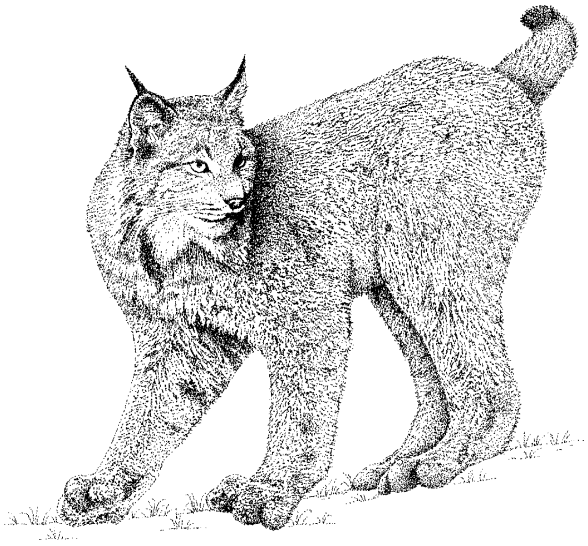
DRAFT

Washington State Recovery Plan

for the

Lynx



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In 1990, the Washington Fish and Wildlife Commission adopted procedures for listing and delisting species as endangered, threatened, or sensitive and for writing recovery and management plans for listed species (WAC 232-12-297, Appendix C). The lynx was classified by the Washington Fish and Wildlife Commission as a threatened species in 1993 (Washington Administrative Code 232-12-011). The procedures, developed by a group of citizens, interest groups, and state and federal agencies, require that recovery plans be developed for species listed as threatened or endangered.

Recovery, as defined by the U.S. Fish and Wildlife Service, is "the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured."

This document summarizes the historic and current distribution and abundance of the lynx in Washington, describes factors affecting the population and its habitat, and prescribes strategies to recover the species in Washington.

This is the Draft Washington State Recovery Plan for the Lynx. It is available for a 90 day public comment period. Please submit written comments on this report by 1October 2000 to:

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ACKNOWLEDGMENTS

This report contains material from *Status of the North American Lynx* (Lynx canadensis) *in Washington* (Washington Depart. of Wildlife 1993) that was written by Michelle Tirhi, and from an early draft initiated by Scott Richardson. Scott also coordinated meetings of a WDFW recovery team that included Harriet Allen, Eric Cummins, Scott Fitkin, Gary Koehler, Tracy Lloyd, Lee Stream, and Steve Zender.

Tom Owens conducted the analyses that produced some of the tabular data, and manipulated spatial data to create several map figures which are important components of the plan. Mike Badry and Brian Harris of the Wildlife Branch, Ministry of Environment, British Columbia provided helpful trapper and hunter harvest data and habitat info for BC. Darrell Pruett created the lynx and bobcat illustration, and Peggy Ushakoff created figures 2 and 3. The following individuals also graciously provided data, GIS coverages, publications, habitat data, or other material assistance: Keith Aubry, Dana Base, Tim Bertram, Scott Fitkin, John Jacobsen, Martha Jensen, Gina King, Camryn Lee, Sandy Lembcke, Chris Loggers, Bob Naney, Eduardo Olmedo, Cheryl Quade, Elaine Rybak, Tom Williams, and Steve Zender.

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EXECUTIVE SUMMARY

The lynx (*Lynx canadensis*) is the rarest of three cat species native to Washington, with at most 200, and perhaps fewer than 100, individuals living in the state. Lynx have large feet and long legs that give them a competitive advantage in deep snow over other carnivores that might otherwise compete for habitat and prey. Lynx are largely dependent upon a single prey species, the snowshoe hare, but they also eat red squirrels, small mammals, birds, and carrion. Lynx are primarily associated with subalpine and boreal forest types in the mountains of north-central and northeastern Washington, and formerly occurred in the southern Cascades near Mt. Adams and Mt Rainier. Topographic relief gives these forests a patchy distribution which in turn affects their potential to support lynx.

Across most of their range in northern boreal forests, lynx undergo cyclic changes in abundance that lag 1 year behind snowshoe hare population cycles. This 10-year cycle in snowshoe hare abundance may occur in Washington with a reduced amplitude, but it has not been clearly demonstrated. Peaks in the lynx cycle and hare declines produce pulses of dispersing individuals that may travel long distances in search of suitable habitat. At these times, some lynx may immigrate to Washington from larger populations in British Columbia and Alberta. Immigration from northern populations, and dispersal between subpopulations in Washington may be essential to the long-term viability of Washington's lynx population.

Lynx were trapped or hunted in Washington until 1991 when a decline was readily apparent. It now seems clear that the lynx population in Washington could not sustain perennial exploitation due to the fragmented nature of subalpine-boreal habitats and low density of snowshoe hares. The lynx was listed as a state threatened species in 1993, and became a Threatened species under the federal Endangered Species Act (ESA) in April 2000.

The major factors affecting habitat and the lynx population include forest management, fire and fire suppression, insect epidemics, and management of lynx harvest and habitats in southern British Columbia. Lynx are relatively tolerant of human activity, but recreational developments and roads with high traffic volumes may affect lynx movements. Anecdotal observations have fueled speculation that snow compaction on forest roads and trails may affect the degree to which lynx must compete with coyotes and other carnivores, but little data exists from which to draw conclusions about the affect on lynx.

Most of the land in 6 Lynx Management Zones is on federal lands (85-95%), and about 37% is in wilderness and other reserves. Petitions to list the lynx under the ESA, and the subsequent listing in March 2000 has increased attention on lynx. The large proportion of habitat in national forests provides the opportunity for the U. S. Forest Service to manage

for lynx at the ecosystem scale. The understanding of lynx harvest management has also improved, providing British Columbia and Alberta the ability to prevent overharvests that could reduce the frequency of immigration to Washington. These factors improve the prospects for the recovery of lynx populations in Washington.

Meaningful population based recovery objectives are not possible to formulate at this time due to the rudimentary knowledge of lynx population dynamics in southern boreal forests. Interim objectives to down-list the lynx to Sensitive involve consistent occupancy of most of the habitat (>75% of lynx analysis units) capable of supporting reproductive populations. Recovery objectives will be revised as new information becomes available about lynx.

PART ONE: BACKGROUND

TAXONOMY

Lynx in North America are thought to have descended from Eurasian ancestors that crossed the Bering land bridge during the Pleistocene (Quinn and Parker 1987). Present-day lynx and bobcat populations in North America originated from separate colonizations. Lynx ancestors presumably arrived after glacial retreat to inhabit boreal regions. These immigrants were apparently preceded by bobcat (*Lynx rufus*) ancestors, which had settled south of glacier-covered areas.

Lynx are classified in the Order Carnivora, the Family Felidae, and the Subfamily Felinae, but authorities disagree on generic and specific assignments. Some authorities retain these cats in the more inclusive genus *Felis*, in part because *Lynx* and *Felis* cats can hybridize (McCord and Cardoza 1982; Van Gelder 1977 *in* Tumlison 1987) but most place lynx and bobcat in the genus *Lynx*, based on dentition and tail length. *Lynx* bears the weight of history, having been used for these cats since Kerr's (1792) classification. The specific epithet is also controversial, with authorities debating whether North American populations (*L. canadensis*) merit taxonomic distinction from the Eurasion form (*L. lynx*). We refer to the species in Washington as *Lynx canadensis*, the name used by Hall (1981), Wilson and Reeder (1993), and Verts and Carraway (1998). The term "lynx" in this recovery plan refers to the North American or Canada lynx.

DESCRIPTION

Lynx are medium-sized felines slightly larger than bobcats and smaller than cougars (*Felis concolor*). The lynx's long fur and longer legs make them appear considerably larger than bobcats, but the mass of adult males is often exceeded by male bobcats (Quinn and Parker 1987, Rolley 1987, Verts and Carraway 1998). Features that help to distinguish them from the similar bobcat include longer legs, larger paws, fuller facial ruff, projecting ear tufts, and a blunt, black-tipped tail (Fig. 1). The lynx's long legs enhance springing action (Mandal and Talukder 1975), while large paws produce a "snowshoe" effect that decreases foot-loading (ratio of body mass to foot surface area) to facilitate movement across snow (Murray and Boutin 1991).

Lynx attain mature body length, weight, and coloration in their second year (Parker et al. 1983), with males being slightly longer and heavier than females. Adult males average 10 kg (22 lb) in weight and 85 cm (33.5 in) in length, while females average 8.5 kg (19 lb) and 82 cm (32 in) (Quinn and Parker 1987).

The head, throat, and ears of a lynx are mixed grayish white, black, and brown. Vertical black lines extend from the outer corners of the eyes to the chin, and blend with the facial ruff. The ear margins and tufts are black. In winter, the upper parts are given a silvery appearance by guard hairs that have a white base, dark center, and silver-gray to grizzled-brown tip. In summer, the pelage is a mixture of light browns and tans. At all seasons, the underparts and insides of the legs are light buff to grayish white, often showing black bars or spots. Immature lynx are yellowish to buff and spotted or streaked with brown or black (McCord and Cardoza 1982).

Lynx are good swimmers and tree climbers (Deems and Pursley 1983, O'Donoghue et al 1998, Mowat et al. 2000: ch.9), but they have low endurance and tire easily after a chase (Seton 1929; Jackson 1961; Ognev 1962 *in* McCord and Cardoza 1982). Their senses of vision and hearing are well developed, in contrast to their poor sense of smell (Lindemann 1955, Saunders 1963b).

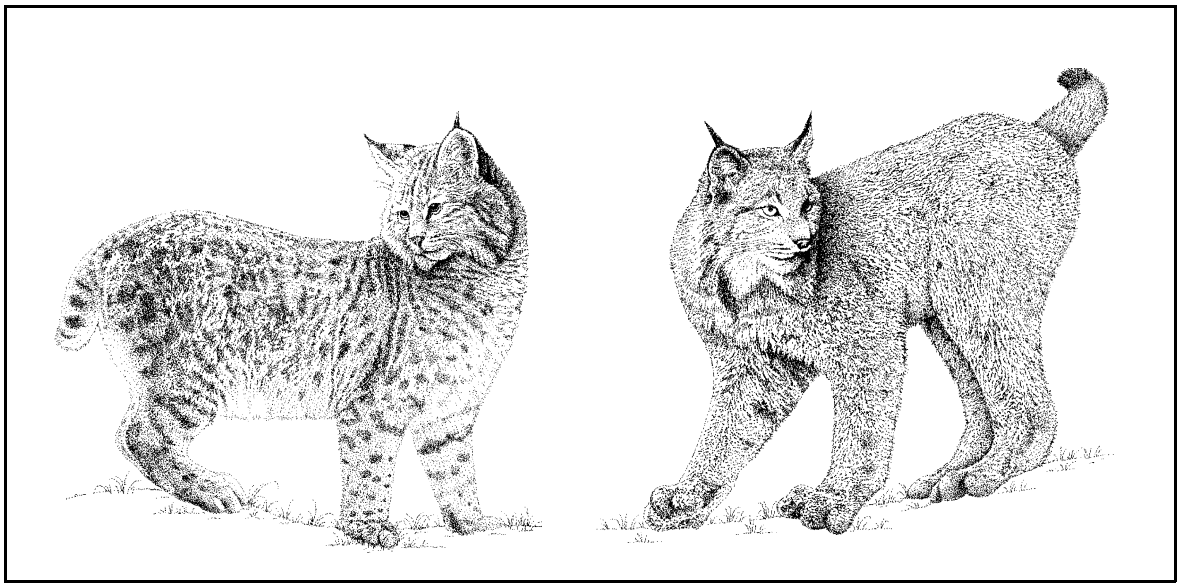


Figure 1. Comparison of bobcat (left), and lynx (right).

GEOGRAPHICAL DISTRIBUTION

North America

North American lynx inhabit coniferous forests and wet bogs from Newfoundland to Alaska and British Columbia, and from the arctic treeline to the northern United States (Fig. 2). Within the United States, lynx are primarily restricted to peninsula extensions of boreal forest into northern New England, parts of the Great Lake states, the Rocky Mountains south to Utah, and mountains of the Pacific Northwest (McKelvey et al. 2000: ch.8). Many peripheral records probably reflect transient individuals rather than resident populations (McCord and Cardoza 1982, Verts and Carraway 1998).

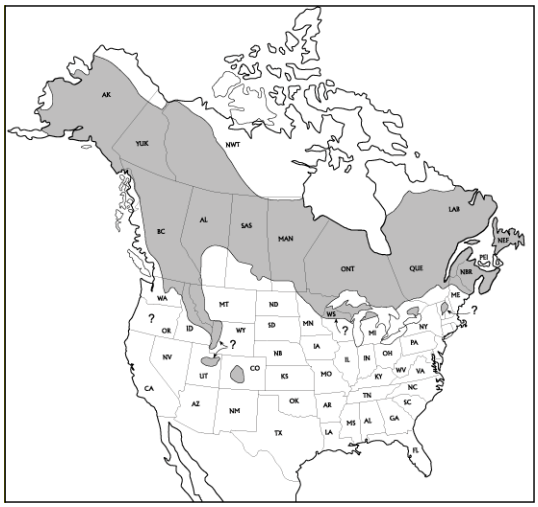


Figure 2. Lynx range in North America (modified from Quinn and Parker 1987).

Washington

Lynx are primarily found in high-elevation forests of northcentral and northeast Washington, including Okanogan, Chelan, Ferry, Stevens, and Pend Oreille counties. Most of the museum specimens for which we have location data (62 of 76, or 81.6%) are from these Counties, and only 5% of 76 specimens are from locations other than these Counties or the Mt. Adams area (Appendix A). There is little evidence that lynx were ever resident in the coastal forests west of the Cascades, or in the Olympics. Interviews with Indians of Puget Sound indicated that lynx were not found in the Sound area (Suckley and Cooper 1860). Webster (1920) reported only one lynx species, the bay lynx (bobcat), in the Olympics in 1920. The 10 specimens in the U.S. National Museum that were caught near Mt. Adams in 1896-97 confirms the claims of Taylor and Shaw (1927,1929) and Dalquest (1948) that lynx were also historically found in the southern Cascades (Fig. 3).

Taylor and Shaw (1929) give the range of lynx as :

> Cascades Mountains easterly, north to Toats Coulee Creek near Loomis, south to Mount Adams, and west to Mount Rainier. Also Okanogan Highlands northeast to Stevens County. Scarce on the west slopes of the Cascades; apparently absent from the Olympic and Blue Mountains.

It is not clear exactly when or if lynx were extirpated from the southern Cascades. There were a very small number of reports of lynx caught in Yakima, Kittitas, Pierce, and Lewis

Counties in the 1960s and '70s that may have been transients. More recently, Weaver and Amato (1999) reported a handful of possible lynx detections in Whatcom, Kittitas, eastern Skamania, eastern Lewis and southern Chelan counties that could represent transients, or small local populations.

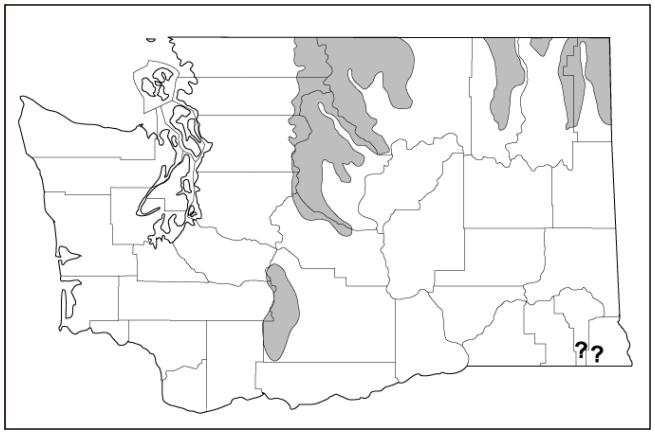


Figure 3. Theorized historical distribution of lynx in Washington; historical status in the Blue Mountains is uncertain.

In 1928 lynx were reported (1 trapped, and tracks) on the upper Skagit in the Mount Baker National Forest by the supervisor, L. B. Pagter (Edson 1930). Allen Brooks (1930) noted that although bobcat were common throughout the Mount Baker National Forest, the only definite record of lynx was one trapped by his brother in 1897. There are a few other scattered unverified reports west of the Cascade crest (M. Jensen, pers. comm.; McKelvey et al. 2000: Fig. 8.19). The absence of lynx records in British Columbia fur harvest reports for west of the Cascades also supports the idea that lynx have never been common in western Washington (M. Badry, pers. comm.).

The response of lynx populations to snowshoe hare cycles can produce pulses of dispersing individuals when prey is scarce (*see Cycles page* 9). These transient lynx often show up further south than lynx usually occur and in habitats not normally used (for example: in Douglas County in 1965, and Whitman County in 1962 and 1963).

Given the few scattered records, it is not clear whether or not lynx populations were consistently present in the Blue Mountains of Washington (Appendix A, B). Taylor and Shaw (1929) called it "absent." Couch (1932) reported a male that was captured in 1931 near Mt. Misery in Garfield County, and noted that according to Jewett and Dobyns that "several Canada lynx have been taken in the Blue Mountains in Oregon, and are known in the Wallowa Mountains." There are 5 specimen records from the Blue Mountains of Oregon. Verts and Carraway (1998) note that the dates of collection for nearly all the Oregon specimens correspond to peaks in the lynx cycle. There have been several lynx sight reports from northeastern Oregon in recent years (C. Lee, pers. comm.), but extensive hair snag surveys in Oregon that included the Umatilla, Ochoco, Malheur, and Wallowa-Whitman National Forests did not detect any lynx in 1999 ("Lynx Update," E. Rybak, pers. comm.). Verts and Carraway (1998) consider it unlikely, given the existence of only 9

specimens from appropriate habitat, that self-maintaining populations of lynx existed in Oregon in historic times. The habitat in the Blue and Wallowa Mountains, as well as habitat in the southern Cascades in Washington, may be somewhat marginal and is occupied off and on. If the old scattered reports from the Blues, and elsewhere are the result of transients, then it would appear that there has been no major change in the Washington distribution of lynx since the 1920s.

NATURAL HISTORY

Home Range

Lynx establish a home range when they become resident in a suitable area. An adequate prey base is probably the main factor determining lynx use, but home range shape and size are also influenced by lynx density, geographic and physiographic features, and season. Males tend to have larger home ranges than females, and they may exhibit a greater seasonal shift in core area (Squires and Laurion 2000: ch. 11). Individual home ranges sometimes overlap, particularly between sexes, but ranges of males are more exclusive (Mech 1980, Ward and Krebs 1985, Stephenson 1986, Brittell et al. 1989, Koehler 1990, Poole 1995). Mutual avoidance apparently reduces conflict in shared home ranges, and there may be an exclusive core area with little overlap (Brittell et al. 1989:62, Poole 1995). Brittell et al. (1989) observed a high degree of overlap of male and female home ranges (31.4-43.9%) in the Okanogan region of Washington. Poole (1995) reported that home ranges in an untrapped area of Northwest Territory were quite stable for 3 years but broke down with the first full winter of low hare density, when the resident lynx died or dispersed. Spatial organization prior to prey scarcity was described as a “land-tenure system” like that described for cougars and bobcats (Hornocker 1969, Bailey 1974, Poole 1995). The extensive overlap of ranges and association of certain female pairs suggested that related females can be tolerant to the point of being social (Mowat et al. 2000: ch. 9).

Food availability may be the most important criterion in the determination of home range size in many carnivores (Gittleman and Harvey 1982). Research conducted in the Yukon found lynx increasing their home ranges considerably during a decline in the density of snowshoe hares (Ward 1984, Ward and Krebs 1985). However, a recent study conducted in the Yukon found increased overlap of home ranges during the peak in the cycle but little difference in the size of individual home range between the peak and the base (Slough and Mowat 1996). Slough and Mowat (1996) suggest that a small portion of lynx populations may maintain large home ranges at any density. Home range size seems to be stable when hare densities are adequate, but increases dramatically when hare density drops below a threshold during a crash (Mowat et al. 2000: ch. 9). Home range size may also be influenced by physiography and the distribution of potential lynx habitat (Apps 2000)

The average annual home range reported in southern boreal forests is about 151 km^2 for males, and 72 km^2 for females (Aubry et al. 2000: ch 13). Home ranges for Washington are comparable to those estimated by some researchers in Alaska, Montana, and the Yukon (Table 1). They are neither the largest nor the smallest home ranges reported in numerous studies across North America. In general, home ranges in southern boreal areas are larger than those in northern areas during the hare peak. Hare densities in southern boreal habitats seem to remain low compared to northern boreal forests (0.1-2/ha; Hodges 2000: ch.7).

Table 1. Mean annual home ranges (km^2) for lynx in Washington and other selected southern boreal and northern boreal locations.

Location	Mean (km^2)+sd	Method	Source
Washington	49±25 (male; n=8) 37±26 (female; n=3)	100% MCP [a]	Brittell et al.(1989) unpublished
	69 ±28 (male: n=5) 39 ±2 (female; n=2)	100% MCP	Koehler (1990)
Montana	122 (male; n=6) 43 (female; n=3)	100% MCP	Brainerd (1985)
	238±99 (male; n=4) 115±50(female;n=2)	95% MCP	Squires and Laurion (2000)
Southern Canadian Rockies	277±71(male; n=3) 135±+124(female; n=3)	95% MCP	Apps (2000)
Yukon (hare population low)	119±189 (male;n=6) 266±106 (male; n=2) 23±7 (female;n=10) 507±297(female;n=4)	95% MCP, 1992-93 1993-94 1992-93 1993-94	Slough and Mowat (1996)
Yukon (hare population high)	44±23 (male;n=12) 13±4 (female;n=13)	95%MCP, 1990-91	

[a] MCP = minimum convex polygon.

Movements and Dispersal

Based on snow tracking daily travel distances in Alberta and eastern Canada averaged 5-9 km (Mowat et al. 2000: ch. 9) and straight-line travel determined with telemetry was 2-4 km in Montana and the southern Canadian Rockies (Apps 2000: ch.12, Squires and Laurion 2000: ch. 11). In some study areas, movements seem to increase as greater effort is required per kill (Poole 1994), but in Alberta and the Yukon, movements were reduced by increased use of ambush beds during the hare low (Brand et al. 1976, O'Donoghue 1998).

When residents are unable to find sufficient food, they may depart their home range to find more productive habitat (Poole 1994).

Dispersal and colonization is likely to be very important for lynx in the more fragmented habitat that is characteristic of lynx range in Washington (*see Metapopulation dynamics, p.* 33). Dispersal refers to permanent movements that take the animal away from its home range, and may be the result of local prey scarcity, or the innate drive of subadults to seek out and establish a home range. Transient females seldom reproduce or successfully raise kittens, but these periodic pulses of dispersal may be important to maintain lynx populations across their range. Dispersing or transient lynx reside in areas temporarily, searching for unoccupied suitable habitat. Young lynx may venture into marginal or unsuitable habitat, such as shrub-steppe or marginal forest types (Verts and Carraway 1998), but those that find suitable home ranges may be critical to re-establishing populations after local extirpation.

Large numbers of lynx may undergo long-distance dispersal during a decline in the hare population, producing the "irruptions" or "invasions" for which lynx are known (Adams 1963; Mech 1973, 1980; Ward 1985; Ward and Krebs 1985). Lynx have traveled straight-line distances of up to 1100 km (Mowat et al. 2000). Straight-line dispersal distance of 40 lynx in Northwest Territories averaged 163 ±209 km (median 88, range 17-930), and two animals traveled 900 and 930 km (Poole 1997). Most of the dispersing lynx were kittens and yearlings, and the adult residents that dispersed, left the first two winters after the hare decline. One male tracked from Washington to British Columbia traveled 616 km in 202 days (Brittell et al. 1989). Dispersing lynx have been known to cross highways and rivers, although highways do influence movements (Apps 2000).

Southward "invasions" from Canada have been reported in various U.S. localities, but northward movements also occur. Brittell et al. (1989) documented 4 of 19 lynx moving from Washington to British Columbia. In the Northwest Territories, Poole (1997) found that dispersal direction was uniform for females, but favored south and west for males. In most mammalian species males exhibit greater dispersal rates or distances than females (Greenwood 1980), but this has not been reported in lynx (Mowat et al. 2000: ch. 9).

Reproduction

Lynx ovulate in late March and early April (Alaska Dept. Fish and Game 1977, Brittell et al. 1989). Nine weeks later they bear 2-5 altricial young. Perhaps the greatest factor influencing lynx natality is the availability of snowshoe hares. During highs in the hare cycle, litters of 4 or 5 (rarely 6) are produced, but when hares are rare productivity suffers; in some years no litters are produced or no young survive (Brand et al. 1976, Brand and Keith 1979, O'Connor 1984, Slough and Ward 1990). In the Okanogan area of Washington, Brittell et

al. (1989) reported an average litter size of two kittens (N=4). Koehler (1990) documented litter sizes of three and four kittens in 1986 (N=3). No kittens were found in 1987. Hatler (1988) reported an average litter size of 2.77 (N=26) for populations in Canada, Alaska, and Washington.

The kittens open their eyes after about 2 weeks and are weaned by 12 weeks (McCord and Cardoza 1982). They remain with their mothers through their first winter and disperse at 10-11 months (Poole 1997). Lynx generally reach sexual maturity as yearlings, but kittens of young females rarely survive. Low survival of yearling's kittens may be due to a later birth date and the inexperience of yearlings at raising young (Slough and Mowat 1996).

Mortality

Lynx rarely survive more than 15 years in the wild, though they may live 22 years in captivity (Tumlison 1987). Starvation is a well known cause of death among lynx, especially during snowshoe hare declines (Seton 1925, Ward 1985, Brittell et al. 1989). Although mortality occurs in all age classes during hare declines, kittens are especially vulnerable (Nellis et al. 1972, Brand et al. 1976, Brand and Keith 1979). Koehler (1988) documented low birth rates and high juvenile mortality in his Okanogan study which he attributed to low prey availability.

Lynx are killed by other predators, including cougars, wolves, wolverines, coyotes (Berrie 1974, Koehler et al. 1979, Koehler 1990, O'Donoghue et al. 1995), and occasionally other lynx (Elsey 1954, O'Donoghue et al. 1995). Low rates of disease and parasitic infestation in lynx may be partially attributed to the species' solitary nature (McCord and Cardoza 1982).

Lynx are susceptible to trapping (Mech 1980, Carbyn and Patriquin 1983, Parker et al. 1983). Half the animals marked (n=98) in eight studies died due to trapping and other human-related causes (Nellis et al. 1972, Mech 1980, Carbyn and Patriquin 1983, Parker et al. 1983, Ward and Krebs 1985, Bailey et al. 1986, Stephenson 1986, Bailey et al. 1987). Yearlings and kittens seem to be more vulnerable to trapping than adults, and males more vulnerable than females (van Zyll de Jong 1963, Stewart 1973, Berrie 1974, Parker et al. 1983, Quinn and Thompson 1987). Risk of capture increases when lynx expand home ranges or disperse in response to hare declines or high recruitment (Ward and Krebs 1985). During years of low recruitment, lynx populations may be locally extirpated by trapping. Trapping mortality can exceed recruitment even when lynx productivity is high so that the persistence of lynx in areas depends on immigration from refugia (Slough and Ward 1990, Slough and Mowat 1996). Brand and Keith (1979) suspected that trapping mortality was additive to natural mortality in their study area in Alberta. However, high natural mortality

during 2-3 winters after the hare decline in Northwest Territories suggested that trapping during this period is at least partly compensitory (Poole 1997).

Cycles

Lynx populations in northern boreal areas fluctuate on an approximate 10-year cycle in response to population levels of snowshoe hares (Stenseth et al. 1997). Hare populations increase 5-25 fold and lynx increase 3-17 fold above cycle lows (Hodges 2000: ch 6, Mowat et al. 2000: ch. 9). Elton and Nicholson (1942) and Bulmer (1974) analyzed 206 years of pelt data to reveal an average 9.6-year interval between lynx population peaks. The peak in lynx numbers lags the decline in hares by about 1 year (Elton and Nicholson 1942, Brand and Keith 1979, Boutin et al.1995). Data from the last 4 decades indicate that the cycle has been largely synchronous across the continent (Hodges 2000: ch.6).

Keith (1974, 1990) theorized that the hare decline is initiated by food shortage, but is accentuated by the lag in response by predators. When predator numbers have fallen due to hare scarcity, the cyclic increase of hares begins when survival rises sharply (Keith et al. 1977, Keith and Windberg 1978, Cary and Keith 1979, Pease et al. 1979, Vaughan and Keith 1981). More recent analyses suggest the explanation of cycles is a more complex interaction of predation, stress, behavior, and habitat use (Hodges 2000: ch. 6)

Cyclic fluctuations are dramatic in Canada and Alaska, but no such dramatic cycles have been reported in Washington. A recent review suggests that lynx and hare populations in southern boreal regions may fluctuate more than previously believed (Hodges 2000: ch. 7).

Foraging and Food

> *The lynx, "lives on rabbits, follows the rabbits, thinks rabbits, tastes like rabbits, increases with them, and on their failure dies of starvation in the unrabbited woods"* (Seton 1925).

Few species are so dependent on one prey item as the North American lynx is on the snowshoe hare. Snowshoe hares were the primary food item in 27 studies done throughout Canada, Washington, and Alaska (summarized by Hatler 1988, and Aubry et al. 2000 ch.13). Frequency of occurrence ranged from 35 to 97% and estimated biomass ranged from 41 to 100%. Indices of lynx body fat increase when snowshoe hares are common and decrease when hares are scarce (Brand and Keith 1979). Consumption increased 37% during winters when hares were plentiful and decreased 20% when they were rare. Lynx consume the equivalent biomass of 0.5-1 hare/day (Saunders 1963a, Parker 1981).

Lynx concentrate foraging in areas where hares are relatively abundant (Ward and Krebs 1985). During hare declines (and probably during the snowfree seasons) their diet is supplemented by other prey when they are available (Stuart-Smith and Boutin 1995, O'Donoghue et al. 1998). Red squirrels (*Tamiasciurus hudsonicus*), mice, voles, ground squirrels (*Spermophilus* spp.), flying squirrels (*Glaucomys sabrinus*), beavers (*Castor canadensis*), muskrats (*Ondatra zibethicus*), porcupines (*Erithizon dorsatum*), shrews, foxes (*Vulpes vulpes*), marten (*Martes americana*), songbirds, and grouse [especially ruffed grouse (*Bonasa umbellus*)] comprise the remainder of the lynx diet (Nellis et al. 1972, Parker et al. 1983, Stephenson 1986, Hatler 1988, Brittell et al. 1989, Koehler 1990, Lewis and Wenger 1998, Apps 2000). Ungulates, obtained as carrion from bait, winter kills, or hunter loss, may also be eaten. In Washington, Koehler (1990) found the remains of fawns and adult deer in scat samples. Lynx have also been reported preying on caribou (*Rangifer tarandus*) in Newfoundland (Bergerud 1971) and Alaska (Stephenson 1986, 1991), white-tailed deer (*Odocoileus virginianus*) in Nova Scotia (Parker et al. 1983), mule deer in British Columbia (Apps, pers. comm.), and Dall sheep in Alaska (Nelson 1916, Stephenson et al. 1991). Predation on ungulates is mostly restricted to calves (Mowat et al. 2000: ch. 9).

O'Donoghue et al.(1998) reported that in the Yukon the proportion of red squirrels changed through the hare cycle. No red squirrels were taken when they accounted for $\leq$ 30% of the biomass of available prey, but lynx did kill squirrels (up to 43.9% of diet biomass) when they represented more than 55% of available prey. More data on diet and the importance of alternate prey in southern boreal areas during snow-free seasons is needed (Ruggiero et al. 2000 ch. 16).

Hunting behavior. Lynx typically locate food by sight and sound while following hare runways, or waiting in ambush (Saunders 1963b, Haglund 1966, Guggisberg 1975). They stalk as closely as possible to prey and then pounce on it with 1-2 bounds or pursue it for 20-50 m (Tumlison 1987, Murray et al. 1995). Capture success rates of 19-57% have been reported (Mowat et al. 2000: ch. 9), with success depending in part on snow conditions and the distance between the lynx and its prey when a chase begins (Haglund 1966, Nellis and Keith 1968). Lynx experience and familiarity with an area contribute to hunting success (Nellis and Keith 1968). Lynx may consume captured prey immediately or cache it (Nellis and Keith 1968; McCord and Cardoza 1982). Lynx are generally solitary, but groups of 2-3 adults, and family groups of 2-5 (usually mothers with kits or yearlings) have occasionally been observed hunting together (Saunders 1963b, Haglund 1966, Parker et al. 1983, O'Donoghue et al. 1998).

HABITAT REQUIREMENTS

The presence of adequate numbers of snowshoe hares is the key characteristic of habitat. A minimum threshold density of 0.5 hares/ha seems to be required to support lynx in northwestern Canada and Ruggiero et al. (2000: ch.16) suggest this density may also be required for lynx to persist in southern regions as well. However, Apps (2000: ch 12), in a large southern BC-Alberta study area with a patchy distribution of resident lynx, reported hare densities of 0.01-0.47/ha.

Lynx are adapted to the cold temperatures and deep snows of boreal forest environments. In Washington this includes subalpine and high elevation mixed conifer zones in the mountains, generally above 1,220 m (4,000 ft) in the Cascades, and above 1,070 m (3,500 ft) in Pend Oreille County. At these elevations where snow depths of $\geq$1 m normally accumulate, lynx have a competitive advantage over other carnivores (Murray and Boutin 1991). In Koehler (1990) and Brittell's (1989) Okanogan study areas, lynx primarily used a zone between 1400 and 2150 m elevation. During summer, lynx showed increased use of northern aspects, and consistently avoided warm dry slopes (McKelvey et al. 2000:ch10). During winter, lynx increased the proportion of their activities below 1520 m and on flatter slopes (Koehler 1990, McKelvey et al. 2000: ch.10).

Forest types used by lynx vary geographically throughout their range and include both conifers and hardwoods. The main vegetation zones included in recent maps include subalpine fir (*Abies lasiocarpa*), grand fir (*Abies grandis*), interior western hemlock (*Tsuga heterophylla*), and interior western redcedar (*Thuja plicata*) (Fig. 4). It is uncertain if all these types support the hare densities needed for lynx. In the Cascades, grand fir, interior redcedar and hemlock types may only be used where intermixed with the subalpine fir zone. Lynx in the Okanogan were often found in lodgepole pine (*Pinus contorta*) or Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) forests and rarely in dry lowland forests (Brittell et al. 1989 Koehler 1990). Home ranges contained 56% lodgepole pine, 26% Engelmann spruce-subalpine fir, 13% Douglas-fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*), and 5% open meadow and ponderosa pine (*Pinus ponderosa*). Lynx used lodgepole types more than expected and Douglas-fir less than expected (McKelvey et al. 2000: ch. 10). Forest types used by lynx east of the Okanogan River may differ somewhat, but most lynx observations in Ferry and Stevens counties are associated with lodgepole pine communities. In Pend Oreille County, lynx use lodgepole pine about half the time, but also use western redcedar, western hemlock and subalpine fir communities (S. Zender, pers. comm.). Interior western redcedar and hemlock communities in the Selkirks of northeastern Washington are boreal in nature (Ruediger et al. 2000:46-47).

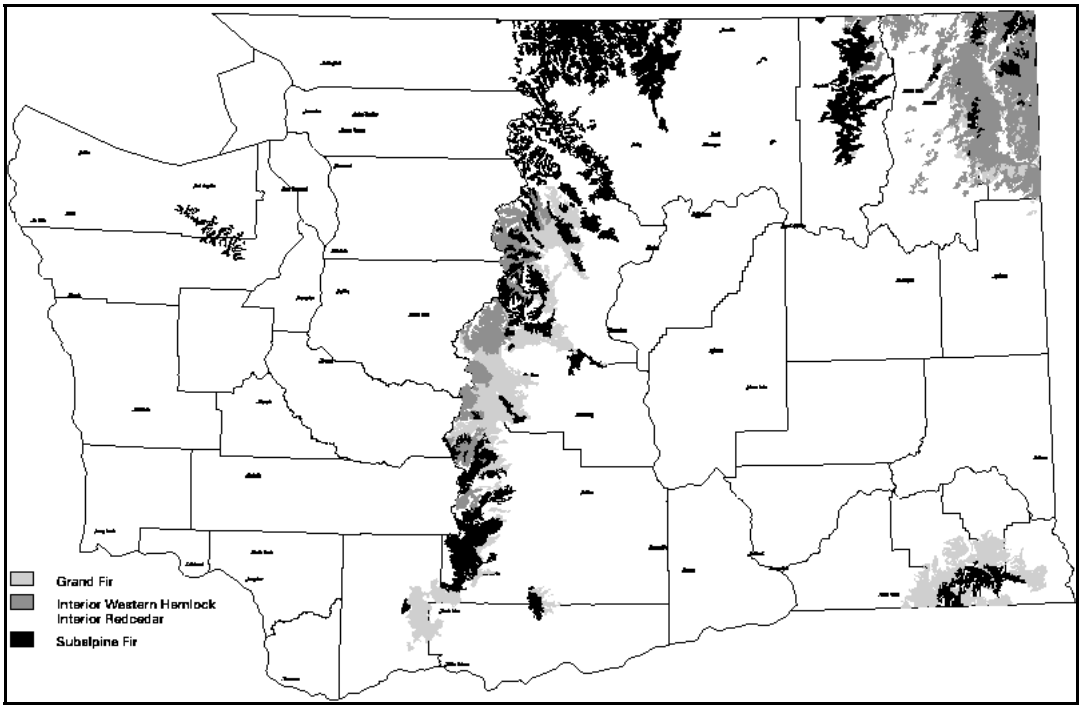


Figure 4. Subalpine fir, Interior Western Redcedar, Interior Western Hemlock, and Grand Fir Forest Zones in Washington (Cassidy 1997).

Denning Habitat

All lynx natal den sites found to date in the western U.S. were in mature or old timber with large woody debris (Aubry et al. 2000: ch.13), although natal dens have been found in young stands in northern boreal forests (Slough 1999). Lynx natal dens in Washington were in old stands (>200 years old) of lodgepole pine, Engelmann spruce, and subalpine fir on northeast slopes (Koehler and Brittell 1990, Koehler 1990). Windthrow and burns can build a dense network of fallen logs, creating spaces where kittens can hide.

In addition to natal dens where kittens are born, as kittens mature they may be moved to alternate sites with understory structure that provides hiding cover. Denning sites may be reused where habitat is poor, but females often change denning sites within and between reproductive seasons where alternate sites exist (J. D. Brittell, pers. comm., Slough 1999).

Forage Habitat

Lynx usually hunt in habitats that support snowshoe hares. Woody browse, bark, needles, and succulent herbaceous vegetation are dietary staples for hares (Bittner and Rongstad

1982, Brittell et al. 1989, Koehler and Brittell 1990, Thomas et al. 1998). Dense stands of saplings and abundant woody debris provide ample foraging and escape cover for hares, and lynx seek out these patches of hare habitat to hunt.

Fires in lodgepole pine habitats result in regenerating stands with very high stem densities that provide optimal hare habitat. Koehler (1990) reported that, in the Okanogan, dense, young (20-year-old) stands of lodgepole pine support hare densities 4 to 5 times greater than older (≥82-year-old) stands. Young lodgepole stands also support hare densities 9 times greater than those found in Engelmann spruce-subalpine fir stands. In northeastern Washington, vegetation cover at 2 m explained the most variance in pellet density (Thomas et al. 1998). Total stem densities in good hare cover in Washington and elsewhere can exceed 15,000 stems/ha (6,070 stems/ac) (Wolff 1980, Litvaitis et al. 1985, Koehler 1990), equivalent to about 0.8 m (3 ft) spacing between trees. In the Yukon, lynx used less dense cover than hares, and they may be less successful hunting in very dense cover and tend to hunt the edge and fringes of the densest stands (O'Donoghue et al. 1998).

Hares will browse stems up to 2.5 cm (1 in) in diameter (Pease et al. 1979, Litvaitis et al. 1985, Koehler 1990), but small stems are richer in nutrients than larger ones (Wolff 1980). Snowshoe hares in the Okanogan region browsed lodgepole pine stems <2.5 cm in diameter, and often consumed whole stems < 1cm in diameter (Koehler 1990).

During winter, snowshoe hares survive on shrubs and seedlings tall enough to rise above the snow line, or saplings that have branches within reach. Deciduous shrubs (*Rosa* spp., *Amelanchier alnifolia*, *Vaccinium* spp., *Rubus parviflora*, and *Ceanothus* spp.) can comprise >50% of browsed stems during low snow years when tree branches are unreachable (Thomas et al. 1998). As snowpack increases, so does the reach of hares. In Washington, trees and deciduous shrubs at least 2 m in height generally provide adequate winter browse for hares (Brittell et al. 1989), but snow sometimes buries vegetation of this height. Cover that is tall enough to hides hares from raptors despite deep snow, may also be important (S. Zender, pers. comm.). Hares also obtain forage when wind, squirrels, and heavy snow break branches from trees. The fallen boughs may provide an important food source in relatively mature lodgepole stands (S. Zender, G. Koehler pers. comm.).

Red squirrels are an important alternative prey. Although red squirrels can be well distributed in forested landscapes, they are probably more abundant in mature stands, or where cone production is higher through time (Obbard 1987, Buchanan et al. 1990, Carey 1995). Mature stands that have developed canopy gaps may also provide sufficient forage for low to moderate populations of hares, as well as habitat for other prey such as flying squirrels. The importance of alternative prey and of mature forest for foraging in southern boreal forest may be underestimated (Parker et al. 1983, Buskirk et al. 2000 ch.14). In drier

areas, mature stands may provide the best habitat, because regenerating stands may have low stem densities, and not be productive hare habitat (Buskirk et al.2000: ch 14)

Travel Habitat and Corridors

Lynx have large home ranges of fairly contiguous forest habitat. Barriers that inhibit or prevent movements between habitat patches may effectively prevent resident lynx from using an area. Observations of the movement patterns and behavioral response of lynx to topography and habitat structure in Washington by Koehler and Brittell (1990) using snow tracking and radio-telemetry resulted in several generalizations:

1) Lynx tend to limit their activities to areas with overhead and horizontal cover, and usually avoid moving through large openings. Lynx have been observed crossing open meadows ≤ 100 m (328 ft) in width but not hunting in these areas (Koehler 1990).
2) Lynx also often use ridge lines, saddles and forested riparian areas when dispersing and traveling among foraging patches and dens (Brittell et al. 1989). Taylor and Shaw (1927) reported that lynx tracks and sign were most evident on backbone ridges at or just above timber line in Mount Rainier National Park.
3) Pole and mature coniferous stands that may not provide optimal hunting or denning cover are important for providing cover for movements from one hunting area to another.

This information and more specific data on the structure of stands used by lynx is the basis for habitat models that include the concepts of "Travel Cover" and "Travel Corridors" (WDNR 1996, Interagency Lynx Committee 1999, Lloyd 1999).

"Travel Cover" has been defined as contiguous areas of coniferous or deciduous vegetation that extends 3-4 feet in height above average winter snow depths (Brittell et al. 1989, Lloyd 1999). Foraging habitat may be used as travel cover, but travel cover may not provide forage. Stands of pole or saw timber size trees with a minimum of 450 tree stems/ha (180 stems/ac; equates to about 16 ft between trees) provide Travel Cover, but may have little value for hunting hares or denning. Where large amounts of downed wood and bushy trees that provide cover are present, stands with lower stem densities may be used for travel. Mature stands with >70% canopy closure may also provide adequate travel cover (Lloyd 1999). The concept of "travel cover" was not used in the federal interagency lynx conservation strategy (LCAS) (Ruediger et al. 2000). The LCAS focused primarily on providing denning and forage habitat for lynx and habitat for hares in patterns similar to those that were present historically (B. Naney, pers. comm.). Recommendations include investigating natural disturbance patterns and developing management to resemble those patterns (Ruedigeret al. 2000).

Travel Corridors are areas of travel cover on ridges, saddles, and along drainages that may be used by lynx as travel routes, or that connect larger patches of forested habitat. Management recommendations include maintaining these corridors for lynx movement above the minimum standard for Travel Cover in managed forest landscapes (Interagency Lynx Committee 1999, Lloyd 1999).

POPULATION STATUS

Past

Population in the 1800s. There is little historical information concerning lynx populations in Washington. Nineteenth century Hudson's Bay Company fur records for forts in present-day Washington did not distinguish between lynx and bobcats (HBC Archives, Winnepeg; Cowan 1938). There are few historical references to North American lynx by naturalists, explorers, or surveyors. Suckley & Cooper (1860) could say only that the lynx may be present north of the Columbia River based on a report that it was present in Oregon.

There is a total of 765 records of lynx in Washington, including 134 "verified" records and 78 museum specimens (Appendix A; Washington Dept. Of Wildlife [WDW] 1993, McKelvey 2000: ch.8). These records and historical accounts largely confirm the description of the range given by Taylor and Shaw (1929), the lynx seemed to be largely absent from the humid coastal zone west of the Cascades, and was mostly confined to the eastern Cascades and northeastern Washington. The lynx was somewhat more widespread and perhaps more common historically, but never very abundant compared to numbers present in British Columbia (mean harvest of 2,655/yr for 1920-1998; deVos and Matel 1952, Hatler 1988, M. Badry, pers. comm.), and Canada as a whole (mean harvest of 8,000-80,000/yr, 1820-1984; van Zyl de Jong 1971, Obbard et al. 1987). This relative rarity is not unexpected given the limited and fragmented nature of the lynx's high elevation boreal habitat in Washington (Aubry et al. 2000: ch.13).

Lynx populations in Washington are essentially the southern terminus of populations in British Columbia. When lynx populations were high in Canada, a larger number of lynx may have dispersed to Washington when hare populations crashed. Canadian trapping records indicate high annual harvests (80,000+) in the late 1880's, but harvest records are affected by pelt price and trapping effort. Lynx harvests in central BC were not consistently higher during the 19th century, but dipped below 100 several times between 1825 and 1856 (Elton and Nicholson 1942: data for region 10). If the lynx population level in Washington is reflected by harvest in Canada, then lynx may have been more numerous in the late 1880's, but declined after the turn of the century (Elton and Nicholson 1942).

Populations in the 1900s. In this century, lynx harvest in Canada declined from about 19,000 per year in the 1920s to less than 8,000 in the 1940s (Obbard et al. 1987). Lynx distribution across North America appeared to be shrinking in a northerly direction, and they had disappeared from parts of the US and southern Canada (deVos and Matel 1952). This decline was attributed to over-harvests and/or habitat changes (deVos and Matel 1952, van Zyll de Jong 1971, Todd 1985). The Canadian harvest increased again to about 30,000 per year in 1960s-80s, and the 1962-63 harvest of 12,570 was the highest single year ever recorded for BC (Obbard et al. 1987, Hatler 1988). Higher fur prices, snowmobiles, and increased road access facilitated trapping efforts and influenced harvest figures during this period.

Dalquest (1948:240) summed up the perception of the importance of lynx trapping in Washington:

> Although the lynx is an important fur bearer in Canada and Alaska, it is unimportant in Washington because only a few are trapped each winter. Most of the natural range is in the remote and wilder parts of the mountains. Here each of several trappers regularly takes a dozen or more each year. In the more accessible parts of the animal's range, such as the Blue Mountains and the mountains of northeastern Washington, lynxes are rare.

Lynx harvest numbers for British Columbia appear to indicate a decline in cyclic peaks since the high of 1962-63, although this may also reflect shortened seasons and more restricted harvest in recent years (*See Lynx Management in BC,* p. 41).

Monitoring of lynx harvests in Washington did not begin until the 1960-61 season, and there is almost no data on lynx populations prior to that time. Relative to present numbers, lynx were probably more numerous in the Kettle Range. Bert Edwards, a marten and lynx trapper counted 15 lynx crossings of his marten route on the Kettle Crest in the winter of 1953 (S. Zender, corresp. on file). Edwards also reported that lynx were present south of South Baldy Mountain in Pend Oreille County in the 1930s. From 1960-61 to 1990-91, a total harvest of 232 lynx is known to have occurred (Fig. 5, Appendix B). Reported harvest may not represent all of the actual harvest that took place because compliance with reporting requirements was incomplete, particularly before mandatory pelt tagging to comply with CITES (Convention on International Trade in Endangered Species) began in 1978. Based on all available reports, the highest harvest occurred in Ferry County (35% of 232 total) followed by Okanogan (22%) and Stevens (10%) counties. Peak harvests occurred during the 1969-70 (31 lynx) and 1976-77 (38 lynx) seasons. The trapper report for the 1976-77 season may have grossly underestimated true harvest as 2 local trappers reported harvesting a total of 35 lynx that season in the Kettle Range alone (S. Zender pers. comm.). A few lynx were harvested incidentally to other furbearers in the southern

Cascades and southeastern Washington during this period. Lynx caught during the 1960's and 70's in these locations may be transients that coincided roughly with northern population peaks (e.g. Garfield County in 1964 and 1975; Whitman County 1962, 1963; Appendix B). An increase in pelt price from the $20-40 range in the late 1960s to $80-90 in 1972 increased trapper effort for lynx, and snowmobiles, lure and new roads greatly facilitated trap success. Yearly harvest rates dropped dramatically following the peak of the 1976-77, even though the average pelt price was $315 in 1977-78, and increased to a high of $672 in 1984-85 (Hatler 1988). From 1981 to 1991, only 16 lynx were trapped statewide, although shortened trapping seasons and area closures are partially responsible for this decline (WDW 1993).

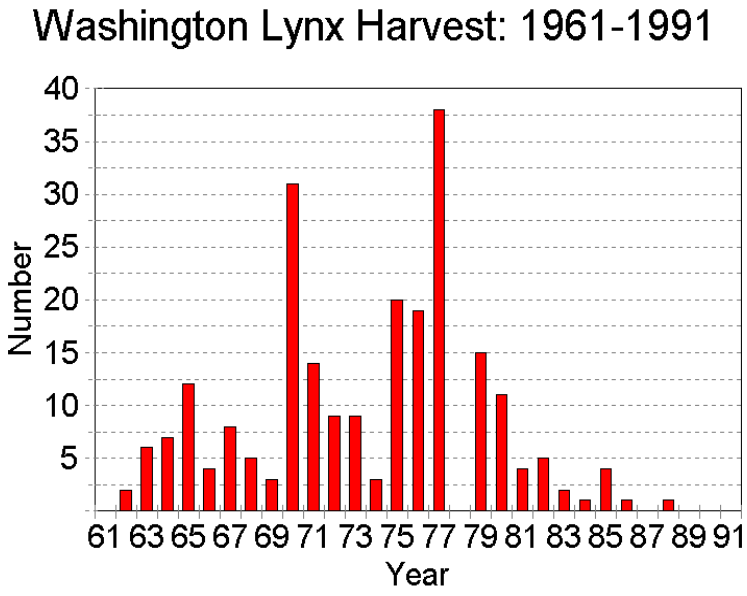


Figure 5. Known lynx harvest in Washington, 1961-1991 (includes illegals and museum specimens, excludes "lynx cats").

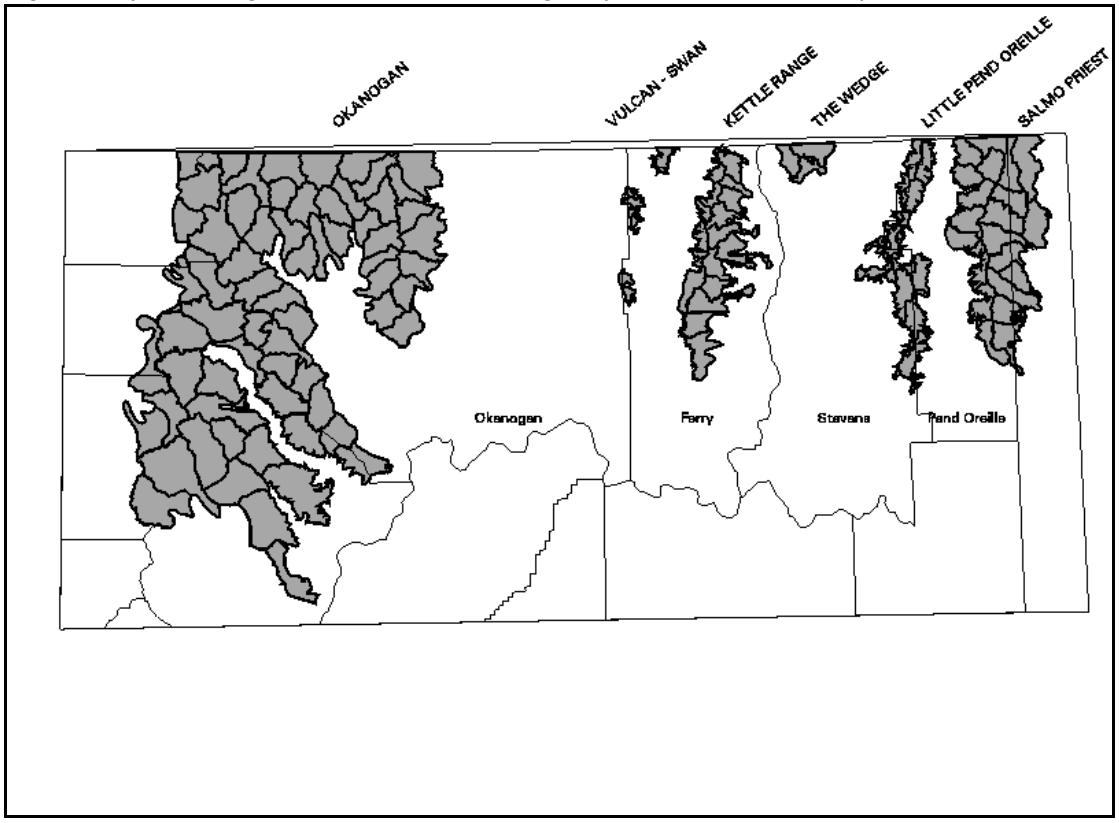
In the early 1980's, trappers and houndsmen in northeast Washington were consulted regarding the status of lynx there. The consensus was that lynx populations were low and in decline (S. Zender, letter dated 23 April 1984). Few tracks had been found in the Kettle Range, a traditional lynx stronghold. Legal harvest in Ferry County had declined from 17 in 1976-77 to a total of only two for the years 1978-91. In northwest Stevens County (The Wedge), tracks of multiple lynx, including kittens, were reportedly found regularly, but the population was thought to be very small. Lynx had also become rare in Pend Oreille County, with sightings of isolated individuals or small family groups over a wide area of fragmented habitat. The decline in the lynx population in northeastern Washington from 1970 to the mid-1980's probably resulted from over-harvest that was compounded by

habitat changes, including the maturation of lodgepole that had burned early in the century. Timber harvest and conversion of lodgepole pine thickets to other species, maturation of early successional forests, road construction and the subsequent increased access by trappers with snowmobiles and all-terrain vehicles, all may have had a role in the population decline.

Present

Lynx Management Zones and Lynx Analysis Units. The Department originally identified six Lynx Management Zones (LMZ's) that represented the distribution of primary lynx habitat in Washington (Brittell et al. 1989, WDW 1993). Boundaries were initially drawn based on the 4,000' (1220 m) elevation contour and were refined based on the knowledge of biologists involved in lynx surveys. The original LMZ boundaries have been modified by incorporating new information on habitat from the Forest Service (Fig. 6). LMZ's do not encompass all areas potentially used by lynx, but habitat management within these zones is expected to hold the greatest promise for supporting lynx populations. LMZs have been divided into Lynx Analysis Units (LAU's), that were established for assessing habitat

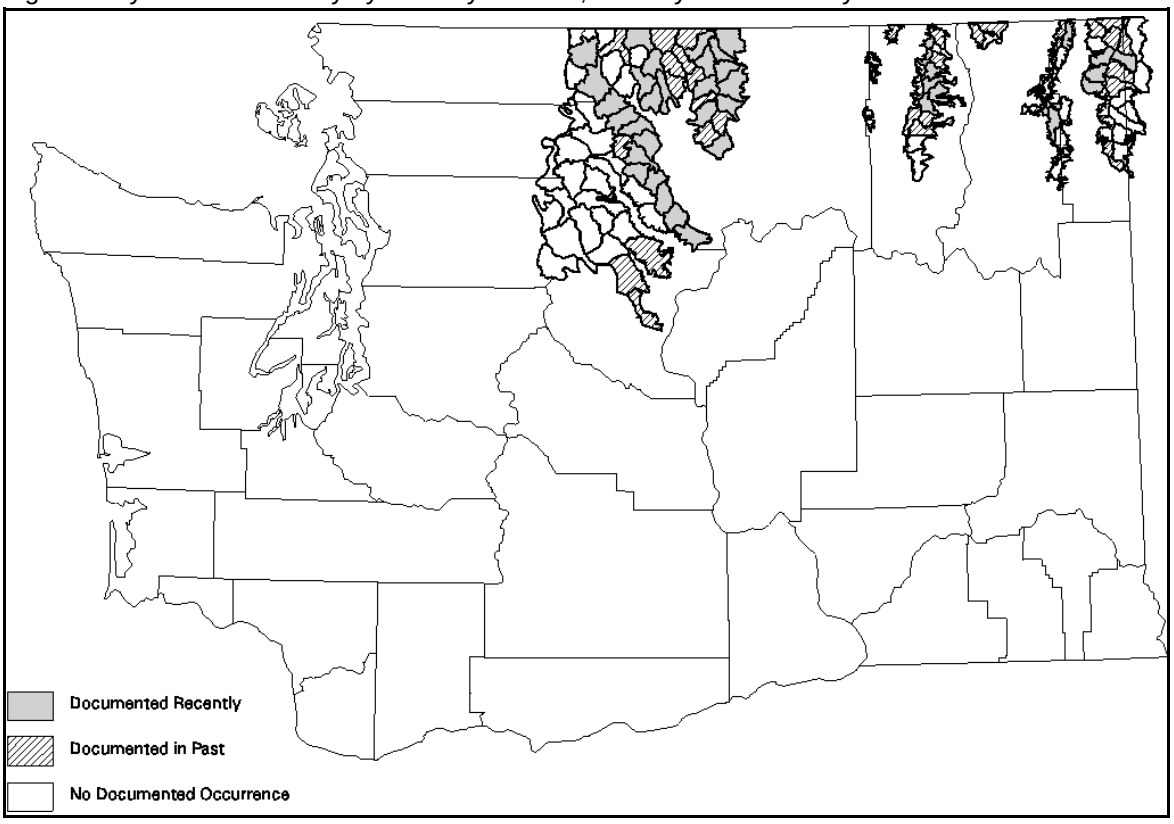
Figure 6. Lynx Management Zones in Washington (as revised June 2000).



condition and are useful as survey units for documenting lynx occurrence (see Appendix D). LAU boundaries were delineated roughly on watershed boundaries with an area approximating an average home range size of male lynx in Washington (25 mi^2), although some units were made larger to account for permanent non-lynx habitats such as rock and ice.

Annual lynx surveys. Annual lynx surveys have sampled potential lynx habitat by snow tracking, automated camera sets, and hair snares (*see Management Activities*, p.28). The presence of lynx has been documented recently in 40, and at some time in 72, of 115 LAUs (Fig. 7). Lynx are known to be present in the Okanogan, Kettle Range, Little Pend Oreille, and Salmo Priest LMZs. Lynx have not been detected in The Wedge LMZ since 1987, nor the Vulcan Mountain LAU since 1988. Some LAUs have not been surveyed in the last 5 years. The Okanogan County portion of the Okanogan LMZ has the most occupied LAUs; of the LAUs in Okanogan County that have had some form of systematic survey, only one had no lynx detections (S. Fitkin, pers. comm.). Snow-tracking, automated camera sets, and incidental detections indicate that lynx numbers may have increased in recent years. One

Figure 7. Lynx occurrence by Lynx Analysis Units; recently = since 1 July 1995.



female with 3 kittens was tracked in 1998-99, and 2 females, each with 3 kittens, were detected in the same area of Okanogan County in 1999-2000 (M.Skatrud, pers. comm.). An increase would be consistent with expectations that the lynx cycle in British Columbia will peak sometime in 2001-2003 (M. Badry, corresp. on file), although C. Apps (pers. comm.) reported a lynx population crash in his southeastern BC study area in 1999-2000.

Extensive hair snare surveys. The status of lynx populations in the U.S. has generated considerable interest in recent years which included petitions to give the species protection under ESA in 1991 and 1994, and the listing in April 2000. The potential for federal protection generated a desire to clearly define the past and present distribution of lynx in the Pacific Northwest. Survey efforts by USFS and USFWS using DNA collected by hair snagging pads suggest that at least a few lynx may exist outside of the 6 LMZ's (*see Hair Snags*, p. 29). Surveys in 1998 involved 30 survey units totaling 360 sites in the Washington Cascades. This produced hair that was tentatively identified as lynx from 9 locations: 3 in the Mt. Baker Snoqualmie, 3 in the Wenatchee , and 3 in the Gifford Pinchot national forests (Weaver and Amato 1999), although the DNA determinations have not been verified.

The Forest Service and USFWS conducted additional surveys in Washington and Oregon in 1999 using a total of 2960 pads, (including 750 pad stations in Washington) using either the Weaver sampling protocol (Weaver and Amato 1999; used by USFWS in Oregon) or a new sampling scheme (25 transects of 5 pads each in 5 different survey areas; McKelvey et al. 1999; used by FS). The Washington surveys in the Okanogan, Mt. Baker-Snoqualomie, Wenatchee, and Gifford Pinchot National Forests did not detect lynx outside of the existing LMZs, but only in the Okanogan National Forest ("Lynx Update," E. Rybak, pers. comm.). No lynx were detected in Oregon.

Current population. The Washington lynx population almost certainly numbers fewer than 200 and may number fewer than 100 individuals, based on a density estimate and the amount of suitable or potential habitat in each of the 6 LMZs (Table 2). The density used to derive population estimates (2.5 lynx/100 km^2) is the average of two figures from Okanogan County, Washington (Brittell et al. 1989; Koehler 1990). Koehler (unpubl. data) used GIS analysis of forest cover types to determine that 67% of the Okanogan LMZ was suitable lynx habitat. Habitat potential outside of the Okanogan study area is generally lower because suitable patches are smaller and more fragmented. Therefore, the density-based estimates are probably high. The adjusted population estimates that total <100 lynx were based on the assessment of biologists involved in annual surveys and trappers familiar with the lynx and its habitat. McKelvey (2000:fig.8.20) arrived at an estimate of 15,100 km^2 of habitat area based on lynx occurrence records that includes polygons in the southern Cascades of Washington. Using the same density based methods, that amount of habitat

(and subtracting the estimate of 33% unsuitable for the Okanogan) results in an absolute hypothetical maximum of about 300 lynx.

Table 2. Density-based estimates of Washington's lynx population by Lynx Management Zone (WDW 1993).

Lynx Management Zone	Area (km^2)	Density-based estimate [a]	Adjusted estimate [b]
Okanogan	9,308	155	50
Vulcan-Swan	125	3	?
Kettle Range	987	25	<12 ± 8
The Wedge	177	4	<4 ± 2
Little Pend Oreille	700	17	<10 ± 6
Salmo Priest	1,210	30	<19 ± 10
Total	12,507	234	<100

[a] Based on density of 2.5 lynx/100km^2 extrapolated to available habitat; Okanogan estimate was adjusted for 33% unsuitable area; the % unsuitable types in other LMZs is unknown.

[b] Based on biologist opinion of conditions.

HABITAT STATUS

The boreal forest habitat of lynx, represented in Washington by subalpine fir and other mesic boreal forest types, is naturally restricted to high elevations and therefore fragmented by topography. The fragmented distribution of habitat has important implications for lynx conservation, in addition to limiting the total population size (see *Metapopulation dynamics*, p. 33). The amount of primary habitat in Washington has been variously estimated at about 10,000 to 15,000 km^2 depending on how habitat is defined, with the higher estimate including areas in the southern Cascades and Blue Mountains (Brittell et al. 1989, WDFW 1993, McKelvey et al. 2000:ch.8). Brittell et al. (1989:82-83) identified 17,019 km^2 of lynx habitat in Washington. This included 9,555 km^2 of primary habitat in the core Okanogan and northeastern areas, and two polygons totaling 7,464 km^2 of secondary habitat (described as "marginal habitats which are primarily occupied by transient lynx"; Brittell et al. 1989:82) in the central and southern Cascades. The original LMZs and LAUs (Richardson 1999) were modified in 2000 by the Colville, Idaho Panhandle, and Wenatchee National Forests using a more liberal definition of habitat that included elevations down to 3500 ft in northeastern Washington, and took into account local detections of lynx, and deleted some areas of permanent non-lynx habitats (dry pine,

openings) along the LMZ periphery. Some LAU boundaries were also changed to coincide with FS administrative boundaries to facilitate planning (C. Loggers, pers. comm.). These recent LMZ boundary changes resulted in a revised estimate of about 12,507 km^2 of what could be considered primary habitat (Table 2).

The Wenatchee, Gifford Pinchot, and Umatilla National Forests recently mapped potential lynx habitat in the central and southern Cascades, and Blue Mountains that encompasses areas in addition to the secondary habitat delineated by Brittell et al. (1989). The historic lynx records from the Mt. Adams area and the distribution of subalpine forest suggest that habitat in the southern Cascades of Yakima County may be capable of supporting reproducing lynx populations, but the remaining secondary area may have low potential to support lynx. This discussion is limited to the Okanogan and northeastern Washington LMZs.

In contrast to the habitat of many rare species, potential lynx habitat has not been developed or converted to agriculture, but most is still forested and the potential to manage it for lynx still exists. Federal land jurisdictions include 91.7% of the habitat in the 6 Lynx Management Zones. The U.S. Forest Service (USFS) administers the greatest proportion (about 87%), and the National Park Service administers about 4% of primary lynx habitat across Washington (Brittell et al. 1989). State and private lands encompass only about 8%. Reserve type designations (Wilderness Areas, National Parks, National Recreation Areas, Roadless Areas, or Research Natural Areas) account for $\geq$37% of the lynx habitat in Washington (*see Land Ownership* ..., p. 34). These protected areas are reasonably secure from development or uses that would be incompatible with lynx conservation, but forest habitat in these areas is not all suitable for lynx, and portions are above timberline or the habitat is otherwise fragmented. Also, fire suppression may affect the quality of suitable habitat in protected areas.

Fire, insects, succession as do timber harvest, road construction, and recreational development change the character of a forested landscape,The quality of lynx habitat in each LMZ changes through time. Fires that burned large portions of the forest in northeastern Washington between about 1920-1934, totaling 34,747 ac in 1920, 28,398 in 1921, 80,000 ac in 1926, and 160,000 ac in 1929, produced good forage conditions in the 1960s-70s, but no longer provides optimal conditions for hare (Hoagland 1941, S. Zender, pers. comm.). Across all zones, timber removal by harvest and fire on USFS lands during the 15 to 20 years prior to 1993 was estimated at about 23% (WDFW 1993). Most watersheds in the region show a trend in the last 50 years of a reduction in area of seedling/sapling/pole age classes that are good potential hare habitat and an increase of young and mature age classes on the landscape (Lehmkuhl et al. 1994). The Pend Oreille Basin (which accounts for much of the Salmo-Priest and Little Pend Oreille LMZs), generally shows a decrease in area of seedling/sapling/pole of 52% for lodgepole and 33%

for subalpine fir types, and an average increase of 53% in Douglas-fir and western hemlock (Lehmkhul et al. 1994).

The Colville National Forest administers most of the land in the Salmo Priest, Little Pend Oreille, Kettle Range, Wedge, and Vulcan-Swan LMZ's. The Forest Service divides land into management categories called Management Areas (MA) that are not directly related to LAUs. Reserves and other areas that do not allow management account for 31.4% of lynx habitat (Management Areas 1,2,4,9,10,11; 156,552 ac, as mapped in 1995), while timber harvest is allowed on 57.5% (286,554 ac) (E. Schultze, 1995 memo on file). According to the Colville National Forest Plan (1988), lynx and snowshoe hare belong to the Franklin's grouse [spruce grouse *(Dendragapus canadensis*)] indicator species group. Recent Standards and Guidelines for this group required that 20% of extensive lodgepole pine stands in Management Areas (MA) 5, 6, 7, and 8 be maintained in the <20-year age class and half of this area not be thinned.

Salmo Priest LMZ (295,379 acres). This zone is connected to habitat in British Columbia and Idaho, providing strong potential for immigration. This zone encompasses the northeastern corner of the state, south to Bead Lake. The westernmost part includes Molybdenite Mountain and extends eastward to Idaho. The northern portion holds excellent habitat and is relatively inaccessible due to rugged terrain, and includes the Salmo-Priest Wilderness. The northern portion is also in a Grizzly Bear Recovery zone that further restricts vehicle access. The southern portion is in checkerboard ownership and a significant portion has been logged in recent decades. The Forest Service administers 90 %, and 8.3% is privately owned, with Stimson Lumber Company being the largest private landowner. A LANDSAT analysis of lynx habitat was conducted in 1994-95, and although the LMZ boundary has been changed or expanded somewhat by the Colville and Idaho Panhandle National Forests, the analysis still provides some indication of habitat condition (Jacobsen 1999, WDFW unpubl.data). The analysis indicated about 17% of the area was foraging habitat, 6% was in denning, and 45% in travel habitat (low or moderate stem density of early to mid-seral stands, and late seral stands not suitable for denning) (23% had snow cover that prevented classification; WDFW unpubl. data). Denning habitat seems to be limited, but recent harvests may improve foraging. Conditions may slowly improve with the increased attention to management by the Forest Service (Ruediger et al. 2000) and the lynx habitat plan for Stimson's lands.

Little Pend Oreille LMZ (172,984 acres). This zone's suitable habitat is naturally fragmented by openings and has limited contiguity with habitat in British Columbia because the Pend Oreille River flows around the north end just north of the border. Habitat has also been considerably altered. This zone begins at the Canadian border north of Frisco Mountain. It reaches Blacktail Butte in the west, Chewelah Mountain in the south, and Hooknose Mountain in the east. Private landowners account for about 25,000 ac (14.4 %).

Stimson owns >21,000 ac that is covered by a lynx plan and is checkerboard with national forest lands in the southern part of this LMZ. Thomas et al. (1998) reported cattle damage and the presence of wolf-dog hybrids that may negatively affect hare populations in some of the LAUs. LANDSAT analysis indicated that as of 1993, denning habitat may be in short supply (5%), and 62% was classed as travel cover. Foraging habitat appeared to be limited (9%), but 10% could not be classified due to snow. Forage may be improving as areas harvested in the 1980s recover. The best habitat is currently in the northern portion of the zone. The southern portion of the LMZ has high road densities, high levels of recreational use, particularly by snowmobiles, and has been extensively harvested. Timber harvest combined with some large natural openings, may have reduced the quality of habitat for lynx.

The Wedge LMZ (44,464 acres). This zone is situated between the Kettle and Columbia rivers and runs from the Canadian border south to Mineral Mountain. This zone has somewhat marginal lynx habitat, but it is connected to better habitat in British Columbia (WDW 1993). The zone's main value may be as a corridor to the Kettle Range LMZ. LANDSAT analysis indicated extensive travel cover (75%), but forage habitat was limited in 1993. Timber harvest has been extensive, resulting in a paucity of older stands and structure for denning cover. The LMZ is about 17.8% privately owned. Boise Cascade owns a block of 5,600 ac, or about 12.6% of the LMZ and has developed a lynx habitat management plan for this area (Whitwill and Roloff 1996).

Kettle Range LMZ (243,984 acres). This zone contains the second-largest block of lynx habitat in Washington, but it lacks a connection to suitable lynx habitat in British Columbia. The population was heavily trapped in the 1960's and 1970's and timber harvest has been extensive. Maturation of burns that occurred early in this century may also be a factor in recent low lynx numbers. The 142,000 ac Dollar Mountain fire of 1929 that burned the east slope of Kettle crest and the Taylor Ridge fire produced good habitat where trappers caught lynx in the 1970s (S. Zender, pers. comm.). The current lynx population may be well below the theoretical area-based capacity as only about 1/3 of the LAUs seem to be occupied by lynx (Fig. 6, p. 19). The LANDSAT image indicated that denning and forage habitat was limited in some LAUs in 1993. Road development and the resulting improved access have changed the character of the central portion. Large fires, such as 1988's White Mountain fire (19,760 ac), created a mosaic of forest in some areas that could produce good lynx habitat, but large salvage operations and extensive grass seeding may have decreased the potential for improving habitat. The southern portion of the LMZ (18%) occurs on the Colville Indian Reservation.

Vulcan-Swan LMZ (30,869 acres). This zone contains three separate LAUs, including Vulcan Mountain on the Canadian border, one at Bodie Mountain, and a third near Swan Lake. The two latter LAUs delineated by the Forest Service have been combined with an

expanded Vulcan Mountain LMZ since Richardson (1999). Each individual LAU may or may not be large enough for one lynx home range. This zone may be important to improve the chance of lynx successfully dispersing between the Kettle Range and Okanogan LMZs. LANDSAT analysis of the original Vulcan Mountain LAU indicated a shortage of denning and foraging habitat. No data are available on the Bodie and Swan units.

Okanogan LMZ (2,300,095 acres). This LMZ contains extensive stands of lodgepole pine and supports the largest lynx subpopulation in Washington. Lynx habitat is extensive and contiguous with British Columbia, allowing immigration (see Fig. 9, p. 43). Federal jurisdictions account for 95% of the land in the zone. Most of the land in the LMZ is administered by the Okanogan and Wenatchee national forests, with smaller portions administered by the Mt. Baker-Snoqualmie NF, the National Park Service, and WDNR. Included are all or parts of the Pasayten, Glacier Peak, and Sawtooth Wilderness areas, Loomis State Forest, and parts of Lake Chelan National Recreation Area and North Cascades National Park.

A portion (<5%) of the Okanogan NF is contained in Management Area 12 (MA-12), which was designed to provide lynx habitat while growing and producing merchantable wood fiber (Okanogan NF 1989). Standards and guidelines allowed a road density of 1 linear mile per square mile, but the affect of roads of this density is unknown. Management of the entire LMZ will change somewhat with the implementation of the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000). The Wenatchee NF has had no management plan for lynx, although certain habitat requirements may be addressed through standards and guidelines for other species. No 1994-95 LANDSAT analysis was done for lynx habitat in the Okanogan LMZ, but the Forest Service is expected to conduct an analysis of habitat conditions on the landscape (Ruediger 2000:77). Estimates for the Methow Basin indicate a decline in area in the last 50 years of seedling/sapling/pole age classes for lodgepole and subalpine fir of 30% and 36% respectively (Lehmkuhl et al. 1994). Old subalpine fir/spruce, which may be preferred for denning, declined 47%. One Methow watershed showed a decline of 84% in lodgepole and a 450% increase in Douglas-fir (Lehmkhul et al. 1994). Lodgepole also declined in all age classes in the Wenatchee Basin (-3% seedling/sapling/pole, -95% young, -100% mature).

CONSERVATION STATUS

Legal Status

Washington. The lynx became a State Candidate for listing on 27 November 1991 (Washington Department of Wildlife Policy 4802). In 1993, the Department prepared a status report and listing recommendation for the lynx (WDW 1993), and the Fish and

Wildlife Commission listed the lynx as a State Threatened species, effective 14 November 1993 (Table 3).

U.S. Department of the Interior, Fish and Wildlife Service. Federal listing of the lynx under the Endangered Species Act has been a protracted and litigious process (U.S. Fish and Wildlife Service 1998:37000-37001). On June 26, 1998, the Service proposed that U.S. lynx populations be listed as threatened (U.S. Fish and Wildlife Service 1998). The lynx was finally listed as threatened in the 48 contiguous states, effective 24 April 2000 (U.S. Fish and Wildlife Service 2000).

U.S. Department of Agriculture, Forest Service. The lynx has been considered a Sensitive species by the Forest Service in Washington (Regions 1 and 6) since the 1980s (Ruggiero et al. 1994, B. Naney, pers. comm.). Sensitive species are those "for which population viability is a concern as evidenced by significant current or predicted downward trends in population numbers or density, or habitat capability." With this designation, the lynx must be given special management emphasis to ensure its viability. The March 2000 listing under the Endangered Species Act has changed the status of lynx to Threatened.

Canada. In Canada, the lynx is managed as a furbearer. Harvest produces pelts for the fur industry and significant income for rural communities. In British Columbia it is a Class 2 species, one that is not present on most registered traplines in manageable numbers and that is vulnerable to over-harvest (Hatler 1988).

Colville Tribe. On the Colville Indian Reservation, the lynx is a furbearer with closed trapping and hunting seasons.

Table 3. Lynx conservation in Washington: significant events and publications, 1988-2000.

Date	Activity or publication
1988	B.C. Ministry of Environment issues: *A Lynx Management Strategy for British Columbia*, Wildlife Bull. No. B-61 by D.F. Hatler.
1989	WDW issues: *Native Cats of Washington*, by J.D. Brittell et al. which includes summary of Brittell and Koehler's Okanogan Lynx studies.
1990	Publication of: Koehler, G.M. and J.D. Brittell. *Managing spruce-fir habitat for lynx and snowshoe hares*. J. Forestry 88:10-14. Koehler, G. M. *Population and habitat characteristics of lynx and snowshoe hares in north-central Washington*. Can. J. Zool. 68:845-851.
1991	National Audubon and 11 other organizations submit a petition to USFWS to list the lynx as endangered.
1991	Greater Ecosystem Alliance submits petition to WDW to list lynx as endangered.
1991	WDW accepts GEA petition and designates lynx as state candidate; hunting and trapping seasons for lynx are closed.
1992	Interagency Lynx Committee formed with representatives from agencies, timber companies, and environmental groups to exchange information and discuss lynx issues in Washington.
1992	Forest Service produces literature review and bibliography (Butts 1992).
1993	*Status of the North American Lynx in Washington* issued by WDW with recommendation that the lynx be listed as threatened. Washington Wildlife Commission lists the lynx as threatened in Washington.
1994	USFS issues: *The Scientific Basis for Conserving Forest Carnivores* GTR RM 254.
1996	WA Forest Practices Board and WDFW approve 3 state/private lynx habitat management plans (WDNR, Boise Cascade, Plum Creek), in lieu of a state critical habitat rule.
1999	Interagency Lynx Committee publishes: *Lynx Habitat Field Reference Notebook*.
1999	Coalition of environmental groups contribute $16.5 million in an agreement with WDNR that changes management of parts of Loomis State Forest so it is managed as a resource natural area.
1999	Federal interagency teams produce: Ruediger et al. *Canada Lynx Conservation Assessment and Strategy* (LCAS) and Ruggiero et al. *Ecology and Conservation of Lynx in the United States* (the science report).
2000	In February, USFWS and USFS sign an agreement that agency actions will follow the guidance contained in the LCAS and science report.
2000	The USFWS lists the lynx as threatened in the contiguous 48 states. After 2 petitions and 3 law suits, the lynx is protected under the Endangered Species Act, effective 24 April.

MANAGEMENT ACTIVITIES

Lynx Harvest

During the 1800s, game management was primarily the responsibility of counties. Following the formation of the Washington Game Department in 1933, the lynx was classified a furbearer with a 3 month trapping season. Several trappers took a dozen or more lynx per year (Dalquest 1948). Bobcats were considered a predator with a bounty, and some lynx were probably killed for bobcat bounties. Monitoring of lynx harvest did not begin until 1961, when the Department began requiring trapper's catch reports. Mandatory tagging of pelts began in 1978 in order to comply with CITES (Convention on the International Trade of Endangered Species). Lynx harvest was greatly restricted in the 1980s, and allowed only minimal quotas after 1987 (WDW 1993). The species was added to the list of candidates in November 1991 and the season was closed.

Research

Two intensive research projects investigated lynx habitat preference, use of space, productivity, mortality, and diet in an Okanogan study area. This research by Dave Brittell (1981-83) and Gary Koehler (1984-88) was summarized in *Native Cats of Washington* (Brittell et al. 1989), *Population and Habitat Characteristics of Lynx and Snowshoe Hares in North Central Washington* (Koehler 1990) and *Managing Spruce-Fir Habitat for Lynx and Snowshoe Hares* (Koehler and Brittell 1990). These three documents greatly influenced the direction of lynx management in Washington. McKelvey et al.(2000: ch.10) re-analyzed the lynx habitat use data from this work.

Recent projects that may influence lynx management in Washington include investigations of hare browse preference and habitat use (Thomas et al. 1998), and other hare and lynx projects underway or being initiated (G. Koehler, C. Quade, pers. comm.).

LANDSAT habitat analysis. In 1994 and 1995, the Department used 1993 satellite data to classify habitat in northeastern Washington using a lynx habitat model (Jacobsen et al. 1999). Where possible, habitat was classified as denning, foraging, or travel cover, and non-lynx habitat. The use of satellite data allowed coverage of a broad landscape and has proved helpful for assessing lynx habitat.

Lynx Surveys

Snow tracking and monitoring. WDFW conducts winter track surveys for lynx and other mammals in cooperation with the Okanogan and Colville National Forest, and several

volunteers. The Department conducted snow-track surveys in 1990-97 on 4 established survey routes in Okanogan, Ferry, Stevens, and Pend Oreille counties in order to document presence and assess recruitment. The surveys involved traveling via snowmobile and watching for lynx footprints crossing the trail. Beginning in 1998/1999, geographic coverage was increased by ending adherence to specified survey routes. Instead, LAU's constitute the survey unit, and other methods of detection can be used. Once lynx presence is confirmed in a LAU, surveyors shift attention to unsurveyed LAU's. Surveys are scheduled so that LAUs are sampled on a 3-year rotation, to attempt to monitor the persistence of lynx in the LAUs. Lynx tracks have also been observed on ridges from helicopter during winter surveys for wolverines (S. Fitkin, pers. comm.).

Carnivore Camera Stations. The presence of forest carnivores is frequently determined photographically, with a remote camera triggered by an animal visiting a bait station. Several survey efforts with baited automatic cameras to determine the status and distribution of forest carnivores in Washington were conducted during 1990-97 (Lewis and Stinson 1998). WDFW and USFS surveys involved ~1500 sample stations and totaled over 17,000 camera/track plate nights. Most of that effort was focused on marten and fisher, but occasionally, lynx were photographed at these stations. Camera stations are relatively expensive for extensive surveys for lynx, and lynx are not reliably attracted to the same baits as other carnivores. Camera stations are still used to document and monitor lynx in some local surveys (Fitkin 2000, Zender and Base 1999, Base and Zender 2000; Skatrud, pers. comm.)

Volunteer Observers and Incidental Sightings. Volunteers who are familiar with lynx and their habitats provide valuable data on lynx distribution in Washington. Skiers, snowshoers, and other back-country recreationists often report their observations to the WDFW, which enters appropriate records into its lynx database. Reports without dates or with imprecise location data are retained in files, but are typically not entered into the database. Occasionally, the Department receives reports of lynx from other sources. Incidental sightings by relatively inexperienced observers are difficult to assess. Cases of mistaken identity (bobcat for lynx, for example) are common, but some reports appear valid, and convincing but unconfirmed reports are indicated as such in the Department's files.

Hair Snags. A new method for detecting lynx has been developed in recent years that exploits the cat's natural cheek-rubbing behavior. Small pads of carpet, studded with roofing nails and scented to attract lynx, are attached to trees within a survey area and subsequently checked for use (McDaniel et al. 2000). Hairs are collected and sent to a laboratory for DNA analysis. The lab uses hair samples to identify species and gender. The technique promises to enhance understanding of Washington's lynx population and will complement results from snow-tracking and other surveys. The technique can be done in

snow-free periods, and is less costly than cameras for extensive efforts (McDaniel et al. 2000). The Forest Service and U.S. Fish and Wildlife Service sponsored or conducted surveys in 1998, and a three year program of extensive surveys on national forests in Washington and Oregon was initiated in 1999.

Interagency Committees

The Interagency Lynx Committee is a committee of professionals interested and concerned with lynx conservation in Washington that has met annually since 1992. Participants include representatives from state, federal, tribal, and British Columbia agencies, private timber companies, non-governmental conservation organizations, and interested citizens. Members of the Interagency Lynx Committee long recognized the need for a field manual that would allow researchers, lynx biologists, and managers to "speak the same language" when describing lynx habitat features. The committee developed a descriptive photographic guide to lynx habitats and non-habitats, which was published by the Washington Department of Natural Resources in 1999 (Interagency Lynx Committee 1999). More than 400 copies were sold and distributed.

The Western Forest Carnivore Committee, a national group formed in 1991, meets annually for an inter- and intra-agency exchange of information about the conservation needs of lynx, wolverine, fisher, and marten in western forests.

State and Private Lynx Management Plans

The Washington Forest Practices Board, which has regulatory authority over timber harvest on state and private lands, designates critical wildlife habitat for state-listed species that may be affected by forest practices (WAC 222-16-010). Forest practice regulations, however, allow landowners to prepare special wildlife management plans in lieu of being subject to a critical habitat rule (WAC 222-16-080, section 2). Early in 1994, the three major non-federal landowners in the Washington lynx range — WDNR, Boise Cascade Corporation, and the Plum Creek Timber Company — began to develop lynx plans. In November 1996, the Forest Practices Board determined that no critical habitat rule would be needed for lynx since all of the significant state and private land in lynx range that would be subject to the rule was covered by the 3 landowner plans. Each lynx management plan includes a process for monitoring the plan's effectiveness and annual or biennial reporting. It is not clear how these plans will be affected by federal listing.

Stimson Lumber Company. Plum Creek used a Habitat Suitability Index model to quantitatively assess habitat in LAU's with at least 20% company ownership(Roloff 1994, Gilbert 1996). The HSI model approach involves quantifying habitat based on 3 parameters (forage, denning, and interspersion), and assigning a value from 0.0 (poor) to 1 (excellent).

The objective of the plan is to maintain or increase the quantity and quality of lynx habitat over time in the planning area (Gilbert 1996). The plan accounted for ¾ of Plum Creek's 40,500 acres in the Little Pend Oreille and Salmo Priest LMZ's. The remainder of Plum Creek land underwent a qualitative assessment. After completing its plan, Plum Creek sold its affected lands to Stimson Lumber Company, which adopted the lynx management plan. Stimson has harvested about 20% less than was scheduled in the original Plum Creek plan schedule (Duke Engineeering 1998). The planning period was 5 years (through 2000) and Stimson is currently updating the plan for the next 5- year period.

Boise Cascade. Boise Cascade Corporation owns about 5,000 acres in The Wedge LMZ. They developed a lynx habitat potential model that was the basis for a lynx management plan for the Sheep Creek LAU. They have used the Habitat Suitability Index model (Roloff 1994) to predict effects of forest management through 2015. The duration of the initial planning period was 5 years, through 2000, and the plan is currently being revised (G. Roloff, pers. comm.). The HSI model was recently applied to 298,000 ha in a test using snow-tracking in Manitoba. Nylen-Nemetchek (1999) reported that habitat with the lowest HSI values ($\leq$0.09) were used by lynx less than expected, but otherwise the model values correlated well with lynx occurrence as indicated by tracks.

Department of Natural Resources Lynx Plan. WDNR manages about 125,000 acres in the Okanogan and northeastern LMZs, most of which is managed for timber production. WDNR is mandated to manage these lands to produce revenue for the state Common School Trust fund. WDNR developed the Lynx Habitat Management Plan for these lands and modeled habitat for LAUs in which WDNR owned $\geq$20% of the land (WDNR 1996). The plan outlines timber harvest schedules for these modeled LAUs to maintain a balance of forage and denning habitat over an 80 year period. On all DNR lands in the LMZs, travel corridors are maintained, and other stand scale recommendations are followed (Lloyd 1999). The plan has been criticized for not stipulating stem densities in forage habitat and for having commercial timber production as the focus (Tanimoto 1998). However, the plan includes monitoring and adaptive management provisions to test whether harvested stands produce hare habitat (WDNR 1997). McKelvey et al. (2000:ch15) criticizes the WDNR approach for its single species focus, and for being based on an untested habitat model that assumes, for example, the retention of small patches of old forest for denning is adequate for lynx. Whatever its faults, the DNR plan is the most detailed and scientifically credible effort to date to reconcile lynx habitat needs with commercial timber production. The largest blocks of WDNR lynx habitat are in the Loomis State Forest (WDNR 1996). Part of the Loomis State Forest (24,600 ac) that was included in the Plan and formerly managed for timber income, was transferred to management under laws that govern Natural Resource Conservation Areas (*see Land ownership...*, p. 34).

Federal Land Management Activities

As a USFS Region 1 and 6 sensitive species, the lynx was given special management emphasis to ensure their viability in the Okanogan, Colville, Wenatchee, and Idaho Panhandle National Forests. In recent years while the decision to list the lynx under the ESA was pending, Federal interagency task groups developed the *Lynx Conservation Assessment and Strategy* for interim guidance for management activities, and the science report, *Ecology and Conservation of Lynx in the United States*. These documents provide interim guidance for the development of a landscape scale ecosystem management program for lynx conservation. The Forest Service and Bureau of Land Management (BLM) also conducted a biological assessment of all Forest and BLM Resource Area Plans that might affect lynx, and concluded that these Plans needed to be revised to reduce potential impacts to lynx. The Forest Service signed an agreement with the USFWS on 7 February 2000 to manage habitat specifically for lynx in order to minimize the impact of the listing on operations and comply with the Endangered Species Act (USFWS 2000:16083).

In addition to these documents, the Forest Service has mapped potential lynx habitat based on historical records, vegetation zones and elevation on all forests where lynx may be present. They also are developing Lynx Analysis Unit maps for all these forests, and are conducting an analysis of habitat condition.

FACTORS AFFECTING CONTINUED EXISTENCE

Southern Boreal Habitat and Lynx Population Dynamics

Lynx populations in southern boreal forests seem to be similar in density, survival, and recruitment to northern populations during lows in the hare cycle (Aubry et al. 2000: ch13). Brittell et al. (1989) and Koehler (1990) reported densities of lynx in the Okanogan of 2.3-2.7 lynx/100 km^2. Northern boreal populations may exhibit similar densities during the cyclic low (<3/100 km^2), but can peak at 8-45 lynx/100km^2 (Aubry et al. 2000: ch13).

Prey Biology and Cycles. Lynx persistence in an area is dependent on prey populations. Red squirrels, grouse, and other alternate prey may be more important to lynx survival in southern boreal areas. Squirrels tend to be more abundant in older forest (Buchanan et al. 1990). The relative importance of mature forest in southern boreal areas for providing alternate prey may be more important than formerly believed (Ruggiero et al. 2000:ch16).

Although red squirrels may be more important in southern than in northern areas, snowshoe hares still seem to be the key prey species. The peak density of hares reported for southern boreal forests (1-2 hares/ha) are generally much lower than that in northern boreal areas (4-

>6 hares/ha) (Hodges 2000:ch7). Pellet counts reported by Koehler (1990) suggest hare densities of 0.09-1.79 hares/ha for the Okanogan (Hodges 2000:ch 7), although a recent study suggests that the equation to convert pellets density to hare density may produce inaccurate estimates for southern habitats (G. Koehler, pers. comm.). Differences between northern and southern boreal forests include more limited and patchy habitat and possibly a larger suite of generalist predators (bobcat, long-tailed weasel) in southern boreal forests (Hodges 2000:ch7). The low density, small litter size, and lower kitten survival for lynx in Washington may reflect the lower densities and patchy distribution of hares (Brittell et al. 1989, Koehler 1990, Hodges 2000:ch7, Aubry et al. 2000:ch13).

Limited data in hare harvest reports and track surveys for Washington (WDFW, unpubl. data), and short-term studies in Colorado (Dolbeer and Clark 1975) show no indication of cycles in hare populations. However, an analysis of longer term data suggest that hare are cyclic in southern boreal regions, but the amplitude of cycles are less than in northern areas (Hodges 2000:ch7). Snowshoe hare scarcity during cyclic lows leads to lynx declines and dispersal in northern areas and cycles may affect lynx similarly here.

Metapopulation dynamics. The restriction of boreal forest habitat to higher elevations in Washington produces islands of habitat. This island-like distribution suggests that lynx populations may act as a metapopulation. A metapopulation is made up of several to many smaller populations that increase and decline independently, but the risk of extinction of each is decreased by immigration from the others (McKelvey et al. 2000:ch 2). Individual populations may go extinct but they are recolonized. The risk of extinction of the entire population is lower than it would be if the entire population fluctuated synchronously. Sweanor et al. (2000) describes a montane cougar population in New Mexico that generally fits the metapopulation model. However, the Washington lynx population violates the classical metapopulation model (Weins 1996) in that the interior Canada population may act as a large source population, and Washington subpopulations may vary synchronously. If hare cycles are reflected in lynx survival, recruitment, and dispersal movements in Washington, this may increase the risk of simultaneous extinction of several lynx subpopulations.

The survival of local populations is determined in part by the rate of colonization and extinction. Most of the habitat islands will be occupied at any point in time if colonization rates greatly exceed the rates of extinction (McKelvey et al. 2000: ch. 2, Ruggiero 2000: ch.16). Population sizes and factors that affect successful dispersal, such as the distance and barriers between habitat islands, are critical factors to the viability of the metapopulation (Ruggiero et al. 2000:ch16). Whether Washington hare populations cycle or not, hare cycles in British Columbia probably affect Washington lynx populations by producing pulses of immigration when lynx numbers peak and decline with hare scarcity. Although there are no data on immigration into Washington from BC, Poole (1997)

reported that lynx in Northwest Territories dispersed up to 930 km. Females dispersed in all directions, and males favored south and west (Poole 1997). Also, the small sub-populations of lynx in Washington <20 (all except Okanogan), particularly those which lack connections to habitat in BC (e.g. Kettle Range and Little Pend Oreille LMZs) probably cannot persist indefinitely without demographic rescue by immigration from other sub-populations (Sweanor et al. 2000, Beier 1993, 1996).

Land Ownership and Management Status

Most of the lynx forest types occur on federal lands and federal management, primarily by the Forest Service has the greatest affect on lynx conservation in Washington.(Table 4). Depending on how habitat is defined, about 80-90% of the lynx forest habitat in Washington is managed by the Forest Service (WDNR 1996, USFWS 2000:16073). Significant portions of lynx habitat lies in designated Wilderness areas, and other nondevelopmental allocations, although the habitat is highly fragmented and portions are above timberline (USFWS 2000:16073). Of the portion in managed forest, additional acres lie within late successional reserves under the Northwest Forest Plan that allow limited timber harvest. If Forest Plans are amended based on the science report, and management is revised as the results of future research, then the prospects for lynx conservation in Washington are good.

In addition to the large percentage of lynx habitat in national forests, a significant amount of potential habitat lies on the Yakama Indian Reservation. Based on the historic Mt. Adams records, and the occurrence of subalpine fir forest types (Fig.4, p. 12), this area may have the best potential for supporting lynx, outside of the existing LMZs (Richardson 1999). A significant portion of this area (100,000± ac) is in reserve land designations for wildlife, cultural and other values (McCorquodale et al. 1997).

Most of the state and private lands in the Okanogan and northeastern LMZs are covered under lynx management plans that provide for maintaining suitable habitat through time (see *State and Private Lynx Management Plans*, p. 30). Part of the Loomis State Forest (24,600 ac) is now managed under laws that govern Natural Resource Conservation Areas (that would preclude most harvest) under an agreement with a coalition of conservation groups. The Loomis Forest Fund provided $16.5 million from private donations to the state Common School trust fund under the agreement.

Table 4. Land ownership or jurisdiction of 6 Lynx Management Zones in Washington

Landowner by LMZ	Acres	% LMZ total	Reserves [a] (ac)
OKANOGAN			
U.S. Forest Service	2,043,376	88.8	1,078,102
U.S. National Park Service	138,530	6.0	
Washington Dep. of Natural Resources	98,393	4.3	24,600
U.S. Bureau of Land Management	1,495	<0.1	
Private	18,056	0.8	
Total	2,300,095	100	
VULCAN-SWAN			
U.S. Forest Service	28,450	92	
U.S. Bureau of Land Management	171	0.5	
Washington Dep. of Natural Resources	801	2.6	
Private	1,445	5	
Total	30,869	100	
KETTLE RANGE			
U.S. Forest Service	196,737	80.6	
Colville Indian Reservation	44,616	18.3	
Washington Dep. of Natural Resources	1,512	0.6	
Private	586	0.2	
Washington Dep. of Fish and Wildlife	166	<0.1	
U.S. Fish and Wildlife Service	235	<0.1	
U.S. Bureau of Land Management	132	<0.1	
Total	243,984	100	
THE WEDGE			
U.S. Forest Service	33,537	75	
Washington Dep. of Natural Resources	2,943	6.6	
Private ownership (mostly Boise Cascade)	7,895	17.8	
U.S. Bureau of Land Management	89	0.2	
Total	44,464	100	
LITTLE PEND OREILLE			
U.S. Forest Service	120,388	69.6	
Private (mostly Stimson Lumber)	24,890	14.4	
Washington Dep. of Natural Resources	18,980	15.8	
U.S. Fish and Wildlife Service	8,688	5.0	
U.S. Bureau of Land Management	36	<0.1	
Washington Dep. Fish & Wildlife	8	<0.01	
Total	172,984	100	
SALMO PRIEST			
U.S. Forest Service	262,119	87.7	41,066
Private (mostly Stimson Lumber)	31,999	10.7	
Washington Dep. of Natural Resources	4,925	1.6	
Total	299,044	100	
TOTAL, all LMZs	3,090,700[b]		1,143,768.0[b]

[a] Reserves include wilderness, national parks and state conservation areas.

[b] Totals include all lands without regard to habitat suitability.

Forest Management

Timber Harvest. The interaction of forest management, succession, hares and lynx are not well understood. Lynx seem to benefit most from the existence of a mosaic including dense early regenerating stands that support high numbers of snowshoe hares and old stands with an abundance of downed wood for denning. Prior to management, dense young stands resulted from stand replacement fires, that also helped to maintain lodgepole pine in the landscape. Clearcutting or heavy partial cutting, like fire, creates stands that are unused by lynx until regrowth provides cover. Trees can require 10-20 years at these elevations, and some tree species and sites can take 40-50 years, to attain 7 feet or so in height (WDNR 1997:59). Harvest may result in more rapid regeneration than fires, but not the tree density that is optimal for hares so may be of little use to lynx. Also, ground disturbance and compaction that occur during harvest may produce a different response by vegetation. Also, pre-commercial thinning can eliminate the dense cover hares prefer. Pre-commercial thinning has occurred on approximately 1/3-1/5 of the early successional stands created by timber harvest in potential lynx habitat on western federal lands in the last decade (USFWS 2000:16072).

Harvest of large areas may temporarily inhibit lynx movements across the landscape and isolate stands that otherwise would be used by lynx for forage or denning. The cut stands may later provide good forage habitat for hares, until the stand closes and self-pruning puts the lowest branches out of reach of hares. In at least some vegetation types there then may be a stage for many decades with little understory that contains little forage for hares. Some hare forage would again be present when the stand matures and openings occur through natural mortality, or possibly sooner if a thinning harvest occurs. The conversion of lodgepole stands to more economically valuable species, and the reduction of downed woody debris by slash burning have probably also affected lynx habitat quality.

Based primarily on the work of Brittell and Koehler in the Okanogan, state and private landowners have used habitat models that include maintaining the landscape in proportions of denning and forage habitat by Lynx Analysis Unit (LAU). For example the WDNR schedules harvest in LAUs where they own >20% of the land so that no more than 30% is in temporary non-lynx habitat (i.e. recent harvest) and of the remaining 70%, 10% is in denning habitat, and 20% is in foraging (WDNR 1996:3-76). The two private companies, Boise Cascade and Stimson, have used HSI models that consider interspersion of similar proportions to rate suitability. All assume that old timber for denning or foraging is not required, as long as sites with high downed wood (slash piles, blow downs, etc.) are present at some frequency (for DNR, 2 patches/ mi^2, priority given to patches of mature to over-mature). They also consider connectivity of forested areas by limiting clearcut size and maintaining forest cover in important corridors. Another assumption of lynx management plans is that conventional timber harvest will produce sufficient stem densities to benefit

hare. None of the plans strictly limit pre-commercial thinning. Stem densities of natural regeneration are often sufficient on wet and mesic sites typical of lynx habitat. The plans have addressed this question through adaptive management processes.

More recently the federal agencies have outlined a more conservative approach that recognizes the uncertainties about the importance of mature and old stands for lynx, the risks of applying the information obtained in the Okanogan to other regions, and the need to manage for other species (Ruediger et al. 2000, Ruggiero et al. 2000). This approach would use the stand age distributions of historical landscapes that resulted from the local fire regime as a model for management (McKelvey et al. 2000: ch15). Under a natural fire regime, the scale and pattern of the vegetative mosaic is affected by the size, intensity, and frequency of fire (Patton 1992). In boreal and subalpine forests, high intensity fires occurred in sizes and frequencies that produced a stand age distribution that approximates a negative exponential curve (Johnson et al. 1995, Agee 2000: ch3). In such a forest, 36% of the landscape would be older than the average stand age, 13% would be older than twice the average, and 5% would be older than three times the average (McKelvey et al. 2000:ch15).

The federal lands provide the ability to manage on a landscape scale. In contrast to conventional matrix/reserve management, the natural stochastic regime approach provides the advantage that older stands would not be permanent spatially- assigned fixtures of the landscape which would eventually be lost to fire. The average stand age would be twice the rotation age, which would benefit many other species, and harvest would be planned with the knowledge that some stands will be lost to fire. This management may differ from current Forest Service policy and from current recommendations for lynx (Lloyd 1999) by departing from the 40 ac clearcut size limit. Natural fire regimes produce some very large patches that were probably temporarily of little use to lynx, but later provided excellent foraging habitat. Thomas et al. (1998) reported that hare pellet density was twice as high in patches that were $\geq$ 80 ac (32 ha) than in stands of $\leq$ 40 ac (16 ha). Larger stands may provide habitat for a threshold population size, or very dense cover refugia that allow hares to persist despite predation pressures. Another advantage of larger management units would be reducing the needed road network (McKelvey et al. 2000: ch15).

Fire history and suppression. Wildfire helped to create the high-elevation forest ecosystem in eastern Washington. For example, from 1910 to 1940, an average of 83 fires burned an average of 8,200 ha (20,523 ac) each year in the Colville NF (Hougland 1941). Sporadic wildfires encourage a variety of tree species and age classes, improve soil, modify ground vegetation to encourage seedling growth, and reduce susceptibility to insect and disease epidemics. Following a fire, browse species proliferate and remain high in nutritional quality for several years (Komarek 1984, Patton 1992). Lodgepole pine, an aggressive pioneer species, was the predominant post-glacial tree invader that was maintained through post-glacial time by repeated fires (Brown 1973). The relationship between lodgepole,

beetles, and fire operated against succession to perpetuate lodgepole. Although lodgepole will regenerate in the absence of fire where soil and light conditions are favorable, it responds to fire by regenerating very densely, providing the forage and cover that is optimal for hares (Brown 1973). Fires can benefit lynx by the development of extensive, even-aged tracts of lodgepole pine that contain patches of dense dead wood and fire skips of old timber that provide denning opportunities.

Fire suppression which has occurred for most of the 20th century, has not had as great an impact in lynx habitat as in high fire frequency forest types (e.g. ponderosa pine) because of the relatively long fire return intervals (100-250 years in the Cascades) of these higher elevations (Agee 2000: ch 3). Fire hazard in the subalpine zone may result primarily from its proximity to dense stands of Douglas-fir and grand fir at lower elevation that are at high risk to catastrophic fire (Hessburg et al. 1994). Recent fire management integrates prescribed fires on managed lands and a policy to allow confined fires in wilderness and roadless recreation areas to burn (Okanogan NF 1989). These approaches may enhance lynx habitat while reducing the risk of catastrophic fires.

Forest roads. The introduction of a road system in previously undisturbed landscapes has direct and indirect effects on lynx. Although road edges may provide foraging opportunities, roads eliminate some lynx habitat (6 ac per mile) while increasing recreational access to remote areas. Lynx may become more vulnerable to disturbance and illegal and incidental hunting and trapping mortalities. The role of compacted snow on roads and trails in increasing the use of high elevations by coyotes and bobcats is unknown (see *Competition...*, p. 39)

Grazing and grass seeding. Grazing by cattle has the potential to impact lynx by removing the herbaceous forage that snowshoe hares use during the summer. Cattle grazing is a factor in the decline of aspen regeneration in Rocky Mountain subalpine areas, and probably degrades the habitat value for hares of riparian willow (Ruediger et al. 2000: 26,70). Observations on state lands suggested that cows tended to focus on recent clearcuts in Douglas-fir stand types that are more likely to have continuous grass cover than subalpine fir types, and where cattle and hare overlapped, there was no negative correlation between cattle sign and hare pellets abundance (WDNR 1997). New clearcuts may not be colonized by hares for several years. Thus cattle and hares seem to exhibit some temporal and spatial separation. However, Thomas et al. (1998) reported grazing damage and little hare use of some regenerating stands in the Little Pend Oreille LMZ. Grazing may have locally significant impacts on hare forage, and the topic warrants further investigation and management attention. Grazing by cattle and wild ungulates is sometimes improved or facilitated by seeding non-native grasses. Seeding of grass after logging to enhance grazing may affect the density of regeneration of woody species, reducing the habitat value for snowshoe hares.

Forest Management in British Columbia. Washington habitat is comprised of the southward continuation of the Cascades and outlying habitat islands of the Rocky Mountains of eastern British Columbia. Habitat changes in southern BC have the potential to reduce local lynx populations and thus, movements into Washington. Occasional immigration of lynx from BC may have a demographic rescue effect important to the long-term persistence of lynx in Washington. In BC the Annual Trapper's Survey conducted by the Wildlife Branch consistently has attributed declines in furbearer habitat quality to logging and road-building (Rollins 1992, M. Badry, letter on file). The Provincial government owns 94% of the land in BC, with most of the private lands in valley bottoms (B. Harris, pers. comm.). Most of the lynx habitat is managed by the Ministry of Forests. The Province recently passed legislation intended to maintain biodiversity at the stand and landscape scale. The new Forest Practices Code stand level guidelines prescribe clearcut sizes, and retention of leave trees, coarse woody debris, and riparian reserve zones. Landscape scale planning is intended to maintain the temporal and spatial distribution of seral stages and connectivity of forest cover. There are no requirements regarding thinning and herbicide applications that would affect the quality and duration of hare foraging habitat. According to M. Badry, Wildlife Branch, biodiversity targets are downgraded, and no procedure for implementing landscape unit plans has been developed.

There are other land use planning processes in southeastern BC that have identified wide-ranging carnivore corridors; corridors are designated for management that will not inhibit wildlife movements, and they take advantage of the locations of large protected areas such as provincial and national parks.

Competition and predation

The presence of a larger number of potential competitors in southern boreal habitats than in much of the northern regions has fueled speculation about competition between lynx and other carnivores. Cougars, bobcats, coyotes and foxes all may have some negative affect on lynx through competing with, or preying on lynx, but there are little data on which to draw conclusions. Cougars are known to kill lynx and there is some overlap in seasonal habitat use (Koehler and Hornocker 1991, Squires and Laurion 2000: ch 11). With the exception of British Columbia and western Alberta, cougars are not present in much of the northern boreal forest (Dixon 1982). Buskirk et al. (2000: ch 4) suggest that lynx may avoid areas when cougars are present. Bobcats are not present in northern boreal regions and may occasionally compete for prey with lynx in Washington. Bobcats are generally found at lower elevations, but will use higher elevations during summer (Brittell et al. 1989), and occasionally in winter (4800'; Zender and Base 1999), but deep snow would likely prevent bobcats from effectively competing with lynx during winter.

Coyotes. Coyotes often prey on rabbits and hares and have expanded into much of the boreal forest since the early 1800s (Voigt and Berg 1987:fig.2). In Washington, coyotes were historically present in the Columbia Basin and adjoining valleys, but were absent from western Washington, possibly having been excluded from the coniferous forest by wolves (Suckley and Cooper 1860:75, Brooks 1930, Voigt and Berg 1987:fig 2). Buskirk et al. (2000:ch. 4) cited the difference in Washington harvests between the early 1960s (an average of 365/year for 1960-65) and the period 1977-82 (16,250 /year), as evidence of the increase and expanded range of coyotes. However, coyote harvests have fluctuated dramatically with the 1945-47 average exceeding 10,000/year, but dropping to 0 in 1948-49 (Novak et al. 1987). The low harvest of the early 1960s may reflect pelt prices which dropped below $6, compared to $35-60 in the period 1972-82 (Noval et al. 1987). More recent coyote harvests ranged from 922-1864/year (WDFW Game Harvest Reports 1995, 1996, 1997, 1998). Historical accounts suggest that coyotes have indeed expanded their range, but trapper harvest data do not clearly indicate an increase in number, and the significance of competition with lynx is unknown.

In the Yukon, coyotes are a facultative specialist that feeds heavily on hares, especially during winter when other prey are unavailable (O'Donoghue et al. 1998). Buskirk et al. (2000:ch.4) suggest that the density of coyotes affects lynx populations, based on reciprocal abundances in 2 study areas. O'Donoghue et al. (1998) saw no evidence that competition between lynx and coyotes affected lynx habitat use patterns. During periods of hare scarcity, coyotes spent more time mousing in meadows, and lynx preyed more on red squirrels in forests. The potential for competition between lynx and coyotes has led to speculation that human induced changes to the landscape, particularly logging roads, compacted trails, and clearcuts, have increased the amount of crusted or compacted snow, thus improving the coyote's ability to exploit higher elevation habitats. Lynx would still possess the advantage of lower foot loading in deep snow and would be able to use elevations and snow conditions where coyotes would likely be excluded. Buskirk et al. (2000:ch 4) speculate that lynx would benefit from the recovery of wolves because they would reduce coyote populations and, unlike coyotes, would not compete with lynx for hares. Wolves have been observed to exclude coyotes in some areas, but coexist in others (Peterson 1995, Crabtree and Sheldon 1999). Paquet (1991) observed that in southwest Manitoba, coyotes were not displaced by wolves, and coyotes obtained most of their food by following wolf trails and scavenging wolf kills. Wolves killed coyotes opportunistically, but they did not seem to actively hunt them (Paquet 1991).

Incidental hunting and trapping mortalities

Lynx mortalities from accidental, incidental and illegal shooting and trapping are probably rare but could temporarily impact local populations. Lynx hunting and trapping seasons in Washington were closed in November 1991, and legal harvest is no longer a concern. The

amount of illegal harvest of lynx is probably very small. Hound hunters after bobcat and lynx took several lynx during the 1970s (S. Zender, pers. comm.), but hound hunting for these species is no longer legal in the state. Federal protection that began in April 2000 will likely decrease illegal harvest should pelt prices again become high as they were in the 1980s. Of greater concern is lynx mortality from incidental shooting and trapping intended for other species. A lynx, presumably mistaken for a bobcat, was shot by a deer hunter in 1999 (WDFW files). Incidental non-target capture in traps may occur, but may be very unusual because coyote and bobcat trap sets, which are most likely to catch lynx, are more commonly used at lower elevations than in areas occupied by lynx. There are also far fewer trappers, particularly in the mountains that in recent decades (S. Zender, pers. comm.). Though these types of mortality may be relatively rare, it may be at least partly additive to natural mortality. Revision to trapping regulations may need to be made to minimize the capture of lynx and increase the likelihood that they can be released uninjured. Trapper and hunter education programs may significantly reduce this source of mortality. These provisions may be incorporated into a 4(d) rule under the Endangered Species Act that is in preparation (U.S. Fish and Wildlife Service 2000: 16067)

Lynx management in British Columbia

The small size of lynx sub-populations and metapopulation theory suggest that the Washington lynx population may be dependent on occasional immigration of animals from British Columbia. During peaks in the lynx population cycle and the initial years of the subsequent decline, some individuals probably emigrate from Canada in search of suitable habitat. Thus the status and management of lynx populations and habitat in southern BC is very important to lynx conservation in Washington. It is unknown if the level of harvest in recent years has affected the frequency of movements of lynx between BC and Washington.

Harvest data in recent decades suggested a widespread decline in lynx in western Canada (Todd 1985). In BC, the 1962-63 peak of 12,500 (the highest on record), was followed by a double peak from 1972-73,1973-74 with about 8,500 each year (Fig. 8). The most recent

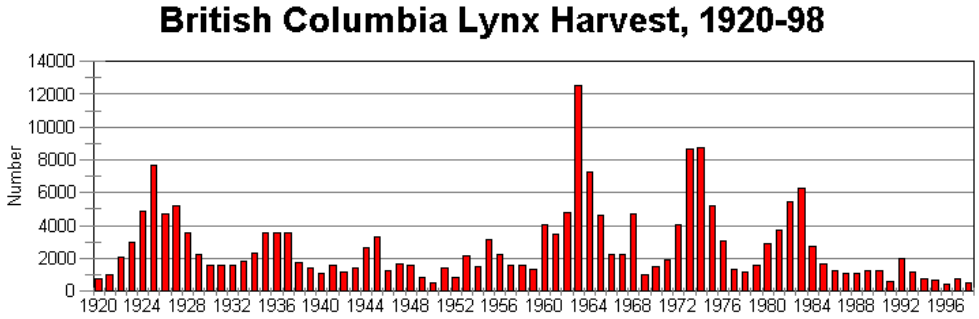


Figure 8. Harvest of lynx in British Columbia from 1920-1998 (from Hatler 1988, and deVos and Matel 1952).

peaks in 1982-83 and 1991-92 were substantially lower at 6300 and 2000 (M. Badry, pers. comm; Hatler 1988). Pelt prices were at historic highs from 1985-87 when the average pelt price was $500-670 (Hatler 1988). Pelt prices have declined since then, ranging from $75-121 for 1994-99 (M. Badry, pers. comm.). Todd (1985) summarized evidence that the widespread declines resulted from overharvest. It is now generally accepted that trapping should be restricted during the cycle lows to avoid eliminating the resident females needed to produce the response to the next hare increase (Quinn & Parker 1987, Hatler 1988, V. Banci, notes on file). British Columbia has adopted a strategy of "tracking" the lynx population cycle so that trapping can be restricted for a few years during the cyclic lows (Hatler 1988, BC Wildlife Branch n.d.). During the early-mid 1990s, seasons were restricted and quotas implemented in southern and central regions in response to the low level of the previous peak. The proportion of kits in the harvest is indicative of recruitment and can range from 3-66% (BC Wildlife Branch). Increases in the proportion of kits (15% in 1992, 45% in 1996, 40% in 1999) suggest the population, though low, is stable with good recruitment (M. Badry, pers. comm.). Harvest trends and age structure will be tracked through the next peak expected sometime in 2001-2003, and quotas and season restrictions will be implemented as needed.

Mowat et al. (2000:ch. 9) recommend that in areas where distribution is more limited, or harvest more intense, harvest should be restricted starting one year after lynx numbers begin to decline. This restriction should continue for 3-4 years, or until there is evidence of recruitment and population increase.

Lynx populations are highest in northern and eastern BC. Southern BC is similar to Washington in that it has a low density of lynx due to limited and patchy habitat (Fig. 9)(V. Banci, notes on file). There are also more trappers and road access is greater in southern BC. British Columbia trapping is regulated through a system of Registered Traplines. The southern portion of the Province within 120 miles of the Washington border includes all or portions of four resource management Regions (2, 3, 4 and 8). The current lynx trapping seasons are 15 Nov-15 Feb in Regions 3 and 8, 15 Nov-31 Dec in Region 4. In Region 2 (west of Cascades crest) the season is closed, and the carcass and pelt of any lynx incidentally caught must be turned in. In Regions 4 and 8, trappers must report lynx caught for each season, and fur traders must measure pelts and submit a monthly report. The number of lynx trapped or shot for regions 8 and the portions of 3 and 4 closest to Washington are low compared to the rest of the Province (Table 5), but could affect the frequency that lynx disperse to Washington. Trapping seasons are scheduled to minimize harvest of adults, so that trapping is somewhat selective. A few lynx are shot by hunters in these areas each year (mean = 5.25/year; range 0-10), and there is a bag-limit of 1 lynx/hunter. Shooting by hunters is non-selective, and may be additive to other sources of mortality (Hatler 1988).

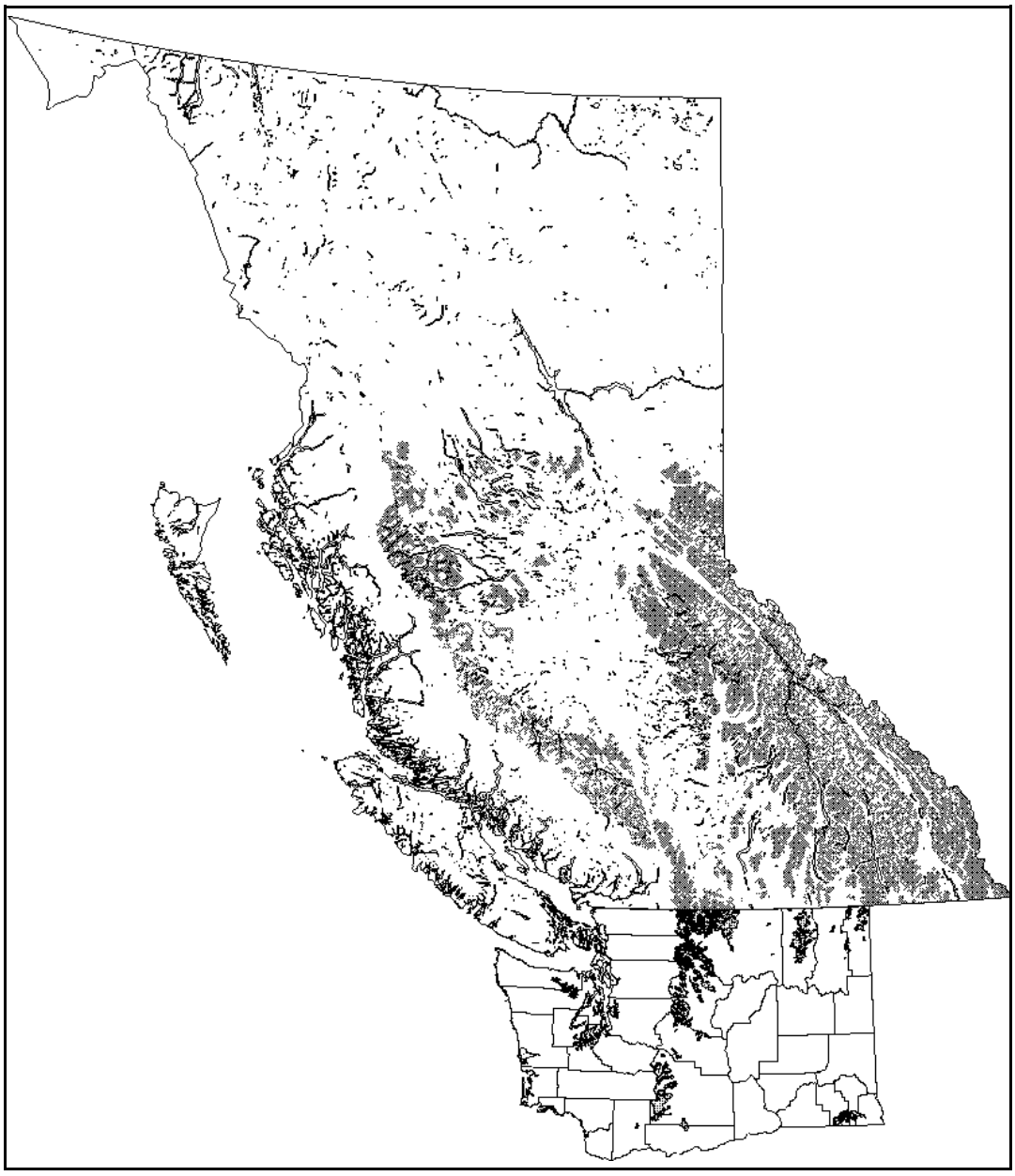


Figure 9. Subalpine fir zone in Washington (Cassidy 1997) and British Columbia (BC Ministry of Environment).

Provincial regulations were amended for 1999-2000 to change lynx from a Small Game to a Big Game species. This change will require an additional licence to take lynx and may reduce incidental harvest by hunters (M. Badry, pers. comm.). These improvements in harvest management may prevent over-harvest that could eliminate dispersal of lynx to Washington.

Table 5. Lynx harvest in southern Management Units in British Columbia, 1991-98.

Year	Southern interior British Columbia[a]	BC Total
1987	99	1050
1988	92	1050
1989	63	1253
1990	40	1230
1991	44	600
1992	27	2017
1993	29	1172
1994	24	750
1995	31	641
1996	31	382
1997	71	722
1998	35	533

[a] This includes Region 8, the southwestern units of Region 4, east as far as Kootenay Lake (MUs: 7, 8, 9, 14, 15, 16, 17, 18, 29, 30, 31, 32), and the south eastern units of Region 3, north to Kamloops and Shuswap Lake (MUs: 12, 19, 20, 26, 34); this covers an area extending north of Washington about 120 miles.

Forest Insect Epidemics

Large blocks of lodgepole pine just north of Okanogan County and east of Manning Provincial Park in BC are presently slated for clearcutting due to a mountain pine beetle (*Dendroctonus ponderosae*) epidemic (B. Harris, pers. comm.). These areas are adjacent to areas recently salvaged after a bark beetle (Scolytidae) outbreak. These outbreaks and the extensive harvest that occurs in response may affect the local lynx population and the potential for movement into Washington until the canopy is re-established. When forests mature many individual trees lose vigor and stands can become susceptible to insects and disease. Mature lodgepole pine is notably susceptible to pine beetle attacks. Traditional mountain pine beetle management has recommended harvesting a stand of lodgepole after 70 to 80 years, when trees measure 18 to 20 cm (7-8 in) in diameter. Alternatively, stands can be heavily thinned and the rotation extended (Mitchell et al. 1983). Attacks of the mountain pine beetle generally persist for 15 to 20 years, followed by 30 to 40 years of quiescence.

Fire suppression in forests has allowed more trees to reach maturity increasing the rate of infestation by mountain pine beetles, bark beetles, and western spruce budworms (*Choristoneura occidentalis*) (Hessburg et al. 1994). Silvicultural prescriptions have been aimed at reducing the threat of epidemics before an outbreak occurs. Salvage logging of

dead and dying trees 1 or 2 years after an attack is another common practice (Pitman et al. 1982).

Condition of Matrix Habitats

The condition of the low elevation matrix habitat may affect the ability of lynx to survive while dispersing between mountain habitats. Lynx are resident of mountain habitats that are often isolated by low elevation dry forest and non-forest habitats. The ability of lynx to move through these other habitats to rebuild or re-establish local populations may be essential to the persistence of the Washington metapopulation. Lynx may take advantage of high populations of jackrabbits or ground squirrels in sage brush or other habitats where they are in close proximity to subalpine forest (Lewis and Wenger 1998, Ruediger 2000:14). Management that maintains prey populations in dry forest and shrub habitat may benefit lynx that are dispersing between higher elevation habitat islands. High traffic volume roadways may also affect the ability of lynx to successfully disperse. For example, Interstate 90 averages >24,000 vehicles/day (Singleton and Lehmkuhl 2000), and may affect the chance that lynx will re-colonize potential habitat in the southern Cascades, and would affect movements between subpopulations.

Management of Other Species of Concern: Caribou and Grizzly

The Selkirk Mountains Woodland Caribou (*Rangifer tarandus caribou*), a federal and state endangered species, is found in the Salmo Priest LMZ (Figure 10). The Salmo Priest LMZ contains a portion of the recovery zone for caribou (Almack 1998), including 77,000 ac in the Colville National Forest and 174,760 in the Idaho Panhandle National Forest. This habitat is primarily above 4,000 ft in subalpine fir/Englemann spruce and western redcedar/western hemlock forest types. Caribou primarily use mature and old stands, and open canopied areas adjacent to mature forest (USFWS 1994). The cumulative effects of fire and logging have eliminated much historic habitat for caribou and management for caribou restricts harvest and burning. Management for caribou habitat may inhibit harvest designed to create additional hare forage areas. Stands in caribou habitat have often been pre-commercially thinned in order to speed growth and development of old growth structure, but thinning may preclude the stem density needed for hares (T. Bertram, pers. comm.). However, a need for calving areas with abundant understory may provide some areas with good hare cover. It is not clear how the potential conflicts between caribou and lynx habitat management that may occur in the Salmo-Priest LMZ will be resolved.

There is geographic overlap in areas considered habitat of grizzly bears and lynx in the north Cascades and in the northern portion of the Salmo-Priest LMZ. Grizzly bears are habitat generalists that use a variety of forest and non-forest habitats. A major focus of grizzly bear conservation is road and trails management to maintain refugia free of

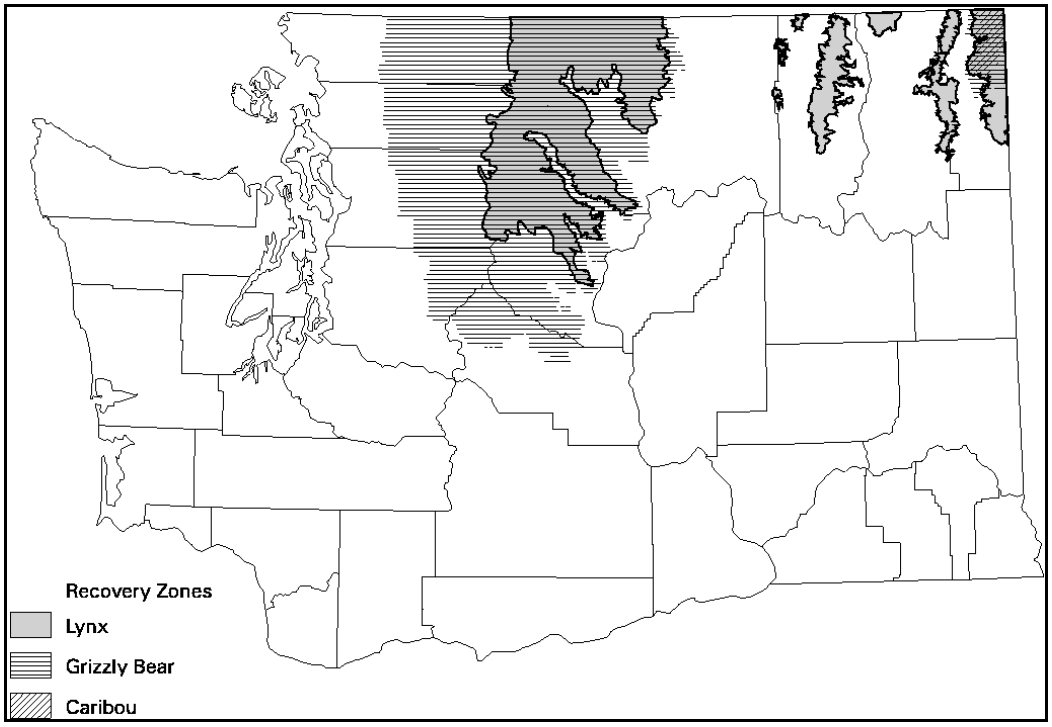


Figure 10. Lynx, Grizzly Bear, and Woodland Caribou recovery zones in Washington.

significant human disturbances (USFWS 1993). Lynx seem to be tolerant of moderate levels of human disturbance though they may be sensitive to disturbance of maternal den sites (Mowat et al. 2000: ch 9, Claar et al. 1999). Reductions in disturbance of higher elevation habitats intended to benefit grizzly may also benefit lynx.

CONCLUSION

The lynx population in Washington almost certainly numbers fewer than 200, and may be less than 100 individuals. Several factors combine to put the population at risk for extirpation. The population includes several small sub-populations (<20) that are somewhat isolated. Survival and recruitment of lynx in Washington is probably affected by fluctuations in prey populations. Lynx habitat is limited in extent and fragmented by topography. Habitat quality is affected, either positively or negatively, by forest succession, forest management, fires, roads, recreation, and beetle epidemics. The population dynamics of the Washington lynx population may require "demographic rescue" by occasional immigration of lynx from populations in Canada to remain viable over the long term.

Cooperative management of lynx habitat is required to assure the long-term stability of this species in Washington. Most of lynx habitat in Washington occurs on lands in federal jurisdictions, particularly National Forests. Recent listing of the lynx by the U. S. Fish and Wildlife Service as Threatened under the Endangered Species Act and increased attention from federal agencies has improved the outlook for lynx conservation in Washington.

PART TWO: RECOVERY

RECOVERY GOAL

The goal of the lynx recovery program is to restore lynx populations to a level where there is a high probability that lynx will reside in Washington through the foreseeable future. This Recovery Plan outlines strategies which, when implemented, will enhance lynx habitat and populations to the point where the lynx can be down-listed to Sensitive.

RECOVERY OBJECTIVES

The lynx will be considered for downlisting from State Threatened status to State Sensitive when:

1) Recovery Zone maps have been revised, adding potential lynx habitat that can be expected to sustain reproductive lynx populations, and removing any areas of existing recovery zones that prove to be unsuited to sustaining lynx.

2) Lynx are consistently present during 10 consecutive years in >75% of the LAUs in the Okanogan-Cascades, Northeast, and any new identified Recovery Zones (Figs. 7, 11).

3) Lynx surveys indicate that recruitment from local reproduction regularly occurs.

4) Agreements or forest management plans are in place for federal, state, and major private landholdings that assure suitable habitat will continue to be managed in a way consistent with lynx conservation after downlisting.

Rationale

Interim recovery objectives. The current state of knowledge for lynx in southern boreal habitats does not allow the development of population-based recovery objectives. Until data on vital rates, dispersal, and the variation of lynx populations in Washington are available, interim objectives involve consistent occupancy of habitat capable of sustaining lynx populations. Recovery strategies and tasks include the research needed to produce the data necessary to begin evaluating population viability. Lynx conservation is complicated by the metapopulation-like structure of Washington populations, the potential for synchronous fluctuations associated with hare cycles that may occur in Washington, and the importance of dispersal between sub-populations. Even the simplest count-based population models require good population estimates for >10 years for 2 or more

subpopulations with low variation due to observers or methodology to estimate it (Morris et al. 1999). More complex viability models require detailed age-specific demographic information and data on year to year variation (Beissenger and Westphal 1998). Normally 6-10 years of data are needed; for a species like lynx that may be cyclic, data through 2 or more 10 year cycles may be needed. Habitat patch presence/absence data has been used to model population persistence previously, but involved an endangered butterfly with data from >1500 patches (Hanski et al. 1996).

If future population analysis indicates that demographic rescue by lynx dispersing from BC is critical to the species long-term persistence in Washington, recovery objectives may be revised to include cooperative agreements with British Columbia.

The retention of a mosaic of habitat types over time requires the strategic management of fire and timber harvest. Habitat security will be assured by coordinating management agreements or plans that specify how denning, forage, and connectivity will be maintained over the long term (100 years). It is not expected that 100% of LAUs would be consistently occupied, because at any point in time some will probably have low habitat value due to fires, insect epidemics, or other problems. Historically, large fires may have made some areas temporarily unsuitable for lynx, and new management approaches may incorporate some large patch sizes (McKelvey et al.2000: ch.15).

When lynx consistently occupy the recovery zones that approximate their historic Washington range, their distribution should represent relative population stability, and the species may be moderately secure. Recovery objectives for lynx will be re-evaluated, and changed if necessary, as new information becomes available. If the lynx is down-listed to State Sensitive, new objectives will be written for de-listing of the lynx in Washington.

Recovery Zones. The interim Okanogan-Cascades and Northeastern Washington Recovery Zones, are based on the original LMZs described in the status report and update (WDW 1993, Richardson 1999), and modified to include the new extent of lynx habitat in those regions as mapped by the national forests (Fig. 11). The original LMZs were developed based on the overwhelming majority of lynx records, and the opinion of local biologists about habitat. However, that was done without an awareness of the 10 specimens from the Mt. Adams area that indicate a population existed in the southern Cascades at the turn of the century. The Forest Service has mapped all potential habitat throughout the Cascades and Blue Mountains, but it is uncertain how much of this is capable of supporting reproductive lynx populations. Recovery zones will include regions of the state which should be managed for lynx because they have the potential to support, and historically probably did support, reproducing lynx populations. Transient lynx will wander into a variety of habitats, including shrub-steppe, that can not support reproduction or year-round occupancy. We have included the Subalpine fir, Grand Fir, Interior Western Hemlock, and

Interior Western Redcedar vegetation zones (Cassidy 1997) above 4000 ft in the Cascade and Blue Mountains, and above 3500 ft in northeastern Washington, as "potential lynx habitat" to be evaluated. These vegetation zones should be evaluated for the density of snowshoe hares, but a complete analysis may be delayed until more data are available on lynx and hare habitat use from southern boreal habitats. The grand fir, hemlock and redcedar types in the Cascades and Blue Mountains may not be capable of supporting lynx, and may only be used where they are interspersed with subalpine types. We may add additional recovery area(s), or remove portions of existing zones, in future revisions of this Recovery Plan when that habitat analysis is complete.

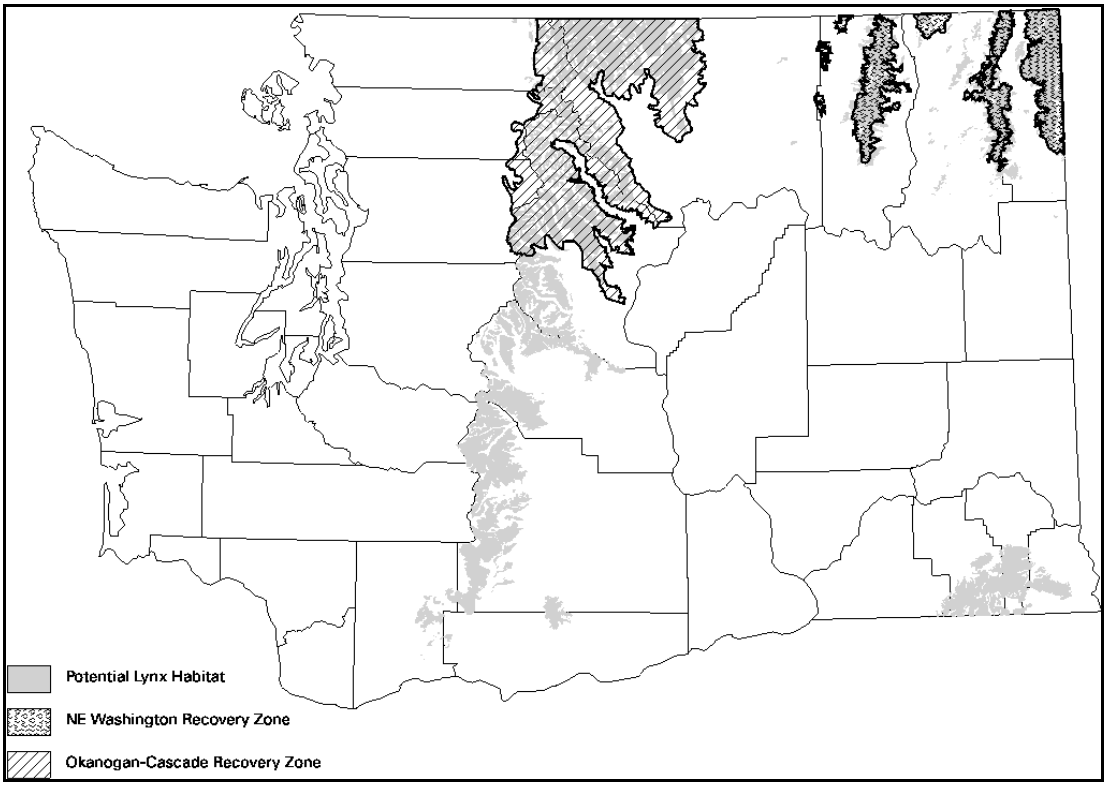


Figure 11. Lynx Recovery Zones and other potential lynx habitat in Washington.

RECOVERY STRATEGIES AND TASKS

1. Survey and Monitor lynx.

1.1 Conduct extensive surveys in potential lynx habitat to determine where lynx exist outside of current recovery areas.

Extensive surveys are needed to more clearly identify where lynx are present, and not present, and to identify areas for more intensive surveys (Aubry et al. 2000 ch. 17).

1.2 Conduct annual surveys of occupied LMZs to determine population persistence by surveying each LAU at least every three years.

This may require a cooperative effort, perhaps combining winter surveys with the use of hare snares in summer where access is problematic. Current WDFW staffing is not adequate to fulfill this survey frequency with the current system, but could coordinate interagency cooperative data collection and storage. Once presence is established, volunteer surveyors may be used to confirm presence in subsequent years. Survey Record Forms and Species Detection Forms should be submitted to the Wildlife Resource Data System at WDFW, (as well as other appropriate data facility for the agency/owner involved).

2. Manage habitat to improve conditions for lynx over time.

2.1. Analyze the habitat conditions of Recovery Zones by LAU.

Important landscape connections and shortages of foraging or denning habitat in LAUs should be identified and incorporated in timber harvest and fire management planning.

2.2. Manage habitat to improve conditions for lynx over time.

The Lynx Conservation Assessment and Strategy (Ruediger 2000) provides guidance to the Forest Service for landscape ratios of denning and foraging habitat and ecosystem planning that will be incorporated into Forest Plans. Lloyd (1999) provides guidance that can be used by smaller landowners. Both these documents will need to be updated and revised as new information becomes available.

2.3. Evaluate and revise management recommendations based on latest research.

Assumptions of existing habitat models need to be evaluated. For example, models assume that leaving small patches of denning habitat is sufficient to support lynx. What is the potential of old/mature forest role as forage habitat? What is the best interspersion or arrangement of old and young stands to support lynx? Does 180 trees per acre provide adequate travel cover?

2.4. Develop an ecosystem approach toward managing landscapes for lynx based on historical fire regime, patch size, and stand age distribution.

The Lynx Conservation Assessment and Strategy (p.77) directs federal agencies to "prepare a broad-scale assessment of landscape patterns that compares historical and current ecological processes and vegetation patterns, such as age-class distributions and patch size characteristics."

2.4.1. Revise management guidelines incorporating an ecosystem approach.

2.5. Evaluate matrix of lands in Recovery Zones for their ability to temporarily support dispersing lynx.

Metapopulation theory suggests that the ability of lynx to disperse between islands of habitat may be critical to the long-term survival of sub-populations. Critical linkages should be identified so that land uses that would prevent lynx movements (e.g., high traffic volume roads, elimination of forest) are prevented.

3. Protect lynx by minimizing human-caused mortality.

3.1. Identify and implement policies and regulations that will minimize incidental take by hunters and trappers

3.1.1. Cooperate with USFWS in the development of a special rule for hunting and trapping (Section 4(d) of the Endangered Species Act)..

Effective implementation may require revision of existing trapping regulations with local restrictions on set types, check intervals, or locations. Also would include actions under 6 (public education).

3.2. Cooperate with Washington Dept. of Transportation in developing highway crossings if necessary to connect key areas.

High volume highways, like I-90 that has an average daily traffic volume of >24,000 vehicles (Singleton and Lehmkuhl 2000), pose a hazard to dispersing lynx, and wildlife crossing points should be incorporated into any highways built between habitat islands.

4. Undertake research designed to improve recovery of lynx in Washington.

Aubry et al. (2000: ch. 17) and Ruggiero et al. (2000: ch. 16) identify information gaps for lynx in southern boreal habitats and research needed to address these gaps.

4.1. Conduct intensive telemetry studies of lynx population.

4.1.1. Investigate reproduction, recruitment, mortality, density, dispersal, and population dynamics for one or more lynx populations.

Additional data is needed on population dynamics, and whether immigration of lynx from Canada is critical to the persistence of lynx in Washington.

4.1.2. Investigate metapopulation scale movements, colonization, and extinction of subpopulations.

4.1.3. Investigate seasonal diet and the importance of secondary prey.

4.2. Investigate lynx use of habitats and travel patterns in relation to snowmobile, cross-country and down-hill ski trails and activity.

4.3. Conduct investigations of snowshoe hare and red squirrel ecology.

4.3.1. Investigate hare abundance by stand age and in different vegetation types in Recovery Zones and potential recovery areas.

4.3.2. Investigate the short and long-term effects of pre-commercial thinning and other forest practices on hare and secondary prey species.

4.3.3. Investigate the effects of fire on forest regeneration and the distribution and abundance of prey.

4.3.4. Investigate long term dynamics of hare populations in Washington.

4.4. Conduct investigations of potential competition between lynx and other carnivores and the possible role of human-induced habitat changes.

There has been much speculation about snow compaction, and other habitat impacts. Investigation may show that this is not a significant factor for lynx habitat use, or interactions with other carnivores.

5. Maintain information management system for lynx data.

5.1. Act as lynx data clearinghouse for survey efforts and lynx detections.

The Wildlife Resource Data System (WRDS) at WDFW, Olympia maintains a database of lynx data and has established staff and procedures for information storage, retrieval, and management. For this system to be useful, WRDS must receive statewide survey data (both positive lynx detections, and negative results) so that information will be comprehensive and up to date.

6. Develop public information and education materials and programs.

6.1. Create and distribute a brochure about lynx that can be used to inform hunters and the public about lynx.

WDFW and WDNR are working on a brochure, and expect to have it available for distribution late in 2000.

6.2. Work with trappers to minimize incidental capture of lynx and other non-target species.

6.2.1. Incorporate information about avoiding lynx capture into trapper education materials, attend trapper meetings, etc.

Non-target capture of lynx in traps is minimized somewhat because deep snow at higher elevations reduces trapping activity, and the number of trappers using trap sizes that would affect lynx is very low. Reducing the types of sets most likely to capture lynx in locations where lynx are present should reduce the chances of incidental take. Trap types that allow release of non-target species uninjured can also reduce the take.

6.3. Create and maintain URL (web page) on the WDFW web site with lynx planning documents and information.

7. Coordinate and cooperate in recovery activities with landowners and other public agencies.

7.1. Develop management plans or conservation agreements for critical pieces of connecting dry forest and shrub-steppe habitats to prevent land uses incompatible with lynx dispersal.

7.2. Review and comment on revisions of lynx habitat plans and implementation and monitoring reports for state and private lands, as well as Habitat Conservation Plans, WDOT highway plans, and Forest Service management strategies.

7.3. Establish and maintain relationships for information exchange on lynx issues with Provincial agencies in British Columbia (e.g. Ministry of the Environment, Wildife Branch, and Ministry of Forests)

7.3.1. Monitor habitat condition and management in the Washington-British Columbia border area.

The ability for lynx to move between islands of habitat is important for populations in Washington and BC. Habitat conditions in the cross-border region could be mapped, and periodically updated.

7.3.1. Monitor lynx population cycles and harvest in BC.

An awareness of populations, harvest pressures, and cycles in BC may help explain patterns in lynx abundance and movements in Washington.

7.4. Revise Recovery Plan and Recovery Zone maps.

This recovery plan is interim in nature given the state of knowledge about lynx, hares, and habitat, and the potential that new research will affect changes in management.

7.4.1. Evaluate potential and existing recovery areas for the capability to support lynx populations and revise Recovery Zone map if needed.

The criteria for evaluation would include vegetation types, patch size and connectivity, slope, and hare populations.

7.4.2 Update Recovery Zone and LMZ maps when lynx habitat needs are better understood.

7.4.3. Revise lynx status information and recovery objectives and tasks with new data from surveys and demographic studies.

7.5. Facilitate interagency meetings on lynx, prey, and habitat to coordinate exchange of information.

8. Enhance lynx populations by direct intervention if needed and feasible.

8.1. Evaluate the need and feasibility of translocation of lynx to unoccupied recovery areas.

The lynx is a wide ranging species with pulses of dispersal during population peaks. Translocations will not be necessary if dispersers can successfully re-colonize large areas of suitable habitat.

8.2. Conduct translocation of lynx if necessary for recovery, and if animals are available.

A translocation project would require telemetric monitoring to evaluate success. Animals would have to be obtained from regional populations in order to maintain the genetic integrity of meta-populations.

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IMPLEMENTATION SCHEDULE

The outline of strategies and tasks on the following pages identifies agencies, WDFW involvement, task priorities, and estimates of annual expenditures. The following conventions are used:

Priority 1 Actions necessary to prevent the extirpation of the species from Washington and to monitor the population.

Priority 2 Actions to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extirpation.

Priority 3 All other actions necessary to meet recovery objectives.

Acronyms for other owners and agencies are:

DNR	Washington Department of Natural Resources
FS	USDA Forest Service
FWS	USDI Fish and Wildlife Service
PT	Private timber companies (Stimson, Boise Cascade)

Acronyms for the Department of Fish and Wildlife are:

DFW	
d	Wildlife Resource Data Systems, Wildlife Program
g	Game Division
h	Habitat Program
i	Resource Policy Lead, Intergovernmental Policy
e	Volunteer Services and Education
l	Lands division
s	Science Div., Wildlife Program
w	Wildlife Program

Implementation of Recovery Strategies is contingent upon availability of sufficient funds to undertake Recovery Tasks.

Implementation Schedule for Washington State Recovery Plan for the Lynx and estimated costs.

	Priority	Duration	Responsibility	Estimated Annual cost ($1000s)	DFW share [a]
Survey and monitor lynx in Washington	1	-	-	-	-
1.1. Conduct extensive surveys in potential lynx habitat outside current recovery areas	1	2	FS, FWS, DFW(w)	40	5
1.2. Monitor lynx by surveys in LAUs every 3 years	1	ongoing	DFW(w), FS	30	25
5-year total [b]				**210**	
Manage habitat to improve conditions for lynx	2	-	-	-	-
2.1. Analyze habitat of Recovery Zones by LAU	2	periodic	FS,PT	tbd	0
2.2. Manage habitat to improve conditions for lynx over time	2	as feasible	FS, DNR, PT	_tbd_	-
2.3. Evaluate and revise management recommendations	2	(1)periodic	FS, DNR,PT	15	6
2.4. Develop ecosystem approach to managing landscapes for lynx	2	4	FS	20	-
2.5. Evaluate matrix lands for dispersal corridors and capability	2	2	DFW(w)	20	20
5-year total [b]				—	
Protect lynx by minimizing human-caused mortality	2	-	-	-	-
3.1. Implement policies to minimize incidental take of lynx by hunters and trappers	2	1	DFW(g), FWS	10	10
3.2. Develop highway crossings if needed	2	1	WDOT, DFW(w,s)	contingent	4
5-year total [b]				**10**	
Undertake research designed to improve recovery of lynx	2	-	-	-	-
4.1. Conduct intensive telemetry studies of lynx	2	12	FS,DFW(s),FWS	200	25
4.2. Investigate lynx use of habitats and travel patterns in relation to recreational activity	2	3	FS, (DFW(s), FWS	50	5
4.3. Conduct investigations of snowshoe hare and red squirrel ecology	2	15	FS,DFW(s), FWS	60	5
4.4. Investigate potential competition with other carnivores	3	5	FS, FWS, DFW(s)	100	-
5-year total [b]				1,950	
Maintain information management system for lynx data	2	-	-	-	-
5.1. Act as lynx data clearinghouse for surveys	2	ongoing	DFW(d)	3	3
5-year total [b]				**15**	
Develop public information and education materials	2	-	-	-	
6.1. Create and distribute lynx brochure to help hunters and others identify lynx	2	1	DFW(w,e), DNR, FWS	10	4
6.2. Minimize incidental capture of lynx through trapper education programs, materials	2	ongoing	DFW(g,e)	1	1
6.3. Create and maintain URL (web page) with lynx information and planning documents	3	1	DFW(d)	3	3
5-year total [b]				**18**	

	Priority	Duration	Responsibility	Estimated Annual cost ($1000s)	DFW share
Coordinate and cooperate in recovery with landowners and public agencies	2	-	-	-	-
7.1. Develop management agreements for critical matrix lands	2	5	DFW(w,l)	10	10
7.2. Review and comment on land management plans, conservation plans, and adaptive management	2	3 & periodic	DFW(w,h)	3	3
7.3. Develop information exchange with British Columbia agencies	3	ongoing	DFW(i,w)	1	1
7.4. Revise Recovery Plan and Recovery Zone maps	3	1(every10 yr)	DFW(w)	10	10
7.5. Facilitate interagency meetings	3	ongoing	DFW, DNR, FS	1	-
5-year total [b]				**75**	
Enhance lynx populations by direct intervention	3	-	-	-	
8.1. Evaluate the need for and feasibility of translocation of lynx to recovery areas	3	1	FWS, DFW(s,w)	8	5
8.2. Conduct translocation of lynx if needed and feasible	3	4, if needed	FWS, DFW(s)	130	30
5-year total [b]				**528**	

[a] Anticipated DFW share of cost if funds are available.

[b] Estimated total cost for 5 year period, assuming all tasks initiated during period. Some tasks, such translocation (8.2) are not likely to be needed.

APPENDICES

Appendix A. Lynx specimens collected in Washington.

no.	Year	County	Location	Collector	Museum # [a]	Sex	Type
1	1896	Yakima	Mt.Adams, Trout Lake	Kaegi,D.N.	USNM76622	F	skin and skull
2	1896	Yakima	Mt.Adams, Trout Lake	Schmid,P.	USNM81950	M	skull only
3	1896	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM81910	M	skin and skull
4	1896	Yakima	Mt.Adams, Trout Lake	Kaegi, D. N.	USNM77095	F	skin and skull
5	1896	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM76647	F	skin and skull
6	1897	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM81970	F	skin and skull
7	1897	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM87155	M	skin and skull
8	1897	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM87161	F	skin and skull
9	1897	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM81969	M	skin and skull
10	1897	Yakima	Mt.Adams, Trout Lake	Schmid, P.	USNM81962	F	skull only
11	1916	Chelan	Meadow Cr., E side Lake Chelan	Williams, E.	USNM228542	M	skin and skull
12	1916	Okanogan	20 mi NW of Loomis	Williams, E.	USNM215002	F	skin and skull
13	1916	Chelan	Lake Chelan, Deer Pt.	Williams, E.	USNM224183	F	skin and skull
14	1916	Chelan	Lake Chelan, Deer Pt.	Williams, E.	USNM224417	M	skull only
15	1916	Okanogan	15 mi above Loomis	Williams, E.	USNM215001	M	skin and skull
16	1916	Okanogan	20 mi NW of Loomis	Williams, E.	USNM214947	-	skull only
17	1916	Ferry	10 mi E of Malo	Taylor, N. E.	USNM215408	M	skin and skull
18	1916	Okanogan	9 mi S of Loomis	Williams, E.	USNM228545	M	skin only
19	1917	Stevens	near Chewelah?	Bramley, W. H.	USNM228490	F	skull only
20	1917	Okanogan	Loomis	Vail, R. B.	USNM228066	M	skull only

no.	Year	County	Location	Collector	Museum # [a]	Sex	Type
21	1917	Okanogan	Loomis	Vail, R. B.	USNM228064	F	skull only
22	1917	Okanogan	Loomis	Vail, R. B.	USNM228065	M	skull only
23	1917	Okanogan	Loomis	Vail, R. B.	UMDB2293	M	skin
24	1918	Stevens/Ferry?	Iron Mt., Orient	Rose, G. T.	USNM230795	F	skin only
25	1918	Stevens	Papoon Lake, Orient	Rose, G. T.	USNM229281	F	skin ans skull
26	1918	Chelan	Lake Chelan, Round Mt.	Williams, E.	USNM229280	F	skin and skull
27	1918	Stevens	Papoon Lake, Orient	Rose, G. T.	USNM229282	M	skin and skull
28	1918	Stevens	Jumbo Mt., Orient	Rose, G. T.	USNM230794	M	skin only
29	1918	Chelan	Fish Creek, Lake Chelan	Willaims, E.	USNM229277	M	skin and skull
30	1918	Stevens	Fifteen Mile Crk., Orient	Rose, G. T.	USNM229283	F	skin and skull
31	1918	Stevens/Ferry?	Iron Mt., Orient	Rose, G. T.	USNM230694	M	skin and skull
32	1918	Stevens	Deep Creek., Orient	Rose, G. T.	USNM230791	F	skin and skull
33	1918	Stevens/Ferry?	Iron Mt., Orient	Rose, G. T.	USNM230693	F	skull only
34	1918	Stevens	Jumbo Mt., Orient	Rose, G. T.	USNM230793	F	skin and skull
35	1918	Stevens	Jumbo Mt., Orient	Rose, G. T.	USNM230792	F	skin and skull
36	1919	Okanogan	Tonasket	Haley, C. H.	USNM231974	F	skull only
37	1919	Chelan	Manson, [Lake Chelan]	Williams, E.	USNM232490	F	skin and skull
38	1919	Stevens/Ferry?	25 mi W of Springdale	Rose, G. T.	USNM232475	M	skin and skull
39	1920	Okanogan	Loomis, Basin	Vail, R. B.	USNM234859	F	skin and skull
40	1920	Okanogan	Loomis, Basin Country	Vail, R. B.	USNM234858	F	skin and skull
41	1920	Okanogan	Loomis	Vail, R. B.	USNM235144	F	skin and skull

no.	Year	County	Location	Collector	Museum # [a]	Sex	Type
42	1920	Okanogan	Loomis	Vail, R. B.	USNM235145	M	skin and skull
43	1928	Chelan	Lake Chelan	Steiner, F.	MVZB86914	?	skull
44	1929	Okanogan	Twisp, Drumheller Range	Munden, E.	USNM249111	F	skin and skull
45	1930	Ferry	near Republic	Wadman, J.	USNM249640	M	skin and skull
46	1931	Garfield	30 mi SW of Asotin, near Mt.Misery	Black, S.	USNM250186	M	skull only
47	1939	Okanogan	mountain near Oroville	Dalquest, W.W.	MVZB135007	M	skull
48	1939	Chelan	Chiwawa River, head of Marble Crk.	Scheffer, V. B.	USNM271814	M	skull only
49	1939	Chelan	Little Wenatchee R., elev.1900 ft.	Scheffer, V.B.	USNM271985	F	skull only
50	1940	Stevens	4 mi E of Park Rapids	Scheffer, V. B.	USNM275921	F	skull only
51	1951	Chelan	Chiwawa River	Kranz, J. R.	CRCM51-318	M	skeleton
52	1953	Chelan	Slide Ridge, Lake Chelan	Willis, J.& Zwickel, F.	CRCM53-280	F	skin and skull
53	1953	Ferry	16 mi E of Republic	Guenther, S. E.	CRCM53-218	M	skin and skeleton
54	1954	Okanogan	8 Mile Creek	Martinson, C.F.	CRCM54-305	M	skin and skull
55	1954	Okanogan	8 Mile Creek	Martinson, C.F.	CRCM54-304	M	skull
56	1955	Ferry	10 mi N of Sherman Pass	Mabbolt, M.H.	CRCM55-425	M	skin and skeleton
57	1957	Chelan	Chumstick Mountain	?	CRCM-TC-557	F	skin
58	1959	Okanogan	Little Bridge Creek	?	CRCM-TC556	?	skin and skull
59	1962	Whitman	4.5 mi S of Pullman	E. Hibbs	CRCM63-22	F	skin and skull
60	1963	Whitman	Busby, 2.5 mi S of Pullman	Mullalley ,T.M.	CRCM63-76	M	skin and skeleton
61	1965	Douglas	Badger Mountain	K. Bergenn to T. Anderson	CRCM66-98	?	skull

no.	Year	County	Location	Collector	Museum # [a]	Sex	Type
62	1977	?	eastern Washington	Poelker	SMNH28277	?	skull
63	1978	?	eastern Washington	WA Dept. Game	SMNH28276	?	skeleton
64	1978	Okanogan	Chewack, Long Swamp, T39N R23E	WA Dept. Game	SMNH28267	F	skull
65	1978	Okanogan	Granite Crk area, Perrygin	WA Dept. Game	SMNH28265	M	skull
66	1978	Okanogan	Monte Carlo Meadow, T38N R24E	WA Dept. Game	SMNH28264	F	skull
67	1978	Okanogan	Chewack, Long Swamp, T39N R23E	WA Dept. Game	SMNH28266	M	skull
68	1979	Okanogan	Mid Fork Toats Coulee, T39N R23E	WA Dept. Game	SMNH28270	M	skull
69	1979	Okanogan	Baldy pass, T36N R23E	WA Dept. Game	SMNH28268	M	skull
70	1979	Okanogan	Long Swamp, T39N R23E	WA Dept. Game	SMNH28269	M	skull
71	1981	Ferry	Boulder, Deadman Crk,(GMU#103)	Taylor, D.	SMNH28263	F	skull
72	1982	Okanogan	20 Mile Meadows	Brittell, J. D.	SMNH28427	M	skin and skeleton
73	1982	Okanogan	Corral Butte	WA Dept. Game	SMNH28275	F	skin and skeleton
74	1982	Okanogan	Rock Mt., Pasayton Wilderness	WA Dept. Game	SMNH28274	M	skeleton
75	1982	Okanogan	Billy Goat Corral, T38N R20E	WA Dept. Game	SMNH28273	F	skeleton
76	1982	Okanogan	Bridge Creek	WA Dept. Game	SMNH28272	M	skeleton
77	1982	Okanogan	Bridge Creek	WA Dept. Game	SMNH28271	M	skeleton
78	1982	Okanogan	North Fork Windy Crk., Horshoe Basin	Brittell, J.D.	UWBM52055	F	scalp and skeleton

[a] Museum abbreviations include: CRCM = Charles R. Conner Museum, Washington State University; MVZB = Museum of Vertebrate Biology, University California, Berkeley; SMNH = Slater Museum of Natural History, University of Puget Sound; UMBD = University of Massachusetts, Biology Dept.; USNM = U.S. National Museum of Natural History (Smithsonian Institution); UWBM = University of Washington, Burke Museum.

Appendix B. Total known Lynx harvest in Washington by County, 1961-1989[a].

County	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	total[b]
Asotin		1																												1
Chelan					10			1							1										1					13
Cowlitz				1		1																								2
Douglas					1						14					1														16
Ferry			1			3	7		2	26		3	1	3		14	17			1			1		1	1				81
Garfield				1											4															5
Klickitat								1																						1
Lewis				1																										1
Lincoln			1																											1
Mason				1																										1
Okanogan			1	1			1	2	1	4		2	4			4	6		14	4	2	2	1		2			1		52
Pend Oreille												1			6		5			4		2								18
Snohomish					1																									1
Spokane			2	2				1		1										1										7
Stevens													4		9		8		1	1		1								24
Whitman		1	1																											2
Yakima												3					2													5
unknown																								1						1
year total[b]	0	2	6	7	12	4	8	5	3	31	14	9	9	3	20	19	38	0	15	11	2	5	2	1	4	1	0	1	0	232

[a] Years listed are the spring portion of a trapping season (i.e., 1960-61 season is listed as '61).

[b] Harvest totals for 1990 and 1991 were both 0. The County list and harvest numbers differ from WDFW 1993 due to:

1) the addition of museum specimen records for Whitman County 1962 (1), 1963 (1), and Douglas County 1965 (1);
2) known illegal kills for 1970-1990 (Okanogan County: 1976 [1], 1977 [1], 1979 [5], 1985 [1],1988 [1]; Pend Oreille 1980 [1],1982 [2]; Stevens 1979 [1], 1982 [1]; Ferry 1986 [1];
3) the deletion of obvious references to "lynx cats," a term trappers once used for bobcats (1 each in Lewis County 1970-71, Grant County1973-74, Pierce County 1975-76, Franklin County 1976-77, Lincoln County 1976-77, Klickitat County 1980-81; trapping records prior to 1970 may still contain "lynx cats".

Appendix C. Washington Administrative Code 232-12-297. Section 11 addresses Recovery Plans.

WAC 232-12-297 Endangered, threatened, and sensitive wildlife species classification.

PURPOSE

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

DEFINITIONS

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the forseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long term survival of the population in Washington.

LISTING CRITERIA

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

DELISTING CRITERIA

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

INITIATION OF LISTING PROCESS

5.1 Any one of the following events may initiate the listing process.

5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.

5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.

5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

INITIATION OF DELISTING PROCESS

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

SPECIES STATUS REVIEW AND AGENCY RECOMMENDATIONS

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends.

7.1.2 Natural history, including ecological relationships (e.g., food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g., survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

PUBLIC REVIEW

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

8.1.2 The agency will hold at least one Eastern Washington and one Western Washington public meeting during the public review period.

FINAL RECOMMENDATIONS AND COMMISSION ACTION

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

PERIODIC SPECIES STATUS REVIEW

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a

species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

RECOVERY AND MANAGEMENT OF LISTED SPECIES

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives.

11.1.2 Criteria for reclassification.

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs.

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within five years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

CLASSIFICATION PROCEDURES REVIEW

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

AUTHORITY

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC 232-12-014, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC 232-12-011, as amended. [Statutory Authority: RCW 77.12.020. 90-11-066 (Order 442), § 232-12-297, filed 5/15/90, effective 6/15/90.]

Appendix D: Lynx Analysis Units by LMZ in Washington

Lynx Analysis Units (LAU) are used to report survey data and to analyze the condition of habitat. LAUs are shaded on the maps on the following pages to indicate whether lynx have been detected recently (since 1 July 1995), prior to that, or not at all. The LAU names and the year of the most recent lynx detection are listed below. Analysis Units are coded with a unique 3-digit number. The first digit indicates the National Forest that administers most of the lands in the vicinity of that LAU, as follows:

100 = Idaho Panhandle National Forest
200 = Colville National Forest
300 = Okanogan National Forest
400 = Wenatchee National Forest

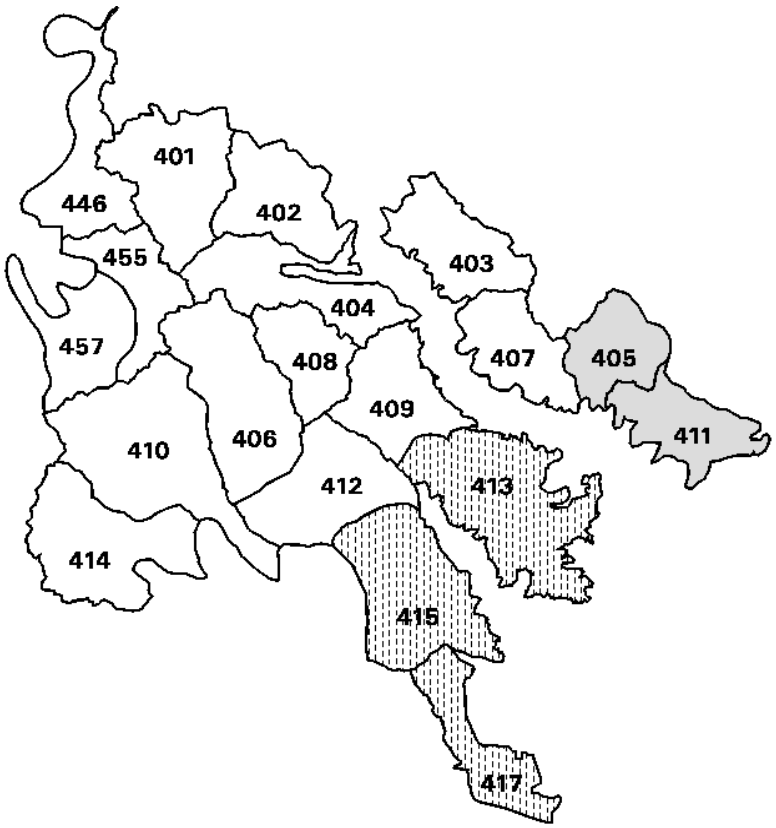
Number	Name	Year of Most Recent Lynx Detection
101	UPPER PRIEST (entirely in Idaho)	-
102	HUGHES	1992
103	HEMLOCK	1997
104	WILLOW	1991
105	BLACKTAIL (entirely in Idaho)	-
106	SEMA	1992
107	KALISPELL	-
108	LAMB BATH	-
109	UPPER W BRANCH	-
110	PELKE	-
111	LOWER W BRANCH	1992
201	SALMO	1992
202	SLATE	1978
203	GYPSY	1990
204	TOTEM	-
205	HALL	1996

Number	Name	Year of Most Recent Lynx Detection
206	HARVEY	1998
207	PAUPAC	1998
209	GROUSE	-
210	BEAD	1978
211	RUSSIAN	1999
212	ABERCROMBIE	1983
213	CEDAR	-
214	HUCKLEBERRY	-
215	MILL	1983
216	LAKES	1996
217	RUBY	-
218	CALISPEL	1996
219	TACOMA	-
220	CHEWELAH	-
221	SHEEP	1980
222	PIERRE	1987
223	SOUTH WEDGE	-
224	NORTH KETTLE	1990
225	LONG ALEC	2000
226	EAST DEER	-
227	NORTH BOULDER	1990
228	LAMBERT NORTH	1989
229	INDIAN	1997
230	U.S.	1997
231	LAMBERT	1993
232	DEADMAN	1997
233	NORTH SHERMAN	2000
234	WEST SHERMAN	1994

Number	Name	Year of Most Recent Lynx Detection
235	SOUTH SHERMAN	1991
236	WHITE	1991
237	HALL CREEK	-
238	LYNX MOUNTAIN	-
239	VULCAN	1988
240	BODIE	-
241	SWAN	-
302	NF TOATS COULEE	1997
303	APEX MOUNTAIN	1987
304	HOZOMEEN	-
306	BALD MOUNTAIN	1977
307	FROSTY LAKE	-
308	LEASE CREEK	1952
309	BUNKER HILL	2000
310	HORSESHOE CREEK	1997
311	SF TOATS COULEE	1997
312	THREE FOOLS CREEK	2000
313	ANDREWS CREEK	1987
314	THIRTYMILE PEAK	1998
315	MANY TRAITS CREEK	-
316	NANNY GOAT MOUNTAIN	2000
317	BUCKSKIN RIDGE	-
318	HALFMOON LAKE	1987
320	SLATE CREEK	2000
321	NOHOKOMEEN GLACIER	-
322	RABBIT RIDGE	1997
323	CECILE CREEK	1996
324	EUREKA LAKE	-

Number	Name	Year of Most Recent Lynx Detection
325	MONUMENT CREEK	1998
326	FAREWELL PEAK	1995
327	BIG CRAGGY PEAK	2000
328	YARROW CREEK	1998
330	WHITEFACE CREEK	2000
331	HANCOCK RIDGE	1998
332	NORTH FORK BOULDER CREEK	1995
333	GRANITE CREEK	-
334	NORTH FORK SALMON CREEK	1995
335	THUNDER CREEK	-
336	MIDDLE FORK BOULDER CREEK	1997
338	MAZAMA	1999
339	WEST FORK SALMON CREEK	1992
340	SANDY BUTTE	2000
341	BLUE BUCK RIDGE	1992
342	FRISCO MOUNTAIN	-
343	MILTON MOUNTAIN	2000
344	GLORY MOUNTAIN	-
345	CRESCENT MOUNTAIN	1979
346	SOUTH FORK BEAVER CREEK	2000
347	TWISP	2000
348	PURPLE MOUNTAIN	-
350	SNOWSHOE RIDGE	2000
352	SPIRIT MOUNTAIN	2000
354	METHOW GOLD CREEK	2000
401	AGNES	-
402	FOURTH OF JULY BASIN	-
403	INDIANHEAD BASIN	-

Number	Name	Year of Most Recent Lynx Detection
404	COPPER PEAK	-
405	HUNGRY RIDGE	2000
406	CHIWAWA	-
407	FERRY BASIN	-
408	UPPER ENTIAT	-
409	PYRAMID	-
410	WHITE RIVER	-
411	COOPER MOUNTAIN	2000
412	GARLAND	-
413	LAKE BASIN	1991
414	LITTLE WENATCHEE	-
415	COUGAR	1989
417	CHUMSTICK MOUNTAIN	1973
446	CASCADE PASS	-
455	IMAGE LAKE	-
457	CHOCOLATE GLACIER	-

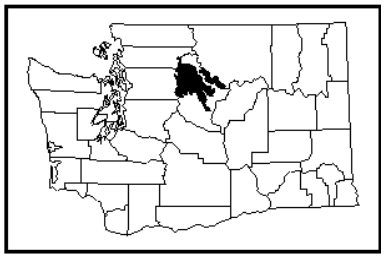


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

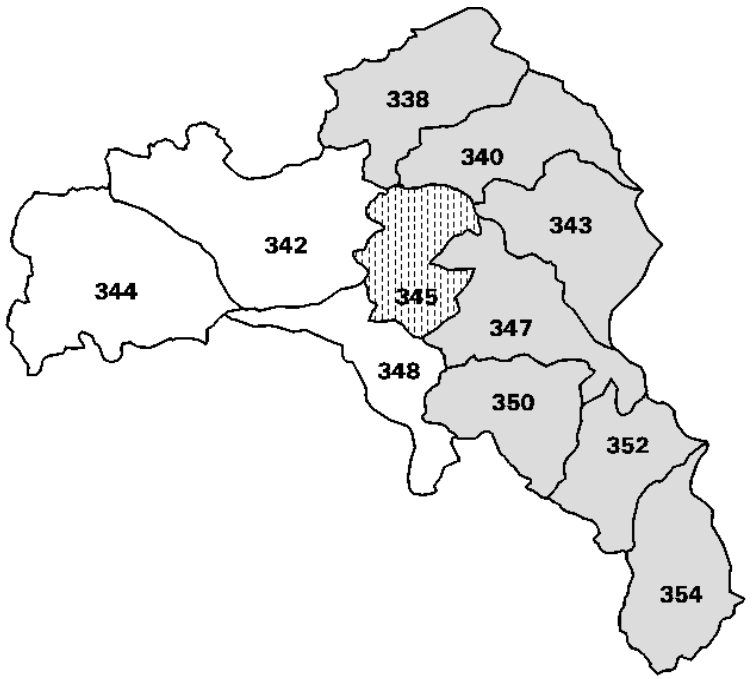
No documented occurrences



0 1 2 3 4 5 6 7 8 9 10

MILES

SOUTHWEST Okanogan Lynx Management Zone - Lynx Analysis Units

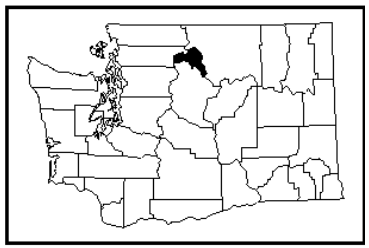


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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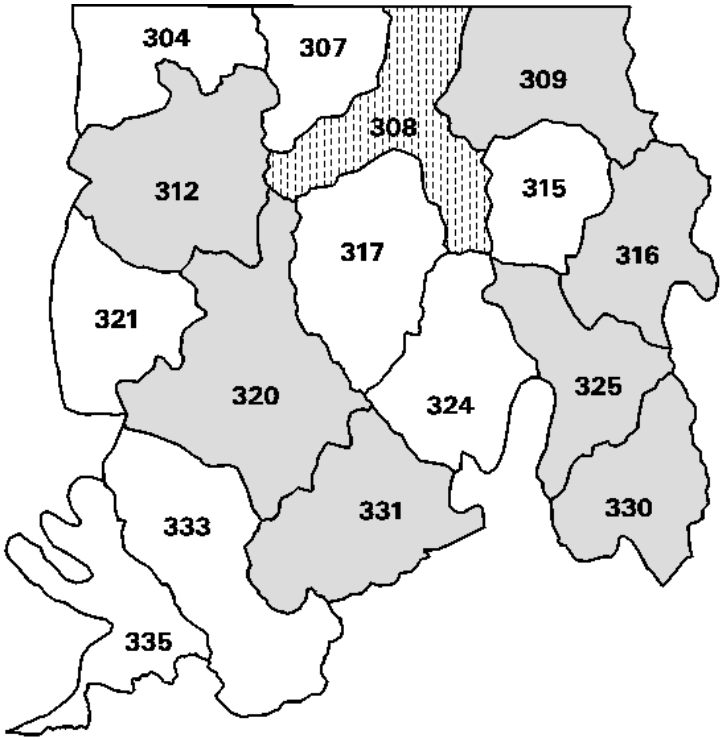
CENTRAL Okanogan Lynx Management Zone - Lynx Analysis Units

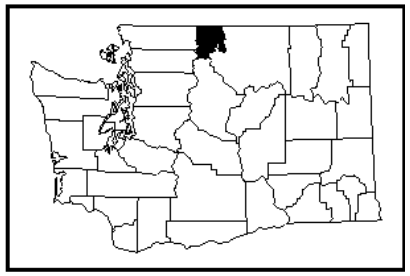


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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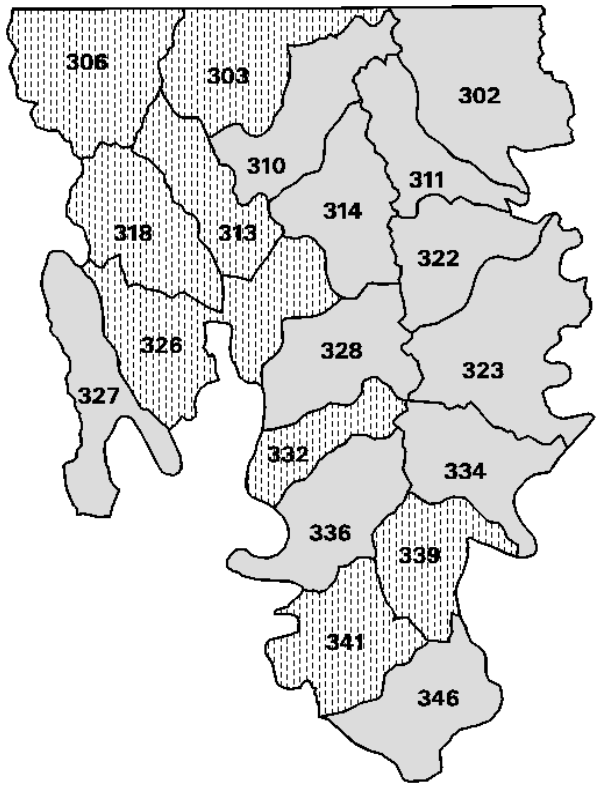
NORTHWEST Okanogan Lynx Management Zone - Lynx Analysis Units



Documented Lynx Occurrences per LAU

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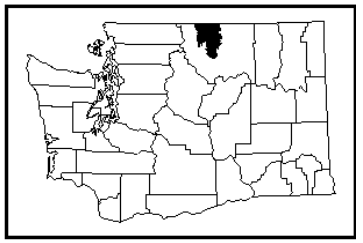
Documented in past, not recently

No documented occurrences



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MILES

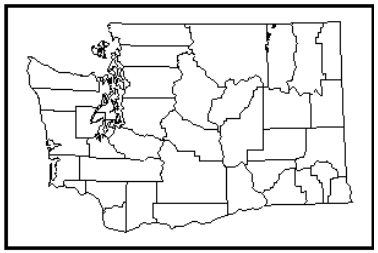
NORTHEAST Okanogan Lynx Management Zone - Lynx Analysis Units

Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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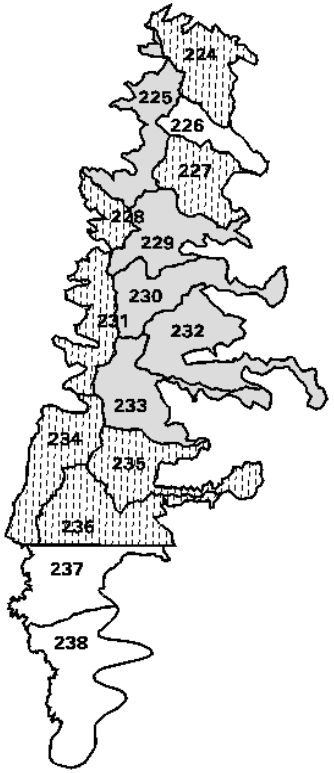
MILES

VULCAN-SWAN Lynx Management Zone - Lynx Analysis Units

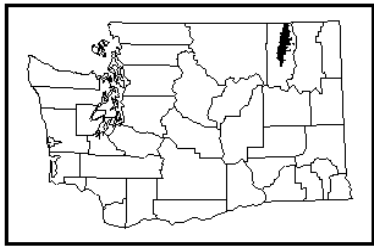


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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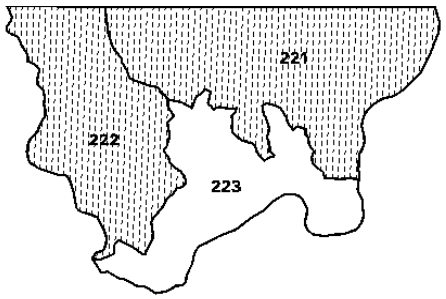
MILES

KETTLE RANGE Lynx Management Zone - Lynx Analysis Units

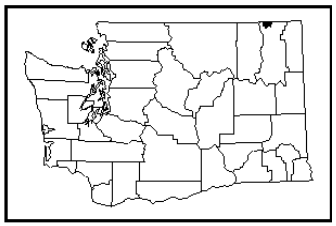


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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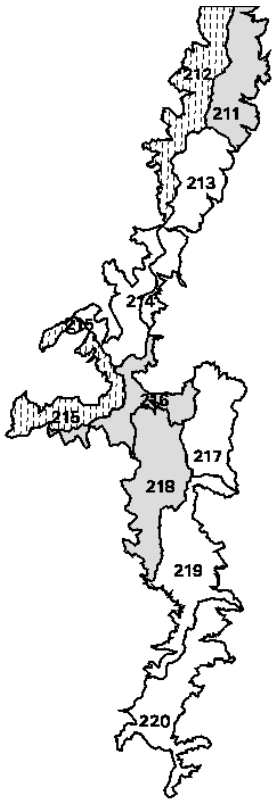
MILES

THE WEDGE Lynx Management Zone - Lynx Analysis Units

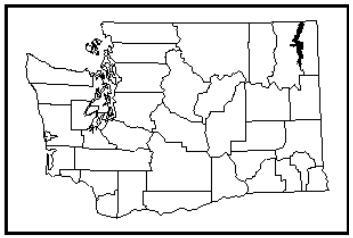


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



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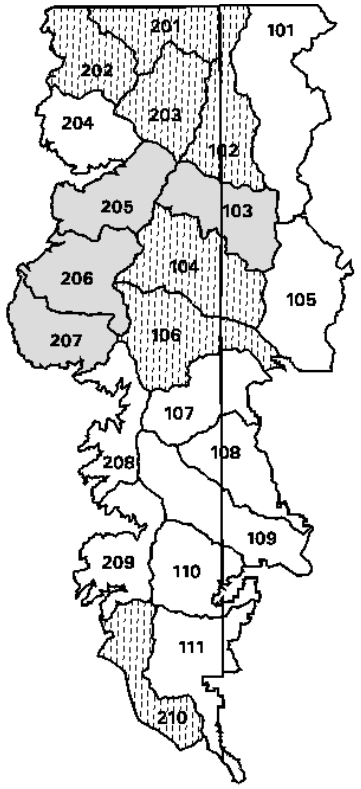
MILES

LITTLE PEND OREILLE Lynx Management Zone - Lynx Analysis Units

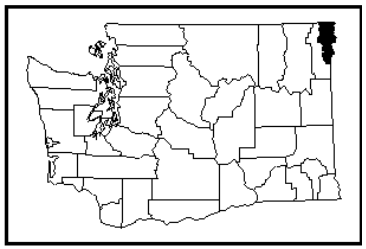


Documented Lynx Occurrences per LAU

Documented recently

Documented in past, not recently

No documented occurrences



0 1 2 3 4 5 6 7 8 9 10

MILES

SALMO-PRIEST Lynx Management Zone - Lynx Analysis Units