Occurrence of Lynx in the North Cascades Highway Corridor

Collection Agreement No. PNW 01-CO-11261992-086
Washington Department of Transportation

and

Interagency Agreement No. PNW 01-IA-11261992-095
U.S. Fish and Wildlife Service

Final Report

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Introduction

In 1994, the lynx was listed as a 'threatened' species by the State of Washington; in April 2000, the U.S. Fish and Wildlife Service listed the lynx as 'threatened' throughout its range in the contiguous U.S. The only known resident population of lynx in the Pacific Northwest is located in an island of boreal forest habitat in the northeastern Cascade Range in Washington. Because boreal forests occur in a peninsular or insular distribution in southern latitudes, lynx habitat in the contiguous U.S. is naturally fragmented; highways and traffic that may further fragment lynx habitat could have adverse effects on critical habitat areas for lynx. Accordingly, the influence of human activities on lynx populations in north-central Washington is of significant concern to both public and private resource managers.

Some activists have argued that logging, road construction, and ski and snowmobile areas degrade or destroy lynx habitat and constrain their movements and spatial patterns. In addition, roads and recreational trails provide human access to lynx habitat, which may disrupt hunting activities and reproduction, and increase the likelihood that lynx will be killed illegally or incidentally. However, reliable information that could be used to critically evaluate the validity of these claims is lacking. Information on the effects of paved roads on lynx is urgently needed for managers to accurately assess the impacts of such roads on habitat use by lynx at the landscape scale. In particular, information is needed on the extent to which such roads may serve as barriers to lynx movements and dispersal, and disrupt connectivity among sub-populations. The objectives of this study are to (1) use hair-snagging techniques and DNA analyses to conduct surveys to detect the presence of lynx along the Washington State Highway 20 (North Cascades Highway) corridor in north-central Washington, and (2) attempt to document lynx crossing this highway during the snow-free period when vehicular traffic is present on the highway.

Methods

To survey the Highway 20 corridor for the presence of lynx, we used a modification of protocols developed by the USDA Forest Service to conduct surveys for lynx throughout its range in the contiguous U.S. The objective of the National Lynx Survey is to sample broad areas for the presence of lynx; consequently, sampling is conducted with a variably shaped grid of transects spaced about 3 km apart. Each transect is 400 m long and contains 5 sampling stations spaced 100 m apart. At each station, a 6 x 6 in. carpet square containing an array of nails that have been driven through the back of the carpet square is nailed to a tree about 50 cm from the ground. An aluminum pie plate is suspended as a visual attractant, and each pad is baited with a lure containing beaver castorium and catnip oil, which elicits neck-rubbing behavior by lynx on the pad. During rubbing, the nails and the pad collect hairs from the animal. The hairs, and especially the follicles that are pulled out, contain enough DNA to enable geneticists to identify hairs to species and, if sufficient DNA is present, to distinguish individual lynx using mitochondrial and microsatellite DNA analyses. The Carnivore Conservation Genetics Laboratory, which is administered jointly by the USDA Forest Service's Rocky Mountain Research Station and the University of Montana, analyzed the hairs we collected during this study using techniques identical to those used for samples from the National Lynx Survey.

During the course of this study, we conducted a total of 4 months of hair snag-pad surveys along Highway 20 in north-central Washington, including 1 month of surveys during the fall of 2000 and 3 consecutive months of surveys during the summer of 2001. From October 2-6, 2000, we established 29 hair-snag transects approximately 1.5 km apart on alternating sides of Highway 20 from the Klipchuck Campground in Okanogan Co. to East Creek in Whatcom Co. (Figure 1; note that in Figures 1-3, the side of the highway where the transect number is written

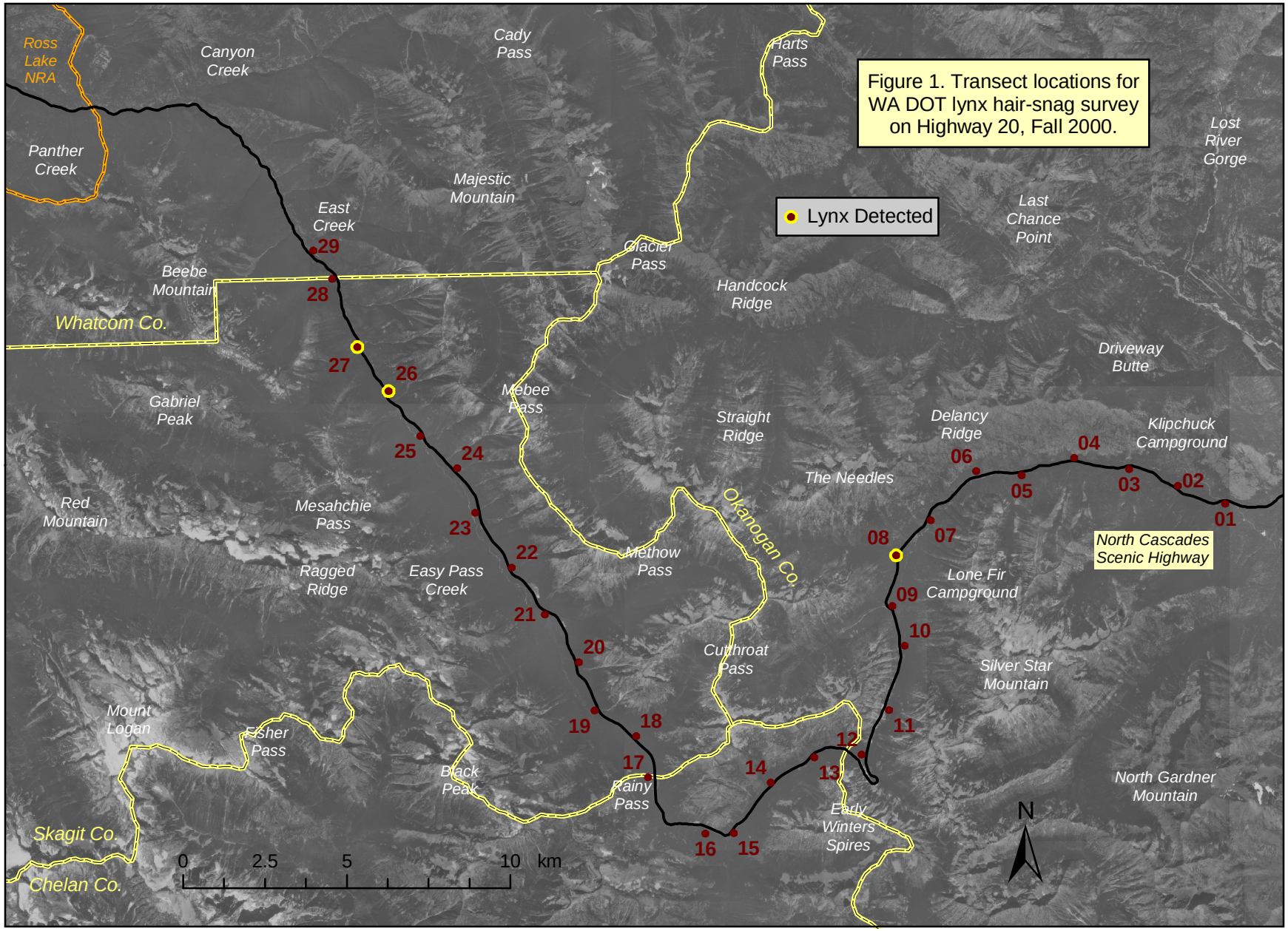
Figure 1. Transect locations for WA DOT lynx hair-snag survey on Highway 20, Fall 2000.
Lynx Detected
Ross Lake NRA
Canyon Creek
Cady Pass
Harts Pass
Lost River Gorge
Panther Creek
Majestic Mountain
East Creek
Last Chance Point
Glacier Pass
Beebe Mountain
Handcock Ridge
Whatcom Co.
Driveway Butte
Gabriel Peak
Mebee Pass
Straight Ridge
Delancy Ridge
Klipchuck Campground
The Needles
Red Mountain
Mesahchie Pass
Okanogan Co.
North Cascades Scenic Highway
Ragged Ridge
Easy Pass Creek
Methow Pass
Lone Fir Campground
Cutthroat Pass
Silver Star Mountain
Mount Logan
Fisher Pass
Black Peak
Rainy Pass
North Gardner Mountain
Early Winters Spires
Skagit Co.
Chelan Co.
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
0 2.5 5 10 km
N

indicates the side of the highway where the transect was located). Among the 29 transects, 17 were on the east side of the Cascade crest (i.e., east of Rainy Pass) and 12 were on the west side. We checked the pads every 2 weeks; if hair was found on a pad, we placed the pad in a ziploc bag and replaced it with a new one. We ran each transect for about 30 days and removed them from October 30 to November 3, 2000. We sent all pads containing hair to the genetics lab in Missoula for analysis.

We conducted a second hair-snag survey in the same general area along Highway 20 for about 90 days during the summer of 2001. The purpose of the second survey was to (1) obtain additional data on lynx occurrence in the vicinity of Highway 20, (2) expand our survey area further west of the Cascade crest, and (3) determine if a longer survey period would result in substantially more lynx hits. From July 9-19, 2001, we established 33 transects along alternating sides of Highway 20 (with a few exceptions due to topographic constraints) from the Klipchuck Campground in Okanogan Co. to Panther Creek in the Ross Lake National Recreation Area in Whatcom Co. (Figure 2). We added 1 transect to the Fall 2000 survey locations near Rainy Pass and 3 transects between East Creek and Panther Creek. During the Summer 2001 survey, 17 transects were located on the east side of the Cascade crest and 16 were on the west side. As before, we checked the pads every 2 weeks; if hair was found on a pad, we placed the pad in a ziploc bag and replaced it with a new one. We ran each transect for about 90 days and removed them from October 1-15, 2001. As with the fall sample, we sent all pads containing hair to the genetics lab in Missoula for analysis.

Because we did not permanently mark the locations of the transects we established and removed all flagging from the transects at the close of the Fall 2000 survey, the precise locations of most of the transects we established in the Summer 2001 survey varied somewhat from those

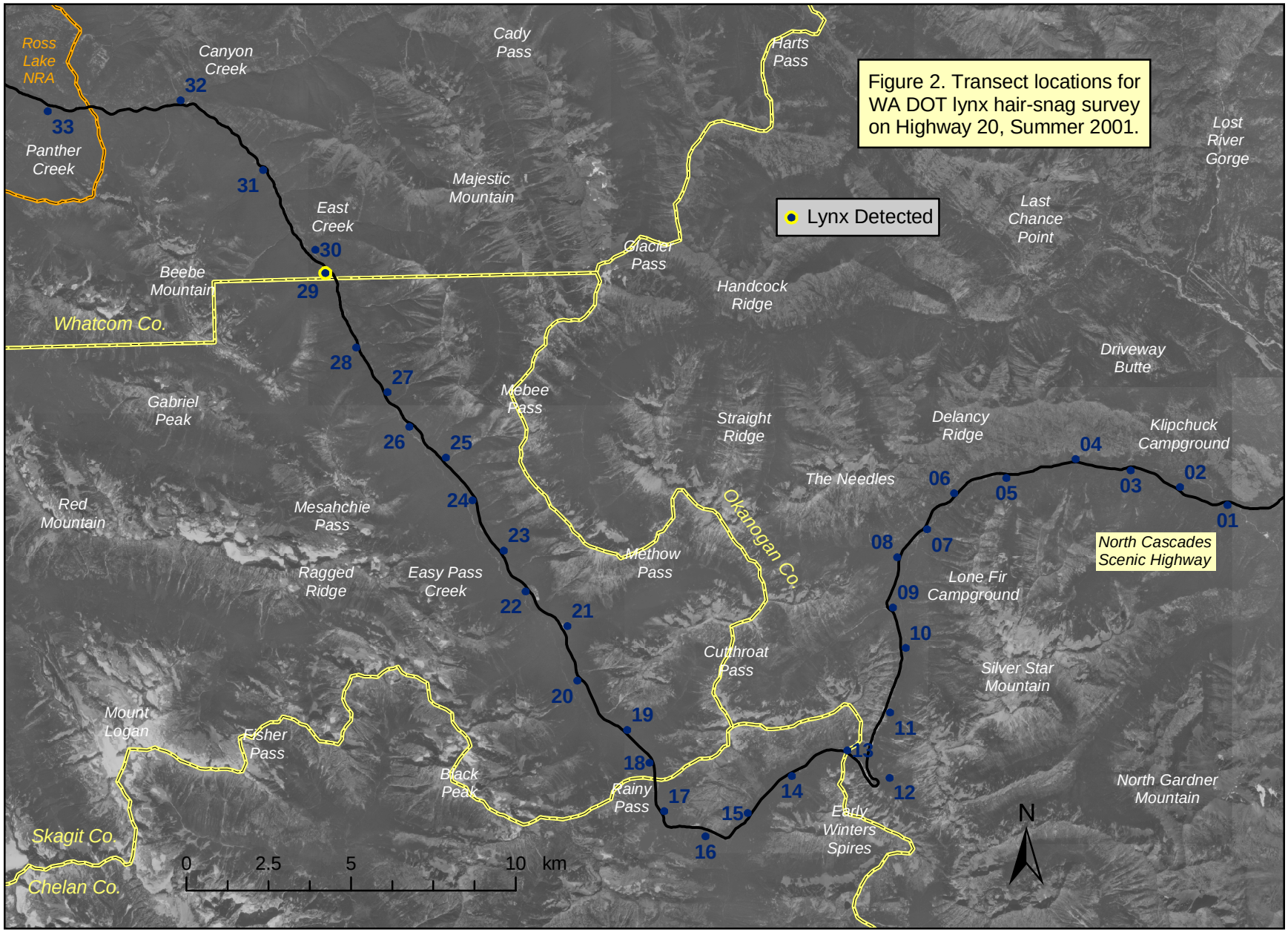
Figure 2. Transect locations for WA DOT lynx hair-snag survey on Highway 20, Summer 2001.
Lynx Detected
Ross Lake NRA
Canyon Creek
Cady Pass
Harts Pass
Lost River Gorge
Panther Creek
Majestic Mountain
East Creek
Last Chance Point
Glacier Pass
Beebe Mountain
Handcock Ridge
Whatcom Co.
Driveway Butte
Gabriel Peak
Mebee Pass
Straight Ridge
Delancy Ridge
Klipchuck Campground
The Needles
Red Mountain
Mesahchie Pass
Okanogan Co.
North Cascades Scenic Highway
Methow Pass
Ragged Ridge
Easy Pass Creek
Lone Fir Campground
Cutthroat Pass
Silver Star Mountain
Mount Logan
Fisher Pass
Black Peak
Rainy Pass
North Gardner Mountain
Early Winters Spires
Skagit Co.
Chelan Co.
0 2.5 5 10 km
N
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

we ran during Fall 2000. Figure 3 shows the location of all transects sampled during both survey periods. Transects whose locations were coincident in both sampling periods are shown in purple; transects that were unique to the Fall 2000 sample are shown in blue, and transects that were unique to the Summer 2001 sample are shown in red. Note that because we added a transect (no. 17) on the north side of the highway near Rainy Pass during the Summer 2001 survey, the numbering of transects 17-29 does not match between years. Thus, for all transects that are not colored purple in Figure 3, it is important to distinguish between the Fall 2000 and Summer 2001 transect numbers.

Results

Fall 2000 survey. During the Fall 2000 survey, we obtained hair at 14 stations on 12 transects, 11 of which contained adequate amounts and quality of DNA for identification at the species level (Table 1). We detected black bear on 7 transects, domestic cat on 1 transect, and lynx on 3 transects (nos. 8, 26, and 27). Transect 8 is near Pine Creek and is approximately 10 km west of the starting point of our survey on the east side of the Cascade crest; sites 26 and 27 are near Cabinet Creek and are approximately 3 and 4.5 km east of the end point of the survey on the west side of the Cascade crest. Sites 26 and 27 are adjacent and are located on opposite sides of Highway 20 (Figure 2); however, there was insufficient DNA in these samples to determine if they were from the same individual or not. Site characteristics at the 3 stations where lynx were detected during the Fall 2000 survey are presented in Table 2.

Summer 2001 survey. During the Summer 2001 survey, we obtained hair at 61 stations on 28 transects, 48 of which contained adequate amounts and quality of DNA for identification at the species level; we also collected hair on one transect (no. 7) while moving between stations

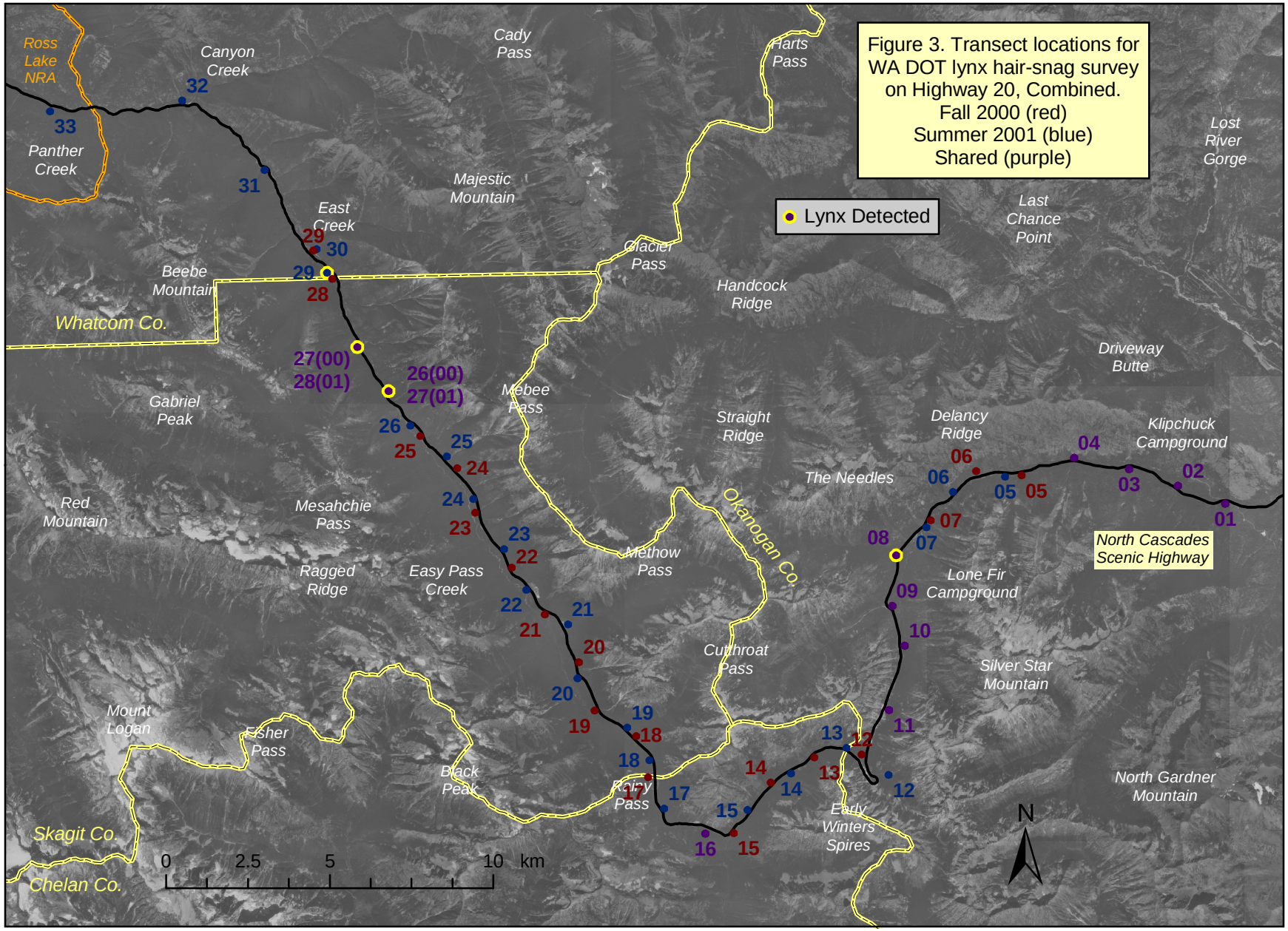
Figure 3. Transect locations for WA DOT lynx hair-snag survey on Highway 20, Combined.
Fall 2000 (red)
Summer 2001 (blue)
Shared (purple)
Lynx Detected
Ross Lake NRA
Canyon Creek
Cady Pass
Harts Pass
Lost River Gorge
Panther Creek
Majestic Mountain
East Creek
Last Chance Point
Glacier Pass
Beebe Mountain
Handcock Ridge
Whatcom Co.
Driveway Butte
Gabriel Peak
Mebee Pass
Straight Ridge
Delancy Ridge
Klipchuck Campground
The Needles
Red Mountain
Mesahchie Pass
Okanogan Co.
North Cascades Scenic Highway
Ragged Ridge
Easy Pass Creek
Methow Pass
Lone Fir Campground
Cutthroat Pass
Silver Star Mountain
Mount Logan
Fisher Pass
Black Peak
Rainy Pass
North Gardner Mountain
Early Winters Spires
Skagit Co.
Chelan Co.
0 2.5 5 10 km
N

Table 1. Results of hair-snag surveys for lynx on Highway 20, Fall 2000.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
1	684840	5384500	2947	15.0	October 2	October 30	4	yes	black bear
2	683400	5385050	2990	8.4	October 2	October 30	---	---	---
3	681900	5385550	3242	27.8	October 2	October 30	2	no	---
4	680220	5385900	3154	25.2	October 4	October 30	---	---	---
5	678620	5385360	3698	35.6	October 3	October 30	5	yes	black bear
6	677240	5385490	3634	13.6	October 3	October 30	5	yes	black bear
7	675840	5383990	3700	2.0	October 3	October 30	---	---	---
8	674790	5382920	4058	21.4	October 3	October 30	5	yes	lynx
9	674670	5381380	3914	17.6	October 4	October 31	---	---	---
10	675050	5380160	3972	20.0	October 4	October 31	---	---	---
11	674580	5378190	4550	22.0	October 4	October 31	---	---	---
12	673740	5376840	5370	25.6	October 4	October 31	---	---	---
13	672290	5376750	5656	36.0	October 5	October 31	---	---	---
14	670960	5375990	5268	21.0	October 5	November 1	3	yes	domestic cat
							5	yes	black bear
15	669830	5374440	4869	45.0	October 5	November 1	5	no	---
16	668970	5374430	4620	35.2	October 5	November 1	2	no	---
							3	yes	black bear
17	667220	5376150	4954	28.0	October 5	November 3	---	---	---

Table 1 (cont.). Results of hair-snag surveys for lynx on Highway 20, Fall 2000.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
18	666850	5377400	4888	20.4	October 5	November 1	---	---	---
19	665580	5378180	4420	18.6	October 5	November 1	---	---	---
20	665110	5379650	4564	30.6	October 5	November 1	5	yes	black bear
21	664070	5381110	4024	2.6	October 5	November 1	---	---	---
22	663060	5382550	4136	16.0	October 5	November 1	---	---	---
23	661940	5384220	3682	7.0	October 6	November 3	---	---	---
24	661390	5385590	3860	37.8	October 6	November 3	---	---	---
25	660260	5386560	3481	16.4	October 6	November 3	---	---	---
26	659300	5387940	3458	23.0	October 6	November 3	1	yes	lynx
27	658340	5389290	3396	20.6	October 6	November 3	5	yes	lynx
28	657580	5391360	3104	35.4	October 6	November 3	5	yes	black bear
29	657000	5392240	3046	47.0	October 6	November 3	---	---	---

[1]Datum for UTM coordinates is NAD 27, Zone 10.

Table 2. Site characteristics at stations where lynx were detected on Highway 20, fall 2000.

Transect	Station	Elevation (feet)	Slope (%)	Overstory characteristics	Understory characteristics
8	5	4170	20	Primary species: Engelmann spruce 40%, subalpine fir 40% mountain hemlock 10%, western white pine 10%. Mean dbh: 6". Crown closure: 30%.	Primary species: mountain hemlock 30%, subalpine fir 20% black huckleberry 20%, Prince's pine 10%, falsebox 10%, twinflower 10%. Understory closure: 80%.
Notes: Good lynx and snowshoe hare cover and forage for hares. Snowshoe hare pellets were found at the station. Lynx hair was collected on the second check (October 30, 2000) .					
26	1	3360	13	Primary species: mountain hemlock 90%, Pacific silver fir 10%. Mean dbh: 20". Crown closure: 80%.	Primary species: Pacific silver fir 90%; black huckleberry 5%, Prince's pine 5%. Understory closure: 10%.
Notes: High sight distance; no hiding cover. Lynx hair was collected on the second check (November 3, 2000).					
27	5	3520	12	Primary species: lodgepole pine 95%, mountain hemlock 5%. Mean dbh: 8". Crown closure: 30%.	Primary species: lodgepole pine 20%, Scouler's willow 20%, black huckleberry 20%, kinnikinnick 20%, mountain hemlock 10%, western white pine 10%. Understory closure: 15%.
Notes: Station is located in an open area on a bench. Good sight distance in foreground, background denser. Lynx hair was collected on the second check (November 3, 2000). Most lodgepole pine near station are dead.					

(Table 3). In addition, the genetics lab identified one sample to species based on gross morphology. We detected black bear on 21 transects, dog/wolf on 3 transects, coyote on 2 transects, cougar on 1 transect, deer on 1 transect, unknown ungulate on 6 transects, 'other' on 3 transects, and lynx on 1 transect (no. 29). Site characteristics at the station where a lynx was detected during the Summer 2001 survey are presented in Table 4.

Discussion

Because the lynx detections at sites 26 and 27 were located only 1.5 km apart on opposite sides of Highway 20 and were collected during the same 2-week period (Table 2), it is tempting to assume that they were from the same individual, and therefore demonstrate that lynx cross Highway 20 during the summer when vehicular traffic is present. Without additional samples having sufficient DNA for individual identification, however, this conclusion remains speculative. Our results and additional field observations indicate, however, that lynx occur throughout the year in subalpine habitats on the west side of the Cascade crest in eastern Whatcom and Skagit Cos. In addition to the DNA detections we obtained on transects 26 and 27 in northeastern Skagit Co. during the Fall 2000 survey, and on transect 29 in southeastern Whatcom Co. during the Summer 2001 survey, our field personnel reported finding lynx tracks during the winter in the vicinity of these sites. Furthermore, the presence of lynx at McMillan Park in southeastern Whatcom Co., which is located about 10 km northeast of the western end of the Summer 2001 survey area, was documented by other researchers in June 2000 (Figure 4; K. Romain, pers. comm.). Romain's record, combined with the results of this study extend the documented range of Canada lynx in north-central Washington about 25 km west of previously known localities.

Table 3. Results of hair-snag surveys for lynx on Highway 20, Summer 2001.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
1	684840	5384500	2814	15.6	11 July	1 October	3	yes	dog/wolf
							3	yes	black bear
2	683400	5385050	2910	15.2	11 July	3 October	2	no	---
							5	yes	other
3	681900	5385550	3168	23.2	11 July	3 October	3	yes	black bear
							4	yes	other
							5	yes	cougar
4	680220	5385900	3124	9.8	11 July	9 October	1	yes	black bear
							2	no	---
							4	yes	black bear
							5	yes	black bear
5	678110	5385330	3472	33.8	9 July	1 October	4	yes	black bear
6	676530	5384860	3485	15.8	9 July	1 October	1	yes	black bear
7	675710	5383770	3408	12.0	9 July	1 October	3	yes	black bear
							0[2]	yes	coyote
8	674790	5382920	3678	26.6	10 July	1 October	---	---	---
9	674670	5381380	3520	12.2	10 July	3 October	1	yes	black bear
							2	yes	black bear
							4	yes	black bear
							4	yes	ungulate

Table 3 (cont.). Results of hair-snag surveys for lynx on Highway 20, Summer 2001.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
10	675050	5380160	3796	19.4	10 July	3 October	3	yes	ungulate
							4	yes	black bear
11	674580	5378190	4140	22.2	11 July	3 October	1	yes	black bear
							2	yes	black bear
							4	yes	black bear
							5	yes	black bear
12	674560	5376210	4904	28.4	11 July	4 October	1	yes	black bear
13	673280	5377040	5370	18.2	12 July	4 October	1	no	---
							3	yes	ungulate
							5	no	---
14	671590	5376260	5288	15.0	12 July	4 October	---	---	---
15	670250	5375140	4775	12.5	12 July	4 October	1	no	---
16	668970	5374430	4498	25.8	13 July	9 October	3	no	---
							5	yes	black bear
17	667710	5375190	4798	24.0	13 July	9 October	---	---	---
18	667260	5376660	4764	16.4	13 July	9 October	2	yes	black bear
							3	no	---
							4	yes	black bear

Table 3 (cont.). Results of hair-snag surveys for lynx on Highway 20, Summer 2001.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
19	666580	5377660	4740	23.8	17 July	9 October	1	yes	black bear
							3	yes	black bear
							4	yes	black bear
20	665060	5379160	4250	12.4	17 July	9 October	---	---	---
21	664770	5380820	4355	30.4	17 July	9 October	2	yes	black bear
							3	yes	dog/wolf
							3	N/A[3]	ungulate
22	663500	5381870	4010	6.0	17 July	10 October	2	yes	black bear
							4	no	---
23	662830	5383110	4150	34.2	18 July	10 October	---	---	---
24	661880	5384650	3735	12.4	18 July	10 October	1	no	---
							2	no	---
25	661070	5385950	3844	44.8	18 July	10 October	1	yes	ungulate
26	659960	5386880	3516	20.8	18 July	15 October	2	yes	black bear
							3	yes	black bear
							4	yes	deer
27	659300	5387940	3474	18.2	18 July	15 October	2	yes	other
							4	yes	black bear
							5	yes	dog/wolf

Table 3 (cont.). Results of hair-snag surveys for lynx on Highway 20, Summer 2001.

Transect	Location[1]		Mean elevation (feet)	Mean slope (%)	Date transect was set up	Date of final check and pickup	Station nos. with hairs on pad	Quality DNA?	Species detected
	UTM Easting	UTM Northing							
28	658340	5389290	3390	20.8	18 July	15 October	5	yes	black bear
29	657410	5391560	3006	47.2	18 July	15 October	2	no	---
							3	yes	lynx
							4	yes	black bear
30	657100	5392270	3145	44.2	18 July	15 October	1	yes	black bear
							2	yes	black bear
							4	yes	black bear
							5	yes	black bear
31	655510	5394690	2600	41.0	18 July	15 October	2	no	---
							5	yes	ungulate
32	653000	5396810	2335	40.4	19 July	15 October	4	yes	coyote
							5	yes	black bear
33	648960	5396480	2165	38.4	19 July	15 October	4	no	---

[1]Datum for UTM coordinates is NAD 27, Zone 10.

[2]Hair was vialed in the field along transect but not on pad (e.g., ground, tree, etc.).

[3]Hair was identified on the basis of gross morphology.

Table 4. Site characteristics at stations where lynx were detected on Highway 20, summer 2001.

Transect number	Station	Elevation (feet)	Slope (%)	Overstory characteristics	Understory characteristics
29	3	3030	53	Primary tree species: lodgepole pine 95%, western hemlock 5%. Mean dbh: 5". Crown closure: 20%.	Primary species: black huckleberry 60%, western hemlock 30%, false azalea 10%. Understory closure: 20%.

Notes: Site distance is good, but hiding cover is present. High mortality in lodgepole pine overstory. Lynx hair was collected on both the first and fourth checks (August 1 and September 12, 2001).

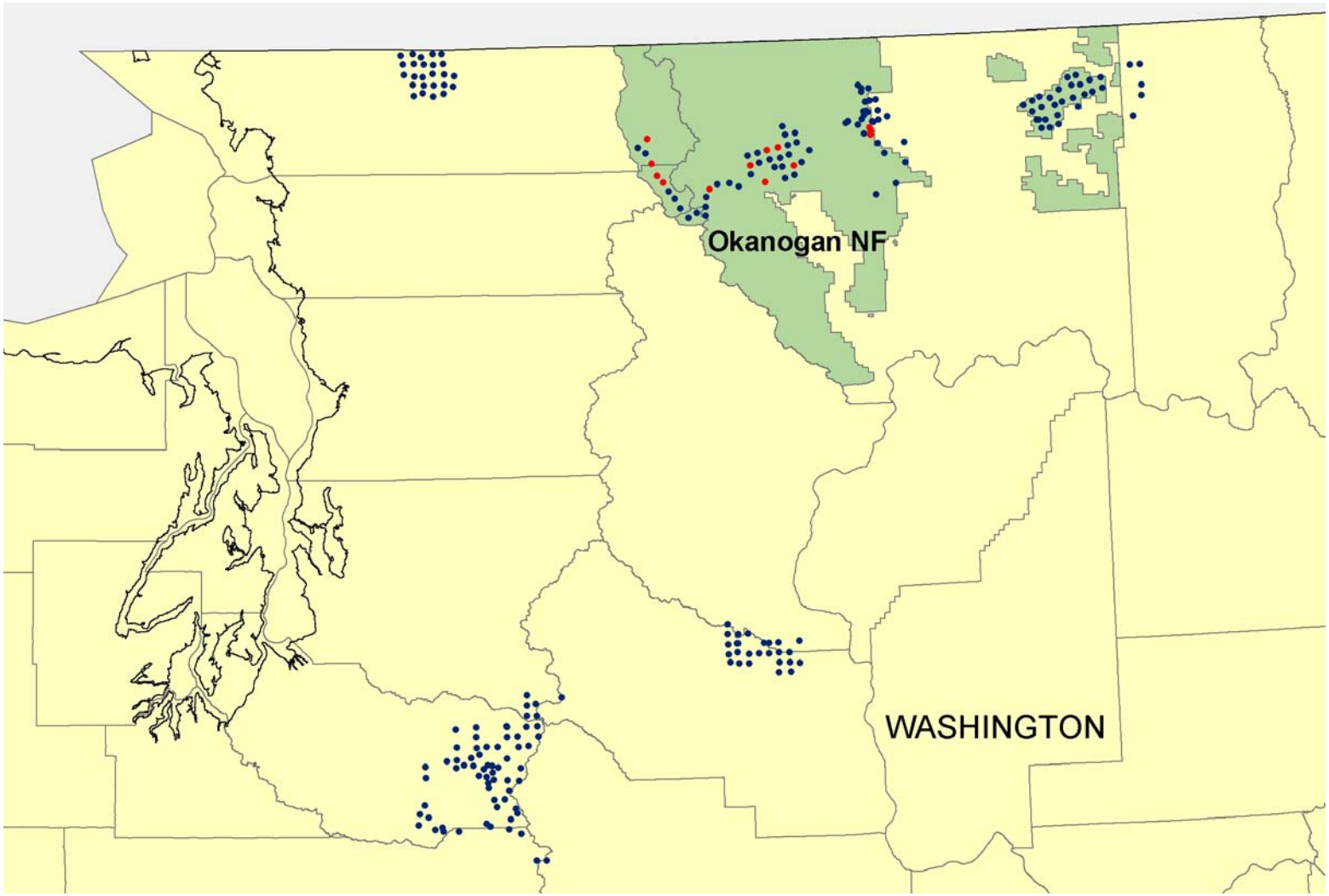

Figure 4. Location of the Highway 20 lynx surveys relative to the National Lynx Survey. Dots indicate the locations of sample transects for hair-snag surveys conducted in northwestern Washington from 1999 to 2001; red dots indicate transects at which lynx were detected and blue dots indicate surveys that failed to detect lynx. The Highway 20 survey area is represented by the linear array of dots at the western edge of the Okanogan National Forest. The McMillan Park detection is the red dot just northeast of the west end of the Highway 20 survey area, and represents the westernmost documented lynx record in Washington.

Results from the Summer 2001 survey were disappointing and failed to provide documentation of individual lynx crossing Highway 20 when vehicular traffic was present. Although the lynx detection we obtained was several kilometers northwest of the westernmost lynx detection from the Fall 2000 survey (Figure 3), the 90-day survey we conducted in Summer 2001 did not result in substantially more detections than the initial 30-day survey period, nor did it provide new information about lynx occurrence along the Highway 20 corridor. It is possible that lynx become habituated to hair-snag pads after the initial survey period. In areas where several annual surveys have been conducted, lynx detection rates often drop substantially after the initial survey. For example, a 30-day winter survey and a 90-day summer survey conducted in 1999 in the Black Pine Basin area of north-central Washington (the cluster of points just east of the Highway 20 survey area in Figure 4) resulted in 8 lynx hits (3 during winter and 5 during summer) representing 6 different individuals. Subsequent 90-day surveys in the summers of 2000 and 2001 in the same area resulted in only 1 lynx hit in 2000 and 0 hits in 2001. We don't know if a 90-day survey period will result in substantially more lynx hits than a 30-day survey, but our results indicate that if longer survey periods are being considered, they should be conducted during the initial survey in a given area, and not during surveys in subsequent years.

Our survey demonstrated that lynx occur in the immediate vicinity of Highway 20 in at least 2 general locations: near Pine Creek at about 4,200 ft. elevation on the east side of the Cascade crest, and near Cabinet Creek at about 3,300 ft. elevation on the west side of the Cascade crest. However, additional surveys will be needed to determine whether lynx cross Highway 20 when vehicular traffic is present, and intensive field studies using radio-telemetry will be required to investigate the extent to which such roads may serve as barriers to lynx movements and dispersal. The results of our survey demonstrate that opportunities exist for

studying the effects of a major highway on lynx movements and habitat use in north-central Washington.

Acknowledgments

We thank the many employees of the Okanogan National Forest who made important contributions to the success of this survey, including John Rohrer for his generous field and logistical support throughout the course of the survey; John Jakubowski for his outstanding leadership and dedication during all phases of the fieldwork; and Ann Sprague, Jeremy Cerka, Dan Harrington, Sherrie Farmer, John Daily, Ben Maletzke, and Laurie Dowie for assistance in the field. Cathy Raley of the Pacific Northwest Research Station and Paul Wagner and Bill Leonard of the Washington Department of Transportation helped with the establishment of survey transects. Leslie Jagger of the Pacific Northwest Research Station prepared all of the maps included in this report. The Carnivore Conservation Genetics Laboratory in Missoula, MT provided logistical support, survey kits, and genetic analyses, often without compensation.