CITIZEN WILDLIFE MONITORING PROJECT

2014 SPRING-FALL FIELD SEASON REPORT

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(Photo of wolverine (Gulo gulo) at Ice Lake site)

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EXECUTIVE SUMMARY

For over a decade, the Citizen Wildlife Monitoring Project has marshalled citizen scientists looking for Washington's rare and sensitive wildlife. Using remote cameras and snow tracking, project volunteers monitor for wolverines, gray wolves, North Cascades grizzly bears, Canada lynx, and more, while also focusing on detecting wildlife present in places critical for wildlife connectivity, conservation, and habitat such as along the Interstate 90 (I-90) corridor.

Citizen scientists contribute valuable new information on the presence and patterns of wildlife in our state. Our project efforts cover geographic areas outside those where professional research efforts are ongoing, adding to and strengthening the work of agencies, biologists, and others.

From May through November 2014, 76 volunteers in the Citizen Wildlife Monitoring Project installed and maintained 22 sites in Washington and British Columbia. Sites were focused on Washington's Cascade Mountains and the Kettle River Range (the Kettle River Range encompasses southeastern British Columbia and Ferry County, Washington, in the United States). The main objectives for the 2014 spring-fall field season were to 1) monitor gray wolf (*Canis lupus*) presence in the Southern Cascades, 2) detect wolverine (*Gulo gulo*) presence in the North, Central, and Southern Cascades, 3) document grizzly bears (*Ursus arctos*) in North Cascades Grizzly Bear Recovery Zone , 4) observe all wildlife presence between Hyak and Easton adjacent to I90, and 5) document transboundary Canada lynx (*Lynx canadensis*) activity between northeast Washington and British Columbia.

With the assistance of Conservation Northwest program staff and our Advisory Council (Appendix I); we established four sites in the North Cascades, three sites in the Central Cascades, five sites in the I-90 corridor, and eight sites in the Southern Cascades (our points of delineation for Cascades regions can be found on Page 6 of this report). Though three sites were installed in the Kettles Range, one site on the British Columbia side and two sites on the Washington side, only two sites reported data to date. Since this was our second season in this region monitoring on both sides of the border, we expected some minor setbacks, ergo we will continue and expand monitoring in the Kettle Range during our 2014-2015 winter monitoring season, as well as our 2015 spring-fall season.

Over the course of the 2014 spring-fall season, we detected ten species. Our greatest success this field season was continued documentation of wolverines where we know they occur in the North and Central Cascades but continued genetic profiling and documentation of new individuals is meaningful. These wolverines are on the frontlines of recovery for the species in our region. Our other success this season was documenting Canada lynx in the British Columbia Kettle Range. Other season highlights include:

- Wolverines documented at both Ice Lake and Union Gap in the North Cascades and at Chiwaukum in the Central Cascades. Photo evidence from Ice Lake identified four unique individual wolverines; including Sasha who has been previously documented and may be denning in the area. Genetic material was collected by volunteers and is undergoing analysis by the project advisors from the USDA Pacific Northwest Research Lab. Chiwaukum also received visits from a number of wolverine this year. Similar to Ice Lake, genetic material is currently being analyzed for the wolverine documented at Chiwaukum.
- Two sites dedicated to documenting the presence of grizzly bears in the North Cascades were established. Monitoring for this species is a new endeavor this year as a result of movement in recovering grizzly bears in the North Cascades. One site was located directly in the National Park and established new relationships for the project there.
- Canada lynx detected at a new site in British Columbia near Highway 3 located in a crucial corridor for lynx movement between Canada and the U.S. Ongoing winter monitoring will continue at this site, which contains four cameras located within proximity to one another.
- American martens recorded at multiple sites, a sign of late successional forest nearby where martens often den and hunt. While not a target species of our project, data collected on martens will be shared with the Cascades Carnivore Connectivity Project[1], which is studying the barrier effects of highways in genetic diversity among populations of black bears and martens.
- The highest diversity of species observed at three different sites this year. Two sites were located in the South Cascades (Cowiche Creek and Rimrock Lake), while the other was located in British Columbia and included a target species, Canada lynx. Each of these sites documented eight different species, including Canada lynx, cougar, bobcat, elk, and deer, among others.
- Animals documented at the Gold Creek site were of particular interest this season due to the completion of two wildlife underpasses at Gold Creek. The recording of seven different species in habitat adjacent to these new crossing structures speaks to their use for wildlife to safely cross under I-90. Since the underpasses have transitioned from a construction to restoration phase, we expect to see wildlife using the underpasses and the areas adjacent to them.

The work of our volunteers through the Citizen's Wildlife Monitoring Project increases our understanding of wildlife on the Washington landscape and in the transboundary region

[1] Cascades Carnivore Connectivity Project, http://www.cascadesconnectivity.org/

between Washington and British Columbia. Not only does visual documentation of species influence research and policy decisions, these images create a narrative and put a face to our wildlands; the Citizen Wildlife Monitoring Project underscores the importance of monitoring and conservation efforts to ensure a stable landscape for Washington's wildlife.

PROJECT OVERVIEW

Over a decade ago, Conservation Northwest began using citizen science as a way to fulfill our mission of protecting and connecting wildlife and wildlands from the Washington Coast to the B.C. Rockies. Although the technology has changed since then, we continue to train and deploy hundreds of citizen scientists each year throughout our mission area with the Citizen Wildlife Monitoring Project (CWMP). The project uses remote cameras and snow tracking to document rare and sensitive species throughout core areas, providing security habitat for rarer wildlife, as well as more common species in strategically important locations. Since its inception, CWMP has remained an asset to wildlife agencies and professionals by providing additive monitoring efforts in areas identified as potential core habitat for some of our region's rarest wildlife. Our main project objectives are:

1. To engage and educate citizens on wildlife species and monitoring in critical habitat areas;
2. To record wildlife presence in the I-90 corridor and along the I-90 Snoqualmie Pass East Project in strategic locations and in core habitat through remote cameras and snow tracking;
3. To record the presence of rare and sensitive species that regional and national conservation efforts aim to recover including fisher, gray wolf, grizzly bear, lynx, and wolverine;
4. To facilitate exchange of information on wildlife, including data from monitoring efforts, between public agencies, organizations, and interested individuals.

Due to the number of partners in the Cascades ecosystem, CWMP operates in the Cascade Range through a collaborative effort, formalized in 2006, between Conservation Northwest, the I-90 Wildlife Bridges Coalition, and Wilderness Awareness School. Throughout each monitoring year, each organization leads a faction of the project: Conservation Northwest acts as the main volunteer coordinator for all efforts, as well as taking the lead in all remote camera efforts beyond the I-90 corridor in the north and south Cascades. I-90 Wildlife Bridges Coalition and the Wilderness Awareness School provide in-kind and financial support to the project.

CWMP has broadened its positive impact through an Advisory Council made up of project partners, government agency biologists, and professional researchers (Appendix I). Our Advisory Council provides valuable input to the review of our program; it also steers our yearly monitoring objectives and site locations. Councilmembers assist in developing our protocols, confirm identification of priority images from the season, and provide a scientific audience for results gained in the field from hair samples to tracks. These collaborations between project partners and advisors are crucial to the success of the program year to year. Collaboration keeps our efforts scientifically informed and relevant, ensures coordination rather than duplication of monitoring efforts statewide, and adds valuable on the ground information to the conservation community.

Monitoring seasons are broken into two terms: April – November (spring-fall) remote camera monitoring and December – March (winter) remote camera monitoring and snow tracking. At the finale of each season a monitoring report is prepared and made public through Conservation Northwest's website (http://www.conservationnw.org/what-we-do/wildlife-habitat/wildlife-monitoring). For the purposes of this report, we focus here on our results from the 2014 spring-fall monitoring season.

This season, we concentrated our study area in two distinct regions – the Cascade Mountains in Washington and the Kettle Range (the Kettle Range encompasses southeastern British Columbia and Ferry County, Washington, in the United States). Within the Cascade Mountains, we have refined the study area into four distinct regions:

1. North Cascades: North of US 2 and west of US 97
2. Central Cascades: Between I-90 and US 2
3. I-90 Corridor: Between Hyak and Easton along I-90
4. Southern Cascades: South of I-90

At the start of each season, monitoring objectives are established by project staff with feedback and guidance from the Advisory Council. These objectives are typically in response to current statewide priority species and habitat identified as important for these species. In 2014, our spring-fall monitoring objectives were to:

1. Monitor the recovery of gray wolves (*Canis lupus*) in the Cascade Mountains, with a particular focus on the Southern Recovery Zone. These sites were identified to respond to identified high-quality habitat where wolves are expected to expand their existing range and recover.

2. Document the presence of wolverines (*Gulo gulo*) in the North, Central, and Southern Cascades outside of the geographic scope of the ongoing North Cascades Wolverine Study.[2] In addition to collecting visual documentation through remote cameras, these sites also are set up to collect genetic information valuable to wildlife agencies.

3. Document grizzly bears (*Ursus arctos*) in North Cascades Grizzly Bear Recovery Zone as part of the Cascade Carnivore Connectivity Project's ongoing research.

4. Observe the behavior and presence of all wildlife species in key habitat connectivity areas east of Snoqualmie Pass along Interstate 90, where wildlife crossing structures are completed, under construction, or planned for construction under the I-90 Snoqualmie Pass East Project.[3]

5. Detect transboundary wildlife activity between northeast Washington and British Columbia with a specific focus on documenting and collecting genetic information of Canada lynx (*Lynx canadensis*).

Wolf Monitoring

Since 2008 when this program's remote cameras documented the first wolf pack in Washington in over 70 years, Conservation Northwest placed major focus on wolf recovery in Washington. As of March 2014, Washington is home to thirteen confirmed wolf packs making up over 52 wolves.[4] Though the majority of these packs have established territories in eastern Washington, three packs now reside in the North Cascades. Conservation Northwest partners with the Washington Department of Fish and Wildlife to implement the state's wolf conservation and management plan developed in 2011. In addition to shaping wolf policy in Washington, Conservation Northwest through CWMP provides on-the-ground data used to better understand the distribution of wolves across the state.

The Wolf Conservation and Management Plan, written in 2011, identify three recovery zones in Washington: Eastern Washington, the North Cascades, and the Southern Cascades and Northwest Coast.[5] According to this plan, wolves will be considered recovered in the state of Washington if there are 15 successful breeding pairs for three consecutive years. Additionally, each recovery zone must have at least four breeding pairs for three consecutive years. To date,

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[2] North Cascades Wolverine Study. Lead Principle Investigator: Keith Aubry (USDA Forest Service, Pacific Northwest Research Station, Olympia, WA)

[3] The I-90 Snoqualmie Pass East Project is designed to improve wildlife movement across I-90 between Hyak and Easton. The I-90 project design includes 14 key animal-travel areas, where one or more improvements will be made to allow for wildlife to better move across the interstate and waterways under the interstate. Maps of the identified areas for wildlife passage can be found at: wsdot.wa.gov/NR/rdonlyres/F6513B4C-12AE-43D3-ABA1-95104CAAD29D/72075/I90_Project_Folio_ConstWeb.pdf

[4] Washington Department of Fish and Wildlife Gray Wolf Packs Map: wdfw.wa.gov/conservation/gray_wolf/packs

[5] Gary J. Wiles, Harriet L. Allen, and Gerald E. Hayes, *Wolf Conservation and Management Plan: State of Washington* (Olympia, WA, USA: Washington Department of Fish and Wildlife, December 2011).

there are 12 packs in Washington, none of which have been documented in the Southern Cascades and Northwest Coast recovery zones. To address the lack of documentation in the Southern Cascades, during the CWMP 2014 monitoring season we focused our efforts on responding to anecdotal reports of wolf activity south of I-90.

Wolverine Monitoring

The largest terrestrial members of the weasel family, wolverines are one of the rarest carnivores in North America.[6] Wolverines prefer alpine environments where snow packs persist well into summer months. In addition to living in these difficult environments where food is scarce, wolverines are extremely mobile carnivores with home ranges between 100 km² to upwards of 900 km²; this means they typically live in low densities across large landscapes.[7] After almost complete eradication in the 1900s from the lower 48 states, wolverines have begun a comeback to places such as the North Cascades; and since 2005, state researchers have identified a dozen individual wolverines. But much is still unknown about these rare and elusive species, and that's where the Citizen Wildlife Monitoring Project comes in.

Though currently unprotected, conservation groups have pursued listing the wolverine for endangered status under the Endangered Species Act at both the federal and state levels. In the fall of 2014, the USFWS published their final ruling on the listing status for wolverine nationwide and found the species did not warrant federal protections.[8] In response to the negative finding from UWFWS, conservation groups have filed a lawsuit against the government to continue to pursue protection. Conservation Northwest and other organizations are pushing decision makers to create state and federal safeguards for wolverines as they recover across Washington and the lower 48 states.

Through CWMP monitoring activities, Conservation Northwest will help shape recovery and critical habitat plans for Washington, inform land management, and build upon ongoing research in the Cascades. Our goals for wolverine monitoring in 2014 were to 1) help the Entiat Ranger District of the Okanogan-Wenatchee National Forest monitor wolverines' presence in the Entiat Valley in the Glacier Peak Wilderness in the North Cascades, with a specific interest in documenting Sasha, a potentially denning and reproducing female wolverine, 2) document the presence of wolverines in the Central and Southern Cascades; and 3) collect genetic data through hair samples to help identify individual wolverines documented. In 2014, our

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[6] Keith B. Aubry, Kevin S. Mckelvey, and Jeffrey P. Copeland, "Distribution and Broadscale Habitat Relations of the Wolverine in the Contiguous United States," *Journal of Wildlife Management* 71, no. 7 (2007): 2147, doi:10.2193/2006-548.; Vivian Banci, "Wolverine," in *The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States.*, ed. Leonard F. Ruggiero et al. (Fort Collins, Colorado, USA: USDA Forest Service Technical Report, 1994), 99–127.

[7] Banci, "Wolverine."

[8] Washington Department of Fish and Wildlife December 17, 2013,press release: fws.gov/mountain-prairie/pressrel/2013/12172013_wolverine.php

wolverine monitoring continued in the Chiwaukum and Bootjack Mountains where our remote cameras have documented over four individual wolverines to date. To ensure that our efforts add to existing research, we focus on areas that lie outside of the current study area established by the North Cascades Wolverine Study and on geographic locations where specific requests for assistance from ongoing researchers are made to complement their efforts.

Grizzly Bear Monitoring

At one time grizzly bears (*Ursus arctos*) roamed throughout the wild areas of Washington. Since their near extirpation from the lower 48 states in the 1800's, grizzly bears were listed as endangered under the Endangered Species Act in 1975. In 1997 the North Cascades, along with five other recovery zones, was identified as a key area for recovery of the endangered bear species.[9] Now, 20 years later after the recovery plan was written, the National Park Service and the U.S. Fish and Wildlife Service are embarking on an important public process to explore options on how to recover grizzly bears in the North Cascades.

Despite anecdotal reports of grizzlies in the North Cascades, no population or individuals has been confirmed in the area. Based on expert opinion and a database of sightings, the U.S. Fish and Wildlife Service believe there are fewer than 20 grizzly bears remaining in Washington's North Cascades ecosystem. The British Columbia Ministry of Environment estimates there are six grizzly bears in the Canadian North Cascades.

In 2010, with oversight from the North Cascades Interagency Grizzly Bear Subcommittee, the Cascade Carnivore Connectivity Project (CCCP) and other project partners began an extensive survey to detect grizzlies potentially occupying Washington's North Cascades Ecosystem (NCE). While this project has not yet found photographic or genetic evidence of grizzly bears in the study area, they continue to monitor the area to assist the National Park Service and the U.S. Fish and Wildlife Service in evaluating potential options for grizzly bear recovery in the region. CWMP's effort to detect grizzly bears in the NCE is designed to complement the work already carried out by the CCCP. Locations for surveying are selected based on the sampling model created by CCCP and the sampling method they employed based on the "hair corral" described by Kendall and McKelvey (2008).[10] CWMP's field methods are adapted from these methods to focus on simple detection using remote camera data rather than DNA analysis based on genetic sample (hair) collection. CCCP's primary research objectives where to collect information on the

[9] Servheen, C. 1997. Grizzly bear recovery plan: North Cascades ecosystem recovery plan chapter. U.S. Fish and Wildlife Service. Missoula, MT.

[10] Long, R.A., J.S. Begley, P. MacKay, W.L. Gaines, and A.J. Shirk. 2013. The Cascades Carnivore Connectivity Project: A landscape genetic assessment of connectivity for carnivores in Washington's North Cascades Ecosystem. Final report for the Seattle City Light Wildlife Research Program, Seattle, Washington. Western Transportation Institute, Montana State University, Bozeman. 57 pp. and Kendall, K.C., and K.S. McKelvey. 2008. Hair collection. Pages 141–182 in Long, R. A., P. MacKay, W. J. Zielinski, and J. C. Ray, editors. Noninvasive survey methods for carnivores. Island Press, Washington, D.C.

genetic structure of carnivore populations in the NCE and secondarily to detect grizzly bears and other rare carnivores. CWMP's primary research goal is detection of grizzly bears.

I-90 Corridor Monitoring

Historically, I-90 has been known as a major barrier to north and south wildlife movement in the Cascades. As a result of an earlier large scale connectivity analysis of the Cascade Mountains, a narrow crucial corridor across Interstate 90 was identified for wildlife passage.[11] In an effort to create a more permeable interstate, the Washington State Department of Transportation has developed a 15-mile highway expansion project (I-90 Snoqualmie Pass East Project) where measures for safe wildlife passage have been incorporated into the plan. Multiple crossing structures, including two overpasses, are slated for construction within the next five years.

For over five years, our project has worked in concert with the Washington State Department of Transportation and Western Transportation Institute to monitor wildlife activity along I-90 in the project area. Through both remote camera monitoring and snow tracking, CWMP has provided valuable data informing the I-90 Snoqualmie Pass East Project (I-90 SPE) throughout its planning and implementation phases. During the 2014 monitoring season, construction of Phase 1 of the I-90 SPE project was underway while the three wildlife underpasses at Gold Creek and Rocky Run were in the post-construction phase and awaiting habitat restoration of habitat within them. In 2015, restoration projects will begin underneath the two Gold Creek underpasses.

Our goals in 2014 for monitoring the I-90 stretch from Hyak to Easton were to document wildlife activity in the habitat leading into to these completed wildlife crossing structures, while also documenting wildlife presence in key connectivity emphasis areas in future phases of the project.

Transboundary Lynx Monitoring

Washington is home to one of the largest populations of Canada lynx, the rarest wild cats in North America, in the lower 48 states.[12] Much like the history of wolverines in our state, lynx were targeted for trapping and hunting in the fur trade in the 1800s and early 1900s. Hunting pressure along with habitat decline reduced their numbers drastically in Washington.[13] As a result of these pressures, lynx are protected under the federal and state Endangered Species Acts. Based on the preferred habitat of lynx, Koelher et al. estimate that Washington has

[11] I-90 Wildlife Bridges Project description and connectivity analysis: i90wildlifebridges.org/project-info
[12] Derek W. Stinson, *Washington State Recovery Plan for the Lynx* (Olympia, WA, USA: Washington Department of Fish and Wildlife, 2001).
[13] Ibid.

approximately 3,800 km^2 of available habitat.[14] Researchers have documented dispersal of lynx across the Canadian border in northeastern Washington.[15] Since wildlife often move across political boundaries, Conservation Northwest works closely with U.S. and Canadian conservation allies to ensure that lynx and other wildlife can travel safely and seamlessly across the border. In 2013, Conservation Northwest began a pilot season in the Rossland Range of British Columbia to document lynx activity near the U.S.-Canadian border. We continued this program into 2014 and expanded into the Washington side of the Kettles Range.

Our major objective for 2014 lynx monitoring in British Columbia was to 1) document the presence of lynx in the transboundary linking habitats between British Columbia and Washington, and 2) collect genetic data from hair snags placed at each remote camera site to increase our understanding of lynx here and their relation to adjacent, better studied, lynx populations in the Rockies and Cascade Mountains.

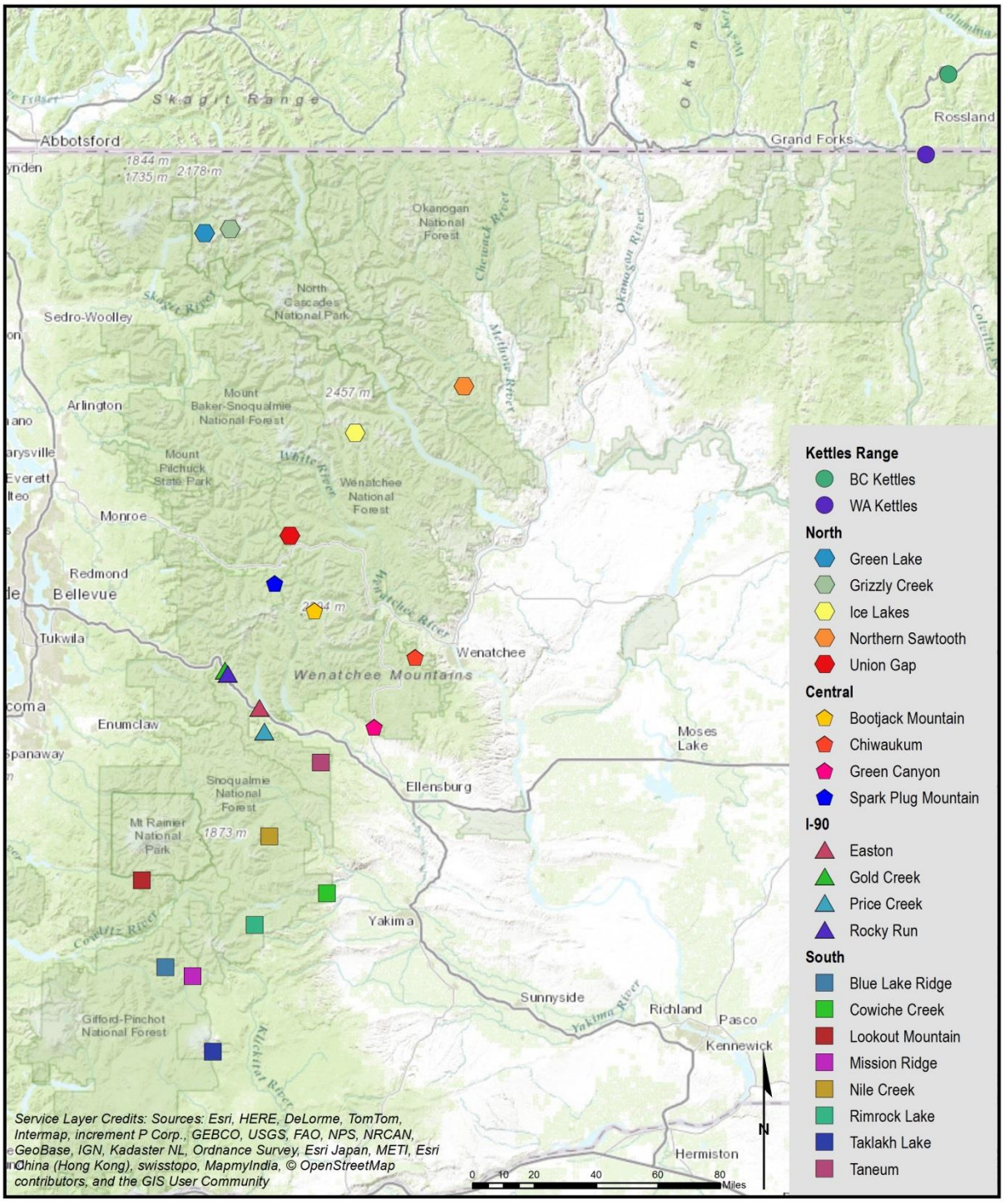
METHODOLOGY

CWMP is an entirely volunteer-based project supported by Conservation Northwest, interns, and other project partner staff. Though our winter monitoring season includes snow tracking techniques, the bulk of our work is accomplished through the use of remote motion-triggered cameras. The use of motion-triggered cameras represents an easy and verifiable method of documenting wildlife presence and has been used as a significant research tool in many projects worldwide.[16] Additionally, motion-triggered cameras provide a tangible, low-cost way to engage citizens in wildlife monitoring and conservation. Together, our network of volunteers and cameras provide invaluable verifiable data on rare and sensitive species presence.

[14] Gary M. Koehler et al., "Habitat Fragmentation and the Persistence of Lynx Populations in Washington State," *The Journal of Wildlife Management* 72, no. 7 (2008): 1518–1524, doi:10.2193/2007-437.

[15] Stinson, *Washington State Recovery Plan for the Lynx*.; J.D. Brittell et al., *Native Cats of Washington, Section III: Lynx*, Unpublished (Olympia, WA, USA: Washington Department of Fish and Wildlife, 1989).; and Kim G. Poole, "Dispersal Patterns of Lynx in the Northwest Territories," *The Journal of Wildlife Management* 61, no. 2 (1997): 497–505.

[16] Masatoshi Yasuda, "Monitoring Diversity and Abundance of Mammals with Camera Traps: A Case Study on Mount Tsukuba, Central Japan," *Mammal Study* 29, no. 1 (2004): 37–46.; and Christen Wemmer, Thomas H. Kunz, and Virginia Hayssen, "Mammalian Sign," in *Measuring and Monitoring Biological Diversity.*, by Don E Wilson et al. (Washington: Smithsonian Institution Press, 1996).



2014 Spring-Fall Monitoring Sites

Citizens Wildlife Monitoring Project

Study Area

This season our primarily focus was on the Cascade Mountains in Washington. However, we continued our pilot project in the Rossland Range region of British Columbia and expanded into the Washington side of the Kettles range looking for lynx in areas not far from the U.S.-Canadian border. To further delineate core habitats and to give geographic context to our site selections, we have defined our study area by the following boundaries:

1. North Cascades: North of US 2 and west of US 97
2. Central Cascades: Between I-90 and US 2
3. I-90 Corridor: Between Hyak and Easton along I-90
4. Southern Cascades: South of I-90
5. Kettle River Range: southeastern British Columbia and Ferry County, Washington, in the United States

Site Selection

At the beginning of each season, we select and prioritize monitoring sites in collaboration with all project partners and our Advisory Council. Sites are initially selected based on target species and core habitat with consideration to equipment inventory, as well as staff and volunteer capacity. Our list of sites goes through numerous iterations as we discuss priorities and capacity with our Advisory Council. The finalized list of sites serves as a guide for volunteer recruitment.

Each site is chosen with a particular target species based on our monitoring objectives for the year. For the 2014 spring-fall season, our priorities were wolves, wolverines, grizzly bears, all wildlife at I-90, and lynx in the Kettle Range in BC and Washington. Project staff works with specific advisors from our Advisory Council to develop site descriptions that include the purpose of the site, special considerations, and general information useful for site construction.

Throughout the season, volunteer field knowledge and experience help CWMP staff and the Advisory Council reassess each site based on data gathered during the season. Thanks to their constant presence on the ground in core habitat, our volunteers provide invaluable feedback on best site locations, as well as actual field conditions and habitat.

Over the course of our 2014 spring-fall field season, we placed cameras at 22 sites throughout our study area. 20 of these sites were located in the Cascade Mountains with the remaining three located in the Kettle Range (one in British Columbia and two in Washington), designated for our transboundary lynx monitoring. Guided by our Advisory Council, eight of these Cascade Mountain sites focused on documenting wolves, six focused on capturing wolverine,

two focused on documenting the North Cascades grizzly bear, and the remaining four were dedicated to documenting species along I-90.

Camera Stations

Depending on the targeted species and location of each site, remote camera station setup can vary. In conjunction with project staff, protocols were developed for each type of remote camera station. All camera stations targeting wolves or I-90 structures have a similar setup that includes motion-triggered cameras secured to trees and scent lure, unless specifically instructed otherwise (Appendix III and IV). Generally two cameras are placed within the same designated area; however, they are far enough apart to potentially capture different individual animals.

Though not much different than camera sets for general wildlife and wolves, sites targeting grizzly bears use a special lure developed by the U.S. Forest Service containing fermented cattle blood and fish oil. This lure is highly attractant to bears and is poured over a large pile of brush and sticks constructed by volunteers maintaining these sites (Appendix V). Cameras are positioned to capture bears as they smell and explore the brush pile and lure. Though these sites do not have hair snagging devices installed, if grizzlies are suspected to have visited the site, volunteers have bene instructed to collect hair if available.

Sites targeting wolverine have a setup conducive to capturing visual documentation of their chest blazes (Appendix VI). These sites, called run-pole stations, are constructed with natural materials on site. Wolverine run-pole stations include two cameras, one set directly across from the run pole and the other off to the side. Each run-pole site includes bait strung strategically above the run-pole. Wild bait (deer, elk, etc., often from road kills) is preferred for these sites. However, in cases where wild bait was unavailable, bait was purchased at butcher shops. In addition to run-pole structures and bait, each site designated for wolverine detection was also equipped with snags for hair collection. Though individual wolverine can be identified visually from chest blaze photographs, DNA analysis is important to confirming individuals and retrieving additional information. The hair snag system CWMP employs consists of a gun brush belt with eight gun brushes attached horizontally. This belt is attached just below the run-pole around the tree. Hair samples are removed from the gun brushes using latex gloves at each visit and are sent away immediately for lab analysis.

Sites targeting lynx follow a National protocol developed in 1999 by McKlevey et. al (Appendix VII). In addition to having remote cameras, these sites are also equipped with hair snagging devices and scent stations designed to attract lynx for DNA analysis. The lure used for our 2014 season was different from our normal scent lure. However, in 2015 we will begin using a special mixture of glycol, glycerine and beaver castorium as recommended by McKlevey et. al. Scent stations are also equipped with catnip that elicits a rubbing motion on the hair snagging

devices. In addition to using scent to attract lynx to the stations, volunteers are also required to hang shiny material from an overhanging limb.

During the 2014 spring-fall season, the majority of our cameras were Bushnell Trophy Cam XLT though a few sites also had Reconyx RC55 or RC60. Camera settings are standardized across each site for comparability across the study area as outlined in the protocols (Appendix III). Volunteers are trained in camera installation and maintenance prior to each season at a training held by project staff.

All sites, regardless of target species, are marked with a scent lure with exceptions made in the I-90 corridor where the proximity of the site is too close to the roadway. Wildlife use scent markings as important means of communication to establish territories, find mates and prey, assess levels of danger, and ascertain other individuals within the same vicinity.[17] Scent lure mimics this natural mode of communication and acts as an attractant bringing individual wildlife into the remote camera site.[18] The application of scent lure in our project adheres to guidelines and best practices established by our Advisory Council.

Species Prioritization

Though each site is established with a specific target species in mind, data gathered on the presence of non-target wildlife is also valuable. We use a species priority list that categorizes Washington species in order of significance to our project as established by project staff in consultation with our Advisory Council. Using our category structure, we are able to establish protocols for documenting certain species of interest and facilitating timely communication with project partners during the season. All Level 1 species detected at a remote camera site during the season are immediately reported to project staff for confirmation and further communication. The priority listing for our 2014 season is as follows:

Level 1
Wolverine
Fisher
Lynx
Wolf
Grizzly bear

Level 2
Cougar
Marten

[17] Fredrick V. Schlexer, "Attracting Animals to Detection Devices," in *Noninvasive Survey Methods for Carnivores*, by Robert A Long (Washington, D.C.: Island Press, 2008).
[18] Ibid.

Mountain goat
Mountain red fox/Cascades red fox

Level 3
Black bear
Bobcat
Coyote
Elk
Mule deer
Raccoon
Snowshoe hare and smaller mammals
Livestock
Human (non-volunteer)

RESULTS AND DISCUSSION

During the 2014 spring-fall monitoring season data was collected from May through November. However, due to accessibility restrictions, information collected during the previous winter is included from sites (Ice Lakes and Sparkplug Mountain) which were established in 2013 but not reported on in 2013 and remained active through the current monitoring season.

Over the course of the season 22 sites were established and maintained by project volunteers. These sites were strategically positioned throughout the Cascade Mountain Range, northeastern Washington, and into the southern regions of British Columbia. The following results involve species of interest to this program as identified by our Advisory Council and project staff. Only species falling within the three priority levels are included (found on page 15). Due to increasing interest in the interaction of wolves and livestock in Washington, any observed domestic livestock and human activity is included in the analysis as a Level 3 species.

Though our program expands knowledge of wildlife presence in Washington, limitations to the breadth of our data do exist. Our data cannot ascertain species diversity, population size, or species absence. Rather, our data focuses on species richness, which has invaluable applications to the conservation and management of rare and sensitive species in Washington. Species richness is defined as the number of different species present within a defined area. In addition to assessing species richness, we also assess the number of observed events of identified priority-level species per site. For the purposes of this project, an event is defined as any visit of a single animal (or group of animals belonging to the same species) to a camera site with no gap greater than 5 minutes between images. Thus, the more events recorded from each level (with a particular emphasis on Level 1 species), the greater the importance to the goals of our project.

To give geographical context to the data, the results are summarized following the five study area divisions described in our methodology. Additionally, each site represents combined data from two separately situated motion-triggered cameras set up within the same vicinity, unless otherwise noted.

Cascades Mountains

North Cascades

Designated as the area North of US 2 and west of US 97, the North Cascades region consisted of four sites this season. The Ice Lakes and Union Gap sites were dedicated to wolverine detection (Table 1). Two new sites, Northern Sawtooth and Grizzly creek, were established in compliance with the 2014 CWMP primary goal to detect the presence of grizzly bears in the Cascade Range. The Ice Lakes site was established in the fall of last year. It was decided the site would be left up over the winter when rough terrain rendered it too difficult to access. Information collected during that time is included in this analysis.

Table 1: North Cascade remote camera sites

North Cascades Camera Sites				
Site Name	**Target Species**	**Date Installed**	**Date Uninstalled**	**Lure/Bait**
Grizzly Creek	Grizzly Bear	9/5/2014	10/27/2014	Lure
Ice Lake	Wolverine	N/A	N/A*	Both
Northern	Grizzly Bear	8/2/2014	10/11/2014	Lure
Union Gap	Wolverine	N/A*	N/A*	Both

*site remained active all year.

The Ice Lakes site was established within the known home range of Sasha, a previously documented female wolverine through the North Cascades Wolverine Study who was believed to be denning in the area. Our goal was to record not only Sasha's presence, but kits or other evidence of her reproduction. During the 2013 spring-fall monitoring season wolverine were documented at the site, however, identifiable chest blazes were not captured on camera as a result of misapplied scent lure and we were unable to specifically link the photos to her. To aid in identification, gun brushes were installed to collect hair samples for DNA analysis. This season Ice lakes documented species from all three priority levels, including 18 events from its target species, wolverine (Table 2 & 3). Images of chest blazes were successfully captured and show at least 4 individual wolverines, one of which may be Sasha. Hair samples were collected and a DNA analysis is being conducted to ascertain the number of individuals documented at the site and to confirm the presence of Sasha. No evidence of reproduction was recorded. This site will continue to be monitored through the winter under the guidance of Forest Service

biologists in the Entiat Ranger District and Pacific Northwest Research Lab in hopes of achieving our goals.

Union gap received visits from level 2, and 3 species. Specifically, 26 American martin events were documented, the highest number observed for this species at any site this year (Table 3). Improvements to this site's setup were made in preparation for the upcoming 2015 winter monitoring season according to new protocols used by the U.S. Forest Service. A new hair snagging device equipped with alligator clips was added to the run pole, as well as a separate hanging wire that allows volunteers to raise and lower the meat without having to walk out on the pole. We hope these improvements will yield successful documentation of wolverine in the subsequent monitoring seasons.

No evidence of grizzly bear presence was captured at either Grizzly Creek or Northern Sawtooth. These results may have been influenced by an abbreviated monitoring period brought on by wilderness use regulations enforced by the National Forest Service. Access to these areas is limited to persons holding the required permits. Unfortunately, the time needed to obtain the appropriate permits interfered with establishment of these sites and we were unable to collect data for the full length of the season. Monitoring at Grizzly Creek and Northern Sawtooth will continue in 2015 for the entire 2015 spring-fall season. Only species belonging to level 3 were documented.

Table 2: North Cascade species detected by site

North Cascades						
Species Priority	**Level 1**	**Level 2**		**Level 3**		
Site Name	**Wolverine**	**Cougar**	**Marten**	**Black Bear**	**Coyote**	**Mule Deer**
Grizzly Creek				x		
Ice Lakes	x	x	x			x
Northern Sawtooth				x	x	x
Union Gap			x			x

Table 3: North Cascade capture events per species by site

North Cascades						
Species Priority	**Level 1**	**Level 2**		**Level 3**		
Site Name	**Wolverine**	**Cougar**	**Marten**	**Black Bear**	**Coyote**	**Mule Deer**
Grizzly Creek				15		
Ice Lakes	18	1	8			4
Northern Sawtooth				5	1	12
Union Gap			26			1

Central Cascades

The central cascades region is defined as the area North of I-90 to US 2 and housed a total of nine sites. Six of those sites fell within the I-90 corridor and will be discussed in the following section. This section describes the results from Chiwaukum, Green Canyon, and Bootjack Mountain (Table 4). The Chiwaukum and Bootjack Mountain sites were focused on wolverine detection while the Green Canyon site targeted wolves. Monitoring activities were continued at the Chiwaukum site from the previous seasons. Data reported from Chiwaukum represents data from four individual cameras at two sites in near proximity. CWMP has now been monitoring this site since the winter of 2011 and, to date, have documented at least five new individual wolverine using photo data and genetic analysis. Bootjack Mountain is another site continued from previous monitoring seasons. In the 2012 spring-fall monitoring season, Bootjack successfully documented a wolverine also documented at the nearby Chiwaukum cameras.

Table 4: Central Cascades remote camera sites

Central Cascades Camera Sites				
Site Name	**Target Species**	**Date Installed**	**Date Uninstalled**	**Lure/Bait**
Bootjack Mountain	Wolverine	7/27/2014	9/21/2014	Both
Chiwaukum	Wolverine	N/A*	N/A*	Both
Green Canyon	Wolf	6/27/2014	10/29/2014	Lure

*site remained active all year.

Monitoring at one location in Chiwaukum was cut short this season after the site was destroyed in a wildfire that claimed over 14,000 acres of the Chiwaukum Complex. Volunteers were instructed not to access the site until they were certain they could do so safely. Upon their return, they found two cameras holding their data had been incinerated along with the site. As a result, information was only gathered at this location through the end of June. The second location, however, was unharmed in the fire, allowing monitoring to continue within the Chiwaukum complex.

The Chiwaukum site was visited by species of all three priority levels including wolverine (Table 5). A DNA analysis of collected hair samples will tell us if the documented wolverine is a member of the previously observed wolverine or a documentation of a new individual. Though wolverines were not detected at Bootjack Mountain this season, it was important to return to both successful sites to continue collecting information on this population of wolverines residing in part or completely south of Highway 2.

Both the Chiwaukum and Bootjack sites documented the presence of American marten (Table 5). This is not surprising given that these wolverine sites coincide with prime American marten habitat. The presence of American marten in these areas may prove useful to the Cascades

Carnivore Connectivity Project, which is studying the barrier effects of highways in genetic diversity among populations of black bears and martens. The results of this study will help to inform future transportation infrastructure and policy as it relates to wildlife and road interactions.

Though targeting wolves, species detected at the Green Canyon site all fell within the level 3 priorities (Table 5). The Green Canyon site was selected in response to continued reports of wolf activity in the known Wenatchee pack territory. WDFW has had reports of two wolves traveling through the territory. However, there has been no confirmation that these wolves are a breeding pair or have established a consistent territory. Due to the proximity of the area to public grazing allotments and a city, WDFW conflict specialists requested assistance in documenting the activities of wolves in this area.

Table 5: Central Cascades species detected per site

Central Cascades										
Species Priority	**Level 1**	**Level 2**		**Level 3**						
Site Name	**Wolverine**	**Cougar**	**Marten**	**Black Bear**	**Bobcat**	**Elk**	**Mule Deer**	**Other**	**Livestock**	**Human**
Bootjack Mountain		x						x		
Chiwaukum	x		x	x			x	x		
Green Canyon				x	x	x	x		x	x

Table 6: Central Cascades capture events per species by site

Central Cascades										
Species Priority	**Level 1**	**Level 2**		**Level 3**						
Site Name	**Wolverine**	**Cougar**	**Marten**	**Black Bear**	**Bobcat**	**Elk**	**Mule Deer**	**Other**	**Livestock**	**Human**
Bootjack Mountain		1						5		
Chiwaukum	1		16	42			8	17		
Green Canyon				10	2	30	23		19	1

I-90 Corridor

The area along I-90 of interest to the CWMP lies in the 15 mile stretch between Hyak (milepost 54) and Easton (milepost 70). As a result of connectivity analysis, this section of I-90 was identified as a crucial corridor for wildlife passing from the North Cascades to the South Cascades. Unfortunately, the construction of I-90 resulted in, not only a physical barrier for wildlife seeking safe passage throughout the Cascade Range, but also exposed and highly degraded habitat. In efforts to mitigate harm to our wildlife, the I-90 Snoqualmie Pass East Project was introduced and the construction of safe wildlife passages began. Monitoring these sites gives invaluable information to the Washington Department of Transportation and other decision makers as they upgrade and retrofit the interstate.

CWMP has prioritized the I-90 corridor for multiple years with both remote camera monitoring and snow tracking. The closing of the 2013 monitoring season coincided with the completion of three wildlife underpasses and the conclusion of Phase 1 of the I-90 Snoqualmie Pass East Project. In the 2014 spring-fall season, six cameras were installed in the I-90 corridor to document all wildlife activity (Table 7).

Although originally established as a 2013-2014 winter monitoring site, data for the Rocky Run site was not analyzed until this season when the camera was retrieved. The camera was positioned directly north of one completed underpass. The analysis of the Rocky Run site is included in this report. Additionally, another site was monitored over the 2014 season however due to unforeseen circumstances we have yet to receive the full season's data. Any data collected from the Upper Gold Creek site will be reported during our winter monitoring season.

Table 7: I-90 remote camera sites

1-90 Camera Sites				
Site Name	**Target Species**	**Date installed**	**Date Uninstalled**	**Lure/Bait**
Easton	All	N/A*	N/A*	None
Gold Creek	All	6/14/2014	11/1/2014	None
Price Creek	All	6/29/2014	7/12/2014	None
Rocky Run	All	1/25/2014	8/14/2014	None

*site remained active all year.

All of the 1-90 sites were visited by a wide range of level 3 species and a majority of them documented the presence of cougar, a level 2 species (Table 8). These sites also had high event detections of ungulates, more so than our other study areas (Table 9). This is significant, particularly with the Gold Creek site, due to the proximity of these sites to the highway and the newly completed underpasses. It is notable that all these sites are in habitat directly adjacent to where several wildlife crossing structures will be constructed as part of the I-90 Snoqualmie Pass East Project, including the first wildlife overpass, which is scheduled to begin construction following snow melt in 2015.

Two of the completed underpasses are located at Gold Creek, thus making species documented at Gold Creek and Upper Gold Creek of particular interest this season. Construction of the underpasses had been ongoing since 2009, leaving debris and construction material remaining within the underpasses. To complement the construction of these underpasses, Conservation Northwest has hosted multiple workshops enlisting volunteers in the restoration of habitat adjacent to these structures. In 2015, Conservation Northwest will begin restoration activities within the underpasses to complement our ongoing restoration work. As these underpasses transition from construction to restoration, continued monitoring is important to record wildlife

as they use the structure. During the spring-fall season our cameras were placed in the habitat approaching the underpasses both North and South, while in winter we monitored directly within the underpasses. This season Gold Creek documented seven priority level species, including one level 2 species, cougar (Table 8). In the 2013 spring-fall monitoring season fewer species were documented in the I-90 corridor and all documented species belonged to priority Level 3. The recording of this progress and seven species in the habitat adjacent to these new crossing structures speaks to their potential use by wildlife to safely cross I-90.

Table 8: I-90 sites species detected by site

I-90 Sites									
Species Priority	**Level 2**	**Level 3**							
Site Name	**Cougar**	**Black Bear**	**Bobcat**	**Coyote**	**Elk**	**Mule Deer**	**Racoon**	**Other**	**Human**
Easton	x	x	x	x	x	x			x
Gold Creek	x	x	x	x	x	x	x		
Price Creek	x		x	x	x	x		x	
Rocky Run					x	x		x	

Table 9: I-90 capture events per species by site

I-90 Sites									
Species Priority	**Level 2**	**Level 3**							
Site Name	**Cougar**	**Black Bear**	**Bobcat**	**Coyote**	**Elk**	**Mule Deer**	**Racoon**	**Other**	**Human**
Easton	2	11	5	19	45	28			12
Gold Creek	1	1	2	7	22	68	1		
Price Creek	1		2	3	7	3		3	
Rocky Run					7	27		29	

South Cascades

The South Cascades, defined as south of I-90, represents the Southern Recovery Zone as designated in the Washington Wolf Conservation and Management Plan. To date, no wolves have been confirmed south of I-90, though anecdotal reports have placed wolves in this area for years. Since 2008, wolves have continued to recover in Washington steadily re-colonizing in new parts of the state. Now, three packs have made the North Cascades home, two of which are just north of I-90 in the Teanaway and Wenatchee/Colockum areas. As wolves recover in the state, documenting their dispersal to new areas of Washington is crucial to inform land and species management of wolves.

Seven of the eight monitoring sites in the South Cascades were dedicated to wolves (Table 10). The exception being Lookout Mountain which was a run-pole site focused on wolverine detection just south of Mount Rainier in the Gifford Pinchot National Forest. All sites were

chosen as a result of anecdotal reports of the target species in the area and guidance from agency biologists in the local ranger districts in each location.

Monitoring at Nile Creek was cut short this season due to camera theft. Unfortunately, both cameras from this site were stolen; the first camera was discovered missing in the beginning of the season, and the last, upon return for the final check. As a result, data is only included from this site in the months between June and August. Additionally, a camera was also stolen at Taklakh Lake. However, we were able to replace the camera and retrieve data for the remainder of the season.

Table 10: South Cascades remote camera sites

South Cascades Camera Sites				
Site Name	**Target Species**	**Date Installed**	**Date Uninstalled**	**Lure/Bait**
Blue Lake Ridge	Wolf	5/19/2014	N/A*	Lure
Cowiche Creek	Wolf	6/8/2014	9/20/2014	Lure
Lookout Mountain	Wolverine	6/17/2014	9/28/2014	Both
Mission Ridge	Wolf	6/14/2014	10/25/2014	Lure
Nile Creek	Wolf	6/14/2014	8/16/2014	Lure
Rimrock Lake	Wolf	5/16/2014	8/23/2014	Lure
Taklakh Lake	Wolf	6/1/2014	11/16/2014	Lure
Taneum	Wolf	5/26/2014	7/27/2014	Lure

*Site will be continued throughout the winter.

Neither wolves nor wolverines were documented at any of the South Cascade sites (table 11). Despite non-detections, CWMP will continue to monitor the Southern Recovery Zone and respond to anecdotal reports as directed by agency biologists in 2015. Although the target species were not recorded, all of the sites documented the presence of deer and elk, which are primary prey for wolves (Table 11). Both Cowiche Creek and Rimrock Lake captured the largest diversity of species for the project, totaling eight species per site (Table 11).

Table 11: South Cascades species detected per site

South Cascades									
Species Priority	Level 2	Level 3							
Site Name	Cougar	Black Bear	Bobcat	Coyote	Elk	Mule Deer	Other	Livestock	Human
Blue Lake Ridge	x	x	x	x	x	x			x
Cowiche Creek	x	x		x	x	x	x	x	x
Lookout Mountain		x	x		x	x			
Mission Ridge	x	x	x	x	x	x			
Nile Creek	x			x	x	x		x	x
Rimrock Lake	x	x		x	x	x	x	x	x
Taklakh Lake				x	x	x			
Taneum		x	x	x	x	x	x		

Table 12: South Cascades capture events per species by site

South Cascades									
Species Priority	Level 2	Level 3							
Site Name	Cougar	Black Bear	Bobcat	Coyote	Elk	Mule Deer	Other	Livestock	Human
Blue Lake Ridge	19	10	1	6	27	37			10
Cowiche Creek	1	1		1	5	6	90	2	1
Lookout Mountain		11	1		6	2			
Mission Ridge	2	4	4	19	31	11	88		1
Nile Creek	1			10	22	10	1	1	3
Rimrock Lake	1	1		13	81	15	46	18	4
Taklakh Lake				x	x	x			
Taneum		2	1	6	5	15	5		

Kettle River Range

Following its pilot season in 2013, Canada lynx monitoring in the Kettle River Range this season occurred on both sides of the U.S.-Canadian border. One site was established in southeastern British Columbia and two additional sites were established in Northeast Washington to document transboundary lynx activity (Table 13). The site in British Columbia was equipped with four different camera locations, while Northeast Washington sites each monitored at the standard two locations. Data for the one of the sites in the Kettles has not been reported yet; as a result the data collected at that site will be reported in our 2014-2015 Winter Monitoring Report.

Table 13: Kettle River Range remote camera site.

Kettle River Range				
Site Name	Target Species	Date Installed	Date Uninstalled	Lure/Bait
WA Kettles	Lynx	7/19/2014	N/A*	Lure
BC Kettles	Lynx	8/28/2014	10/14/2014	Lure

*site will remain active through the winter.

Although the Washington Kettles sites only found evidence of level 3 species, the B.C. Kettles sites observed species in all three priority levels (Table 14). Most importantly, a lynx was successfully documented at one of the B.C. camera locations. In addition to visually documenting the species, hair samples were collected using a hair snagging device (Appendix VII). These samples will be analyzed within the next year.

Information on transboundary activity of rare and sensitive species is sparse and much needed. This makes our efforts in this area vital to the understanding of species near political boundaries. Due to differing management techniques and wildlife policies, transboundary issues are paramount to Washington's management of its wildlife. The British Columbian Canada lynx population likely acts as a source population for the U.S. population, increasing the genetic variation and, subsequently, stability of our diminishing lynx populations. As conversations continue on the future of Canada lynx populations in Washington, continued monitoring efforts provide valuable information on the state of the population in the Kettle Range. For this reason, further expansion of sites on both sides of the border is planned for CWMP in 2015. Additionally, CWMP will begin partnering with researchers at Washington State University who have just begun similar research on Canada lynx in the nearby Colville National Forest

Table 14: Kettle River Range species detected by site

Kettle River Range									
Species Priority	Level 1	Level 2	Level 3						
Site Name	Lynx	Cougar	Black Bear	Elk	Coyote	Moose	Mule Deer	Other	Livestock
WA Kettles			x				x	x	x
BC Kettles	x	x	x	x	x	x	x	x	

Table 15: Kettle River Range capture events per species by site

Kettle River Range									
Species Priority	Level 1	Level 2	Level 3						
Site Name	Lynx	Cougar	Black Bear	Elk	Coyote	Moose	Mule Deer	Other	Livestock
WA Kettles			6				16	17	3
BC Kettles	1	1	2	2	1	2	5	4	

RECOMMENDATIONS FOR FUTURE MONITORING

At the end of each season we reflect on lessons learned as we begin the process of planning for the next field season. Information and guidance from volunteers, project advisors, project

partners, and project staff helps us compile best practices for remote camera monitoring in Washington. These recommendations improve the efficacy, efficiency, and power of our work.

Already being assessed and incorporated in the 2015 spring-fall monitoring season are specific recommendations. In the 2015, CWMP will:

- Conduct a review of site selection standards to deter camera theft and loss of project resources. We saw six cameras stolen over the course of the 2014 season, in order to reduce this amount of loss; the leadership team will consider techniques and equipment that will deter theft.
- Continue and expand monitoring efforts for grizzly bears in the North Cascade Ecosystem, as well as continue to develop research relationships within the North Cascades Park.
- Continue to focus on wolverine sites in areas that can be monitored safely year-round. Assess current methods for collecting hair samples at run-pole stations via Union Gap pilot site.
- Expand monitoring activities further into the Gifford Pinchot National Forest and adjacent wilderness areas.
- Reach out to colleges and universities to engage upcoming wildlife professionals in wildlife monitoring in the state and look for other opportunities to partner with ongoing efforts.
- Develop a new strategy to provide volunteer and coordination capacity to build off of our second pilot year effort in the Kettle Range in British Columbia and Northeastern Washington to study Canada lynx in this transboundary region.
- Compliment and streamline efforts between CWMP, Washington State University, and Selkirk College researchers monitoring Canada lynx in Northeast Washington.
- Ensure early coordination with other monitoring efforts throughout our coverage area both professional and citizen.
- Evaluate our new data management system implemented this season to facilitate data exchange between volunteers and project staff. Look for new methods of data collection that may ease data management on both the volunteer and project staff end of the project.
- Refine our database so that we can tackle larger research and conservation questions with the robust data set we have from years of monitoring efforts across the state.
- Provide expanded opportunities for connections between volunteers and other ongoing wildlife field research in our state, and field skill trainings.

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APPENDICES

Appendix I: Advisory Council

(includes specific site advisors and project collaborators)

Jocelyn Akins, Cascades Carnivore Project
Keith Aubrey, USDA Forest Service, PNW Research Station
Paul Balle, I-90 Wildlife Bridges Coalition Steering Committee and Woodland Park Zoo
Scott Becker, WA Dept. of Fish and Wildlife
Michael Borysewicz, Colville National Forest
Craig Broadhead, WA Department of Transportation
Carol Chandler, Gifford Pinchot National Forest
Roger Christophersen, North Cascades National Park
Scott Fitkin, WA Department of Fish and Wildlife
William Gaines, Conservation Science Institute
Patty Garvey-Darda, Okanogan-Wenatchee National Forest
John Jakubowski, Gifford Pinchot National Forest
Gregg Kurz, US Fish and Wildlife Service
Chris Loggers, Colville National Forest
Robert Long, Woodland Park Zoo, formerly Western Transportation Institute
Andrea Lyons, Okanogan-Wenatchee National Forest
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Aja Woodrow, Okanogan-Wenatchee National Forest
Don Youkey, Okanogan-Wenatchee National Forest
Josh Zylstra, WA Department of Transportation

Appendix II: 2014 Photo Highlights

Canada lynx (*Lynx canadensis*), B.C. Kettles

Moose (*Alces alces*) Washington Kettles

Black bear (*Ursus americanus*), Northern Sawtooth

Wolverine (*Gulo gulo*), Ice lakes

Coyotes (*Canis latrans*), Taenum

Black bear (*Ursus americanus*), Chiwaukum

Pine marten (*Martes americana*), Chiwaukum

Elk (*Cervus elaphus*), Gold Creek

Appendix III: Remote Camera Trap Installation and Servicing Protocol

Contents

Field Preparation

1. Research the target species for your camera, including its habitat preferences, tracks and signs, and previous sightings in the area you are going.

2. Research your site, consider your access and field conditions. *Where will you park? Do you need a permit to park in this location? What is your hiking route?* Call the local ranger district office closest to your site for information on current field conditions, especially when snow is possible to still be present.

3. Know your site: familiarize yourself with your location, purpose of your monitoring, target species, and site specific instructions (i.e. scent application, additional protocols).

4. Review this protocol and the species-specific protocol for your camera trap installation, to understand processes and priorities for the overall program this year.

5. Coordinate with your team leader before conducting your camera check to make sure you receive any important updates.

6. Gather the supplies needed for your check and schedule the pick-up either from the nearest Conservation Northwest office or your team leader/members. Conservation Northwest contacts Seattle Office: Alison Huyett (Monitoring Project Coordinator) 206.675.9747 ext 201

7. Resources such as data sheets and protocols are available for download from our website at: www.conservationnw.org/what-we-do/northcascades/resources-page-for-wildlife-monitoring-volunteers/ or from the CWMP Google Drive folder:

https://drive.google.com/folderview?id=0B2I2IM4EW_OkZHNKLVNJd0dCR1U&usp=sharing

8. Before going into the field, make sure you/your team members have a copy of this document as well as everything else needed on the equipment checklist. **Most important: keys for cable locks on cameras, fresh camera batteries and memory cards, lure, blank data sheet, pencil, maps, a GPS to find your camera/document wildlife sign, and a digital camera to document wildlife sign.**

9. Ensure you review the camera technical tips and field manual for your camera, and if you have access to the camera conduct a mock set up.

Installing a Remote Camera Trap

(For the first time the camera is placed in the field for the season, or in case you move a camera trap)

Target Species Guidelines

Creating a remote camera trap involves more than simply attaching a remote camera to a tree with the appropriate settings. The components of a remote camera trap include: specific location of the camera based on knowledge and prediction of target species behavior and activity, camera settings, and found or imported attractants.
All remote camera traps set up for CWMP are designed to target a specific species and with specific research questions in mind. In some instances such as along Interstate 90, camera traps are installed to monitor general wildlife activity in an area. See the relevant species specific camera trap installation guidelines for details for your specific location (links below for online access to these documents).

Wolves: http://www.conservationnw.org/files/wolf-remote-camera-trap-guidelines.pdf
Grizzly bear: http://www.conservationnw.org/files/grizzly-bear-remote-camera-trap-field-methods.pdf
Wolverine: http://www.conservationnw.org/files/run.pdf
Canada lynx: http://www.conservationnw.org/files/lynx_detection_protocol.pdf

General consideration

These are some general considerations for installing a remote camera trap, which apply to general wildlife monitoring sets and for most applications for species specific traps.

Location: Find a location where wildlife will most likely pass by – a game trail, a location with tracks or sign, travel corridors (valleys, river corridors), and/or excellent habitat for your target species (i.e. dense forested cover for martens). Landscape features that tend to funnel wildlife movement and areas close to water may be good sites. Place the camera so that it is pointed toward this area. Avoid sites within 500 m of campsites or human sign, or 250 m of human trails if possible (*this may be difficult for some of the I-90 locations*). At a minimum select a site out of the line of site from major trails and/or roads.

Trail Sets: If setting up a camera to target a trail, try to aim it at a 45-degree angle to the trail (instead of shooting up or down the trail, or directly perpendicular to it). A 45-degree angle generally captures the best images. When setting a trail camera on a road or trail used by humans, besides using a lock box and python lock, consider trying to set the camera below orro above head height to keep it out of the line of site of people. Setting it in a location that doesn't draw attention can also help with keeping it concealed from people.

Lighting: For best results, consider how the light may affect the photos. Shadows and light changes themselves can actually trigger the camera, but note that pointing the camera in a north-south direction often offers the best results when possible.

Visual obstructions and False Triggers: Look for a clear site or one that you can easily clear the camera's view if obstructed by branches, leaves, or brush – plan to use a knife or saw if needed in forested areas to clear the screen. Be diligent about removing vegetation in the camera's view, especially from the foreground, as it can produce false triggers when swaying in the wind or when the sun hits it and creates shadows.

Mounting Instructions: Attach the camera to the mounting tree, above eye level (or at chest level) and pointed downward toward the trunk of the other tree/feature that you are spreading lure on. Depending upon the camera model you have, use the laser or test feature (see details below) and other team members to help aim it at the right location. Consider the size of the animal species that you are targeting while aiming the camera. Point it low enough to capture smaller animals like wolverine and pine marten, while the placement of the actual camera on the tree is high enough to get a view of larger animals, like deer or bear, walking by in front of it. Most often, cameras are mounted with an error of pointing too high, so aim on the low side.

Once you have the camera in position, use bungee cords and/or other methods to secure the camera to the tree. Branches or nearby wood may be helpful to help tilt the camera downward to ensure the aim is correct. Anticipating spring snowmelt and changing conditions in many locations, this step may need to be repeated during future camera checks. **After camera is secure, place your lock around the camera or through the provided lockbox the camera is mounted in.**

Test Your Set: Most of our cameras have a test function in setup mode. Following your camera model instructions, place your camera in test mode. Have one person walk in front of the camera and look for the red flashing light. Test the range of your camera by walking back and forth. The red flashing light indicates where the camera catches an image. Some cameras have a viewer feature that will allow you to actually view the test images recorded. Use this feature if you have it, or you can use a standard digital camera to view images as well. Set up your camera and walk in front of it in the location you anticipate wildlife to travel. Then turn off the camera, remove the memory card and view the photos on your viewer or camera. Reposition as needed. **Be sure to replace the memory card back in the camera and turn it back on!**

Data Sheet: Record the GPS coordinates (use Datum WGS 84, lat/long coordinates) on your data sheet only if this is a camera install/move or they were not previously recorded. Carefully fill out all of the other information requested on the data sheet. Include relevant notes on the location and accessing it for people who will be servicing the camera trap. A few photographs of the area and the approach might be useful for this as well.

Flagging: If needed to find the location surveyors flagging tape can be used to help mark the location but don't rely on it because it can disappear and there may be flagging out there unrelated to our project. **Be careful about placing flagging that could give away our camera locations for security reasons. Use your judgment as to whether flagging is necessary and where and how much to use.**

Scent Lures and Imported Attractants

Some CWMP remote camera traps utilize imported attractants including bait, scent lures, visual attractants, and auditory attractants. Guidelines for the specific types of attractants are outlined in the species specific protocol documents. Below are some general considerations relevant for all uses of scent lures and other imported attractants on CWMP remote camera traps.

General application of scent lures: Find two trees (or a tree and a rock, log or other feature the camera can be aimed downward at), about 10 feet apart; one tree that is both large enough to mount the camera on and sturdy enough that it won't sway too much in breezes. The other tree or landscape feature is for spreading the lure on and can be any size, but make sure it is large/sturdy enough though to withstand animals rubbing and leaning against it and that the camera is angled properly to aim toward that area. Apply the attractant at a height where the target species can inspect it.

Scent lure can also be attached higher on a tree trunk or overhanging branch where it will catch the wind and travel further, acting to draw in animals from a longer distance.

Trapper's lures: With the highly concentrated trapper's scent lures (those in small bottles) remember a little goes a long ways. Simply use a branch dipped into the bottle for application, and drop a few drops at the base of the tree. You can apply some to the bark of the tree as well and hang the "lure twig" there or insert it in the bark, but do remember moderation.

With fish oil, fish fertilizer, or oil from a sardine can, you can apply the scent more liberally by pouring some with the aid of a branch lower on the tree and also higher, creating an oil slick that will remain on the tree through rain events.

Aiming the remote camera: Placing the camera about 10 feet from the lure tree/feature (or even a little farther out depending on the angle of the camera) is best for most camera models to avoid cutting off or only capturing portions of animals. Full view

of an animal's features is often needed for sure species identification. Make sure that every place that an attractant is applied is within the view of the camera so that wildlife spending time sniffing are captured on the camera. Set the camera and then trigger it and review the images to be sure that the area within the photo frame is appropriate.

Handling scent lures: Because the scent lures are so powerful it is vital to keep them separate from the remote camera to avoid drawing attention to the camera its self. Bears in particular can destroy remote cameras. Have one person on a team carry and handle the lures and a separate person handle the camera. When traveling in bear country with carnivore scent lures, always carry bear spray. When camping with it, treat it like food and store it away from where you camp, ideally hung from a tree as with precautions for food in bear country.

Make sure to record the exact names of the lure(s) applied by your team on your data sheet. This information will be entered into our database to track the wildlife response to different lures.

Setting Two Remote Camera Traps in the Same Area

Most teams will have two remote cameras to deploy in their assigned area. Refer to the specific guidelines for spacing of these camera traps and considerations for variations between the two in the species-specific protocols for wolves, bears, and lynx. For wolverines, these two cameras are used in conjunction with each other at the same trap site (see wolverine specific protocol).

For general wildlife survey camera traps, as along Interstate 90, space your camera traps at least 1 kilometer apart and attempt to set up the two cameras in distinctive habitats. This will help increase the diversity of captured wildlife. Other considerations might include setting cameras on opposite sides of the interstate, setting one on a trail that clearly leads to the road or a culvert under the road, and a second in habitat a bit more distant from the road.

Servicing a Remote Camera Trap

Instructions for servicing a previously installed camera trap
Getting to Camera Site

1. Use the site write-up, maps, written directions, GPS coordinates and photographs of the area taken by the installation crew to locate your cameras. It might be helpful to take a copy of the data sheet from the installation and/or previous visit, which may have useful notes on it.

2. Be on the lookout for tracks, scat, or other wildlife sign on the way to the camera and if encountered, document per **Wildlife Sign Documentation Protocol** section (below).

3. Look for flagging along the route and near the actual camera location if your team has elected to place it,

4. If you move camera location for any reason be sure to follow all the relevant instructions for creating a new camera trap installation including recording the location on the datasheet you fill out.

Basic Overview of Camera Trap Check

1. Upon arriving, walk in front of the camera and trigger the motion sensor. This picture will verify that the camera is working and also serve as a reference if the date/time is incorrect (*make sure to record the actual date and time of the check on your data sheet so that we can match against the date/time on the photos when we download them in the office in case there is any malfunction with the camera date/time*). If the camera does not trigger, your batteries may already have died or your memory card is full.

2. Unlock the cable lock with your keys to access the camera.

3. Use the technical instructions for the appropriate camera model to replace the batteries and memory card, check/set up all of the camera settings (*Links to all models users guides is below and on our website. Hard copies of user manuals are made available to team leaders and stored in the office.*).

4. If applicable for your camera trap, apply lure and install bait according to your specific sites instructions (*Every site has unique directions, be sure to understand and follow yours*). Please remember that a very little amount of lure goes a long ways, and that too much long can deter animals. Their noses are much more powerful than ours. If you are applying bait you will receive specific instructions from our staff and/or advisory council on this. Do not apply bait at your site unless instructed.

5. **Carefully fill out the data sheet with all requested information.**

6. Arm the camera to take pictures before leaving the site. Be sure to step in front of the camera to be sure you capture a “camera check” image which will act as a reference for the survey period when the camera trap is next serviced.

After your Camera Trap Check

Email a brief report of your visit to your team leader. If there are any important news/findings, such as signs of a Level 1 species, problems with the camera or location, etc… contact your team leader immediately upon return and cc: alison@conservationnw.org and jwatkins@conservationnw.org If not critical, still please

pass on any information about the site to your team leader. The next team will greatly benefit from a brief report, including site conditions, what you learned about animals in the area, topography, hazards, and any outstanding questions. Team leaders will be the communication point between your team and Conservation Northwest.

Upload photos from retrieved memory cards to Google Drive (online photos sharing service) and fill out online data form (see instructions for both below). Or you have the option of returning the memory card(s) and data sheet(s) to your team leader or the nearest Conservation Northwest office ASAP, so that we can get the photos from your camera downloaded and reviewed and store the camera check information into our database. Mark on your data sheet how data is being returned, in case the images become separated from it.

Cameras should ideally be checked roughly each month throughout the season, depending on the camera location and accessibility. Your team leader will schedule checks to ensure that cameras are being checked regularly and lure refreshed at the camera location.

Review, tag, and upload photos from retrieved memory cards on online Google Drive (online photos sharing service) and fill out online data form (see instructions for both below). Email a brief report of your visit to your team leader and Alison Huyett (ahuyett@conservationnw.org). If there are any important news/findings, such as photos of the target species, problems with the camera or location, etc., contact your team leader and CNW immediately (ahuyett@conservationnw.org and jwatkins@conservationnw.org). The next people from your team checking the camera will greatly benefit from a brief report, including site conditions, what you learned about animals in the area, topography, hazards, and any outstanding questions.

Considerations for relocating a camera trap

Selecting a camera trap location, preparing the site and setting the trap can be labor intensive. Most of our target species have very large home ranges and even if they occupy the habitat where the camera trap is set, they may not return to it for weeks or even months. For both of these reasons once set, barring extraordinary circumstances, camera traps should be left in place for at least one month. Extraordinary events might include: large changes to the landscape where the camera has been set such as logging, fire, snow pack changes, increase in human activity in the vicinity, or compelling and time sensitive evidence of a much more promising location in the area being surveyed.

After one month, it is reasonable to assess whether or not to continue to monitor the specific area where you have set your camera trap or relocating it. Sites that have been very active with a variety of other carnivore species might encourage you leave the camera trap where it is currently located. Sets that have had a very low amount of activity might suggest that you relocate the camera. Other considerations could also

include an abundance of other promising locations to monitor or conversely, the location where it is currently set still appearing to be the most promising option.

Remote Camera Data Sheet and Online Photo Submission

Photos should be processed following the guidelines in the Remote Camera Photo and Data Management Guidelines (available online at http://www.conservationnw.org/files/field-team-photo-managment-guidelines.pdf). Below is a synopsis of this process. Refer to full document for details.

Process Remote Camera photos: Review and tag photos in Picasa

1. Download Photos to your computer.
2. Open Photo Folder in Picasa (Under the "File" menu select "Add Folder to Picasa and navigate to the folder on your computer with remote camera photos").
3. Determine if you have any series of photos taken by false triggers such as light changes, temperature changes, waving branches, etc. Delete all false triggers (carefully inspect images before deleting to ensure not missing something subtle). Sometimes these can number in the hundreds or thousands and we do not need to catalogue or store them. Note that you can select multiple photos at once to delete when in the screen with rows of thumbnails.
4. In Picasa using the "tags" feature (found in the lower right corner of the screen) to tag all photos with species ID using the labeling conventions guidelines listed at the bottom of this document. Note that you can tag multiple photos at once by selecting as many as you want to tag at once in the screen with rows of thumbnails than adding a tag. Follow guidelines for tagging photos in the Remote Camera Photo and Data Management Guidelines.

Upload photos to Google Drive

5. Navigate to the folder on Google Drive labeled with the team leader name and camera location name, which should be set up for you already by Conservation Northwest. If this folder has not been set up you can create it and share it with wildlifemonitoringproject@gmail.com or you can send an email to Alison Huyett (ahuyett@conservationnw.org) asking for help setting up this shared folder. Once you have found this folder you can add it to "My Drive" on Google Drive so it is easy to locate in the future.
6. Each time you upload new photos from a camera check you will need to create a folder within the folder mentioned above for each camera you check (most teams will have two camera sites) within the above folder. The folder will need to be labeled as such:
   Location_XXX (previous visit date)-XXX (current visit date)
   Example: Mt. Rainier Camera #1_12AUG12-30AUG12
   And for second site:
   Mt. Rainier Camera #2_12AUG12-30AUG12

7. If applicable you can include a note in each camera folder (via word document or google text document) for any instances of runaway photo taking from false triggers, or other relevant issues. Place this word document in the folder with the applicable photos

Other general field photos

Within the main folder for each camera location you will also find a folder (or can create one) named <General Photos>. Upload any relevant photos you take with your own digital camera of the site/route to site/wildlife tracks sign, etc. Within the "General Field Photos" folder create a folder for each time you head into the field. (***Example "Mt. Rainier site visit 8_30_12"***)

Label Photos as best you can prior to uploading into the folder and include a word document with additional details such as GPS coordinates of specific photos and route descriptions, etc as needed. Note that if you have the ability to add GPS coordinates and captions to individual photos metadata, CNW will be able to access this information.

Enter data into online Remote Camera Check Data Form

All data from each camera install, check, location change, and removal needs to be entered in the field on your Camera Data Deployment/Check form while in the field. Once you get home enter all data from field data forms into the online form: https://docs.google.com/forms/d/1Vp8xGm7RnelGWBtL7SQXhJC9v8s3kFJS9cxiCzjRWJQ/viewform. This data form needs to be filled out for each camera you install/check/remove every time you visit it!

Notify CNW once you have uploaded your photos

Once photos are completely uploaded to the shared folder, email wildlifemonitoringproject@gmail.com that photos have been uploaded.

CWMP Communications Protocol

Due to the potential social and political sensitivity of some species and the importance of this work being shared in a scientific and thoughtful manner, the Citizen Wildlife Monitoring Project has a Communications Protocol for all volunteers and staff of the effort.

All photos taken by cameras owned by the CWMP are owned by the non-profit organizations sponsoring this effort, and we strongly encourage that any cameras not owned by our effort but participating in it please follow this protocol as well.

- All photos taken by cameras and retrieved by teams are only released to people outside the program by one of the three program sponsor organizations or by an agency affiliated with our Advisory Council. *Volunteers are not to share their results with anyone outside the program directly*.
- Photos gathered off of a camera are sent in per the protocol above for review and decisions about communicating.
- If you feel you have captured a photo of your target species, or a unique photo that interests you – you can upload it to Google Drive and alert our staff to view OR email it directly to our staff. Photos can be emailed simultaneously to alison@conservationnw.org and jwatkins@conservationnw.org (to ensure that even if one of us is on vacation they are viewed).
- Selected photos are shared on our website, and results reported monthly in our volunteer e-newsletter. Requests for any photographs can be made through our program to alison@conservationnw.org or jwatkins@conservationnw.org
- Photos that need further identification or discussion are taken to our Advisory Council prior to any wider release, and we will notify you of the discussion and outcome.
- Any interaction with the media based on the results of a camera is decided upon by the host non-profit organizations, and shared with the Advisory Council.
- An annual report is prepared at the close of each season that will report on all results, and at that time all results, with the exception of details of camera locations, are public knowledge.

If any member of the press approaches you about the program, please re-direct them to our offices and staff.

Wildlife Sign Documentation

It is not uncommon for the carnivores we are working on detecting to leave tracks or signs of their presence even if they do not trigger our remote camera trap. If you observe tracks, scat or other signs that maybe of one of our target species on your way to the camera or at the camera site, use these procedures for documenting the sign. This information may be useful for refining our camera trapping effort or as evidence in its own right of the presence of our target species.

Target Species

CWMP remote camera efforts focus on several different target species around the Pacific Northwest.

North Cascades and Northeast Washington: wolves, wolverines, grizzly bear, Canada lynx

Southern and Central Washington Cascades: wolves, wolverines

Interstate 90: Mammals larger than a snowshoe hare. Especially interested in observations associated with these species in relationship to their use of areas immediately adjacent to the highway, crossing the interstate or using crossing structures to travel under the interstate.

Documenting Tracks and Signs

See appendix for diagrams and further instructions.

Stop your companion(s) and bring tracks to their attention. Stop walking to prevent destroying tracks. Determine if you believe the tracks or sign in question could possibly be one of our target species. If so, proceed to documenting them. If not, carry on with your other activities.

Select the clearest tracks for photographs (and measurements). Consider photographing tracks in a variety of locations if possible. When ambiguous or unidentifiable tracks are found, the first step is to search the area for better tracks of the same animal. If there is a trail you can follow, this is one way you may discover clearer tracks for that individual. In general, look for where the creature has entered more sheltered areas away from direct sunlight, wind, further snowfall, or whatever has likely obscured the tracks.

If clearer identifiable tracks cannot be found, then ambiguous tracks, which could be one of our target species, should be documented with care. Unclear tracks that are clearly NOT the target species do not need to be documented. Photograph tracks, trail patterns, and other signs as per photo-documentation procedures below.

General consideration

Take multiple photographs to ensure you get a quality shot. Take at least one picture of the track that includes a card in the picture with:

- Date
- Location name
- Observer name
- GPS coordinates and map datum

Individual tracks

Take photo looking directly down on track to reduce distortion. Include two scales, preferably rulers, one running lengthwise, the second widthwise (Collapsible ski poles with cm calibrations showing also work).

Track patterns, trails, and other signs

Include a scale of some sort. Often this may be leaving the scale you used for an individual track on the ground by that track (thus also giving a reference for where the individual track sits in the pattern). Try to take picture looking straight down on trail to reduce distortion. If this is impossible due to size of trail, include scales both near and far to account for distortion. Including a person in a photo can help with scale for larger frames. Also consider taking photographs of people looking at the tracks or sign, or pictures, which show the tracks in the context of the location they are found to accompany the detail photographs.

Trailing And Specimen Collection (Optional/Recommended)

Assuming time and safety permit, attempt to follow the animals trail in both directions for as long as possible. Trailing is carried out for two reasons:

- To collect more geographic information on the potential target species' trail.
- To search for and collect specimens that can be used for DNA analysis (e.g. hairs or scats).

If you are able to locate and collect a genetic specimen related to tracks which you have photo documented, carefully collect the specimen following the same guidelines laid out for our camera traps which also include genetic specimen collection or our wolverine track documentation protocol (http://www.conservationnw.org/what-we-do/northcascades/pdf-reports-and-forms/2010_wolverine-protocol-1).

Out Of The Field

Once you come out of the field contact Conservation Northwest for specific instructions on how to handle delivery of materials (photographs, specimens). Immediate communication is highly valued as strong evidence may solicit a hasty follow up response in the area of discovery that might include setting up/resituating remote cameras, hair snags, or follow up tracking surveys.

Appendix IV: Wolf Remote Camera Traps: Scouting Guidelines and Installation Protocol

Contents

Introduction

Wolves (Canis lupus) are currently undergoing a range expansion in Washington State. The primary object of the Citizen Wildlife Monitoring Project (CWMP) in regards to wolves is to use remote camera traps and other non-invasive methods to document new populations of wolves. Secondarily, the project aims to verify breeding status and actual numbers of wolves in new and documented packs. The focus of this document is provide relevant information for CWMP volunteers to effectively set remote camera traps to capture images of wolves in areas where their current presence is unknown. The final section of the document discusses methods and considerations for documenting breeding status and actual numbers using remote cameras in areas where wolf presence has already been established.

Wolves are wide-ranging species whose home range can vary considerably based on seasonal changes in prey species distribution, snow conditions, and human activity on the landscape. On a day-to-day scale, they will often travel many miles in a single night. On the broadest scale, young adult wolves typically disperse from their natal home range and travel up to hundreds of miles before localizing and establishing a new home range for themselves. Young non-resident animals that have not set up a home range may pass through an area and never return to it. Because of these features of wolf biology, pinpointing a specific location to detect the species over the course of even several months can be very challenging. Even with reliable sightings and track and sign evidence, the past presence of a wolf in a specific location is not a guarantee that the animal will return there any time soon, if at all.

However, the wide-ranging nature of wolves and territoriality of the species offer several opportunities for documenting their presence. Wolves typically use lightly traveled or gated roads for travel, as well as established human and game trails. They also carry out a variety of scent marking behaviors along these travel routes. As such roads and trails make excellent locations for setting camera traps as well as offering an efficient method for scouting potential locations for tracks and sign and selecting the best location to set a camera trap.

During the spring and early summer, wolves that are part of an established pack will have slightly more predictable travel patterns as they are tied to a den or rendezvous location for pup rearing. Winter months are the least predictable time for anticipating wolf location and movement as young of the year are capable of traveling long distances and the pack can wonder their home range widely. However, snow pack and ungulate winter range will typically guide their habitat use at this time.

Wolves have excellent vision and an exceptional sense of smell. Their sense of smell and social nature can be used by researchers to elicit curiosity and territorial responses to help

attract wolves to camera trap locations or slow them down during their travels to enable photo documentation by remote cameras. However, wolves are notoriously skittish and can be very wary of unusual scents, especially if they have had negative encounters with humans and traps.

Camera Trap Site Selection-General Location

CWMP uses recent sighting reports provided by the public, the Washington Department of Fish and Wildlife (WDFW), and the United States Forest Service (USFS), along with models that predict high quality wolf habitat in Washington State, to select general locations for camera trap installations. Research from other ecologically similar landscapes, suggest that in Washington State wolves will typically select for rolling topography and middle to low elevations rather than high elevations and exceptionally steep habitat (WDFW 2011). This habitat selection mirrors prime habitat for their primary prey species in the region, deer and elk.

In conjunction with the projects advisory board and the WDFW and USFS biologists working with the project leadership team, CWMP identifies priority locations to field camera teams. The scale of these general locations range in size from 10 to several hundred square mile areas that appears promising for the detection of wolves.

Once these general locations have been identified and a field team is assigned to the area, a specific locations to actually set cameras must be selected. CWMP's leadership team works with each volunteer camera team to provide them with all of the available information which has contributed to selected the general location, including suggestions from local biologists and citizens about specific locations or landscape features that might be productive, specific location of recent putative wolf sightings from the area. Ideally, each field team will have several specific locations to target for installation when they head out in the field. Along with materials to set the camera trap, they will also have maps of the area, notes and coordinates of recent sightings (if applicable) as well as notes, and coordinates of specific locations in the field that appear to be promising locations to set camera traps.

Once in the field volunteer camera teams must select the specific microhabitat features to locate their camera trap. This step is key, as without very careful site selection the chances of capturing photos of a wolf on a remote camera are very low. Because of this, it is suggested that field teams allot a reasonable amount of time to explore the general location they have been assigned to assess multiple potential locations for their camera trap before they install. This may be a full day or even several days of scouting depending on the size and accessibility of the location.

Scouting: Guidelines for finding the best specific location to set a camera trap

Preparation For the Field

Prior to heading into the field, review maps of the area, material on wolf tracks and signs, and guidelines for various methods for setting a camera trap (see below). Be sure to plan enough time for your trip to allow for getting to the general location, an appropriate amount of time to scout for setting camera traps and then actually setting cameras. Successful camera traps often require several days of scouting in order to locate the specific location to set them and up to an hour to sort out and prepare the specific location for actually setting the camera.

Collect all of the field equipment needed for the trip (see list below). Test remote cameras, ensure that memory cards are empty and batteries are full. Ensure that you know how to use the cameras and set cameras to the projects recommended settings. If there have been specific locations to target for scouting or setting your cameras, enter these coordinates into the GPS unit.

In the Field

Wolves often use roads, human trails, and game trails along streams, wetlands, through mountain passes or along ridgelines to travel through their home range. Roads that are used infrequently by people are often particularly sought out by wolves (Fritts et al 2003). Wolves leave recognizable tracks and scats along these travel routes. Walk, bike, or drive as much of the road and trail system within the targeted area as possible, focusing specifically on areas that had been identified as promising based on habitat and putative sightings. While exploring these area, search for tracks, scats, and other signs of wolf presence (see below). Areas with a concentration of sign would help narrow down where to locate a camera trap. If no sign is detected, scouting will allow the team to view a variety of options for setting camera traps before selecting the best option.

While scouting the area, consider various locations and how you would set your camera there, keeping in mind the various methods (covered below) for setting a camera trap. For trail sets, along with tracks and sign, look for locations that funnel activity in an area, such as were a road or trail goes through a pass or saddle, or where vegetation around the road or trail funnel wildlife travel onto the trail. Along travel routes consider where you would apply a scent lure and how you would set your camera on it. Inspect trail junctions for signs of scent marking (scats and scratch marks). Look for carcasses of ungulates that may attract attention from wolves (these may be visited even a month or more after the carcass has been on the ground). In areas with human use, consider how you would set a camera in a way that would not likely be detected by people and how you will secure the camera.

Most teams have two cameras at their disposal. Once you have scouted your entire area, select the two most promising locations, ideally situated to monitor as broad a cross section of your area as possible.

Camera Trap Set Types

There are several methods for designing a remote camera trap for wolves. The basic tool for all of these traps is the remote camera itself. The other components of a camera trap set are: the microhabitat selected for the set, potentially the addition of one or more attractants (scent lures) to the field of view of the camera. Various camera trap sets attempt to take advantage of different behaviors of wolves (Long et al 2008). These include:

a. General travel: non-baited trail sets
b. Intra and inter-species communication: trail sets on existing scats, scent marking, use of artificial scent lures
c. Foraging behavior: sets on carcasses, bait, and food-item related scent lures.
d. Pup-rearing behavior: sets on or near potential rendezvous locations.

Understanding the specific behavior which is the focus of the camera trap set is an important part of selecting the specific location for the set and the design of where to set the camera and whether and how to add an attractant.

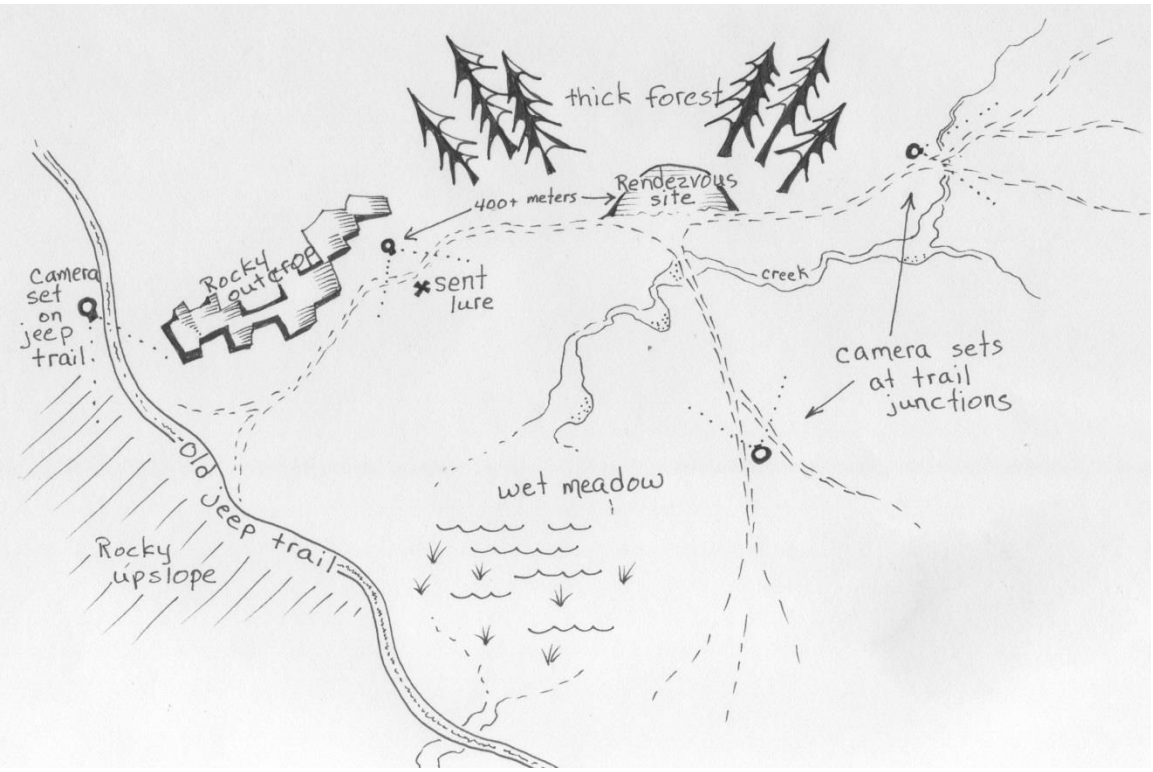

Figure 1. Overview of possible locations for remote camera traps for wolves, focusing on game trails and lightly traveled or gated roads. Illustration by Jenn Wolfe.

Use of Imported Attractants

A variety of scent attractants can be used to draw wolves in front of your camera or get them to pause as they travel through the field of view of the remote camera. These include scent lures such as Gusto and other trapper's lures (see Table below). Bait, an actual food item, such as a deer carcass can also be used. Use of imported baits has a variety of ethical

issues that must be considered as well as research permitting requirements. As such, importing of baits for remote camera traps targeting wolves for CWMP is typically not done. However, use of existing "bait" found on site, such as a deer carcass discovered in the area targeted for monitoring can be an excellent attractant.

The responses of wolves to attractants may vary considerably depending on the past experience of individual wolves and on the context in which the attractant is being used, specifically the amount of human activity in an area. Wolves are notorious for their ability to learn about and avoid potential traps set by humans. Scent lures typically work well for wolves that have not been negatively conditioned to the specific smell. However wolves that have been exposed to trapper's lures in conjunction with being radio collared (or attempts at this) or an actual trapping season may actually avoid those scents in the future rather than being drawn to them (Gabe Spence, pers. com.). Baits that have a human scent associated with them may similarly be treated with suspicion in some instances. However, in locations where human presence is common and typically benign, wolves may show little or no aversion to human scent in conjunction with scent attractants.

Attractant	Type	Producer	Use Notes
Caven's Gusto	Scent lure	Minnesota Trapline Products	Long range attractant, primarily designed for mustelids but has been effective in our efforts with canines and felines.
Caven's Yodel Dog	Scent lure	Minnesota Trapline Products	Alternate to Gusto. Primarily designed for coyotes according to manufacturer.
Castorum	Scent lure	Various producers	Beaver scent. Consider application on or close to the ground, such as on a rock, in a small manufactured dig or a small pile of sticks in front of the camera.
Found carcass	Bait	NA	Ideal if one is located in the field. If location is not ideal, can be dragged to a location that works better for a camera trap. Drag route may act as a scent trail the target species might detect and follow into camera trap. Use caution in handling and working around carcasses in regards to disease transmission and bears.
Imported bait	Bait	NA	Ethical consideration, permit requirements. Not sanctioned for use in 2014 for wolf camera traps

Table 16 Attractants available for use by CWMP Camera Trap teams for wolf sets.

Trail Sets

Wolves often travel along lightly traveled roads, gated roads and game trails and because of this are commonly used to detect the species using remote camera traps. These sets can include the addition of an artificial attractant to slow down or direct the animal to a specific location.

Often game trails follow landscape features such as ridgelines or the edges of riparian corridors. Such trails often become better defined in some locations and more dispersed in others. Looking for a part of the trail where the trail is well defined and where vegetation and landscape features funnel the likely travel route of wolves onto the trail. Locations such as this have the highest likelihood of capturing an image of wolves that pass through the area.

While trail and road junctions often attract attention from wolves as a location for scent marking, at other times, wolves will avoid actual junctions and "cut corners" from one trail or road to the other. Because of this, setting a camera trap on a trail before a likely corner cut might help catch wolves on the travel route. Alternately, the use of a scent attractant on a camera set on or near a trail or road junction designed to elicit a intra-species communication response could be effective at bringing wolves all the way to the junction and encouraging the animal to come into the field of view of the camera.

Trail Set Without Additional Attractant

Creating a trail set without any artificial attractant is less likely to cause an adverse response from trap shy animals, a consideration for sets in locations where game managers have been trying to trap and collar wolves. However, these sets require extremely careful attention to the specific location. Good situations for such a set would include identifying a spot on a trail where the landscape and vegetation strongly funnels animals along this specific location and where you have evidence that suggests multiple events of passage of wolves, such as repeated sightings along the route or tracks on the trail of multiple ages.

Wolves typically trot when traveling along travel routes such as roads or trails. Without an attractant applied in the field of view of the camera to stop the wolf, the animal may pass quickly in front of the camera causing either a very blurry image or the animal passing almost or completely through the field of view before the camera triggers. To account for this, be sure to set your camera angled down the trail rather than perpendicular to the trail. This will increase the time that a traveling wolf will be in the field of view of the camera. Camera settings should be set to get as many images as possible in each burst (3 typically) and the shortest rest period between triggers (1 second typically).

Photo 1. A wolf from Washington's Lookout Pack in the North Cascades. This camera was set at the junction of two game trails. No additional attractant was used. Photograph by David Moskowitz.

Trail Sets with Artificial Attractant

Adding a scent lure within the field of view of the camera can help slow down or stop the animal to increase the chances of getting a clear photo with identifying features. Similarly, in places where there are multiple possible travel routes, adding a scent lure can increase the chances that a wolf will use the one that you have set your camera trap on.

Scent lures should be applied in a way that fits with the type of behavior the lure is designed to elicit. For a scent lure designed to trigger a scent marking response apply the lure to an object that would typically be marked by wolves or other animals. This might be a branch or log along the side of a travel route, or a prominent rock along the route. For lures designed to trigger a foraging/feeding response, creating a small dig along the edge of the route and applying the lure to the inside of the dig can mimic the caching behavior wolves are familiar with or the work of a small rodent. Scent lures along trail sets are not designed to draw in wolves from a long distance but reroute or stop them once they are in the general vicinity. As such, applying the lure high in a tree, or applying a lot of lure may not increase their effectiveness and may trigger wariness of trap shy wolves.

On roads and trails where there is human traffic, another consideration for the camera set will be avoiding detection and theft by people. Besides a security box and cable lock, setting the camera in a location that is obscured from the typical field of view for walking or driving humans can help with this, such as setting it on a tree with branches hanging over it and the camera aimed towards the ground in front of the camera where an attractant has been applied (Gabe Spence, pers. com.). This sort of set can help reduce the number of hits

from human traffic along the main part of the road by taking this out of the field of the camera's sensor.

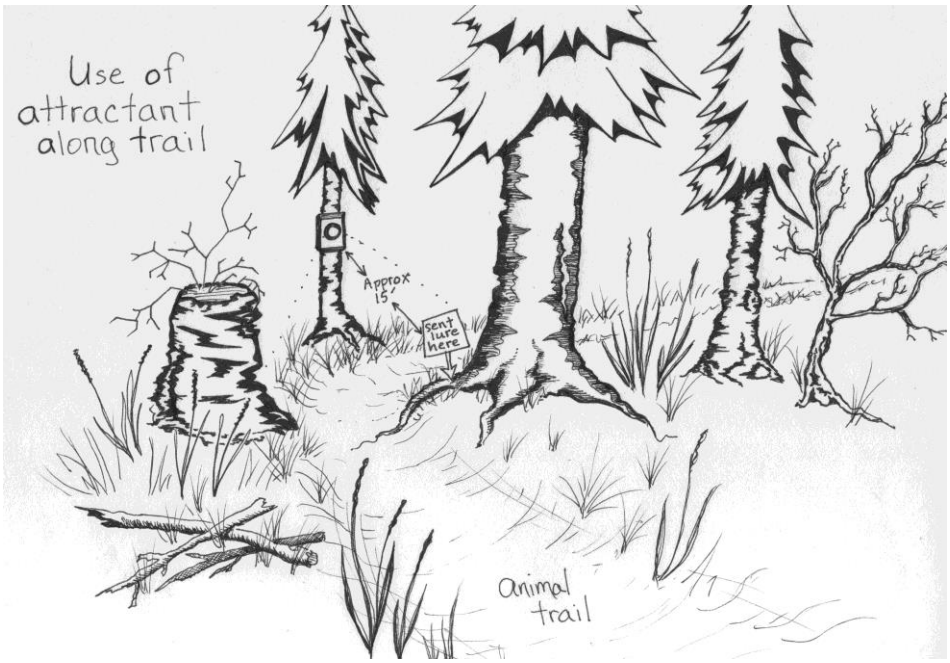

Figure 2. Remote camera trap set along a game trail incorporating a scent lure. Note the camera is looking down the trail rather than just across it. This should increase the amount of time an animal ends up in the view of the camera. Illustration by Jenn Wolfe.

Figure 3. Camera set along a route often used by humans. Illustration by Jenn Wolfe.

Figure 4. If the camera is set to view the road or trail, setting it below head height and with branches that partially obscure it from the view of a walking or driving human can help reduce likelihood of detection by passing people. Illustration by Jenn Wolfe.

Natural Bait: Found Carcass or Other Food Source

Wolves have evolved not only to kill but also find and scavenge the remains of hoofed mammals. Because of this, found carcasses on the landscape, no matter what their origin, make an excellent attractant for a remote camera trap. Carcasses may be the result of predation by wolves or mountain lions, animals wounded but not retrieved by human hunters, malnourishment, road kill, or remains dumped by humans after being butchered. Wolves are able to consume an entire carcass including the bones. While a carcass will be the strongest attractant when they are fresh, wolves will at times inspect or return to remains a month or more after they have been on the ground and been reduced to little more than bones and scraps of hide.

While scouting an area look for carcasses on the landscape. Fresh carcasses often have a strong scent. Follow up on these potential smells to see if you can detect a carcass. Similarly, fresh carcasses often attract a lot of attention from birds such as ravens, crows, jays, and magpies. Attend to and follow up on concentrations of these birds or their calls as they may lead you to a carcass. On travel routes in the vicinity of a carcass you may find an increase in the density of carnivore scats, particularly coyotes or wolves. If you find multiple scats along a travel route in a short distance, consider spending a little extra time exploring the vicinity to see if there may be a carcass in the vicinity.

Camera traps on a carcass can be created where the carcass is found or the carcass can be relocated to a spot more conducive to the trap. Road killed deer could be dragged off of the

road to a more secluded location where detection by humans will be less likely. Carcasses found far from cover and trees can be dragged to a spot where a camera can be attached to a nearby tree (conversely, a structure such as a log can be dragged to the carcass location to attach a camera to). Dragging the carcass to a new location will create a sent trail which a wolf can follow to find the carcass. Dragging the carcass for some distance before setting the trap might help draw in wolves as there is an increased likelihood that they will intersect the scent.

When setting a camera trap on a carcass, be sure to set the camera far enough away to capture the entire carcass and the area around it to increase the likelihood of capturing a wolf that approaches but doesn't feed on the carcass. Conversely, carefully test the camera to be sure that it is close enough to the carcass so that movement on the carcass triggers the camera. If there is one most likely approach route to the carcass, setting the camera to both view the carcass and the approach route can increase the chances of catching animals that approach but don't come all the way to the carcass. Wolves, bears, and lions will often move and reposition a carcass in the course of feeding on it. A piece of cord can be used to secure a carcass to a tree or other stationary feature to keep the carcass in view.

Figure 5. Remote camera trap set on a found carcass, set to view carcass on possible aproach routes to carcass. Illustration by Jenn Wolfe.

Photo 2. Wolf captured on a remote camera trap set on the remains of a deer carcass that had likely been killed by wolves. The carcass was moved by the photographer to a location more conducive for monitoring with a remote camera (about 200 meters). This wolf arrived over 1.5 months after when the deer was killed. Photo by David Moskowitz.

Besides a simple carcass, other locations that may attract wolves include bone yards where hunters or ranchers have dumped the remains of animals over time, locations where the Department of Transportation dump road killed carcasses, refuse sites such as illegal dump spots along forest roads, gut piles where a human has field dressed an ungulate, and hunter camps where animals have been field dressed, hung, or butchered. As part of a field teams research for locations that include a highway, a phone call to the local Department of Transportation office to learn if there is a roadkill dump location in the area might be productive.

While not as powerful of an attract, even a small patch of deer hide can be used to draw a nearby wolf in front of a camera or pause on a trail set to allow for clearer photos to be taken of the animal (Adam Lieberg, pers. com.)

There are several safety considerations that are important in conjunction with fresh carcasses on the landscape. While mountain lions and wolves are typically retreating in the presence of humans around carcasses, black bears and grizzly bears are both attracted to carcasses and can be aggressive in defending these carcasses from intruders (such as citizen scientists!). Dead animals can be vectors of human disease. When ever in the field in bear country, especially when carrying attractants or searching for natural attractants, field teams should carry bear spray in a readily accessible location (e.g. on your hip) and be trained and prepared to use it. If a carcass is detected, observe the vicinity carefully and approach the location slowly. A group of people is less likely to be accosted by a bear. Making noise and keeping at least one person assigned to be a lookout can help reduce the likelihood of surprising or being surprised by a bear. When inspecting a carcass or setting

up a camera trap around a carcass be efficient and spend as little time in the vicinity as possible.

To reduce the risks of disease transmission from a carcass avoid handling the carcass. If you want to move a carcass to a better location for your camera trap use gloves and wash your hands immediately after finishing the task. As with artificial attractants, avoid touching a carcass and then handling your camera to avoid drawing attention to the camera by attaching scent to it. Have one team member deal with the carcass while another handles the camera.

Potential Den and Rendezvous Sites

The only time of the year when wolf activity is consistently limited and predictable to some degree is during pup rearing when adults return consistently to den or rendezvous locations. Research suggests that in some areas, specific habitat features can help predict where these sites may be situated on the landscape. This information, in conjunction with putative sighting reports, and knowledge of track and sign patterns around these locations can help direct scouting activities to identify these locations on the landscape. Because they have a high density of use during the late spring and early summer, setting cameras on travel routes coming into these locations could increase the chances of detecting wolves during this time.

Den sites are typically in relatively secluded locations and within about a quarter mile from water (Trapp 2004). In some regions, habitat features such as wet meadow systems are good predictors of potential rendezvous sites (Ausband et al 2010). In the Cascades, rendezvous sites have been documented in a wide variety of habitats, without any discernable patterns thus far (Gabe Spence, Ray Robertson, pers. com.).

Field teams should consider identifying potential denning and rendezvous locations prior to heading into the field and then carefully scouting these locations for wolf tracks and signs and potential camera trap set locations. Using maps and satellite images, (such as through Google earth or Google maps), identify wet meadows, wetlands, and other small clearings in forested landscapes and figure out the best ways to access these locations.

Game trails in the vicinity of den or rendezvous locations typically get relatively heavy travel and scent marking attention (scats, scrapes, and urine) by wolves. Rendezvous sites that have been well used will often collect bones and parts of carcasses that have been killed in the area or brought back to the area by adults. Once in the field, visit potential locations and check game trails into and out of the area for sign.

Consider creating a trail set on routes leading into a den or rendezvous location. For potential rendezvous locations, setting a camera trap that observes the meadow or clearing and adding a scent lure in the proximate area can both cover the general area and attempt to draw wolves into close proximity to guarantee they trigger the camera. Rendezvous

locations often have carcasses in the vicinity. These carcasses could be used for camera traps as described previously.

Den and rendezvous locations are very sensitive features of a wolf pack's home range. Field teams should work hard to minimize disturbance at these locations. For potential den locations, camera sets should be set on travel routes close by but not actually at the location, such as on game trails 400 meters or more away. For both potential den and rendezvous locations, setting camera traps before rather than during the breeding season can help reduce disturbance. Some rendezvous sites are used repetitively and for prolonged periods of time while others are ephemeral. During camera servicing trips, field teams should reassess the area to determine if relocating a camera trap might be appropriate.

Managing Multiple Camera Traps In One Area

Camera teams are typically assigned two cameras. Follow the following criteria for setting your two camera traps in the area you are assigned to monitor.

If there in compelling evidence of recent wolf activity in a specific location you may be directed to place both camera sets in relatively close proximity, such as along two different trails or roads within a small area. More typically you will be assigned a larger general area to monitor. As such, in order to cover as large an area as possible, remote camera traps should be set up at least 1 kilometer apart from each other. Barring compelling circumstances to move a camera quickly, camera traps should be left installed for at least one month.

After 1 month, consider moving the camera trap to a new location to increase our coverage of the area. However, it is not uncommon for a wolf to go several months before returning to a specific part of its home range. If there has been a lot of other carnivore and ungulate activity at a promising location, leaving the set for up to two months could be appropriate. Another consideration would be the quality of other available locations to move the camera trap to.

Consider setting two different types of camera traps in your area, perhaps one using an imported attractant and the other not, or using a different attractants at each location. This variation can help detect wolves in areas where one scent might work better than another for local wolves.

Considerations for Documenting Breeding Status and Numbers

The primary goal of CWMP remote camera teams is typically, at least initially to document presence of wolves in an area. Once this has been established, the project may wish to address additional questions such as residency of the animal or animals, breeding status, and actual numbers of wolves in a pack. Camera traps set to simply detect wolves may also

incidentally help answer these more detailed questions. However, there are several considerations to help design camera traps to help answer these questions.

Resident versus transient wolves

Resident wolves will localize their activity in a specific home range and carry out scent marking and other territorial behaviors in the vicinity. Establishing a territory is typically associated with pairing of an adult male and female animal and eventually leads to the establishment of pack including subadult animals. Transient, dispersers are typically solitary and may be documented in an area once and then never again. Camera trapping efforts over a period of months that document wolves repetitively and document more than one wolf suggest that the wolves are resident in the area and likely to be attempting to reproduce in the general area. Camera traps that document scent marking behavior such as raised leg urinations, over marking of one animal on top of another's scent mark, scratching after defecation or urination are behaviors suggestive of resident rather than transient animals.

Camera traps set in locations where scent marking behavior would be predicted and using scent lures which might induce marking behavior from resident animals should be considered to help collect information on potentially resident wolves.

Breeding Status

Two observations that can be captured on remote cameras about the breeding status of wolves are pups/subadult wolves and a female with swollen teats (indicating a lactating female). Breeding females have enlarged nipples (Kreeger 2003), probably most apparent when the wolf is actively lactating and nursing young. Carefully inspect photographs captured by camera traps for enlarged teats. Targeting potential rendezvous locations in late June through the late summer should be considered to capture images of juvenile wolves.

Photo 3. Wolf pups captured on a remote camera set on a travel route adjacent to a suspected rendezvous location. A scent lure was applied to a rock where the two animals on the left are sniffing. Photo from mid-July in north-central Washington. Camera trap set by Ray Robertson for Conservation Northwest.

Photo 4. Note the enlarged teats of this breeding female wolf taken by a remote camera. Photo from early April, northwestern Montana. Photo by Adam Lieberg, Northwest Connections.

Photo 5. Note the enlarged teats of this female wolf, indicating it has breed and is likely currently lactating. Photographed in May. Photo by David Moskowitz

Pack Size

Capturing images of multiple wolves on the same frame is the easiest way to assess numbers of wolves in an area using remote cameras. However, this only provides a minimum number, as some wolves in a pack may not be in the frame. Setting cameras on rendezvous sites and clearings where wolves might be predicted to congregate can increase the chances of detecting multiple wolves. On trail sets, aiming the camera down a trail rather than perpendicular to it can also help with this. In winter, in deep snow, wolves often travel single file. On trail sets, wolves may pass sequentially in front of the camera, allowing them to be counted. Constructing a camera trap in a location where this sort of movement is predicted can increase chances of capturing them on film. Setting the camera to the shortest time between photo burst can help ensure getting all the animals passing by. Setting the camera to video with a long run time (60 seconds) could also help capture the sequential travel of animals.

Cameras set on carcasses are poor for determining actual numbers as wolves will often come and go from the carcass individually rather than communally. It may be impossible to identify individual wolves in a pack when size and pelage color are similar and therefor not possible to use sequential images to assess numbers of animals in a situation where one wolf is likely returning more than once to the camera trap location, such as at a carcass.

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Appendix V: Grizzly Bear Remote Camera Traps: Installation and Monitoring Protocol

Contents

Introduction

CWMP's effort to detect Grizzly bears (*Ursus arctos*) in the North Cascades Ecosystem (NCE) is designed to compliment the work already carried out by the Cascade Carnivore Connectivity Project (CCCP). Locations for surveying are selected based on the sampling model created by CCCP (Long et al 2013) and the sampling method they employed based on the "hair corral" described by Kendall and McKelvey (2008). CWMP's field methods are adapted from these methods to focus on simple detection using remote camera data rather than DNA analysis based on genetic sample (hair) collection. CCCP's primary research objectives where to collect information on the genetic structure of carnivore populations in the NCE and secondarily to detect grizzly bears and other rare carnivores. CWMP's primary

research goal is detection of grizzly bears. Because of this, replacing hair collection with a remote camera allows for a simplified set up and removal of the detection system. Data collected require much less complex and expensive analysis. Because field identification of grizzly bears as compared to black bears (*Ursus americanus*) involves features that are relatively easy to detect in close up photographs (head and shoulder shape), remote cameras set to take multiple photographs and photograph continuously once triggered should allow for definitive identification of grizzly bears if detected.

Methods for attempting to collect genetic samples (hair), if a putative grizzly bear is detected via photograph, are covered as well to help confirm identification and potentially shed more light on the genetic relatedness of grizzly bears in the NCE to elsewhere in the Pacific Northwest.

Safety consideration

Travel in bear country requires attention to several safety considerations, especially when hiking, and potentially camping with a powerful scent lure designed to attract bears. Teams should carefully review how to distinguish between black bears and grizzly bears and procedures for how to behave during a bear encounter. Western Wildlife Outreach's website (http://westernwildlife.org) provides an excellent overview of this topic, as well as links to more resources. Below are a few key expectations for CWMP camera teams traveling in the backcountry in potential grizzly bear country.

Always carry bear spray. CWMP provides teams with at least one canister of commercial pepper spray designed to deter bears. Teams should keep this out and accessible at all times while in bear country and be familiar with how and when to employ it. The chances of an aggressive encounter with a black or grizzly bear are relatively low but often happen unexpectedly and teams need to be prepared for this eventuality.

Keep scent lure out of campsites. Carry scent lure in a sealed container inside of a dry bag (provided by CWMP) clipped to the outside of a team members backpack. For overnight trips never bring this bag into camp. Instead, before entering camp, hang the bag from a tree using a rope to hoist it out of reach of a potentially curious bear. Lure should be left at least 50 meters outside of your camp, similar to how food is handled for bear safe backpacking.

Stick together. As part of scouting for a specific location to set a camera trap, teams will be looking for the best habitat, food sources, and marking signs of bears. Doing so inherently puts teams at a greater risk of having an actual encounter with a bear. Staying together as a group while searching for and installing a camera trap can greatly increase the chance of early detection of a bear and decrease the chances that the bear will act aggressively towards the team.

Camera Trap Site Selection

In 2014, CWMP will be selecting field locations based on the sampling model created by CCCP (2013). CWMP camera teams will sample areas as yet unmonitored by CCCP. CCCP divided the NCE into hexagonal sample units, each 2500 hectares. Each field team will be assigned two specific sample units for the summer to be monitored successively for one month each. Each unit should be sampled with two remote camera traps, set about 2-3 km apart (minimum 1 km). Each trap should be set for 1 month. Camera teams should deploy and recover both camera traps on the same visit to the study area.

Selecting a location

Once in the targeted sample area, remote camera teams need to select an appropriate specific location to set the camera trap. The attractant used for these traps is designed to appeal to a grizzly bear's foraging curiosity, though it often also elicits a marking response in bears as well. While the scent lure used for these installations is very powerful, locating the camera trap in a place where bears will likely be traveling and foraging naturally will increase the odds of detection of bears at the site.

Grizzly bears in the NCE likely depend on plant foods for the majority of their diet (North Cascades Grizzly Bear Recovery Team 2004) including glacier lily bulbs, grasses and sedges, and various species of berries. Subalpine meadows, riparian and wetlands, and forests or opens with a high density of fruiting berry bushes would all be natural attractants for grizzly bears. While plant foods likely make up the majority of grizzly bears' diet in the NCE, this species is opportunistic in its feeding and will seek out animal foods whenever possible. The carcasses of large animals are a particularly strong attractant for grizzly bears. Grizzly bears will scent mark by rubbing their bodies against trees located along travel routes as well as in and adjacent to important food resource locations.

Besides clear footprints, the foraging digs of grizzly bears are both relatively easy to detect if present and distinctive making them a particularly useful sign to search for (refer to Appendix 2 for examples of foraging and marking signs of grizzly bears).

High quality habitat can be predicted based on a review of maps and satellite images prior to heading into the field and then scouted for actual conditions and suitability for a camera trap once in the field. Allotting time to scout several possible locations before constructing the camera trap can help increase the effectiveness of the placement of the trap. Field teams will be briefed by project leadership and advisors on particularly promising locations to focus on in their sampling unit prior to field trips. Once a location has been selected to set the remote camera trap, follow the guidelines below to select the specific location to deploy the trap.

Camera Trap Set

This camera trap is an adaptation of the hair corral described by Kendall and McKelvey (2008) and utilized by CCCP (Long et al 2013) in the NCE. It is based on a classic bait

structure that bear hunters from around the world have used to attract both black and brown/grizzly bears.

The scent lure used for this trap is a combination of fermenting cattle blood and fish oil provided by United States Forest Service to CWMP. This lure is extremely strong smelling. Care in transporting the lure in the field and out is key. The lure is designed to trigger a foraging/curiosity response in bears to draw them to its location but has also been observed to elicit rubbing behavior (a communication behavior) once they are at the location. Because of this, situating the trap in a location that will likely attract bears because of nearby natural food sources, existing marking trees, or trails and travel routes that appear to be or would predicted to be used by bears are all habitat features that can increase the chances of success of the camera trap.

If in the process of scouting for a specific location for the camera trap, a team encounters a rub tree, large animal carcass, or other feature that acts as a natural attractant for bears, this camera trap can be constructed adjacent to the natural attractant.

Once an area has been selected (see above for guidelines), look specifically for a small clearing where a debris pile can be created in the middle of it. Construct a pile of sticks, branches and woody debris. Pile should be about 3 feet in diameter and similar in height with a mix of fine and course material and dense enough so that the full liter of scent lure poured on it will have a lot of surface area to adhere to.

The pile should be constructed in a location where the remote camera can be attached to a tree about 15 feet away facing the pile. Ideally the camera will be facing roughly north to decrease the chances of the sun triggering the camera and also avoiding backlighting animals which trigger the camera when they visit the bait.

Follow general guidelines for remote camera trap installation in regards to situating the camera. Because the scent lure used for these traps is so powerful it is vital that who ever is handling the bait does not touch or go near the camera. Ideally one person can be responsible for handling the bait and another for the camera.

Putting out the scent lure should be the absolute last thing you do at the camera trap location. Completely construct the entire debris pile and set up the remote camera and test it first. Fill out the camera check datasheet completely. Once the camera is set with all the appropriate settings and situated facing the debris pile correctly, turn on the camera and close it. Then have one person open up the scent lure and apply it to the debris pile and any overhanging structure available.

If possible constructing the debris pile around a tree sapling or snag or under the overhanging branches of a nearby tree will give additional surface area to attach scent lure too. In this instance pour a small amount of the attractant higher on the tree or dip a branch or frond from the overhanging branch into the lure before pouring the remainder over the debris pile. Be sure that wherever you place scent lure is within the field of view of the remote camera and activity there will trigger the camera.

Figure 6. Layout of camera trap set. Illustration by Jenn Wolfe.

Remote Camera Settings

Photo, 3 shots in series, 1 second delay, 5 megapixels.

Data Collection

Based on the sampling protocol set by CCCP (Long et al 2013), each installation should be left for a month. The CCCP protocol called for servicing each camera at 2 weeks but this was primarily to reduce the destruction of genetic samples collected at the trap. For CWMP purposes the scent lure should persist for an entire month and the remote cameras used can easily function for 1 month.

At one month, return to the camera trap location and walk in front of the camera to trigger it and capture the date and time of when you arrive on the site. Before disturbing the debris pile, remove the memory card from the camera and review the images on it using a digital camera or devise designed to review images from SD cards. If it appears you have captured images of a grizzly bear AND it was engaging in rubbing behavior on a tree or debris pile in the trap area inspect these locations and see if it has left hair in this location, carefully collect these genetic samples if possible following directions below. If not carry on with camera trap disassembly.

Fill out the camera check datasheet completely. Use a stout stick to deconstruct and disperse the debris pile. Avoid getting residual scent lure on hands or gear. Ensure that who ever is handling the remote camera does not approach or deal with the debris pile in any way.

Genetic Sample Collection

Upon arrival at a remote camera trap for servicing or de-install, field teams should walk in front of the camera to trigger it and capture an index photo which will note exact time of arrival and thus inform the exact survey period the trap was operational. Before disassembling the site, crews should review all the images stored on the memory card of the camera. For remote cameras without an image viewing function, the card can be viewed by inserting it into a standard digital camera. If the review of images reveals a potential grizzly bear has visited the site and its behavior included rubbing on the debris pile or nearby trees, it may be possible to collect hairs from the animal.

Carefully inspect the areas the animal rubbed (as seen in the photographs). Scan the location from several different angles as hairs may pop out more clearly depending on lighting and background. Every effort should be made not to touch the hairs directly as this can contaminate them for DNA analysis. Ideally a sterilized tweezers would be used to extract the hair(s). Deposit the hairs in a coin envelop (included in field kits provided at trainings). Label the container clearly with the location, date, coordinates, and your name (observer). Fill out a specimen collection datasheet.

Prevent contamination of genetic samples by using a clean pair of Nitrile gloves for *each* sample. At any given camera station, you will not know whether the hair or scat samples you find are from a single species or a single individual. ***Do not place samples in plastic bags or other plastic containers.*** Plastic traps moisture which will ruin the samples; thus, the genetics lab will not be able to extract DNA from the samples. Completely label all samples with the date, GPS coordinates, name of camera station, where the sample was found, and collector (refer to data sheet on the left for additional details). When you return from the field, check samples to make sure they are labeled properly and contact Conservation Northwest for instructions for delivering the material to our project partners for analysis.

Photographs of potential tracks and signs

During scouting, installation and removal of remote camera traps document any tracks and signs that appear to have been left by grizzly bears. Follow the guidelines laid out in the Remote Camera Trap Installation and Servicing Protocol for this. Appendix 2 of this document provides basic guidelines for track identification and others signs to look for in the field.

Relocation of camera trap

Each camera team will be assigned two locations to monitor over the course of the summer. After deconstructing the first traps, the team will travel to a second location and redeploy their camera traps in the second target location, following all the same guidelines for the initial installation of the season.

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Appendix VI: Wolverine Run-pole Camera Station Protocol

Developed by the North Cascades Wolverine Study (NCWS)
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Objectives: Camera survey results contribute important information on the current distribution of wolverines in our region. The primary objective for installing and operating run-pole camera stations is to detect any wolverines in the area and obtain the best possible photos of ventral blazes on the chest and throat. These markings are unique among individuals; thus, with good photos we are able to identify individual wolverines and determine how frequently they are detected and whether they are detected at multiple locations or during multiple years. This protocol follows the basic run-pole and camera set-up design developed and used by Audrey Magoun in Alaska (Magoun et al. 2011). However, this protocol does not include the hair-snag frame developed by Magoun et al. (2011). The frame they developed requires substantial effort to install and maintain, and has not been adequately tested in our region. Thus, when the deployment of hair-snagging devices is needed, we recommend that CNW volunteers use a simple gun-brush belt.

The run-pole sets should be constructed using natural logs (not milled lumber). When determined by the survey coordinator, a hair-snagging device may also be deployed at a run-pole camera site, as in many cases it will be important to collect genetic samples for DNA analyses. Regardless, to maximize the chances of detecting wolverines, the run-pole camera sites need to be kept as natural looking as possible with the minimum number of necessary detection devices.

Selecting a camera site: The objectives are to: 1) survey areas that are adjacent to the North Cascades Wolverine Study Area to document additional resident wolverines in the Cascade Range, and 2) survey areas that have a high potential of containing wolverines based on the

spring snow coverage developed by Copeland et al. (2010). Based on results from Copeland et al. (2010), and telemetry locations of wolverines monitored by the NCWS thus far (Aubry et al. 2012), wolverine occurrence in the northern Cascade Range of Washington is closely associated with those areas that have snow cover persisting into the late spring (mid-April to mid-May). The NCWS has provided CNW staff with a map of late spring snow cover to assist with locating the best areas in which to deploy run-pole camera stations for detecting wolverine.

Camera sites should be >100 m from regularly used snowmobile routes and ski trails, or other activities that may deter wolverines from approaching the area. The site must have at least a couple of trees that are of the appropriate size and distance apart for constructing and supporting a run-pole, hanging the bait, and setting up the camera according to the specifications below.

If possible, use Trail Watcher systems at all run-pole stations; i.e., these will be the cameras focused on the run-pole. Trail Watchers take higher resolution photos than Reconyx systems and have a flash that can be set to be "on" continuously. Trail Watchers enable us to obtain high-resolution photos during both the day and night. This increases our ability to identify individual wolverines, and our chances of determining the gender and reproductive condition.

Survey period: Run-pole camera stations should be operated for as long as possible during the winter months. Although run-pole camera stations have been successfully operated during the snow-free period in Washington and British Columbia, the probability of detecting a wolverine is greater during the winter than at other times of the year. There is no maximum survey period; thus, surveyors should continue to operate a station for as long as possible and regardless of whether a wolverine has been detected. It is not uncommon for an individual wolverine to revisit a site weeks or months later or for >1 wolverine to be detected at a single camera station.

Constructing the run-pole and setting up Trail Watcher cameras (see Figures 1 thru 8):

1. Pick a site with 2 suitable trees (1 for the run-pole and 1 for the camera system) about 10 feet apart for Trail Watcher cameras (Figures 1 and 2). If you must use a Reconyx system for the run-pole, the trees need to be about 11-12 feet apart. If the trees are too far apart, we won't obtain the best possible photos. The run-pole tree should be >11-12 inches in diameter (at breast height), and the camera tree needs to be sturdy enough to support the camera system (note that the camera will need to mounted on the bole of the tree above the height of the run-pole) and, more importantly, to prevent the tree from swaying too much in windy conditions. Also, it is best if the camera is not facing south (glare from the sun can interfere with the camera operation and quality of photos) unless there is enough canopy cover to block the sun. The bait is hung from an overhead horizontal braided steel cable (not rope) that is anchored to 2 nearby trees. You can use any 2 suitable trees that put the overhead cable in the right position, including the camera and/or the run-pole trees (Figure 3).

2. For the run-pole itself, use a log that is about 4 inches in diameter cut to 3.5-4 feet long

(so that when it is bolted to the tree, it will stick out beyond the bole of the tree about 3-3.5 feet). You want to be sure the run-pole is long enough that the wolverine doesn't try to climb up the tree past the pole, and then reach out from the tree-bole to the bait.

3. Attach the run-pole to the tree at a height that will be about 3 feet above the snow surface. The run-pole must be level (not at an angle) in order for the camera to take the best possible "straight-on" photo of the chest area (and so that the end of the pole does not obstruct the camera's view of the chest area). If the site will get a lot of snowfall, it will be difficult to get high enough on the tree bole to install the run-pole, bait, and camera (because bait and camera need to be higher than the run-pole). In that case, just install the run-pole as high as you can easily reach and then raise the height of the run-pole periodically during the winter as the snow pack builds. Use lag bolts and a cordless drill (take a couple of extra battery packs) to construct run-pole and for attachments to tree bole (much better method than nails or screwing in bolts by hand).

4. At the end of the run-pole, secure a 14-16 inch crosspiece (you can use a piece of the same log you made the run-pole from – shave off some wood at the end of the run-pole and on the underside of the cross-piece to create flat spots for a tighter, better-fitting joint). The crosspiece is critical to making this system work effectively, so make sure that it is attached securely and rigidly to the run-pole log!! The crosspiece provides a platform for the wolverine to stand on such that the front of their body is directly facing the camera.

5. Use another log to brace the run-pole. An angle brace (from run-pole to tree bole) is a preferable method, however, a vertical brace placed near the far end of the run-pole (Figure 2) is also acceptable as long as the base of the brace is on the ground and not resting on the snowpack (i.e., if there is snow on the ground when you install the run-pole, you'll have to dig down until you hit solid ground to secure a vertical brace). The run-pole has to be strong enough to hold the weight of a person (so you can stand on the run-pole to hang or change the bait) and sturdy enough to support a bear. A wolverine might use the brace to climb up to the run-pole (instead of approaching the run-pole by climbing up the bole of the run-pole tree), but that is okay as long the run-pole is constructed properly and the bait is hung properly.

6. The placement of the bait is critical for the run-pole stations to work properly. Hang the bait from a horizontal cable stretched and secured between 2 trees (Figures 1 and 3). Do not use rope as it will sag too much. From the horizontal cable, use another cable to hang the bait about **27-30 inches** above the run-pole and about **12 inches** in front of the end of the run-pole. Do not hang the bait any lower: the recommended height is specific for the size/length of wolverines in our area, and will force animals to at least look up (exposing the chest and neck area), if not stand up, to reach the bait. Do not hang the bait much higher because if it's too high, the wolverine may not even try to get at it; i.e., they will realize it is beyond their reach and may not go out on the run-pole or else spend their time climbing other nearby trees (which are outside of the camera's view) to try and access the bait. Ideally, we want the wolverines to

have to stand up to reach the bait (they should just barely be able to reach the bait when standing on their hind feet) not only to obtain photos of their throat and chest blazes, bust also enabling us to determine gender and reproductive condition. So you may need to adjust the placement of the bait once you get detections and can see how animals are responding.

7. Bait – use a piece of bait that has a large, dense bone in it (e.g., femur, skull, or pelvis). Drill a hole through the bone and run a 3/32-inch wire cable through the bait and bone to secure it and then hang the bait using the same type of cable. Do not use baling or rebar wire (single-strand wires will break as the animals pull and work on the bait and could cut the animal's mouth). The piece of bait does not have to be large. Even if martens or other animals eat all the meat, the bone will continue to put out scent. Also, make sure not to use a chunk of bait that will eventually have long pieces of hide or limb bones hanging down, as this will change the height of the bait, decreasing the chances that we will get diagnostic photos for identifying individuals, and may even block the wolverine from the camera's view (see Figure 4). The bait hanging from the horizontal cable should be the only bait at the camera site. However, we recommend that some lure be used at the site for an attractant and that you should refresh the lure during each site visit.

8. Set the camera high enough on an opposite tree (one that is no more than 10-12 feet away – see Figure 1) so that the field of view is squarely on the area just above the end of the run-pole and crosspiece. Take test pictures and make sure the head of the wolverine will not be cut out of the frame. Try to get the end crosspiece of the run-pole in the frame as well. Although the chest and head area are our primary focus, markings on the front feet of a wolverine can also be useful for distinguishing individuals (see Figures 5 and 6). A laser beam or pointer can also be used to help line up the camera.

9. Camera settings for Trail Watcher systems: Set flash to be ON at all times. Activity Mode = OFF. Set time delay to 5 seconds with 1 picture per event. The best sensitivity setting for the distance at which the camera will be from the end of the run-pole appears to be in the "low to medium" range (this will need to be determined in the field at each camera station). These cameras can take very high resolution photos (almost 4 MB each). 1-2 MB photos appear to have enough resolution for us to make individual ID and determine sex and reproductive condition. Only set the resolution higher than 2 MB if you know for certain that the camera card will not run out of room (remembering that you can obtain several hundred photos in a 2-week period).

10. Check time and date settings. Trail Watchers do not have an option for setting a time and date stamp on the photo. But the camera does have an internal clock, and you must make sure that is working properly so that the correct date and time are associated with the file properties for each image that is taken.

11. Take a photo of yourself next to the crosspiece at the end of the run-pole, and hold up a card with the station number written on it with a black sharpie (to make sure it can be

clearly seen in the photo). Before you leave the site, make sure the flash goes off (if the camera system at that station has a flash; e.g., Trail Watchers), and that the lens retracts.

12. If you have enough cameras to set up 2 at a site (1 as the run-pole camera [Trail Watcher] and 1 as a backup/general camera [e.g., Reconyx]), we suggest the 2nd camera can be used to capture a wider view of the site to document whether a wolverine might be visiting the site but not approaching the run-pole. See Figure 7 for an example of how to set-up this arrangement.

Operating camera stations:

1. After the initial set-up, check the camera station within 1 week (without fail) to make sure everything is working properly. Crews should always approach the camera stations carefully, checking for potential wolverine tracks and genetic samples (hair and scat; see #8 below) and avoid disturbing any potential wolverine tracks in the area.

2. After the initial 1-week check, check cameras every 2 weeks (3 weeks maximum) – do not check the camera or replace the bait more frequently than every 2 weeks. The bait needs time to age (like a carcass would), and a 2-week check schedule will also minimize disturbance at the site.

3. Every time the crew arrives at a camera station, have 1 person walk over to the end of the run-pole to trigger the camera and take a photo of that person before anyone checks the camera. Same process if there is also a Reconyx system at the site – make sure you trigger it before you check the camera. If a camera is not working, record that information on your data form so that there is a permanent record that the survey period was shorter than expected.

4. After arriving at a station and taking a check-photo, remove the memory card from each camera, enter the card # on the appropriate data form, and put in a fresh memory card. Do this every time regardless of whether there were any detections. Do not delete any photos – set-up and check photos along with detection photos are all very important. If you keep an accurate record all of the photos taken between camera station visits, including photos of the crew when they arrive to a station and then before they leave the station, that information can be used to help determine the probability of detecting a wolverine in this region (i.e., the detection rate).

5. Perform other necessary maintenance procedures including replacing batteries and checking date and time stamps. For Trail Watchers, we recommend that you replace the camera battery each visit and replace the 9 volt battery as follows: replace alkaline 9-volts every 2 weeks; replace lithium 9-volts every 2 months or sooner if temperatures fall below 0°F for an extended period (per A. Magoun recommendations). For Reconyx, record % battery remaining on the data form and then replace the C cells when battery-life is down to 75% (threshold that John Rohrer [NCWS] and his crew have been using).

6. Every time before the crew leaves the station, have the camera take a picture of 1 person standing next to the crosspiece at the end of the run-pole holding up a card with the station number written on it. This is a critical step to make sure everything is working properly and to get a photo with the station number on the memory card. If the camera is not working, the crew will need to troubleshoot any problems, and then repeat this step until the camera takes a picture properly. Perform this step for each camera deployed at the site.

7. During each camera check, field personnel should record all required information on the appropriate data form for each detection device before leaving the site. At the end of this document are the **Camera Station Data Forms** used by the NCWS: 1 data form for Trail Watcher cameras and another for Reconyx (see pages 13 and 14). These data forms can be used or modified by CNW, but show the type of information that is important to record at each camera station and during each camera-check visit. There are different forms for the 2 camera types because of differences in settings and the type and number of batteries that need to be maintained.

8. If there is evidence that a wolverine has visited the station (e.g., tracks or a photo-detection), the crew should carefully inspect the area around the station for scats and hair (see Figure 8). If a wolverine accesses the run-pole, there is a good chance that they left hair on the run-pole arm. So it is important to inspect that surface for potential hair samples to collect. Please collect any possible wolverine scats or hair according to the directions on the NCWS's **Genetic Sample Data Form** (see page 15). To prevent potential contamination of genetic samples, wear Nitrile gloves to collect samples and place them in collection bags or envelopes. Always use paper bags for scats (a separate bag for each scat) and paper collection envelopes for hair (never plastic bags which can trap moisture and ruin the samples for DNA extraction). When using a gun-brush hair-snagging device, place each gun-brush that has a potential sample into a separate paper envelope (or small paper bag).

9. Back in the office, immediately download all photos into separate folders (do not delete any photos from the memory cards for any reason). Create a folder for each camera station and camera device and subfolders for each check date. Example: if there are 2 cameras at Easy Pass (a Trail Watcher and a Reconyx) create 2 folders "EasyPassTW" and "EasyPassRx". If you have 2 of the same camera type at a station, name the folders as follows: e.g., "EasyPassTW1" and "EasyPassTW2". Within each of these folders, create subfolders for each camera visit. The subfolder name should be the dates that go with that camera check; e.g., Feb9-Feb19. Immediately back up images on a CD, DVD, or another hard drive.

10. Back in the office, immediately make a copy of the data form for each camera station that was checked.

11. Back in the office, immediately make sure any genetic samples that were collected are processed and mailed according to instructions on the **Genetic Sample Data Form** (see page 15). This includes using desiccant to remove any moisture from the samples; do not refrigerate

or freeze samples and do not place them in plastic bags for mailing. Notify CNW staff so that the samples can be mailed as soon as possible to Keith Aubry or Cathy Raley at the Pacific Northwest Research Station, Olympia, WA. The NCWS's **Genetic Sample Data Form** can be used or modified by CNW to record detailed data on each genetic sample collected by volunteers. If so, please include a copy of the completed form when sending labeled genetic samples to Keith or Cathy.

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Appendix VII: National Lynx Detection Protocol

Purpose

A variety of means have been developed to detect lynx and other carnivores. The purpose of this protocol is to add reliability, efficacy, and representativeness to the process of lynx detection. Each element of the protocol has been designed to achieve this end.

Representativeness. While it can be argued that selective sampling (where one goes to the "best" places and samples) may provide detections at lower cost, the data generated using these methods is much less valuable. Non-representative surveys at best can provide simple occurrence data. Other more meaningful metrics: where lynx are present and absent, the habitat relationships of lynx, minimum viable population estimates, and current range all require representative sampling. Hair-pad methods were chosen because they allow sampling during the snow-free period, are durable, inexpensive, and lightweight. A lightweight, inexpensive sampling scheme which could be implemented in the summer was a necessity for representative sampling. Areas that are dangerous or away from roads will not be representatively sampled in the winter, and very expensive or high-maintenance detection stations can only be placed at a few locations. Representative sampling requires unbiased and uniform placement rules for the sample points. To this end, the protocol is grid-based and uses simple placement rules which can be applied to most landscapes.

Efficacy. Even if sampling is representative, if detection rates are too low, the method will fail the test of efficacy. To address this, we tested 5 commercial scent lures on wild lynx in Canada to determine which

lure produced the highest detection rate. While all lures were "hit" by lynx, one lure, a combination of beaver castorium and catnip oil was twice as effective as the others. Additionally, we made use of transects to sample lynx in Canada. Over a 2-4 week period, we had hits on nearly half (35/78 = 45%) of these 5-station line transects. Based on these results, we use line transects and the most effective lure.

Reliability. Reliability is largely a product of effective and representative sampling, but there are additional properties that a reliable survey protocol should have. It should be reliable in the sense that if applied, it will produce interpretable results. At the finest scale (traditionally the scent station but, in our design, the transect) if a lynx is present in the area, the probability of detection should be as constant as possible. This allows the proportion of occurrences to infer use. At a larger scale, we want to reliably state that, given a certain level of effort, we will have detections if lynx are present, and therefore a lack of detections indicates a lack of lynx.

At the fine scale, placing scent stations 100 m apart and perpendicular to the major slope produces a structure that will be encountered by lynx moving through the country and removes small-scale differences associated with station placement. At a broader scale, the protocol requires placing no fewer than 25 transects at a density of 1 transect per every 2 miles for a period of 2-4 weeks to ensure that an area is adequately sampled.

Details

Broad decisions concerning where to sample

Decisions as to where to sample are based primarily on the interest of the managers. If grids (25+ transects) were placed randomly within a major cover type, the grids themselves would be a representative sample of the cover type. A manager may, however, need information about lynx in a specific area, and can place grids preferentially. In broken habitat, such as forested areas separated by low elevation prairie, dry forest types or deciduous forests not thought to be lynx habitat, or lands which have been converted to agriculture, the sampling does not need to conform to a rectangular grid. All that is required is that the placement within the lynx habitat be at a density of about 1 transect per every 2 miles. An easy way to accomplish this is to put a large 2x2 mile grid across the landscape and use only those points which fall into habitat as the sample. In all cases the grid should start at a random location. Do not move the grid to get the highest number of points in habitat. One approach that may work well is simply to use section boundaries as the grid. If these boundaries are not associated with vegetation changes, then they can be thought of as random. If, however, there are specific features that are generally associated with section boundaries, such as changes in forest age associated with "checkerboard" ownership patterns in the West, then section boundaries will not work, and you will need to start the grid at a random location.

As was mentioned above, managers can decide where to sample, but our recommendations are generally to sample in cover types and areas which there is some evidence of historical lynx occurrence. Maps of broad cover-types associated with historic lynx occurrence are available for the contiguous US. These cover-type maps, or local vegetation coverage, can serve as a guide for determining priority of survey

efforts. We would caution that, early in the process, deciding *a priori* that an area cannot support lynx without detailed local knowledge, is not without risk. If grids are designed as a representative sample of a particular cover type, sampling within this cover type provides no information about any other cover type. There will always be this trade-off: tight stratification rules will presumably increase the efficacy, but they limit the inference. Additionally, this grid-based approach works best and is most efficient in areas where cover types are reasonably contiguous.

Exactly how you resolve the relative importance of these two properties: efficacy vs inference, and hence how you stratify your landscape prior to sampling, will largely be a function of local knowledge, priorities, and vegetation patterns. Two examples may provide insight into this process. In the Superior NF a question of primary importance is: Do we have any resident populations of lynx? To answer this question, the Superior will be looking to place grids in those areas where they have the most recent evidence of lynx occurrence and where the habitat appears to be most suitable. In the Okanogan NF, the presence of lynx in the area studied by Koehler and Brittell is not in question. The Okanogan, therefore is placing grids in areas where they have some information that lynx occur, and would like to gather more data concerning these lynx. They are not, therefore, necessarily placing the surveys in the "best" areas, as is the Superior, but they are still only surveying in-and-adjacent-to cool wet forest types.

In all cases, we recommend avoiding multiple fine-scale stratification rules, and particularly rules not supported by scientific data. For instance, there is no evidence, particularly in the summer, that lynx use specific topographic features preferentially. Lynx telemetry locations are not found adjacent to creeks or on flatter topography more than expectation within the study areas. Employing such rules in landscape stratification radically reduces the ability to infer the sample to the landscape (because so much of the landscape will be outside of the strata) without any direct evidence that the rules will increase the sampling efficacy.

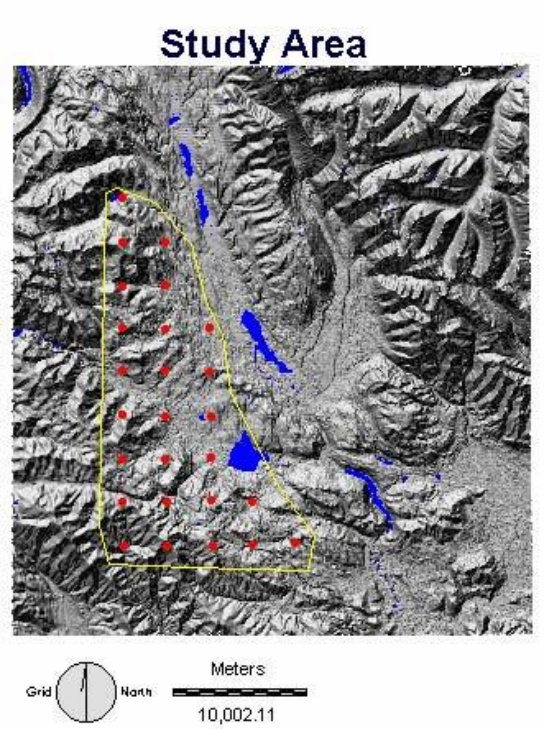
Working in conjunction with other survey efforts

Hair snagging can be used to compliment other survey methods, such as snow tracking. For instance, if snow tracks were found in an area, particularly where lynx were thought to be absent, then placing a grid across the area would potentially validate the snow tracks. If individual DNA identification was performed on the samples, the addition of a hair survey could provide information concerning the number of lynx in the area. Using snow tracking as a pre-sampling method to determine grid placement in no way invalidates the protocol. In many areas this is a very sensible approach.

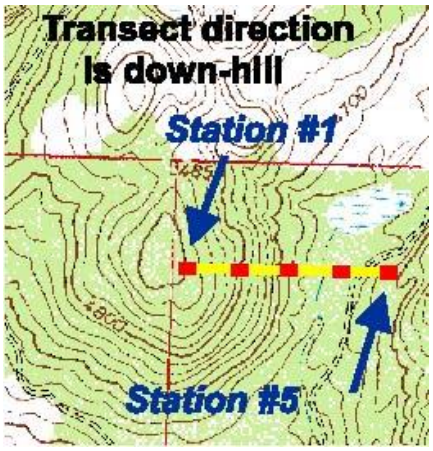
Non representative placement of transects, or even individual scent stations can sometimes provide useful information. For instance, if a lynx is known to exist within a specific drainage, one might want to specifically sample the drainage to try to determine whether the lynx is still present, or to obtain a sample of its DNA for research purposes. Similarly, scent stations can be used as a double-sampling method to directly validate snow tracks (as camera sets have been used in the past). These non-representative surveys, however, are entirely exterior to the National Survey Protocol, and we are doing no testing which can directly be used to indicate their efficacy. Additionally, as mentioned above, these data are extremely limited in their utility. They cannot, for instance, be used to infer anything about habitat

relationships, the spatial extent of a local population, or the absence of lynx within a specific area. We therefore strongly recommend that these methods only be used to answer very specific questions in very specific areas. In most cases, laying a grid of transects across an area of interest will provide more usable information and is a better allocation of resources.

Selection of sites and station positions



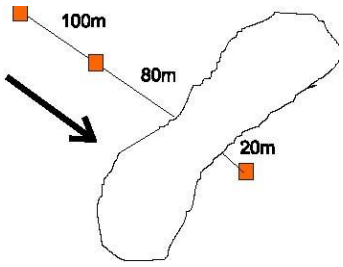
Each survey consists of placing 25 sites within a predetermined study area. Place sites 2.0 mi apart in a grid fashion with the beginning of grid randomly located. Each site consists of one transect with 5 stations spaced 100 m apart and directed downhill. In areas lacking any measurable slope, transect direction can be random. Ideally, transect length is 400 m, however when transects encounter human development, natural openings, meadows, new clear-cuts, ponds or small lakes, breaks in transect may occur and increase the overall transect length. If these breaks cause over-all transect length to exceed 1 km, part of the transect can be run uphill from the starting location (with the same rules concerning meadows, water etc.). If the overall transect length is still longer than 1 km, relocate the starting point to a location not further than ½ km of the original start, then repeat the protocol. If the relocated transect still encounters too much human development, open water, meadows, etc., then remove the site from the grid and locate the transect at the next closest grid location. It is best to accomplish this task using aerial photo and topographic maps prior to going into the field.



Locate the 1st station at the point indicated by the 2x2 mile grid and locate the remaining stations (n=4) 100 m apart in a straight line and directed downhill from the 1st station. Only place stations in >10% tree cover (eye level and above). When you encounter natural openings, meadows, new clear-cuts, ponds or small lakes that exceed 30 m in width while walking transects, do not include the distance across these open areas as part of the 100 m between transects (Fig 3). For example, stop counting your steps when you enter an open area, then continue your count when you exit the open area. When you encounter roads (or other developments) place station on the other side of the road and out-of-sight.

Figure 2. Transects are located downhill from the position of the site. Stations are 100 m apart.

Figure 1. Example demonstrating placement of sites. Yellow line is area of interest. Red symbols are location of sites with 2-mile spacing.



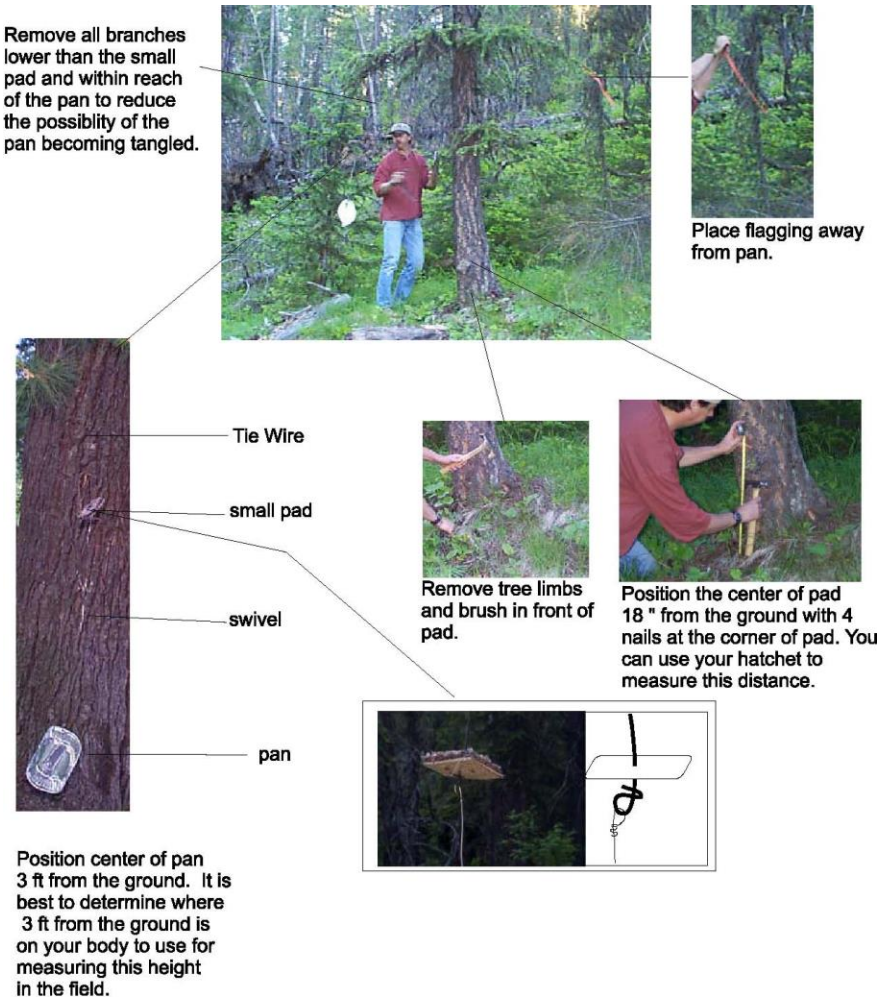
Keep good notes on the location of sites. Record directions to the site and the bearing of the transect line. If breaks or changes are made in the transect, make notes on these changes. Good records can save hours of searching when you revisit the site. If the site is close to a road, then flag where you leave the road to go to the site; this will help you when you return.

Construction of scent stations

Select a tree that is large enough to nail the hair snare onto; preferably one that has a good canopy, few low branches and shrubs. A good tree canopy will assist in keeping rain off the carpet pads. Clear all brush and branches 5 ft from the ground on the side of the tree where you will put the hair-snare. Your objective is to reduce or eliminate any obstacles for lynx to enter, rub on the hair-snare, and exit.

Nail a hair-snare onto the tree with the center of the hair-snare about 18 in from the ground. Your drywall hatchet is about 15 in long and can be used to make quick measurements in the field. Use 4 shingle nails – one at each corner of the pad. Hang a small carpet pad from a nearby tree branch (5 ft from the ground). The best placement is within sight of and at about 9 ft from the hair-snare – no more than 15 ft. First, select a tree branch that is at least 6 ft from the trunk of the tree, as high as you can reach and with few obstructions below the branch. You will probably need to cut brush and other branches that might tangle the pie-plate. Then, cut off the amount of wire that is needed. Push the wire through the center of the small carpet pad (2.5 X 2.5 in) provided in your kit using a twisting motion. Gently putting pressure on the wire is better than brute force here because the wire can easily buckle. Twist the end of the wire in a single loop below the pad to hold the pad on the wire.

Figure 3. Example showing a transect crossing an open area. One hundred meters were measured between 1st and 2nd station; then 80 m was measured from 2nd station and edge of an open area. The open area was crossed without measuring distance and 20 m was measured on the far side to get to the 3rd station.



Hang an aluminum pie-pan (8-9 in diameter, center 3 ft from the ground) with the attached wire and swivel from the loop below the carpet pad. Make sure the wire loop below the carpet pad is closed so that the wire on the pie-pan can not jump out of the loop. The pie-pan should already be shaped in an S-shape, but re-shape it if necessary. In addition, make sure that the wires are straight.

Figure 4. Construction of a scent station.

Clear branches away from the pie-pan so that it will not get tangled. Place flagging near the station so you can easily relocate the site. Do not hang flagging on the same branch as the pie-pan because the pie-pan will get tangled with the flagging. Using permanent marker, write the station number on the flagging and pie-pan. This will help in relocating stations. Often, the second station is relocated first and misidentified as the first station.

Baiting hair-snares

It is best to prepare hair-snares before going into the field. Place hair-snares and small carpet pads on a table. The lure is already pre-mixed. Thoroughly shake or stir the lure. Put 2 teaspoons (1/3 oz) of the lure on each hair-snare and 2 teaspoons of the lure on each small carpet pad. Spread out the lure on the pad as much as possible. Squeeze dried catnip between your thumb and fingers to help release the odor and sprinkle onto the hair-snare. The amount of dried catnip per pad is the maximum the pad can retain once it is lifted vertically, usually about 1 teaspoon. No dried catnip is put onto the small carpet pad that is hung from the tree branch.

Bait ingredients:

1:1: 6 ratio of propylene glycol, glycerine and beaver castorium. Six drops per oz of catnip oil was added to this mixture.

Figure 5. Put 2 spoons of mixture on hair-snares and 2 spoons of mixture on small pads. Note that small pads are not shown in this picture.

Habitat Measurements

Record topographic features using a clinometer for slope and a compass for aspect. Make sure your compass has been adjusted for declination between true and magnetic north (declinations are provide on USGS topographic

maps). Provide elevation at stations using the most accurate source available. Record over-story species and a visual estimate of over-story cover within approximately 30 ft of station. Likewise, provide understory shrub species and a visual estimate of shrub cover within approximately 30 ft of stations. Give a visually estimated dbh of a typical over-story tree species.

Safety Precautions

Bears are attracted to bait used at these stations and may become defensive by treating the bait as a food source. Extra precaution should be taken if possible bear encounters exist. Often bait gets on your hands. Avoid cleaning your hands on your cloths. Excess bait on your hands can be removed by rubbing them in dry dirt. Avoid getting bait on your pack. Garbage bags are provided to line the inside of your pack. In addition, 2-gal sealed containers are provided to transport baited hair-snares and pads in the field. Often bait will accumulate on the outside of the 2-gal containers. Occasionally clean the outside of these containers to avoid spreading the bait to other items in your pack. Do not transport other items besides hair-snares, pads and pie-pans in these 2 gal containers.

Checking stations for lynx hair

Check stations for lynx hair after a 2-week period. Take notes on tracks that you find at stations, condition of the station such as if pie-pan was tangled, or any other observations. Look for hair at a distance of 1 foot from the pad. Most hair is not noticeable at greater distances. You need to know what a carpet fiber look like so that you do not misidentify it as hair. If you intend to run stations longer than the initial 2-week period then re-bait station and check again after another 2-week period using the same procedures as was used to set up the station except apply only 1 teaspoon of lure per pad instead of 2 teaspoons. When you find hair, put the pad in a plastic bag using surgical gloves and mark bag with the survey location, date, site and station number, and the name of observer. If you are running the stations for an additional 2-week period, replace the pad with a new one baited with 2 teaspoons of lure and catnip. After returning to an inside work area then remove as much hair as possible from the pad into a sealed plastic vial with desiccant using tweezers and clean surgical latex gloves. Be sure that you do not touch the hair with your fingers. Oils from your fingers will inhibit genetic analysis. While working with hair samples, maintain a clean environment such as to avoid cross-contamination of hair samples. Label samples with your initials, survey location, site number, station number and date. Keep the hair-snare in the plastic bag and store it and the sealed plastic vial in a cool dry place (IMPORTANT: do not freeze).

Appendix VIII: Individual Sites with GPS Coordinates (available only upon request)