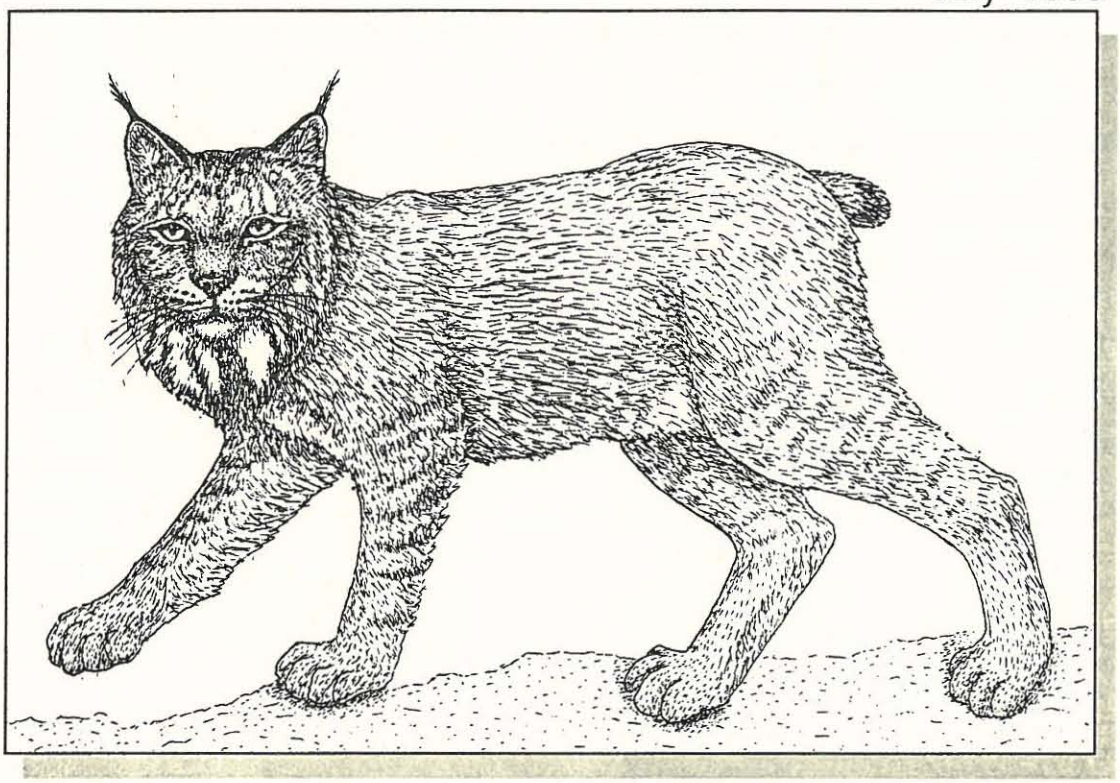
DEPARTMENT OF WILDLIFE

Washington

July 1993



STATUS OF THE NORTH AMERICAN LYNX *(Lynx canadensis)* IN WASHINGTON

Washington
Department of Wildlife
Wildlife Management Division

The Washington Department of Wildlife maintains a list of endangered, threatened and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011, Appendix E). Species are evaluated for listing using a set of procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297, Appendix E). The procedures were adopted by the Washington Wildlife Commission in 1990. They specify how species listing will be initiated, criteria for listing and delisting, public review, and recovery and management of listed species.

The first step in the process is to develop a preliminary species status report. The report includes a review of information relevant to the species' status in Washington including, but not limited to: historic, current, and future species population trends, natural history including ecological relationships, historic and current habitat trends, population demographics and their relationship to long term sustainability, and historic and current species management activities.

The procedures then provide for a 90-day public review opportunity for interested parties to submit new scientific data relevant to the status report and classification recommendation. During the 90-day review period, the Department holds one public meeting in each of its administrative regions. At the close of the review of the draft report, the Department completes a final status report and listing recommendation for presentation to the Washington Wildlife Commission. The final report, listing recommendation, and any State Environmental Policy Act findings are then released for public review 30 days prior to the Commission presentation.

This report is the Department of Wildlife's final Status Report and listing recommendation for the North American lynx. The listing proposal will be presented to the Washington Wildlife Commission on August 14, 1993 at the Colville Community Center, Colville, Washington. Comments on the report and recommendation may be sent to: Endangered Species Program Manager, Washington Department of Wildlife, 600 Capitol Way N, Olympia, WA 98501-1091; or presented to the Wildlife Commission at its August 14 meeting.

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Status of the

North American Lynx
(*Lynx canadensis*)

in Washington

July 1993

Washington Department of Wildlife
600 Capitol Way N
Olympia, WA 98501-1091

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EXECUTIVE SUMMARY

Washington is one of 15 states constituting the southern edge of lynx (*Lynx canadensis*) range in North America. Consequently, the historic lynx population has been restricted and relatively small. Lynx are adapted to harsh climates with cold temperatures and deep snows. In Washington this allows them to live in habitat that is not occupied during portions of the year when other carnivores might compete with them for food or space.

Lynx live in boreal forests which occur as small fingers along mountain ridges that extend into Washington from Canada and Idaho. The largest contiguous block of this type of habitat occurs in north-central Washington along the east slope of the Cascade Mountain range. Further south, these habitats become smaller and disjunct making them unsuitable to support resident populations of lynx.

Washington's lynx population is estimated to range from <96 to 191 individuals. Lynx undergo population cycles related to the abundance of snowshoe hares, their principle prey. These cycles occur throughout their range and are typically one to two years behind snowshoe hare population cycles. Cycles may not be as noticeable in the southern extremes of lynx range.

Lynx tend to make relatively long movements in search of new territories during a decline in prey abundance or a peak in the population cycle. This replenishes more moderate or vacant habitats and results in incidental lynx sightings in areas that cannot support resident lynx. This phenomenon has occurred throughout the northern-tiered states including Washington. In the early 1960's, lynx were documented in Whitman and Douglas counties. These are predominantly agricultural areas with almost no lynx habitat characteristics. Incidental sightings continue to occur in the southern Cascades, with sightings as recent as 1991.

While lynx continue to occupy their traditional habitats in Washington, concern for their future has intensified largely due to significant recent and planned habitat alterations and past trapping pressure. Lynx are difficult to census and historic population numbers are limited. However, based on trapper interviews and track sightings by field biologists, lynx densities in northeast Washington appear to have been depressed during at least the past 20 years, with no indication of population increases typical of lynx during favorable years. The most likely causes are extensive timber harvest and high trapping levels in Washington during the mid-1970's and in British Columbia. Planned timber harvest and associated road construction in formerly primitive areas of the north-central Cascades and in northeastern Washington have elevated concern for lynx populations residing there. Furthermore, there is concern regarding a potential reduction in the number of lynx immigrating from British Columbia. This reduction may further increase the vulnerability of this population.

Due to the compounded effects of forest maturation, past habitat alteration, planned habitat alteration, reduced lynx population in British Columbia to provide immigration of lynx from

core populations, and the lack of management plans or monitoring programs to ensure long-term maintenance of lynx habitat, the WDW has determined that the lynx population in Washington is vulnerable. The key consideration for reducing future risks is the level of commitment from the U. S. Forest Service and the WDNR (administrators of 91% of lynx range) to adequately protect habitat for lynx.

It is recommended that the lynx be designated a threatened species in Washington.

TAXONOMY

The North American and European lynx share an evolutionary lineage of the order Carnivora, family Felidae (Lions 1965), subfamily Felinae, genus *Lynx*. Kerr (1792) apparently described the species. The North American lynx was listed in True's 1885 classification list as *Lynx borealis canadensis* (Gray) *Mivart*. This designation separated the North American lynx from the spotted lynx [*Lynx maculatus* (Vigors and Horsfield)] and the red lynx [*Lynx rufus* (Guldenstadt) *Rafinesque*]. Prior to the mid 1970's, lynx and bobcat were classified in the genus *Lynx* based on a tail less than half the length of the body and dental differentiation. The remainder of the cat family was classified in the genus *Felis*. In 1977, Van Gelder argued that the ability to hybridize *Felis* and *Lynx* negated the generic separation of the cat family; subsequently all cats were generically classified as *Felis*. Jones et al. (1975) and Corbet (1978) concurred upon the classification of *Felis rufus* for the bobcat and *Felis lynx* for the lynx. However, Jones et al. (1992) recognize *Lynx canadensis* as currently accepted nomenclature. Walker (1968) indicated that the scientific community in general recognizes four distince species, *L. canadensis, L. rufus, L. lynx,* and *L. caracal*.

The North American lynx has several common names including Canada lynx, lynx, gray wildcat, gray lynx, link, lucivee, loup-cervier (French Canadian), pichu (French Canadian), lynx boreal (French), and luchs (German) (Butts 1992).

DESCRIPTION

The most distinguishing attributes of the lynx are its long legs, large furry paws, long cheek hairs (facial ruff), blunt tail with a black tip, and tufted ears. The specialized paws are thermoregulatory and represent structural adaptations to its snowy environment (McCord and Cardoza 1982), enabling a 30% increase in surface area when the foot is spread (the "snowshoe" effect) (Brittell et al. 1989). The ears are pointed and project black hairs (ear tufts) extending 5 cm (2 in) or longer. The elongated back legs are special adaptations for springing action (Mandal and Talukder 1975). Slight color and size variations have been reported among lynx, the most notable between North American, European, and Asian populations.

These medium-sized felines are larger than bobcats yet smaller than cougars (*Felis concolor*). Males and females are similar in appearance but males are slightly longer and heavier than females (Tables 1 and 2). Geographic variations also occur. Both the length and the weight of lynx in Washington are comparable to those reported for lynx elsewhere.

Table 1. Average lengths (cm) of North American lynx.

Location	Male Length[a] (N)	Female Length (N)	Source
Alaska	103 (4)	98 (7)	Berrie (1969)
Alaska	87 (23)	82 (186)	Nava (1970)
Alberta	92 (12)	86 (11)	van Zyll de Jong (1963)
Minnesota	no data	84 (1)	Mech (1977, 1980)
Newfoundland	89 (96)	84 (89)	Saunders (1964)
Ontario	85.28 (120)	81.27 (118)	Quinn and Gardner (1984)
Washington	94.1 (10)	90.7 (8)	Brittell et al.(1989)
Washington	99.1 (5)	92.75 (2)	Koehler (1987)
Washington	no data	90 (1)	Dalquest (1948)
Wisconsin	83 (1)	no data	Doll et al. (1957)
Wisconsin	no data	98 (1)	Schorgen (1947)
Wyoming	97 (1)	no data	Halloran and Blanchard (1959)
Yukon	adult 103 ± 6 (37)	101 ± 4 (27)	Slough and Mowat (unpubl. data)
	yearling 105 ± 5 (6)	97 ± 7 (8)	
	kitten 91 ± 4 (38)	88 ± 3 (23)	

Table 2. Average weights (kg) of North American lynx.

Location	Male Weight (N)	Female Weight (N)	Source
Alaska	9.9 (9)	8.8 (6)	Nava (1970)
Alaska	10.6 (6)	8.6 (8)	Stephenson (1986)
Alaska	12.5 (6)	10.1 (14)	Berrie (1969)
British Columbia	8.2 (3)	8.2 (4)	Cowan and Guiguet (1965)
Manitoba	15.0 (1)	12.3 (2)	Carbyn and Patriquin (1983)
Michigan	11.8 (1)	no data	Erickson (1955)
Minnesota	10.6 (12)	no data	Mech (1977, 1980)
Newfoundland	10.7 (93)	8.6 (91)	Saunders (1964)
North-central British Columbia	10.8 (3)	8.8 (3)	Hatler (unpubl. data)
Nova Scotia	9.9	8.8	Parker et al. (1983)
Oregon	no data	14.5 (1)	Coggins (1969)
Washington	9.1 (12)	7.7 (11)	Brittell et al. (1989)
Washington	11.32 (5)	8.15 (2)	Koehler (1987)
Wisconsin	no data	8.6 (1)	Doll et al. (1957)
Yukon	adult 12 (51)	11 (33)	Slough and Mowat (unpubl. data)
	yearling 12 (8)	9 (9)	
	kitten 7 (42)	6 (24)	

Male and female lynx have similar coloration with a single annual molt beginning in late spring (Jackson 1961). The winter pelt is fully developed by January. Winter pelts are characterized by tricolored guard hairs (white at the base, dark in the middle, and silvery gray to grizzled brown at the tip) which cover the majority of the body. The underparts and inner legs are light buff to grayish white, often having black bars or spots. The head, throat, and ears are a mixture of grayish white, black, and brown and the margins and tufts of the ears are black. Historically, North American lynx were often confused with lynx cats, a name given to light-colored bobcats. Today this reference to bobcats is seldom used outside of the fur industry.

A vertical black line on each side of the head extends from the outer eyes to the chin area, intermixing with the facial ruff. The tail is used to distinguish the lynx from the bobcat. Lynx exhibit a shorter, brownish tail completely tipped with black (Appendix A). The bobcat's is brownish on top and white underneath with several black bands encircling it.

By late spring the silvery winter pelt is slowly replaced by the summer coat. The summer pelage displays a mixture of light browns and tans along the back, head, and legs. The pelt is generally thinner and more ragged in summer. Immature lynx are yellowish to buff and spotted or streaked with brown or black (McCord and Cardoza 1982). Both sexes reach mature body length, weight, and coloration the second year of age (Parker et al. 1983).

Lynx are excellent swimmers and tree climbers (Murrill 1927, Deems and Pursley 1983), however they have poor endurance and tire easily after a chase (Seton 1929; Jackson 1961 and Ognev 1962 *in* McCord and Cardoza 1982). Sight and hearing are well developed in the lynx, yet their sense of smell is not (Lindemann 1955, Saunders 1963).

Individual lynx are often characterized as resident or transient animals. A resident lynx is one which has established a defined home range and for the most part is nonmigratory. These animals reproduce and bear young in the area for which they are a resident. Transient lynx reside in an area temporarily, searching for unoccupied habitat in which to establish a home range. Actual lynx range contains habitat components which are fundamental to the long term survival of lynx in Washington. Habitat found outside lynx range (in which transient individuals reside) is patchily distributed, of marginal quality, found at lower elevations when compared to habitat contained within lynx range, and is incapable of supporting lynx for long durations. Transient females seldom reproduce or successfully raise kittens; however transient males may be sexually active while in the area (B. Slough, pers. comm.).

GEOGRAPHICAL DISTRIBUTION

North America

Lynx historically ranged across the boreal regions of North America (the Canadian and Hudsonian Life Zones) and Eurasia. The lack of cartographical precision in the past has precluded the development of accurate historical maps of lynx range. However, Nelson (1916) described lynx distribution as ranging from the Rocky Mountains south to Colorado and the Sierra Nevadas to Mount Whitney. Currently, lynx inhabit the coniferous forests and wet bogs from Newfoundland and Labrador on the east to Alaska and British Columbia on the west and from the arctic treeline south to the United States (Figure 1). Within the United States, lynx reside in northern New England, parts of the Lake States, the Pacific Northwest, and the Rocky Mountains south to Utah (Rust 1946, Durrant 1952, Ingles 1965, Hoffman et al. 1969, Nellis 1971, Godin 1977). Lynx occurrence has changed substantially outside of the current distribution with peripheral records likely reflecting transient individuals rather than resident populations (McCord and Cardoza 1982). The northern states in which lynx currently reside represent the southern periphery of lynx range in North America.

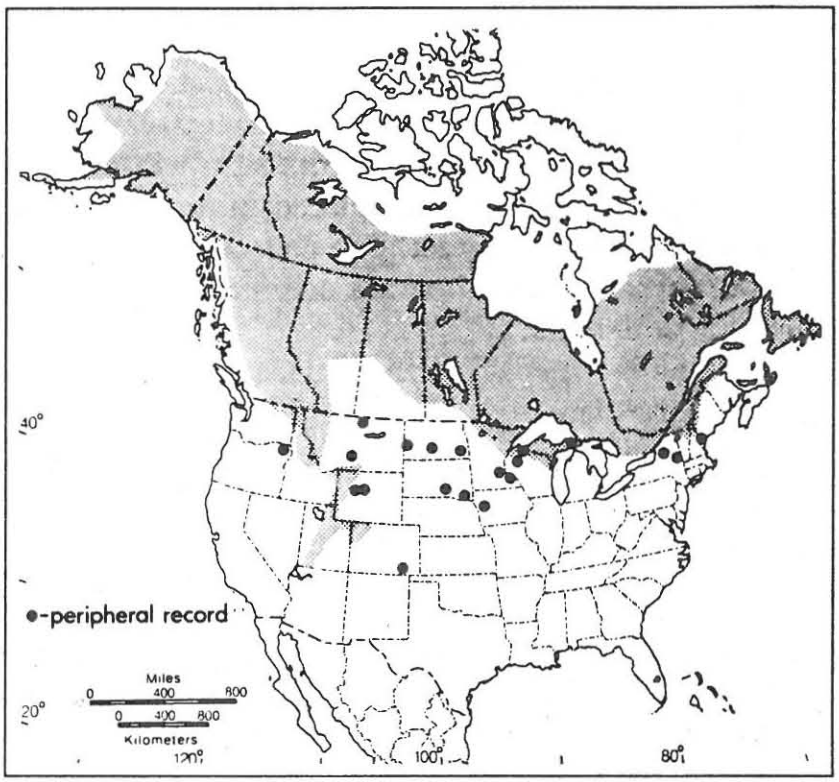

Figure 1. Distribution of the North American lynx (McCord and Cardoza 1982).

Lynx have traditionally been scarce in Oregon, occurring in various high elevation localities east of the Cascade Mountains (Bailey 1936). The species has been considered extirpated for many years although three lynx sightings were reported by United States Forest Service (USFS) personnel in the northern Wallowa Mountain range in 1991 (B. Posey, pers. comm.). Sightings exist in eight widely distributed counties throughout the state (Zielinski 1992).

Lynx were apparently well distributed in 8 of 10 counties in northern Idaho in the 1940's with an estimated population of 600-630 individuals (Rust 1946). Currently, lynx are found in five counties of northern Idaho (Zielinski 1992). Many of these animals are believed to be transients although a few resident individuals also exist (G. Will, pers. comm.).

Lynx were extremely scarce in the first half of the century in Montana, with specimen records restricted to two western counties (Hoffman et al. 1969). In 1950, lynx began to increase and peaked in 1963-64. By 1979, the lynx population was estimated between 1,800 and 2,500 animals (H. Hash, letter dated 29 Jan. 1979 to C. Head). Lynx have declined in numbers since that time and are presently scattered throughout western Montana (Zielinski 1992). Recent track surveys indicate that lynx distribution is stable, however accurate trend information is lacking (G. Erickson, pers. comm.).

Wyoming lynx populations are found mainly in the northwestern portion of the state (H. Harju, pers. comm.), particularly in the Absoraka, Wind River, and Wyoming mountain ranges (D. Crowe, letter dated 22 Feb. 1985 to M. Stout). Having always occurred in low densities with few lynx ever trapped, the range of the lynx is currently northwestern Wyoming with scattered locations in six other counties (Zielinski 1992). The current statewide population estimate is less than 100 individuals and possibly less than 20 (H. Harju, pers. comm.).

Utah lynx populations historically ranged from the Uinta Mountains in the north, through central Utah, and south to Iron County (Durrant 1952). The lynx was a resident of the state but never abundant and never heavily trapped. Currently, lynx exist only in the high elevation Uinta Mountains; however, this remnant population is not considered stable (reproducing) (B. Blackwell, pers. comm.).

It is doubtful whether lynx were ever numerous in Colorado, with few sightings verified in eight counties from the late 1800's to 1972 (Scott 1977, Miller 1980). Positive and possible tracks have been reported since 1989 (J. Sheppard, pers. comm.). In Colorado, the current range extends through the Rocky Mountains (Zielinski 1992).

Lynx are the only cats native to Alaska, occurring throughout the state except on the Aleutian Islands, the Kodiak Archipelago, the islands of the Bering Sea, and certain islands of the Prince William Sound and southeastern Alaska (Alas. Dept. Fish and Game 1977). The population is currently stable in Alaska, experiencing neither major increases nor declines (S. Peterson, pers. comm.). However, cyclic peaks in Alaska vary and the 1991 peak was lower than peaks observed in the 1970's (H. Golden, pers. comm.). This decline may be a response to habitat maturation, trapper effort, or both (H. Golden, pers. comm.).

In other states, lynx are scarce or have become extirpated. Historically, few lynx existed in North Dakota (S. Allen, pers. comm.) and South Dakota (L. Frederickson, pers. comm.) and currently densities are extremely low to nonexistent. The last reported sighting of lynx in South Dakota was in 1950 (L. Frederickson, pers. comm.). Historical records also reflect

low populations in Michigan, Wisconsin, Maine, and Vermont; these states currently retain remnant populations (Deems and Pursley 1983, Orff 1985). Lynx have become extirpated in Nebraska, New York, and Massachusetts (Deems and Pursley 1983). Few peripheral sightings of lynx occurred in Iowa, the last of which was in 1963 (Rasmussen 1969). Lynx may have been widely distributed in the forest of New Hampshire historically; however, current evidence of lynx activity is scarce (Orff 1985). A low peripheral population of resident lynx also occurs in northern Minnesota. Lynx were never abundant in New York and were extirpated from the state circa 1900 (Seagears 1952, Bergstrom 1979). Only scattered sightings have occurred since that time. A lynx reintroduction project was begun in 1988 in New York's Adirondack Park. The project is ongoing with additional lynx released during the winter of 1990-91.

Historically, North American lynx occupied all forested areas of Canada with the exception of southern Ontario, coastal British Columbia, and Prince Edward Island (van Zyll de Jong 1971, Orff 1985). Since the 1900's, lynx have been rare in New Brunswick and the mainland of Nova Scotia (although common on Cape Breton Island) (Orff 1985). Currently, lynx are found in Newfoundland, Labrador, Quebec, British Columbia, the Yukon Territory, Saskatchewan, Ontario, Nova Scotia (Cape Breton Island), the Northwest Territories, Manitoba, and Alberta (Deems and Pursley 1983).

Washington

Dalquest (1948) depicted lynx range extending from Oroville in the north to Mount Adams in the south and included both resident lynx and individuals migrating in response to low prey availability and high recruitment. No significant change in the distribution of North American lynx has occurred in Washington since 1920. This assumption is based on an evaluation of habitat suitability, historical accounts prior to 1950, 6 years of research performed by Brittell et al. (1989) and Koehler (1990) in Washington's Okanogan highlands, sighting and track information, and WDW trapping records. Habitat existing outside of lynx range which may support transients will be considered in future management efforts, specifically in regards to habitat evaluation and population monitoring. Currently, lynx range consists of six zones in Washington (Figure 2 and 3)

Okanogan	The Okanogan zone is the largest contiguous area for lynx in Washington. On the northern boundary, this zone extends along the Canadian border north of Hurley Peak to the eastern edge of the Ross Lake National Recreation Area. The Okanogan zone continues south to the Entiat-Chelan Mountain ranges and Cooper Mountain.
Vulcan Mountain	Vulcan Mountain encompasses the entire Vulcan Mountain area.
Kettle Range	The Kettle Range begins at Boundary Mountain and ends just west of the Twin Lakes area. The easternmost border is Bisbee Mountain and the westernmost border is South Seventeen Mile Mountain.
The Wedge	The Wedge is situated between the Kettle and Columbia rivers from the Canadian border south to Mineral Mountain.
Little Pend Oreille	The Little Pend Oreille zone begins at the Canadian border north of Frisco Mountain and continues south to Chewelah Mountain, west to Blacktail Butte, and east to Hooknose Mountain.
Salmo Priest	This zone begins at the Canadian and Idaho borders in the north and extends to Cooks Mountain in the south. The western boundary is Molybdenite Mountain.

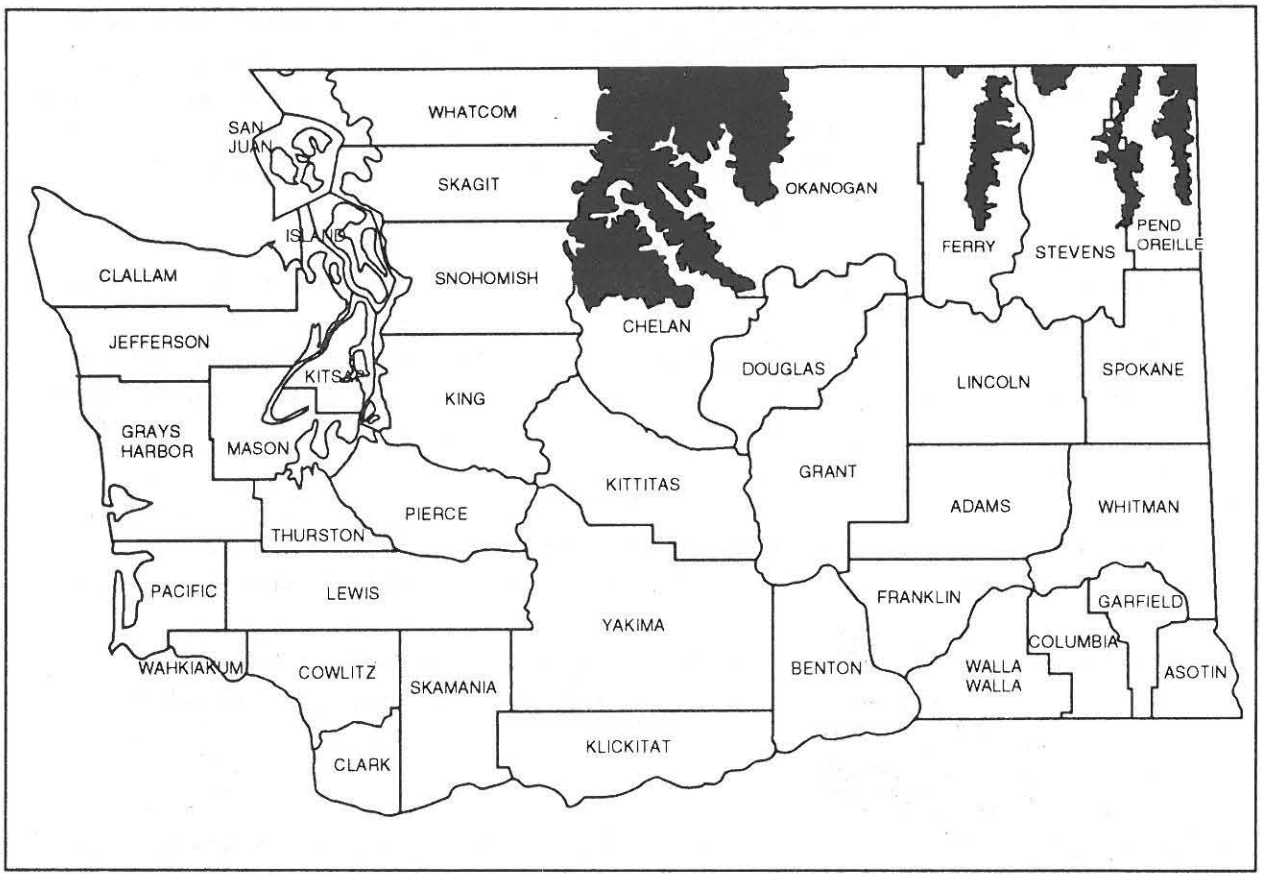

Figure 2. Current range of North American lynx in Washington based on biological evaluation, habitat evaluation, and sighting and track records.

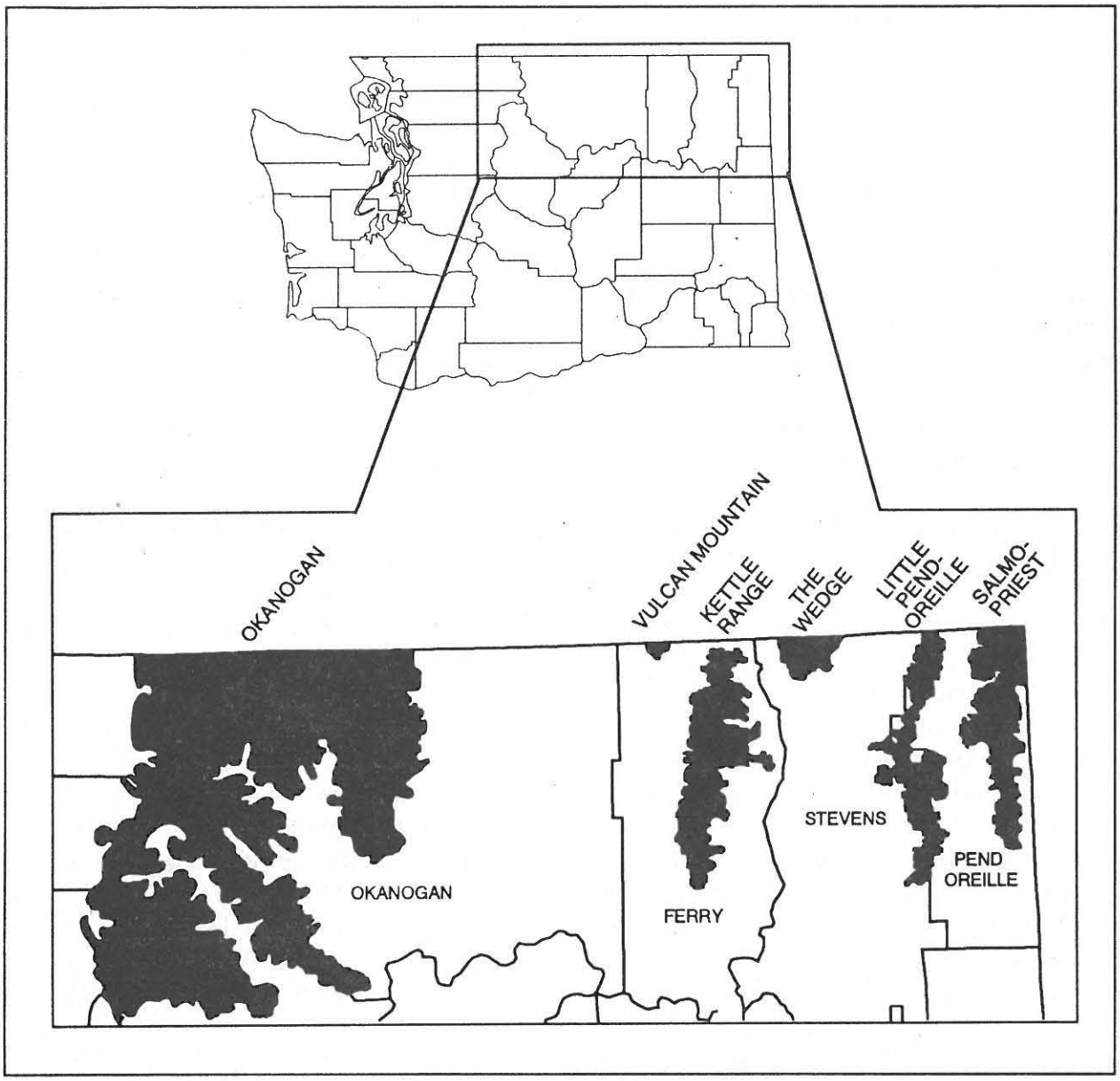

Figure 3. Current range of North American lynx in Washington by zone.

NATURAL HISTORY

Territoriality

Territoriality is the occupation and defense of an area of land and is the system used by lynx to secure a mate and/or habitat. Linemann (1955) described a solitary, home-based territorial system among European lynx through direct observation of captive animals. Lynx are known to defend their territory through social intolerance (Brand et al. 1976), similar to the cougar (Hornocker 1969) and other cat species. Typically, territorial behavior appears strongest in males (Mech 1980, Brittell et al. 1989) but may increase within the female cohort during the reproductive season or during declines in food abundance. In such circumstances, adult females may be more intolerant of other females than are males (Berrie 1974). As food becomes more abundant, adult females have been known to donate a part of their home range to their daughters (S. Boutin, pers. comm.).

Keith (1974) suggested that mutual avoidance behavior serves to separate lynx temporally and spatially, particularly in view of the overlapping tendency of lynx home ranges (Nellis et al. 1972, Brand et al. 1976, Brittell et al. 1989). Mutual avoidance may be greatest between resident and transient lynx. There is some indication that the lynx may be more tolerant of its own kind than are the cougar or bobcat (Turbak 1986). Bergerud (1971) did not observe lynx in Newfoundland excluding other lynx, whether resident or transient, and B. Slough (pers. comm.) observed territoriality only at low lynx densities in the Yukon. Adult and yearlings are often seen together (S. Boutin, pers. comm.) and adult males have been observed travelling briefly with females and family groups (Saunders 1963, Haglund 1966). A greater overlap of home ranges occurs between animals of the opposite sex (Mech 1980, Stephenson 1986, Brittell et al. 1989, Koehler 1990) and a lesser degree of overlap between animals of the same sex (Ward and Krebs 1985). Brittell et al. (1989) observed a high degree of overlap of female-to-male home ranges (31.4%) and male-to-female home ranges (43.9%) in the Okanogan region of Washington. The lack of overlap between same sexes may be an artifact of environmental conditions (prey availability) (Brittell et al. 1989).

Territorial areas usually vary in size depending on habitat characteristics, food availability, and the sex and age of the animal (McCord and Cardoza 1982). Lynx establish territories by marking the boundaries of a chosen area. Lynx may deposit feces, urinate, or otherwise mark an area by rubbing their bodies against trees within their home range (Brittell et al. 1989).

Home Range

Home range estimates are used as a tool for analyzing habitat conditions available to a population and to evaluate population stability. Small sample sizes, differing survey methodology, geographical and seasonal differences, and individual differences in the animals make the results difficult to interpret and/or compare. Insufficient telemetry fixes, erratic

lynx movements, and inherent biases in identifying individual lynx may also lead to false conclusions (Berrie 1974, Mech 1980).

Favorable environmental conditions encourage small home ranges while less favorable conditions result in large home ranges (Berrie 1974, Bailey et al. 1986, Brittell et al. 1989). Food availability may be the most important criterion in the determination of a lynx home range size. An increase in home range size as a function of metabolic needs and/or diet has been shown for other 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 (*Lepus americanus*) (Ward 1984, Ward and Krebs 1985). However, recent studies conducted in the Yukon found increased overlap of home range during the peak in the cycle but little difference in the size of individual home range between the peak and the base (B. Slough, pers. comm.). Increased home range size typically leads to higher mortality rates, as increased movements result in greater opportunity for accidents, predators, and trapping.

Home range estimates have ranged from a low of 1 km^2 (0.4 mi^2) to a high of 783 km^2 (305 mi^2), depending on the location, sex, and age of the animal (Novikov 1962, Bailey et al. 1986) (Table 3). In general, home ranges have a higher percentage of usable habitat than surrounding areas. Females typically have smaller home range sizes than males (Saunders 1961, Bailey 1974, Ward and Krebs 1985). In Washington, lynx home ranges are larger than those reported for 5 of the 11 locations listed in Table 3. However, they are smaller than four of the reported home ranges and relatively comparable to those reported in Alaska by Bailey et al (1987), in Montana by Brainerd (1985), and in the Yukon by Slough and Ward (1990). The size of home ranges for Washington's lynx may be a response to habitat and/or prey availability.

Movements and Dispersal

Research has consistently shown that lynx undergo local movements and long distance dispersal in response to prey availability and population recruitment. Daily movement refers to brief relocations undertaken on a daily basis within a lynx home range. Daily movements are closely related to both hunting activity and home range (Hatler 1988). During a low in the hare cycle, lynx will move greater distances in search of food (Brand et al. 1976, Alas. Dept. Fish and Game 1977). Home range size will also increase under these conditions. In exploited populations, increased daily movements and larger home range sizes may bring individuals into contact with more traplines, leading to higher trapping mortality. On the other hand, mobility may reduce the likelihood of local extirpations in response to environmental pressure in otherwise suitable habitat (B.C. Minist. Env. 1988).

Table 3. Home range estimates of North American lynx in North America, Europe, and Asia.

Location	Range Estimate km^2 (average)	Sex(N)[d]	Survey Method	Source
Alaska	12.8-25.5	F(1)	Convex polygon	Berrie (1974)
	14-25	M(1)		
Alaska	51-89 (25)[a](49)[b]	F(2)	Convex polygon	Bailey et al. (1986)
	8.3-783	M(3)		
Alaska	47-114 (75)	F(3)	Snow tracking	Stephenson (1986)
	70-210 (142)	M(3)		
Washington	8.5-87.9	F(7)	Convex polygon	Brittell et al. (1989)
	14.3-106.8	M(8)		
Washington	38.5-43.6 (41.5)	F(2)	Convex polygon	Koehler (1990)
	32.3-102.3 (67.8)	M(5)		
Minnesota	51-122 (87)	F(2)	Convex polygon	Mech (1980)
	145-243 (194)	M(2)		
Montana	11.0-32.2 (43.1)	F(2)	Convex polygon	Brainerd (1985)
	47.3-246.1 (122.0)	M(5)		
Alberta	11.1-49.5[c]	Ad(8)	Snow tracking	Brand et al. (1976)
Newfoundland	15.5	F(1)	Convex polygon	Saunders (1963)
	(19.4)	M(2)		
Manitoba	138-177 (158)	F(2)	Convex polygon	Carbyn and Patriquin (1983)
	221	M(1)		
Nova Scotia	19-32+	F(1)	Convex polygon	Parker et al. (1983)
	12-26+	M(1)		
Yukon	12-114	F(11)	Convex polygon	Ward and Krebs (1985)
Soviet Union	1-25	Unknown	Unknown	Novikov (1962)

[a] Summer home range of adult females.
[b] Winter home range of adult females.
[c] Minimum home range of lynx trailed 50 km or more.
[d] Ad=adults, M=male, F=female.

As the density of snowshoe hares decrease, lynx hunting success also decreases. This forces lynx to travel farther in order to fulfill their energy requirements (Brand et al. 1976, Parker 1981, Ward and Krebs 1985). Snowshoe hares tend to occur in patches rather than an even distribution during a decline in their cycle (Wolff 1980). It would be advantageous for lynx to seek out these patches of prey availability, regardless of the likelihood of increased daily movements. When lynx are no longer able to locate patches for feeding, they may opt for long-distance dispersal.

Dispersal refers to permanent movements that take the animal outside of its home range and includes emigration and immigration. Evidence exists that large numbers of lynx may undergo long-distance dispersal during and after a decline in the hare population (Adams

1963; Mech 1973, 1980; Ward 1985; Ward and Krebs 1985) (Table 4). However, the direction of movement is neither completely predictable nor fully understood (Hatler 1988) and may possibly be influenced by topographic features (B. Slough, pers. comm.). Local "irruptions" and "invasions" from Canada have been reported in various localities in the northern United States (Hatler 1988, Brittell et al. 1989), including areas lacking traditional habitat components. There is a strong likelihood that similar movements are occurring northwards (G. Erickson, pers. comm.; J. Brittell, pers. comm.). Brittell et al. (1989) documented 4 of 19 lynx wandering from Washington to British Columbia. Brainerd (1985) suggested that long-distance dispersal may indicate high cat densities and/or low prey availability. However, lynx dispersal as a function of high cat densities has yet to be proven (B. Slough, pers. comm.; S. Boutin, pers. comm.). Increased competition in fully occupied areas would inevitably result during periods of high reproductive success when immature lynx are attempting to establish territories. Young lynx may even venture into marginal habitat if unoccupied, such as that found in the southern portion of the Cascade range in Washington.

Table 4. Long range movements of adult North American lynx.

Beginning Location	Ending Location	Distance Travelled (km)	Length of Travel (days)	Sex	Source
Alaska	Alaska	169	44	Female	Stephenson (1986)
Alberta	Alberta	164	163	Male	Nellis and Wetmore (1969)
Minnesota	Ontario	483	1,080	Female	Mech (1977)
Newfoundland	Newfoundland	103	587	Male	Saunders (1963)
Washington	British Columbia	616	202	Male	Brittell et al. (1989)
Washington	British Columbia	224	Unknown	Male	Brittell et al. (1989)
Yukon	Alaska	700	240	Female	Ward (1985)
Yukon	Yukon	250	231	Male	Ward (1985)
Yukon	Yukon	250	201	Female	Ward (1985)

Foraging and Food

Diet. Few other species are as dependent on one prey item as is the North American lynx. The relationship between the lynx and the snowshoe hare has been apparent to trappers and biologists for years. In Seton (1925) stated that 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." In Hatler (1988) upheld this relationship by finding snowshoe hares to be the primary food item in 27 samples taken throughout Canada,

Washington, and Alaska. Frequency of occurrence ranged from 35-97% and estimated percentage volume (biomass) ranged from 41-100%. By comparison, European lynx (*Lynx lynx*) were also found to rely heavily on hares in Finland (Pulliainen 1981) and central USSR (Iurgenson 1955).

Although lynx often seek out and concentrate their foraging efforts in areas of relatively high hare abundance (Ward and Krebs 1985), the diet is often supplemented by other prey items during hare declines and during certain seasons (H. Golden, pers. comm.). Mice, voles, and other microtines, red squirrels (*Tamiasciurus hudsonicus*), ground squirrels (*Citellus* sp.), flying squirrels (*Glaucomys sabrinus*), beavers (*Castor canadensis*), passerine birds, muskrats (*Ondatra zibethicus*), shrews, foxes (*Vulpes vulpes*), and grouse [especially ruffed grouse (*Bonasa umbellus*)] comprise the remainder of the lynx diet (Nelson 1916, Nellis et al. 1972, Parker et al. 1983, Stephenson 1986, Hatler 1988, Brittell et al. 1989, Koehler 1990). During the summer months, the variety of items in the diet increases as different prey become available. 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 and on Cape Breton Island in Nova Scotia, white-tailed deer (*Odocoileus virginianus*) was the second most important food item for lynx (Parker et al. 1983). Lynx have also been reported preying on Caribou (*Rangifer tarandus*) in Newfoundland (Bergerud 1971) and Alaska (Stephenson 1986, 1991) and on sheep in France (Herrenschmidt 1990), Alaska (Stephenson et al. 1991), and Switzerland (Breitenmoser 1990).

Nutritional Requirements. During periods of hare scarcity, Brand et al. (1976) held that lynx must: 1) increase hunting success rate (captures/attempts), 2) increase the use of alternative food sources, and/or 3) increase search effort (daily travel distance). In Newfoundland, Saunders (1963) concluded that lynx required an average of 0.5 hares/day, or the equivalent biomass of other prey species. Parker (1981) found lynx consuming approximately 1 hare/day on Cape Breton Island, Nova Scotia. For nutritional comparison, a grouse equals roughly 0.5 hare-equivalents and a squirrel equals 0.2 hare-equivalents in a lynx diet (Nellis and Keith 1968). Consumption rates vary depending on the hare cycle. In central Alberta, Brand et al. (1976) estimated the average daily consumption rate per lynx to be 590 g (20.65 oz). During years of high hare densities the consumption rate rose 37% to 930 g (32.55 oz) and during winters of low hare densities, consumption rates dropped 20% below the normal maintenance level for wild lynx.

Brand and Keith (1979) found that indices of lynx body fat increased significantly between early and late winter when snowshoe hares were at intermediate or abundant levels, but decreased significantly during years of hare scarcity suggesting a negative energy balance. Prey availability and consumption rates have a strong influence on productivity, mortality, and dispersal. Elton and Nicholson (1942) postulated that lynx starvation occurs when varying hare population lows are combined with poor hunting conditions.

Hunting Behavior. Lynx often locate food by sight and sound (Saunders 1963, Haglund 1966, Guggisberg 1975). Brand et al. (1976) described three hunting methods utilized by lynx: 1) following well-used hare runways, 2) concentrating movements within small areas of hare activity, especially during hare population lows, and 3) using short-term "waiting beds" usually on ridges overlooking areas of hare activity or beside well used hare runways. The success of capturing a hare depends on the distance between the lynx and the hare at the beginning of the chase and upon the snow conditions influencing the lynx ability to spring towards the hare (Haglund 1966, Nellis and Keith 1968). Lynx experience (age), familiarity with the area, and individual differences all contribute to the hunting success rate (Nellis and Keith 1968). Upon successfully capturing a hare or other prey item, the individual may consume its prey on the spot or stash (cache) its prey for later feeding (Nellis and Keith 1968; McCord and Cardoza 1982; S. Boutin, pers. comm.).

HABITAT REQUIREMENTS

General

Lynx use a mosaic of forest types, from early successional to mature coniferous and deciduous stands. Habitat suitability rests overwhelmingly on whether or not such habitat provides snowshoe hares as a food source (L. Keith, pers. comm.). Lynx use of forested habitats was documented in interior Alaska (Berrie 1974) and the Kenai Peninsula (Bailey et al. 1986), Michigan (Bradt 1947), the Yukon (Slough and Ward 1987), Newfoundland (Saunders 1963), Montana (Koehler et al. 1979), and Washington (Brittell et al. 1989, Koehler 1990, Koehler and Brittell 1990). Most research on lynx habitat use has been performed in suitable study areas. Further research is needed to develop a widely applicable habitat suitability model.

Forest composition varies geographically throughout the lynx range and includes both conifers and hardwoods (Adams 1959, Wolff 1980, Litvaitis et al. 1985, Fuller and Heisey 1986). In Alaska, scrub-alpine areas, brushlands, white spruce-birch communities (*Picea glauca-Betula* sp.), and black spruce (*Picea mariana*) stands are common lynx habitat (Alas. Dept. Fish and Game 1977). Optimum habitat in interior Alaska is described as more open aspen (*Populus* sp.) and birch communities with brushy understories of willow (*Salix* sp.), alder (*Alnus* sp.), highbush cranberry (*Vaccinium oxycoccos*) and wild rose (*Rosa* sp.), and riparian situations with an abundance of willow (*Salix* sp.) (Berrie 1974). Forested areas in Alaska also contained black spruce, white spruce (*Picea glauca*), alder, and willow nearly 50% of the time. Wet tundra was rarely used by lynx. In one Yukon lynx research site, white spruce was the dominant tree species (Ward and Krebs 1985) while in a second site, mixtures of regenerating lodgepole pine (*Pinus contorta*), willow-shrub birch (*Salix* sp.-*Betula glandulosa*), aspen, and white spruce were predominant (Slough and Ward 1987).

In the Okanogan region of Washington, dense stands of lodgepole pine represent the primary form of early successional forests utilized by local lynx populations (Brittell et al. 1989). Koehler (1990) found radio-collared lynx using lodgepole pine and Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) forests extensively and xeric lowland forests seldom. Home range areas 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*) forests (Koehler 1990).

Tree species used by lynx east of the Okanogan River may differ in comparison to those used by lynx in north-central Washington. Lodgepole pine communities retain their importance in northeastern Washington yet other species play an increasing role further east. Douglas-fir, western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and subalpine fir are the major tree species within this forest (Williams et al. 1990). The majority of lynx observations in Ferry and Stevens counties are associated with lodgepole pine communities (S. Zender, pers. comm.). In Pend Oreille County, lynx use lodgepole pine communities approximately half of the time and western redcedar, western hemlock and subalpine fir communities the remaining time. Subalpine fir remains an important species throughout the northeastern lynx range. Further research may find lynx in northeastern Washington using available lodgepole pine stands as well as tree species which are unique to that area and quite different from tree species used in north-central Washington.

Elevation

Lynx have special adaptations which enable them to live at high elevations. They are the only known North American felines to endure the cold winters and deep snow of the high mountains. Elevations at which lynx are found vary depending on the extent of boreal forests. Lynx may be found at lower elevations in Canada and Alaska in comparison to the United States. Berrie (1974) reported an elevation range of 300 to 1,075 m (984-3,526 ft) within the study area used for lynx investigations in interior Alaska. Lynx are known to occur above 1,220 m (4,000 ft) in Washington, Idaho, and Montana, above 1,980 m (6,500 ft) in Wyoming, and above 2,440 m (8,000 ft) in Colorado and Utah (Koehler and Brittell 1990). Koehler (1990) located lynx at higher elevations during the summer than in the winter in Washington. This movement may be to avoid increased competition with other predators or to seek cooler daytime temperatures (J. Brittell, pers. comm.).

Climate

Berrie described the area used by lynx in his 1974 study in interior Alaska as having a continental climate with an average snowfall from 1 to 1.5 m (3.28-4.92 ft). In the Yukon region, Slough and Ward (1987) determined an average annual temperature of -1 to -3°C (27-30°F) with average annual precipitation of 32.6 to 34.6 cm (12.7-13.5 in). Murray and Boutin's (1991) Yukon study found lynx using areas having an average snow depth in winter

of 54.5±16.2 cm (21.3±6.3 in). In the Okanogan highlands of Washington, temperatures where lynx exist range from -23 to 35°C (-9 to 95°F) with a mean annual precipitation of 51 cm (19.9 in) at 600 m (2,000 ft) elevation (Koehler 1990). During the winter, snow depths exceeded 1 m above 1,980 m (6,490 ft) elevation. In Nova Scotia, Parker (1981) measured snow depths of 2 m over 6 months of the year within areas supporting local lynx populations.

Forage Cover

Similar habitat is used by lynx for foraging activities, escape, hiding, thermal protection, and stalking of prey. Lynx are most often associated with habitats containing an abundance of snowshoe hares (Koehler et al. 1979, Parker 1981, Bailey et al. 1986, Koehler 1990). Included in this habitat type are both coniferous and hardwood trees (Adams 1959, Wolff 1980, Litvaitis et al. 1985, Fuller and Heisey 1986). Early successional forests result in optimum conditions for hares year round (Koehler and Brittell 1990).

During the winter, hares must survive on shrubs and seedlings tall enough to rise above the snow line yet short enough to be reached. As the snowpack increases, so does the reach of the hares. Wolfe et al. (1982) considered only that portion of the vegetation profile 1.0 m above late winter snow level as constituting winter snowshoe hare cover. In Washington, regenerating lodgepole pine stands provide the majority of hare browse. Brittell et al. (1989) considered deciduous shrubs and trees at least 1.8 m (6 ft) tall or coniferous trees containing at least 75% lodgepole pine as foraging cover. There is some concern that trees of this height may not provide winter feeding habitat for snowshoe hares in eastern Washington as snow depths often exceed 6 feet (T. Burke, pers. comm.). Koehler (1990) located four to five times greater densities of snowshoe hares in 20-year-old stands of lodgepole pine compared to older lodgepole pine ($\geq$ 82-year-old stands) based on hare pellet counts. Young lodgepole contained nine times greater densities of hares when compared to Engelmann spruce-subalpine fir stands. These results are consistent with those of Parker (1981, 1983) on Cape Breton Island who also found lynx preferring early and advanced successional forests, as well as open and closed mature conifers and open bogs. Certain forest types supporting high densities of snowshoe hares were not used, possibly demonstrating learned and traditional hunting and travel patterns.

Woody browse, bark, needles, and succulent herbaceous vegetation (including grasses, sedges, ferns, and forbs) are the staple diet for snowshoe hares (Bittner and Rongstad 1982, Brittell et al. 1989, Koehler and Brittell 1990). Densely stocked stands of sapling trees and an abundance of fallen woody debris provide ample foraging and escape cover for snowshoe hares and therefore, increased prey for lynx. In Washington, lynx foraging habitat contained an average stem density of 15,840 stems/ha (6,413 stems/ac) (Koehler 1990) which equates to approximately 0.8 m (3 ft) between trees. Stem densities in excess of 15,000 stems/ha have been reported in other states (Wolff 1980, Litvaitis et al. 1985). Stem diameter is also critical to the survival of snowshoe hares. Available research points to the use of small diameter stems, typically 3 to 25 mm (0.1-1 in) diameter at point of browsing (Pease et al.

1979, Wolff 1980, Litvaitis et al. 1985, Koehler 1990). Pease et al. (1979) determined a twig diameter of ≤ 3 mm to be normal for hare browse; a diameter at point of browsing of >3 mm indicates food stress for hares. Wolff (1980) supported this conclusion, stating that larger twigs (≥3 mm) had lower nutrient concentration in comparison to those 3 mm or smaller. In Washington, Koehler (1990) found that 96% of the stems browsed by snowshoe hares in the vicinity were lodgepole pine stems <2.5 cm (0.98 in) in diameter. Snowshoe hares ate the bark on stems and often consumed whole stems <10 mm (0.4 in) in diameter.

Litvaitis et al. (1985) found dense softwood stands (which includes most coniferous trees such as lodgepole pine, Engelmann spruce, and subalpine fir) supportive of higher densities of hares than hardwood stands (most deciduous trees). However, in boreal forests it appears that mixed stands may possibly provide the best blend of food and escape cover to snowshoe hares (A. Todd, pers. comm.). It may be that tree species composition becomes increasingly important in locations where the density of snowshoe hares is low, such as in Washington. Koehler (1990) found hares using early successional lodgepole pine stands regardless of the low occurrence of these stands (<10% of his Okanogan study area versus >80% occurrence of mature stands). Almost all cover types are inhabited during periods of high hare populations, except for those containing little or no understory (Pietz and Tester 1983, Fuller and Heisey 1986). In order to adequately meet the needs of lynx, foraging habitat must be adjacent to travel cover and denning habitat.

Denning

In Washington, lynx require heavy down material associated with mature forests for denning during the reproductive period (Koehler and Brittell 1990, Koehler 1990). Dominant stands ≥ 150-year-old are used as denning sites (Brittell et al. 1989, Koehler and Brittell 1990, Koehler 1990). Overstories of Engelmann spruce, subalpine fir, and lodgepole pine are common in these stands as are north-northeast aspects (Koehler and Brittell 1990, Koehler 1990). In Alaska, females with kittens have been observed using blown-down spruce and spruce roots washed up on creek beds (Berrie 1974). Previously burned areas (30-year-old stands) containing abundant fallen woody debris were also selected as denning sites in Alaska (Slough and Ward 1990). A high density of fallen logs [>1 log/m (40 logs/150 ft)] lying 0.3 to 1.2 m (1-4 ft) above ground are necessary (Koehler and Brittell 1990). Large spaces underneath downed logs are apparently used by kittens as escape cover. Downed logs ≥ 0.3 m (1 ft) in diameter are necessary; cavities created by smaller diameter logs may be too small to be used by lynx kittens (J. Brittell, pers. comm.). Other important features of denning sites include minimal human disturbance, close proximity to natural travel corridors, and foraging cover on at least 50% of their edges. Denning sites should be a minimum of 2 ha (5 ac) and should be interspersed among other cover types (Brittell et al. 1989).

Individual female lynx may re-use the same denning sites when quality denning habitat is lacking (J. Brittell, pers. comm.; B. Slough, pers. comm.). However, in areas where denning habitat is abundant female lynx often change denning sites throughout and between

seasons. Females in areas where high densities of lynx occur may use variable denning habitat types. In areas supporting low densities of lynx, females often restrict their use of denning habitat to particular tree species or cover types.

Travel Corridors and Cover

Travel corridors are semi-permanent features of the land which are used by lynx as travel routes. In Washington, travel corridors are an important component of lynx habitat in view of the large home range sizes and movement patterns of lynx (Brittell et al. 1989). In Nova Scotia, lynx used road edges and forest trails 20% of the time as travel corridors (Parker 1981). Mature coniferous forests were also important for travel from one hunting area to another. Mountain ridges and saddles may also serve as lynx travel corridors (Brittell et al. 1989). In Washington's Mount Rainier National Park, lynx tracks and sign were most evident historically on backbone ridges at or just above timber line (Taylor and Shaw 1927). It is assumed that natural travel corridors are preferred by lynx and created travel corridors (roads, trails) are used because of availability.

Travel cover pertains to vegetative cover used by lynx for travel and other activities and involves a variety of cover types. In Washington, travel cover is defined as contiguous areas close to and/or encompassing foraging cover which contains coniferous or deciduous vegetation >1.8 m (6 ft) in height (Brittell et al. 1989). Foraging habitat may be used as travel cover; however, the opposite is not always true. Travel cover contains pole and saw timber size trees with a minimum of 450 tree stems/ha (180 stems/ac) which equates to approximately 5 m (16 ft) between trees. Stem density may be reduced when significant down material or bushy trees are present. Lynx have been observed crossing open meadows $\leq$ 100 m (328 ft) in width but not hunting in these areas. Commercially thinned areas >100 m (328 ft) wide with no understory and having only 420-640 trees/ha [170-259 trees/ac and 4 to 5 m (13-16 ft) between trees] were also crossed in the winter (Koehler 1990).

POPULATION DYNAMICS

Cycles

The lynx population cycle and its dependence on snowshoe hare populations was first documented by the Hudson Bay Company in the early 1900's. In Elton and Nicholson (1942) analyzed pelt data taken over a 206-year period and found consistent cycles reflecting an average frequency of 9.6 years. Many individuals have since questioned the degree to which indirect factors affected the harvest trends, including pelt prices, trapping pressure, hunting strategy, weather, and disease (Weinstein 1977, Finerty 1979, Winterhalder 1980, Wing 1953 and Gilpin 1973 *in* Hatler 1988). These factors probably cause inconsistencies in the amplitude of the cycle but do not negate its existence.

There have been several attempts to explain the cycle, including an analysis of weather patterns (Arditi 1979), lunar influences (Archibald 1977), and wildfire trends (Fox 1978). The fact that lynx are so strongly dependent on snowshoe hares leads researchers to examine lynx population fluctuations in terms of hare abundance. Seven years of research were spent investigating the interaction of snowshoe hares, their habitat, and their predators in Alberta (Keith et al. 1977, Keith and Windberg 1978, Cary and Keith 1979, Pease et al. 1979, Vaughan and Keith 1981). The major conclusions of the study supported the following explanation of the hare cycle (Buehler and Keith 1982):

> The 10-year cycle is produced intrinsically by successive hare-winter food and hare-predator interactions...Food shortage initiates a major decline from peak abundance by reducing rates of both reproduction and juvenile survival. This decline, coupled with a lag in the numerical response of hare predators, greatly increases the predator-hare ratio. As a consequence, survival remains low well after the food shortage has ended, thereby extending the period of decline and depressing the hare population still further. Its cyclic increase begins after predator numbers have fallen due to hare scarcity, and hare survival has risen sharply.

The cycle occurs throughout the majority of lynx range. Butler (1953) found lynx population peaks beginning in the northern prairies of Canada and radiating outwards, reaching British Columbia one year following the northern peak and Ontario and Quebec 2 years later. In a later analysis, Smith and Davis (1981) determined that the origin of the population increase had shifted approximately 800 to 960 km (500-600 mi) to the southeast (now beginning in northeastern Saskatchewan) over the previous 100 years. They further concluded that the outer boundaries of lynx range in Canada lagged behind the regional center by 2 to 4 years. Migration of individual lynx from depressed areas to areas of high food availability has been used to explain the time lag. Hare cycles may be absent (Koehler 1990) or of much lower amplitude (Brittell et al. 1989; V. Banci, pers. comm.; S. DeStefano, pers. comm.) in the southern portion of the range, such as in southern British Columbia and Washington. Keith (1990) reported that cyclic fluctuations occur where optimal habitat is both continuous and extensive, primarily in Canada and Alaska. Cycles may occur in Washington but low population densities, small harvest sample sizes, and the lack of current sampling have made detection of the cycle impossible.

Throughout the lynx range, areas having adequate lynx and snowshoe hare habitat and healthy populations of both species display cyclic behavior in a fairly predictable manner. However, events could occur which would lead to disruptions of the cycle. Potentially, such a situation could cause future peaks to have lower amplitudes. For example, a population may be depressed to the point that it will decline and not recover. As discussed in Hatler (1988), the fact that predictable population cycles have repeatedly occurred does not necessarily mean that they will always continue. Such a trend is apparent in the Hudson Bay Company harvest figures which show declines in the peaks of lynx harvest from a high of

80,000 in the late 1880's to approximately 20,000 after 30 years (Elton and Nicholson 1942). It should be noted that from 1880 to 1925, lynx harvest was uncontrolled and trapping was allowed year round. In 1939, several provinces of Canada began actively managing for lynx and other furbearers which likely played a part in reducing the lynx harvest. However, pelt prices and trapper effort remained stable over this period (Todd 1985); therefore a major decline in lynx abundance around the turn of the century due to over-exploitation appears to have been the cause for the decrease in peaks after 1920. Fire suppression, which began at approximately the same time, may have contributed to the decline in lynx populations by reducing available habitat for snowshoe hares (B. Slough, pers. comm.). Forty years later lynx populations began to recover in response to reduced pelt values from 1940 to 1960 (L. Keith, pers. comm.) and intensive management efforts, such as registered traplines and regulated trapping seasons, throughout Canada.

Reproduction

North American lynx breed in March and April (Alas. Dept. Fish and Game 1977, Brittell et al. 1989) and bear young 9 weeks later in May and early June. Kittens are altricial, open their eyes two weeks post-partum, and are weaned at 4 to 6 weeks of age. Kittens usually stay with the mother until the following breeding season (B. Slough, pers. comm.). Kittens are mature in their first spring.

Perhaps the greatest factor influencing lynx natality is the availability of snowshoe hares. During highs in the hare cycle, greater numbers of lynx breed, individual litter sizes are larger, and kittens have higher survival rates (Brand et al. 1976, Brand and Keith 1979, O'Connor 1985). Well-fed females often produce four or five kittens. Yearling females are also known to breed when hares are abundant. In Alaska, O'Connor (1985) observed significantly higher rates of reproduction in yearling females versus adult females during a peak in the snowshoe hare cycle. Although yearlings may show increased productivity during this time, the kittens they produce rarely survive (B. Slough, pers. comm.). During lows in the hare cycle no yearlings and few adult females reproduce, litter sizes are smaller, and survival rate for kittens are low. Kittens surviving through winters of declining hare populations may experience nutritive stress that delays their sexual maturity and lowers their reproductive rate (Sadleir 1969 in Brand et al. 1976). Poor condition of females during lows in hare abundance reduces productivity throughout the population (Brand and Keith 1979, O'Connor 1985). For example, it appears that there are years in which no litters are produced (Brand et al. 1976) or no young are recruited to the winter population (L. Keith, pers. comm.). This would presumably have a greater impact on long-term recruitment than lower pregnancy rates or litter sizes. The majority of reproductive research has been performed in areas containing healthy lynx populations and adequate habitat. Information is lacking on reproductive success in areas containing marginal lynx populations and habitat.

Hatler (1988) reported an average litter size of 2.77 (n=26) for lynx populations in Canada, Alaska, and Washington. The greatest number of kittens reported per litter is six in the

Yukon Territory (N=2) (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. Small sample sizes might have influenced the results of these Washington studies. Average snowshoe hare density recorded by Koehler (1990) in the best hare habitat amounted to 25.4 pellets/m^2 (21.2 pellets/$yard^2$) which was lower than densities reported in the most abundant hare habitat in Alaska [81.5 pellets/m^2 (67.9 pellets/$yard^2$)] and in Nova Scotia [65 pellets/m^2 (54 pellets/$yard^2$)] (Bailey et al. 1986, Parker 1981, respectively). However, snowshoe hare numbers appear to be stable, based on WDW annual furbearer harvest reports (WDW 1992, 1993) and hare track surveys (WDW unpubl. data). Lynx productivity in Washington based on hare abundance likely fluctuates around the reported average of 2.77 kittens per reproducing female. Brittell et al. (1989) and Koehler (1990) located few breeding females in their Okanogan study. The results obtained from their research may be attributed to unsuitable environmental conditions which lower reproductive potential, the lack of intensive efforts to radio collar and monitor females, or both. More research is needed to evaluate lynx reproductive rates in Washington.

The presence of corpora lutea (a follicle of the ovary formed after the release of an ovum) and/or placental scars is an indication of past reproductive activity. Hatler (1988) summarized the findings of five studies involving post-mortem inspection of yearling and adult female reproductive tracts and found the percentage of females with corpora lutea ranged from 61 to 99% (mean= 90%, n=1,065) during a high in the hare population cycle to 0 to 94% (mean=43%, n=254) during a low in the hare population cycle. Females having placental scars ranged from 33 to 85% (mean=65%, n=1,046) during high hare abundance to 0 to 64% (mean of 27%, n=270) during low hare abundance. Production rates obtained serve as a measurement tool only as eggs are often unfertilized, many embryos are lost *in utero*, and kitten mortality occurs (O'Connor 1985). O'Connor (1985) noted that surveys of kittens in the field were the most accurate measurements of recruitment.

Mortality

The majority of information regarding mortality is derived from harvest data analysis and the final outcome of radio-collared animals. Lynx rarely survive past 15 years in the wild, though they may reach 22 years in captivity (Tumlison 1987). Lynx mortality may increase or decrease in response to prey availability (Nellis et al. 1972, Brand and Keith 1979). Seton (1952) described several lynx as having starved to death during the beginning of a decline in their cycle. In Washington, Brittell et al. (1989) held starvation responsible for the death of one out of five radio-collared lynx. During a decline in the hare cycle, Stephenson (1986) found lynx stressed and in poor condition and Ward (1985) described emaciated lynx and attributed one female mortality to starvation. Although mortality occurs in all age classes during hare declines, kittens are especially susceptible (Nellis et al. 1972, Brand et al. 1976, Brand and Keith 1979). It is assumed that survival rates are similar between areas experiencing a decline in prey availability and areas with consistently low

numbers of snowshoe hares. In Washington, Koehler (1988) documented low birth rates in his Okanogan study which he attributed to low prey availability. High juvenile mortality further reduced recruitment levels. D. Brittell (pers. comm.) noted that information obtained on juvenile mortality and birth rates during the Okanogan study may have been affected by the inability to gather recruitment and mortality data when prey was more available (during an increase in the hare cycle).

Other causes of death reported in the literature include one lynx killing another (Elsey 1954) and predation (Berrie 1974, Koehler et al. 1979, Koehler 1990). Few predators inhabit the remote regions where lynx exist; therefore, the likelihood of predation and competition for prey is reduced. Lynx solitary nature and use of different habitats may be partly responsible for their low disease and parasitic rates (McCord and Cardoza 1982).

Lynx are highly susceptible to trapping (Mech 1980, Carbyn and Patriquin 1983, Parker et al. 1983). Susceptibility increases when lynx increase home range size and movements in response to snowshoe hare declines or high recruitment (Ward and Krebs 1985). Mortality of radio-collared lynx caused by (and/or related to) trapping has ranged from 24 to 100% in studies conducted in Canada and Minnesota. Of 98 radio-collared or marked research animals in eight studies, 49 (50%) died from human related causes, the majority of which were trapping (Nellis et al. 1972, Mech 1980, Carbyn and Patriquin 1983, Parker et al. 1983, Ward 1985, Bailey et al. 1986, Stephenson 1986, Bailey et al. 1987). Estimates of the proportion of total populations annually removed by trapping have ranged from 65 to 100% (Ward and Slough 1987). These rates of mortality exceed recruitment into the population even during snowshoe hare abundance when lynx reproduction is highest (Ward and Slough 1987).

Mortality research has involved primarily small sample sizes which may bias the results. Furthermore, most studies were conducted on areas chosen as study sites due to their accessibility. Research sites chosen for accessibility may not represent conditions throughout the entire lynx range. Regardless, trapping mortality does appear to be positively related to pelt prices and definitely additive to natural mortality (Brand and Keith 1979, Todd 1985). Trapping may also be selective in regard to the age (greater proportion of yearlings and kittens) and sex (greater proportion of males) of animals taken (van Zyll de Jong 1963, Stewart 1973, Berrie 1974, Parker et al. 1983, Quinn and Thompson 1987). During years of low recruitment in response to lower food availability, local lynx populations may be extirpated in exploited areas.

POPULATION STATUS

Past

Sightings and Records. There are few references to North American lynx by historical naturalists, explorers, or surveyors. Early explorers including Andre Michaux (1801 *in* Thwaites 1966), Lewis and Clark (1804 *in* Coues 1965), and Farnham (1839 *in* Thwaites 1966) and surveyors working on railroad exploration (U.S. Dept. Defense 1857) attest to the presence of North American lynx in the United States, specifically in the Pacific Northwest.

Inconsistent harvest figures and a lack of sufficient sighting information and specimen collection prior to 1960 makes a reliable assessment of lynx population trends in Washington difficult. It is likely that populations prior to 1910 were larger than those of the 1920's to 1940's based on Canadian harvest history. Canadian trapping records indicate annual high harvests (80,000+) in the late 1880's (Elton and Nicholson 1942). High lynx populations in Canada undoubtedly provided a larger proportion of transient lynx to Washington. After the turn of the century, lynx harvest in Canada began to decline, reaching a low in 1920 of approximately 20,000 pelts. Lynx distribution throughout a majority of the Canadian range also appeared to be shrinking in a northerly direction; the Northern and Yukon Territories alone showed no change in range boundaries (DeVos and Matel 1952, B. Slough, pers. comm.). Based on declines in Canada, it is feasible that lynx underwent a decline in Washington from the late nineteenth to the early twentieth centuries. The degree of decline is undeterminable based on available information. Following the low of 1920, lynx populations in Canada began to recover and peaked in 1960 to 1970 (van Zyll de Jong 1971). These peaks were considerably lower than the peaks witnessed prior to 1900. Trapping pressure in the early 1900's is partly responsible for the lower peaks. Furthermore, the maturation of large expanses of boreal forests which burned in the 1920's likely contributed to sustained lower populations. Following the peaks of the 1970's, an apparent decline in lynx abundance occurred (Todd 1985). This assumption was based on lower than expected harvest in Canada during the most recent peak in the population (1981-82 season) despite high pelt values for lynx (Todd 1985). The Northern and Yukon Territories alone showed lynx harvest to be increasing in Canada.

Based on WDW records, the highest concentration of lynx historically was in northeastern (Ferry, Stevens, and Pend Oreille counties) and north-central (Okanogan and Chelan counties) Washington. Lynx occurrence in the south Cascades and the Blue Mountains are believed to represent transient individuals undertaking long distances movements in response to high recruitment and/or low prey availability. For the years 1927 to 1993, Washington's lynx records consist of 185 lynx sighting and/or track reports by the WDW and USFS, 27 museum specimens, and 7 literature references (Appendix B). Additional lynx were seen or trapped in the Mt. Baker National Forest. Roughly 300 km (185 mi) of open terrain separate the northern specimens from the southern. The northeastern and north-central lynx probably represented the southern extension of the British Columbia lynx population while lynx in

southeastern Washington may have been part of the Wallowa County population in Oregon. There are several possible reasons for the low number of lynx sightings and/or carcasses contained in the WDW files including the low population densities, the remoteness of the areas inhabited by lynx, and the wariness of the animal. Furthermore, as a furbearer WDW and USFS biologists were not required to report lynx observations in the past.

There are no records of lynx ever inhabiting the humid coastal zone of Washington. Webster (1920) located only one lynx species, the bay lynx (bobcat), in the Olympics in 1920 and described the Canada lynx as a "dweller in the more open land of long winters east and north of the Cascades." One lynx was killed on the western side of the Cascade Mountain range in the upper Skagit River drainage in 1928 and tracks were reported in the same area in 1929 (Appendix B). Another lynx was trapped farther south in the Fall City area of King County in 1951 (Appendix B). In 1927, Taylor and Shaw included lynx in the list of mammals occupying the Mount Rainier National Park. Estimates of population size were not determined but the lack of information suggests that lynx were scarce in the park.

In 1929, lynx were reported in the Mount Baker National Forest by the supervisor, L. B. Pagter (Edson 1930). Edson (1930) regarded the lynx as being on the verge of extinction within the forest. Allen Brooks (1930) noted that although bobcat (*Lynx fasciatus*) were common throughout the Mount Baker National Forest, the only definite record of a *Lynx canadensis* was one trapped by his brother in 1897.

Dalquest (1948:240) noted:

> 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 sightings occasionally occurred in southeastern Washington. A male captured in 1931 near Mt. Misery in the Blue Mountains of Garfield County confirmed the presence of lynx in this vicinity (Couch 1932). By 1948 lynx were seldom seen in the Blue Mountains but remained in the higher elevations of the Cascade Mountains and the mountains of northeastern Washington. Nellis (1971) attributed the apparent decrease in the distribution and abundance of lynx prior to 1940 to trapping pressure.

Harvest Reports. During the 1800's lynx pelt prices were low and lynx were harvested incidental to other furbearers in Washington (Brittell et al. 1989). Lynx harvest was unregulated and occurred when pelts were in prime condition. In 1933 the lynx was classified as a furbearer by the Washington Department of Game (WDW). As a furbearer,

lynx were not harvested for bounty although an occasional lynx may have been misidentified as a bobcat and killed for bounty. Trapping was proclaimed the only legal harvest method and hunting was prohibited. The first lynx season was set for 3 months (1934-35).

Monitoring of lynx harvest by the WDW began in 1961 with the inclusion of lynx in the mandatory Trapper's Report of Catch. In 1978, WDW initiated mandatory pelt tagging of all harvested North American lynx in cooperation with the Convention on the International Trade of Endangered Species (CITES). CITES Reports reflect actual tagged pelts and therefore provide a more accurate estimate of harvested lynx. With the initiation of the hunting permit season in 1985, lynx harvest information was obtained directly from sportsmen drawn for permits. For the trapping and permit seasons 1960-61 to 1990-91, a harvest of 215 lynx was reported in Washington (Figure 4, Appendix C). Reported harvest likely represents only a portion of the actual harvest that took place. Based on all available reports, the highest harvest occurred in Ferry County (37%) followed by Okanogan (19%) and Stevens (10%) counties. Peak harvests occurred during the 1969-70 (31 lynx) and 1976-77 (39 lynx) seasons. The trapper report for the 1976-77 season in Ferry County may have grossly underestimated true harvest as two local trappers reported harvesting a total of 35 lynx that season in the Kettle Range alone (S. Zender, pers. comm.). Lynx were harvested incidentally to other furbearers in the south Cascades and southeastern Washington; individuals harvested during the 1960's and 70's in these locations were likely transient lynx. Yearly harvest rates dropped dramatically following the peak of the 1976-77 season. From 1980 to 1991, seven harvested lynx were reported statewide. Shortened trapping seasons (Appendix D) and area closures are partially responsible for this decline. An analysis of the harvest in 5-year segments beginning with the 1960-61 season shows a general shift in harvest from northeastern Washington to central Washington (Table 5). Reports from southeastern Washington had slowly diminished; the last report occurred on 30 August 1963 in Whitman County (Appendix B).

Local trappers and houndmen in northeastern Washington have a good knowledge of the condition of local lynx populations. These sportsmen were consulted in the early and mid-1980's regarding the general status of the lynx. The consensus was that lynx populations were low and since the late 1970's had continued to decline (S. Zender, letter dated 23 Apr 1984 to D. Brittell). Few track sightings were witnessed in the Kettle Range of Ferry County in northeastern Washington, traditionally known to support a high concentration of lynx. According to trapper reports, harvest rates county-wide had declined from 17 in 1976-77 to only two for the years 1978 to 1990. Shorter season lengths may be partly responsible for the apparent decline, having been reduced from 3.5 months in 1976-77 to 1 month for the years 1977 to 1987. Lynx presence remained in the Wedge area of Stevens County, another traditional area. However, local biologists estimated a maximum of 15 to 20 cats scattered in small family groups (S. Zender, letter dated 23 Apr 1984 to D. Brittell). Lynx sightings and track observations had also become rare in Pend Oreille County and may have been attributed to declining populations, the lack of surveys, or both. The apparent decline in the lynx population in northeastern Washington from 1970 to the mid-1980's may have been the

Figure 4. North American lynx harvest in Washington, 1960-1991.

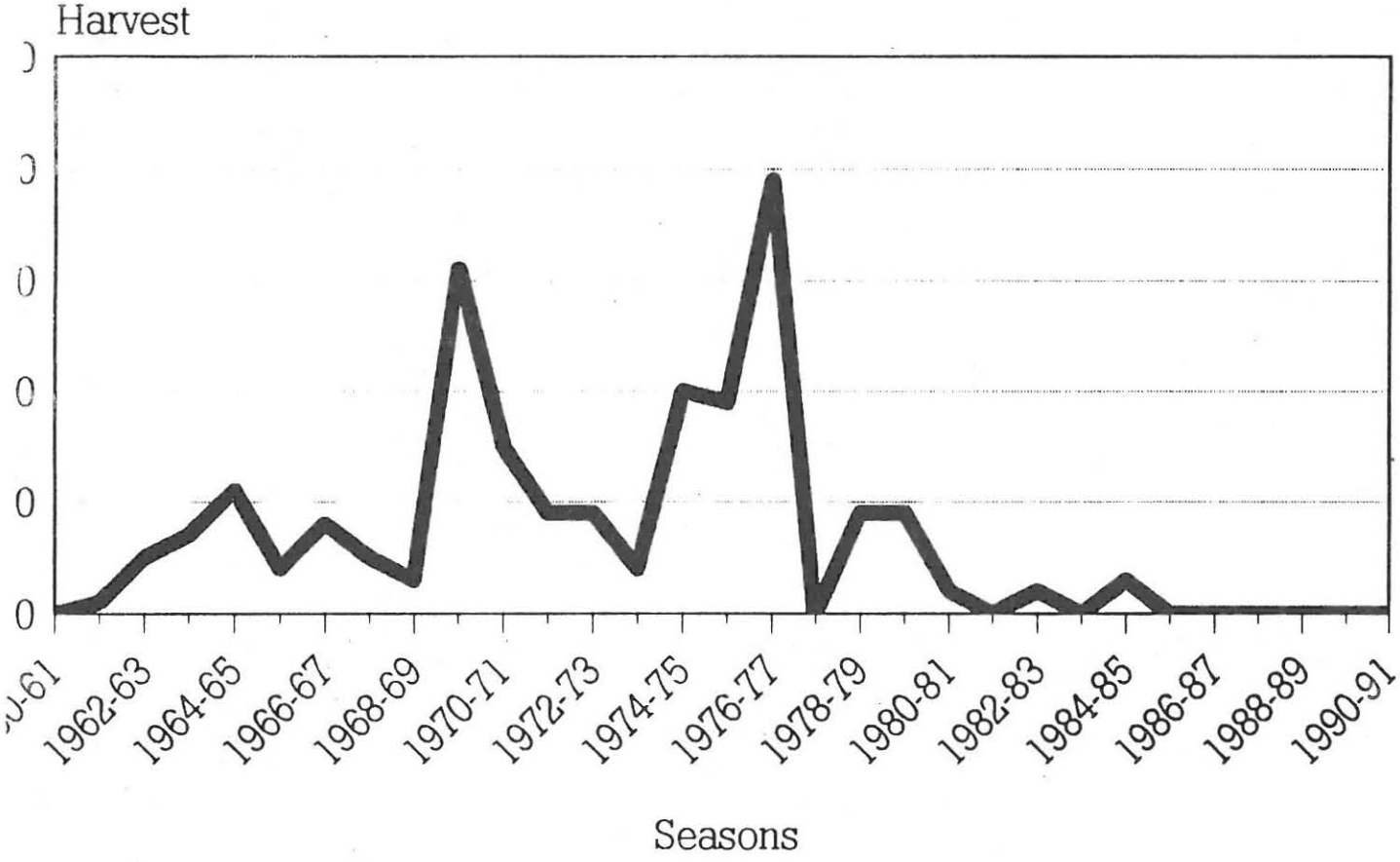

Table 5. North American lynx harvest in Washington by county in five year segments.

Seasons	Total Harvest[a]	County	County Harvest	County %
1960-61 to 1965-66	28	Chelan	10	36
		Ferry	4	14
		Spokane	4	14
		Okanogan	2	7
		Cowlitz	2	7
		Asotin	1	4
		Garfield	1	4
		Lincoln	1	4
		Snohomish	1	4
		Lewis	1	4
		Mason	1	4
1966-67 to 1970-71	62	Ferry	35	56
		Douglas	14	23
		Okanogan	8	13
		Spokane	2	3
		Chelan	1	2
		Klickitat	1	2
		Lewis	1	2
1971-72 to 1975-76	61	Ferry	21	34
		Stevens	13	21
		Okanogan	9	15
		Pend Oreille	7	11
		Garfield	4	7
		Yakima	3	5
		Douglas	1	2
		Grant	1	2
		Chelan	1	2
		Pierce	1	2
1976-77 to 1980-81	59	Okanogan	19	32
		Ferry	17	29
		Stevens	9	15
		Pend Oreille	8	14
		Yakima	2	3
		Lincoln	1	2
		Spokane	1	2
		Franklin	1	2
		Klickitat	1	2
1981-82 to 1985-86	5	Ferry	2	40
		Okanogan	2	40
		Chelan	1	20
1986-87 to 1990-91[b]	0		0	0
TOTAL	215		215	100

[a] Harvest figures derived from WDW furbearer reports and may include lynx cats (misidentified bobcats).
[b] From 1987 to 1989 WDW permit system reduced from four to two statewide. Lynx season closed in 1991.

result of habitat alteration (removal of lodgepole pine thickets through timber harvest), habitat maturation (versus early successional forests preferred by lynx), road construction and the subsequent increased access for snowmobiles and all-terrain vehicles which led to excess trapping, or some combination of these factors.

Incidental Sightings/Occurrence. Lynx are often seen in non-traditional areas or habitats during years of unusually high numbers in Canada and Alaska. In North Dakota, lynx were shot in towns and were seen in plowed fields and pastures miles from forests during the high populations years of 1961-62 (Adams 1963). Presumably, the animals were in search of food and adequate habitat. Todd (1985) commented on lynx sightings since the early 1960's in the partly cleared, mixed farming district near Rochester in central Alberta. Wooded sections of this area contain prime lynx habitat whereas the agricultural lands do not (Brand et al. 1976). Todd believes lynx are tolerant of human activity if unmolested based on observations of lynx in close proximity to major highways and towns in Alberta and the lack of alarm behavior demonstrated by these animals. B. Slough (pers. comm.) has observed similar behavior in the city of Whitehorse, Yukon during a lynx and snowshoe hare decline.

Incidental sightings in Washington also coincide with peaks in northern populations. For example, during the Canadian peaks of the 1960's and 1970's lynx were collected in Whitman and Douglas counties (1962-1965) and there were sightings from several western Washington locations (mid-1970's) (Appendix B). Incidental sightings of lynx in the south Cascades and southeastern Washington historically and today are assumed to represent transient individuals migrating.

Present

Washington's lynx population is estimated to range from <96 to 191 individuals. This range was determined using two methods: applying a density estimate to suitable habitat; and a biological adjustment based on current conditions. Lynx range in Washington contains approximately 7,532 km^2 (2,937 mi^2) of suitable habitat based on GIS information (WDW unpubl. data) (Table 6). A density of 2.5 lynx/100 km^2 was extrapolated to suitable habitat within each of the six zones. This density estimate is derived from the average of 2.4 lynx/100 km^2 (Brittell et al. 1989) and 2.6 lynx/100 km^2 (Koehler 1990) determined in the Okanogan study area. The amount of suitable habitat within the Okanogan zone was reduced from 7,620 km^2 to 5,105 km^2 to account for the existence of non-lynx habitat. Non-lynx habitat was identified using data from a WDW Grizzly Bear Study (unpubl. data) and adjusted based on the existence of non-lynx habitat components in occupied lynx range (Brittell et al. 1989). Extrapolations using this technique result in a statewide estimate of 191 lynx (Table 6). This estimate is comparable to Brittell et al.'s (1989) estimate of 225 lynx using a statewide habitat tabulation of 9,550 km^2 (3,673 mi^2). These estimation techniques imply that habitat suitability and lynx densities are similar throughout lynx range. This is not the case and these population numbers may be overestimated.

To account for differences in the ability of the habitat to support lynx and to reflect the current occupancy of the different zones, a more conservative estimate was made. This second technique, using biological evaluation, resulted in a statewide estimate of <96 lynx. The estimate of 50 for the Okanogan zone is based on an analysis performed by Koehler (1990). Estimates derived for the remaining five zones were based on personal communications with WDW and USFS biologists and experienced trappers.

Table 6. Population estimates of North American lynx in Washington by zone[a].

Zone	Area (km^2)	Suitable Habitat (km^2)	Density Derived Estimate[b]	Adjusted Estimate[c]
Okanogan	7,620	5,105[a]	128 lynx	50 lynx
Vulcan Mountain	17	17	1 lynx	0 lynx
Kettle Range	903	903	23 lynx	<12 lynx
The Wedge	180	180	5 lynx	< 5 lynx
Little Pend Oreille	585	585	15 lynx	<10 lynx
Salmo Priest	742	742	19 lynx	19 lynx
TOTAL	10,047	7,532	191 lynx	<96 lynx

[a] 67% of the Okanogan zone is considered suitable habitat.
[b] Estimates derived from extrapolating a density of 2.5 lynx/100 km^2.
[c] Adjusted population estimate based on biologist evaluation of current conditions (S. Zender, pers. comm.; G. Koehler unpubl. data)

Lynx sightings have not been documented recently in the Blue Mountains of southeastern Washington. Sporadic sightings continue in the Cascade Range south of the Entiat-Chelan Mountains but this area is not considered supportive of a resident population. The six zones identified as lynx range potentially support resident lynx.

Okanogan Zone. This zone supports the most viable lynx population based on expanse of habitat, population size, past and current sightings and track records, research performed within the area, and management opportunities. Lynx within the Okanogan zone are believed to be more sustainable due to the contiguity of habitat in Washington and British Columbia and because of the high proportion of public lands and potential for management. Trapping pressure in the Okanogan zone has been relatively low in intensity, ranging from one to five animals per year; the exception being the 1978-79 season in which nine lynx were harvested. A moderate reduction in population size from historic numbers has likely occurred as a result of fire suppression and the subsequent maturation of forests in this zone (Koehler 1988). An apparent decline in the population of North American lynx in British Columbia may also limit the number of migrating lynx which could potentially augment Washington's population in favorable years. However, adequate numbers of lynx would likely reach the Okanogan region from British Columbia to add genetic strength to the population.

Vulcan Mountain Zone. The Vulcan Mountain lynx population is the least viable of the six subpopulations. Vulcan Mountain consists of 1,722 ha (4,253 ac) and strictly relies on its connection to Canada. Without this connection, the area is too small to support a resident population of lynx [< 1 lynx possible based on density extrapolations]. Currently, no lynx are believed to occupy the Vulcan Mountain zone. The likelihood of maintaining Vulcan Mountain as an extension of the British Columbia population is high provided public agencies are willing to cooperate on management activities. Vulcan Mountain, like the Wedge, may serve its greatest purpose as a travel corridor from British Columbia to the Kettle Range. However, lynx immigrating to areas other than the Kettle Range would need to pass through extensive grasslands. A trapper north of Vulcan Mountain in British Columbia has recently harvested lynx in the area and attests to the quality of lynx habitat (S. Zender, pers. comm.). Current levels of habitat alteration by logging and/or other activities northwards of Vulcan Mountain is unknown. Although this zone is too small to support a distinct population of lynx in Washington, the habitat is suitable enough to comprise the southern tip of one or more lynx home ranges. Thus, although important as a travel corridor, the Vulcan Mountain is not currently considered supportive of a distinct resident population of a lynx in Washington.

Kettle Range Zone. The third most viable population is that within the Kettle Range. The Kettle Range contains the second largest block of lynx habitat in Washington. By extrapolating density figures to available habitat, the Kettle Range should be capable of supporting 23 lynx. Based on local biologist evaluation of current habitat conditions and numbers of sightings, a more realistic population estimate may be less than half the potential. Recent sightings of adults and juveniles confirm the presence of a lynx population in this zone. Past timber harvest in the Kettle Range has been extensive. Compounded with habitat alteration, lynx were over-exploited in the 1960's and 1970's through trapping (66 lynx were reported harvested in Ferry County from 1970 to 1980). Lynx harvest during this time was partly a reflection of the influx of individuals from Canada. Since the late 1970's, the lynx population in the Kettle Range has been sustained at low levels. Furthermore, the influx of lynx from Canada has apparently been low over the past 13 years. In summary, a significant reduction in the population of lynx occupying the Kettle Range has occurred since the 1960's. The lynx population in this zone is believed to currently be vulnerable due to the compounded effects of habitat alteration, past trapping mortality, and lack of a direct connection to British Columbia therefore decreasing the potential for resettlement by immigrating lynx.

The Wedge Zone. It is questionable as to whether there is a reproducing population currently occupying the Wedge. The Wedge contains 17,988 ha (44,430 ac) and exists solely as a function of its connection to Canada. Habitat within this area has always been marginal; however, habitat northwards into Canada is excellent. Potentially, the Wedge could support five lynx based on density figure extrapolations. More realistically, the Wedge probably supports fewer lynx. The last track record for the Wedge was in 1987 and was a solitary animal. Due to the connection to Canada, the potential for immigrating lynx to resettle the

Wedge continues to be high. However, the lack of suitable habitat may preclude immigrating lynx from actually settling once they have reached the area. Furthermore, there are no refugia or roadless areas remaining in the Wedge. The greatest value for this zone may be to serve as a corridor for immigrating lynx to both the Kettle Range and Little Pend Oreille. Presently, lynx populations in the Wedge are believed to be highly vulnerable due to an insufficient amount of habitat, alteration of suitable habitat which exists, and a possible reduction in the number of lynx immigrating from British Columbia.

Little Pend Oreille Zone. Population viability in the Little Pend Oreille zone is questionable due to past habitat alteration and the natural fragmentation of suitable habitat, the lack of current sightings and track information (last sighting in 1980), and limited connection to British Columbia. The area could support 15 lynx based on extrapolations of density figures but likely supports much fewer. Habitat alteration has been significant in this area. Trapping has been light in the Little Pend Oreille although reported mortality from illegal hound hunting was significant in localized areas in the 1960's and 1970's. The only suitable habitat remaining which is contiguous enough to support lynx may be in the northern section (Abercrombie Mountain to Frisco Mountain). Overall, there appears to have been a significant decline in the population occupying the Little Pend Oreille zone since 1960.

Salmo Priest Zone. This zone supports the second most viable lynx population based on expanse of habitat, population size, past and current sightings and track records, and management potential. The zones connection to Canada and Idaho is good and the potential for immigrating lynx to occupy available habitat is strong. The northern portion of this area contains excellent habitat and is fairly inaccessible due to the rugged terrain and USFS wilderness designation restrictions on road construction. The occurrence of recent sightings in this area (along with a majority of past sighting for northeastern Washington) confirms the continued presence of resident lynx. Trapping intensity in the Salmo Priest has been relatively light with a high harvest of six in 1974-75 and five in 1976-77. Illegal harvest was thought to be significant in local areas but only for short durations. Based on biological evaluation and habitat conditions, a moderate decline in lynx abundance has occurred in the Salmo Priest zone. This decline is primarily due to alteration and/or maturation of habitat.

Future

A prediction of the future population status may be based on several facts and assumptions. States and provinces use various techniques to estimate future lynx population numbers. These techniques include:

> *Monitor harvest*: An analysis of lynx or snowshoe hare harvest trends in order to predict the next peak in the 10-year cycle.

Table 7. Past timber harvest (ha) estimates within North American lynx range on lands administered by the USFS and the WDNR by zone in Washington[a].

Zone	Agency	Area Administered for Timber Management[b]	Harvested Area	
			ha	%
Okanogan	USFS	284,364	39,085	14
	WDNR	39,166	2,141	5
Vulcan Mountain	USFS	1,317	1,109	84
	WDNR	70	70	100
Kettle Range	USFS	52,199	22,566	43
	WDNR	779	0	0
The Wedge	USFS	13,494	5,749	43
	WDNR	1,190	241	20
Little Pend Oreille	USFS	31,813	9,958	31
	WDNR	7,665	0	0
Salmo Priest	USFS	44,710	5,992	13
	WDNR	1,689	0	0
TOTAL	USFS	428,021	84,459	20
	WDNR	50,559	2,452	5

[a] Information obtained from GIS mapping of timber harvest data collected from the USFS and the WDNR. Estimates reflect activity over the past 5 to 10 years.
[b] Does not include wilderness, parks, national recreation areas, research natural areas, or roadless areas.

Table 8. Fire history within North American lynx range on lands administered by the USFS in Washington[a].

Zone	Administered Area (ha)	Burned Area	
		ha	%
Okanogan	675,366	13,551	2
Vulcan Mountain	1,317	236	18
Kettle Range	70,800	8,887	13
The Wedge	13,494	0	0
Little Pend Oreille	36,994	247	0.7
Salmo Priest	62,807	589	0.9
TOTAL	860,778	23,510	3

[a] Information obtained from GIS mapping of fire history data. Tabulations represent fire occurrence over the past 15 to 20 years.

The Wedge Zone. Past timber harvest on lands managed for timber production by the CNF within the Wedge has amounted to approximately 43%. The Washington Department of Natural Resources has harvested roughly 20% of the land which they administer in the Wedge in the past five years. Total harvest within the Wedge by the CNF and the WDNR combined amounts to a minimum of 41% of the land administered by these 2 agencies. Fire occurrence has not been documented within the Wedge. Timber harvest activity may be significant on private lands (amounting to 18% of the zone).

Little Pend Oreille. Past timber harvest by the CNF has been significant in the Little Pend Oreille (31% of the non-protected area administered by the CNF) and has involved mostly selective cuts. The Washington Department of Natural Resources activity database documents zero timber harvest on the 7,665 ha (18,933 ac) administered by this agency. Total past harvest by the CNF and the WDNR in the Little Pend Oreille zone amounts to a minimum of 25% of area managed by these 2 agencies over the past 5 to 10 years. Past timber harvest activity on private lands would likely inflate the past habitat alteration estimate. Road construction has also been significant and has lowered the potential of the area. Fire history is unavailable for lands administered by the WDNR; however, fire occurrence on CNF lands in the Little Pend Oreille zone has amounted to a mere 0.7%.

Salmo Priest. Timber harvest on lands administered by the CNF has amounted to roughly 13%. The Washington Department of Natural Resources database documented zero timber harvest on WDNR lands in the Salmo Priest in the past five years. Fire history on CNF lands within the Salmo Priest zone is negligible at 0.9%. A fire estimate for WDNR lands is unavailable but likely insignificant in the Salmo Priest. The level of past timber harvest on private lands (amounting to 13% of zone) in the Salmo Priest is unknown but would likely inflate the harvest estimation.

Present

Lynx distribution may be divided into two broad categories: 1) that which supports resident, reproducing individuals (range) and; 2) that which is occupied by transient animals which may or may not reproduce and/or reside throughout the year in the area. The range statewide encompasses 1,004,655 ha (2,481,498 ac) (Table 9). Included in this habitat base is the Colville National Forest, Salmo Priest Wilderness, the Kaniksu National Forest, Department of Natural Resources lands, Bureau of Land Management (BLM) lands, private lands, a portion of the Colville Indian Reservation, the Pasayten Wilderness, Okanogan National Forest, North Cascades National Park, Lake Chelan National Recreation Area, Sawtooth

Table 9. North American lynx range by county in Washington.

County	Area (ha)
Chelan	209,885
Ferry	92,013
Okanogan	424,254
Pend Oreille	101,952
Skagit	34,309
Snohomish	33,755
Stevens	48,201
Whatcom	59,354
British Columbia and Idaho borders	932
TOTAL	1,004,655

Wilderness, Glacier Peak Wilderness, Wenatchee National Forest, and the Mount Baker-Snoqualmie National Forest. Incidental sightings occur south of the Entiat-Chelan Mountains to Mount Adams. This area amounts to approximately 7,459 km^2 (2,869 mi^2) (Brittell et al. 1989). Incidental occurrence of lynx in the Blue Mountains is no longer believed to occur. Lynx range in Washington may be divided by administration as seen in Table 10 and by zone as seen in Table 11.

Table 10. Administration of North American lynx range in Washington.

	Agency Administration	
Administration	(ha)	%
USFS	860,779	85
WDNR	50,560	5
National Park	45,312	5
Other/Private	25,533	3
Tribal	18,153	2
USFWS	3,201	0.3
BLM	906	0.1
WDW	211	<0.1
TOTAL	1,004,655	101.5

Table 11. Administration of North American lynx range by zone in Washington.

Zone		Administration		
Name	(ha)	Agency	(ha)	%
Okanogan	761,979	USFS	675,366	89
		National Park	45,312	6
		WDNR	39,166	5
		Other/private	1,248	0.2
		BLM	804	0.1
		WDW	83	<0.1
Vulcan Mountain	1,723	USFS	1,317	76
		Other/private	336	20
		WDNR	70	4
Kettle Range	90,290	USFS	70,800	78
		Tribal	18,153	20
		WDNR	779	0.9
		Other/private	330	0.4
		WDW	126	0.1
		BLM	102	0.1
The Wedge	17,988	USFS	13,494	75
		Other/private	3,304	18
		WDNR	1,190	7
Little Pend Oreille	58,510	USFS	36,994	63
		Other/private	10,648	18
		WDNR	7,665	13
		USFWS	3,201	5
		WDW	2	<0.1
Salmo Priest	74,165	USFS	62,807	85
		Other/private	9,669	13
		WDNR	1,689	2

Of the 1,004,655 ha (2,481,498 ac) of land contained in lynx range, 48% are situated within the boundaries of designated wilderness areas, federal and state parks, national recreation areas, roadless areas, and research natural areas (Table 12). Area maintenance (fire management and road development) and/or response to natural conversion (wildfires, insect and disease epidemics) are site-specific. The intent is to maintain these areas in a pristine condition (Fed. Comm. Ecol. Reserves 1977, E. Gastellum, pers. comm.). The only roadless areas included in this tabulation are those in the CNF designated as Management Area 11 (MA-11, semi-primitive, non-motorized). Roadless areas throughout lynx range which are subject to timber management, road construction, and/or those which allow

seasonal off-road recreation are not included. Habitat contained within designated wilderness areas, federal and state parks, national recreation areas, roadless areas, and research natural areas is reasonably protected from human disturbance in the form of intensive timber management and road construction. However, habitat contained within these areas is not necessarily adequate lynx habitat based on designation. Marginal habitat conditions and maturation of suitable habitat may naturally exist.

Table 12. Designated wilderness areas, parks, national recreation areas, roadless areas, and research natural areas (ha) within North American lynx range by zone in Washington.

Zone	Area Within Zone	Wilderness Area	Federal and State Park	National Recreation Area	Roadless Area[a]	Research Natural Area	Percent of Zone Under Designation
Okanogan	761,979	390,878	33,118	12,194	0	124	57
Vulcan Mtn	1,723	0	0	0	0	0	0
Kettle Range	90,290	0	0	0	18,601	0	21
The Wedge	17,988	0	0	0	0	0	0
Little Pend Oreille	58,510	0	0	0	5,181	0	9
Salmo Priest	74,165	15,876	0	0	1,658	563	24
TOTAL	1,004,655	406,754	33,118	12,194	25,440	687	48[b]

[a] To be maintained in a primitive condition; designated until the release of subsequent forest plans.
[b] Represents total lynx range designated as wilderness, park, national recreation area, roadless area, and research natural area.

Future

Potential habitat alteration manifests in the form of timber harvest, wildfires, and insect and disease infestations. The 10-year future timber harvest plans for the Colville (CNF 1988), Okanogan (ONF 1989), and Wenatchee (WNF 1990) national forests outline potential timber harvest boundaries which do not generally equal actual cut areas. Future timber harvest assessment for lands managed by the USFS within lynx range amounts to 35% of the available land in the next 8 years (Table 13). Future timber harvest information on lands managed by the WDNR was unavailable.

Table 13. Potential timber harvest (ha) within North American lynx range by the USFS in Washington[a].

Zone	Presently Administered for Timber Management[b] (ha)	Under Assessment for Timber Harvest ha	%
Okanogan	284,488	58,913	21
Vulcan Mountain	1,317	247	19
Kettle Range	52,199	47,308	91
The Wedge	13,494	9,423	70
Little Pend Oreille	31,813	20,810	65
Salmo Priest	44,710	11,511	26
TOTAL	428,021	148,212	35

[a] Information obtained from GIS mapping of future timber sales by the USFS. Represents planned sales from 1993 to 2000.
[b] Does not include national recreation areas, research natural areas, parks, roadless areas, or wilderness areas.

According to the WDNR's Draft Forest Resource Policy Plan (1991), harvest levels for the coming decade are calculated and divided over a 10-year period to obtain the average annual harvest volume. The Washington Department of Natural Resources has not calculated precise harvest figures for department lands outside of the Loomis Forest for the 1990's. Average yearly timber harvest in the 1980's throughout WDNR holdings amounted to 756 million board feet.

Natural environmental disturbances have the ability to alter additional habitat. For example, from 1910 to 1940, an average of 83 fires occurred each year in the CNF burning an average of 8,200 ha (20,523 ac) yearly (Hougland 1941). Fire suppression, which began some 50 years ago, has reduced the frequency of fire occurrence but has resulted in a build-up of fuel over large areas. The ability of the USFS and the WDNR to curtail large fires resulting from this build-up is questionable. Insect and disease epidemics would further remove available habitat and elevate fire potential.

Okanogan Zone. According to the ONF Land and Resource Management Plan (1989), 21% of the zone is under assessment for future timber harvest in the next five years. The Washington Department of Natural Resources plans to harvest an additional 11 MMBF [approximately 174 ha (430 ac)] per year in the Loomis Forest, which has a total land base of 34,219 ha (84,521 ac) (R. Paul, pers. comm.). Planned timber harvest estimates by the WDNR on lands outside the Loomis Forest within the Okanogan zone are unavailable. As outlined in the lynx habitat management guidelines, maximum acceptable non-lynx cover over a 20-year period is 30%. Based on past timber harvest history and planned harvest within the Loomis Forest we assume that timber harvest on WDNR lands will exceed this ratio. Total area under assessment for timber harvest by the ONF and WDNR combined in

20-year time span would result in the vulnerability of lynx habitat in this area. In localized areas, habitat maturation has created sites unsuitable for lynx. Where this has occurred, timber harvest may benefit lynx by creating habitat over time. However, this will depend on maintaining a rate of harvest which ensures the stability of lynx within the zone between the time of cut and the replacement of suitable habitat.

CONSERVATION STATUS

Legal Status

Washington. Lynx are a furbearer and a game species in Washington. They were added to the WDW list of candidate species on 27 November 1991 (WDW Policy 4802). The trapping and hunting (permit only) season on lynx was closed in November 1991.

Colville Tribe. Lynx are a furbearer on the Colville Indian Reservation with a closed trapping season beginning in the late 1980's and a closed hunting season beginning in 1991 (S. Judd, pers. comm.).

U.S. Fish and Wildlife Service (USFWS). The lynx is considered a category 2 species throughout its range by the USFWS. Category 2 species are "Taxa for which information now in possession of the Service indicates that proposing to list as endangered is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available." On 22 August 1991 the USFWS received a petition to emergency list the lynx in the North Cascades Ecosystem as endangered. The USFWS made a "no action" decision on 4 February 1992. The decline was based on the inability of the petition to show a substantial decline throughout a significant portion of lynx range and the petition's failure to present other substantial evidence (Federal Register 1992).

U.S. Department of Agriculture, Forest Service. The lynx is on the USFS Region 6 (Pacific Northwest Region) Sensitive Species List. A sensitive species is "one for which population viability is a concern as evidenced by significant current or predicted downward trends in population numbers or density, or habitat capability."

Alaska. The lynx is classified as a furbearer (subject to taking with a trapping license) and a fur animal (subject to taking with a hunters license) (S. Peterson, pers. comm.). Only one of the 23 management units in Alaska maintains a bag limit (three) for trappers. The harvest limit for hunters statewide is two. Harvest seasons for lynx have recently been liberalized in Alaska due to high production rates as reflected in the annual harvest (S. Peterson, pers. comm.). Current season lengths range from 1 to 4.5 months, depending on the location.

Colorado. The lynx season was closed in 1970 in Colorado. In 1973, the lynx was classified as endangered by the Colorado Division of Wildlife (J. Sheppard, pers. comm.).

Idaho. Lynx are considered a furbearer in Idaho. The Idaho Fish and Game Department maintains a lynx trapping (trapping permit required), hunting (hunting permit required), and pursuit season (G. Wills, pers. comm.). The lynx season is open through December with a statewide harvest limit of three.

Minnesota. The lynx is considered a furbearer in Minnesota with a closed season beginning in 1984 (M. Doncarlos, pers. comm.).

Montana. Lynx are considered a furbearer in Montana with a 2.5 month trapping season (1 Dec.-15 Feb.). In 1990 the trapping districts were combined and a statewide quota of 10 (reduced from 40) was enacted (G. Erickson, pers. comm.).

North Dakota. Lynx are considered a furbearer in North Dakota with a closed season beginning in 1981. The North Dakota State Game and Fish Department is currently not considering any change in status or management of lynx (S. Allen, pers. comm.).

Oregon. Lynx have been considered extirpated for many years in Oregon although no formal listing or management plan has been conducted (B. Posey, pers. comm.). Lynx are currently classified as game species with a closed season.

South Dakota. Resident lynx populations have never existed in South Dakota and lynx have never been classified (L. Frederickson, pers. comm.).

Utah. Lynx are a listed as a threatened species in Utah (B. Blackwell pers comm.).

Wisconsin. The lynx was listed as an endangered species by the Wisconsin Department of Natural Resources in 1973 and is a fully protected species (R. Jurewicz, pers. comm.).
Wyoming. In 1973, the lynx was reclassified as a protected species in Wyoming (H. Harju, pers. comm.).

Northeastern United States. Lynx populations in Maine, Michigan, New Hampshire, and Vermont are not trapped or hunted (Deems and Pursley 1983).

Canada. North American lynx are considered a furbearer throughout Canada and are managed for commercial use (Goodchild and Munro 1980). In British Columbia, the lynx was recently classified as a Class 2 species: those furbearers not present on most registered traplines in manageable numbers, and which are vulnerable to over-harvest (Hatler 1988).

Management Activities

Washington Department of Wildlife. In 1989, the WDW made public a draft of *Native Cats of Washington* (Brittell et al. 1989) which described the lynx and its distribution, food habits, habitat preference, use of space, productivity and mortality, population estimate, and

However, 6 tickets were issued for the illegal capture of lynx in 1978-79 and 10 from 1975 to 1981 (Brittell et al. 1989). The adequacy of regulating illegal harvest during years of high pelt prices is a concern.

Washington Department of Natural Resources. The lynx is not currently listed as an endangered, threatened, or sensitive species by the USFWS or WDW and are therefore not actively managed by the WDNR. The Washington Department of Natural Resources is currently developing the Loomis Landscape Management Plan which will address lynx habitat issues on a watershed basis. Presently, watershed analysis boundaries have not been agreed upon by the WDW and the WDNR. Furthermore, the memorandum of understanding between the WDW and the WDNR has not been initiated pending complete agreement on lynx habitat requirements. The WDNR has not shown a commitment to implement the lynx habitat recommendations in their entirety as developed by the USFS and the WDW on either the Loomis Forest or on other WDNR holdings within the lynx range. Furthermore, the citizens' advisory committee organized to review timber sales within the Loomis Forest has been redirected to develop a forest plan. Lynx range administered by the WDNR is considered to be at a high risk of removal due to extensive planned timber harvest, the lack of agreement on watershed analysis boundaries, and on the failure to fully implement lynx habitat recommendations as developed by the USFS and the WDW.

Okanogan National Forest. The Okanogan National Forest, in full cooperation with the WDW, have addressed the needs of lynx through its development of lynx habitat guidelines for north-central Washington. These guidelines have been implemented within the MA-12 designation. There is currently no written commitment by the ONF to manage for lynx on the remaining lands, some of which are documented high lynx concentration areas. Many of these concentration areas contain standards and guidelines for intensive timber and range resource management. Standards and guidelines developed for MA-12 are designed to provide lynx habitat while concurrently growing and producing merchantable wood fiber. Clarification on the execution of the guidelines may be needed prior to acceptance (K. Woodruff, pers. comm.), especially regarding timber harvest ratios and road construction. A verbal commitment has recently been expressed by the ONF (B. Naney, pers. comm.) to consider lynx habitat needs during environmental assessments throughout the Forest. Regardless, both habitat and lynx populations outside of MA-12 are considered to be at a higher risk than that within the MA-12 designation.

Colville National Forest. The Colville National Forest currently uses management prescriptions for Franklins grouse and other old growth dependent species to address the needs of lynx. The greatest discrepancies between lynx management guidelines and the CNF Forest Plan likely include (T. Burke, pers. comm.):

1) consistency of foraging habitat for lynx over time (would depend on an even ratio of timber harvest and efforts focused at forest health in lodgepole pine communities);
2) lodgepole pine stand conversion;
3) contiguity of travel cover (especially the protection of major ridges and saddles);
4) adequacy of meeting denning cover requirements through prescriptions for old growth dependent species (J. McGowan, pers. comm.);
5) exceeding the 30% non-lynx habitat guideline.

Closely monitoring the forest (as outlined in the forest plan) would be vital in order to measure the ability of the plan to produce the desired results (T. Burke, pers. comm.). Key consideration for monitoring activities would include:

1) the creation of adequate stem densities in managed stands;
2) the dispersion of age classes in managed stands;
3) the contiguity between cover types (travel corridors);
4) the percentage of denning habitat throughout the forest;
5) acceptable levels of down material in denning cover;
6) adequate amounts of down material in travel cover for thermal protection (especially in view of prescribed fire use for lodgepole pine management);
7)acceptable human disturbance (especially within recreation, wilderness, motorized recreation, and non-motorized recreation management units);
8) the application of pesticides for pest management;
9) road construction and road density.

Feasibly, timber management would include silviculture prescriptions which create habitat that meets travel cover requirements and possibly foraging requirements. Assessment areas are also larger than the actual cut areas. In spite of these considerations, it is likely that timber removal may exceed the 30% non-lynx cover area restrictions creating a high risk situation in those areas administered by the CNF.

Wenatchee National Forest. The Wenatchee National Forest has not developed a species management plan for lynx and will not be developing one in the foreseeable future (C. Phillips, pers. comm.). In the absence of lynx management guidelines, the adequacy of management for viability is questionable. Certain lynx requirements may be addressed through standards and guidelines for other species. However, the ability to maintain a resident population of lynx in the WNF cannot be assured without specific habitat and population management recommendations. These recommendations must thoroughly meet the needs of lynx and must contain a schedule of monitoring activities. Implementation of

the standards and guidelines developed for MA-12 in the ONF to lynx range within the WNF would increase the stability of lynx in this area. Until these actions are taken, habitat and populations within the WNF are considered to be at risk.

Colville Tribe. Lynx habitat requirements are considered in land management activities on the Colville Indian Reservation; however, forest health and potential income loss make it difficult to carry out management guidelines. Forest Practice Rules and Regulations (State Wash. For. Practice Board and Dept. Ecol. 1992) do not apply to tribal lands except for lands enrolled in federal programs. Lands owned and operated by private companies within the Colville Indian Reservation are subject to the Forest Practice Rules and Regulations (State Wash. For. Practice Board and Dept. Ecol. 1992) which require limitations in watershed usage, woodlands conversion, and stream and forest manipulation.

British Columbia Ministry of Environment, Wildlife Branch. Currently, there are no coordinated lynx management activities or cooperative agreements between the WDW and the British Columbia Ministry of Environment. Biologists for the Ministry have attended several U.S. state and federal interagency meetings which have taken place in Washington and Oregon. However, no management plans or agreements have been developed which would ensure lynx habitat and population protection. The Ministry curtails lynx trapping and hunting during a decline in the lynx cycle but does not close the season across southern British Columbia where lynx densities are low. Exploitation of lynx in British Columbia could affect the number of lynx immigrating to Washington.

Prey Availability

Lynx dependence on snowshoe hares as prey is commonly accepted throughout their range. A lack of snowshoe hares may be considered one of the greatest limiting factors of North American lynx. Presently snowshoe hare densities are considered stable in Washington based on furbearer harvest reports (WDW Wildl. Manage. Div. 1992, 1993) and hare track surveys (WDW unpubl. data). Lynx would be adversely affected and local populations potentially eliminated should snowshoe hare numbers or snowshoe hare habitat greatly decline. A decline in the lynx population during a low in the snowshoe hare cycle (albeit undetectable in Washington) should not have drastic effects on future populations provided suitable foraging and denning habitat exists. This is due to the resiliency of lynx to improved prey conditions expressed as a function of greater reproduction and kitten survival. Due to the strong interaction of lynx and snowshoe hare populations, management for one species must take into consideration the other.

Human Interaction

Human activity results in the greatest mortality of lynx, principally through trapping. Illegal harvest in Washington by hound hunters has been significant in localized areas in the past. Other causes of death appear negligible (cannibalism, predation, disease). However,

starvation of kittens may be significant during periods of limited numbers of snowshoe hares. Currently, pelt prices for lynx are low and likely indirectly control the illegal harvest of lynx. Higher pelt prices and increased road construction leading to greater access may elevate the threat of human-caused mortality. Road construction which accompanies timber management is of primary concern in eastern Washington.

Insect and Disease Epidemics of Forests

Insect and disease epidemics could potentially increase forest fuels (dead and down material) which elevate the risk of catastrophic fires (Geiszler et al. 1980). However, epidemics are a natural function of the forest ecosystem. Early successional forests such as extensive tracts of even-aged lodgepole pine are a result of the cyclic interactions of mountain pine beetle (*Dendroctonus ponderosae*) attacks and stand regeneration by fire (Brown 1975). Insect outbreaks also increase foliage and root production in the ground layer and in herbs, shrubs, and trees (McCambridge et al. 1982, Waring and Pitman 1985). Romme et al. (1986) further noted that a massive and sudden disturbance (the death of a large fraction of the plant community within a few years) leads to only a brief drop in primary productivity (of a stand) and to a more equitable distribution of living matter and resources.

Insect epidemics depend upon several interacting factors including stand vigor, distribution of tree sizes, distance between trees, the reservoir of trees available for attack, and the size of the beetle population (Mitchell in press). When forests become mature and stem density increases, individual trees lose vigor and tree stands become susceptible to insect and disease epidemics (Raffa and Berryman 1983). Epidemics, such as the mountain pine beetle epidemic occurring in eastern Washington, typically endure for 15 to 20 years, followed by a quiet period of 30 to 40 years (Mitchell in press). These epidemics may result in the death of 100 to 300 trees/acre. Historically, sporadic fires served to rejuvenate mature stands of lodgepole pine and other fire tolerant tree species creating early- and late-successional thickets (Johnson 1992). In creating such successional thickets, insects and forest diseases which typically infect mature stands were reduced. Fire suppression (R. Mitchell, pers. comm.) and the subsequent maturation of forests have elevated infestation rates by insects such as the mountain pine beetle and the western spruce budworm (*Choristoneura occidentalis*) and diseases such as mistletoe and root rot in the forests of eastern Washington. Infestations of mountain pine beetles began in the Boulder Creek drainage of the ONF in 1986 and appear to be spreading to adjacent, susceptible stands (ONF Final Environ. Impact Statement 1989: III-39). Lands being invaded by mountain pine beetle include both USFS and WDNR holdings.

Of concern in forest health issues are large silvicultural prescriptions aimed at reducing potential threats of epidemics prior to an outbreak. In order to control an epidemic once its begun, pesticides, herbicides, timber harvest, or prescribed burns may be used. These methods pose a problem in that target areas are not always defined for pesticides and herbicides and may affect uninfested areas. Pitman et al. (1982) reasoned that chemical

control of mountain pine beetle attacks is not an option, except on individual high-value trees. The primary practice in mountain pine beetle management has been to harvest a stand when it reaches approximately 70 to 80 years and an average diameter at breast height of 18 to 20 cm (7-8 in). Salvage logging of dead and dying trees during the first or second year after an attack is also common practice (Pitman et al. 1982). Large scale timber harvest may pose a greater threat than infestation by creating openings too large to be used by lynx. Timber harvest and roads developed for harvesting also removes essential foraging, thermal, stalking, and denning habitat and increases access potential. Prescribed fires are the preferred management option.

Insect and disease outbreaks may be reduced by maintaining a mosaic of stands with a variety of age classes (Pitman et al. 1982, Mitchell in press). Thinning young stands (<50 year-old trees) and older stands (120 years) may be used to increase tree vigor and reduce the number of trees which will eventually fall into the susceptible age class (≥ 60 year-old trees) for a mountain pine beetle attack. Salvage of beetle killed trees may permit some economic recovery but has little impact on the outbreak due to the prior emergence of new generations of beetles (Pitman et al. 1982). Fertilizers may also be applied to increase tree vigor. Forest health management which provides a temporal and spatial mosaic of age classes can be compatible with lynx habitat management. The need is a management plan that preserves diversity in tree age, species, and stocking over a rather large forest area (Mitchell 1989). Diversity dampens the opportunity for beetles to develop as large populations; good stocking control and healthy trees discourage attacks, even in stands with moderate to large trees (Mitchell in press). Managed stands bordering unmanaged areas such as national parks and wilderness areas are going to be exposed to periodic beetle outbreaks. In these instances, establishment of a buffer zone between managed and unmanaged areas which is intensively controlled may be warranted (Mitchell in press).

Timber Management

Lynx are a forest-dependent species, therefore, forest alteration has the greatest potential for preserving or adversely affecting lynx populations in the future. Depending upon prescription and intensity of harvest, logging may benefit lynx, snowshoe hares, and other small mammals by converting mature forests to early successional stages. Timber harvest may also compensate for forest maturation which has resulted from fire suppression and control. Carefully planned, integrated, and implemented silvicultural treatments could closely mimic known natural processes (Freedman and Habeck 1984). This will depend on the coordination of future development policies and the multiple land users involved. Lynx habitat management guidelines developed by the USFS and the WDW specify key considerations in the management of habitat for lynx. Although untested, forestry activities consistent with these guidelines have the ability to maintain or increase lynx populations (Burris 1971, Nellis 1971, Parker et al. 1983). Brittell et al. (1989) recommended timber harvest managed under a long term sustained yield philosophy to provide for the needs of lynx in all forest ecosystems wherever lynx occur. Of primary consideration in habitat

management is the ratio of denning, travel, forage and non-lynx cover areas. Vegetative manipulation as outlined by Brittell et al. (1989) would provide a plant community mosaic; set limits on managed stand size and openings; allow for timber harvest and fire control; and protect lodgepole pine thickets, understory vegetation, and snowshoe hares. Koehler and Brittell (1990) also called for the provision of a temporal and spatial mosaic of forest age classes. Whether or not these management guidelines are adhered to may be the deciding factor in the security of lynx in Washington. Concern has been expressed regarding how management guidelines are to be implemented and the stability of lynx during habitat recovery.

Clearcutting and extensive thinning have been the most common forms of timber harvest throughout the lynx distribution. Clearcut units in the past were much larger than they are today, extending over several thousand acres. Lynx typically do not cross openings wider than 91 m (300 ft) (Koehler and Brittell 1990). However, burned and clearcut areas can provide favorable conditions for snowshoe hares and lynx once seedlings and saplings become established (Koehler and Brittell 1990). For this reason, clearcuts should be designated < 91 m (300 ft) wide or be irregular in shape with periodic constriction < 91 m (300 ft) wide. Furthermore, clearcuts should not be positioned near large meadows, burned areas, or recent clearcuts (Koehler and Brittell 1990). Following the harvest of timber, forestry management often calls for the removal or burning of slash (downed debris). Slash is vital to lynx and their prey. Silviculture treatments frequently prescribe the planting of more profitable trees at the expense of lodgepole pine which further reduces available habitat. The problem is then compounded by the application of herbicides or the use of livestock grazing to retard the growth of understory vegetation used by snowshoe hares. Finally, should successional plant species such as lodgepole pine grow in response to fire or timber harvest, commercial thinning of lodgepole pine may be prescribed to accelerate the successional process and allow the rapid growth of more profitable trees. These practices may improve the economics of timber management, but they lessen the amount of time lynx and snowshoe hares may use an area and in general reduce habitat quality for lynx. Forest management for timber production typically increases landscape fragmentation. Unless carefully planned, this landscape will not replicate one found under natural conditions.

Fire Management

Natural wildfires helped form the ecosystem in the high elevation forests of eastern Washington. 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). Wildfires tend to be irregular in nature, creating a variety of tree species and age classes. Certain tree species such as lodgepole pine depend on hot fires for distribution of new seeds (Johnson 1992). Fires also assist in improving soil conditions and increasing the growth of seedlings by removing competing ground vegetation. Following a fire, browse species proliferate and remain high in nutritional quality for several years (Komarek 1984, Patton 1992). As much as 225 kg (500 lb) of forage/ac may be produced within 6 to 16 years following a burn

(USFS Handbook 1973). A clearcut or thinned stand typically provides less than half this amount (mean=45 kg (100 lb)/ac in 4-8 years).

Over the past 50 years, fire suppression and control has been a dominant feature in the management of Washington's forests. While potentially protecting timber for the short duration, this control has led to the creation of mature thickets which are of little use to snowshoe hares and lynx. The creation of mature thickets through fire suppression also increases fuel loads. Mountain pine beetle epidemics which are a natural occurrence in slow-growing, even-aged lodgepole pine stands, create even more dead, dry timber. Combined, these two conditions elevate the threat of catastrophic wildfires. Unlike sporadic fires which assist in a sustained ratio of early successional forests, catastrophic fires may eliminate large tracts of lynx habitat in a short period of time. This concern is eminent in lynx habitat of eastern Washington where extensive stands of lodgepole pine exist. Koehler and Brittell (1990) called for the use of a variety of fire intensities and fire types to create a temporal and spatial habitat pattern for prey while leaving unburned mature stands for denning females.

In the past, the USFS fire management policy was directed at "attacking forest fires with sufficient forces to gain control of all fires as quickly as possible" (ONF Land and Resour. Manage. Plan 1989: 3-2). The use of prescribed fires on managed lands and the allowance of confined fires in wilderness and roadless recreation areas is currently allowed under wildfire suppression policies in each national forest (ONF 1989). The Washington Department of Wildlife will encourage the use of prescribed fires in managed units and a "let-burn policy" in pristine areas (both applying a variety of fire intensities and fire types) for the creation of the preferred forest mosaic. Indirectly, fires will likely alleviate fuel loading and decrease the threat of large scale habitat removal to insect and disease epidemics. The Washington Department of Wildlife will further discourage the planting of more profitable tree species and other post-silvicultural treatments which retard natural succession of lodgepole pine following natural or prescribed burns.

Road Construction and Recreational Use

Road construction and the subsequent increased access for recreationists has been viewed as one of the greatest impacts to lynx populations in certain zones of northeastern Washington (S. Zender, pers. comm.). Brittell et al. (1989) believed road construction directly affected lynx by removing habitat. Indirect effects may include increased human-lynx interactions, increased access for recreationists which leads to a higher vulnerability to legal and illegal harvest, and/or increased harassment of lynx. Vulnerability to human-induced mortality along vehicular access routes and development roads in pristine areas occurred during lynx reintroduction efforts in New York (Brocke et al. 1992) and in studies of other large mammalian predators (Elgmork 1978, Thiel 1985, Van Dyke et al. 1986, Knight et al. 1988, Mech et al. 1988).

The preferred recommendation is the avoidance of road construction within lynx range. Where this is unavoidable, road destruction following timber operations is the preferred recommendation. Maintaining roads to minimum standards, the avoidance of loop roads, and the construction of physical barriers on roads are also recommended (Koehler and Brittell 1990). There is concern regarding the effectiveness of road closures to winter recreationists and the ability to adequately fund such closures following timber harvest (K. Woodruff, pers. comm.). Furthermore, vehicular disturbance may increase with the allowance of motorized trails.

Migration of Lynx from British Columbia

Washington has traditionally been dependent on the immigration of lynx from Canada to replenish local populations. The steady movement of lynx across the Washington-Canada border decreases the likelihood of genetic inbreeding which often adversely affects an isolated population of animals. Furthermore, local populations are augmented by migrating lynx which move into suitable, unoccupied habitat.

The status of lynx populations in British Columbia and northwards serves as an indicator to population trends in Washington. Harvest peaks in British Columbia have declined since the 1960's possibly due to a decrease in the lynx population but likely a function of the trapper effort (V. Banci, pers. comm.)(Figure 5). Results of the British Columbia trapper questionnaire for the years 1988 to 1991 show a consensus among trappers that both lynx populations and habitat are generally decreasing with the exception of the North Boreal Mountains and Taiga Plains (Rollins 1992). Over-exploitation of lynx since the early 1970's due to increased pelt prices has affected both the amplitude and timing of the lynx cycle in western Canada, especially in the prairie provinces of Saskatchewan and Alberta (Ward and Slough 1987). Trapping regulations have been changed to protect lynx in Alberta, Manitoba, and the Yukon (B.C. Minist. Env. 1990). In some of these regions, current regulations include complete closures of the season. Most areas, including British Columbia, have shortened seasons in recent years, and trapline quotas have been used in Alberta and Manitoba (B.C. Minist. Env. 1990). Productivity, expressed as a function of kittens in the harvest, has also declined in southern British Columbia, from 41% in 1987-88 to 15% in 1991-92 (V. Banci, pers. comm.). Exploitation and lowered productivity may reduce the number of immigrating lynx into Washington. Timber management and timber salvage projects in response to the mountain pine beetle epidemic in the forests of southern British Columbia (B. Harris, pers. comm.) have also reduced available habitat. Intensive timber harvest in southern British Columbia for salvage and commercial use could potentially reduce travel corridors utilized by lynx emigrating into Washington and cause a reduction in the British Columbia population.

Over-exploitation of lynx in British Columbia and the prairie provinces may also affect the number of emigrating lynx. British Columbia currently holds a three month trapping and hunting season throughout most of the province. Southern British Columbia is divided into

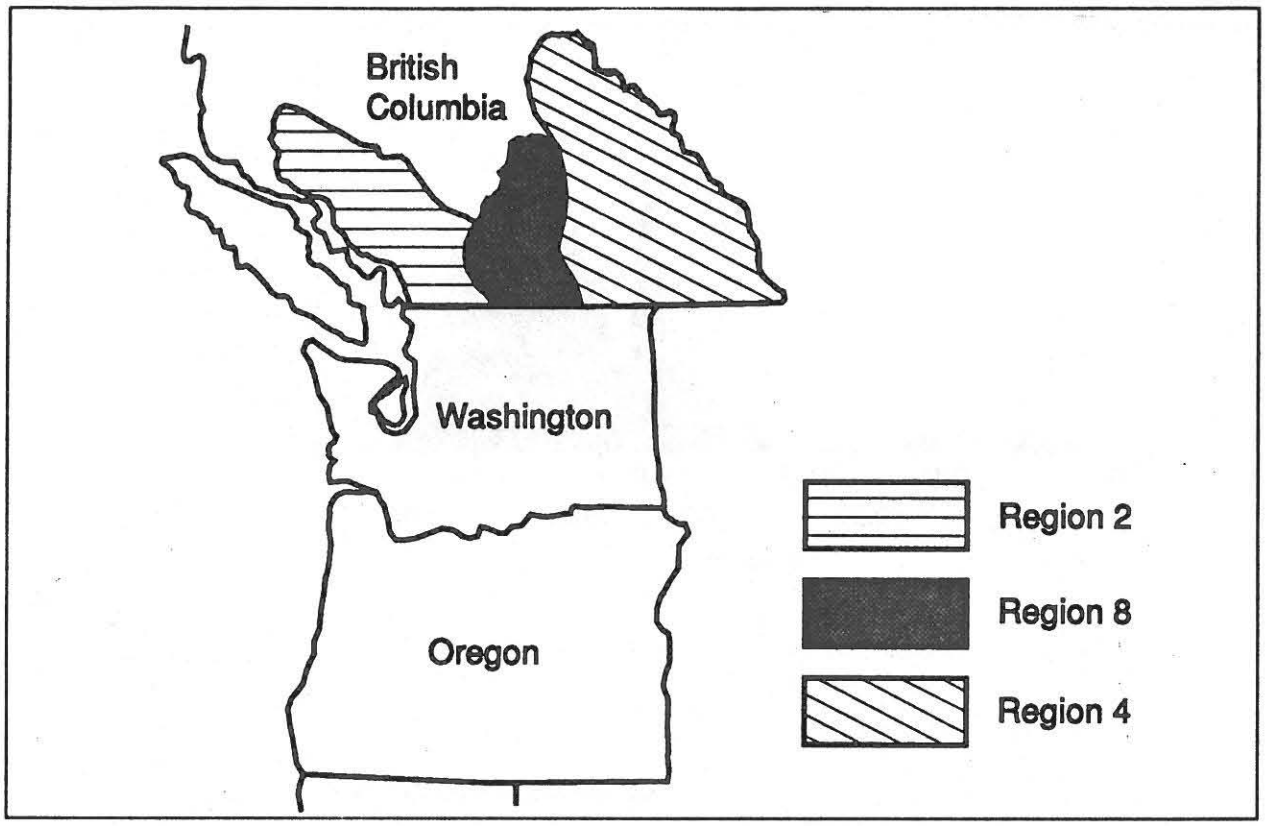

Figure 6. British Columbia resource Management Regions 2, 4, and 8.

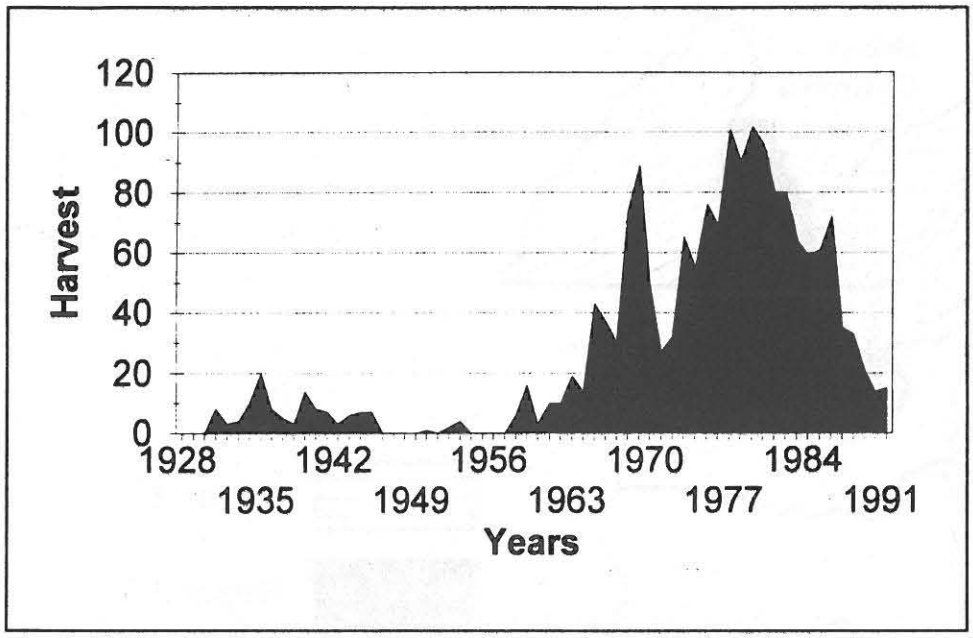

Figure 7. British Columbia lynx harvest (Region 8), 160 km north of the international border.

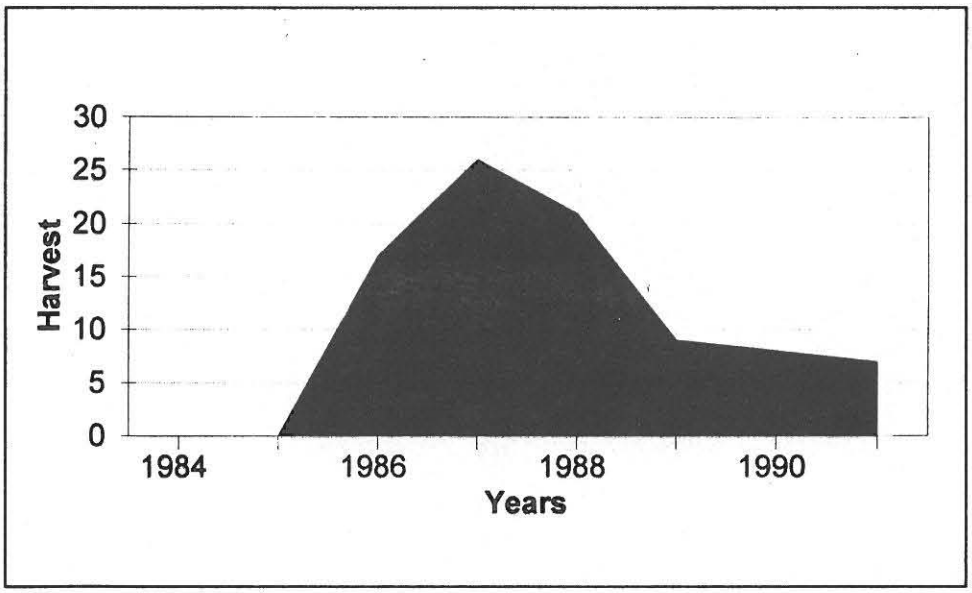

Figure 8. British Columbia lynx harvest (Region 4), 160 km north of the international border.

CONCLUSION/RECOMMENDATION

The lynx population in northeastern Washington, with the exception of those lynx occupying the Salmo Priest zone, is currently vulnerable due to low numbers, forest maturation, past habitat alteration, reduction of conductivity to British Columbia, reduced lynx immigration from core populations in Canada, and reduced reoccupation of suitable habitat. All of the areas are vulnerable to significant planned habitat alteration and there are no management plans in place to ensure long-term maintenance of lynx habitat. These factors lead to the conclusion that the northeastern Washington population is vulnerable.

Population characteristics of the north-central Cascade lynx population make it vulnerable to habitat perturbations. Planned habitat alterations in lynx range outside MA-12 in the north-central Cascades will reduce habitat capability over a 10 to 20 year period, the absence of silvicultural management plans or monitoring programs to maintain lynx outside MA-12 will likely lead to long-term reduced habitat suitability, and the potential for lynx immigration from Canada to provide residency in the population may be reduced. In combination, these factors present a significant threat to the lynx population in the Okanogan zone and may lead to a situation in which the population may not naturally recover.

It is recommended that the lynx be designated a threatened species in Washington.

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R. Paul, District Manager, Dept. Nat. Resour., North Central Washington.

S. Peterson, Senior Staff Biologist, Alas. Dept. Fish and Game, Juneau.

C. Phillips, Wildlife Biologist, Wenatchee Natl. For., Wenatchee, Washington.

B. Posey, Furbearer Manager, Oreg. Dept. Fish and Wildl., Portland.

J. Sheppard, Terrestrial Nongame Manager, Colo. Dept. Nat. Resour., Div. Wildl., Denver.

B. Slough, Wildlife Biologist, Yukon Dept. Renewable Resour., Fish and Wildl. Branch, Whitehorse, Y.T.

M. Stout, Endangered Wildlife Program, Defenders of Wildl., Washington D.C.

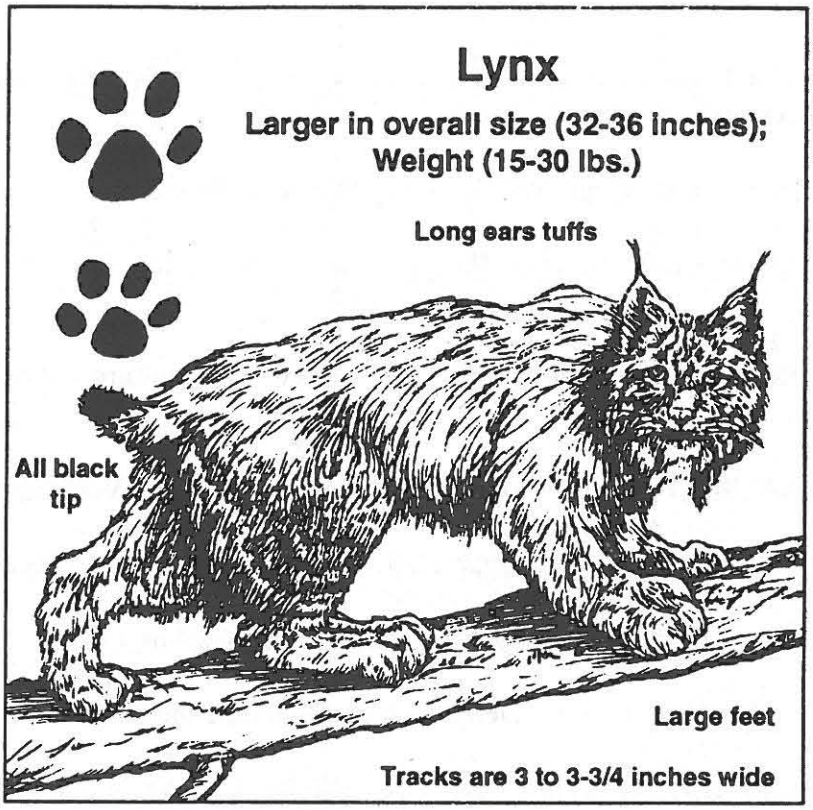
A. Todd, Wildlife Management Planner, Alta For., Lands and Wildl., Fish and Wildl. Div., Alta, Canada.

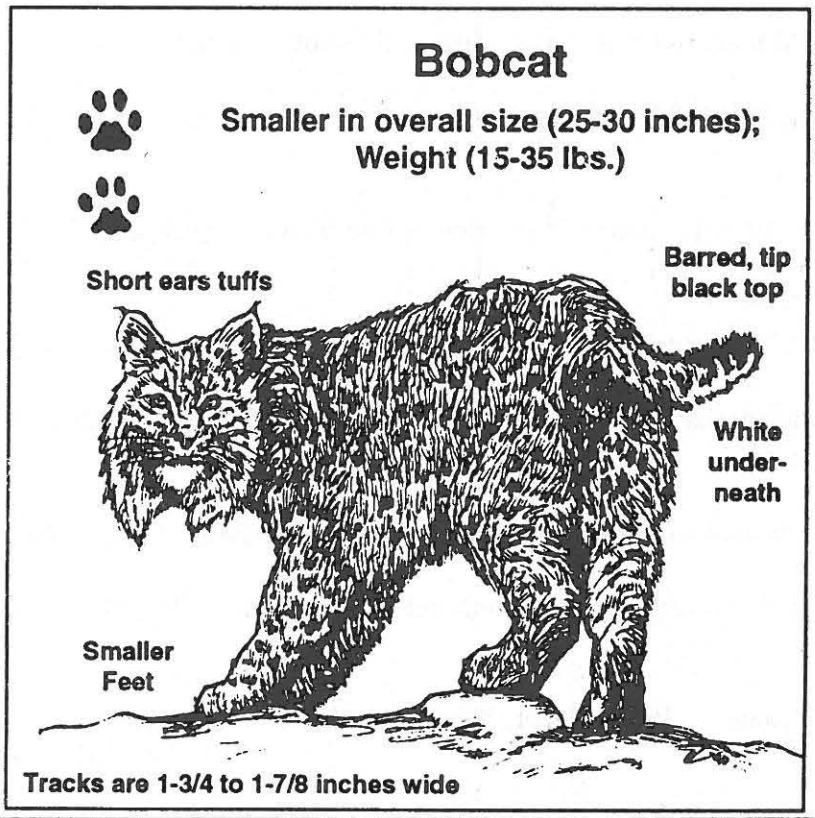
G. Will, Wildlife Game and Research Manager, Id. Fish and Game Dept., Boise.

K. Woodruff, District Wildlife Biologist, Tonasket Ranger Dist., Okanogan Nat. For., Tonasket, Washington.

S. Zender, Wildlife Biologist, Wash. Dept. Wildl., Spokane, Chewelah.

Appendix A. Comparison of North American lynx and bobcat.





Appendix B. Records of North American lynx in Washington.

Locality	County	Date	Details	Reported by	Reference[a]
Sawtooth Range, Mount Rainier Natl. Park	Lewis	pre-1927	1 caught	C. A. Stoner	Taylor and Shaw 1927
Burroughs Mountain	Pierce	22 Aug 1927	sign	unknown	Taylor and Shaw 1927
Mount Rainier Nat'l Park	Pierce	1927	tracks and sign	unknown	Taylor and Shaw 1927
Near Mount Misery	Garfield	4 Nov 1931	track	S. Black	
Icicle Creek, 16 km above Leavenworth Creek CCC Camp	Chelan	24 Jan 1939	ad male	USFS personnel	WDW files
E. of Vulcan Mountain	Ferry	1940-1980	trapping	B. Edwards	WDW files
Fall City	King	1951	female	WDW	UWBM #12931
Chiwawa River	Chelan	22 Oct 1951	ad male	J. R. Kranz	CRCM #51-318
Pasayten Airport Area, Frosty Creek	Okanogan	1952	tracks	G. Brady	WDW files
Cascade Mountain, Meadow Crest	Okanogan	Dec 1952	male skull	H. Tuttle	PSM #4008
26 km E. of Republic	Ferry	11 Apr 1953	ad male	S. E. Guenther	CRCM #53-218
Slide Ridge, Lake Chelan	Chelan	Sep 1953	ad female	J. Willis/F. Zwickel	CRCM #53-280
8-Mile Creek	Okanogan	6 Nov 1954	shot by hunter	C. F. Martinson	CRCM #54-305
8-Mile Creek	Okanogan	6 Nov 1954	ad female	C. F. Martinson	CRCM #54-304
16 km N. of Sherman Pass	Ferry	8 Sep 1955	ad male	L. H. Mabbolt	CRCM #55-425
Area OSS Peak	Chelan	1960	tracks	houndmen to G. Brady	WDW files

7 km S. of Pullman	Whitman	28 Oct 1962	ad female	E. Hibbs	CRCM #63-22
Busby, 4 km S. of Pullman	Whitman	30 Aug 1963	ad female	T. M. Mullalley	CRCM #63-76
Badger Mountain	Douglas	2 Mar 1965	ad female	K. Bergenn to T. Anderson	CRCM #66-98
Panorama, near Pebble Creek, Mount Rainier Nat'l Park	Pierce	9 Jun 1966	tracks	unknown	Taber and Payne 1974
Near Halfway Flat CG	Kittitas	1969	1 seen	R. Simmons	Taber and Payne 1974
Naneum Basin	Kittitas	summer/fall 1970	1 seen	K. Hammond	WDW files
Hansen Creek Rd, S of South Fork Mill Creek Park rapids	Stevens	Feb 1971	track	T. Burke	WDW files
Ellensburg Canyon	Yakima	Oct 1971	trapped	N. F. Payne and R. D. Taber	WDW files
W. side of Green Mtn	Snohomish	1972	trapped	N. F. Payne and R. D. Taber	WDW files
Granite Falls, W side of Green Mountain	Pend Oreille	1972	trapped	R. Kelley	Taber and Payne 1974
Stossel Creek near Lake Hannel, Woodinville	King	1972	1 seen	R. "Tex" Reynolds	Taber and Payne 1974
Wenas area	Yakima	1972	tracks	unknown	WDW files
Chopaka Mountain	Okanogan	16 Apr 1972	tracks	J. King	WDW files
OSS Peak	Chelan	1973	2 seen together	G. Brady	WDW files
0.8 km up from Panjab Creek, Blue Mountains	Columbia	28 Aug 1973	1 seen	B. Overly and D. Brittell	WDW files
Sugar Loaf Peak area, 1.6 km SW of Deer Camp	Chelan	1973	tracks	unknown	USFS files
Martin Peak, SW of Foggy Dew Falls	Okanogan	fall 1974	2 tracks, ad	G. Brady	WDW files

Cache Creek Cabin area	Okanogan	winter 1974/1975	tracks	J. Fish and B. Kenady	WDW files
N. of Company Creek CG, Stehekin	Chelan	winter 1974	tracks	G. Brady	WDW files
Ruby Creek, Tacoma Creek	Pend Oreille	1975	tracks	B. Linds and J. Schubert to S. Zender	WDW files
Lost River area, W of Last Chance Point	Okanogan	1975	trapped kitten	G. Lambert	WDW files
Petit Lake	Pend Oreille	1975-1987	tracks	trappers to S. Zender	WDW files
Deemer Creek	Pend Oreille	1975-1987	tracks	trappers to S. Zender	WDW files
Gypsy Meadow	Pend Oreille	1975-1987	tracks	trappers to S. Zender	WDW files
Packwood and Randle USFS Ranger Districts	Lewis	Apr 1976	few sightings	R. Scharpf	WDW files
T40N R24E S19	Okanogan	11 Sep 1976	tracks	W. R. Randall	WDW files
Iron Gate Rd, Toats Coulee	Okanogan	18 Oct 1976	tracks	W. R. Randall	WDW files
T35N R30E S25	Okanogan	Nov 1976	tracks	M. Neville	WDW files
Granite Mountain area, Loup Loup summit	Okanogan	10 Dec 1976	male trapped	D. Byrd to R. Friesz	WDW files
High Mountains	Ferry	1976		T. Burke	WDW files
E. fork Buttermilk Creek, Martin Peak	Okanogan	1976-1977	tracks	G. Brady	WDW files
Eastern Washington	unknown	1976-1977	skull only	Wash. Dept. Game	PSM #2827
E. of Ashnola Crossing	Okanogan	18 Sep 1977	tracks on trail	W. Ranger	WDW files
Lead Hill area	Pend Oreille	1978	tracks	S. Zender and D. Weatherman	WDW files
North Slate Creek bend	Pend Oreille	1978	tracks	S. Zender	WDW files
Line Creek/Hidden Creek, Wenatchee Lake GIS #L-601 U T27N R15E S12 SE of SE	Chelan	1978	tracks	unknown	USFS
Long Swamp	Okanogan	12 Mar 1978	tracks	D. Brittell	WDW files

Tieton Rd 143	Yakima	26 Jun 1978	crossing road	L. Dahlgreen	WDW files
Hwy 12, E of Tieton Rd 143, 1.6 km above Tieton Ranger Station	Yakima	28 Jun 1978	ad male	D. Guess	WDW files
Near Ruby Creek	Pend Oreille	fall 1978	track	G. J. Carter and D. Brittell	WDW files
Bead Lake	Pend Oreille	fall 1978	track	G. J. Carter and D. Brittell	WDW files
Near Survival Base	Pend Oreille	Oct 1978	track	G. J. Carter	WDW files
Little Horse Creek	Skagit	1978	track	J. R. Hook	WDW files
Monte Carlo Meadow T38N R24E	Okanogan	6 Dec 1978	female skull	Wash. Dept. Game	PSM #28264
Long Swamp, Chewak	Okanogan	9 Dec 1978	male skull	Wash. Dept. Game	PSM #28266
Long Swamp, Chewak	Okanogan	9 Dec 1978	male skull	Wash. Dept. Game	PSM #28267
Granite Creek, Perrygin	Okanogan	12 Dec 1978	male skull	Wash. Dept. Game	PSM #28265
Churchill Moutain area, Boundary Mountain	Ferry	15 Dec 1978	1 ad, 1 kitten killed	S. Zender	WDW files
Sheep Creek Rd at Crown Creek Rd	Stevens	15 Dec 1978	track of 1 ad	S. Zender	WDW files
Churchill Mountain area, unit 105	Stevens	20 Dec 1978	tracks of 1 female and 1 kitten	J. Hynse	WDW files
Churchill Mountain area, unit 105	Stevens	20 Dec 1978	tracks of 1 male and 2 kittens	J. Hynse	WDW files
Eastern Washington	unknown	1978-1979	skeleton	Wash. Dept. Game	PSM #28276
Head of Twisp River, near Gilbert T34N R18E S12	Okanogan	8 Jan 1979	ad tracks	G. Brady	WDW files
N. side Lead Creek T40N R44E S11 SE of NE	Pend Oreille	16 Jan 1979	ad tracks	M. Matney and S. Zender	WDW files
Salmo drainage T40N R45E S24 SE of SE	Pend Oreille	16 Feb 1979	ad tracks	M. Matney	WDW files
Sullivan Creek area	Pend Oreille	Nov 1979	track	M. Cook and S. Zender	WDW files

Unknown	Chelan	10 Nov 1979	tracks	K. J. Raedeke	WDW files
Near Helmer Creek T39N R45 S35	Pend Oreille	29 Nov 1979	track	M. Cook and S. Zender	WDW files
Sheep Creek area	Stevens	Dec 1979	tracks	D. Denny and F. Reber	WDW files
Boulder Creek/Deadman Creek Divide	Ferry	Dec 1979	track	D. Denny and F. Reber	WDW files
South fork Sherman Pass	Ferry	Dec 1979	1 seen	D. Denny and F. Reber	WDW files
Baldy Pass T36N R23E	Okanogan	4 Dec 1979	male skull	Wash. Dept. Game	PSM #28268
Upper Toat Coulee Rd, 3-5 km below Long Swamp	Okanogan	11 Dec 1979	tracks	J. Danielson	WDW files
Next to Middle Fork Coulee T39N R23E S23	Okanogan	11 Dec 1979	tracks	J. Danielson	WDW files
Long Swamp	Okanogan	13 Dec 1979	skull of male aged 4.5 yr	Wash. Dept. Game	PSM #28269
Middle Fork Toats Coulee T39N R23E	Stevens	14 Dec 1979	skull of male aged 1.5 yr	Wash. Dept. Game	PSM #28270
Crown Creek Rd at Sheep Creek Rd T40N R38E S14	Stevens	15 Dec 1979	track	D. Brittell	WDW files
Sullivan Lake, Slate Peak	Okanogan	28 Dec 1979	male killed	J. Caswell	WDW files
Marble Green area, Boundary Mountain	Okanogan	1980	1 ad, 1 kitten	H. Honeycutt	WDW files
Sinalahekin Valley, Loomis	Okanogan	early 1980	tracks	G. Lavoy and D. Brittell	WDW files
Hall Creek area, Seventeen Mile Mountain	Ferry	28 Jan 1980	1 killed	D. Brittell	WDW files
Churchill Mountain area, unit 105	Stevens	24 Feb 1980	tracks of 1 ad and 2 young	S. Zender and D. Brittell	WDW files
1 km up War Creek Trail, Twisp River	Okanogan	6 Mar 1980	track	G. L. Brady	WDW files
Cedar River Watershed Road 600, North Bend T21N R10E S4	King	6 Jun 1980	tracks of 1 ad	B. Tokach	WDW files

Diamond Peak Rd, Petit Lake area T36N R45E S11	Pend Oreille	26-28 Nov 1980	ad	K. Dollarhyde and S. Zender	WDW files
S. of Dog Creek, Corral Butte	Okanogan	Dec 1980	track of 1 ad male	M. Lateer	WDW files
Sheep Creek area	Stevens	1 Dec 1980	tracks of 3 ad and 2 young	J. Hynse	WDW files
South fork Sherman Creek, Sherman Peak	Ferry	1 Dec 1980	track	J. Hynse	WDW files
Near Hendrick residence, T37N R39E S26	Stevens	24-30 Dec 1980	tracks	L. Hendrick, D. Weatherman, and S. Zender	WDW files
Deadman Creek area, Jackknife Mountain	Ferry	1980-1981	tracks	D. Denney to S. Zender	WDW files
Orwig-Hump, Petit Lake area	Pend Oreille	5 Jan 1981	track	D. Weatherman	WDW files
Sheep Creek	Stevens	1 Dec 1981	tracks of 1 ad and 2 young	J. Hynse	WDW files
Deadman Creek, Boulder	Ferry	26 Dec 1981	trapped female aged 1.5 yr	D. Taylor	PSM #28263
Harts Pass, Slate Peak	Okanogan	1982	illegal take, radio-collared	M. Taylor	WDW files
Amazon Creek, Lake Gillette	Stevens	1982	tracks	S. Zender	WDW files
Bridge Creek	Okanogan	5 Jan 1982	male aged 2.5 yr	Wash. Dept. Game	PSM #28271
Bridge Creek	Okanogan	9 Jan 1982	male aged 1.5 yr	Wash. Dept. Game	PSM #28272
Deadman Creek, Jackknife Mountain	Ferry	16 Jan 1982	tracks	D. Denney to S. Zender	WDW files
Rock Mountain, Pasayten Wilderness	Okanogan	spring 1982	male aged 8.5 yr killed	Wash. Dept. Game	PSM #28274
North fork Windy Creek, Horseshoe Basin	Okanogan	Jun 1982	found dead	D. Brittell and J. King	WDW files
Shedwood Divide Trail, north slope Grassy Top Mountain	Pend Oreille	7 Aug 1982	tracks of 1 ad and 1 unknown	D. Drake	WDW files

Corral Butte	Okanogan	22 Nov 1982	female aged 2.5 yr	Wash. Dept. Game	PSM #28275
Billy Goat Corral T38N R20E S14	Okanogan	12 Dec 1982	female aged 7.5 yr	Wash. Dept. Game	PSM #28273
Trapping area up 8-Mile Creek, Billy Goat Mountain	Okanogan	12 Dec 1982	female tracks	R. Chambers	WDW files
Twenty Mile Meadows	Okanogan	19 Dec 1982	male	D. Brittell	PSM #28427
Between Mount Aix and Nelson Ridge T15N R13E S13	Yakima	1982-1990	tracks, pair in area?	B. Ozmer to L. Stream	WDW files
Bon Ayre Ridge, Alladin	Stevens	1982-1983	tracks	D. Denney to S. Zender	WDW files
SW of Coxit Mountain	Okanogan	7 Jan 1983	tracks of female and kittens	D. Brittell	WDW files
Silver Creek area	Ferry, Stevens, Pend Oreille	8 Feb 1983	1 or 2 in area	F. Graham	WDW files
Columbia River to Abercrombie Mountain	Stevens Pend Oreille	8 Feb 1983	3 present	F. Graham	WDW files
Near Ramsey Creek, Pearygin Peak	Okanogan	23 Oct 1983	1 killed	S. Bakke	WDW files
N. of Billy Goat Corral, Billy Goat Mountain	Okanogan	1983-1984	tracks	G. Brady	WDW files
8-Mile Creek, S of Billy Goat Corral	Okanogan	1984	female trapped	G. Brady	WDW files
T36N R41,42E S25	Stevens	1984	tracks	K. Hires	WDW files
East branch of Leclerc Creek at Seco Creek, Timber Mountain	Pend Oreille	4 Jan 1984	tracks	D. Weatherman	WDW files
Petit Lake area, Orwig-Hump	Pend Oreille	1 Feb 1984	tracks	S. Zender and M. Matney	WDW files
Cache Creek, W of Last Chance Point, Robinson Mountain	Okanogan	Jan 1985	tracks	USFS personnel	WDW files
Hwy S. of LPO Lakes area, Lake Gillette	Stevens	1986	tracks across hwy	G. Hickman	WDW files

S. of Hodges Horse Pasture, Horseshoe Basin	Okanogan	Feb 1986	1 trapped	G. Koehler and J. King	WDW files
W. of Queer Creek, Horseshoe Basin	Okanogan	May 1986	den	G. Koehler and J. King	WDW files
Hwy 206, 0.8 km below Mount Spokane State Park	Spokane	16 Jun 1986	ad track	E. Koller	WDW files
T15N R15E S4	Yakima	Jan 1987	male tracks	B. Ozmer to L. Stream	WDW files
Churchill Moutain area, Unit 105	Stevens	10 Jan 1987	tracks of 1	B. Edwards and M. Matney	WDW files
2 km up from McDaniel Lake	Yakima	11 Sep 1987	male tracks	J. Norb to WDW Reg. 3	WDW files
Vulcan Mountain	Ferry	Dec 1987	tracks	K. Hainse	WDW files
Gypsy Meadows, N of Sullivan and Leola Creek convergence, Salmo Mountain T15N R14E S6	Pend Oreille	22 Dec 1987	track	K. Warren to S. Zender	WDW files
Roger Lake, Tiffany Mountain	Okanogan	1988	2 tracks	D. King	WDW files
Goat Creek above Whiteface Creek, Sweetgrass Butte	Okanogan	1988	1 track set	C. Paul	WDW files
Starvation Mountain, Old Baldy	Okanogan	1988	2 tracks	D. King	WDW files
Tenasket Mountain area, Mount Leona	Ferry	1988	track	B. Edwards	WDW files
Cedar Creek, Early Winters to Mazama area	Okanogan	1988	3 tracks	C. Paul and W. Meyers	WDW files
Road 1935-030 T37N R44E S29 SW of SE	Pend Oreille	16 Jan 1988	ad tracks	M. Matney	WDW files
Road 1936, White Man drainage, T37N R44E S29 NW of SE	Pend Oreille	19 Jan 1988	ad track	M. Matney	WDW files
Vulcan Mountain	Pend Oreille	Feb 1988	track	B. Edwards	WDW files
T28N R18E S34 SW of NW	Chelan	15 Jul 1988	tracks of 1 ad	M. Davis	WDW files

N. of North Fork Beaver Creek, Mount Bonaparte	Okanogan	fall 1988	track of 1	W. Brazle to D. Swedberg	WDW files
Above McDaniel Lake, just before end of road T15N R13E S1	Yakima	Sep 1988	male track	N. Effler to B. Ozmer and L. Stream	WDW files
Cougar Creek T28N R18E S34 NW of SW	Chelan	15 Sep 1988	tracks	M. Davis	WDW files
North brach Disappointment Creek, Hurley Peak	Okanogan	Dec 1988	1 shot	G. Koehler to J. King	WDW files
S. of Pass Creek, Sherman Peak area	Ferry	5 Dec 1988	tracks of ad and young	M. Matney to S. Zender	WDW files
Baldy Pass, Old Baldy	Okanogan	19 Dec 1988	track	D. King	WDW files
McCay Creek, Bernhardt Creek, middle fork Boulder, Old Baldy	Okanogan	19 Dec 1988	2 tracks	D. King	WDW files
Swauk Pass	Chelan	1988	1 seen	C. Phillips to M. Tirhi	WDW files
Nancy Creek, Boyds	Ferry	1989	track	M. Matney to S. Zender	WDW files
W. of Monumental Mountain	Pend Oreille	Jan 1989	track	M. Matney to S. Zender	WDW files
Harvey Creek, north fork 8 Pass Creek	Pend Oreille	Jan 1989	tracks	M. Matney to S. Zender	WDW files
Hall Creek near reservation, 17 Mile Mountain	Ferry	27 Jan 1989	track	M. Matney to S. Zender	WDW files
Road to Baldy, 0.8 km up Roger Lake to Tiffany Mountain	Okanogan	2 Apr 1989	tracks of 1 ad and 2 young	D. Rivard to D. Blatt	WDW files
S. side Boulder Creek, down drainage from junction near big burn, Old Baldy	Okanogan	2 Apr 1989	track	D. Rivard to D. Blatt	WDW files
Harts Pass Rd, Rattlesnake drainage, T37N R18E	Okanogan	14 Jun 1989	tracks	D. Therriau	WDW files
N. of lake, Mount Bonaparte	Okanogan	fall 1989	tracks of 2	W. Brazle to D. Swedberg	WDW files
South fork Beaver Creek	Okanogan	fall 1989	tracks of 1 along road	W. Brazle to D. Swedberg	WDW files

Near Bear Mountain, Loup Loup Summit	Okanogan	28 Nov 1989	track	D. King	WDW files
White Face and Long creek drainages	Okanogan	28 Dec 1989	track	G. W. McClure	WDW files
Copper Glance, 8 Mile Creek area and Falls Creek drainage, Sweetgrass Butte	Okanogan	28 Dec 1989	tracks	G. W. McClure	WDW files
Goat Wall Creek, McCloud Mountain	Okanogan	31 Dec 1989	tracks	G. W. McClure	WDW files
Loomis	Okanogan	1989-1990	track	M. Skatrud, G. Lavoy, and J. Rohrer	WDW files
30-Mile Creek area corral	Okanogan	1990	tracks	R. Schimke	WDW files
8-Mile Creek, Hurley Peak	Okanogan	1990	tracks	J. King and D. Swedberg	WDW files
Coxit Mountain survey route	Okanogan	1990-1992	tracks	J. King and D. Swedberg	WDW files
Cabin Creek, Bulldog Mountain	Ferry	Jan 1990	track	B. Edwards to S. Zender	WDW files
Petit Lake area	Pend Oreille	Jan 1990	track	T. Holden	WDW files
Granite Creek area, S 38, 45, and 13, Helmer Mountain	Pend Oreille	Feb 1990	track	M. Matney to S. Zender	WDW files
Near Road 274, Deemer drainage T40N R45E S21 SW of SE	Pend Oreille	12 Feb 1990	ad tracks	Wash. Dept. Wildl.	WDW files
Gypsy Meadows T39N R45E S3 SW	Pend Oreille	12 Feb 1990	ad tracks	Wash. Dept. Wildl.	WDW files
Bear Pasture T39N R45E	Pend Oreille	12 Feb 1990	ad tracks	Wash. Dept. Wildl.	WDW files
Timber planning site T40N R35E S21 NE	Ferry	Feb 1990	track	W. Merritt to S. Zender	WDW files
Gypsy Meadows	Pend Oreille	Mar 1990	tracks	D. Weatherman	WDW files
Gypsy Meadows, along Sullivan Creek	Pend Oreille	Mar 1990	tracks	D. Weatherman	WDW files
Bear Trap Canyon, Buckhorn Mountain	Okanogan	Nov 1990	tracks	T. Fewkes to D. Swedberg	WDW files

Near White Man Creek, Scotchman Lake	Pend Oreille	Dec 1990	track	S. Zender and M. Matney	WDW files
S. of Havillah	Okanogan	Dec 1990	tracks	unknown	WDW files
LPO Wildlife Area, Calispell Peak	Stevens	Dec 1990	track	D. Denney to S. Zender	WDW files
Deemer Creek, S of Salmo Mountain	Pend Oreille	Dec 1990	tracks	M. Matney to S. Zender	WDW files
Tiffany Mountain	Okanogan	Dec 1990-Dec 1991	tracks	J. King and D. Swedberg	WDW files
Corral Butte, along survey route 8	Okanogan	1990-1992	tracks	J. King and D. Swedberg	WDW files
Survey route E and S of End Branch Creek, Hurley Peak	Okanogan	1991	tracks	J. King and D. Swedberg	WDW files
South Sherman Creek area, S27, Monumental Mountain	Pend Oreille	Jan 1991	track	D. Weatherman	WDW files
E. tip of south fork Beaver Creek	Okanogan	18 Jan 1991-7 Mar 1992	tracks	J. Danielson, G. Brady, and F. Wittse	WDW files
S. of Starvation Mountain and E of Beaver Ridge, Old Baldy	Okanogan	18 Jan 1991-7 Mar 1992	tracks	J. Danielson, G. Brady, and F. Wittse	WDW files
Headwaters of Noisy and Pass creeks, S15, 22, and 23	Pend Oreille	Feb 1991	tracks of 3 lynx--(possibly 2 yearlings)	S. Zender	WDW files
Albion Hill area, near Scar Mountain, Copper Butte	Ferry	Feb 1991	track	D. Weatherman and C. Weatherman	WDW files
Lodgepole T38N R44E S23 SW of NE	Pend Oreille	14 Feb 1991	ad tracks	Wash. Dept. Wildl.	WDW files
North fork Harvey drainage, Lodgepole T38N R44E S26	Pend Oreille	14 Feb 1991	ad tracks	Wash. Dept. Wildl.	WDW files
North fork Harvey drainage, Lodgepole T38N R44E S27 SW of NE	Pend Oreille	14 Feb 1991	ad tracks	Wash. Dept. Wildl.	WDW files
Headwaters of Willow Creek, S29, Helmer Mountain	Pend Oreille	Mar 1991	track	T. Layser	WDW files

Near Road 8410 T27N R20E S14 NE	Chelan	11 Apr 1991	tracks of 1 ad	K. Fredrick	WDW files
Harts Pass Road T37N R18E	Okanogan	31 Jul 1991	tracks	USFS Winthrop Ranger District	WDW files
Freeze Out Pass, CF17 T37N R23E S33 NW	Okanogan	fall 1991	tracks	T. Johnson	WDW files
Sedge Ridge, Red Saddle T12N R14E S35	Yakima	24 Nov 1991	tracks	P. Hull and K. Guimer to L. Stream	WDW files
Gold Creek and Granite Creek, Helmer Mountain	Pend Oreille	Jan 1992	tracks	T. Layser	WDW files
Hall Creek, Seventeen Mile Mountain	Ferry	Jan 1992	freed 1	L. Hughs to S. Zender	WDW files
Stage Rd, Copper Butte T37N R34E S12 SW	Ferry	3 Jan 1992	track	M. Matney to S. Zender	WDW files
Coyote Hill, Scotchman Lake	Pend Oreille	4 Jan 1992	track	M. Matney to S. Zender	WDW files
North fork Harvey Creek, S23, Pass Creek	Pend Oreille	5 Mar 1992	tracks of 2 ad	S. Zender and T. Holden	WDW files
Lightning Creek and middle and south forks Beaver Creek, W of Beaver Mountain, Loup Loup Summit	Okanogan	7 Mar 1992	tracks	J. Danielson, G. Brady, and F. Wittse	WDW files
Coyote Hill T37N R43E S25 NE	Pend Oreille	10 Nov 1992	track of 1 ad	M. Matney to S. Zender	WDW files
Lighting Creek, Road 4230 near Beaver Creek T34N R23E S15	Okanogan	13 Nov 1992	tracks of 1 female and 2 kittens	J. Rohrer and A. Sprague	WDW files
Road 025 near Beaver 10 clearcut, Beaver Creek	Okanogan	13 Nov 1992	one set tracks	J. Rohrer and A. Sprague	WDW files
0.8 km from Buck Pass saddle, 3.2 km from Road 260 junction T34N R24E S20	Okanogan	20 Nov 1992	tracks of 1 female and 1 kitten	A. Sprague and J. Jakubowski	WDW files
South fork Beaver Creek, 1.3 km from Road 260 junction T34N R24E S19	Okanogan	20 Nov 1992	tracks	A. Sprague and J. Jakubowski	WDW files

W of south fork Beaver Creek, 3.2 km from Road 260 junction T34N R24E S20	Okanogan	20 Nov 1992	tracks of 1 ad and 1 kitten	A. Sprague and J. Jakubowski	WDW files
Monumental Mountain T37N R44E S26	Pend Oreille	Dec 1992	ad track	M. Matney to S. Zender	WDW files
South fork Granite Creek, T37N R45E S26	Pend Oreille	Dec 1992	ad track	M. Matney to S. Zender	WDW files
Cabin Creek, T38N R35E S1	Ferry	Dec 1992	ad track	B. Edwards	WDW files
McFarland Creek T30N R21E S13	Okanogan	3 Dec 1992	tracks	J. Rohrer, A. Sprague, and J. King	WDW files
End of Saint Luise Creek T30N R21E S17	Okanogan	3 Dec 1992	tracks	J. Rohrer, A. Sprague, and J. King	WDW files
N of Douglas Ingram Ridge T30N R21E S13 T30N R22E S18	Okanogan	3 Dec 1992	tracks	J. Rohrer, A. Sprague, and J. King	WDW files
Grade Creek T30N R20 S13	Chelan	3 Dec 1992	tracks	J. Rohrer, A. Sprague, and J. King	WDW files
Upper edge of clearcut, Copper Butte T37N R37E S13	Ferry	Jan 1993	track	C. Weatherman	WDW files
Stage Trail near US Creek	Ferry	4 Feb 1993	one track	S. Zender and W. Merritt	WDW files
South Fork Meadows, Leighty Camp	Okanogan	5 Feb 1993	5 tracks	J. Rohrer, J. Jakubonski	WDW files
South Fork Meadows, Bear Mountain	Okanogan	2 Feb 1993	1 track	J. Rohrer	WDW files
5.6 mi. from Snopark S. Fork Gold Creek,	Okanogan	8 March 1993	1 track	J. Rohrer, A. Sprague	WDW files
0.4 mi. from South Fork Gold Creek crossing, NE of Sawtooth Ridge	Okanogan	8 March 1993	7 tracks	J. Rohrer, A. Sprague	WDW files
From Fox Peak to Poison Springs along the Okanogan-Chelan county line	Okanogan-Chelan	8 March 1993	6 tracks	J. Rohrer, A. Sprague	WDW files

McFarland Creek, SE of Hungry Ridge	Okanogan	8 March 1993	many tracks	J. Rohrer, A. Sprague	WDW Files
Maverick Ridge	Chelan	unknown	tracks	C. Phillips to M. Tirhi	USFS files
Devils Gulch	Chelan	unknown	many tracks	C. Phillips to M. Tirhi	USFS files

[a]Records are taken from the literature, Washington Department of Wildlife Observation Cards, and museum specimens. Museums are abbreviated as follows: CRCM = Charles R. Conner Museum, Washington State University, Pullman; PSM = James R. Slater Museum of Natural History, University of Puget Sound, Tacoma; UWBM = Thomas Burke Memorial Washington State Museum, University of Washington, Seattle.

Appendix C. North American lynx harvest figures for Washington.

Region	County	1990-91 Harvest <>	1989-90 Harvest >>	1988-89 Harvest <<	1987-88 Harvest **	1986-87 Harvest	1985-86 Harvest	1984-85 Harvest	1983-84 Harvest	1982-83 Harvest
1	Asotin	0	0	0	0	0	0	0	0	0
	Columbia	0	0	0	0	0	0	0	0	0
	Ferry	0	0	0	0	0	0	1	0	1
	Garfield	0	0	0	0	0	0	0	0	0
	Lincoln	0	0	0	0	0	0	0	0	0
	Pend Oreille	0	0	0	0	0	0	0	0	0
	Spokane	0	0	0	0	0	0	0	0	0
	Stevens	0	0	0	0	0	0	0	0	0
	Walla Walla	0	0	0	0	0	0	0	0	0
	Whitman	0	0	0	0	0	0	0	0	0
2	Adams	0	0	0	0	0	0	0	0	0
	Douglas	0	0	0	0	0	0	0	0	0
	Franklin	0	0	0	0	0	0	0	0	0
	Grant	0	0	0	0	0	0	0	0	0
	Okanogan	0	0	0	0	0	0	1	0	1
3	Benton	0	0	0	0	0	0	0	0	0
	Chelan	0	0	0	0	0	0	1	0	0
	Kittitas	0	0	0	0	0	0	0	0	0
	Yakima	0	0	0	0	0	0	0	0	0
4	Island	0	0	0	0	0	0	0	0	0
	King	0	0	0	0	0	0	0	0	0
	Pierce	0	0	0	0	0	0	0	0	0
	San Juan	0	0	0	0	0	0	0	0	0
	Skagit	0	0	0	0	0	0	0	0	0
	Snohomish	0	0	0	0	0	0	0	0	0
	Whatcom	0	0	0	0	0	0	0	0	0
5	Clark	0	0	0	0	0	0	0	0	0
	Cowlitz	0	0	0	0	0	0	0	0	0
	Klickitat	0	0	0	0	0	0	0	0	0
	Lewis	0	0	0	0	0	0	0	0	0
	Skamania	0	0	0	0	0	0	0	0	0
	Wahkiakum	0	0	0	0	0	0	0	0	0
6	Clallam	0	0	0	0	0	0	0	0	0
	Grays Harbor	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0
	Kitsap	0	0	0	0	0	0	0	0	0
	Mason	0	0	0	0	0	0	0	0	0
	Pacific	0	0	0	0	0	0	0	0	0
	Thurston	0	0	0	0	0	0	0	0	0
FURBEARER HARVEST TOTAL		0	0	0	0	0	0	3	0	2
CITES TOTAL		0	0	0	0	0	1	2	0	

* First year of mandatory pelt tagging. CITES totals may reflect some pelts from previous years.
** The WDW initiated lynx permit system (four permits issued statewide).
<< WDW lynx permits reduced to three statewide (Okanogan county only).
>> WDW lynx permits reduced to two statewide (Okanogan county only).
<> Emergency lynx season closure statewide.

Appendix C. continued. North American lynx harvest figures for Washington.

Region	County	1981-82 Harvest	1980-81 Harvest	1979-80 Harvest	1978-79 Harvest	1977-78 Harvest	1976-77 Harvest	1975-76 Harvest	1974-75 Harvest	1973-74 Harvest
1	Asotin	0	0	0	0	0	0	0	0	0
	Columbia	0	0	0	0	0	0	0	0	0
	Ferry	0	0	0	0	0	17	14	0	3
	Garfield	0	0	0	0	0	0	0	4	0
	Lincoln	0	0	0	0	0	1	0	0	0
	Pend Oreille	0	0	3	0	0	5	0	6	0
	Spokane	0	0	1	0	0	0	0	0	0
	Stevens	0	0	1	0	0	8	0	9	0
	Walla Walla	0	0	0	0	0	0	0	0	0
	Whitman	0	0	0	0	0	0	0	0	0
2	Adams	0	0	0	0	0	0	0	0	0
	Douglas	0	0	0	0	0	0	1	0	0
	Franklin	0	0	0	0	0	1	0	0	0
	Grant	0	0	0	0	0	0	0	0	1
	Okanogan	0	1	4	9	0	5	3	0	0
3	Benton	0	0	0	0	0	0	0	0	0
	Chelan	0	0	0	0	0	0	0	1	0
	Kittitas	0	0	0	0	0	0	0	0	0
	Yakima	0	0	0	0	0	2	0	0	0
4	Island	0	0	0	0	0	0	0	0	0
	King	0	0	0	0	0	0	0	0	0
	Pierce	0	0	0	0	0	0	1	0	0
	San Juan	0	0	0	0	0	0	0	0	0
	Skagit	0	0	0	0	0	0	0	0	0
	Snohomish	0	0	0	0	0	0	0	0	0
	Whatcom	0	0	0	0	0	0	0	0	0
5	Clark	0	0	0	0	0	0	0	0	0
	Cowlitz	0	0	0	0	0	0	0	0	0
	Klickitat	0	1	0	0	0	0	0	0	0
	Lewis	0	0	0	0	0	0	0	0	0
	Skamania	0	0	0	0	0	0	0	0	0
	Wahkiakum	0	0	0	0	0	0	0	0	0
6	Clallam	0	0	0	0	0	0	0	0	0
	Grays Harbor	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0
	Kitsap	0	0	0	0	0	0	0	0	0
	Mason	0	0	0	0	0	0	0	0	0
	Pacific	0	0	0	0	0	0	0	0	0
	Thurston	0	0	0	0	0	0	0	0	0
FURBEARER HARVEST TOTAL		0	2	9	9	0	39	19	20	4
CITES TOTAL		3	2	6	6*					

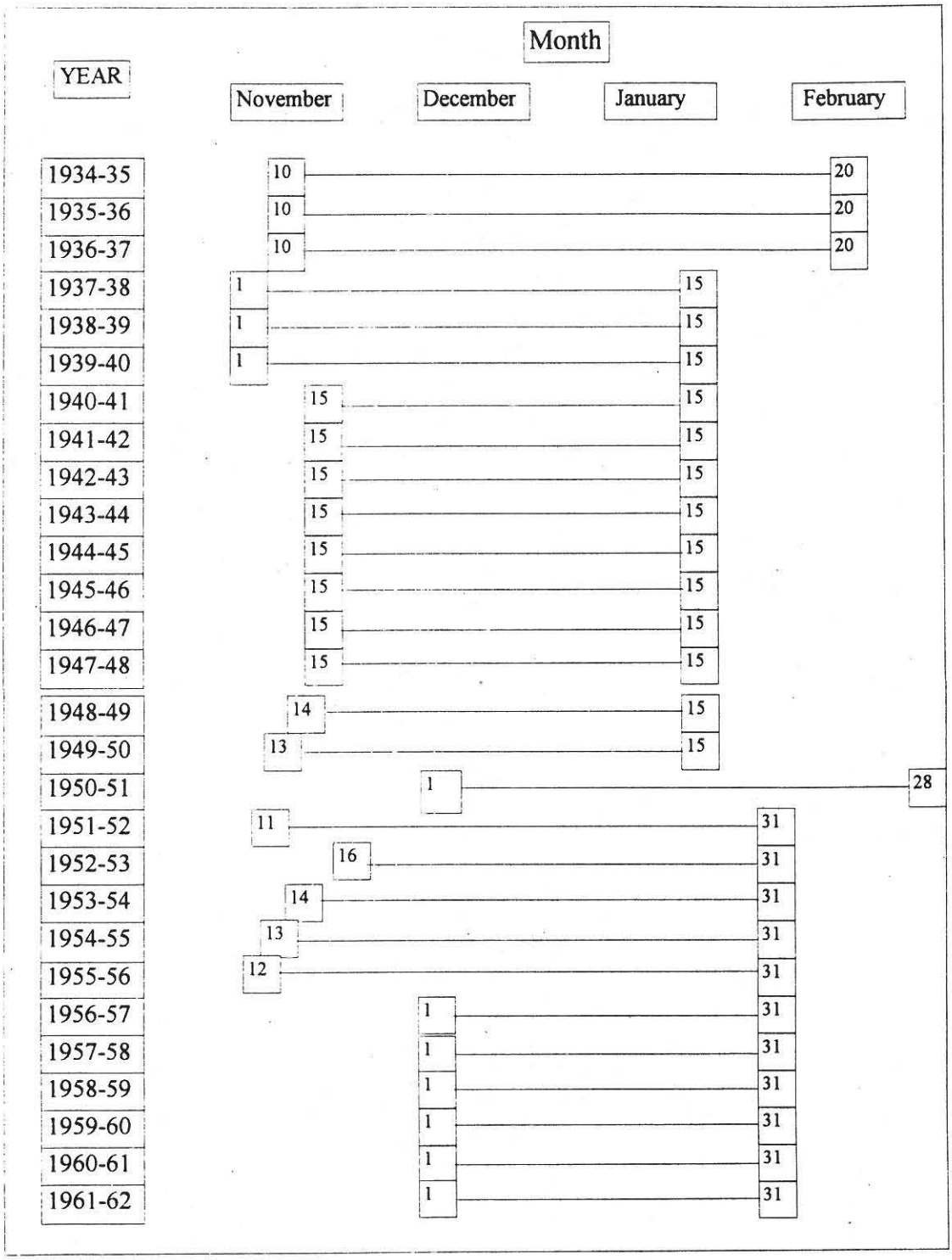
Appendix C. continued. North American lynx harvest figures for Washington.

Region	County	1972-73 Harvest	1971-72 Harvest	1970-71 Harvest	1969-70 Harvest	1968-69 Harvest	1967-68 Harvest	1966-67 Harvest	1965-66 Harvest	1964-65 Harvest
1	Asotin	0	0	0	0	0	0	0	0	0
	Columbia	0	0	0	0	0	0	0	0	0
	Ferry	1	3	0	26	2	0	7	3	0
	Garfield	0	0	0	0	0	0	0	0	0
	Lincoln	0	0	0	0	0	0	0	0	0
	Pend Oreille	0	1	0	0	0	0	0	0	0
	Spokane	0	0	0	1	0	1	0	0	0
	Stevens	4	0	0	0	0	0	0	0	0
	Walla Walla	0	0	0	0	0	0	0	0	0
	Whitman	0	0	0	0	0	0	0	0	0
2	Adams	0	0	0	0	0	0	0	0	0
	Douglas	0	0	14	0	0	0	0	0	0
	Franklin	0	0	0	0	0	0	0	0	0
	Grant	0	0	0	0	0	0	0	0	0
	Okanogan	4	2	0	4	1	2	1	0	0
3	Benton	0	0	0	0	0	0	0	0	0
	Chelan	0	0	0	0	0	1	0	0	10
	Kittitas	0	0	0	0	0	0	0	0	0
	Yakima	0	3	0	0	0	0	0	0	0
4	Island	0	0	0	0	0	0	0	0	0
	King	0	0	0	0	0	0	0	0	0
	Pierce	0	0	0	0	0	0	0	0	0
	San Juan	0	0	0	0	0	0	0	0	0
	Skagit	0	0	0	0	0	0	0	0	0
	Snohomish	0	0	0	0	0	0	0	0	1
	Whatcom	0	0	0	0	0	0	0	0	0
5	Clark	0	0	0	0	0	0	0	0	0
	Cowlitz	0	0	0	0	0	0	0	1	0
	Klickita	0	0	0	0	0	1	0	0	0
	Lewis	0	0	1	0	0	0	0	0	0
	Skamania	0	0	0	0	0	0	0	0	0
	Wahkiakum	0	0	0	0	0	0	0	0	0
6	Clallam	0	0	0	0	0	0	0	0	0
	Grays Harbor	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0
	Kitsap	0	0	0	0	0	0	0	0	0
	Mason	0	0	0	0	0	0	0	0	0
	Pacific	0	0	0	0	0	0	0	0	0
	Thurston	0	0	0	0	0	0	0	0	0
FURBEARER HARVEST TOTAL		9	9	15	31	3	5	8	4	11
CITES TOTAL										

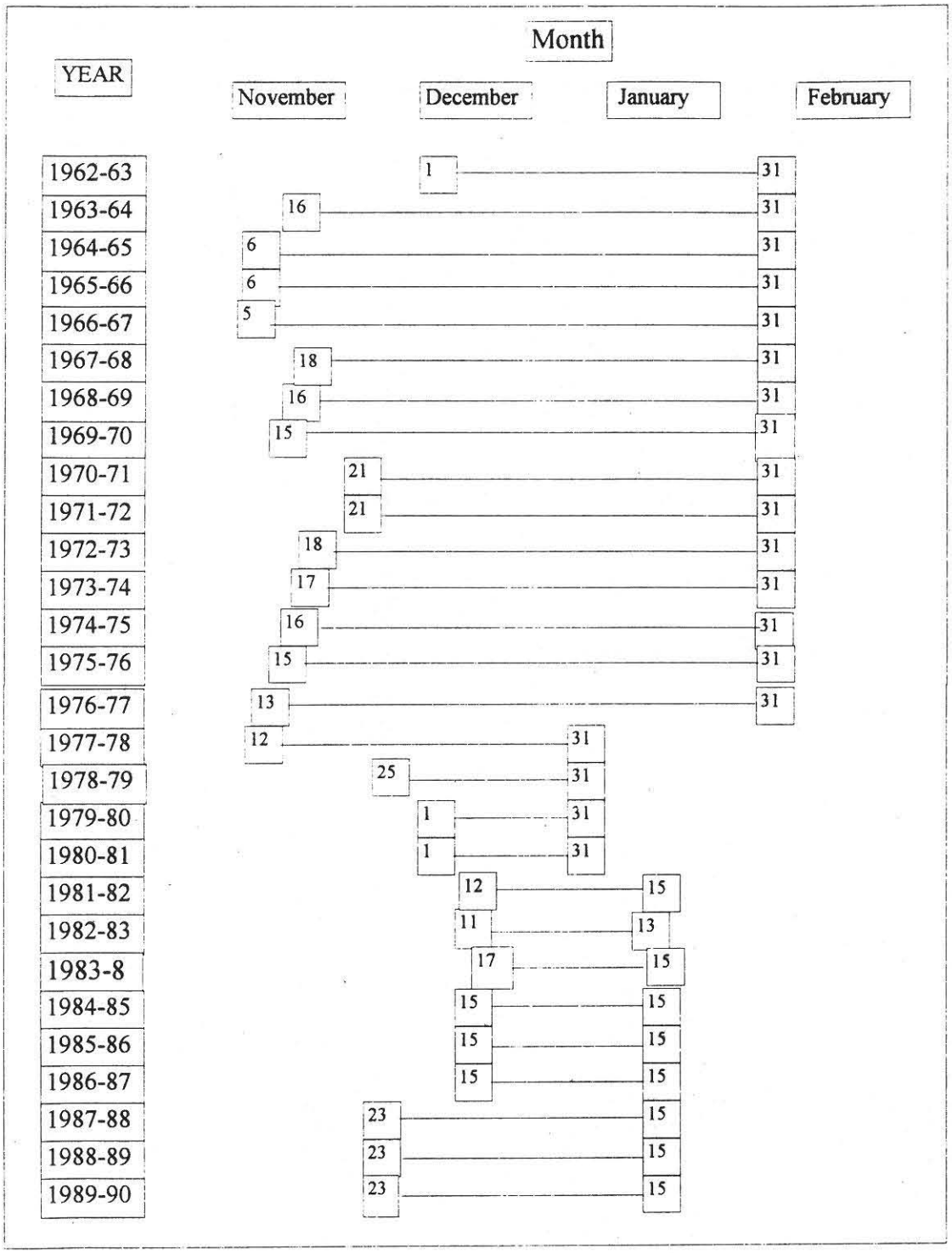
Appendix C. continued. North American lynx harvest figures for Washington.

Region	County	1963-64 Harvest	1962-63 Harvest	1961-62 Harvest	1960-61 Harvest
1	Asotin	0	0	1	0
	Columbia	0	0	0	0
	Ferry	0	1	0	0
	Garfield	1	0	0	0
	Lincoln	0	1	0	0
	Pend Oreilie	0	0	0	0
	Spokane	2	2	0	0
	Stevens	0	0	0	0
	Walla Walla	0	0	0	0
	Whitman	0	0	0	0
2	Adams	0	0	0	0
	Douglas	0	0	0	0
	Franklin	0	0	0	0
	Grant	0	0	0	0
	Okanogan	1	1	0	0
3	Benton	0	0	0	0
	Chelan	0	0	0	0
	Kittitas	0	0	0	0
	Yakima	0	0	0	0
4	Island	0	0	0	0
	King	0	0	0	0
	Pierce	0	0	0	0
	San Juan	0	0	0	0
	Skagit	0	0	0	0
	Snohomish	0	0	0	0
	Whatcom	0	0	0	0
5	Clark	0	0	0	0
	Cowlitz	1	0	0	0
	Klickitat	0	0	0	0
	Lewis	1	0	0	0
	Skamania	0	0	0	0
	Wahkiakum	0	0	0	0
6	Clallam	0	0	0	0
	Grays Harbor	0	0	0	0
	Jefferson	0	0	0	0
	Kitsap	0	0	0	0
	Mason	1	0	0	0
	Pacific	0	0	0	0
	Thurston	0	0	0	0
FURBEARER HARVEST TOTAL		7	5	1	0
CITES TOTAL					

Appendix D. North American lynx trapping seasons for Washington.



Appendix D. continued. North American lynx trapping seasons for Washington.



Appendix E

Washington Administrative Codes

232-12-297, 232-12-011, 232-12-014

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 foreseeable 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 public meeting in each of its administrative regions 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 5 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.]

WAC 232-12-011 Wildlife classified as protected shall not be hunted or fished. Protected wildlife are designated into three subcategories: Threatened, sensitive, and other.

(1) Threatened species are any wildlife species native to the state of Washington that are likely to become endangered within the foreseeable future throughout a significant portion of their range within the state without cooperative management or removal of threats.

Protected wildlife designated as threatened include ferruginous hawk, *Buteoregalis*; bald eagle, *Haliaeetus leucocephalus*; western pond turtle, *Clemmys marmorata*; green sea turtle, *Cheloniia mydas*; loggerhead sea turtle, *Caretta caretta*; Oregon silverspot butterfly, *Speyeria zerene hippolyta*; pygmy rabbit, *Brachylagus idahoensis*.

(2) Sensitive species are any wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats.

(3) Other protected wildlife.

Other protected wildlife include all birds not classified as game birds, predatory birds, or endangered species[,] or designated as threatened species or sensitive species; and fur seal, *Callorhinus ursinus*; fisher, *Martes pennanti*; wolverine, *Gulo luscus*; western gray squirrel, *Sciurus griseus*; Douglas squirrel, *Tamiasciurus douglasii*; red squirrel, *Tamiasciurus hudsonicus*; flying squirrel, *Glaucomys sabrinus*; golden-mantled ground squirrel, *Callospermophilus saturatus*; chipmunks, *Eutamias*; cony or pika, *Ochotona princeps*; hoary marmot, *Marmota caligata* and *olympus*; all wild turtles not otherwise classified as endangered species, or designated as threatened species or sensitive species; mammals of the order *Cetacea*, including whales, porpoises, and mammals of the suborder *Pinnipedia* not otherwise classified as endangered species, or designated as threatened species or sensitive species. This section shall not apply to hair seals and sea lions which are threatening to damage or are damaging commercial fishing gear being utilized in a lawful manner or when said mammals are damaging or threatening to damage commercial fish being lawfully taken with commercial gear.

[Statutory Authority: RCW 77.12.020. 90-11-065 (Order 441), § 232-12-011, filed 5/15/90, effective 6/15/90. Statutory Authority: RCW 77.12.040. 89-11-061 (Order 392), § 232-12-011, filed 5/18/89; 82-19-026 (Order 192), § 232-12-011, filed 9/9/82; 81-22-002 (Order 174), § 232-12-011, filed 10/22/81; 81-12-029 (Order 165), § 232-12-011, filed 6/1/81.]

Reviser's note: RCW 34.05.395 requires the use of underlining and deletion marks to indicate amendments to existing rules, and deems ineffectual changes not filed by the agency in this manner. The bracketed material in the above section does not appear to conform to the statutory requirement.

WAC 232-12-014 Wildlife classified as endangered species. Endangered species include: Columbian white-tailed deer, *Odocoileus virginianus leucurus*; Mountain caribou, *Rangifer tarandus*; Blue whale, *Balaenoptera musculus*; Bowhead whale, *Balaena mysticetus*; Finback whale, *Balaenoptera physalus*; Gray whale, *Eschrichtius gibbosus*; Humpback whale, *Megaptera novaeangliae*; Right whale, *Balaena glacialis*; Sei whale, *Balaenoptera borealis*; Sperm whale, *Physeter catodon*; Wolf, *Canis lupus*; Peregrine falcon, *Falco peregrinus*; Aleutian Canada goose, *Branta canadensis luecopareia*; Brown pelican, *Pelecanus occidentalis*; Leatherback sea turtle, *Dermochelys coriacea*; Grizzly bear, *Ursus arctos horribilis*; Sea Otter, *Enhydra lutris*; White pelican, *Pelecanus erythrorhynchos*; Sandhill crane, *Grus canadensis*; Snowy plover, *Charadrius alexandrinus*; Upland sandpiper, *Bartramia longicauda*; Northern spotted owl, *Strix occidentalis*.

[Statutory Authority: RCW 77.12.020(6). 88-05-032 (Order 305), § 232-12-014, filed 2/12/88. Statutory Authority: RCW 77.12.040. 82-19-026 (Order 192), § 232-12-014, filed 9/9/82; 81-22-002 (Order 174), § 232-12-014, filed 10/22/81; 81-12-029 (Order 165), § 232-12-014, filed 6/1/81.]

Washington Department of Wildlife

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