CITIZEN WILDLIFE MONITORING PROJECT

2016 FIELD SEASON REPORT

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Prepared by:

Laurel Baum, Program Coordinator
Conservation Northwest

David Moskowitz, Technical lead
Wilderness Awareness School

Tanner Humphries, Project Intern
Conservation Northwest

Aleah Jaeger, Past Program Coordinator
Conservation Northwest

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EXECUTIVE SUMMARY

For over a decade, the Citizen Wildlife Monitoring Project has used remote cameras and snow tracking to conduct research related to the study of Washington's rare and sensitive wildlife through citizen science. The Citizen Wildlife Monitoring Project has also been engaged in monitoring wildlife presence and activity in critical areas for wildlife connectivity, conservation, and habitat, primarily in the Interstate 90 (I-90) corridor in the central Washington Cascades.

Citizen scientists contribute valuable new information about the presence and patterns of wildlife in our state. Our project efforts cover geographic areas beyond those of ongoing professional research efforts, supplementing and strengthening the work of involved agencies, biologists, and other collaborators involved in our Advisory Council.

During the 2016 season, 82 volunteers in the Citizen Wildlife Monitoring Project installed and maintained installations in 27 survey areas in Washington and British Columbia. Our survey areas focused on monitoring in Washington's Cascade Mountains and the Kettle River Range in southeastern British Columbia and Ferry County, Washington, in the US. The main objectives for the 2016 field season were to: 1) detect the presence of gray wolf (*Canis lupus*) in the Southern Cascades, 2) detect the presence of wolverine (*Gulo gulo*) in new locations and continue to monitor known populations in the North and South Cascades, 3) attempt to detect grizzly bears (*Ursus arctos horribilis*) in the North Cascades Grizzly Bear Recovery Zone (Appendix I), 4) monitor the presence of a wide variety of species of wildlife between Hyak and Easton adjacent to the I-90 corridor, 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 (listed in Acknowledgements), we established nine survey areas in the North Cascades, three survey areas in the I-90 corridor, and eleven survey areas in the South Cascades (regions are defined on pages 5-6 of this report). There were also four survey areas in the transboundary Kettle River Range for lynx monitoring this season. Our partners at Selkirk College in British Columbia maintained one survey area on the BC side of the border, while program volunteers managed three survey areas on the Washington side of the border.

Over the course of the 2016 season, we detected twenty recordable species. Highlights from this field season include:

- The continued documentation of wolverines in the Cascades. These wolverines appear to be on the front lines of recovery for the species in our region. Our citizen science teams documented wolverines at Union Gap and Chiwawa in the North Cascades. Union Gap had thirty-two wolverine events (see pg. 15 for description) and Chiwawa had two events. Due to highly degraded trail access associated with wildfires and subsequent trail erosion in recent years, the Ice Lakes survey area, which has had high detection rates in the past, was not re-installed in 2016.

- The Chiwaukum survey area, primarily set to detect wolverines, has for two years running, captured gray wolf events. The first of ten detection events took place over a period of two days in April. The animal documented in April was fitted with a GPS collar and determined by our advisers at Washington

Department of Fish and Wildlife to be a member from the Teanaway pack.

- Although our teams recorded no Canada lynx, this August our partners with WSU were successful in documenting the first Canada lynx in the Kettle River Range in Washington[1]. We are awaiting results from the Rossland Range North of the border, which has been successful in documenting Canada lynx in prior years. These efforts contribute to furthering our collective knowledge and conservation efforts to protect this rare and sensitive species.

- Fishers were documented at two survey areas: Bumping Lake and Lone Butte. While these individuals, as part of the fisher reintroduction efforts in the Cascades of Washington State, have internal radio transmitters providing location information, the photo documentation provides our partners with WDFW visual evidence of the health of the animal at the date the photo was taken. We expect our efforts to play a role documenting the presence of offspring from the reintroduced adults that do not carry locating devices in the coming years.

- American martens were recorded at six different survey areas in the Cascades, a sign of late successional forest habitat nearby where martens often den and hunt. While not a target species for our project, data collected on martens is shared with our Advisory Council members carrying out research on martens.

- Our cameras documented a high diversity of recordable species at twelve survey areas this year. Seven of the survey areas were located in the South Cascades; Blue Lake Ridge and Manastash documented nine species; Bumping Lake, Lookout Mountain, and Taneum recorded eight species; Rimrock Lake and Cliffdell documented seven different species. Our Chiwaukum survey area, in the southern portion of the North Cascades, documented eight different species, including a target species, gray wolf. In the Kettle River Range on the Washington side of the boarder, Colville recorded nine species, Sherman and Kettle range recorded eight different species. High-diversity survey areas documented these species: Gray wolf, fisher, mountain lion, black bear, marten, bobcat, coyote, moose, mule deer, elk, Hoary marmot, striped and spotted skunk, raccoon, porcupine, snowshoe hare and smaller mammals.

- Animals documented at I-90 survey areas for the 2016 season were of particular interest due to the completion of two wildlife underpasses at Gold Creek in 2014 and the increased opportunity for movement of wildlife. Easton recorded presence of seven different species in habitat adjacent to the highway. Highway crossing structures are located within close proximity to these survey areas, the presence of high species diversity serves as an example of crossing structures' utility for wildlife safely travel under I-90. Since the underpasses have transitioned to a restoration phase, we expect to see wildlife making more use of them and areas adjacent to them. As construction continues for the overpass, we will continue to pay especially close attention to wildlife activity nearby.

The work of our volunteers through the Citizen Wildlife Monitoring Project increases our understanding of wildlife on the Washington landscape and in the transboundary region between Washington and British Columbia. Not

[1] http://www.conservationnw.org/news/updates/lynx-photographed-in-washingtons-kettle-range/

only does visual documentation of species influence research and policy decisions, these images create a narrative and a face for our wildlands; the Citizen Wildlife Monitoring Project emphasizes the importance of monitoring and conservation efforts to ensure a stable landscape for our region's wildlife.

PROJECT OVERVIEW

Over a decade ago, Conservation Northwest began using citizen science as a way to fulfill our mission to protect and connect wildlife and wildlands from the Washington Coast to the BC Rockies. We continue to train and deploy over a hundred citizen scientists each year throughout our mission area with the Citizen Wildlife Monitoring Project (CWMP). This project uses remote cameras and snow tracking to document the presence and behavior of rare and sensitive species throughout core areas as well as the presence of more common species in strategically important locations. Since its inception, CWMP has remained an asset to wildlife agencies and professionals by providing valuable data from 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 about 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 camera monitoring 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 the exchange of information about 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 Mountains through a collaborative effort, formalized in 2006, between Conservation Northwest, the I-90 Wildlife Bridges Coalition, and Wilderness Awareness School. Throughout each monitoring year, all three organizations lead a faction of the project: Conservation Northwest acts as the main volunteer coordinator for all efforts and leads remote camera monitoring beyond the I-90 corridor in the North and South Cascades. The I-90 Wildlife Bridges Coalition and Wilderness Awareness School provide in-kind and financial support to the project for activities associated with the I-90 corridor.

CWMP has enhanced its positive impact through an Advisory Council (listed in Acknowledgements) made up of project partners, government agency biologists, and professional researchers. Our Advisory Council provides valuable input to the review of our program; it also steers our yearly monitoring objectives and site locations. Council members assist in developing our protocols, confirm identification of priority images from the season, and provide a scientific audience for results gained in the field, ranging from hair samples to tracks. These collaborations between project partners and advisers 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.

CWMP's monitoring efforts are broken into two projects: remote camera monitoring (annual monitoring with heavier effort from May-October) and snow tracking along I-90 (December-March). At the culmination of each project, a monitoring report is prepared and made public through Conservation Northwest's website (http://www.conservationnw.org/what-we-do/wildlife-habitat/wildlife-monitoring). This report focuses on our results from the 2016 remote camera monitoring year.

This year, we concentrated our study area in two distinct landscapes – the Cascade Mountains in Washington and the transboundary Kettle River Range. Within the Cascade Mountains, we have divided the study area into three regions:

1. North Cascades: North of Interstate-90
2. I-90 Corridor: Between Hyak and Easton along I-90
3. Southern Cascades: South of I-90

At the start of each year, 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 2016, our 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 determined in response to identified high-quality habitat where wolves are expected to expand their existing range.
2. Document the presence of wolverines (*Gulo gulo*) in the North and South Cascades, outside of the geographic scope of the ongoing North Cascades Wolverine Study.[2] In addition to visual documentation through remote cameras, these sites are set up to collect valuable genetic information for wildlife agencies.
3. Document grizzly bears (*Ursus arctos horribilis*) in the North Cascades Grizzly Bear Recovery Zone.
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 as part of the I-90 Snoqualmie Pass East Project.[3]
5. Detect transboundary wildlife activity between northeast Washington and British Columbia with a specific

[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

focus on documenting and collecting genetic information from 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 has placed a major focus on wolf recovery in Washington. As of December of 2016, Washington is home to 20 confirmed wolf packs, with the new Sherman pack confirmation in the spring of 2016[4] and the Touchet pack in late 2016. The Washington Department of Fish and Wildlife updated their 2016 Annual Report in March of 2017 to reflect the state's most up-to-date wolf count, with at least 115 wolves calling Washington State home at the end of 2016[5]. Conservation Northwest partners with the Washington Department of Fish and Wildlife to implement the state's wolf conservation and management plan, developed in 2011[6]. In addition to shaping wolf policy in Washington, through CWMP, Conservation Northwest provides on-the-ground data used to better understand the distribution of wolves across the state.

The Wolf Conservation and Management Plan identifies three recovery zones in Washington: Eastern Washington, the North Cascades, and the Southern Cascades and Northwest Coast.[7] 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. As of 2016, none of Washington's 19 wolf packs have been documented in the Southern Cascades and Northwest Coast recovery zones, while 16 are present in the Eastern Washington recovery zone. In 2016, CWMP focused all of its wolf monitoring efforts in the state to detection south of I-90 in the Cascades portion of the Southern Cascades and Northwest Coast recovery zone. Installations were located in areas of predicted high quality wolf habitat or in response to specific anecdotal reports of potential wolf activity within these recovery zones.

WOLVERINE MONITORING

The largest terrestrial members of the weasel family, wolverines are among the rarest carnivores in North America.[8] They prefer alpine environments where snow packs persist into late spring. Perhaps because they live in these harsh environments where food is scarce, wolverines are extremely mobile carnivores with home ranges between 100 km² to over 900 km². This means they typically live in low densities across large landscapes.[9] After

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4 http://wdfw.wa.gov/conservation/gray_wolf/packs/21/

5 http://wdfw.wa.gov/conservation/gray_wolf/packs/annual_survey.html

6 http://wdfw.wa.gov/publications/00001/

7 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).

8 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.

9 Banci, Vivian. "Wolverine." In *The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States.*, edited by Leonard F. Ruggiero, Keith B. Aubry, Steven W. Bushkirk, Jack

near eradication from the lower 48 states in the 1900s, wolverines have begun to recover in areas such as the North Cascades, and, since 2005, state researchers have identified a dozen individual wolverines. Much is still unknown about these rare and elusive species, and CWMP is helping to collect more information.

Though conservation groups have pursued listing the wolverine as endangered 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 determined that the species did not warrant federal protections.[10] In response to the negative finding from USFWS, conservation groups have filed a lawsuit against the government to continue to pursue protection[11]. Conservation Northwest and other organizations are pushing decision-makers to create state and federal safeguards for wolverines as they recover across Washington and other parts of the lower 48 states.

Through CWMP monitoring activities, Conservation Northwest will help shape recovery and critical habitat plans for wolverines in Washington, inform land management decisions, and build upon ongoing research in the Cascades. Our goals for wolverine monitoring in 2016 were to 1) document the presence of wolverines in the southern portion of the North Cascades and the South Cascades, 2) collect definitive evidence of wolverines on the western side of the North Cascades in the Mount Baker vicinity where anecdotal reports of sightings and tracks have been made for a number of years, and 3) collect genetic data through hair samples to help identify individual wolverines at all of our wolverine monitoring locations. In 2016, our wolverine monitoring continued in the Chiwaukum and Blackjack Mountains and Union Gap survey sites where our remote cameras have documented at least five individual wolverines to date. We also established locations at Joe and Alaska Lake in response to potential high reliability sightings. To ensure that our efforts add to existing research, we maintain sites that lie outside of the current study area established by the North Cascades Wolverine Study and focus on locations where ongoing researchers have made specific requests to complement their efforts. A few of our volunteers have also become involved and are sharing data with us from the Multi-State *Gulo gulo* Study through their survey area at Mountaineers Creek. All highlights and data associated with that project will be reported on and communicated through the Multi-State Study. We look forward to providing support and continued collaboration with larger regional studies such as this one.

GRIZZLY BEAR MONITORING

At one time grizzly bears (*Ursus arctos horribilis*) roamed throughout the wild areas of Washington. After 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[12]. In 1997, the North Cascades, along with five other recovery zones, was

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L. Lyon, and William J. Zielinksi, 99–127. Fort Collins, Colorado, USA: USDA Forest Service Technical Report, 1994.

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

[11] Federal Agency Ignores Best Available Science in Decision Not To List Wolverine: http://www.conservationnw.org/news/pressroom/press-releases/federal-agency-ignores-best-available-science-in-decision-not-to-list-wolverine

[12] Grizzly Bears and the Endangered Species Act, *National Parks Service:* http://www.nps.gov/yell/learn/nature/bearesa.htm

identified as a key area for recovery of the endangered bear species.[13] Now, 20 years 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 for recovering grizzly bears in the North Cascades[14].

Despite anecdotal reports of grizzlies in the North Cascades, no population or individual has been confirmed in the area since 1996[15]. 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[16]. As of 2012, the British Columbia Ministry of Environment estimates there are six grizzly bears in the Canadian North Cascades[17].

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)[18]. The efforts of the CCCP covered approximately 25% of the NCE and did not detect photographic or genetic evidence of grizzly bears in the study area. Continued monitoring in the area assists the National Park Service and the U.S. Fish and Wildlife Service in evaluating options for grizzly bear recovery in the region. CWMP's effort to detect grizzly bears in the NCE was designed to complement the work already carried out by the CCCP. Survey locations 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).[19] CWMP's field protocol adapted 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 were to collect information on the genetic structure of carnivore populations in the NCE and to detect grizzly bears and other rare carnivores. CWMP's primary research goal is detection of grizzly bears.

I-90 CORRIDOR MONITORING

I-90 acts as a major barrier to wildlife traveling north and south in the Cascades. Results from a large-scale connectivity analysis designate a narrow corridor along Interstate 90 to be particularly crucial for wildlife

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

14 North Cascades Ecosystem Grizzly Bear Restoration Plan/Environmental Impact Statement: http://parkplanning.nps.gov/projectHome.cfm?projectId=44144

15 http://wdfw.wa.gov/conservation/endangered/species/grizzly_bear.pdf

16 U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form: http://ecos.fws.gov/docs/species/uplisting/doc4748.pdf

17 British Columbia Grizzly Bear Population Estimate for 2012: http://www.env.gov.bc.ca/fw/wildlife/docs/Grizzly_Bear_Pop_Est_Report_Final_2012.pdf

18 Cascades Carnivore Connectivity Project Grizzly Bear Survey: http://www.cascadesconnectivity.org/research/grizzly-bear-survey/

19 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.

passage.[20] In an effort to create a more permeable interstate, the Washington State Department of Transportation has developed a 15-mile highway expansion project called the I-90 Snoqualmie Pass East Project, which includes measures for safer wildlife passage. Multiple crossing structures, including overpasses, are slated for construction within the next five years[21].

Our project has worked in concert with the Washington State Department of Transportation and Western Transportation Institute for close to a decade to monitor wildlife activity along I-90 within the project area. Through remote camera monitoring and snow tracking, CWMP has provided valuable data informing the I-90 Snoqualmie Pass East Project throughout its planning and implementation phases. During the 2016 monitoring season, the wildlife underpasses at Gold Creek and Rocky Run were in the post-construction phase and beginning habitat restoration within and adjacent to the crossing structures. In September of 2016, construction of the first archways for the Keechelus Lake Wildlife Overcrossing began, with the completion of the overcrossing structure projected for 2018[22]. Our goals for CWMP in 2016 along I-90 were to document wildlife activity at habitat adjacent to the completed wildlife crossing structures as well as presence of wildlife in areas relevant to future phases of the project.

TRANSBOUNDARY LYNX MONITORING

Washington is home to one of the largest populations of Canada lynx in the continental United States.[23] Much like the history of wolverines in our state, lynx were targeted for the fur trade in the 1800s and early 1900s, and hunting pressure along with habitat decline reduced their numbers drastically in Washington. Because 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 approximately 3,800 km^2 of available habitat.[24] Researchers have documented the dispersal of lynx across the Canadian border in northeastern Washington.[25] Since wildlife travel 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.

Over the past several years, Conservation Northwest has piloted approaches to extend our monitoring efforts into the transboundary Kettle River and Rossland Ranges in Washington and British Columbia at the southern end of the Monashee Range. These efforts, aimed at documenting the presence of lynx and collecting genetic

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[20] I-90 Wildlife Bridges Project description and connectivity analysis: i90wildlifebridges.org/project-info

[21] I-90 Snoqualmie Pass East Project Final Environmental Impact Statement: http://www.wsdot.wa.gov/Projects/I90/SnoqualmiePassEast/Finaleis

[22] http://i90wildlifebridges.org/construction-begins-on-first-wildlife-overpass-on-i-90/

[23] Derek W. Stinson, *Washington State Recovery Plan for the Lynx* (Olympia, WA, USA: Washington Department of Fish and Wildlife, 2001).

[24] 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.

[25] 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.

information on individuals outside of ongoing agency research in the Cascade Mountains.

Our major objectives for 2016 lynx monitoring in British Columbia were to 1) document the presence of lynx in the transboundary Kettle River Range between British Columbia and Washington and 2) collect genetic data from hair snags placed at each remote camera installation to increase our understanding of lynx in this area, and their relation to adjacent, better-studied lynx populations in the Rockies and Cascade Mountains.

In the fall of 2016, we collaborated with Lui Marinelli and students from Selkirk College in British Columbia, who maintained three lynx monitoring installations in Rossland Range, BC. These cameras, installed in October of 2016, are currently active on the landscape. Additionally, our project volunteers installed and maintained eleven camera installations on the Washington side of the border. Through our program, we hope to provide support and to supplement a larger lynx monitoring effort being established by our partners with Washington State University in 2017.

METHODOLOGY

CWMP is an entirely volunteer-based project supported by Conservation Northwest staff, interns, and other project partners. Though our winter monitoring season includes snow tracking techniques along I-90, the majority 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 have been used as a significant, non-invasive research tool in many projects worldwide.[26] 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 provides invaluable data on the presence of rare and sensitive species. Some of our camera installations also include devices for collecting hair samples.

STUDY AREA

Our primary geographic focus for 2016 was the Cascade Mountains in Washington, while continuing a limited effort in the transboundary Kettle River Range. To further delineate core habitats and to give geographic context to our installation selections, we have defined our study area by the following boundaries:

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

[26] 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).

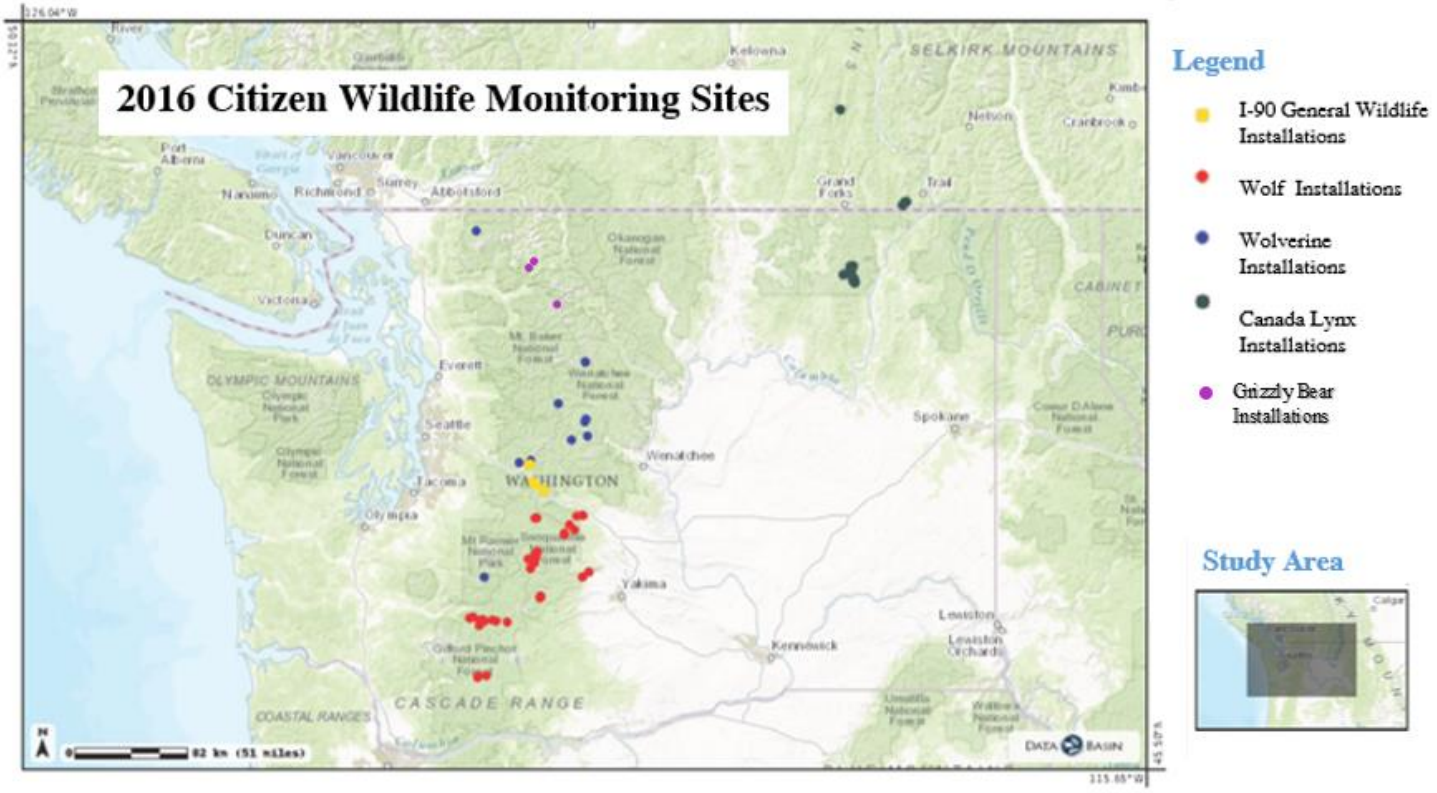

Figure 1: Locations of all 2016 camera installations specified by target species: I-90 general wildlife, wolf, wolverine, Canada lynx, and grizzly bear.

SURVEY AREA SELECTION

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

Each survey area is chosen for a particular target species based on our monitoring objectives for the year (Figure 1). Our project staff works with specific advisers from our Advisory Council to develop survey area descriptions that include the purpose of the survey area, special considerations, and general information that our volunteers use to help select specific installation locations and camera trap design within the general survey area they are charged with monitoring.

Throughout the season, the field knowledge and experience of our volunteers help the CWMP staff and Advisory Council reassess each survey area based on data gathered during the season. Because of their consistent presence in core habitat, volunteers provide invaluable feedback about the best survey area locations, current field conditions, and habitat.

Over the course of the 2016 field season, our volunteers placed cameras at 23 survey areas throughout our study

area in the Cascade Mountains and four survey areas in the Kettle River Range, one of which was on the Canadian side of the border. Each survey area had between one and eight discreet camera trap installations spread out spatially and/or temporally throughout the survey area, with a total of 82 unique camera installations. Based on guidance from our Advisory Council, ten of the Cascade Mountains survey areas focused on documenting wolves, eight focused on documenting wolverine, two focused on documenting the North Cascades grizzly bear, and three were dedicated to documenting species along I-90. The remaining four Kettle River Range survey areas focused on detecting lynx.

CAMERA INSTALLATIONS

Depending on the target species and location of each survey area, remote camera installation setup can vary. CWMP follows specific protocols for remote camera installations based on the target species or monitoring activity. All installations targeting wolves or I-90 structures have a similar setup that includes motion-triggered cameras secured to trees with scent lure applied nearby, unless specifically instructed otherwise (Appendix II). Generally, two cameras are placed within the same designated area, spaced far enough apart to potentially capture different individual animals (spacing varies depending on the target species or monitoring goals for the survey area).

Installations 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 installations (Appendix III). Cameras are positioned to capture bears as they smell and explore the brush pile and lure. Though these installations do not include hair snagging devices, if grizzly bears are suspected to have visited the installation, volunteers are instructed to collect hair if available.

The majority of installations targeting wolverine have a setup conducive to capturing visual documentation of their chest blazes (Appendix IV). These installations, called run-pole stations, are constructed with natural materials on-site. Wolverine run-pole stations include two cameras: a run-pole camera, set directly across from the run pole, and a vicinity camera, off to the side. These cameras are accompanied by bait, strung strategically above the run-pole. The hope is that the wolverine will stand on the run-pole and look up at the bait, allowing the run-pole camera to document its chest blazes. Wild bait (deer, elk, etc., often from road kills) is preferred for these installations. However, in cases where wild bait is unavailable, bait is purchased at butcher shops. In addition to the bait, each installation designated for wolverine detection is equipped with snags for hair collection as well as a scent attractant. Though individual wolverines can be identified visually from chest blaze photographs, DNA analysis is important to confirm individuals and retrieve additional information. The hair snag system that 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 immediately sent for lab analysis.

Installations targeting lynx follow a national protocol developed in 1999 by McKelvey et. al (Appendix V). In addition to having remote cameras, these installations are also equipped with hair-snagging devices and scent stations designed to attract lynx for DNA analysis. We use a special mixture of glycol, glycerine and beaver castorium as recommended by McKelvey et. al. Scent stations also include catnip that prompts lynx to rub on the hair-snagging devices. In addition to using scent to attract lynx to installations, volunteers are encouraged to hang

shiny material from an overhanging limb.

During the 2016 season, the majority of our remote cameras were Bushnell Trophy Cam XLT, with a few installations employing Reconyx RC55 or RC60. Camera settings are standardized for comparability across the study area as outlined in the protocols (Appendix II). Volunteers are trained in camera installation and maintenance prior to each season at a training held by project staff.

All installations, regardless of target species, are marked with a scent lure (with exceptions made in the I-90 corridor where the proximity of the installation 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 interact with other individuals within the same vicinity.[27] Scent lure mimics this natural mode of communication and acts as an attractant, bringing individual wildlife to the remote camera installation. The application of scent lure or bait in our project adheres to guidelines established by our Advisory Council.

SPECIES PRIORITIZATION

Though each survey area is established with a specific target species in mind, data 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 installation during the season are immediately reported to project staff for confirmation and further communication.

The priority listing for our 2016 season is as follows:

Level 1
Wolverine
Fisher
Lynx
Wolf
Grizzly bear
Mountain red fox/Cascades red fox

Level 2
Cougar
Marten
Mountain goat

Level 3
Beaver
Black bear

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

Bobcat
Coyote
Elk
Hoary marmot
Mule deer
Moose
Raccoon
Striped Skunk/ Spotted Skunk
Porcupine
Snowshoe hare and smaller mammals (squirrels, rodents, American pika)
Livestock (cow and sheep)
Human (non-volunteer) includes: domestic dog with human, horse and rider, bicycle, and vehicles

RESULTS AND DISCUSSION

During the 2016 monitoring season, data was collected year-round with the majority of the cameras deployed from May through October. Over the course of the season, 27 survey areas were established and maintained by project volunteers. These survey areas were strategically positioned throughout the Cascade Mountain Range, northeastern Washington, and into the southern regions of British Columbia. The following results cover all of the mammal species detected on our camera traps, including all events involving priority species for the project as outlined above. Only species falling within the three priority levels are included. Due to increasing interest in the interaction of wolves and livestock in Washington, any observed domestic livestock and human activity has also been included in this analysis.

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 given area. In addition to assessing species richness, we assess the number of observed events of identified priority-level species per study area. 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 installation with no gap greater than five 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.

Results for this year are organized by target species, as in 2015. The number of discreet remote camera installations at each general geographic survey area and the total number of trapnights is reported below as an index of relative survey effort in each area. Camera Installations may be moved to a new location for a number of reasons and are left to the volunteers' discretion; for example if non-volunteer humans discover the camera, the location may be moved to potentially prevent theft.

GRIZZLY BEAR

This season two survey areas in the North Cascades were maintained for detecting grizzly bears (Figure 2). The Blum Lake survey area had two installations and was only revisited once throughout the summer season after the

Figure 2: All grizzly bear installations for 2016 were located within the North Cascades National Park.

initial set-up. Two installations were also established at the Crescent Creek survey area. Four cameras remain on the landscape; three from the 2015 season (one at Grizzly Creek and two at Green Lakes), and one from the 2016 season (Blum Lakes). No photos have been received from these four cameras, though we are planning retrieval missions this spring or summer as locations become accessible. These survey areas are in remote, relatively high elevation locations in the North Cascades, most requiring hours of off-trail navigation and bush-whacking to reach. The challenge that these site locations have posed to our volunteers are cause for reflection and potential adjustments in our upcoming 2017 monitoring season.

Table 1. All grizzly bear survey area information. ^ One camera still on the landscape, no data received,* cameras installed in 2015, ** cameras have not been retrieved from wilderness/ no data was received during the season.

2016 Grizzly Bear Camera Survey Areas

Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Blum Lakes	NCNP	2	2016/06/26	9/10/2016^	76 days	Grizzly Bear
Crescent Creek	NCNP	2	2016/07/25	2016/09/25*	124 days	Grizzly Bear
Grizzly Creek	NCNP	1	*	**		Grizzly Bear
Green Lakes	NCNP	2	2015/06/13*	**		Grizzly Bear

Data indicates that four species (black bear, mule deer, pika and human) were detected at Crescent Creek and

Blum Lake (Table 2). No photos were received over the course of the season for our Grizzly Creek or Green Lakes survey areas.

Table 2. Number of detection events by species at grizzly bear survey areas.

Species Detection Events at Grizzly Bear Camera Survey Areas 2016				
Species Priority	**Level 3**			
Survey Area	**Black Bear**	**Mule deer**	**Snowshoe hare and smaller mammals**	**Human (non-volunteer)**
Blum Lakes	1	5		1
Crescent Creek	5		(Pika) 3	

GRAY WOLF

There were ten survey areas with multiple installations for each area, dedicated to detecting wolves (Figure 3).

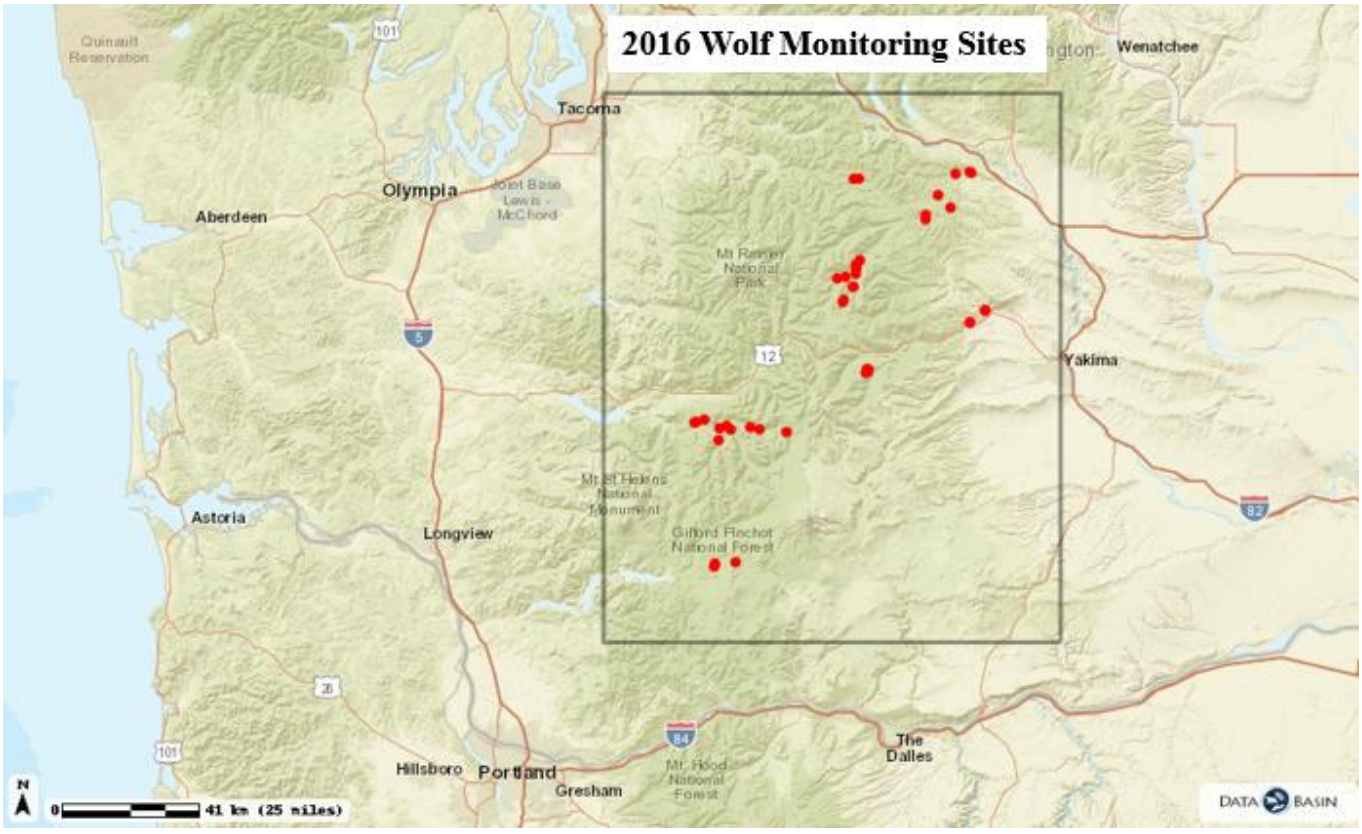

Figure 3: All gray wolf installations for 2016 were located south of the I-90 corridor.

This totals to 41 unique installations surveyed over the course of the season. These installations were located in the Gifford Pinchot and Okanogan-Wenatchee National Forests, on state-owned public lands, and Nature

Conservancy land through special permissions from The Nature Conservancy. All survey areas were located within the South Cascades, defined as the area south of I-90, both on the west and east side of the Cascade Crest. Some installations were left active over the winter season. Two new survey areas, Bumping Lake and Naches River, were established in January 2016 for wolf detection, and Little Naches was established at the end of July in response to potential sightings.

Table 3. All wolf survey area information. ~Cameras active prior to this date, data picks up here from where 2015 left off, *denotes last date photos were checked, but survey area was not uninstalled.

Wolf Camera Survey Areas 2016

Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Blue Lake Ridge	GPNF	5	2015/11/23~	2016/12/05*	641 days	Gusto
Bumping Lake	OWNF	9	2015/12/20	2016/11/05	572 days	Gusto
Cispus	GPNF	5	2016/02/28	2016/11/20*	433 days	Gusto
Cliffdell	OWNF	2	2016/06/05	2016/10/23	203 days	Gusto
Little Naches	OWNF	2	2016/07/30	2016/11/05	196 days	Gusto
Lone Butte	GPNF	4	2016/06/03	2016/10/29	276 days	Gusto
Manastash	OWNF	2	2016/05/28	2016/12/04*	380 days	Gusto
Naches River	OWNF	4	2015/12/20	2016/04/09	222 days	Gusto
Rimrock	OWNF	5	2016/06/04	2016/09/17	259 days	Gusto
Taneum	OWNF	3	2016/04/15	2016/10/29	388 days	Gusto

While no wolves were detected in this region, a fisher from recent reintroduction efforts and two level two species were observed; mountain lion and marten (Table 4). Mountain lion were seen at five of the ten survey areas and marten was observed at Bumping Lake. Eleven level three species, including black bear, bobcat, coyote, elk, mule deer, both striped and spotted skunks, porcupine, raccoon, snowshoe hare and smaller mammals, and livestock and human (non-volunteer) (Table 4), were detected during the season. Of these species, ten were detected at Blue Lake Ridge and Manastash, nine were observed at Bumping Lake and Taneum, and eight at Cliffdell. At the Cispus survey site one Virginia Opossum was detected and it is noted that this survey area is in close proximity to rural human development. While this species is not one of our priority species, the presence of a non-native species has been noted.

Table 4. Number of detection events by species at wolf survey areas. Species of skunk include; ~Striped, *Spotted

Species Detection Events at Wolf Camera Survey Areas 2016														
Species Priority	Level 1	Level 2		Level 3										
Survey Area	Fisher	Mountain Lion	Marten	Bobcat	Black Bear	Coyote	Elk	Mule deer	Skunk	Porcupine	Raccoon	Snowshoe hare and smaller mammals	Live stock	Human (non-volunteer)
Blue Lake Ridge		35		18	16	10	13	83	~2 / 3*		2	14		14
Bumping Lake	1		5	3	1	10	190	17				22		12
Cispus				1	3		15	42	~6					9
Cliffdell		6		1	14	3	21	19				8		2
Little Naches		1				1	46	8				16		3
Lone Butte	1				1	1	64	5						7
Manastash		3		11	12	28	21	13	1*	1		3		9
Naches River				1		3	12					1		1
Rimrock				1	16	81	118	14				66	9	
Taneum		2			2	14	24	22	~5			16	2	12

Of note at one of the Bumping Lake installations was a high concentration of elk in one area, the camera was moved upon revisit to capture a more diverse representation of species in the area (Table 4).

GENERAL WILDLIFE ALONG THE INTERSTATE 90 CORRIDOR

The I-90 corridor for this project is defined as the 15-mile stretch along I-90 between Hyak, at milepost 54, and Easton, at milepost 70 (Figure 4). The I-90 survey areas in 2016 monitored previously-established and novel locations within this 15 mile stretch and within close proximity to the freeway. The three survey areas, each consisting of two camera installations, totaled ten discreet locations being monitored (Table 5). These installations are established in the I-90 corridor to detect general wildlife movement and presence in relation to the interstate.

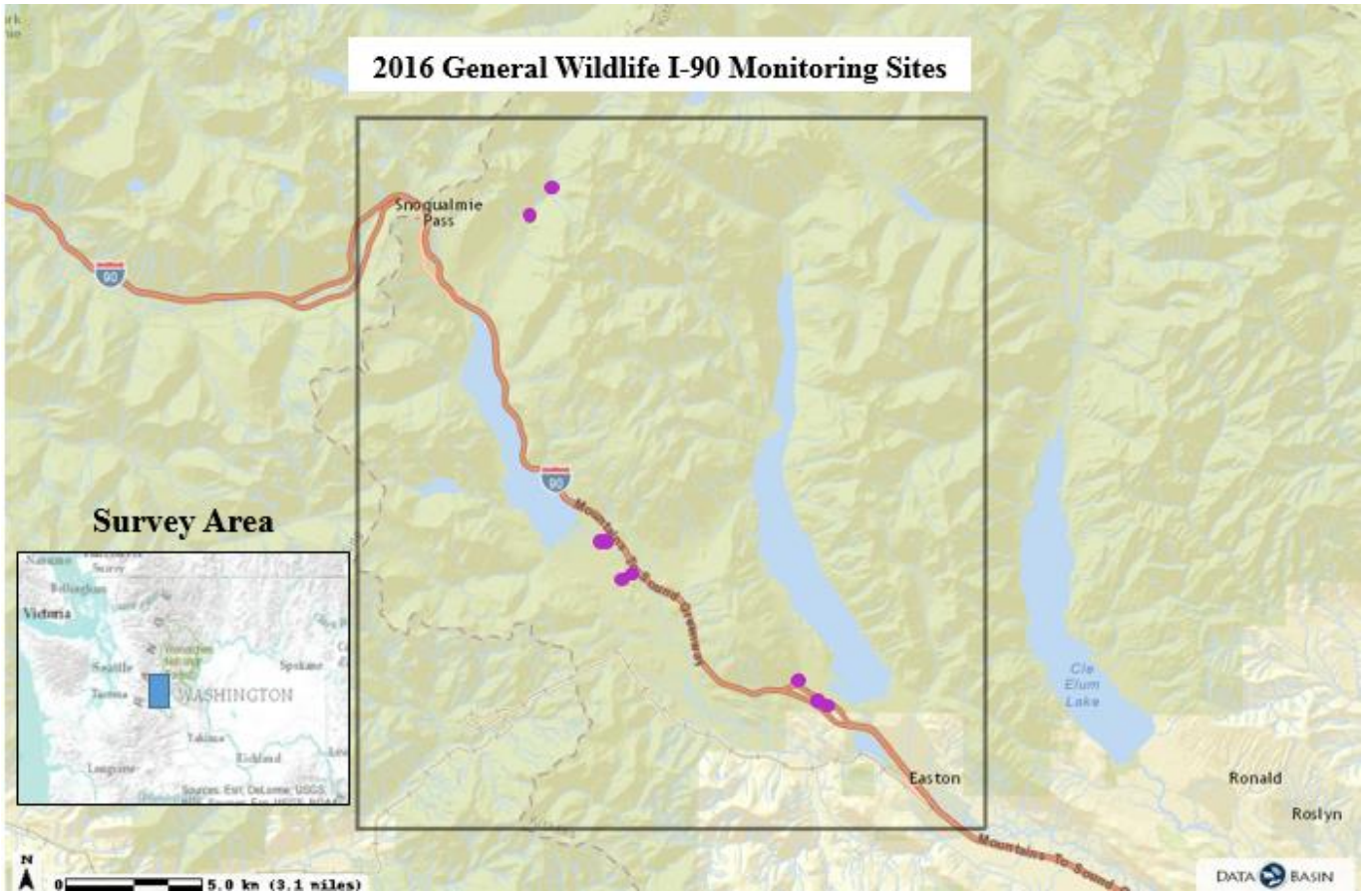

Figure 4: All general wildlife installations for 2016 were located between Hyak and Easton on the I-90 corridor.

Table 5. All I-90 survey areas ^Denotes the first date photos were received in 2016 from survey areas left active over the winter. *Denotes the last date photos were checked, but survey area was not uninstalled.

I-90 Wildlife Corridor Camera Survey Areas 2016

Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Alaska Lake	OWNF	2	2016/05/28	2016/11/29*	292 days	None
Crystal Springs	OWNF	5	2016/06/19	2017/01/15	420 days	None
Easton	OWNF	3	2016/01/09^	2017/01/07*	728 days	None

Over the course of the season, one level two species was recorded: a mountain lion at Easton. Eight level three species, including black bear, bobcat, coyote, elk, mule deer, beaver, snowshoe hare and smaller mammals, and human (non-volunteer) were detected (Table 6). All species were seen at Alaska Lake and Price Creek, while Easton did not get any human (non-volunteer) detection events (Table 6).

Table 6. Number of detection events by species at I-90 wildlife corridor survey areas.

Species Detection Events at I-90 Camera Survey Areas 2016									
Species Priority	**Level 2**	**Level 3**							
Survey Area	**Mountain Lion**	**Bobcat**	**Black Bear**	**Coyote**	**Elk**	**Mule deer**	**Beaver**	**Snowshoe hare and smaller mammals**	**Human (non-volunteer)**
Alaska Lake			2		5	2	9	2	1
Crystal Springs		1	1	2	45	11			13
Easton	1	4	6	13	56	45		57	14

WOLVERINE

Our wolverine survey areas this season were distributed throughout the North and South Cascades, both east and west of the Cascade Crest (Figure 5).

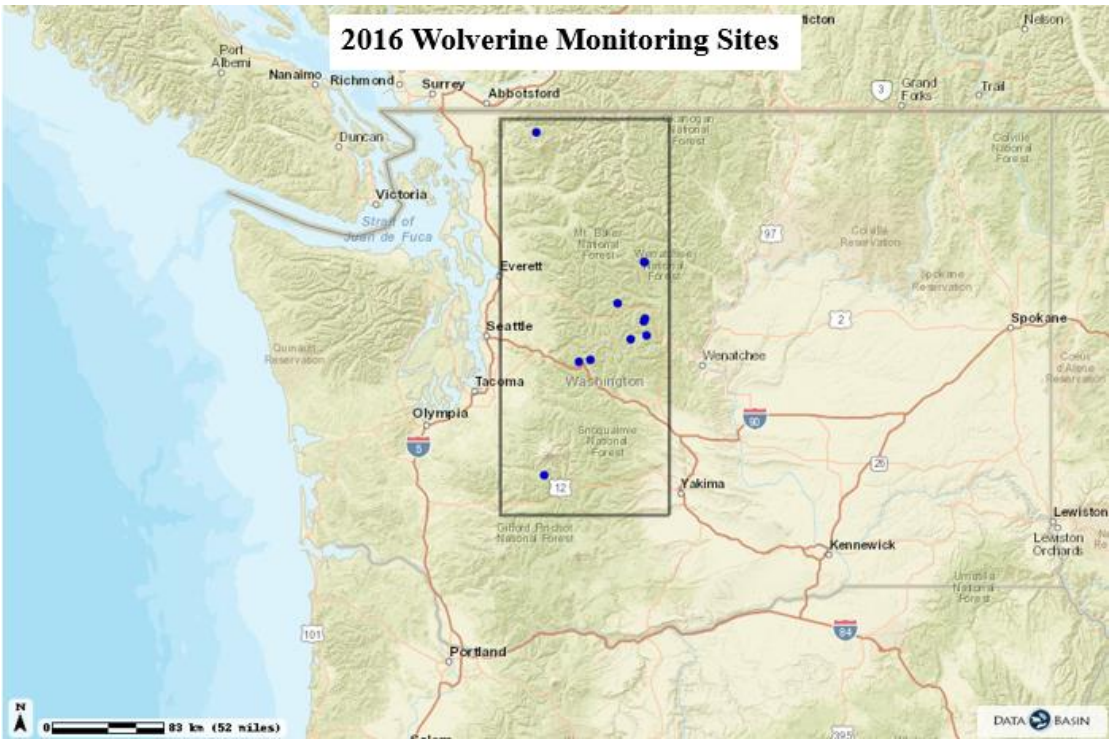

Figure 5: All wolverine installations for 2016 spanned between the Gifford Pinchot National Forest in the southwest to Mount Baker Snoqualmie National Forest in the north.

Two of our eight survey areas dedicated to wolverine monitoring, Chiwaukum and Union Gap, were active all year in 2016 and had a total of 11 distinct installations (Table 7). Numerous wolverine survey areas were maintained over the winter from 2016-17 season, including Chiwawa, Chiwaukum, Union Gap, Lookout Mountain, and a new Installation as of January, 2017 at Kendall Peak, which will be included in the 2017 results and report.

Table 7. All wolverine survey area information. ⁺Denotes a survey area without a run-pole installed. ^Denotes the first date photos were received in 2016 from survey areas left active over the winter. *Denotes the last date photos were checked, but

survey area was not uninstalled. ++ Denotes camera removed from the landscape, + re-installed and active on the landscape.

Wolverine Camera Survey Areas 2016

Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Chiwaukum	OWNF	2	1/3/2016^	12/4/2016*	672 days	Gusto / Bait
Chiwawa	OWNF	2	2016/03/11 11/24/2016+	8/5/2016++	202 days	Gusto / Bait
Joe Lake	OWNF	2	2016/08/08	2016/10/10	148 days	Gusto / Bait
Lookout Mountain	GPNF	1	2016/01/24	10/29/2016 *	279 days	Gusto / Bait
Skyline	MBSNF	1	2016/03/27	2016/04/18	22 days	Gusto / Bait
Union Gap	OWNF	1	1/18/2016 ^	11/19/2016 *	306 days	Gusto / Bait
Blackjack Ridge	OWNF	1	2016/07/05	2016/10/01	88 days	Gusto / Bait
Johnny Creek	OWNF	1	1/16/2016 ^	5/2/2016---	107 days	Gusto / Bait

As previously described, wolverine survey areas are different from our other survey areas because they typically consist of two cameras at each installation. The vicinity camera captures detections within the general area and the run-pole camera detects animals on the run-pole. For this reason, duplicate events are deleted prior to updating our database to obtain a more accurate understanding of detection rate and species detected, without doubling detection events (Table 8). The two installations at Joe Lake did not have run-poles established at the sites and so had one camera each. One of the Skyline cameras was not activated upon installation and the site was removed early on in the season due to lack of team leads. The Summer Blossom Ridge remains on the landscape from 2015 and no data has been collected.

Wolverine and gray wolf, both level one species, were detected at wolverine-targeted survey areas this season. Wolverines were detected at Union Gap and Chiwawa, and a gray wolf was detected at Chiwaukum. A new wolverine detection occurred at Chiwawa with two wolverine detection events which were determined to be the same individual. The high rates of wolverine detections at Union Gap spanned over two days in March, five days in April, and one day in September. Unfortunately, genetic samples that were collected from Union Gap were unable to determine whether these were wolverines with existing DNA profiles or new individuals. However, based on unique chest blaze patterns, at least two distinct individuals were observed (Appendix VI). Genetic samples obtained in the field during the 2016 monitoring season and processed in the lab did not return results of gender or individual ID. This problem is associated with the small sample size of cells related to non-invasive genetic sampling (hair samples compared to blood or tissue) and the degradation of genetic samples from the elements. In areas with high detection rates of target species, like the wolverine, we will be advising volunteers to visit the site more frequently and retrieve the samples as soon as they can, and, if they are wet, to put them in desiccant

to dry and preserve the sample from degradation[28].

Table 8. Number of detection events by species at wolverine survey areas.

Species Detection Events at Wolverine Camera Survey Areas 2016											
Species Priority	**Level 1**		**Level 2**		**Level 3**						
Survey Area	**Wolf**	**Wolverine**	**Mountain Lion**	**Marten**	**Bobcat**	**Black Bear**	**Coyote**	**Elk**	**Mule deer**	**Snowshoe hare and smaller mammals**	**Human (non-volunteer)**
Blackjack Ridge				5			4		3	12	
Chiwaukum	10		1	100	12	48	21		53	210	1
Chiwawa		2		75		21			3		
Joe Lake						4			2		1
Johnny Creek			2		6	16	1	4		8	
Lookout Mountain			1	15	6	8	6	3	3	4	
Skyline											
Union Gap		36	1	351		2			3	14	1

Ten wolf detections were documented at Chiwaukum. The detections of a radio-collared individual spanned a two-day period in early April of 2016. According to our Advisory Council, this animal was a collared member from the Teanaway pack[29].

Mountain lion and marten, both level two species, were detected at four and five of the eight wolverine survey areas, respectively (Table 8). Seven level three species, including black bear, bobcat, coyote, elk, mule deer, snowshoe hare and smaller mammals, and human (non-volunteer) were seen at the wolverine survey areas (Table 8). Marten, black bear, and snowshoe hare and smaller mammals were the most frequently detected across all eight wolverine survey areas (Table 8).

CANADA LYNX

Out of our four survey areas, three were located in Washington's Colville National Forest and one was located on the BC side of the border in the Rossland Range (Figure 6). Eleven distinct camera installations were maintained on the Washington side of the boarder throughout the monitoring season, and three installations in the Rossland Range in British Columbia (Table 9). Photos have not yet been collected from our partners at Selkirk College.

[28] Correspondence with Cory Engkjer; Lab Technician; Forest Service Contractor, RMRS/Wildlife & Terrestrial Ecosystems, February, 2017.

[29] http://www.conservationnw.org/news/scat/wolf-photographed-at-chiwaukum-wolverine-site/?searchterm=wolf%20chiwaukum

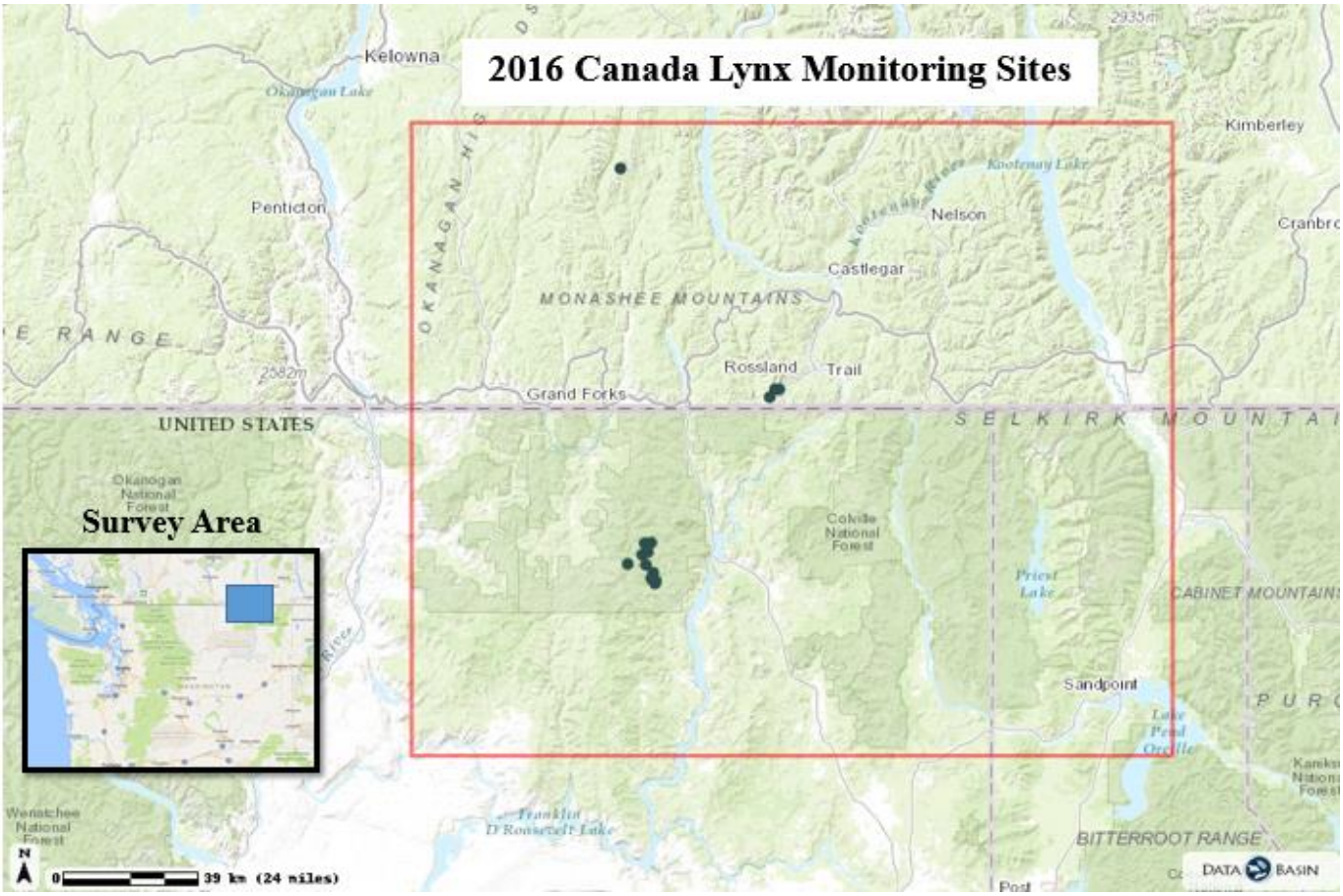

Figure 6: All Canada lynx installations for 2016 spanned from the Rossland Range to the North in British Columbia to the Kettle Range in the United States.

Table 9. Lynx survey area information. ^ denotes date of camera installation, but no photos received, * denotes cameras still active on the landscape.

Canada Lynx Camera Survey Areas 2016

Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Colville	CNF	3	2016/05/31	2016/09/15	195	Lynx
Kettle Range	CNF	5	2016/06/05	2016/10/09	252	Lynx
Rossland Range	BCRR	3	10/23/2016^	*	207	Lynx
Sherman	CNF	3	2016/06/17	2016/10/28	174	Lynx

Although no lynx were documented at our survey areas in 2016, our program compliments larger efforts of those researching the transboundary Canada lynx population, and several lynx were documented within the BC Kettle

Range (Table 10). We look forward to receiving updates from our collaborators at Washington State University researching the Canada Lynx population within the BC Kettle Range.

Of note are the three gray wolf detection events at the Sherman survey site (Table 10). One collared wolf and two non-collared wolves were captured on camera. There are 17 confirmed packs in the Eastern Washington recovery region, which means the likelihood of detecting a wolf is much higher than in the Southern Cascades and Northwest Coast recovery regions, where we focused our wolf monitoring efforts.

Table 10. Number of detection events by species at lynx survey areas.

Species Detection Events at Lynx Camera Survey Areas 2016												
Species Priority	**Level 1**	**Level 2**	**Level 3**									
Survey Area	**Wolf**	**Mountain Lion**	**Bobcat**	**Black Bear**	**Coyote**	**Elk**	**Mule deer**	**Moose**	**Hoary Marmot**	**Striped Skunk**	**Snowshoe hare and smaller mammals**	**Human (non-volunteer)**
Colville			4	2	2	1	43	8	9	1	24	178
Kettle Range			6	9	29	1	8	8		4	136	72
Sherman	3	1	3	5	2		38	6		1		8

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 one. Information and guidance from volunteers, project advisers, project partners, and project staff helps us identify the best practices for remote camera monitoring in Washington. These recommendations improve the efficacy, efficiency, and power of our work.

Our goals for the 2017 remote camera monitoring season are to:

1. Assess monitoring efforts for grizzly bears in the North Cascade Ecosystem. Evaluate volunteers' ability and commitment to long, arduous, off trail navigation and site access, as well as continue to develop research relationships within the North Cascades National Park.
2. Continue to focus on wolverine monitoring in areas that are accessible safely year-round. Assess current methods for collecting hair samples at run-pole stations. Work with other research projects looking at additional monitoring methods for wolverine.
3. Reach out to colleges and universities to engage upcoming wildlife professionals in Washington wildlife monitoring and look for other opportunities to partner with ongoing efforts.
4. Develop a new strategy to obtain volunteers and coordination capacity in Northeastern Washington in order to continue and improve our Canada lynx monitoring efforts in the Kettle River Range.
5. Increase coordination in planning, reporting, and processing results from efforts by CWMP, Washington State University, and Selkirk College researchers monitoring Canada lynx in Northeast Washington and southeastern British Columbia.

6. Ensure early coordination with other monitoring efforts throughout our coverage area, including professional and citizen-based research.
7. Evaluate our new data management system to facilitate data exchange between volunteers and project staff. Look for new methods of data collection that may ease data management for volunteers and project staff.
8. Provide expanded opportunities for connections between volunteers, other ongoing wildlife field research in our state, and field skill trainings.
9. Maintain clear communication with all team leaders in order to ensure that data is collected and submitted in an accurate and efficient manner. Ensure that all protocol materials are easily accessible and well-understood at the beginning of the season, particularly during the spring training.
10. Refine the training system for volunteers and develop new incentives for teams to submit data in a timely manner.
11. Continue inputting current and past year's data from the project into the new online relational database. Provide a simplified process for reporting project results and more detailed and refined analysis of project findings, and facilitate sharing with project partners.
12. Improve genetic sample collection techniques by advising volunteers to visit the site more frequently and retrieve the samples as soon as they can to ensure a high quality sample is collected to improve efficacy of analysis.

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Team Members:

Bill Whipple, Keri Young, Kelli Young Beach, Pete Kelly, Haley Watson, Brian Church, Erin Tudor, Melissa Rienstra, Erik Hagstrom, Karen Ducey, Monica Diaz, Richard Johnson, Tom Andrewjeski, Tracy Popowics, Morgan Thompson, Cara Stoddard, Chelsea Reissler, Kira Peck, Patrick McGee, Bob Cox, Chris Eals, Guthrie Schrengohst, Charles Hahn, Jonathan Dent, Thomas Christensen, Richie Booth, Andy Franjevic, Gabe Clark, Doug Stevens, Robert Swann, Steve Zientko, Matt Christian, Rusty Thurman, Patricia Miller, Larry O'Neil, Selena Nuutinen, Donovan Daly, Sophia Daly, Anna Rogers, David Snair, Liz Snair, Alberto Chavez, Jason Glantz, Christina Burress, Corey Thurman, Chris Carter, Matt Danielson, and Randy Leventhal

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APPENDIX I: North Cascades Grizzly Bear Recovery Zone

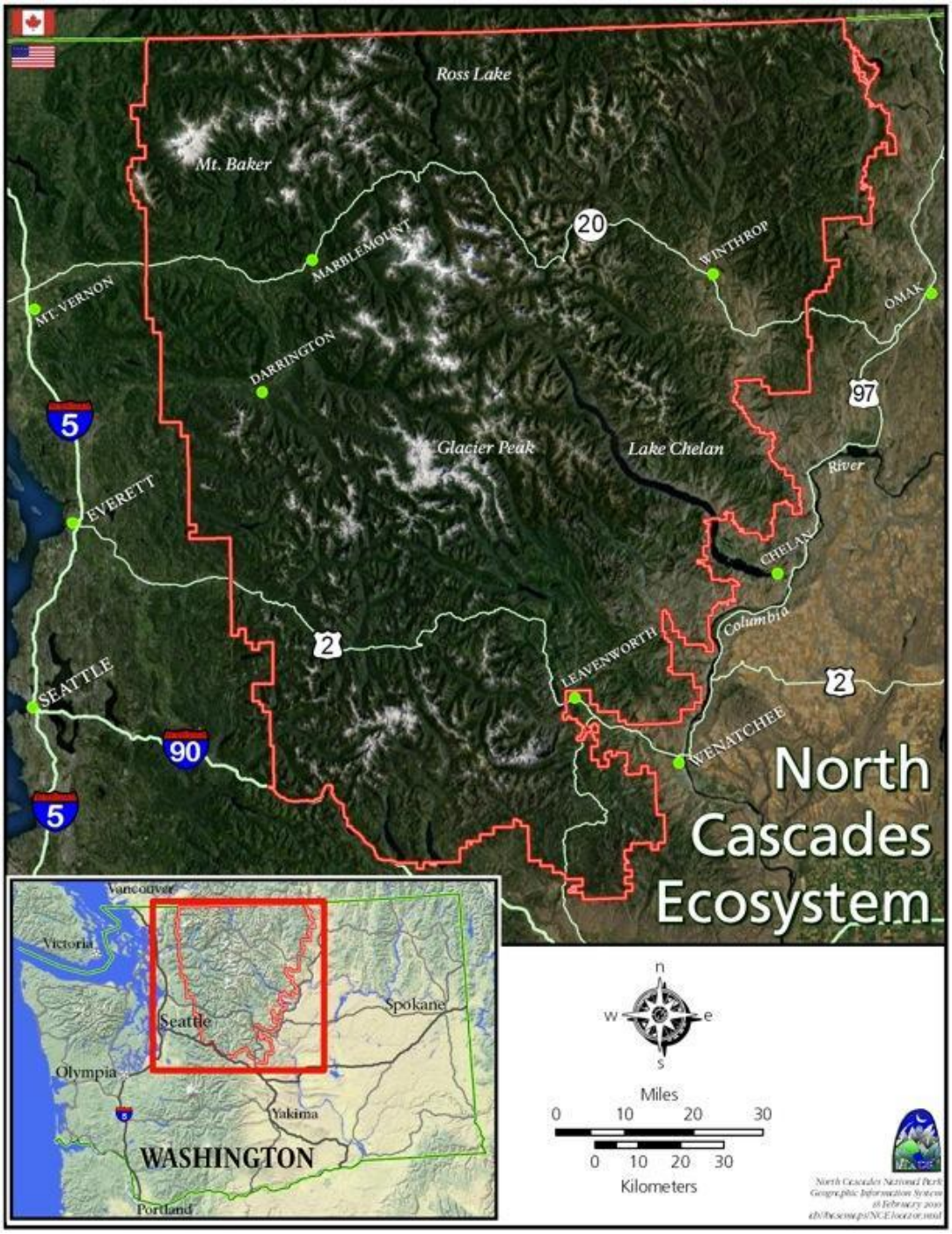

Photo from Western Wildlife Outreach [*http://westernwildlife.org/our-work/north-cascades-grizzly-bear-recovery-area/*](http://westernwildlife.org/our-work/north-cascades-grizzly-bear-recovery-area/)

APPENDIX II

Remote Camera Trap
Installation and Servicing Protocol

Citizen Wildlife Monitoring Project

Prepared by

David Moskowitz

Alison Huyett

This document available online at www.conservationnw.org/what-we-do/northcascades/resources-page-for-wildlife-monitoring-volunteers/

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest, I-90 Wildlife Bridges Coalition, and Wilderness Awareness School

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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: Aleah Jaeger (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: Some 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!**

For cameras without a test function, turn on the camera and walk in front of it in various places, then open the camera and see what is captured in the photo frame.

Index Photos: Whenever you set up or visit a camera trap be sure to capture an index photo. When approaching an existing site walk in front of the camera to be sure to capture the camera team visiting the camera. Before leaving a newly set up or serviced camera trap, once again step in front of the camera to capture an image of the research team.

For new installations hold up a sheet of paper with the following information written in large clear

letters on it: Camera installation name, date, team leader name, latitude, longitude, altitude. All of this information will help us ensure that we are able to keep track of where images have come from.

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.

Defining and labeling discreet camera trap installations: Each time a camera is moved to a new location this is considered a new installation. (An exception to this would be a slight adjustment to a camera where the camera is still monitoring the exact same immediate location, just from a slightly different angle, which might be done in an attempt to reduce false triggers due to lighting or waiving branches.) On the data sheet carefully record the specific name of each individual installation. Use the labeling convention outlined below for creating a discreet label for each new location you set up a camera trap.

This name needs to be the same for every visit to the camera installation. Use the convention outlined below for creating labels for each installation. Be sure to enter it the same on all visits to the camera installation. See the spreadsheet of previous camera visits to double check the title of the installation if you have any questions.

General location-year-installation number	Example: Rainier-2015-1
General location	This title is provided to you by Conservation Northwest when you are issues your camera trap equipment. Use this title for all of the installations you create in that area.
Year	Record the year you INSTALL the camera (in the case of cameras that are out over the transition from one year to the next, the title comes from the year when the installation was created).
Installation Number	Label each installation chronologically starting with 1. If you have two cameras, the first trap you install will be 1, the second 2. If you move camera 1 to a new location after a month, this will become camera 3 and if you move the other camera it would become 4 and

	so on.

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. Hold a sheet of paper with all the information mentioned above for index photos when you step in front of the camera.

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: aleah@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 Aleah Jaeger (aleah@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 (aleah@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.

Remember that when a camera trap is moved it becomes an entirely new camera installation and needs

to be labeled as such in all the data sheets and photo folders submitted. See above for guidelines for labeling discreet installations. If you are using the Coordinate recording feature in a remote camera be sure to reset the coordinates to your new location when putting in a new installation.

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 Aleah Jaeger (aleah@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: Rainier 1_12AUG12-30AUG12

   And for second site:

   Rainier 2_12AUG12-30AUG12

7. For *wolverine run pole camera sets* where two cameras are set for the same installation, within the folder you create for each site visit, place the photos from each camera into a separate folder labeled: "polecam" and "vicinity".

8. 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 "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/1-9WnxfwVna6VBoEeI6UjTXwHT35fJ62dgI1NCKAmNxQ/viewform?usp=send_form. 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 aleah@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 aleah@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.

Contacts for Remote Camera Work for 2016:

Project Coordinator: Aleah Jaeger aleah@conservationnw.org or 206-637-9747 ext 201

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.

Acknowledgements

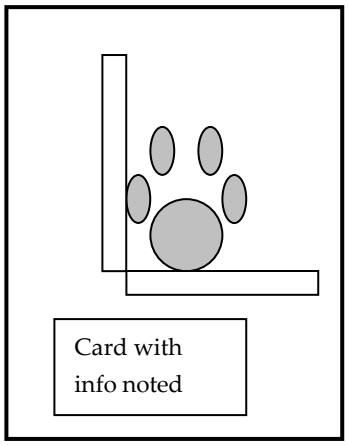
The field methods documented here represent the work of many individuals over the course of the years this project has been underway. Thanks much to all of the past CNW staff and project volunteers that have written, revised, or offered feedback on this and past versions of this document. A special thank you to members of the project's Advisory Council for lending their time to the continued development of our field methods.

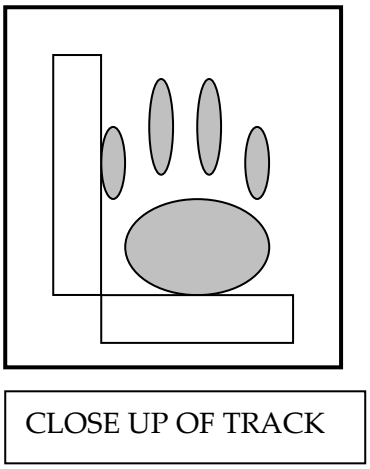
Appendix: Track Photo Documentation Guidelines

PHOTOGRAPHS OF INDIVIDUAL TRACKS:

1. Take photo looking directly down on track to reduce distortion.
2. For close up photographs, fill the entire frame with the track and measuring devises
3. Include two scales, preferably rulers, one running lengthwise, the second widthwise.
4. Take at least one picture of the track that includes a card in the picture with:
    - Site Name
    - Date
    - Observation Number
    - Team leader's name.

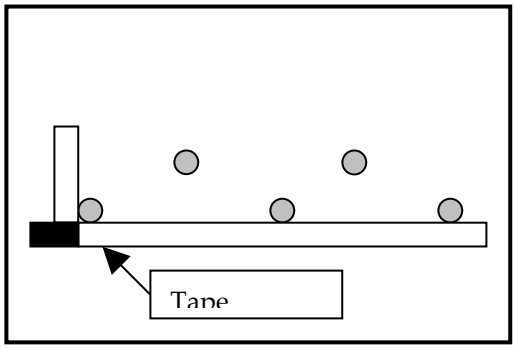
5. Take multiple photographs to ensure you get a quality shot.

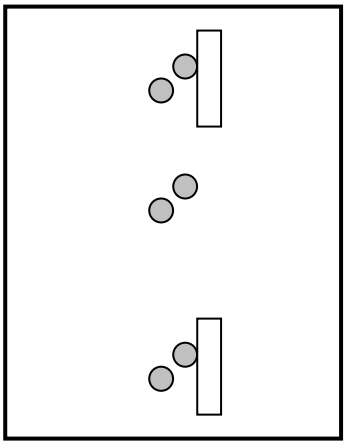




PHOTOGRAPHS OF GAITS/TRAIL PATTERNS

1. 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).
2. 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.





PHOTOGRAPHING THE SETTING

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.

APPENDIX III

Grizzly Bear Remote Camera Traps: Installation and Monitoring Protocol

Citizen Wildlife Monitoring Project

Prepared by

David Moskowitz

and

Alison Huyett

This document available online at

http://www.conservationnw.org/what-we-do/northcascades/cascades-citizen-wildlife-monitoring

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest, I-90 Wildlife Bridges Coalition, and Wilderness Awareness School

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Introduction

CWMP's effort to detect Grizzly bears (*Ursus arctos horribilis*) in the North Cascades Ecosystem (NCE) is designed to complement 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 advisers 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 1. 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.

Acknowledgements

Thanks very much to Bill Gaines, Robert Long for discussing the details of their project and helping adapt our methods to support this work and to Aja Woodrow for helping us refine our adapted field methods and outfitting us with scent lures. The description of genetic sample collections was adapted from field methods text written for the North Cascades Wolverine Project.

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Appendix 1: Grizzly Bear Field Identification

There are three key field marks to look for in photographs of bears, or actual bears.

Shoulders: Grizzly bears have a prominent shoulder hump while black bears typically do not.

Head profile: Grizzly bears have a concave (dished) profile to their forhead and snout and have short rounded ears. Black bears head profile is flat and their ears are taller.

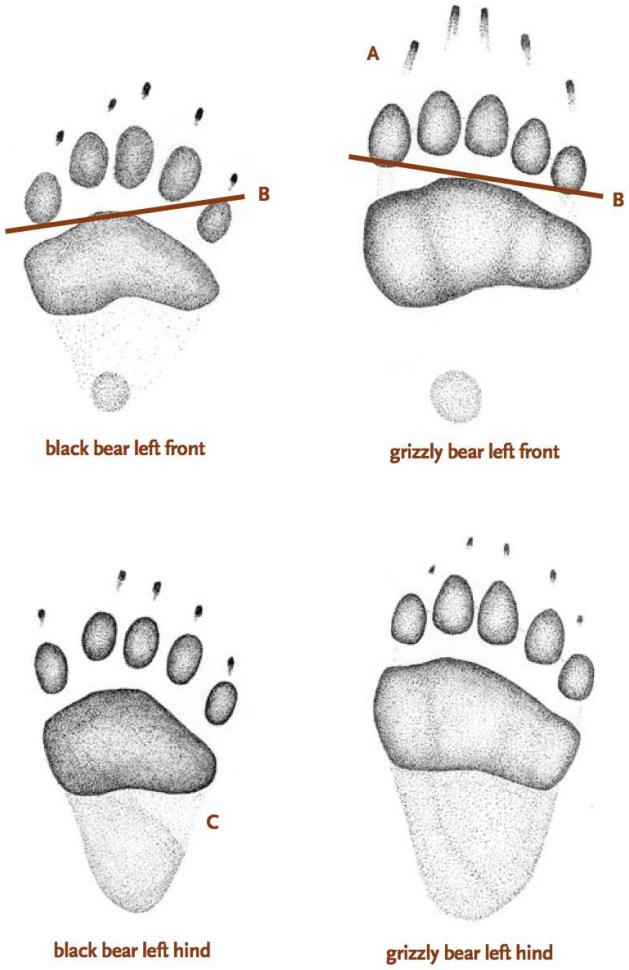
Claws: Claws on the front feet of grizzly bears can be extremely long and relatively flat (used for digging). Claws on the front feet of black bears are not as prominent and are curved (useful for tree climbing).

Figure 2. Field Marks for distinguishing black bear and grizzly bears. Source: Center For Wildlife Information (http://centerforwildlifeinformation.org/BeBearAware/Bears_of_North_America/Black-Grizzly_ID/black-grizzly_id.html, retrieved March 2014).

Appendix 2: Grizzly and Black Bear Tracks and Signs

Follow guidelines laid out in the CWMP's Remote Camera Trap Installation and Servicing Protocol for photo-documenting potential tracks and signs of grizzly bears found while in the field. Below are details for distinguishing grizzly bear and black bear tracks and a description of bear rub trees and foraging signs to keep an eye out for while scouting for where to set up camera traps.

Footprints



Key features distinguish black and grizzly bear tracks: **A** Claws on front tracks are usually longer than the length of associated toe and significantly longer than hind claws. **B** In black bear tracks, inner toe falls mainly below a line drawn from bottom of outermost toe and across the top of palm; inner toe falls above line in grizzly bear tracks ("Palmisciano test" most reliable on front feet). **C** Black bears have a wedge of hair on the inside of their hind foot that can leave a distinctly raised area in this portion of the track.

Figure 3. Comparison of black and grizzly bear tracks (source: Moskowitz 2010)

	Front Length	Front Width	Hind Length	Hind Width
Grizzly Bear	4–5.5 in. 10.5–13.5 cm	4 –5.75 in. 10.5–14.5 cm	4.25–5.25 in 11–13 cm (without heel) 6.25 –8.25 in. 16.0–20.5 cm (with heel)	4 –5.75 in 10.5–14.5 cm
Black Bear	3.75 –5.25 in. 9.4–12.8 cm	3.75 –5.25 in. 9.8–13.1 cm	3.75–4.5 in. 9.5–11.1 cm (without heel) 5.5 –7.5 in. 14.5–19.1 cm (with heel)	3.5—5 in. 9.2–12.5 cm

Table 1. Track measurements for grizzly bears and black bears in the Pacific Northwest (source Moskowitz 2010).

Foraging Digs

Grizzly bears do much more digging than black bears and signs of them foraging for roots and bulbs in subalpine wet meadows can be quite distinctive. Inspecting meadows. Digs are often characterized by large clumps of sod that have been ripped up.

Photo 1. (Left) Foraging digs from a grizzly bear in a subalpine meadow the Selkirk Mountains in southeastern British Columbia. Sign would look similar in the equivalent habitat in the NCE. Photo by David Moskowitz.

Photo 2. (Right) Foraging digs on the edge of a talus field in the Selkirk mountains in southern British Columbia. photo by David Moskowitz.

Photo 3. (Left) Close up of a foraging dig from a grizzly bear. Note that clump of sod removed is about one bear paw width wide and the top edge of it is generally rectangular in shape. Photo by David Moskowitz.

Rub Tree Photo and Description

Both black bears and grizzly bears will scent mark by biting, clawing, and rubbing their bodies on trees and fence posts. These marking posts appear very similar for both species and maybe impossible to distinguish to species without accessory clues (hair left on the tree, tracks associated with the marking post). Grizzly bears and black bears have also been documented to use the same marking posts in places where the two species co-exist.

Photo 4. Two lodgepole pines that have been repeatedly marked by grizzly bears. Look for bark removed at about standing head height for a bear, claw marks and bite marks as well as smooth bark about rump and shoulder height for a bear. Northwestern Montana. Photo by David Moskowitz.

Photo 5. Grizzly bear marking post on an old fence post in northwestern Montana. Note bite and claw marks about head height on the post and hairs caught in the barbed wire on the post. Photo by David Moskowitz.

Appendix 3: Gear list for grizzly bear camera trap teams

For a complete list of field equipment see http://www.conservationnw.org/files/2014camerageararchecklist.pdf. Below are additional items specifically required for camera teams targeting grizzly bears.

Scent lure

Dry bag for carrying lure

Bear spray

Paperwork

- Camera trap installation datasheet
- Map of targeted sample unit
- This protocol document
- General camera installation protocol

Genetic sample kit

- Nitril gloves
- Tweezers
- Coin envelopes

- Genetic sample data sheet

APPENDIX IV

Wolverine Run-pole Camera Station Protocol: Developed for Conservation Northwest (CNW) by the North Cascades Wolverine Study (NCWS) 17 December 2012

Keith B. Aubry (kaubry@fs.fed.us) and Catherine M. Raley (craley@fs.fed.us)
Pacific Northwest Research Station, 3625 93rd Ave SW, Olympia, WA.

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 V

National Lynx Detection Protocol

Kevin S. McKelvey

James J. Claar

Gregory W. McDaniel

Gary Hanvey

July 29, 1999

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.

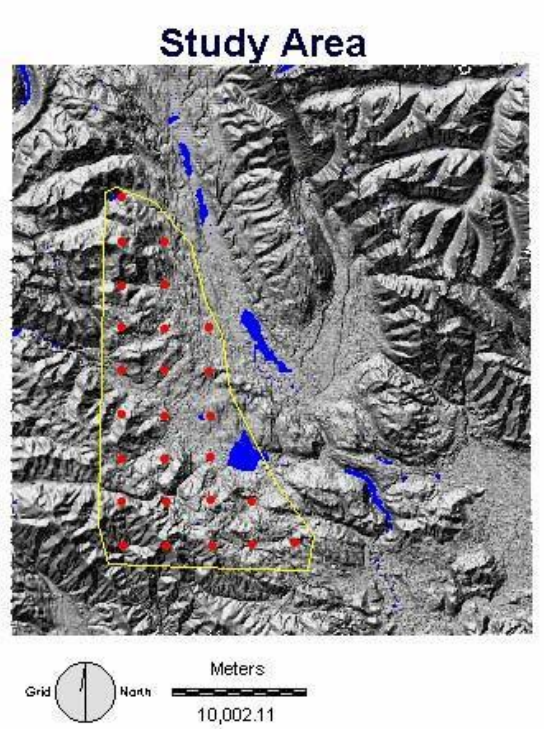
Working in conjunction with other survey efforts

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

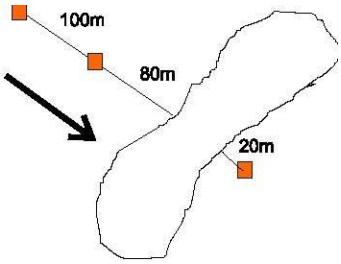
Figure 1. Example demonstrating placement of sites. Yellow line is area of interest. Red symbols are location of sites with 2-mile spacing.



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.

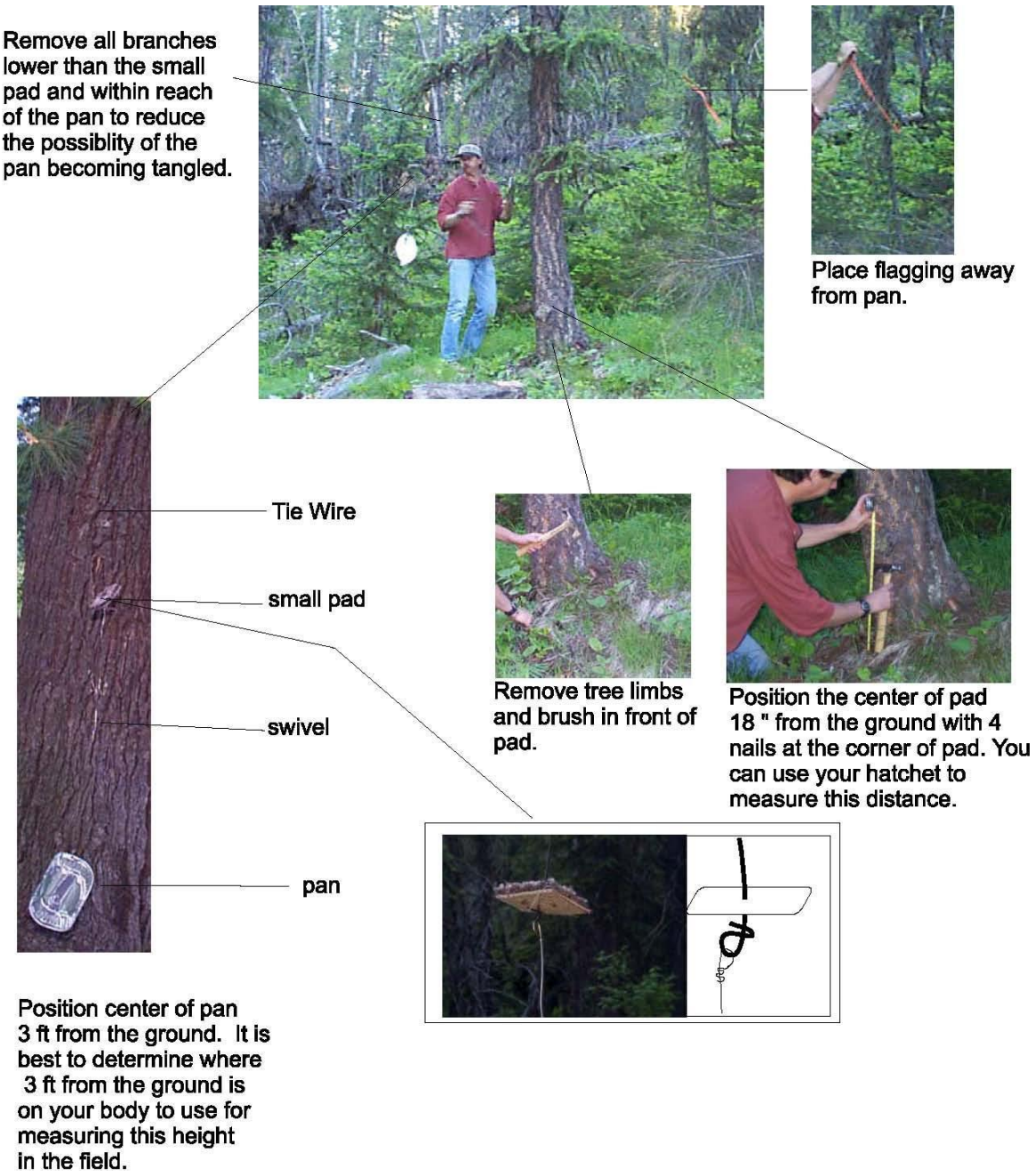
Figure 2. Transects are located downhill from the position of the site. Stations are 100 m apart.

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.



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.

Figure 6. Sprinkle dried catnip over bait on hair-snares

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).

Send samples and data as soon as possible to:

Kevin McKelvey

Rocky Mountain Research Station

800 E Beckwith Ave

Missoula, MT 59801

Samples do not need to be shipped with ice.

Supplies

Storage for vehicle

Garbage bags to line the inside of day packs

Nail pullers

Gallon zip locks for storage

Quart zip lock bags for storage of pads with hair

Permanent marker for marking flagging, plastic bags with hair-snare pads, and dessicant vials

3 rolls of flagging

Forceps for collecting hair from pads

Bait

dessicant vials

3 1/6 oz spoons

vials for carrying mixture into the field to rebait hair-snares

containers for carrying baited hair-snares and pads

150 hair-snares

150 pie-pans

150 small pads

protocol

dried catnip

2 shingle hammers with protection holsters

2 rolls of stove pipe wire for hanging pie-plates

4 lbs of 1 1/2 inch shingle nails

Surgical gloves for handling hair

Small container to assist with putting bait on pads

Note: Supplies are for protocol of 25 sites with extra (5 sites).

APPENDIX VI

2016 Union Gap Wolverine Chest Blaze Photos

April 3 and April 7 – this is not the same wolverine as April 5 or April 13

April 5 – not the same wolverine as April 3 and 7, but might be the same as wolverine detected on April 13. From what can be seen in photos, some similarities in chest blazes, but no photos of front paws on April 5.

April 13