range (Washington and Oregon), northern Rocky Mountains (northeastern Washington, northeastern Oregon, Idaho, Montana, western Wyoming, and northern Utah), southern Rocky Mountains (southeastern Wyoming and Colorado), northern Great Lakes (Minnesota, Wisconsin, and Michigan), and northern New England (Maine, New Hampshire, Vermont, New York, Pennsylvania, and Massachusetts).

Resident populations currently exist only in Maine, Montana, Washington, and possibly Minnesota. Some extant, but no longer self-supporting populations, exist in Wisconsin, Michigan, Oregon, Idaho, Wyoming, Utah, and Colorado; they may be extirpated from New Hampshire, Vermont, New York, Pennsylvania, and Massachusetts (Ruediger et al. 2000). The lynx was listened as threatened under the Endangered Species Act in 2000.

5.1.1.2 Life History

Canada lynx are medium-sized cats generally 30–35 inches long and weighing 18–23 pounds. They have large feet adapted to walking on snow, long legs, tufts on ears, and black-tipped tails (Ruediger et al. 2000).

Lynx are uncommon or absent from the wet coastal forests of Canada and Alaska. Instead, they occur in boreal coniferous forests that have cold, snowy winters and provide a prey base of snowshoe hares (74 FR 8616–8696, McKelvey et al. 2000*b*, Ruggiero et al. 2000). In North America, the distribution of lynx is nearly coincident with that of snowshoe hares. Snowshoe hares are the primary prey of lynx, comprising 35%–97% of the diet. Other prey species include red squirrel, grouse, flying squirrel, and ground squirrel, among others.

Southern populations of lynx may prey on a wider diversity of species than northern populations because of lower average hare densities and differences in small mammal communities; however, snowshoe hares are still their primary prey species. Squires and Ruggiero (2007) indicated that lynx in western Montana prey almost exclusively on snowshoe hares during the winter. Squires and Ruggiero located 86 lynx kills that included 7 prey species: blue grouse, spruce grouse, northern flying squirrel, red squirrel, snowshoe hare, least weasel, and white-tailed deer. Snowshoe hares contributed 96% of prey biomass (4-year average, range equals 94%–99%). Red squirrels were the second most common prey (11 kills), but they only provided 2% biomass to the winter diet (Squires and Ruggiero 2007). In areas characterized by patchy distribution of lynx habitat, lynx may prey opportunistically on other species that occur in adjacent habitats, potentially including white-tailed jackrabbit, black-tailed jackrabbit, sage grouse, and Columbian sharp-tailed grouse (Lewis and Wenger 1998).

The home range size of a snowshoe hare is 5–10 ha (12–25 ac); estimates vary depending on the sampling method (e.g., live-trapping vs. radio telemetry) (Keith 1990, Hodges 2000*a*, Murray 2003 *in* Interagency Lynx Biology Team 2013, p.10). Although hares are non-migratory and generally occupy the same area throughout the year, short-distance seasonal movements between winter and summer foraging areas have been documented (Adams 1959; Bookhout 1965; Wolff 1980; Wolfe et al. 1982 *in* Interagency Lynx Biology Team 2013, p.10*)*. Lynx densities vary across the southern periphery of its range and may be linked to snowshoe hare density and abundance (Interagency Lynx Biology Team 2013, pp. 23–24). Generally, home ranges in the western United States are larger than those reported from the eastern United States or from northern Canada during peaks in snowshoe hare abundance (Aubry et al. 2000).

Both snow conditions and vegetation type are important factors to consider in defining lynx habitat. Across the northern boreal forests of Canada, snow depths are relatively uniform and only moderately deep (total annual snowfall of 39–50 inches) (Kelsall et al. 1977). Snow conditions are very cold and dry. In contrast, in the southern lynx regions, snow depths generally increase, with the deepest snows in the mountains of southern Colorado. Snow in southern lynx habitats may be subjected to more freezing and thawing than in the northern portion of the lynx range (Buskirk et al. 2000b), although this varies depending on elevation, aspect, and local weather conditions. Crusting or compaction of snow may reduce the competitive advantage that lynx have in soft snow with their long legs and low-foot loadings (Buskirk et al. 2000a). At lower snow depths, the competition for prey increases. Likewise, the potential predation on lynx increases.

Most lynx occurrences in the western United States are associated with Rocky Mountain conifer forests, and most are within the 4,920- to 6,560-foot elevation zone. In northwest Montana, lynx used mid- to high-elevation forests during winter (4,134 to 7,726 feet, with a mean elevation of 5,715 feet) and slightly higher elevations during summer (Squires et al. 2010). A gradient in the elevational distribution of lynx habitat occurs from the northern to the southern Rocky Mountains, with lynx habitat occurring at 8,000 to 11,500 feet in the southern Rockies.

The primary vegetation contributing to lynx habitat is lodgepole pine, subalpine fir, and Engelmann spruce (Aubry et al. 2000). In extreme northern Idaho, northeastern Washington, and northwestern Montana, cedar-hemlock habitat types may also be considered primary vegetation. In central Idaho, Douglas-fir on moist sites at higher elevations may also be considered primary vegetation. Secondary vegetation, when interspersed within subalpine forests, that 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, Douglas-fir, or lodgepole pine with a grass-like understory) do not provide lynx habitat (Squires et al. 2010).

Based on examination of historical and recent evidence, the 2005 Canada lynx recovery outline categorized lynx habitat and occurrence within the contiguous United States as either core areas, secondary areas, or peripheral areas (USDI Fish and Wildlife Service 2005). “Core areas” show the strongest long-term evidence of the persistence of lynx populations within the contiguous United States. These areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. At this time, the role of areas outside of these core areas (secondary and peripheral) 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 they are 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. 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. Based on historical lynx occurrence information (McKelvey et al. 2000*b in* Interagency Lynx Biology Team 2013), recent research (Hoving 2001, Von Kienast 2003, Squires et al. 2003, Maletzke 2004, Fuller et al. 2007, Burdett 2008, Koehler et al. 2008, Vashon et al. 2008, Devineau et al. 2010, and Squires et al. 2010 *in* Interagency Lynx Biology Team 2013), results from the National Lynx Survey (K. McKelvey, unpublished data *in* Interagency Lynx Biology Team 2013, p. 87), and snow-tracking surveys, evidence of persistence and reproduction of lynx in the core areas has been confirmed.

Within the boreal forest, lynx foraging habitat supports lynx primary prey (snowshoe hare) and has the vegetation structure suitable for lynx to capture prey. Dense saplings or mature multi-layered stands are the conditions that maximize availability of food and cover for snowshoe hares at varying snow depths throughout the winter (Interagency Lynx Biology Team 2013, p. 27). Natural disturbance processes that create early successional stages exploited by snowshoe hares include fire, insect infestations, wind throw, and disease outbreaks (Plate 2.15, in Interagency Lynx Biology Team 2013, p. 27); Kilgore and Heinselman 1990; Veblen et al. 1998; Agee 2000 *in* Interagency Lynx Biology Team 2013, p. 27). Both timber harvest and natural disturbance processes provide foraging habitat for lynx when the resulting stem densities and stand structure meet the habitat needs of snowshoe hare (Plate 2.16 in Interagency Lynx Biology Team 2013, p. 28); Keith and Surrendi 1971; Fox 1978; Conroy et al. 1979; Wolff 1980; Parker et al. 1983; Litvaitis et al. 1985; Bailey et al. 1986; Monthey 1986; Koehler 1990a,b *in* Interagency Lynx Biology Team 2013, p. 28).

In the western United States, development of a high density >4,500/acre of young conifer stems and branches protruding above the snow was found to provide foraging habitat for lynx within roughly 10–40 years following disturbance, depending on site productivity, forest type, and intensity of disturbance (Sullivan and Sullivan 1988; Koehler 1990*a in* Interagency Lynx Biology Team 2013, p. 29). This habitat is temporary, as the tree stems and branches eventually grow out of reach of snowshoe hares and shade out understory saplings and shrubs. Mature multi-story conifer forests with low limbs and containing a substantial understory of young trees and shrubs provide stable lynx foraging habitat (Murray et al. 1994, Koehler et al. 2008, Squires et al. 2010, Ivan 2011). In north central Washington, high snowshoe hare densities (0.4 hares/ac) were associated with sapling (<4 in dbh) densities of 1,127±114 stems/ac and medium-sized (4–11 in dbh) tree densities of 288±32 stems/ac (Walker 2005 *in* Interagency Lynx Biology Team 2013, p. 29).

Landscapes containing a mix of forest age classes are more likely to provide lynx foraging habitat throughout the year (Poole et al. 1996; Griffin and Mills 2004; Squires et al. 2010 *in* Interagency Lynx Biology Team 2013, p. 28). Winter habitat may be more limiting for lynx (Squires et al. 2010). In winter, lynx do not appear to hunt in openings, where lack of cover limits habitat for snowshoe hares (Mowat et al. 2000; Maletzke et al. 2008; Squires et al. 2010 *in* Interagency Lynx Biology Team 2013, p. 28). Squires (2010) found that when lynx did cross openings, they remained closer to forest edges compared to random tracks, with an average distance of 384 feet from the forest edge. Areas with recent timber harvest and areas recently burned can contribute herbaceous summer foods for snowshoe hares, and woody winter browse will develop on older sites (Fox 1978 *in* Interagency Lynx Biology Team 2013, p. 28). Multi-story stands may provide a greater availability of browse as snow depths vary throughout the winter (Interagency Lynx Biology Team 2013, p. 27).

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 *in* Interagency Lynx Biology Team 2013, p. 72). Stands may continue to provide suitable snowshoe hare habitat for many years until woody stems in the understory become too sparse, as a result of undisturbed forest succession or management (e.g., clear-cutting or thinning) (USDI 2009 74 FR p. 8637).

Denning habitat is the environment lynx use when giving birth and rearing kittens until they are mobile. The most common component is large amounts of coarse woody debris to provide escape and thermal cover for kittens. Den sites typically are situated within older regenerating stands (>20 years since disturbance) or in mature conifer or dense regenerating mixed conifer-deciduous (typically spruce/fir or spruce/birch) forests (Koehler 1990*a;* Slough 1999; Moen et al. 2008; Organ et al. 2008; Squires et al. 2008 *in* Interagency Lynx Biology Team 2013, p. 30). Stand structure appears to be more important than forest cover type (Mowat et al. 2000). The availability of den sites does not appear to be limiting (Gilbert and Pierce 2005; Moen et al. 2008; Organ et al. 2008; Squires et al. 2008 *in* Interagency Lynx Biology Team 2013, p. 30). Denning habitat must be located within daily travel distance of an adult female lynx (typical distance is 3–6 miles) to snowshoe hare habitat (Interagency Lynx Biology Team 2013). In Montana, Squires found that lynx located their dens in a variety of forest stand types—with 80% of dens in mature forest stands and 13% in mid-seral, regenerating stands. Young stands that were either naturally sparse or mechanically thinned were seldom used for denning. Lynx denned along the edges of regenerating forests where trees had blown down into jack-strawed piles of woody debris. At a landscape level, dens were generally in concave or drainage-like topographies and often on northeast aspects. Squires found that denning habitat is generally abundant across the coniferous forested landscape, especially in riparian habitats and in areas where insects or disease kill patches of trees. Given the large home ranges and low den site fidelity of lynx, den sites are not likely to be limiting (Squires et al. 2008).

5.1.1.3 Lynx in Idaho

Canada lynx are classified as an S1 Idaho species of greatest conservation need. S1 is a statewide ranking assigned by the Idaho Conservation Data Center. This ranking indicates a critically imperiled species—at high risk due to extreme rarity, rapidly declining numbers, or other factors—that is particularly vulnerable to rangewide extinction or extirpation (Idaho Department of Fish and Game 2005). Specimen records of lynx in Idaho during the early 1900s are relatively common (McKelvey et al. 2000*b*). McKelvey et al. (2000*b*) reported 22 museum specimens of lynx from 1874 to 1917, all of which were collected north of the Snake River Plain in Idaho. Thirteen other verified records prior to 1960 were also from the north-central and northern regions of the state (McKelvey et al. 2000*b in* Interagency Lynx Biology Team 2013, p. 57). There are 35 verified records from 1960 to 1991, most coinciding with lynx irruptions in the

1970s. The National Lynx Survey found lynx in the Boise National Forest (K. McKelvey, unpublished data, in Interagency Lynx Biology Team 2013, p. 57). Idaho Department of Fish and Game (IDFG) personnel surveyed 20 routes that had adequate snow conditions from 2004 to 2006 and detected no lynx (Patton 2006 *in* Interagency Lynx Biology Team 2013, p. 57). In 2010 to 2013, IDFG conducted forest carnivore surveys in the Selkirk, Purcell, and West Cabinet mountains, finding one male lynx in the Selkirks in 2010, and one male lynx in the Idaho Purcell Mountains in 2011. In 2012 a lynx was found on the Salmon-Challis National Forest and in northern Idaho in 2013. In February of 2014, a lynx was captured and collared in the West Cabinet Mountains.

Subalpine fir potential vegetation types occur at upper elevations. Engelmann spruce potential vegetation types occur on very wet sites, on steep northerly aspects where snow accumulates, and along streams and valley bottoms (Steele et al. 1981 *in* Interagency Lynx Biology Team 2013, p. 60). Large stands of fire-induced lodgepole pine commonly dominate much of the subalpine fir series in central Idaho (Steele et al. 1981 *in* Interagency Lynx Biology Team 2013, p. 60). Sites that are capable of producing dense, tall understory shrubs may be capable of supporting snowshoe hares and lynx. In the western United States, most snowshoe hare populations occurred within conifer forests at elevations from 2,116–11,204 feet (Dolbeer and Clark 1975; Griffin 2004; Lewis et al. 2011; Berg and Gese 2012 *in* Interagency Lynx Biology Team 2013, p. 12). Cover types that support snowshoe hares in this region include Engelmann spruce, subalpine fir, mixed spruce-fir, mixed aspen and spruce-fir, and mixed lodgepole pine and spruce-fir (Hodges 2000*b*; Zahratka 2004; Zimmer 2004; Miller 2005; Berg et al. 2012 *in* Interagency Lynx Biology Team 2013, p. 12). Hare densities on the Clearwater National Forest ranged from 0.004 to 0.04 hares/acre, and hare distribution throughout the study area was positively correlated with the availability of understory cover (Wirsing et al. 2002 *in* Interagency Lynx Biology Team 2013, p. 62). A landscape density of > 0.2 hares/acre has been suggested as necessary to sustain lynx within their home ranges (Mowat et al. 2000, Ruggiero et al. 2000b). In northern Idaho, western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and moist grand-fir potential vegetation types support snowshoe hares (Murray et al. 2002), although these areas do not appear to support lynx (Interagency Lynx Biology Team 2013, p. 62). Ellsworth (2009 *in* Interagency Lynx Biology Team 2013, p. 11) also highlighted the importance of young lodgepole pine stands with high sapling densities to hares in northern Idaho.

Most lynx occurrences in the western United States (83%) are associated with Rocky Mountain conifer forests, and most (77%) fall within the 4,920–6,560 feet elevation zone (McKelvey et al. 2000b), except in Colorado where elevations are higher. Engelmann spruce, subalpine fir, and lodgepole pine forest cover types occurring on cold moist potential vegetation types provide habitat for lynx (Aubry et al. 2000). Dry forest cover types (e.g., ponderosa pine and dry Douglas-fir) do not provide lynx habitat (Koehler et al. 2008, Maletzke et al. 2008, Squires et al. 2010). In winter, lynx selected for mature multi-story stands dominated by Engelmann spruce and subalpine fir consisting of primarily large diameter trees where limbs reached the snow at ground level and contributed to dense horizontal cover (Koehler et al. 2008, Squires et al. 2010). In summer, lynx broadened their selection to include younger regenerating stands comprised of Engelmann spruce and subalpine fir with abundant small diameter and pole sized trees (3–7 inch dbh), abundant total shrubs, and high horizontal cover (Squires et al. 2010). Koehler's work was in Washington, and most of Squires' work was in western Montana.

Snow track surveys in 2007 (Ulizio et al. 2007) and again in 2013 (Stone et al. 2013) on the

Nez Perce National Forest, using protocol developed by Squires et al. (2004 and 2012), did not detect lynx. In 2013, the experienced lynx tracking crew covered all routes twice, which strengthens the detection probability if present or, conversely, can suggest absence with 95% certainty (Squires et al. 2012). Much of the surveyed area appears to be suitable habitat that supports snowshoe hares (*Lepus americanus*); and the lack of detections suggests that lynx are rare or infrequent to the Nez Perce National Forest. Hair snare surveys (5 transects) during summer and fall of 2008 on the Nez Perce National Forest following the protocol established by McKelvey et al. (1999) also did not detect lynx (Bonn 2008).

Lynx are wide-ranging animals, and given the lynx-specific survey work conducted on the Nez Perce National Forest—and extensive surveys for other species using hair snares, snow track surveys, and camera stations conducted on the Clearwater National Forest (e.g., U.S. Fish and Wildlife Service, grizzly bear in 2008–2009; U.S. Forest Service, fisher 2002–2014; IDFG, yearly aerial surveys for many species)—presence of a population should be evident given the vast network of roads and trails. Historical sitings that have been confirmed may be the result of transient lynx moving through the Forest; but the infrequency of such reports suggests that lynx are incidental to the area (Ulizio et al. 2007). Compared to cores areas, secondary areas are defined as having fewer and more sporadic records of lynx occurrence and the quality and quantity of habitat to support populations of snowshoe hares and lynx is questionable (USDI Fish and Wildlife Service 2005). The snow in lynx habitats on the Nez Perce–Clearwater National Forests may be subjected to more freezing and thawing than in the northern portion of lynx range. Crusting or compaction of snow may reduce the competitive advantage that lynx have in soft snow, with their long legs and low-foot loadings (Buskirk et al. 2000a). At lower snow depths there occurs an increase in competition for prey and an increase in potential predation on lynx. While lynx have occasionally been sited on the Forests, currently, due to the infrequent nature of lynx observations, little evidence exists of a resident lynx population or reproduction on the Nez Perce–Clearwater National Forests. The 2005 Canada Lynx Recovery Area map identified the Nez Perce–Clearwater National Forests as a “secondary” Canada lynx areas (USDA Forest Service and USDI Fish and Wildlife Service 2006).

Northern Rockies Lynx Management Direction and Application on the Nez Perce Clearwater National Forest

The U.S. Fish and Wildlife Service (FWS) listed Canada lynx as a threatened species under the Endangered Species Act (ESA) in March 2000. The Lynx Conservation Assessment and Strategy (LCAS) (Ruediger et al. 2000) was developed to provide a consistent and effective approach to conserve Canada lynx and to assist with Section 7 consultation under the Endangered Species Act on federal lands in the contiguous United States. The Forest Service (FS) signed a Lynx Conservation Agreement with the FWS in 2001 to consider the LCAS during project analysis. The FS agreed to halt projects that were “likely to adversely affect” lynx until the plans were amended. The LCAS was renewed in 2005 and added the concept of occupied mapped lynx habitat. The FWS issued a Recovery Outline for Canada lynx (USDI Fish and Wildlife Service 2005) in September 2005 to serve as an interim strategy to guide and encourage recovery efforts until a recovery plan was completed. In 2006, the LCAS was amended to define occupied habitat and to list those National Forests that were occupied; the goal was to provide guidance necessary to conserve lynx (USDA Forest Service and USDI Fish and Wildlife Service 2006). In March 2007, 18 Forest Plans were amended with the Northern Rockies Lynx Management Direction (NRLMD) Record of Decision (ROD) (USDA Forest Service 2007, Attachment 1, p. 1). The

LCAS was revised in August 2013 by the Interagency Lynx Biology Team, incorporating the best available science that had been published since previous editions (Interagency Lynx Biology Team 2013).

The special habitat management considerations needed to ensure lynx recovery were described in the NRLMD; and on March 23, 2007, the U.S. Fish and Wildlife Service issued a Biological Opinion on the effects of the NRLMD (USDI FWS 2007). The Biological Opinion was identified as the first-tier of a consultation framework, with subsequent projects that may affect lynx, as implemented under the amended Forest Plans, being the second-tier of consultation. Second-tier opinions would be issued when appropriate.

In the NRLMD, the Nez Perce National Forest was considered to be unoccupied while the Clearwater National Forest was considered to be occupied based on the best scientific information available at the time of the NRLMD Forest Plan Amendment. However, due to inconsistencies on the status of lynx presence or occupancy on the Nez Perce National Forest, the FWS sent a letter addressed to the Forest Supervisor, Rick Brazell on December 10, 2012 stating that “there is consensus that transient lynx may be present on the Nez Perce National Forest, at least occasionally”. The FWS referenced two pieces of information to come to this conclusion: 1) Ulizio et al. (2007) noted, “Historical sightings that may have been confirmed may be the result of transient lynx moving through the forest, but the infrequency of such reports suggests lynx are incidental to the area”, and 2) McKelvey et al. (2000*b*) reported numerous verified historical records from Idaho County. The letter also stated that, “the issue of lynx occupancy on the NPNF is a separate but related matter that is not the focus of this letter, and did not change the NPNF status as ‘unoccupied’. Therefore, under the NRMLD, the Nez Perce National Forest is considered unoccupied, and the Clearwater National Forest is considered occupied. The FWS has determined that lynx “may be present” on both Forests, and both Forests are considered to be secondary areas.

Lynx Critical Habitat

In February 2009, the FWS designated revised critical habitat in Montana, Wyoming, Idaho, Washington, and other states (50 CFR Part 17, Volume 74 (No. 36), Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx; Final Rule, 2009). Critical habitat was not designated on the Nez Perce or Clearwater National Forests (74 FR pp. 8616–8702, USDI Fish and Wildlife Service 2009). On September 26, 2013, the USFWS published a proposed rule for revised critical habitat in the Federal Register (78 FR pp. 59429–59474). No critical habitat was proposed for the Nez Perce–Clearwater National Forests in the proposed rule.

Lynx Linkages

A linkage area is defined in the NRLMD ROD as “providing connectivity between blocks of lynx habitat”. Linkage areas occur 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. Linkages are designated or officially mapped by the Forest Service and FWS to provide for connectivity across areas that are generally non-forested. The linkage areas on the Nez Perce–Clearwater National Forests are mapped in Figure 1-1 of the NRLMD FEIS (2007).

5.1.1.4 Human Activity and Development

Some human activities such as development of reservoirs or highways with high-speed and high-traffic volumes may impede lynx movement or increase lynx mortality (Ruediger et al. 2000). Although many species of wildlife are disturbed when forest roads are used (Ruediger 1996), preliminary information suggests that lynx do not avoid roads (Ruggiero et al. 2000) except at high-traffic volumes (Apps 2000). Along less-traveled roads, where the vegetation provides good hare habitat, sometimes lynx use the roadbeds for travel and foraging (Koehler and Brittell 1990 *in* Interagency Lynx Biology 2013). An analysis on the Okanogan National Forest in Washington showed lynx neither preferred nor avoided forest roads; and the existing road density did not appear to affect lynx habitat selection (McKelvey et al. 2000c).

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 *in* Interagency Lynx Biology Team 2013). 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 *in* Interagency Lynx Biology Team 2013).

With respect to snow compaction due to human activities, Kolbe was able to directly measure relationships between coyotes, compacted snow routes, and snowshoe hare in an area that also supports a lynx population (USDI Fish and Wildlife Service 2007). Kolbe and others in 2007 suggested that compacted snow routes did not appear to enhance coyotes' access to lynx and hare habitat, and so would not significantly affect competition for snowshoe hares. After evaluating Bunnell et al. (2006, entire) and Kolbe et al. (2007, entire), the USFWS determined that the best information available did not indicate that compacted snow routes increase competition from other species to levels that adversely impact lynx populations (USDI Fish and Wildlife Service 2009, p. 8639); therefore, such activities would result in effects that are insignificant to lynx.

Lynx mortality can be caused by trapping or shooting, predation (especially by mountain lions during the snow-free season), and starvation (Squires et al. 2006). A thorough discussion of the effects of climate change, vegetation management, wildland fire management, and fragmentation of habitat on lynx and lynx habitat can be found in the revised LCAS (Interagency Lynx Biology Team 2013), pp. 68–85. Additional discussion of the effects of incidental trapping, recreation, minerals and energy exploration and development, illegal shooting, forest/backcountry roads and trails, and grazing by domestic livestock is there as well.

5.1.1.5 Lynx Habitat Mapping

The Northern Rockies Lynx Management Direction (NLRMD) (USDA Forest Service 2007) and the LCAS (Ruediger et al. 2000) outlined a number of criteria that should be considered in the mapping of lynx habitat. This information provided the starting point for lynx habitat mapping. On August 22, 2000 additional guidance was provided to field units by the Deputy Regional Forester, USFS Region 1, the Region 6 Director of the FWS, and the Group Manager for Fish, Wildlife, and Forests of the BLM in a document titled "Lynx Habitat Mapping Direction", based on recommendations by the Lynx Steering Committee. The Lynx Steering Committee developed a set of mapping criteria and procedures to guide and clarify the mapping process. The consequences of applying these criteria were also assessed. Subsequent references to this document will be as "recommendations by the Lynx Steering Committee 2000".

Mapping of primary habitat should be based on forest types necessary to support lynx survival and reproduction specific to each geographic area (Ruediger et al. 2000, Interagency Lynx Biology Team 2013). In northern and central Idaho this consists of subalpine fir, Engelmann spruce, and lodgepole pine potential vegetation types (Interagency Lynx Biology Team 2013). The LCAS indicated that Lynx Analysis Units (LAUs) should be developed and used to map lynx habitat, determine habitat conditions, and assess management effects to lynx. An LAU is delineated to represent a home range of a female lynx. Habitat mapping criteria were developed to represent important life history characteristics: foraging and denning. LAU delineations and habitat mapping actions directed by the LCAS (Ruediger et al. 2000) were completed for both Forests. The Nez Perce National Forest mapped lynx habitat on the Forest between 2000 and 2002 and then revised the mapped habitat in 2004. The Clearwater National Forest revised its mapped lynx habitat in 2007. This mapping was completed in coordination with the FWS.

In 2014, as part of the Forest Plan Revision, mapped lynx habitat was revised to develop consistent mapping criteria across both Forests, and to include the best available scientific information (BASI) concerning lynx population dynamics, distribution, habitat use, competitor interactions, prey species, and human interactions that has become available since 2007. This mapping was also completed in coordination with the U.S. Fish and Wildlife Service. This process resulted in the mapping of 78 LAUs across the Nez Perce–Clearwater National Forests (Figure 5-1 and Figure 5-2). LAUs will be used to display the amount, relative quality, and distribution of lynx habitat across the Forests.

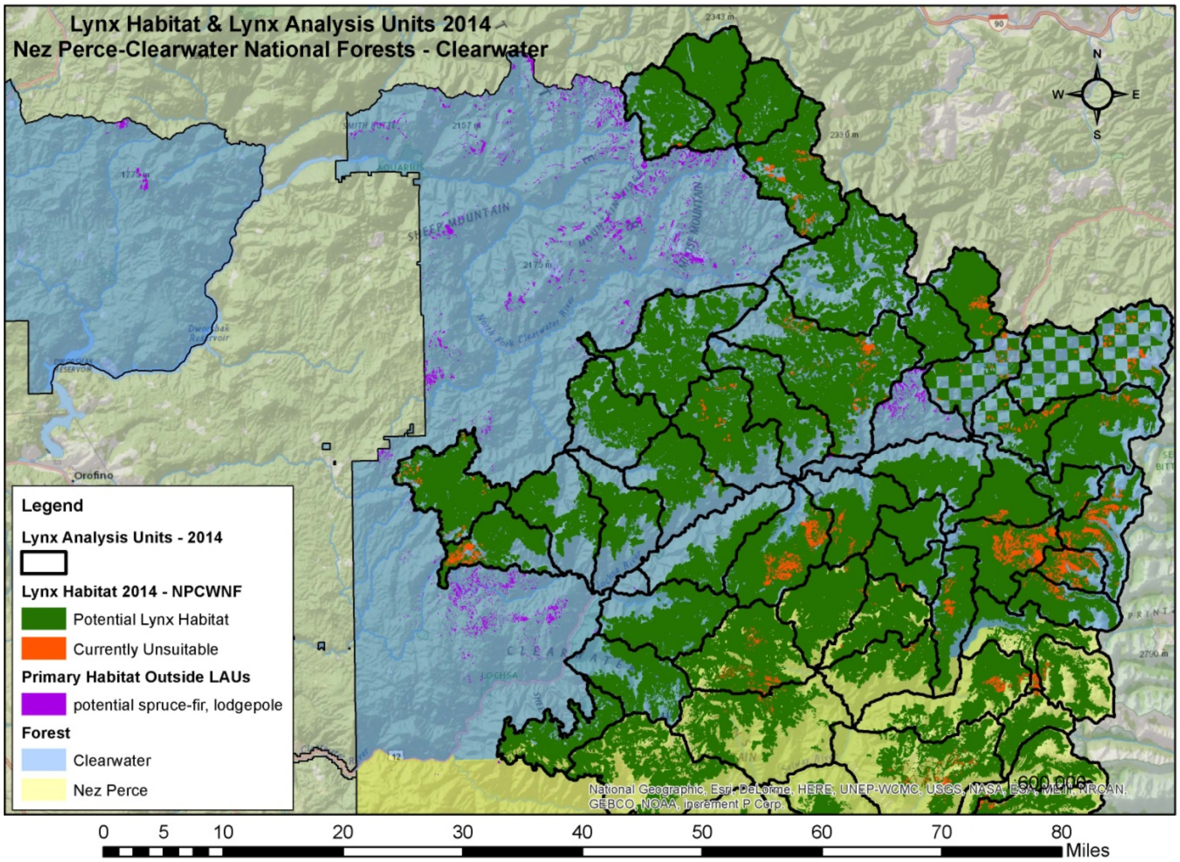

Figure 5-1. Lynx habitat and analysis units for the Clearwater National Forest portion of the Nez Perce–Clearwater National Forests

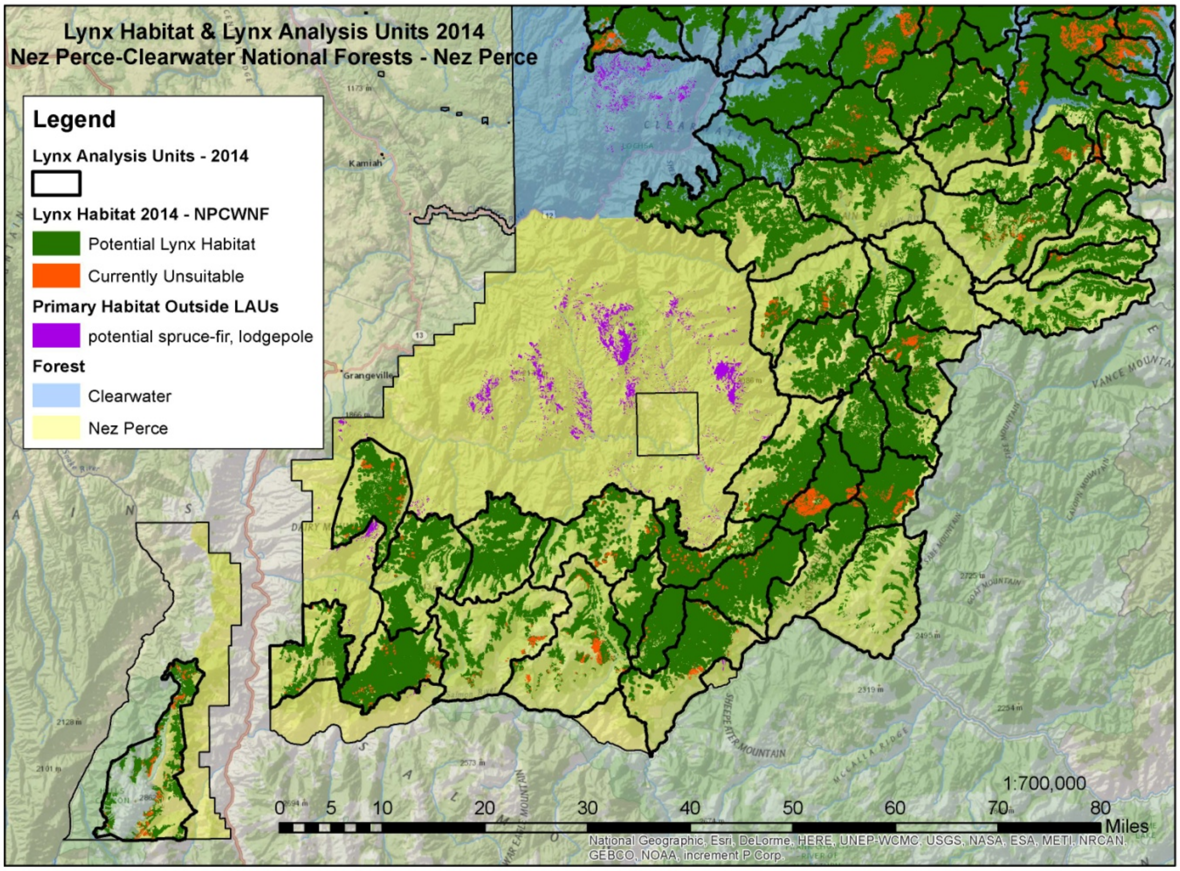

Figure 5-2. Lynx habitat and analysis units for the Nez Perce National Forest portion of the Nez Perce–Clearwater National Forests

Mapping Criteria

Potential natural vegetation types were the basis for mapping lynx habitat on the Nez Perce–Clearwater National Forests because they represent the ecological potential for an area to support primary lynx habitat. Potential vegetation is a landscape scale classification that delineates expected vegetation type groups using ecosystem attributes such as land type, soils, topography, climate, and geographic location. Potential vegetation types define sites within a climatic region that have the potential to produce similar vegetation. Classifications of potential vegetation are often associated with well-documented stable vegetation communities or habitat types that occur in the absence of disturbance (Cooper et al. 1991).

Important advantages exist when using potential vegetation type groups rather than existing vegetation for lynx mapping. Existing vegetation better describes the variability in vegetation cover that exists because of disturbance and seral stage; however, potentially suitable lynx habitat would be underestimated if defined using existing vegetation because stands affected by stand-replacing wildfires and regeneration harvest, which produce stands in initiation structural stage, are reflected in existing vegetation. Forest managers need to consider that stands in early stand initiation stage and stands in stem exclusion stage are potential lynx habitat even if they cannot currently support lynx.

Potential Vegetation Model Selection

Potential Vegetation Type (PVT) classification for western Montana and northern Idaho completed in 2004 for Region 1 (Appendix A) were used as the basis for mapping lynx habitat. We considered 3 existing mapped models of landscape classification for their usefulness in delineating potential vegetation types that characterize lynx habitat: (1) Vegetative Response Units (VRU) available for the Nez Perce National Forest (Table 5-1), (2) the Land Type Associations (LTA) for the Clearwater National Forest (Table 5-1), and (3) Potential Vegetation Types for Region 1 (PVT) (Table 5-2). We did not consider using stand-based Habitat Type Groups (HTG) provided in Field Sampled Vegetation (FSVeg) (USDA Forest Service 2014). Although HTG are classifications of potential natural vegetation types, in FSVeg they are based on individual stand assessment determined from common stand exams, which are not appropriate input for landscape-level modeling. They are not appropriate because they are based on a project-level sampling design and the level of data collection and accuracy requirements are highly spatially varied (USDA Forest Service 2014, chapter 2).

After reviewing the classifications and mapped distributions for the three landtype models (PVT, VRU, and LTA), we selected PVT to define potential lynx habitat. PVT is an ecoregional model based on spatially referenced field data that refers to habitat type and has been extrapolated across the region using climate data, solar radiation, potential lifeform, elevation, aspect, slope, and soils data (Appendix A). One basic advantage of using PVT is that it provides seamless and consistently determined coverage regardless of ownership across both Forests. Additionally, PVT classes are combined into groups based on seral tree species that we were able to cross-reference to habitat types (Cooper et al. 1991) and HTGs (USDA Forest Service 2005) using lookup tables provided by Region 1 (USDA Forest Service Region One Renewable Resource Management) and the appendices in Chew et al. (2012)**,** which provided us with a method for selecting PVT classes that are suitable lynx habitat.

We recognized that using PVT as a basis for lynx habitat mapping had certain limitations. The metadata for the PVT model (Appendix A) does not provide accuracy statistics and, other than the metadata, we could not find a report or document of the model-building. In addition, the model is designed for characterizing broad-scale patterns; and, although it is mapped at a 90-meter resolution, the metadata warns that, “the expected accuracy does not warrant their use for analyses of areas smaller than about 10,000 acres (for example, assessments that typically require 1:24,000 data)”. However, we reviewed other potential vegetation models (see below) and felt that PVT out performed the other systems in terms of being able to predict areas that support primary lynx habitat. In addition, although the Regional Geospatial Analysis Team recognizes the model needs to be updated (J. Barber, GIS specialist, Engineering, USFS Region 1, Missoula, MT, pers. comm.), it is currently the accepted model for potential vegetation in the Region. Of 7 lynx habitat remapping efforts currently in progress in Region 1, 6 National Forests are using PVT (J. Barber pers. comm.). PVT was proven to be reasonable for predicting lynx locations on the Flathead National Forest where 94%–95% of the locations of 8 radio-collared lynx were within PVT where it equaled one of four subalpine fir (*Abies lasiocarpa*) classes (USDA Forest Service 2013a). The same location data were not sensitive to existing vegetation in the Forest Service Region 1 Vegetation Map Product (VMap) (Barber et al. 2011) dominance type classes.

We were not compelled to use a combination of LTAs and VRUs for the Forests after exploring how effective the systems were in defining potential lynx habitat. The primary reason was that both systems delineate multiple classes that include other habitat types that are considered secondary habitat (grand fir (*Abies grandis*), mountain hemlock (*Thuja mertensiana*), western redcedar (*Thuja plicata*), and Douglas-fir (*Pseudotsuga menziesii*)) in addition to subalpine fir habitat types When we reviewed the distribution of potential primary habitat as selected by the different systems, 18% more area of the Nez Perce National Forest was selected by VRUs than PVT and 10% more area of the Clearwater National Forest was selected by LTA groups than PVT, which we attributed to the inclusion of the secondary habitat types. We did not just assume that less primary habitat meant the PVT was more accurate, rather we carefully reviewed the differences in GIS using satellite imagery and existing vegetation maps (VMap and FSVEG), and determined that LTA groups and VRUs delineated areas as primary lynx that would not be spruce-fir or lodgepole pine habitat types. Additionally, when we reviewed the distributions of potential primary habitat adjacent to the border between the two Forests, we saw major differences in distribution that could have been a result of the different methods used for classification for the two systems; LTAs are primarily based on soil and water attributes, while the VRUs are primarily based on vegetative components, disturbance regime, and successional pathways (USDA Forest Service 2013b).

Primary Habitat

Mapping of primary habitat should be based on forest types necessary to support lynx survival and reproduction specific to each geographic area (Ruediger et al. 2000, Interagency Lynx Biology Team 2013), which in northern and central Idaho is subalpine fir, Englemann spruce, and lodgepole pine potential vegetation types (Interagency Lynx Biology Team 2013). We used PVT classes to delineate lynx primary habitat potential to produce forests dominated by subalpine fir, Englemann spruce, or lodgepole pine. The PVT model has 4 classes of potential vegetation dominated by subalpine fir, one class dominated by spruce, and one class dominated by lodgepole pine (Table 5-2).

Secondary Habitat

Where it is interspersed with primary habitat, cedar-hemlock, grand fir, or Douglas-fir on moist sites at higher elevations in central Idaho support snowshoe hares (Murray et al. 2002) and may provide secondary habitat for lynx (Interagency Lynx Biology Team 2013). Secondary habitat was selected from PVT classes where these tree species were dominant and where it was directly adjacent to primary habitat. Because lynx are not associated with these forest types (Interagency Lynx Biology Team 2013) but because they do support snowshoe hares, we only included secondary habitat within 200 meters of primary habitat. There are multiple PVT classes for which each of these tree species is the dominant habitat type (e.g., abgr1, abgr2, abgr3 for grand fir); so we reviewed the PVT description and cross referenced the habitat types and habitat type groups that were associated with each PVT class using lookup tables provided by Region 1 (USDA Forest Service Region One Renewable Resources Management) and the appendices in Chew et al. (2012) (Table 5-2).

We thoroughly researched the different habitat types (Cooper et al. 1991) and HTGs (USDA Forest Service 2005) to determine which were capable of providing the dense horizontal cover to support snowshoe hares. The pvt classes we selected for secondary habitat include: abgr2, abgr3, thpl2, tshe, tsme1, tsme2, tsme3, and psme2 but only where psme2 is on the Clearwater National Forest and above 4,000 ft elevation. For the discussion on secondary habitat, any information on habitat types comes from Cooper et al. 1991, the information about HTG comes from USDA Forest Service (2005), and the table we used to cross reference habitat types is Table 5-2 of this document. Many of the PVT classes included both (a) habitat types that were capable, and (b) habitat types that were unlikely, to provide habitat. Because secondary habitat must be directly adjacent to the primary habitat to be selected in the lynx habitat model and because it was to be cut off 200 meters from any primary habitat, we tended toward being inclusive. We reasoned that habitat types that were too warm or dry to be suitable as secondary habitat were not likely to be growing within 200 meters of primary habitat and would not be selected anyway.

We selected two grand fir classes: abgr2 and abgr3 (Table 5-2). Abgr2 is in HTG 3, which is a group of moderately warm and moderately dry habitat types so we were originally not going to include it as potential secondary habitat. However, abgr2 includes one series with *Vaccinium globulare* (blue huckleberry) as the main undergrowth species, and another habitat type where subalpine fir and spruce can be co-dominant and huckleberry can be present in the shrub layer. Huckleberry is often present in known lynx habitat (Squires et al. 2010) and has the potential to provide cover and forage for snowshoe hare, so we included this PVT class as secondary habitat. Abgr3 includes ABGR/*Asarum caudatum* (ASCA) (wild ginger), ABGR/*Clintonia uniflora* (CLUN) (queen's cup), and ABGR/*Senecio triangularis* (SETR) (ragwort) series, which are in HTG 4. *Menziesia ferruginea* (MEFE) is a shrub species that is often present in known lynx habitat (Squires et al. 2010, Interagency Lynx Biology Team 2013) and potentially provides cover and forage for snowshoe hare (Wirsing and Murray 2002). MEFE is a phase of both ABGR/ASCA and ABGR/CLUN series, which provided more support for selecting it as potential secondary habitat.

In northern Idaho, cedar-hemlock habitat types were previously thought to support lynx but are currently thought to only be potentially secondary habitat (Interagency Lynx Biology Team 2013). Two PVT cedar classes exist (wet type 1 and moist type 2). We did not include the wet type because it includes habitat types that grow in elevations that are too low (1,500–4,700 feet) to be considered snowshoe hare habitat. We selected the cedar moist type 2 and western hemlock habitat type because they include phases with MEFE and therefore have the potential to provide hare foraging habitat. We included all PVT classes with mountain hemlock as the dominant tree species (tsme1, tsme2, tsme3 [Table 5-3]). Mountain hemlock is in the same cool HTGs (7 and 8) as spruce-fir habitat types; it grows in subalpine elevations, and has suitable horizontal structure in the understory because the undergrowth is dominated by MEFE. Blue huckleberry (*Vaccinium globulare* (VAGL) is also well represented.

Moist high-elevation Douglas-fir habitat types in central Idaho potentially contribute to lynx habitat (USDA Forest Service 2007, recommendations by the Lynx Steering Committee 2000). In central Idaho, Douglas-fir habitat types are varied and are distributed over a broad range of habitat types (Cooper et al. 1991). On the Nez Perce—Clearwater National Forests, most of the moist Douglas-fir habitat types are PSME/*Physocarpus capitatus* (PHCA) (ninebark) series. On the Nez Perce National Forest, these habitat types lack the characteristics necessary to provide hare habitat as spruce and lodgepole pine are generally negligible components and tall shrubs are limited (P. Green, data analyst, USFS Region 1, NPCNF, pers. comm.). On the Clearwater National Forest PSME/PHCA above 4,000 feet might be suitable secondary habitat (P. Green pers. comm.), so we only considered PVT with PSME on the Clearwater National Forest above 4,000 ft. We used the PVT class psme2 because it included the PSME/PHCA series that is potentially suitable as secondary habitat.

Elevation

In northwest Montana, lynx occupy subalpine elevations between 4,134 and 7,726 feet (Squires et al. 2010). The LCAS did not directly provide elevation ranges specific to central Idaho but in the August 22, 2000 additional guidance based on recommendations by the Lynx Steering Committee 2000, it was recommended that areas below 4,000 feet should “usually” be excluded from mapping. Snow is a defining characteristic of winter lynx habitat and the snow is deeper in areas used by lynx compared to random availability (Squires et al. 2010). The upper limits of lynx habitat are the upper limits of subalpine forest cover. Lynx select home ranges with high canopy cover (Squires et al. 2013). Ranges above the subalpine zone tree cover are too sparse to support lynx.

Nez Perce–Clearwater National Forests have deep snows in the winter but the elevation band of persistent snow is higher than on the east side of the Continental Divide (M. Bienkowski, silviculturist, USFS Region 1, NPCNF, pers. comm.). We therefore considered raising the minimum elevation in the mapping to higher than 4,000 ft. However, throughout the course of evaluating a preliminary map of primary habitat and discussing the matter with Bryon Holt, USFWS, Northern Idaho Field Office, Spokane, WA, we decided against having a lower elevational limit to the lynx habitat map. Potential spruce-fir habitat rarely occurs below 4,000 ft on the Nez Perce–Clearwater National Forests, but when it does we decided it could be within natural pockets affected by topographic features and climate; and we did not want to exclude potentially suitable habitat based on elevation alone.

We excluded potential habitat above 7,000 ft because of sparse tree cover above this elevation on the Nez Perce–Clearwater National Forests. The selected PVT classes for primary habitat included much of the area above 7,000 ft on the Nez Perce–Clearwater National Forests. After carefully reviewing the high elevation potential primary habitat over satellite imagery and VMap and FSVEG in GIS, we determined that, above 6,800–7,000 ft, very few conifer stands of a size were in existence to support snowshoe hare and lynx.

Denning

Denning habitat is used by females in the late winter and early spring while giving birth and rearing kittens. In northwest Montana, lynx dens were located in mature multi-storied stands of spruce-fir with high horizontal cover, abundant coarse woody debris, and higher canopy closure (Squires et al. 2008). Lynx prefer to den in coarse woody debris such as large diameter mature downed trees or small-diameter piled logs, but will also use protected areas in talus and boulders, disease-infected forests, etc. (Squires et al. 2008). To delineate denning habitat within our map of potential lynx habitat, we used maps of existing vegetation (VMap) to select mature stands with high canopy closure. We selected stands with ≥ 40% canopy cover and used large trees as an indicator for mature forest by selecting for stands with trees with ≥ 20 inch diameter at breast height (DBH).

Denning habitat is generally abundant across the coniferous forest landscape and den sites are not likely to be limiting (USDA Forest Service 2007, Squires et al. 2008). For this reason, some forests are not delineating denning habitat in remapping efforts. However, maintaining high quality and good distributions of denning habitat within an LAU helps to assure survival and reproduction by adult females. To have the option of assessing potential denning habitat and changes based on management, in order to inform management, we included the denning category in this remapping effort.

Currently Unsuitable

Forest stands that are in early stand initiation and stem exclusion structural stage do not provide forage and cover for snowshoe hares in the winter and, therefore, do not provide winter foraging habitat for Canada lynx (Ruediger et al. 2000; Squires et al. 2010, 2013; Interagency Lynx Biology Team 2013). Stands in the initiation structural stage are short enough to be covered by snow in the winter and stands in the stem exclusion stage don't have low horizontal cover and high stem densities to provide cover and foraging for snowshoe hare in the winter (Hodges 2000*b*, Lewis et al. 2011).

Stand-replacing wildfires and regeneration timber harvest create stands that are unsuitable for snowshoe hares and lynx until the stand grows beyond the stem exclusion stage. The number of years after a severe burn or regeneration harvest before a stand has the horizontal stand structure required to support snowshoe hare and lynx depends greatly on the degree of disturbance, stand ecology, local climate, and topography. Therefore, it is difficult to predict an average time a stand grows before it surpasses the stem exclusion stage across the Forests (M. Bienkowski pers. comm.). We estimated 25 years based on a recent forest vegetation simulation analysis by M. Bienkowski (pers. comm.) near Powell, ID. This was consistent with what the Nez Perce National Forest and similar to what the Clearwater National Forest used in previous lynx mapping. We used forestry and fire severity data by year to determine which stands were in unsuitable condition because of stand age and classified those as currently unsuitable.

We would have liked to run a forest vegetation simulation model on representative stands within each LAU to determine the age at which a stand grows beyond the stem exclusion stage (as suggested by M. Bienkowski) but did not have the time. We plan to complete this in the near future to further refine the currently unsuitable habitat for the Nez Perce–Clearwater National Forests lynx habitat map.

Lynx Analysis Units

The Lynx Conservation Assessment Strategy recommended that Lynx Analysis Units (LAUs) be identified for all areas with lynx habitat in order to provide an area to monitor habitat changes and the effects of management on individual lynx (Ruediger et al. 2000). LAUs are intended to approximate an area needed to support a female lynx year-round and should have sufficient primary vegetation in condition that is suitable for survival and reproduction (Ruediger et al. 2000, USDA Forest Service 2007, Interagency Lynx Biology Team 2013). LAUs should be approximately 16,000 to 32,000 acres but may be larger in less continuous, fragmented habitat (Ruediger et al. 2000). At least 6,400 acres (10 miles^2) of primary habitat are necessary within each LAU, which is the estimated amount of habitat needed to support a female lynx all year (Interagency Lynx Biology Team 2013). Existing ecological units, such as watersheds (6th hydrologic unit codes (HUCs)), are to be used as the basis for mapping LAUs except for the following situations: (a) when HUCs with only small patches of habitat are beyond the daily movement distance of a lynx, the LAU can be discarded (Interagency Lynx Biology Team 2013); or (b) HUCs with insufficient amounts of lynx primary habitat can be combined among neighboring LAUs (Ruediger et al. 2000).

Once we mapped primary habitat, we mapped new LAUs for the Nez Perce–Clearwater National Forests (**Table 5-4**). Watersheds (HUCs) were the basis for delineating the LAUs. We mapped primary habitat and used the calculated area of primary habitat within each HUC to determine if it contained sufficient habitat to support a lynx. Where there were HUCs that did not contain sufficient habitat, adjacent HUCs were either combined in full or portions of those were appended to neighboring HUCs. When combining portions of neighboring HUCs, we attempted to consolidate habitat in a way that best represented a potential lynx home range. When drawing LAU boundaries that did not follow HUC boundaries, we preferred to follow geographic features such as streams or ridges. In some areas, consolidated habitat was not bounded by a geographic feature to follow; and in these cases, we buffered the primary habitat by 200 meters and drew the LAU boundary on or near to the buffer edge (Figure 5-3 and Figure 5-4).

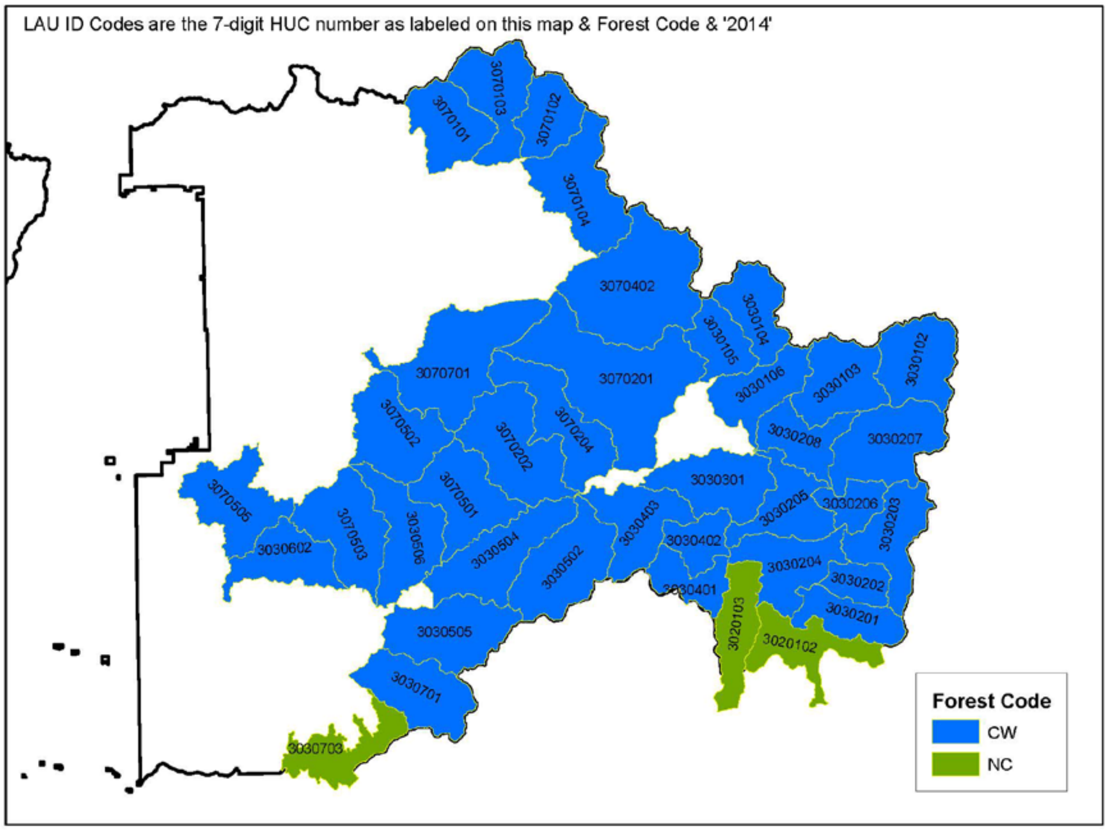

Figure 5-3. Lynx Analysis Unit Identification (LAU ID) codes for the Clearwater National Forest portion of the Nez Perce–Clearwater National Forests

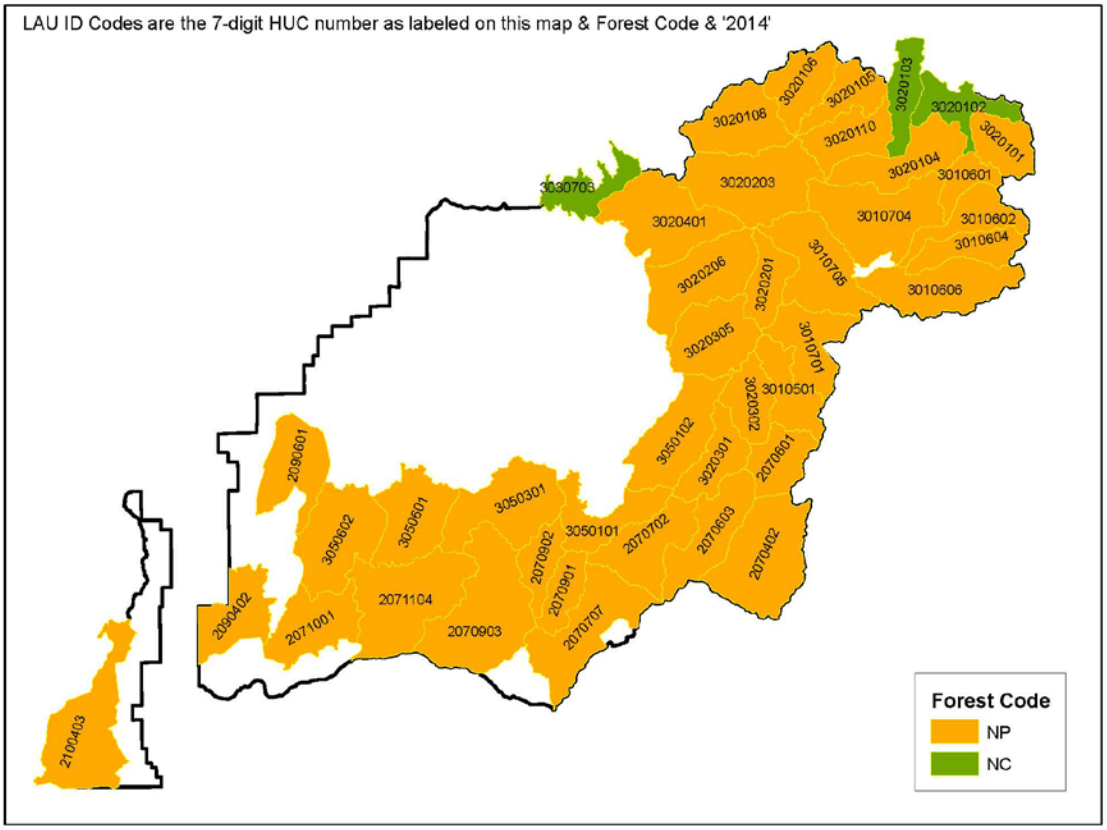

Figure 5-4. Lynx Analysis Unit Identification (LAU ID) codes for the Nez Perce National Forest portion of the Nez Perce–Clearwater National Forests

Mapping Process/Steps

See Table 5-5 for a summary of all GIS datasets used in the mapping process, including full name, acronym, data type, file name, and file pathway for storage location on the T-drive or (in the case of PVT) location to download data on the Web. All GIS processing was done by Kathy Brodhead, wildlife biologist, USFS Region 1, Nez Perce–Clearwater National Forests.

Potential Lynx Habitat

- Reproject Potential Vegetation Type layer for Region 1 to NAD83 zone 11 and clip to the forest boundary buffered by 1 km.
- Reclassify PVT to potential habitat raster.
    - Reclassify classes: abla1, abla2, abla3, abla4, picea, and pico to 1.
    - Reclassify classes: abgr2, abgr3, thpl2, tshe, tsme1, tsme2, and tsme3 to 2.
    - Reclassify psme2 to 3.
    - Reclassify all other classes 'NoData'.
- Convert the reclassified raster to polygon feature class (uncheck 'simplify polygons' box).

- Select grid_code = 1, export to new feature class: primary.
- Select grid_code = 2, export to new feature class: second_1_nopsme.
- Select grid_code = 3, export to new feature class: psme2_1.
- Reclassify 10-meter DEM to three classes: <4,000 ft., 4,000–7,000 ft., >7,000 ft (<1219 m, 1219–2134 m, >2134 m) and convert to polygon feature class with one feature for each elevational band: elev_4to7k.
- Clip psme2 (1) to elevation features above 4,000 ft and then (2) to the CWNF boundary.
- Merge clipped psme2 and second_1_nopsme: second_2_merged.
- Add short integer field habTyp to attribute table of all feature classes and calculate HabTyp = 1 for primary, HabTyp = 2 for secondary.
- Buffer primary habitat by 200 m and clip secondary to the buffer: second_3_clip.
- Dissolve secondary habitat based on habTyp but do not allow the creation of multipart features so that all contiguous habitat is one polygon feature but spatially distinct habitat clumps are separate features: second_4_dissv.
- Use select by location to select secondary habitat that is ***not*** adjacent to primary habitat (select features that share boundary, switch selection) and delete selected features.
- Merge primary and secondary: potentialhab.
- Delete potential habitat >7,000 ft.
- Add ownership information to potential habitat. Add field text field to NFOwner and calculate = "nf" where owner is clw, nez, or nfsl; = "pvt" where owner is timber company or private; all others = CODE. Dissolve on owner: landowner. Intersect potential habitat and landowner: potentialhab_1_allowners.
- Export potential habitat on federal land: potentialhab_2_fed_own.

Denning

- Select vmap polygons where canopy cover is greater than 40% and where, (a) DBH >= 15 for lodgepole (DOM_MID_40 = PICO) or (b) DBH >= 20" for all other species. Export to new layer and clip to potentialhab_2_fedOwn: vmap_denning.
- Denning combined with potential habitat (see Final Model below).

Currently Unsuitable

- The forest's Activity Polygons were related to the Activity Tables (NEZ_ACTV160_2014_02_25 & CLW_ACTV160_2014_02_25). Polygons were selected with Activity Codes =4100 to 4199 and date > 02/1989 and exported to new feature classes (a_nez_regen_p021989 and b_clw_rengen_p021989).
- High severity fires in year > 1988 were selected from Fire Severity by Year (c_sevrfire_p1988).
- Merge three above feature classes (d_RegenNFire_merged) and then clip to potentialhab_2_fedown (e_RegenNFire_inLynxhab).

Final Model

- Combine potential habitat, denning, and currently unsuitable by union. Add short integer field 'denning' and set = 1 where habitat is denning all others = 0. Add text field ‘status’ and set = ‘cus’ where currently unsuitable; all others = ‘hab’. Add Lynx_Hab field and set = ‘cus’ when status = ‘cus’, set = ‘den’ when status = ‘hab’ and denning = 1, all others = ‘genhab’. This feature class is named LynxHabitat_1_noLAU_allDen and can be used if there is a need to find out if currently unsuitable habitat is denning or general habitat.

- Dissolve on LynxHab but uncheck allow multipart features: LynxHabitat_2_noLAU. Add double field, ‘acres’ and calculate acres. Change denning habitat where < 5 acres of contiguous denning habitat to ‘genhab’.
- Dissolve on LynxHab but keep ‘allow multipart features’ checked. This feature class is named LynxHabitat_3_dissv and has three features – one for each type of habitat.
- Intersect LAUs and LynxHabitat_3_dssv: LynxHabitat_4_byLAU. Add ‘acres’ field and calculate acres.
- Add the following fields to LAU_NPCW_2014 layer: acreGenHab, acreDen, acreCUS, acreTotHab. One at a time, for each habitat type (cus, genhab, den), do a definition query on LynxHabitat_4_byLAU (e.g., LynxHab = ‘genhab’), join the table to LAU table by HUC ID, calculate appropriate acre field using Lynx Habitat layer acre (e.g., acreGenHab), remove join, and repeat until all three fields are calculated. Calculate acreTotHab = acreGenHab + acreDen + acreCUS.

Table 5-1. Summary of Vegetation Response Units (VRU) on the Nez Perce National Forest and Land Type Association Groups on the Clearwater National Forest

System	Description	Habitat Type Groups	Forest Cover Type
VRU 1	Convex slopes, ABLA	9, 7, 3, 4	ABLA, ABGR, PICO
VRU 2	Glaciated slopes, ABLA	9, 7, 10, 11	ABLA, PIAL, PICO, PIEN
VRU 5	Moraines, ABLA & ABGR	9, 7, 8	PICO, PIEN, PIAL
VRU 6	Cold basins, ABGR & ABLA	3, 4, 9, 7, 8	ABGR, ABLA
VRU 9	High elevation ridges, ABLA & PIAL	9, 10, 11, 7	ABLA, PIAL
VRU 10	Uplands, alder, ABGR & ABLA	4, 5, 7, 8	ABGR, ABLA, TSME
LTA G2	High elevation stream bottoms and glacial terraces	7, 8, 9	ABLA, PIEN, PICO
LTA G6	Alpine glaciated ridges	7, 8, 9, 10, 11	ABLA, PIEN, PICO, PIAL, TSME
LTA G7	Scoured alpine glaciated troughs	9, 10, 11	PICO, ABLA, PIAL, TSHE, PSME
LTA G8	Plastered alpine glaciated troughs	7, 8	ABLA, PIEN, TSME
LTA G9	Alpine icecap uplands and basins	7, 8, 9	ABLA, PIEN, PSME, PICO
LTA G12	High elevation frost churned ridges	10, 11	PIAL, ABLA
LTA G13	Dry frost churned ridges	7, 9, 4, 8, 9	ABLA, PICO, PSME, ABGR
LTA G14	Moist frost churned ridges	7, 4, 5, 8	ABLA, PICO, ABGR, PSME
LTA G16	Low relief rolling hills - umbric or fragipan	5, 4, 6	ABGR, PSME, ABLA

Note: See Table 5-3 for tree species codes listed in Description and Forest Cover Type

Table 5-2. Potential lynx habitat (primary or secondary), Potential Vegetation Type (PVT) classes that were selected for consideration in mapping potential lynx habitat (see Appendix A), habitat type codes (HT_code) and groups (HTG) for the Nez Perce National Forest (see HTG 2005), habitat types (see Cooper et al. 1991), and habitat type group descriptions (see HTG 2005)

Habitat	PVT	HT_code	HTG NPCNF	Habitat Type	HTG Description
primary	abla1	610	8	abla/opho	cool_wet
primary	abla1	630	8	abla/gatr	cool_wet
primary	abla1	635	8	abla/stam	cool_wet
primary	abla1	636	8	abla/stam-mefe	cool_wet
primary	abla1	637	8	abla/stam-lica	cool_wet
primary	abla1	650	8	abla/caca	cool_wet
primary	abla1	651	8	abla/caca-caca	cool_wet
primary	abla1	652	8	abla/caca-lica	cool_wet
primary	abla1	653	8	abla/caca-gatr	cool_wet
primary	abla1	654	8	abla/caca-vaca	cool_wet
primary	abla1	655	8	abla/caca-legl	cool_wet
primary	abla2	620	7	abla/clun	cool_moist
primary	abla2	621	7	abla/clun-clun	cool_moist
primary	abla2	622	7	abla/clun-arnu	cool_moist
primary	abla2	623	7	abla/clun-vaca	cool_moist
primary	abla2	624	7	abla/clun-xete	cool_moist
primary	abla2	625	7	abla/clun-mefe	cool_moist
primary	abla2	660	7	abla/libo	cool_moist
primary	abla2	661	7	abla/libo-libo	cool_moist
primary	abla2	662	7	abla/libo-xete	cool_moist
primary	abla2	663	9	abla/libo-vasc	cool_mod_dry
primary	abla2	671	7	abla/mefe-cooc	cool_moist
primary	abla2	673	7	abla/mefe-xete	cool_moist
primary	abla2	740	7	abla/alsi	cold_mod_dry
primary	abla3	640	9	abla/vaca	cool_mod_dry
primary	abla3	691	9	abla/xete-vagl	cool_mod_dry
primary	abla3	693	9	abla/xete-cooc	cool_mod_dry
primary	abla3	720	9	abla/vagl	cool_mod_dry
primary	abla3	730	10	abla/vasc	cold_mod_dry
primary	abla3	750	9	abla/caru	cool_mod_dry
primary	abla3	770		abla/clps	cool_mod_dry
primary	abla3	780	9	abla/arco	cool_mod_dry
primary	abla3	790	9	abla/cage	cool_mod_dry
primary	abla3	791	9	abla/cage-cage	cool_mod_dry
primary	abla3	792	9	abla/cage-psme	cool_mod_dry
primary	abla4	670	7	abla/mefe	cool_moist
primary	abla4	672	10	abla/mefe-luhi	cool_moist

Habitat	PVT	HT_code	HTG NPCNF	Habitat Type	HTG Description
primary	abla4	674	10	abla/mefe-vasc	cool_moist
primary	abla4	690	9	abla/xete	cool_mod_dry
primary	abla4	692	10	abla/xete-vasc	cool_mod_dry
primary	abla4	694	10	abla/xete-luhi	cool_mod_dry
primary	abla4	731	10	abla/vasc-caru	cool_mod_dry
primary	abla4	732	10	abla/vasc-vasc	cold_mod_dry
primary	abla4	733	10	abla/vasc-thoc	cool_moist
primary	abla4	810		abla/rimo	cool_moist
primary	abla4	830	10	abla/luhi	cold_mod_dry
primary	abla4	831	10	abla/luhi-vasc	cold_mod_dry
primary	abla4	832	10	abla/luhi-mefe	cool_moist
primary	picea	400		picea series	
primary	picea	410	8	picea/eqar	cool_wet
primary	picea	420	7	picea/clun	cool_moist
primary	picea	421	7	picea/clun-vaca	cool_moist
primary	picea	422	7	picea/clun-clun	cool_moist
primary	picea	430		picea/phma	cool_mod_dry
primary	picea	440	8	picea/gatr	cool_wet
primary	picea	450	9	picea/vaca	cool_mod_dry
primary	picea	460	7	picea/sest	mod_cool_moist
primary	picea	461	7	picea/sest-psme	mod_cool_moist
primary	picea	462	7	picea/sest-picea	mod_cool_moist
primary	picea	470	7	picea/libo	cool_moist
primary	picea	480	8	picea/smst	cool_wet
primary	pico	900		pico series	
primary	pico	910	9	pico/putr	cool_mod_dry
primary	pico	920	9	pico/vaca	cool_mod_dry
primary	pico	925	10	pico/xete	cold_mod_dry
primary	pico	930	9	pico/libo	cool_mod_dry
primary	pico	940	10	pico/vasc	cold_mod_dry
primary	pico	950	9	pico/caru	cool_mod_dry
secondary	abgr1	505	2	abgr/spbe	mod_warm_dry
secondary	abgr1	506	2	abgr/phma	mod_warm_dry
secondary	abgr1	507	2	abgr/phma-cooc	mod_warm_dry
secondary	abgr1	508	2	abgr/phma-phma	mod_warm_dry
secondary	abgr2	510	3	abgr/xete	mod_warm_mod_dry
secondary	abgr2	511	3	abgr/xete-cooc	mod_warm_mod_dry
secondary	abgr2	512	3	abgr/xete-vagl	mod_warm_mod_dry
secondary	abgr2	515	3	abgr/vagl	mod_warm_mod_dry
secondary	abgr2	590	3	abgr/libo	mod_warm_mod_dry

Habitat	PVT	HT_code	HTG NPCNF	Habitat Type	HTG Description
secondary	abgr2	591	3	abgr/libo-libo	mod_warm_mod_dry
secondary	abgr2	592	3	abgr/libo-xete	mod_warm_mod_dry
secondary	abgr3	516	4	abgr/asca	mod_warm_moist
secondary	abgr3	517	4	abgr/asca-asca	mod_warm_moist
secondary	abgr3	518	4	abgr/asca-mefe	mod_warm_moist
secondary	abgr3	519	4	abgr/asca-tabr	mod_warm_moist
secondary	abgr3	520	4	abgr/clun	mod_warm_moist
secondary	abgr3	521	4	abgr/clun-clun	mod_warm_moist
secondary	abgr3	522	4	abgr/clun-arnu	mod_warm_moist
secondary	abgr3	523	3	abgr/clun-xete	mod_warm_mod_dry
secondary	abgr3	524	4	abgr/clun-phma	mod_warm_moist
secondary	abgr3	525	4	abgr/clun-mefe	mod_warm_moist
secondary	abgr3	526	4	abgr/clun-tabr	mod_warm_moist
secondary	abgr3	529	4	abgr/setr	mod_warm_moist
not habitat	psme1	210	1	psme/agsp	warm_dry
not habitat	psme1	220	1	psme/feid	warm_dry
not habitat	psme1	230	1	psme/fesc	warm_dry
not habitat	psme1	380		psme/syor	mod_warm_dry
secondary/not habitat	psme2	250	2	psme/vaca	mod_warm_dry
secondary/not habitat	psme2	260	2	psme/phma	mod_warm_dry
secondary/not habitat	psme2	261	2	psme/phma-phma	mod_warm_dry
secondary/not habitat	psme2	262	2	psme/phma-caru	mod_warm_dry
secondary/not habitat	psme2	263	2	psme/phma-smst	mod_warm_dry
secondary/not habitat	psme2	280	2	psme/vagl	mod_warm_dry
secondary/not habitat	psme2	281	2	psme/vagl-vagl	mod_warm_dry
secondary/not habitat	psme2	282	2	psme/vagl-aruv	mod_warm_dry
secondary/not habitat	psme2	283	2	psme/vagl-xete	mod_warm_dry
secondary/not habitat	psme2	290	3	psme/libo	mod_warm_mod_dry
secondary/not habitat	psme2	291	3	psme/libo-syal	mod_warm_mod_dry
secondary/not habitat	psme2	292	2	psme/libo-caru	mod_warm_dry
secondary/not habitat	psme2	293	3	psme/libo-vagl	mod_warm_mod_dry
secondary/not habitat	psme2	310	2	psme/syal	mod_warm_dry
secondary/not habitat	psme2	311	1	psme/syal-agsp	warm_dry
secondary/not habitat	psme2	312	2	psme/syal-caru	mod_warm_dry
secondary/not habitat	psme2	313	2	psme/syal-syal	mod_warm_dry
not habitat	psme3	320	2	psme/caru	mod_warm_dry
not habitat	psme3	321	1	psme/caru-agsp	warm_dry
not habitat	psme3	322	2	psme/caru-aruv	mod_warm_dry
not habitat	psme3	323	2	psme/caru-caru	mod_warm_dry
not habitat	psme3	324	2	psme/caru-pipo	mod_warm_dry

Habitat	PVT	HT_code	HTG NPCNF	Habitat Type	HTG Description
not habitat	psme3	330	2	psme/cage	mod_warm_dry
not habitat	psme3	340	2	psme/spbe	mod_warm_dry
not habitat	psme3	350	2	psme/aruv	mod_warm_dry
not habitat	psme3	360	2	psme/juco	mod_warm_dry
not habitat	psme3	370	2	psme/arco	mod_warm_dry
not habitat	thpl1	540	6	thpl/atfi	mod_cool_wet
not habitat	thpl1	541	6	thpl/atfi-adpe	mod_cool_wet
not habitat	thpl1	542	6	thpl/atfi-atfi	mod_cool_wet
not habitat	thpl1	550	6	thpl/opho	mod_cool_wet
not habitat	thpl1	555	5	thpl/gydr	mod_cool_moist
not habitat	thpl1	560	6	thpl/adpe	mod_cool_wet
secondary	thpl2	530	5	thpl/clun	mod_cool_moist
secondary	thpl2	531	5	thpl/clun-clun	mod_cool_moist
secondary	thpl2	532	5	thpl/clun-arnu	mod_cool_moist
secondary	thpl2	533	5	thpl/clun-mefe	mod_cool_moist
secondary	thpl2	534	5	thpl/clun-xete	mod_cool_moist
secondary	thpl2	535	5	thpl/clun-tabr	mod_cool_moist
secondary	thpl2	545	5	thpl/asca	mod_cool_moist
secondary	thpl2	546	5	thpl/asca-asca	mod_cool_moist
secondary	thpl2	547	5	thpl/asca-mefe	mod_cool_moist
secondary	thpl2	548	5	thpl/asca-tabr	mod_cool_moist
secondary	tshe	502		tshe series	
secondary	tshe	565	5	tshe/gydr	mod_cool_moist
secondary	tshe	570	5	tshe/clun	mod_cool_moist
secondary	tshe	571	5	tshe/clun-clun	mod_cool_moist
secondary	tshe	572	5	tshe/clun-arnu	mod_cool_moist
secondary	tshe	573	5	tshe/clun-mefe	mod_cool_moist
secondary	tshe	574	5	tshe/clun-xete	mod_cool_moist
secondary	tshe	575	5	tshe/asca	mod_cool_moist
secondary	tshe	576	5	tshe/asca-arnu	mod_cool_moist
secondary	tshe	577	5	tshe/asca-mefe	mod_cool_moist
secondary	tshe	578	5	tshe/asca-asca	mod_cool_moist
secondary	tshe	579	7	tshe/mefe	cool_moist
secondary	tsme1	675	8	tsme/stam	cool_wet
secondary	tsme1	676	10	tsme/stam-luhi	cool_wet
secondary	tsme1	677	8	tsme/stam-mefe	cool_wet
secondary	tsme1	685	7	tsme/clun	cool_moist
secondary	tsme1	686	7	tsme/clun-mefe	cool_moist
secondary	tsme1	687	7	tsme/clun-xete	cool_moist
secondary	tsme2	682	7	tsme/mefe-xete	cool_moist

Habitat	PVT	HT_code	HTG NPCNF	Habitat Type	HTG Description
secondary	tsme2	710	9	tsme/xete	cool_mod_dry
secondary	tsme2	712	9	tsme/xete-vagl	cool_mod_dry
secondary	tsme3	680	7	tsme/mefe	cool_moist
secondary	tsme3	681	10	tsme/mefe-luhi	cool_moist
secondary	tsme3	711	10	tsme/xete-luhi	cool_mod_dry
secondary	tsme3	713	10	tsme/xete-vasc	cool_mod_dry
secondary	tsme3	840	10	tsme/luhi	cold_mod_dry
secondary	tsme3	841	10	tsme/luhi-vasc	cold_mod_dry
secondary	tsme3	842	10	tsme/luhi-mefe	cold_mod_dry

Note: See Table 5-3 for 4-letter tree species codes or see Cooper et al. 1991 or USDA Plants Database online (available at URL: http://plants.usda.gov) for 4-letter understory associate species codes.

Table 5-3. Tree species and species codes

Scientific Name	Common Name	Species Code
Abies grandis	grand fir	ABGR
Abies lasiocarpa	subalpine fir	ABLA
Pinus albicaulis	whitebark pine	PIAL
Pinus contorta	lodgepole pine	PICO
Picea engelmannii	Englemann spruce	PIEN
Pinus monticoloa	western white pine	PIMO
Pinus ponderosa	ponderosa pine	PIPO
Pseudotsuga menziesii	Douglas-fir	PSME
Taxus brevifolia	Pacific yew	TABR
Thuja plicata	western redcedar	THPL
Tsuga heterophylla	western hemlock	TSHE
Tsuga mertensiana	mountain hemlock	TSME

Table 5-4. Lynx Analysis Units (LAUs) summary. The number of acres and square miles in each LAU. Acres of general habitat, denning habitat, and currently unsuitable habitat (CUS). The watershed (HUC12) with the most area in each LAU is listed.

LAU 2014 ID	Forest	LAU (mi^2)	LAU (acres)	GenHab (acres)	Denning (acres)	CUS (acres)	TotHab (acres)	HUC12 Name
3020102NC2014	BOTH	35	22,452	12,176	165	474	12,815	Upper East Fork Moose Creek
3030703NC2014	BOTH	34	21,492	17,850	184	0	18,034	Fire Creek
3020103NC2014	BOTH	33	20,935	14,685	190	690	15,565	Cedar Creek
3070201CW2014	CLW	105	66,882	44,278	1,820	1,836	47,934	Upper Cayuse Creek
3070402CW2014	CLW	89	56,871	34,615	2,084	3	36,702	Upper Kelly Creek
3070701CW2014	CLW	74	47,337	34,964	1,474	0	36,438	Fourth of July Creek
3070202CW2014	CLW	58	36,909	25,875	1,217	535	27,627	Gravey Creek
3070104CW2014	CLW	54	34,393	25,876	2,286	1,264	29,426	Lake Creek (N.Fk.Clw)
3030502CW2014	CLW	52	33,307	24,130	0	3,521	27,651	Lake Creek (Lochsa)
3030207CW2014	CLW	51	32,708	24,643	16	514	25,173	Storm Creek
3030505CW2014	CLW	50	32,109	23,984	0	0	23,984	Boulder Creek
3030504CW2014	CLW	50	32,021	13,358	0	0	13,358	Stanley Creek-Lochsa River
3070503CW2014	CLW	49	31,590	14,375	3,208	0	17,583	Little Weitas Creek
3070502CW2014	CLW	49	31,132	20,905	791	0	21,696	Middle Weitas Creek
3070204CW2014	CLW	47	30,022	19,813	911	82	20,806	Middle Cayuse Creek
3070501CW2014	CLW	47	29,827	17,861	77	55	17,993	Upper Weitas Creek
3070505CW2014	CLW	45	28,685	13,705	11,492	689	25,886	Hemlock Creek
3030506CW2014	CLW	44	28,415	12,489	856	0	13,345	Bald Mountain Creek-Lochsa River
3030701CW2014	CLW	44	28,122	16,883	0	0	16,883	Old Man Creek
3030301CW2014	CLW	43	27,530	16,210	0	2	16,212	Walton Creek-Lochsa River
3070103CW2014	CLW	42	26,831	21,464	3,869	8	25,341	Vanderbilt Creek-North Fork Clearwater River
3030102CW2014	CLW	41	26,150	10,724	0	1,120	11,844	Spruce Creek

LAU 2014 ID	Forest	LAU (mi^2)	LAU (acres)	GenHab (acres)	Denning (acres)	CUS (acres)	TotHab (acres)	HUC12 Name
3030103CW2014	CLW	40	25,841	13,700	40	313	14,053	Lower Brushy Fork Creek
3030403CW2014	CLW	40	25,444	17,743	9	748	18,500	Lower Warm Springs Creek
3030203CW2014	CLW	39	24,758	11,678	0	2,922	14,600	Upper Colt Killed Creek
3030204CW2014	CLW	38	24,497	17,883	9	4,831	22,723	Lower Big Sand Creek
3070101CW2014	CLW	37	23,476	16,551	2,021	132	18,704	Meadow Creek-CLW
3030205CW2014	CLW	35	22,561	17,863	102	507	18,472	Colt Creek
3030602CW2014	CLW	35	22,319	14,709	613	1,451	16,773	Hungery Creek
3030106CW2014	CLW	34	21,853	10,493	121	772	11,386	Lower Crooked Fork Creek
3030104CW2014	CLW	30	19,448	16,446	145	858	17,449	Upper Crooked Fork Creek
3030208CW2014	CLW	29	18,842	11,484	96	758	12,338	Lower Colt Killed Creek
3070102CW2014	CLW	28	17,916	16,236	834	94	17,164	Long Creek
3030201CW2014	CLW	27	17,368	12,314	0	673	12,987	Upper Big Sand Creek
3030105CW2014	CLW	25	16,032	12,937	107	0	13,044	Boulder Creek-Crooked Fork Creek
3030401CW2014	CLW	22	13,786	11,252	0	157	11,409	Upper Warm Springs Creek
3030402CW2014	CLW	20	12,560	10,556	58	0	10,614	Wind Lakes Creek
3030206CW2014	CLW	17	10,811	8,538	25	248	8,811	Middle Colt Killed Creek
3030202CW2014	CLW	16	10,518	5,086	0	2,715	7,801	Hidden Creek
2070903NP2014	NEZ	107	68,510	13,308	0	2,110	15,418	Lake Creek (Salmon)
2071104NP2014	NEZ	97	62,113	12,775	25	899	13,699	Sheep Creek
2070402NP2014	NEZ	89	57,001	10,766	17	46	10,829	Upper Sabe Creek
3020203NP2014	NEZ	88	56,478	23,428	165	317	23,910	Three Links Creek
2100403NP2014	NEZ	88	56,224	15,535	639	2,349	18,523	West Fork Rapid River
3010704NP2014	NEZ	87	55,666	20,501	268	1,147	21,916	Pettibone Creek

LAU 2014 ID	Forest	LAU (mi^2)	LAU (acres)	GenHab (acres)	Denning (acres)	CUS (acres)	TotHab (acres)	HUC12 Name
3020401NP2014	NEZ	82	52,602	27,132	97	14	27,243	Gedney Creek
2070707NP2014	NEZ	77	49,569	22,266	16	1,046	23,328	Jersey Creek-Salmon River
3050301NP2014	NEZ	76	48,597	18,501	1,869	977	21,347	Upper Crooked River
3050602NP2014	NEZ	75	48,303	24,785	2,483	251	27,519	Gospel Creek
3020206NP2014	NEZ	73	46,656	14,076	151	1,405	15,632	Pinchot Creek-Selway River
3010705NP2014	NEZ	72	46,187	14,168	110	11	14,289	Dog Creek-Selway River
3050102NP2014	NEZ	69	44,350	18,792	4,563	571	23,926	Upper Red River
3010606NP2014	NEZ	67	42,923	15,689	54	38	15,781	Lower Cub Creek
2090601NP2014	NEZ	61	39,155	19,844	3,793	1,149	24,786	South Fork White Bird Creek
3020305NP2014	NEZ	60	38,698	23,882	314	104	24,300	Buck Lake Creek
3050601NP2014	NEZ	60	38,529	24,119	842	47	25,008	Upper Johns Creek
2070603NP2014	NEZ	57	36,647	17,516	185	312	18,013	Lower Bargamin Creek
2070702NP2014	NEZ	57	36,529	30,432	19	693	31,144	Big Mallard Creek
3020108NP2014	NEZ	57	36,396	28,225	378	1,279	29,882	Rhoda Creek
3020104NP2014	NEZ	56	35,689	17,559	43	893	18,495	Middle East Fork Moose Creek
2071001NP2014	NEZ	55	34,901	24,329	521	1,008	25,858	Meadow Creek-NEZ
3010701NP2014	NEZ	49	31,446	16,100	37	1,293	17,430	Goat Creek
2090402NP2014	NEZ	48	30,959	10,636	1,790	188	12,614	Fiddle Creek-Salmon River
3050101NP2014	NEZ	44	28,468	19,386	2,301	1,179	22,866	South Fork Red River
3020110NP2014	NEZ	42	26,887	13,964	186	144	14,294	Lower East Fork Moose Creek
3020106NP2014	NEZ	40	25,900	21,852	358	144	22,354	West Moose Creek
3010501NP2014	NEZ	38	24,365	18,385	168	83	18,636	Upper Running Creek
3020301NP2014	NEZ	38	24,072	19,225	0	4,001	23,226	Headwaters Meadow Creek

LAU 2014 ID	Forest	LAU (mi^2)	LAU (acres)	GenHab (acres)	Denning (acres)	CUS (acres)	TotHab (acres)	HUC12 Name
3010602NP2014	NEZ	37	23,777	11,063	21	69	11,153	Upper Bear Creek
2070601NP2014	NEZ	36	23,084	18,644	38	1,695	20,377	Upper Bargamin Creek
3020302NP2014	NEZ	35	22,353	17,955	31	0	17,986	Upper Meadow Creek
3020101NP2014	NEZ	34	21,621	10,970	0	238	11,208	Headwaters East Fork Moose Creek
3010604NP2014	NEZ	33	21,329	11,425	87	338	11,850	Paradise Creek
3020105NP2014	NEZ	33	21,292	16,543	47	193	16,783	Upper North Fork Moose Creek
3020201NP2014	NEZ	33	20,988	12,125	331	1	12,457	Marten Creek
2070902NP2014	NEZ	28	17,984	11,375	0	0	11,375	Big Creek
2070901NP2014	NEZ	27	17,450	15,793	0	97	15,890	Upper Crooked Creek
3010601NP2014	NEZ	21	13,552	8,626	0	104	8,730	Wahoo Creek

Table 5-5. Spatial data layers used for modeling lynx habitat and creating Lynx Analysis Units

Spatial Data	Acronym	File Type	File Name	File Location
Potential Vegetation Types (PVT) Region 1 Classification of Western Montana and Northern Idaho	PVT	raster	zipped file on web	http://www.fs.usda.gov/detail/r1/landmanagement/gis/?cid=fsp5_030918
Administrative ownership	Ownership	feature class	Basic_Ownership_2013_11_05	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Master_gdb\NezClwFPR2012.gdb\Administrative
Activity Polygon - Nez Perce	FACTS	feature class	NEZ_ActivityPolygon	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Vegetation\Activities\FACTS.gdb
Activity Polygon - Clearwater	FACTS	feature class	CLW_ActivityPolygon	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Vegetation\Activities\FACTS.gdb
Forest activity tables - NPNF	Activity Tables	table	NEZ_ACTV160_2014_02_25	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Vegetation\Activities\FACTS.gdb
Forest activity tables - CWNF	Activity Tables	table	CLW_ACTV160_2014_02_25	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Vegetation\Activities\FACTS.gdb
Watersheds	HUC12	feature class	HUC12_Watershed_F2F	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Hydrology\HUC12_F2F.gdb
Fire Severity by Year	FIRE	feature class	Fire_Severity_by_Year	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Fire_Fuels\Fire_History\Fire_Severity.gdb
VMap (existing vegetation)	VMap	feature class	vmap_mid_RA	T:\FS\NFS\NezPerceClearwater\Project\MultiBasin\Planning\NezClwFPR2012\GIS\Data\Resource_Specific\Vegetation\CLWNEZ_VMap_v12_R1ALB_Rapid.gdb

5.1.1.6 Literature Cited

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Appendix A: Metadata for PVT

Full metadata available at URL (Accessed 03/10/2014):
http://www.fs.usda.gov/detail/r1/landmanagement/gis/?cid=fsp5_030918

U.S. Forest Service - Region 1

Potential Vegetation Type (PVT) Classification of western Montana and northern Idaho (2004)

Metadata:

Identification_Information:

Originator: USDA Forest Service, Northern Region

Publication_Date: 10/04/2004

Title: Potential Vegetation Type (PVT) Classification of western Montana and northern Idaho (2004)

Geospatial_Data_Presentation_Form: raster digital data

Publication_Information:

Publication_Place: Kalispell, Montana

Publisher: USDA Forest Service, Northern Region

Online_Linkage: *https://fs.usda.gov/Internet/FSE_DOCUMENTS/fsp5_030424.zip*

Description:

Grouping of habitat types into Potential Vegetation Type (PVT) types completed by Jeff Jones, Northern Region, National Fire Plan Cohesive Strategy Team. Habitat types from 3 sources: Cooper, Stephen V., Kenneth E. Neiman, and David W. Rev. 1991. Forest habitat types of northern Idaho: a second approximation. General Technical Report INT-236. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 143p. Pfister, Robert D., Bernard L. Kovalchik, Stephen F. Arno, and Richard C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service General Technical Report INT-34. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 174p. Mueggler, Walter F. and William L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. USDA Forest Service General Technical Report INT-66. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 154p.

Abstract:

Potential Vegetation Types (PVT) mapping units delineate areas having similar biophysical environments (e.g., similar climate and soil characteristics). PVT was modeled from spatially referenced field data having a reference to habitat type (Pfister et al. 1977, Mueggler and Stewart 1980, Cooper et al. 1991). Individual habitat types were aggregated, simplifying our PVT classification to 35 types (24 forest types, 3 shrubland types, 3 grassland types, 1 alpine type, and 4 non-vegetated types). We used a nearest neighbor technique, that extrapolated plot-level data (i.e., points) across the spatial domain by using precipitation, temperature, solar radiation, potential lifeform, elevation, aspect, slope, and soils data.

Purpose:

These data were prepared to supplement other data to assess integrated risks and opportunities at regional and subregional scales. Most scientific characterizations of ecosystems or assessments of watersheds can be enhanced by the use of some biophysical strata to help partition the natural variability in ecosystem components that occurs across landscapes. All ecosystem processes are constrained within the limits of their biophysical environment. Thus, PVTs are useful for characterizing terrestrial ecosystems that have similar disturbance processes and subsequent fine-scale patterns (e.g., species composition, stand structure, standing and downed wood, etc.). PVTs are a critical data component needed for modeling disturbance processes and their subsequent effects. We derived the PVT theme specifically to support the following models: historical fire regimes, current fire severity, fire-regime condition class, fire-behavior fuel models, crown fire behavior, crown bulk density, height-to-crown, stand height, wildlife habitats, weed susceptibility and threat, and general limitations. These data were derived using field plots from many different sources (e.g., FSVEG, ECODATA, FIA, DNRC) as well as remotely sensed data (e.g., satellite imagery and DEMs). The sampling designs for collecting these data were not intended to sample across environmental gradients. The spatial distribution of field plots was extremely variable. In general, expected accuracy is believed to be much lower in areas where plot data was sparse and relatively higher in areas with concentrated plot locations. These data were designed to characterize broad scale patterns for regional and subregional assessments. Any decisions based on these data should be supported with field verification, especially at scales finer than 1:100,000. Although the resolution of the PVT theme is at a 90 meter cell, the expected accuracy does not warrant their use for analyses of areas smaller than about 10,000 acres (for example, assessments that typically require 1:24,000 data). The data provide a coarse-filter approach to ecosystem assessments. Consequently, not every occurrence of every PVT is mapped; instead, only larger, more generalized distributions of certain types were mapped.

5.1.2 *Wolverine*

5.1.2.1 Distribution

The wolverine (*Gulo gulo luscus*) is circumboreal in distribution, occurring in Europe, Asia, and North America (IDFG 2005). In North America, the wolverine historically occurred in Alaska, Canada, western and northeastern United States, and the Great Lake states. Currently, wolverines appear to be distributed as functioning populations in Alaska, Canada, and in two regions of the contiguous United States: the north Cascades in Washington, and the northern Rocky Mountains in north and central Idaho, western Montana, and northwestern Wyoming (Aubry et al. 2007) (Figure 5-5). Even in the northern Rockies very little is known about the extent and status of wolverine populations (Aubry et al. 2007).

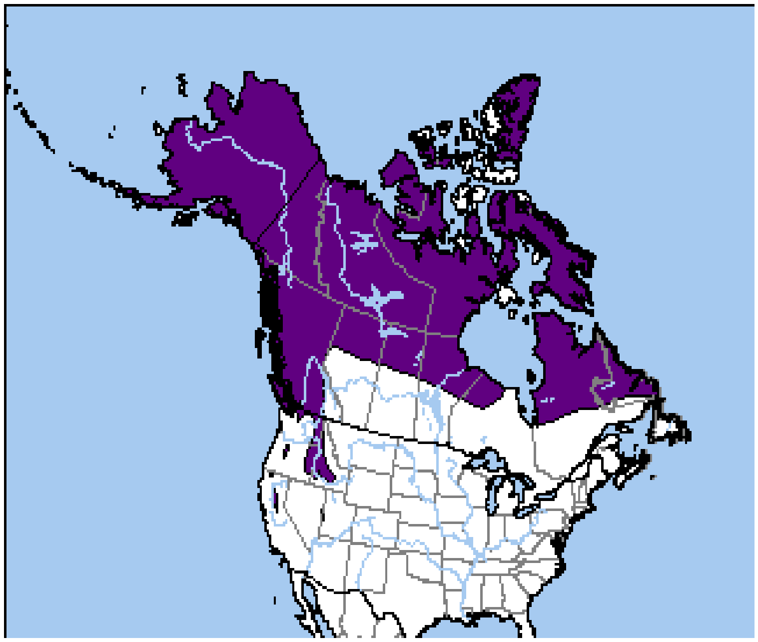

Figure 5-5. Current distribution of wolverines (from NatureServe)

Wolverine populations in Idaho are centered in the Selkirk Mountains, Lochsa and Kelly Creek drainages, and in the Smoky Mountain complex of the Sawtooth Mountains (Groves 1987 *in* IDFG 2005).

Wolverine numbers and population trends are unknown for Idaho (IDFG 2005). Population estimates for Canada and Alaska are approximate because no wolverine surveys have taken place at the state or national scale (USDI FWS 2008, p. 12932). Current population level and trends remain unknown for the contiguous United States because no systematic population census exists over the entire current range of the wolverine in the lower 48 states (USDI FWS 2008, p. 12935). It is estimated that approximately 250–300 wolverines exist in the contiguous United States (USDI FWS 2013, p. 7868). Wolverines typically exist in low density populations where members have notoriously large home ranges (Kucera and Zielinski 1995). Total population size around the world is unknown but estimated in the hundreds of thousands (NatureServe 2011). Substantial populations occur in northern Canada and Alaska. Outside of Alaska, Montana and Idaho likely have the largest populations in the United States.

5.1.2.2 Life History and Wolverine in Idaho

The wolverine is the largest terrestrial member of the family Mustelidae. Adult males weigh 20 to 40 lbs and adult females weigh 17 to 26 lbs (Banci 1994). The wolverine resembles a small bear with a bushy tail. It has a broad, rounded head; short, rounded ears; and small eyes. Each foot has 5 toes with curved, semi-retractable claws used for digging and climbing (Banci 1994). Wolverines have large feet and can move relatively easily through deep snow (Inman et al. 2012a).

Wolverines generally select areas that are cold and have persistent spring snow (USDI FWS 2013, p. 7867). Wolverines occupy a variety of habitats, but require large tracts of land to accommodate large home ranges and extensive movements (IDFG 2005, Banci 1994). Individual animals have large territories and can cover large distances in short time periods.

Home ranges of adult females in central Idaho averaged 148 mi^2, and annual home ranges of adult males averaged 588 mi^2 (Copeland 1996). Wolverine year-round habitat use takes place almost entirely within the area defined by deep persistent spring snow (Copeland et al. 2010).

Due to their large home range size and habitat needs, this species is rare and uncommon and most likely always has been. Wolverines use higher elevation, steep, remote habitat. Wilderness and roadless lands account for much of the areas wolverines are known to use, although it is unknown if this is due to avoidance of people, or that wolverine tend to choose areas that are not conducive to human development (Copeland et al. 2007). Wolverines appear capable of adjusting to human disturbance (USDI FWS 2013, p. 7880)

The primary habitat during the winter is mid-elevation conifer forest; summer habitat is subalpine areas associated with high-elevation cirques (Copeland 1996). Summer use of high elevation habitats is related to the availability of prey and den sites. Forest types used by wolverines in central Idaho include whitebark pine, Douglas-fir, and lodgepole pine (Copeland et al. 2007). Montane coniferous-dominated habitats accounted for 70.2% of adult male wolverine locations (Copeland et al. 2007). High-elevation habitats were used for relief from heat and denning (Copeland et al. 2007). Wolverines were more frequently found in low to moderately stocked stands of mature timber (Hornocker and Hash 1981). Habitat in the areas wolverines selected was characterized by steep terrain with a mix of tree cover, alpine meadow, boulders, and avalanche chutes (Inman et al. 2012a).

Females give birth to 2 to 3 young in late winter to early spring. Young are born in dens dug through the snow to ground level. Dens are located in the upper subalpine zone, at or near treeline and are associated with boulder fields, avalanche debris, or log jams. A source of carrion or other food is usually nearby.

Wolverines appear to be highly selective in choice of natal denning and kit rearing habitat. Denning habitat may be a factor limiting distribution and abundance (Copeland 1996); and the persistence of a snowpack into late spring is a strong determining factor in wolverine presence due to its importance in denning (Copeland et al. 2010, USDI FWS 2013). Persistent spring snow cover may also be a determining factor in wolverine dispersal and has consequences on gene flow (Schwartz et al. 2009).

Figure 5-6 depicts wolverine habitat on the Nez Perce–Clearwater National Forests modeled by Inman et al. (2013). This model was developed using radio transmittered wolverines in the Greater Yellowstone Ecosystem of Idaho, Montana, and Wyoming. Inman et al. (2013) identified areas suitable for specific wolverine uses that are biologically important and valuable for management purposes (survival, reproduction, dispesal). In general, wolverines were distributed in areas of higher elevation, where there was steeper terrain, more snow, fewer roads, less human activity, and which were closer to high elevation talus, tree cover, and areas with April 1 snow cover (Inman et al. 2013). This model was applied to the Nez Perce Clearwater National Forests. Approximately 1,361,301 acres of modeled wolverine habitat exist across the Forests.

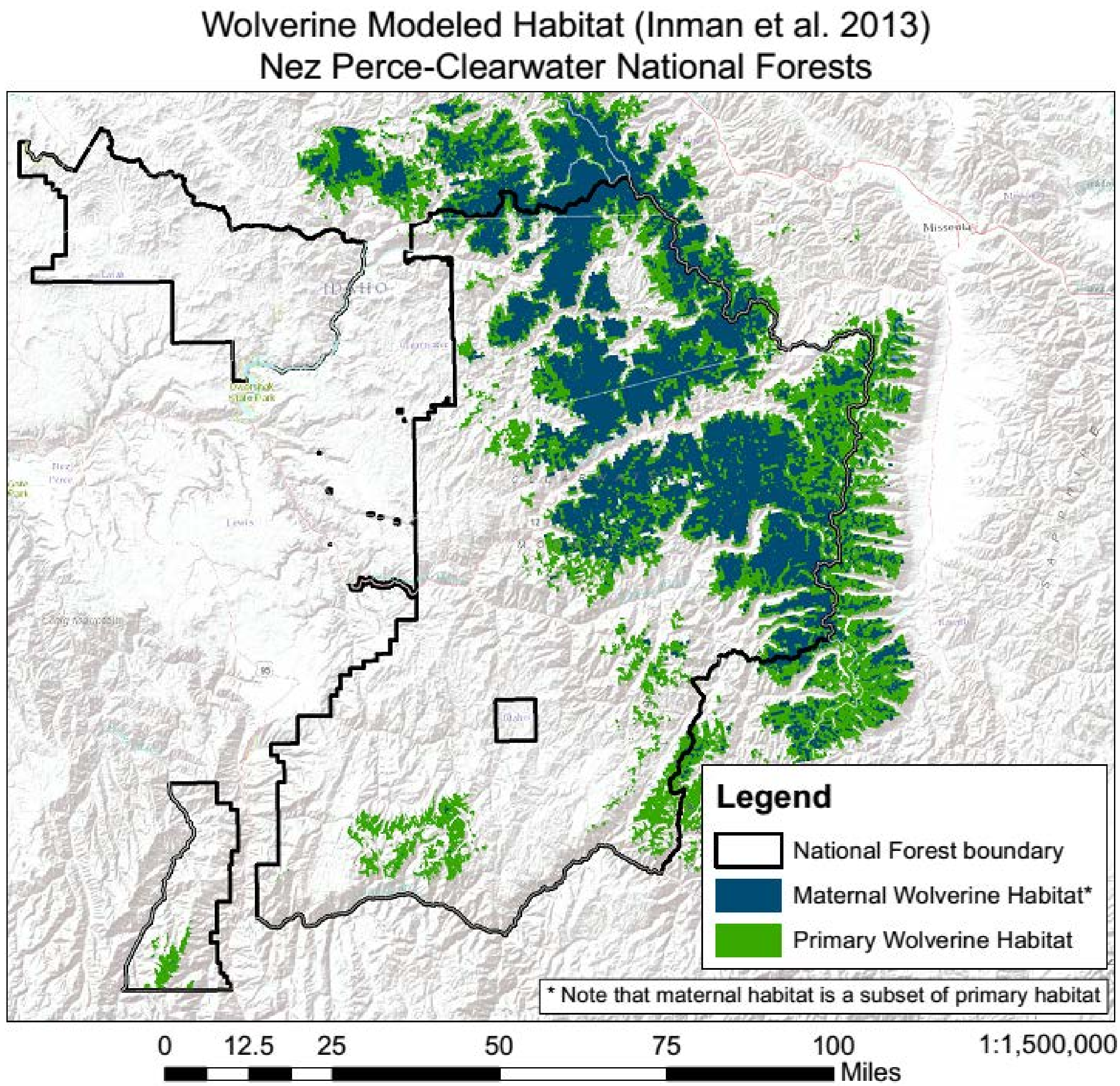

Figure 5-6. Wolverine habitat on the Nez Perce–Clearwater National Forests as modeled by Inman et al. (2013)

Inman et al. (2012b) found a link between persistent snow and wolverine foraging strategy. Wolverines appear to rely on the cold and snow to cache carrion. Cold, structured microsites are used to cache food and this reduces competition from insects, bacteria, and other scavengers for this food source. The authors referred to this as the “refrigeration-zone” hypothesis (Inman et al. 2012b).

In the northern Rockies wolverine natal dens have been found under snow-covered tree roots, logjams, and rocks and boulders (Hash 1987). In central Idaho, Copeland (1996) found natal den sites in boulder talus areas with a north aspect within subalpine cirques. No information is available on den sites on the Forests; however, it is expected that they would be similar to surrounding area den sites.

Wolverines are opportunistic feeders and consume a variety of foods depending on availability. They primarily scavenge on carrion, but they also prey on small animals and birds. They eat fruits, berries, and insects (Hornocker and Hash 1981, p. 1290; Banci 1994, pp. 111–113). Wolverine feed upon carrion or ungulates killed by large predators, such as wolves, bears, cougars, and humans or animals that have died from natural causes. The constant search for food keeps them moving throughout their range; in fact, daily movements of 20 miles are common. Hornocker and Hash (1981) suggested that food availability is the main factor determining movements and range of wolverines in the South Fork drainage.

Occupying cold, snow covered, and relatively unproductive environments is a common pattern throughout the worldwide distribution of wolverines. By occupying this unproductive niche, it appears wolverines balance acquisition of foraging and denning resources with the reduced risk of predation and interspecific competition associated with these environments (Inman et al. 2012a). One way wolverines do this is by using food caching in cold habitats to survive food-scarce winters that other carnivores cannot (Inman et al. 2012a).

Connectivity between wolverine populations and habitat patches is generally tied to persistent spring snow; and wolverines appear to currently be able to disperse between habitats and through areas where human developments occur (Schwartz et al. 2009; USDI FWS 2013, p. 7879). The available evidence indicates that dispersing wolverines can successfully cross transportation corridors (USDI FWS 2013, p. 7879).

5.1.2.3 Management Direction

On February 4, 2013, the USFWS published a proposed rule to list the North American Wolverine as a Threatened Distinct Population Segment (DPS) in the contiguous United States, under the Endangered Species Act of 1973, as amended. No critical habitat has been designated for the wolverine. The zone of consistent snow habitat has been modeled and mapped (Figure 5-6). The wolverine is classified as an S2 species of greatest conservation need. S2 is a statewide ranking assigned by the Idaho Conservation Data Center and indicates imperiled: at risk because of restricted range, few populations (often 20 or fewer), rapidly declining numbers, or other factors that make in vulnerable to rangewide extinction or extirpation (IDFG 2005).

5.1.2.4 Human Activity and Development

Loss and fragmentation of habitat may isolate populations, reduce genetic diversity and increase the risk of population extirpation (Copeland and Whitman 2004, cited in IDFG 2005). These risks result from three main factors: 1) small total population size; 2) effective population size below that needed to maintain genetic diversity and demographic stability; and 3) the fragmented nature of wolverine habitat in the contiguous United States that results in smaller isolated “island” patches separated by unsuitable habitats. Loss of persistent spring snow related to climate change is the main factor in loss/fragmentation of wolverine habitat (USDI FWS 2013, p. 7865).

Harvest is considered a factor affecting wolverine survival, with trapping accounting for the greatest number of individuals (Hornocker and Hash 1981, Banci 1994, Krebs et al. 2004, Squires et al. 2007). Although harvest of wolverines is illegal in Idaho, incidental trapping may contribute to mortality.

According to the proposed listing rule, much of wolverine habitat within the contiguous United States is already in a management status such as wilderness or national parks that provide some protection from management, industrial, and recreational activities. Wolverines are not thought to be dependent on specific vegetation or habitat features that might be manipulated by land management activities; nor is there evidence to suggest that land management activities are a threat to the conservation of the species (USDI FWS 2013, p. 7879).

The USFWS concluded, “Our review of the regulatory mechanisms in place at the National and State level demonstrates that the short-term, site-specific threats to wolverines from direct loss of habitat, disturbance by humans, and direct mortality from hunting and trapping are, for the most part, adequately addressed through State and Federal regulatory mechanisms. However, the primary threat with the greatest severity and magnitude of impact to the species is loss of habitat due to continuing climate warming” (USDI FWS 2013, p. 7883).

The proposed listing rule for the wolverine states, “We have determined that habitat loss due to increasing temperatures and reduced late spring snowpack due to climate change is likely to have a significant negative population-level impact on wolverine populations in the contiguous United States. In the future, wolverine habitat is likely to be reduced to the point that the wolverine in the contiguous United States is in danger of extinction” (USDI FWS 2013).

“The primary impact of climate change on wolverines is expected to be through changes to the availability and distribution of wolverine habitat. Within the 4 States that currently harbor wolverines (Montana, Idaho, Oregon (Wallowas), and Wyoming), an estimated 47,882 mi^2 (124,014 km^2) of wolverine habitat exists. Ninety-four percent 52,277 mi^2 (135,396 km^2) of total wolverine habitat is in Federal ownership with most of that managed by the U.S. Forest Service” (USDI FWS 2013, p. 7874)

Wolverines depend on deep snow that persists into late spring both for successful reproduction and for year-round habitat. Wolverine habitat in the contiguous United States, which supports approximately 250 to 300 wolverines, is shrinking and is likely to continue to shrink with increased climate warming (McKelvey et al. 2011). McKelvey et al. (2011) provide estimates for the northern Rocky Mountain States (Montana, Idaho, and Wyoming), with an estimated 32% and 63% of persistent spring snow lost for the 2045 and 2085 intervals respectively. Central Idaho is predicted to be especially sensitive to climate change effects losing 43% and 78% of wolverine habitat for the 2045 and 2085 intervals respectively (McKelvey et al. 2011). The USFWS expects wolverine populations to be negatively affected by changes in the spatial distribution of habitat patches as remaining habitat islands become progressively more isolated from each other due to climate changes (McKelvey et al. 2011)). Currently, wolverine habitat in the contiguous United States can be described as a series of habitat islands. Some of these groups of islands are large and clumped closely together, such as in the north Cascades, Glacier Park–Bob Marshall Wilderness complex in Montana, and the greater Yellowstone ecosystem. Other islands are smaller and more isolated, such as the island mountain ranges of central and southwestern Montana. Inbreeding and consequent loss of genetic diversity have occurred in the past within these smaller islands of habitat (Cegelski et al. 2006, p. 208); and genetic exchange between subpopulations is difficult to achieve (Schwartz et al. 2009). Climate change projections indicate that, as warming continues, large contiguous blocks of habitat will decrease in size and become isolated to the extent that their ability to support robust populations becomes questionable (USDI FWS 2013, p. 7876). Under the moderate climate change scenarios analyzed by McKelvey et al. (2011), the current wolverine stronghold in central Idaho will become more isolated small subpopulations of family groups, which would require connectivity with other groups to avoid reduced genetic diversity due to inbreeding within a few generations (Cegelski et al. 2006). Isolation of wolverines on small habitat islands with reduced connectivity to other subpopulations would impair the functionality of the wolverine metapopulation in the contiguous United States (USDI FWS 2013,p. 7876).

While other threats are minor in comparison to the primary threat of climate change, cumulatively they could become significant when working in concert with climate change if they further suppress an already stressed population (USDI FWS 2013, p.7886).

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5.2 AQUATICS

5.2.1 *Existing Information*

- Interior Columbia River Basin Science Assessment Team/ICBEMP (Lee et al. 1997)
- 1995/1998 Land and Resource Management Plan (LRMP) (Forest Plan) Biological Opinions (NOAA Fisheries and USFWS 1998)
- Critical habitat designations for Endangered Species Act (ESA)-listed fish species (Columbia River bull trout, Snake River steelhead trout, Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River sockeye salmon)
- Columbia River Bull Trout Draft Recovery Plan, Chapters 16 and 17 (USFWS 2002)
- Bull trout 5-year status review (USFWS 2008)
- Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest (Ford 2011)
- Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p. (Good et al. 2005)
- Pacific Coastal Salmon Recovery Fund (NOAA Fisheries 2012)
- *Draft* Recovery Plan for Snake River Spring/Summer Chinook and Steelhead Populations (NOAA Fisheries 2012)
- Idaho Department of Fish and Game (IDFG) published and unpublished fish monitoring trend data

5.2.2 *Informing the Assessment*

Aquatic conditions on the Nez Perce and Clearwater National Forests have been summarized in watershed analyses, landscape assessments, and various subbasin documents prepared for Endangered Species Act consultations for listed fish and designated critical habitat. These assessments began in the late 1990s and continued through the mid-2000s (see Existing Information, above).

5.2.2.1 Current Threatened, Endangered, and Candidate Species on the Forests

No known endangered or candidate fish species exist on the Nez Perce–Clearwater National Forests. Threatened fish species on the Forests include the following:

Snake River sockeye salmon (*Oncorhynchus nerka)*—Endangered, ESA-listed in Lower Salmon and Middle Salmon–Chamberlain subbasins of the Nez Perce National Forest only

Snake River fall chinook salmon (*Oncorhynchus tshawytscha*)—Threatened, ESA-listed in Lower Salmon, Middle Salmon–Chamberlain, and Lower Clearwater subbasins in both the Nez Perce and Clearwater National Forests

Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*)—Threatened, ESA-listed in Lower Salmon and Middle Salmon–Chamberlain portions of the Nez Perce National Forest only

Snake River steelhead trout (*Oncorhynchus mykiss gairdneri*)—Threatened, ESA-listed in the Lower Salmon, Middle Salmon–Chamberlain, Lower Clearwater, Middle Fork Clearwater, South

Fork Clearwater, Lower Selway, Upper Selway, and Lochsa subbasins on both the Nez Perce and Clearwater National Forests

Columbia River bull trout (*Salvelinus confluentus)*—Threatened, ESA-listed in the Lower Salmon, Middle Salmon–Chamberlain, Lower Clearwater, Middle Fork Clearwater, South Fork Clearwater, North Fork Clearwater, Lower Selway, Upper Selway, and Lochsa subbasins on both the Nez Perce and Clearwater National Forests

No proposed or candidate fish species currently exist on the Forests. Species of special conservation concern were discussed in the aquatic ecosystem assessment.

5.2.2.2 Current Conditions

Spring/summer and fall chinook salmon are present in the Snake and Salmon River basins, including portions of these basins on the Nez Perce–Clearwater National Forests. On the Forests, fall chinook salmon are generally located in the mainstem Clearwater River below the mouth of Lolo Creek, although recent supplementation efforts have resulted in increasing numbers of returning adults in the Clearwater River upstream of Lolo Creek; in the lower reaches of the South Fork Clearwater River and in the Selway River, where both adults and redds have been documented in increasing numbers over the past 5 years. Fall chinook salmon also migrate, spawn, and rear in specific areas adjacent to the Nez Perce National Forest in the Lower Salmon and Middle Salmon–Chamberlain subbasins. In addition, Snake River sockeye salmon use these reaches of the mainstem Salmon River for migration.

Spring chinook salmon in the Clearwater Basin were not listed under the ESA because Lewiston Dam, constructed in the early 1900s, was thought to have eliminated the native run (Waples et al. 1991; Matthews and Waples 1991). Upon removal of the dam in the 1930s, chinook salmon were reintroduced, and a naturalized run was established throughout most of their historic range in the Clearwater Basin. Chinook salmon are no longer present in the North Fork Clearwater River, however, as this population was extirpated by construction of Dworshak Dam. Large numbers of spring and fall chinook salmon are believed to have once occupied all the main tributaries of the Clearwater and Snake rivers within the Nez Perce–Clearwater National Forests (Ecovista et al. 2003).

Steelhead and bull trout distribution on the Forests is similar to the historic distribution, although anadromous steelhead trout no longer exist in the North Fork Clearwater River upstream of Dworshak Dam. While these 2 species are present in much of their historic range, their abundance and resilience are believed to be significantly reduced compared to historic conditions, due to habitat degradation, introduced species, harvest, and migration barriers (Lee et al. 1997). Connectivity between populations within the planning zone remains intact, except where road crossings or other factors have created barriers that prevent upstream migration, and where high-order stream reaches have been degraded, preventing effective migration among disjunct populations. For example in the South Fork Clearwater Basin, high river temperatures and degraded substrate conditions may have prevented or discouraged migrations of fluvial bull trout.

5.2.2.3 Trends and Drivers

Redd count and adult escapement data for **fall chinook salmon** in the Clearwater and Snake rivers suggest substantial increases in adult escapement since the mid-1990s (Good et al. 2005; Ford 2011; Arnsberg 2012), which is strongly correlated with increased hatchery supplementation. Increases in wild-origin fall chinook salmon, however, are not as dramatic, and natural production has not proportionately increased in response to the increasing trend in total spawners (Ford 2011).

Figure 5-7 summarizes adult returns above Lower Granite Dam between 1975 and 2010.

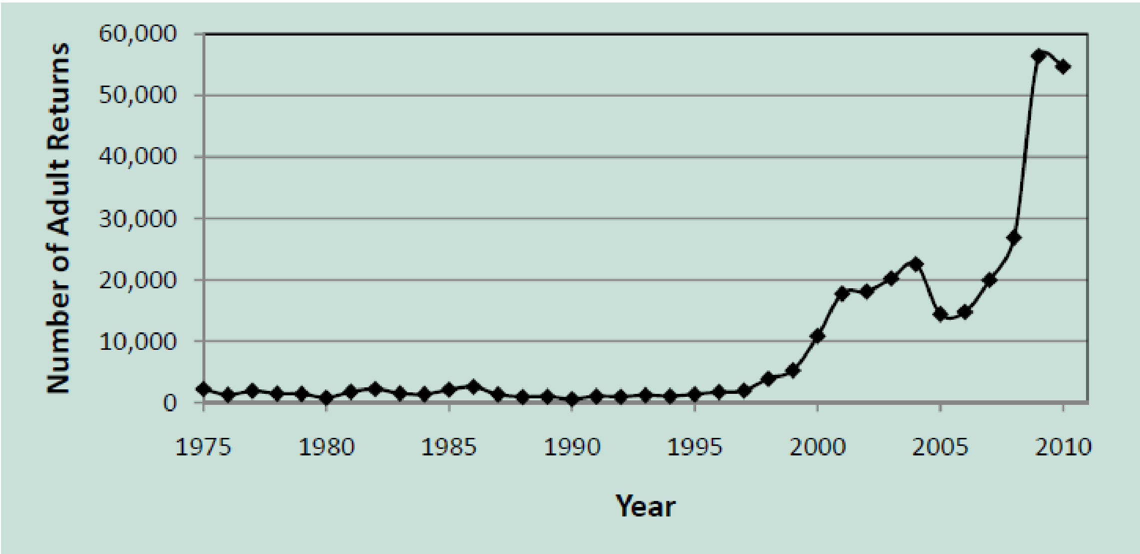

Figure 5-7. Fall chinook crossing Lower Granite Dam, 1975–2010 (NMFS 2011)

Wild and hatchery fall chinook salmon are not counted separately at dams, so the proportions of wild and hatchery fish must be estimated from hatchery returns. The most recent estimates of natural production rates are generally less than 1 through 2004 (NMFS 2008). Recruit-per-spawner productivity was below 1 for all but 3 brood years prior to 1995 but was above 1 between 1995 and 1999 (Cooney and Ford 2007). Snake River fall chinook salmon are remnants of former populations, and nearly all spatial structure has been lost; the remaining natural-origin and hatchery fish generally function as a population (NMFS 2011).

Adult return data for Snake River sockeye salmon indicate an overall increasing trend, from a low of 0 for naturally returning fish in 1990 to current numbers in the hundreds or thousands. These increases are largely due to an aggressive captive broodstock and reintroduction program initiated by state and federal entities (Peterson et al. 2012). In the case of both fall chinook and sockeye salmon, increasing trends are due largely to hatchery supplementation efforts, and trend of returning adults of wild origin is unknown (Ford 2011).

Spring/summer chinook salmon on the Nez Perce National Forest are part of 2 major population groups (MPGs), which include the South Fork Salmon River and the Middle Fork Salmon River. These MPGs are broad geographic groupings that include populations outside their named river basins. Populations with spring/summer chinook salmon spawning and rearing on the Nez Perce National Forest include the Little Salmon population and the Chamberlain population, both of which are considered intermediate populations based on historical habitat potential (ICTRT 2005). Specific streams that support spawning and rearing within these populations include White Bird Creek, Slate Creek, Rapid River, and Bargamin Creek.

The number of returning hatchery and wild-origin spring/summer chinook salmon has increased from the early 1980s to the present, with peak returns occurring in 2001 (Figure 5-8). Since 2001, returns have been substantially lower but greater than the 30-year mean. More-recent year abundance and productivity data indicate that the overall viability for wild-origin Snake River spring/summer chinook salmon remains at high risk (Ford 2011), even though natural spawning abundance for 3 populations in the South Fork Salmon MPG has increased.

The Little Salmon population, however, has not shown an increase in natural spawning abundance, and data are lacking for any conclusions regarding trend of wild-origin adult returns. A qualitative determination was made that the abundance/productivity risk was high. This determination was based on the current status of the ESU (Threatened) and the limited abundance information for the population (NMFS 2011). No major spawning areas have been identified in the population, but 3 minor spawning areas were found: Little Salmon River, White Bird Creek, and Slate Creek. The lack of major spawning areas in the population structure has been identified as an inherent extinction risk for this population (Ford 2011).

The Chamberlain population is 1 of 2 that are closest to meeting minimum viability numbers among populations in the Middle Fork Salmon MPG. A major spawning area on the Nez Perce–Clearwater National Forests was identified in Bargamin Creek (Good et al. 2005; Ford 2011).

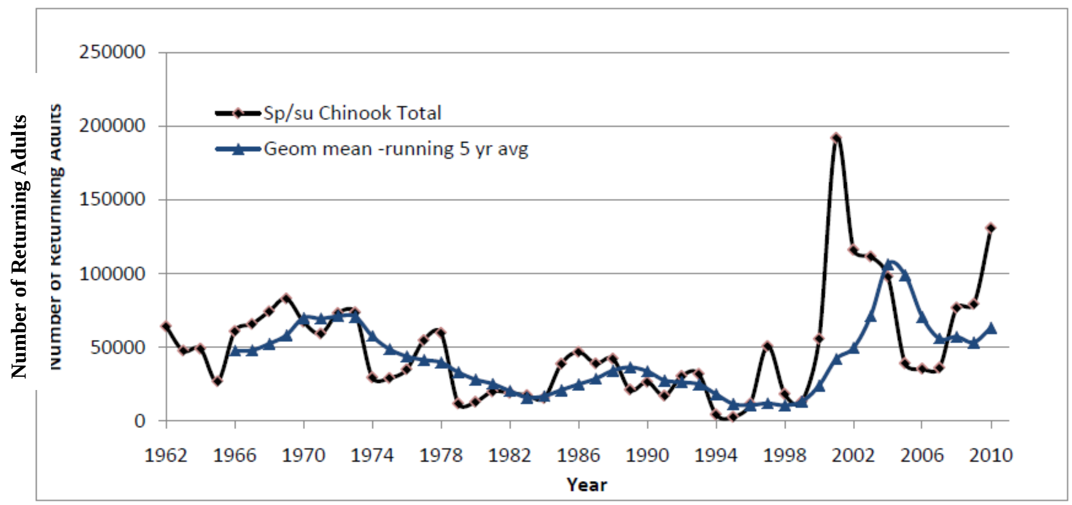

Figure 5-8. Number of adult spring/summer chinook salmon returning to Ice Harbor Dam, 19622010 (data include both hatchery and wild fish)

Steelhead trout on the Nez Perce–Clearwater National Forests are part of the Snake River distinct population segment (DPS), which includes all natural-origin populations of steelhead in the Snake River Basin (SRB) of southeast Washington, northeast Oregon, and Idaho, and 6 hatchery stocks, including fish from the Dworshak National Fish Hatchery and the rearing facilities in Lolo Creek. The SRB steelhead DPS includes all anadromous populations that spawn and rear in the mainstem Snake River from its mouth to Hells Canyon Dam, and all tributaries except the North Fork Clearwater River, which is blocked by the Dworshak Dam. The SRB steelhead DPS is organized in 6 MPGs that are subdivided into 26 populations (ICTRT 2005). The MPGs are defined by the following drainage basins: 1) Grande Ronde River, 2) Imnaha River, 3) Clearwater River, 4) Salmon River, 5) Hells Canyon (Snake River), and 6) Lower Snake River. The Clearwater MPG includes 6 independent populations: North Fork Clearwater (historic only), Clearwater River lower mainstem, Lolo Creek, Lochsa River, Selway River, and South Fork Clearwater River. Portions of all of these populations are located on the Nez Perce–Clearwater National Forests. The Selway steelhead population was identified as genetically unique and has not been subjected to hatchery supplementation (USDA Forest Service 1997 *LRMP Biological Assessment);* therefore, special management provisions were identified to protect this population in an ESA consultation for continued implementation of LRMPs, as amended by PACFISH, in 1998.

The Salmon River MPG includes portions of 2 independent populations (out of a total of 12) that are found on the Nez Perce–Clearwater National Forests: the Lower Salmon River/Little Salmon River population and the Salmon River/Chamberlain population.

In both the Clearwater MPG and the Salmon River MPG, migration timing of steelhead has changed because of anthropogenic effects (NMFS 2011). Water releases from Dworshak Reservoir have caused adults to hold in the mainstem Clearwater River downstream of the North Fork Clearwater River for longer periods. Construction and operation of the lower Snake River dams and reservoirs have changed temperature and flow patterns, which in turn affect both juvenile and adult migration. Upstream migration of adults in the late summer and fall is often delayed because of warm mainstem river temperatures. Smolt entry into the Columbia River estuary has been delayed compared to historic conditions because passage through reservoirs requires longer migration times.

Fisheries managers break the run over Lower Granite Dam into A-run and B-run types, using fish length data recorded along with the counts. A-run returns are believed to primarily represent returns to lower-elevation tributaries, including the Grande Ronde River, the Imnaha River, and some population tributaries in the Clearwater and Salmon rivers. The larger, B-run returns are believed to be produced primarily in higher-elevation tributaries in the Clearwater and Salmon River basins (Ford 2011).

Adult return data at Lower Granite Dam are summarized below in Figure 5-9.

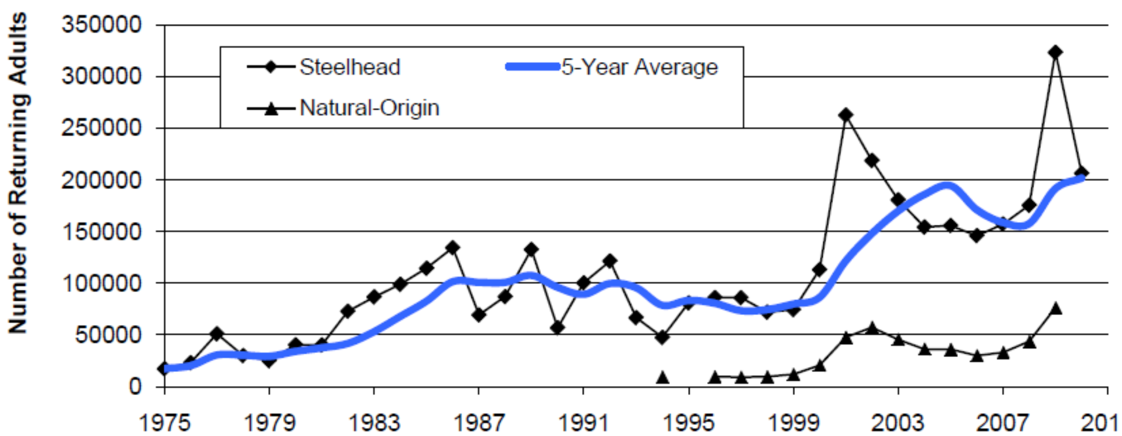

Figure 5-9. Snake River steelhead Distinct Population Segment (DPS) abundance and 5-year average at Lower Granite Dam (NMFS 2011)

Figure 5-9 indicates a large proportion of returning adult steelhead trout are of nonnatural (hatchery) origin.

The following information is from Ford (2011): Natural-origin and hatchery-origin returns of adult steelhead trout each showed increases since 1998, although hatchery fish increased at a higher rate. The aggregate A-run and B-run estimates have increased relative to the levels associated with prior assessments. A large proportion of the hatchery run over Lower Granite Dam returns is removed by hatchery-selective harvest prior to reaching spawning areas. As a result, the hatchery proportions in the aggregate run over Lower Granite Dam are not indicative of the proportions in spawning escapements into most population tributaries. Monitoring the relative contribution of hatchery returns to spawning in natural areas, particularly those areas near major hatchery release sites, is a high priority for improving future assessments.

Also from Ford (2011): Since the mid-1980s, IDFG has routinely collected juvenile steelhead density estimates across a series of fixed transects distributed across tributary habitats in Idaho. The sampling design and intensity were not set up to generate total production estimates at the population or regional level, but the results are considered to be generally indicative of trends in total natural production. IDFG considers the set of transects in B-channel type habitat to be indicative of steelhead production and aggregates annual results across transects in 4 subcategories. Average densities in areas assigned as A-run habitats trended downward from 1985 through the mid-1990s, returning to levels similar to the earliest years in the series after 2000. Similar patterns were observed in transects in areas classified as natural (areas near hatchery production release sites) versus areas classified as wild. Areas classified as B-run wild appear to follow a similar pattern. The average juvenile densities in areas classified by IDFG as natural fluctuated around a relatively constant level from 1985 through the most recent year in the series (2007). In general, the median densities across individual transect series were the highest for lower-elevation populations or tributaries. The highest median densities were observed in the small tributaries below Hells Canyon Dam and in the Lower Clearwater and Lochsa rivers.

IDFG steelhead parr monitoring trend data are summarized in Figure 5-10 and Figure 5-11.

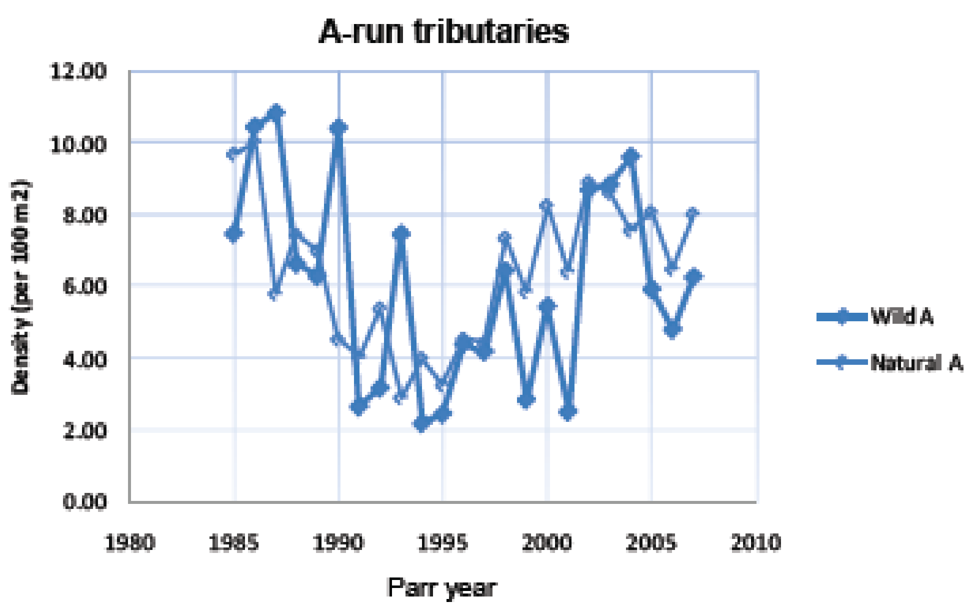

Figure 5-10. Density of steelhead parr in A-run tributaries

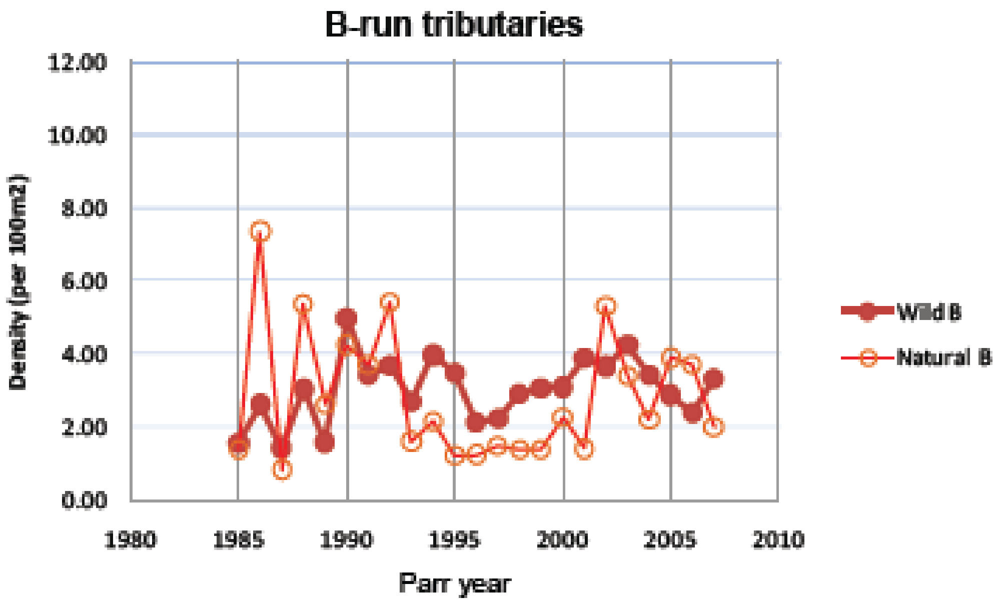

Figure 5-11. Density of steelhead parr in B-run tributaries

In addition to the parr monitoring, some monitoring of fish densities has been implemented in streams on the Clearwater National Forest, including steelhead trout in Lolo, Pete King, and Lower Fish creeks (Figure 5-12, Figure 5-13, and Figure 5-14).

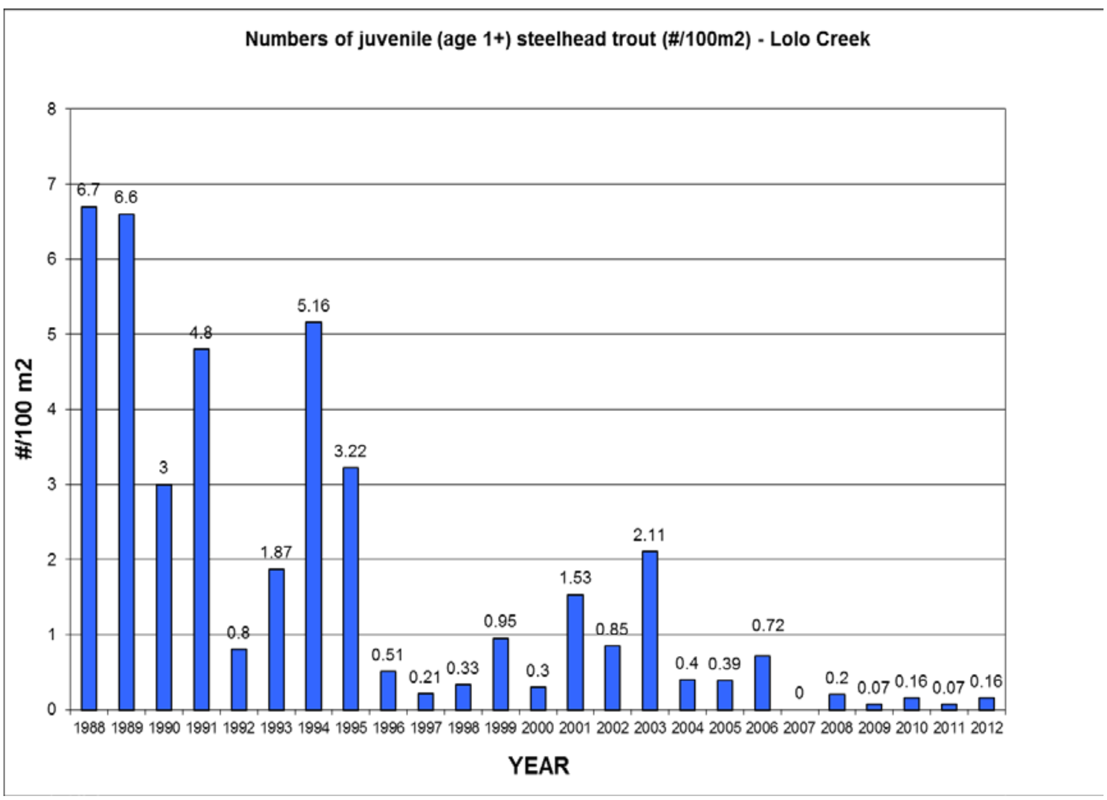

Figure 5-12. Snorkel data for juvenile steelhead trout in Lolo Creek, tributary to mainstem Clearwater River

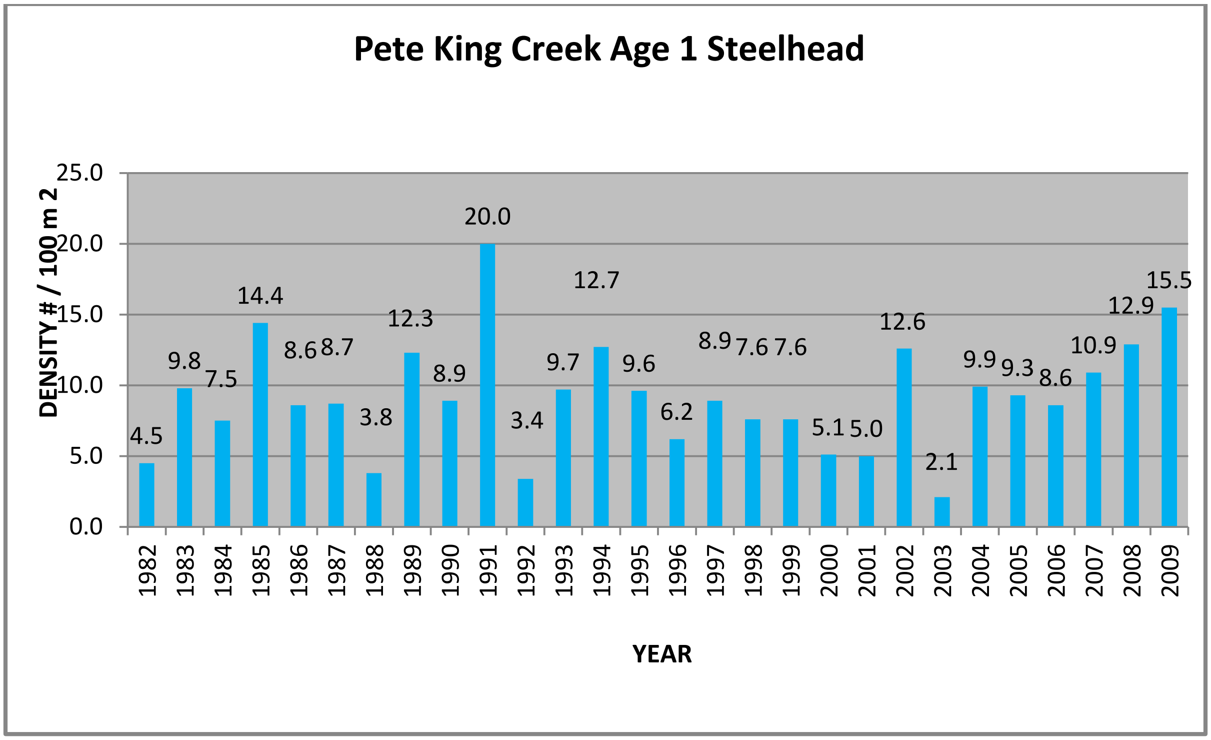

Figure 5-13. Snorkel data for juvenile steelhead trout in Pete King Creek, tributary to the Lochsa River (USDA Forest Service 2009)

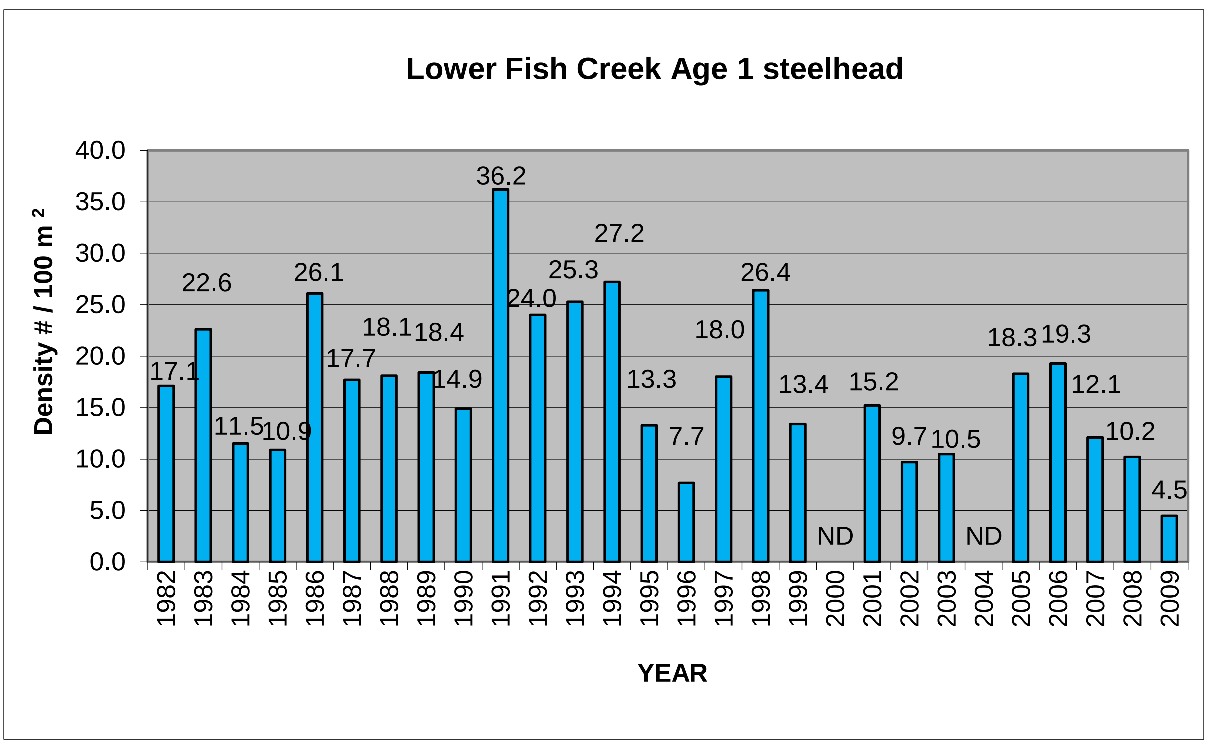

Figure 5-14. Snorkel data for juvenile steelhead trout in Fish Creek, tributary to the Lochsa River (USDA Forest Service 2009)

Bull trout on the Nez Perce–Clearwater National Forests are part of the Columbia River DPS, which was listed as Threatened in 1998. The Forests contain 2 out of 22 recovery units (the Clearwater and Salmon rivers), which are analogous to the MPGs previously identified for ESA-listed anadromous fish. The Clearwater recovery unit includes 7 core areas for bull trout: 1) Middle–Lower Clearwater, 2) North Fork Clearwater, 3) Fish Lake, North Fork Clearwater Basin, 4) Lochsa, 5) Fish Lake, Lochsa Subbasin, 6) Selway, and 7) South Fork Clearwater. Portions of these core areas are located on the Nez Perce–Clearwater National Forests. The Salmon recovery unit includes a total of 10 core areas, 2 of which are partially located on the Nez Perce–Clearwater National Forests: Middle Salmon River–Chamberlain and Little-Lower Salmon River.

Within each core area, local populations and potential local populations of bull trout have been identified (USFWS 2002).

Estimating rangewide bull trout abundance is not currently feasible, due to sampling variability, differences in methods used to estimate abundance, and, in some core areas, a complete lack of data (USFWS 2008). In general, geographically smaller core areas tend to have lower population numbers, while large adult populations (1,000 adults or more) tend to occur in larger core areas where the habitat is spatially well connected and well distributed throughout the core area. The quality and quantity of the habitat and its relative degree of connectivity play a major role in determining population size (USFWS 2005).

The U.S. Fish and Wildlife Service provided a summary of core area rankings for population abundance, distribution, trend, threat, and final rank (USFWS 2008).

The variables that were used to determine the rankings are defined in USFWS (2008). Variables included the following: 1) the present or threatened destruction, modification, or curtailment of bull trout habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or man-made factors affecting the species' continued existence.

Rankings for core areas on the Nez Perce–Clearwater National Forests are presented below in Table 5-6.

Table 5-6. Summary of core area rankings, Columbia River bull trout distinct population segment (DPS) on the Nez Perce–Clearwater National Forests (USFWS 2008)

Core Area	Population Abundance Category	Distribution Range Rank (stream length miles)	Short-Term Trend Rank	Threat Rank	Final Rank
Fish Lake - Lochsa R)	1–50	2.5–25	Unknown	Widespread, low severity	At risk
Fish Lake - NF Clearwater	1–50	125–620	Declining	Moderate, imminent	High risk
Lochsa River	50–250	125–620	Stable	Moderate, imminent	At risk
Mid-Low Clearwater River	Unknown	125–620	Unknown	Substantial, imminent	At risk
North Fork Clearwater River	250–1,000	125–620	Declining	Moderate, imminent	At risk
Selway River	Unknown	125–620	Unknown	Widespread, low severity	Potential risk
South Fork Clearwater River	1,000–2,500	125–620	Unknown	Substantial, imminent	At risk
Little-Lower Salmon River	50–250	125–620	Unknown	Substantial, imminent	High risk
Middle Salmon River–Chamberlain	Unknown	125–620	Unknown	Widespread, low severity	Potential risk

Since the mid-1990s, bull trout redd counts have been conducted in 2 areas on the Clearwater National Forest, which include several index sites in the Upper North Fork Clearwater Subbasin and Fishing Creek (tributary to the Lochsa River). These data are displayed below in Figure 5-15 and Figure 5-16.

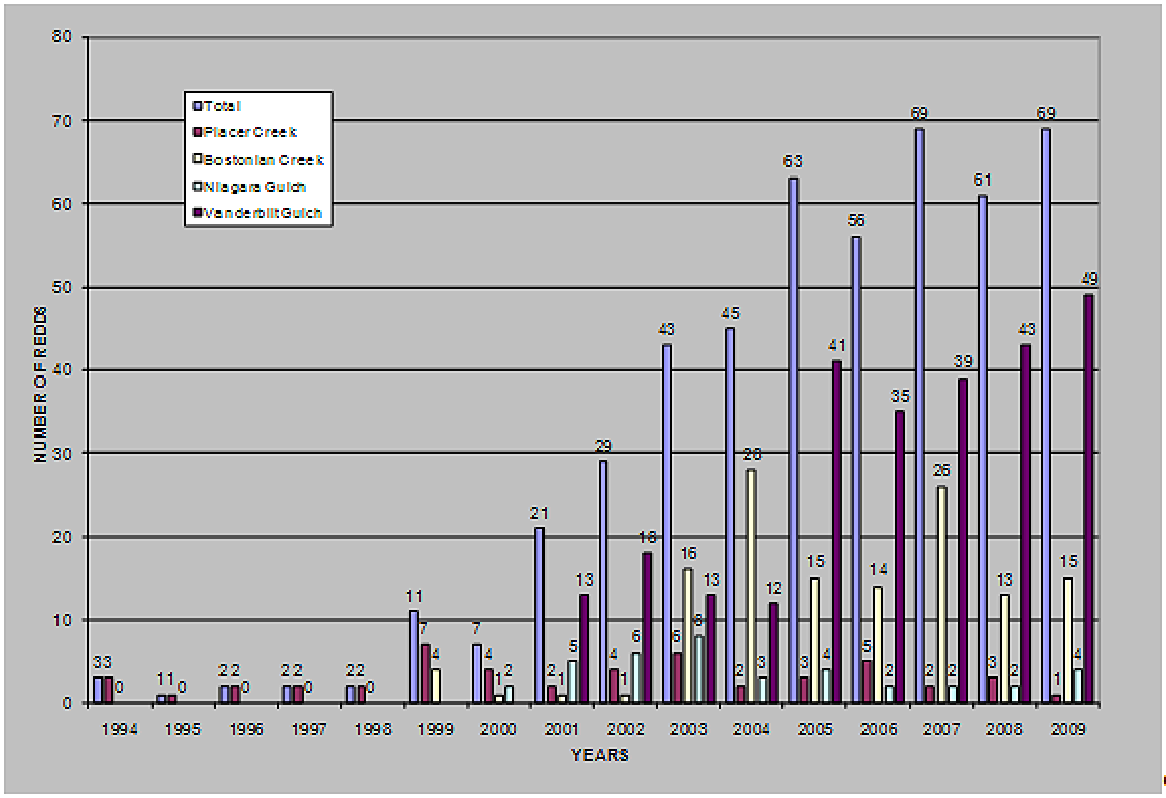

Figure 5-15. Number of bull trout redds observed by Forest and IDFG personnel within spawning index areas on 4 streams in the Upper North Fork Clearwater River drainage (1994–2009)

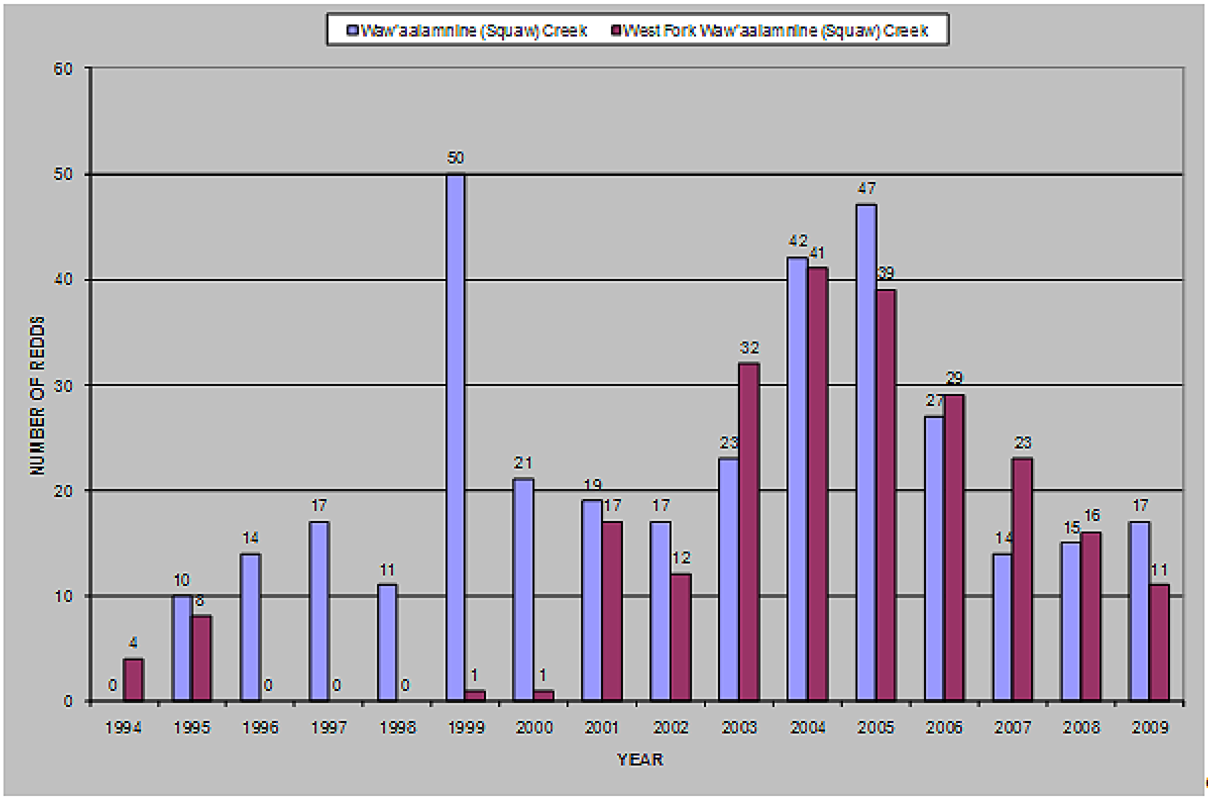

Figure 5-16. Number of bull trout redds observed by Forest personnel in Waw'aalamnine (Fishing) Creek and West Fork Waw'aalamnine (Fishing) Creek during spawning season (1994–2009)

5.2.3 *Literature Cited*

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5.3 Rare Plants

5.3.1 *Existing Information*

- Idaho Natural Heritage Program Technical Reports (IDFG 2014)
- Idaho Native Plant Society resources available at their website[1]
- Conservation Strategy for Spalding's Catchfly (*Silene spaldingii*) (Hill and Gray 2004)
- Conservation Status of Spalding's catchfly (1997)
- Proposed Threatened Status for Spalding's Catchfly (USFWS 1999)
- Modified Idaho Roadless Rule—Biological Opinion and Conference Opinion (USDI FWS 2008)
- Species profile for Spalding's catchfly (CPC 2010)
- Recovery Plan for *Silene spaldingii* (Spalding's catchfly) (USDI FWS 2007)
- Element Occurrence Review and Update for Five Rare Plant Species (Colket et al. 2006)
- Species Account—Macfarlane's Four-o'clock (*Mirabilis macfarlanei*) (1996)
- Status Report Update for *Mirabilis macfarlanei* (Kaye 1992)
- Revised Recovery Plan for the Macfarlane's Four-o'clock (*Mirabilis macfarlanei*) (USDI FWS 2000)
- Reclassification of Macfarlane's Four-o'clock from Endangered to Threatened (Federal Register, Vol. 61, Issue 52, March 15, 1996)
- Range-wide Status Assessment for Howellia aquatilis (*water howellia*) (Mincemoyer 2005)
- Threatened Listing for *Howellia aquatilis* (water howellia) (59 FR 35860 35864)
- Recovery Plan for *Howellia aquatilis* (water howellia) (USFWS 1996)
- U.S. Fish and Wildlife Finding on Petition to List Whitebark Pine (USFWS 2011)
- FS R1 Executive Summary of Response to USFWS (USDA Forest Service 2010)
- FS memo, Sensitive Species Designation Whitebark Pine (USDA Forest Service 2011)
- FS memo, Follow-up to Sensitive Species Designation WBP (USDA Forest Service 2011)
- Status and Dynamics of Whitebark Pine (*Pinus albicaulis Engelm*.) Forests in Southwest Montana, Central Idaho, and Oregon, USA (Larson 2009)
- Plants Report in The Island Ecosystem Analysis at the Watershed Scale(USDA Forest Service 2006)
- Forest Service Handbook 1909.12 Land Management Planning Handbook, Chapter 10 (2013).
- Forest Service Handbook 1909.12 Land Management Planning Handbook, Chapter 20 (2013).

[1] http://www.idahonativeplants.org/

5.3.2 *Informing the Assessment*

Per the Land Management Planning Rule (April 2012), the Forest Service is directed to provide for the diversity of plant and animal communities within Forest Service authority and consistent with the inherent capability of the plan area and maintenance or restoration of ecosystem integrity and diversity (FSH 1909.12, Chapter 20, 23.1). This section of the assessment addresses available information regarding the ecology and distribution of federally recognized endangered, threatened, proposed, or candidate species (FSH 1909.12, Chapter 10, 12.51). Because of potential changes in the status of federally listed species, this section of the Assessment is considered "draft" until the Forest Plan is signed.

5.3.2.1 Current Condition

Spalding's catchfly *(Silene spaldingii) (Threatened)*

Spalding's catchfly (*Silene spaldingii*) was listed as a threatened species under the Endangered Species Act on October 10, 2001 (USFWS 2001). This regional endemic species is a deep-rooted, simple- or multi-stemmed perennial forb that reproduces by seed (Hill and Gray 2004). It is a regional endemic found predominantly in bunchgrass grasslands and sagebrush-steppe, and occasionally in open pine communities, in eastern Washington, northeastern Oregon, west-central Idaho, western Montana, and barely extending into British Columbia, Canada. Spalding's catchfly can live for at least 5 years. It may survive dormant underground for many years (Lesica 1997). In Montana, Lesica (1997) found that the number of Spalding's catchfly plants remained stable over a 5-year period. He also found that the proportion of plants in the prolonged dormancy life stage had a strong biennial periodicity. Hill and Gray (2005) found that the prolonged dormancy life stage may last for one or several years before returning aboveground.

In general, Spalding's catchfly is found in open, mesic (moist) grassland communities or sagebrush-steppe communities. The bunchgrass grasslands where Spalding's catchfly primarily occurs are characterized by either Idaho fescue (*Festuca idahoensis*) or Idaho fescue with bluebunch wheatgrass (*Pseudoroegneria spicata*) except in Montana where the dominant bunchgrass is rough fescue (*Festuca scabrella*). The plant is found at elevations ranging from 365 to 1,615 meters (1,200 to 5,300 feet), usually in deep, productive loess or loamy soils. Plants are generally found on northwest to northeast facing slopes or swales or other landscape features where soil moisture is relatively higher (Hill and Gray 2004). Soils in the tri-state (Idaho, Oregon, and Washington) area are loess (wind-dispersed) and ash (from volcanic eruptions) influenced (Tisdale 1986; Johnson and Simon 1987), while soils in Montana are more glacially influenced (Schassberger 1988). These mesic sites are highly productive, with total plant cover and forage dry weight sometimes three times greater than drier, more shallowly soiled bluebunch wheatgrass communities (Johnson and Simon 1987). Spalding's catchfly is found on a wide range of slopes, from flat areas to slopes as great as 70%. Most occurrences are found on grades ranging from 20% to 40% slope (Hill and Gray 2004), although this may be an artifact of where intact habitat has not been converted to other uses.

On the Nez Perce–Clearwater National Forests (Forests), the species occurs in the Canyon Grasslands Physiographic Province. Of the five provinces in which the species occurs, this is the most intact, largely because the canyon walls are steep and do not lend themselves to agricultural or urban developments. The Canyon Grasslands range widely in elevation, which results in marked variations in the climate and vegetation. Within the Canyon Grasslands, Spalding's catchfly is found at the lowest and highest elevations rangewide from 365 to 1,615 meters (1,200 to 5,300 feet) (USFWS 2007), generally on northerly slopes that support more mesic Idaho fescue communities. At higher elevations (over approximately 1,525 meters [5,000 feet]) in the Canyon Grasslands the northern slopes are inhabited by tree species and Spalding's catchfly is found on gentle southern slopes where bunchgrass communities reside. Because of their steep topography, the Canyon Grasslands are the most under surveyed area for Spalding's catchfly, and also represent the area where large populations of Spalding's catchfly may be most easily conserved because they are more removed from human influence.

Spalding's catchfly is impacted by habitat loss due to human development, habitat degradation associated with adverse grazing and trampling by domestic livestock and wildlife, and invasions of aggressive nonnative plants. In addition, a loss of genetic fitness (the loss of genetic variability and effects of inbreeding) is a problem for many small, fragmented populations where genetic exchange is limited. Other impacts include changes in fire frequency and seasonality, prolonged drought, insect damage and disease, off-road vehicle use, and herbicide spraying and drift. In Idaho, Hill and Gray (2005) found that rodent activity appeared to be related to the mortality of Spalding's catchfly plants. In Montana, Lesica (1999) found that fire did not appear to affect recruits or adults in some years, but Hill and Gray (2005) observed that it may indirectly affect Spalding's catchfly by increasing introduced weed species. At the three occurrences on the Forests, grazing occurs, but although some effects have been noted, grazing generally does not appear to be a major impact due to the preferred livestock movements in relation to population locations. Wildlife grazing and rodent activity have been observed, but at very low levels. The greatest threat to the species on the unit appears to be weeds and general habitat degradation.

A species recovery plan was completed in 2007 by the USFWS. The objective of the recovery program is to recover Spalding's catchfly by protecting and maintaining reproducing, self-sustaining populations in each of the five distinct physiographic regions where it resides. Within each of these regions key conservation areas have been identified to focus conservation efforts at larger populations. Characteristics to qualify a key conservation area are provided in the recovery plan. The protection and management of these key conservation areas or areas that have the potential to serve as key conservation areas, forms the foundation of the recovery strategy for Spalding's catchfly. The goal of the recovery program is to recover Spalding's catchfly to the point where it can be delisted, i.e., to remove the species from threatened status. The primary objectives to meet this goal are to reduce or eliminate the threats to the species, and protect and maintain multiple reproducing, self-sustaining populations distributed across each of the five distinct physiographic regions where it resides sufficient to ensure the long-term persistence of the species.

MacFarlane's four o'clock *(Mirabilis macfarlanei)* (Threatened)

MacFarlane's four o'clock (*Mirabilis macfarlanei*) is a long-lived, deep-rooted perennial forb that reproduces sexually by seed and asexually through long spreading rhizomes (USFWS 2000). Individuals may comprise several hundred stems ranging up to approximately 9 m², making it difficult to ascertain changes in the number of plants at a given site (Callihan 1988, Kaye 1995). In one demographic study, Kaye (1995) found that the number of plants remained relatively stable over a five-year time period at occurrences in the Hells Canyon area. Clonal spread may contribute more to population stability compared to seedling recruitment (Kaye 1995, Barnes et al. 1997), although both are important to long-term genetic stability (USFWS 2000). Some studies have found low rates of seedling recruitment (Kaye et al. 1990, Kaye 1995), while others have found that seedling recruitment is a rare event (Barnes et al. 1994, Johnson 1995, Barnes et al. 1997, USFWS 2000).

MacFarlane's four o'clock is narrowly endemic to portions of the Snake, Salmon, and Imnaha river canyons in northeastern Oregon and adjacent west-central Idaho. The species global range is approximately 46 by 29 km. The species has not been found on National Forest System (NFS) land; however occurrence is less than a mile away and suitable habitat extends from occupied habitat onto the Forest. Extensive modeled habitat occurs in the Rapid River drainage, though this area is close to, but outside the currently known small range for the species.

Habitats supporting MacFarlane's four o'clock are characterized by bunchgrass communities in sandy or rocky soils, typically located on steep slopes with southwestern to western aspects (Mancuso, 1996). MacFarlane's four o'clock occurs in river canyon habitats in sandy to rocky soils. Talus rock often underlies the soils and several sites are unstable and prone to erosion. The climate is characterized by warm and dry conditions and most precipitation occurs during winter and spring rains. Plants are most commonly found on steep slopes with southwest to western aspects, although they may be found at any aspect or slope position. MacFarlane's four o'clock typically occurs in bunchgrass communities dominated by bluebunch wheatgrass (*Pseudoroegnaria spicata*). Other native graminoid associates include sand dropseed (*Sporobolus cryptandrus*), red threeawn (*Aristida longiseta*), Sandberg bluegrass (*Poa secunda*), needle and thread (*Hesperostipa comata*), annual fescue (*Festuca* spp.), and Idaho fescue (*Festuca idahoensis*). Native shrub and tree associates include: gray rabbitbrush (*Chrysothamnus nauseosus*), Saskatoon serviceberry (*Amelanchier alnifolia*), netleaf hackberry (*Celtis reticulata*), smooth sumac (*Rhus glabra*), and spiny greasebush (*Glossopetalon nevadense*).

Non-native plant species and uncharacteristically large or frequent wildfires are likely the greatest threats to MacFarlane's four o'clock (USFWS 2000). The deep, thick roots of MacFarlane's four o'clock can probably survive most fires, especially because wildfires generally occur later in the summer when the plant is dormant (Mancuso, 1996). However, the subsequent increases in non-native plant species associated with these fires may compete for resources. Herbicide and pesticide spraying, landslides and flood damage, and road and trail construction and maintenance are also threats to MacFarlane's four o'clock, especially to one occurrence adjacent to a major highway. Livestock grazing and trampling may indirectly affect MacFarlane's four o'clock through soil erosion, soil compaction, nonnative plant species introduction and seed establishment, and forage selection and avoidance that could alter community composition. Insect damage and disease, wildlife grazing and trampling, recreation (i.e. hiking), off-highway vehicle (OHV) use, plant collecting, mining, pollinator competition with other species, and inbreeding depression are additional threats that may potentially occur or have been documented (Kaye 1995, USFWS 2000).

Water howellia *(Howellia aquatilis)* (Threatened)

Water howellia (*Howellia aquatilis*) is an annual, aquatic plant endemic to the Pacific Northwest region of the United States. Listed as a threatened species under the Endangered Species Act in 1994, its current known distribution includes the states of California, Idaho, Montana, Oregon and Washington. Currently, 214 presumed extant occurrences are known, occupying approximately 285 acres. The majority of occurrences are concentrated in three metapopulations in the Swan Valley of west-central Montana; Spokane County, Washington; and in western Washington, mainly on Fort Lewis Military Reservation (Mincemoyer 2005). In Idaho, there are two known occurrences: one each in Latah and Benewah counties. Water howellia has not been found on the Forests; however, a population in the Palouse River basin is very near the unit boundary and suitable habitat is present. Potentially suitable habitat occurs at other locations.

Water howellia is a glabrous, much-branched, annual, aquatic herb with fragile, submerged and floating stems that are up to 100 cm tall. Beneath the surface of the water, small flowers that produce seeds without opening are solitary in the leaf axils. Once the stems reach the surface, small, white flowers are borne in a narrow, terminal, leafy-bracted inflorescence. The plant reproduces entirely by seed. The plant is predominantly a winter annual with germination taking place in the fall and seedlings over-wintering and resuming growth in the spring. Germination of seeds occurs only when ponds dry out and seeds are exposed to air (Lesica 1990, 1992). Studies by Lesica et al. (1988) and Shelly and Moseley (1988) report that self-pollination appears to be the common means of fertilization and that out-crossing, though possible, is probably extremely rare. Spread of seeds by waterfowl or other animals between ponds, although possible, has not been documented.

Primary threats to water howellia are from changing water levels and invasive species. Long-term seed viability is uncertain though it has been shown that seeds lying in the soil longer than eight months have decreased rates of germination and vigor (Lesica 1992). Therefore, consecutive years of drought or exceedingly wet years may negatively affect populations if ponds remain dry or if they do not dry out enough to allow germination in the fall. Monitoring data has shown that populations can rebound following consecutive years of unfavorable conditions, although germination rates are significantly reduced. Invasive species pose a serious and long-term threat to water howellia. Introduced genotypes of reed canary grass (*Phalaris arundinacea*) are likely the greatest potential threat to water howellia range-wide. In Idaho, although reed canary grass has been treated, it has reinvaded water howellia sites (Gray 2005). Typically this highly aggressive grass significantly reduces or eliminates native plant communities where it invades. Additional aquatic and riparian invasive species also pose threats on a more limited scale, although several have the potential to more severely impact water howellia in the future.

In addition, the annual nature of the species in conjunction with its narrow ecological niche makes it vulnerable to long-term unfavorable weather patterns and climate change. Moreover, the clustering of populations in just a few geographic areas also makes it more susceptible to regional and local influences. A variety of other land uses pose threats across the range of the species, including activities related to timber harvesting, grazing, land development, recreation, military activities, and grazing. Occurrences often occur partially or wholly on private lands that afford little or no protection from human impacts. In some areas, trampling of the drained areas, believed to be caused primarily by duck hunters, has been observed (Gilbert and Lombardi 1999, Clegg and Lombardi 2000).

The dominant habitat for water howellia is small, vernal, freshwater wetlands and ponds with an annual cycle of filling with water and drying up late in the season. These vernal ponds and wetlands usually fill with water over the fall, winter and early spring, but at least partially dry up towards the end of the growing season. Depending on annual patterns of temperature and precipitation the pond drying may be partial or complete by the fall. These sites are usually shallow and less than one meter in depth, although water howellia is sometimes found in water up to two meters deep (USFWS 1996). Additionally, a few occurrences of water howellia are found in oxbow sloughs and surrounding marshy areas such as those on the Swan River Oxbow Preserve managed by The Nature Conservancy in Montana and the type locality in Oregon.

Across its range, water howellia occurs at elevations as low as three meters in Washington to 1372 meters in Montana. Water howellia ponds are typically surrounded at least in part by forested vegetation. Tree species vary across the range of water howellia, although some broadleaf deciduous trees are usually included. A variety of deciduous shrubs and herbaceous species are commonly associated with water howellia occurrences, two of the most common being inflated sedge (*Carex vesicaria*) and reed canary grass (USFWS 1996).

Bottom surfaces of the ponds and wetlands usually consist of organic sediments underlain by consolidated clay (USFWS 1996). In Montana, soil units in the Swan Valley are comprised of Cryochepts, Eutroboralfs and Eutrochrepts from parent materials of clayey alluvium and clayey colluvium (Shelly and Moseley 1988). Soils on the 87,000-acre Fort Lewis Military Reservation are generally composed of nutrient poor, well-drained glacial till (Clegg and Lombardi 2000). Analysis of water chemistry by Lesica (1992), Shapley (1998) and Reeves (2001) in the Swan Valley of Montana shows specific conductance readings from <30 µS/cm to 400 µS/cm with most ponds below 150 µS/cm. Measurements of pH ranged from 6.2 to 7.8 with most measurements between 6.5 and 7.5. The general conclusion drawn from these data is that water howellia prefers freshwater ponds close to neutral. Prior to Shapley's analysis of the basin morphology of water howellia ponds in the Swan Valley, most ponds were considered to be closed under present climatic conditions (Shapley and Lesica 1997). However, 12 of 34 ponds studied were observed to have spill points occupied frequently enough to maintain some channel morphology and that interpond exchange of surface water during wet periods appeared to be more common than previously supposed.

Whitebark pine *(Pinus albicaulis)* (Candidate)

On July 19, 2011, the U.S. Fish and Wildlife Service (FWS) published in the Federal Register its 12-month status review finding on a petition to list whitebark pine (*Pinus albicaulis)* under the Endangered Species Act. After a review of all available scientific and commercial information, the FWS concluded that listing the species as threatened or endangered is warranted, but precluded by higher priority actions. Following this action, Region 1 of the U.S. Forest Service added whitebark pine to its sensitive species list.

The distribution of whitebark pine includes coastal and Rocky Mountain ranges that are connected by scattered populations in northeastern Washington and southeastern British Columbia. Occurrences are found in scattered areas of the warm and dry Great Basin but whitebark pine typically occurs on cold and windy high-elevation or high-latitude sites in western North America. As a result, many stands are geographically isolated (Arno and Hoff 1989, Keane et al. 2010). Extensive forests form in the northern Rocky Mountains of the U.S., and it is also abundant on the eastern slope of the Cascades and Coast Ranges; however, whitebark pine assumes a more patchy distribution at the northern end of its distribution in the Canadian Rockies and Coast Ranges of British Columbia (Arno and Hoff 1990).

On the Forests substantial whitebark pine forests occur in the high Bitterroots in the eastern portion of the unit, in the Gospel Hump Wilderness, the west boundary of the Slate Creek basin and in the Seven Devils to the southwest. Other occurrences are in the Selway Crags and on the highest points west of the Selway River. Outside of these locations scattered whitebark pine are found in low numbers on only a few of the highest summits.

Whitebark pine forests occur in two high mountain biophysical settings. Most common are upper subalpine sites where whitebark pine is the major seral species that is always replaced by the shade-tolerant subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), or mountain hemlock (*Tsuga mertensiana*), depending on geographic region (Arno and Weaver 1990). These sites support upright, closed-canopy forests and occur on favorable positions in the upper subalpine transitioning to timberline, down to above or overlapping with the elevational limit of lodgepole pine (Arno and Weaver 1990; Pfister et al. 1977). On the Forests, most whitebark pine probably occurs in this situation.

Sites where whitebark pine is the only tree species able to successfully dominate high elevation settings are found at particularly harsh sites in the upper subalpine and at treeline on relatively dry, cold slopes, where trees often occur in elfin forests, clusters, groves or tree islands (Arno 1986; Arno and Weaver 1990; Steele et al. 1983). Other species, such subalpine fir, Engelmann spruce, and lodgepole pine (*Pinus contorta*), can occur on these sites, but they occur as scattered individuals with truncated growth forms and they never dominate a stand (Arno and Hoff 1990; Arno and Weaver 1990; Cooper et al. 1991; Pfister et al. 1977). Alpine larch is often found on north-facing climax whitebark pine sites, often in association with sub-surface water (Arno and Habeck 1972). Whitebark pine can also exist as krummholz in the alpine treeline ecotone (Arno and Hoff 1990; Tomback 1989), and as a minor seral in lower subalpine sites (Cooper et al. 1991; Pfister et al. 1977).

Whitebark pine is a long-lived tree of moderate shade tolerance (Minore 1979). It is common to find mature whitebark pine trees well over 400 years of age, especially on harsh growing sites (the oldest is more than 1300 years) (Luckman et al. 1984, Perkins and Swetnam 1996). Whitebark pine is slow growing in both height and diameter, and it rarely grows faster than most of its competitors except on the most severe sites (Arno and Hoff 1990). It is often eventually replaced, in the absence of fire, mainly by the shade-tolerant subalpine fir but also by Engelmann spruce and mountain hemlock. Lodgepole pine can out-compete whitebark pine during early successional stages in some subalpine forests, but both species often share dominance in upper subalpine forests (Day 1967, Mattson and Reinhart 1990, Arno et al. 1993). It can take approximately 50 to 250 years for subalpine fir to replace whitebark pine in the overstory, depending on tree densities, local environment, and previous fire history (Arno and Weaver 1990, Keane 2001).

The Clark’s nutcracker (*Nucifraga columbiana*) plays a critical role in the dispersal of whitebark pine’s heavy, wingless seed (Tomback 1982, Tomback et al. 1990, Tomback 1998, Lorenz et al. 2008). The bird harvests seed from purple cones during late summer and early fall. It carries up to 100 of the seeds in a sublingual pouch up to 10 km away, where it buries up to 15 seeds in a cache 2–3 cm below the ground (Tomback 1998; Lorenz et al. 2008). Nutcrackers can disperse whitebark pine seeds up to 100 times farther (over 10 km) than wind can disperse seeds of its competitors (McCaughey et al. 1985; Tomback et al. 1990, 1993). The birds reclaim many of the thousands of caches created each year, but the seeds that remain eventually germinate.

Nutcrackers often cache in open areas where the ground surface is visible from above, and often near objects on the ground, such as rocks, logs, and snags, because it reclaims seed from caches by pattern recognition (Hutchins and Lanner 1982, Tomback et al. 1993, Lanner 1996). In high-mountain settings, open areas with a high degree of pattern are often created by wildland fire. Three types of fires describe the diverse fire regimes in whitebark pine forests (Arno and Hoff 1990, Morgan and Bunting 1990, Morgan et al. 1994). Some high-elevation stands experience nonlethal surface fires (called underburns in this study) because sparse fuel loadings foster low intensity fires (Keane et al. 1994). The more common fire regime is characterized by fires of mixed severities in space and time that create complex mosaics of tree survival and mortality on the landscape. Mixed-severity fires can occur at 60- to 300-year intervals (Morgan and Bunting 1989, Arno et al. 2001, Murray 2008). Burned patches are often 1 to 100 hectare (ha) in size, depending on topography and fuels, and these openings provide important caching habitat for the Clark's nutcracker (Tomback et al. 1990, Norment 1991). Many whitebark pine forests in northwestern Montana, northern Idaho, and the Cascades originated from large, stand-replacement fires that occurred at time intervals greater than 250 years (Keane and Morgan 1994, Murray 1996). These fires are usually wind driven and often originate in lower-elevation stands (Murray et al. 1998).

Whitebark pine benefits from fire because it is better adapted to surviving and regenerating after fire than associated shade-tolerant trees (Arno and Hoff 1990). Whitebark pine can survive low-severity fires better than its competitors because it has thicker bark, thinner crowns, and deeper roots (Arno and Hoff 1990). It also readily colonizes large, stand replacement burns because nutcrackers transport the seed great distances (Tomback 2005, Lorenz et al. 2008).

There are three primary factors contributing to the decline of whitebark pine, including insect outbreaks, fire management and introduced disease. There have been several major mountain pine beetle (*Dendroctonus ponderosae*) outbreaks that have killed many cone-bearing whitebark pine trees over 20 cm in diameter at breast height (Arno 1986, Waring and Six 2005). The effects of an extensive and successful fire-exclusion management policy since the 1930s have also reduced the area burned in whitebark pine forests, resulting in a decrease of suitable conditions for whitebark pine regeneration (Keane and Arno 1993, Kendall and Keane 2001). Finally, the introduction of the exotic fungus white pine blister rust (*Cronarium ribicola*) to the western United States circa 1910 has killed many five-needle pine trees, and whitebark pine is one of the most susceptible to the disease (Hoff et al. 1980, Keane and Arno 1993, Murray et al. 1995, Kendall and Keane 2001). The cumulative effects of these three agents have resulted in a rapid decrease in mature whitebark pine over recent decades, especially in the more mesic parts of its range (Keane and Arno 1993). What's more, predicted changes in the northern Rocky Mountains due to climate change could further exacerbate whitebark pine decline by increasing the frequency and duration of beetle epidemics, blister rust infections, and severe wildfires (Logan and Powell 2001, Blaustein and Dobson 2006, Running 2006).

Mortality data collected in multiple studies throughout the range of whitebark pine strongly suggests a substantial and pervasive decline throughout almost the entire range of the species (USFWS 2011). In Canada, based on current mortality rates, it is anticipated that whitebark pine will decline by 57% by 2100 (COSEWIC 2010). The value for this anticipated decline is likely an underestimate, as it assumes current mortality rates remain constant into the foreseeable future, while past trends have shown that mortality rates have been increasing over the last several decades. The range of mortality rates for whitebark pine in the United States are similar to those in Canada, which suggests that the anticipated rates of decline will be similar.

At the broad Regional and Forest scales, the Forest Inventory Analysis (FIA) abundance information from the 1990s periodic inventory, and preliminary information on trend from the annualized inventory (2002-2007 data) shows a reduction of the extent of live whitebark pine (plots having at least one tree) across the Region and Forests, and an increase in dead trees (USDA Forest Service 2010). The bulk of the mortality can be attributed to ongoing mortality from white pine blister rust, wildfire, and the mountain pine beetle; only since about 2004 has mortality increased at a rapid rate. The likelihood of continuing mortality due to these disturbance agents, in the case of mountain pine beetle and fire, is very much linked to the future cyclic pattern of warm weather and drought at higher elevations where whitebark pine is abundant. Mortality due to blister rust will continue for the foreseeable future regardless of the near-term climate cycles (USDA Forest Service 2010).

The loss of whitebark pine could have serious consequences for upper subalpine ecosystems of the northern Rocky Mountains and Cascades of the United States because it is considered a keystone species (Mills et al. 1993, Tomback et al. 2001). Whitebark pine forests cover a major portion (approximately 10%–15%) of the northern Rocky Mountain forested landscape (Keane 2000, Tomback et al. 2001). It also produces large, wingless seeds that are an important food source for over 110 animal species (Kendall and Arno 1990, Hutchins 1994). Whitebark pine also inhabits severe high elevation environments where at times it is the only tree species to protect snowpack and delay snowmelt, which reduces the potential for flooding and provides high-quality water into the summer (Hann 1990). It has great value as a recreational resource because of its pleasing aesthetic qualities such as twisted growth forms and open, park-like forests (Cole 1990).

The Pacific Decadal Oscillation (PDO) effects are determined by northern Pacific surface water temperatures, and influence climatic trends across the northern Rockies and Great Plains. Over the last century in Montana and northern Idaho, it is evident that the PDO, influencing the western regional climate including the Region 1 area, has also influenced disturbances such as fire and mountain pine beetle and thus contributed to whitebark pine decline. Given that the probability of continuing disturbance is high as climate projections predict a warming trend, the mortality of large seed-producing whitebark pine may also be high. Thus, restoration efforts to encourage natural regeneration of whitebark pine are urgently needed soon, to take advantage of large cone-bearing rust resistant trees while they are still on the landscape. Planting of stock from the whitebark pine rust resistance work is also important to continue (USDA Forest Service 2010).

In the United States, approximately 96% of land where the species occurs is federally owned or managed. The majority is located on Forest Service lands, thus efforts of the agency are critical to the species. The USFS Rocky Mountain Research Station, in collaboration with academic and agency partners, has compiled a draft rangewide restoration strategy for whitebark pine (Keane et al., 2010). The Integrated Restoration and Protection Strategy and the Northern Region Integrated Restoration and Protection Strategy (IRPS) provide information to help local units identify and prioritize potential areas for accomplishing Forest and Grassland Plan goals and objectives are described in the R1 Executive Summary (USDA Forest Service 2010). The primary treatment opportunities under this strategy include prescribed burning and wildland fire use for resource benefits (to promote seed dispersal by Clark's nutcrackers for natural regeneration and to reduce crown fire potential), and planting of rust-resistant stock in areas where seedbeds have been previously prepared by fire and where local seed source is now limited.

All National Forests in the Northern Region have whitebark pine habitat, and have implemented projects for whitebark pine restoration and protection. In the past decade there has been greater progress in treating lands to aid in protecting existing whitebark pine trees and stands, reforesting whitebark pine, and monitoring the status of whitebark pine forests. Many landscape analyses conducted to identify project opportunities (pre-NEPA) include projects for the restoration of whitebark pine when the project area has suitable habitat (USDA Forest Service 2010). Projects have included the direct planting of young seedlings, the removal of competing vegetation and conifers through hand slashing, or removal of merchantable timber. As well, the use of prescribed fire in whitebark pine habitats provides openings for seed caching. The Region has also been protecting whitebark pine by reducing the attack from mountain pine beetle using the pheromone Verbenone or direct protection with Carbaryl, emphasizing trees of high value and those selected for potential genetic resistance. And in May, 2009, Region 1 issued a letter to the National Forests regarding the management of unplanned ignitions for whitebark pine restoration. The purpose of the letter was to highlight opportunities where wildfire can be used to meet restoration needs for the species (USDA Forest Service 2010).

The primary assumption is that whitebark pine ecosystems can be restored from the damaging effects of blister rust, mountain pine beetle, and fire exclusion through treatments that emulate wildland fire regimes to remove competitors and create habitat suitable for nutcracker caching. The primary objective of these treatments was to increase whitebark pine regeneration. It is assumed that living, cone-producing whitebark pine seed sources at or near restoration sites possess some degree of blister rust resistance, since they have already survived decades of rust infection (Arno et al. 2001). These potentially rust-resistant whitebark pine trees would provide the seed for the nutcrackers to plant in the treated units and, hopefully, the subsequent regeneration would be somewhat resistant to the rust (Hoff et al. 2001).

5.3.2.2 Trends and Drivers

The following are drivers of the trends described for the species above:

- Reduction of grasslands due to forest encroachment
- Noxious weed introduction/expansion, particularly in dry forest/grassland and riparian habitats
- Very small populations sizes threatened by stochastic events and potential genetic concerns
- Climate change as a limitation especially to high elevation species and aquatic species
- Livestock grazing in grassland habitats
- Impacts of insect, disease and alteration of fire regimes to whitebark pine.

5.3.3 *Information Needs*

The following information needs have been identified:

- Verification/validation of availability and suitability of potential habitat for all federally listed species, especially MacFarlane’s four o’clock and water howellia, which potentially occur, but have not been documented, on NFS lands.
- Completion or updates of habitat modeling for each species.

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