CITIZEN WILDLIFE MONITORING PROJECT

2017 FIELD SEASON REPORT

January 2018

Prepared by:

Laurel Baum, Program Coordinator
Conservation Northwest

David Moskowitz, Technical Lead
David Moskowitz Wildlife Tracking and Photography
and Conservation Northwest contractor

Gary Boba, Project Intern
Conservation Northwest

Table of Contents

EXECUTIVE SUMMARY

For more than a decade, the Citizen Wildlife Monitoring Project (CWMP) has conducted research using remote cameras, wildlife tracking, and DNA sample collection to study Washington's rare and sensitive wildlife through citizen science. Led by Conservation Northwest (CNW) in partnership with Wilderness Awareness School and other groups and agencies, the Citizen Wildlife Monitoring Project is engaged in monitoring wildlife presence and activity in critical areas for wildlife connectivity, conservation, and habitat.

Citizen scientists from this project continue to contribute valuable new information about the presence and distribution of wildlife in our state through both remote camera surveys and snow tracking. CWMP often covers geographic areas beyond those of ongoing professional research efforts, supplementing and strengthening the work of agencies, conservation groups, biologists, and other collaborators on our Advisory Council.

During the 2017 remote camera season, 86 volunteers contributed more than 3,500 hours to the Citizen Wildlife Monitoring Project by attending trainings, installing, and maintaining 72 remote camera installations in 30 survey areas in Washington state and British Columbia.

CWMP's monitoring efforts are broken into two projects: remote camera monitoring (annual monitoring with heavier effort from May-October) and snow tracking along Interstate 90 (typically December-March). At the culmination of each project season, a monitoring report is prepared and made public through Conservation Northwest's website (https://www.conservationnw.org/wildlife-monitoring/). This report focuses on our results from the 2017 remote camera monitoring year. Separate snow tracking reports are available on our website.

In 2017, we concentrated our study area in two distinct landscapes – the Cascade Mountains in Washington and the transboundary mountain ranges of northeast Washington and southern British Columbia, specifically the Kettle River Range and the Rossland Range. Within the Cascade Mountains, we have divided our study area into three regions:

1. Washington's North Cascades: North of I-90 to the U.S.-Canada border (North Cascades)
2. I-90 Corridor: Between Snoqualmie Pass and Easton along Interstate 90
3. Washington's South Cascades: South of I-90 to the Columbia River (South Cascades)

The main objectives for the 2017 field season were to:

1) Detect the presence of gray wolf (*Canis lupus*) in the South Cascades.
2) Detect the presence of wolverines (*Gulo gulo*) in new locations and continue to monitor known populations in the North and South Cascades.
3) Detect grizzly bears (*Ursus arctos*) in the North Cascades Grizzly Bear Recovery Zone (Appendix I).
4) Monitor the presence of a wide variety of wildlife species in the I-90 Corridor (Snoqualmie Pass to Easton).
5) Document transboundary Canada lynx (*Lynx canadensis*) presence in northeast Washington and southern British Columbia.

With the assistance of Conservation Northwest program staff, contractors and our Advisory Council (listed in Acknowledgements), survey areas were established based on our target species. Each survey area may contain

multiple remote camera sites. Program volunteers managed two grizzly bear survey areas, eight wolf, eleven wolverine, and five multi-species areas in the I-90 Corridor. There were also three survey areas in northeast Washington's Kettle River Mountain Range for lynx monitoring, with our partners at Selkirk College in British Columbia also maintaining one lynx survey area in southern British Columbia's Rossland Range.

Over the course of the 2017 season, we detected nineteen species that fall into our priority listing for this project. Highlights from this field season include:

- The continued documentation of wolverines in Washington's Cascade Mountains. Our citizen science teams documented wolverines in the southern portion of the North Cascades on eight separate occasions, including two individuals visiting a site together. We continue to work on improving our coverage for difficult to access locations, so that bait and hair snares can be checked on a frequent interval when target species have been detected.

- Although our teams recorded no Canada lynx on the Washington side of the border this year, the efforts of our volunteers have contributed to a larger study by our partners at Washington State University. Dr. Dan Thornton's Mammal Spatial Ecology and Conservation Lab has been able to add our data to their larger study focused on distributions and population density of the Canada Lynx in the Kettle Range and Columbia Highlands of northeast Washington, and has developed a methodology for large-scale, long-term monitoring of lynx in Washington state (Appendix VI). Through the CWMP, Dr. Lui Marinelli's students at Selkirk College were successful in documenting Canada lynx in southern B.C.'s Rossland Range. These efforts contribute to furthering our collective knowledge and conservation efforts to protect this rare and sensitive species.

- Our volunteer teams documented fishers at two survey areas in the South Cascades. Both locations are in close proximity to where fisher reintroduction efforts have taken place in Washington led by the Washington Department of Fish and Wildlife (WDFW), National Park Service and Conservation Northwest. Fisher photo documentation provides visual evidence of the health of the animal at the date the photo was taken. Reintroduced individuals have internal radio transmitters providing location information via overhead telemetry flights; however, the lifespan of these devices will not provide information on the following generation[1]. In the coming years, we plan to expand our fisher monitoring and expect our efforts to play a role in documenting the presence of offspring and provide further evidence of an expanding population.

- American martens were recorded at ten different survey areas in the Cascades. While not a target species for our project, data collected on martens is shared with our Advisory Council members carrying out research on these animals.

- Animals documented at I-90 Corridor survey areas for the 2017 season were of particular interest due to the completion of two large wildlife underpasses at Gold Creek in 2014, recent completion of several smaller undercrossings nearby, and the increased opportunity for movement of wildlife. CWMP's survey areas are located within close proximity to these new highway-crossing structures. Easton sites recorded presence of seven different species in habitat adjacent to the highway. The presence of this high number of species serves

[1] Lewis, Jeff. Restoring fishers in Washington State. Wildlife Seminar at UW Jan 22, 2018.

as an example of the crossing structures' utility for wildlife to travel safely under I-90. Since the underpass areas have transitioned to a restoration phase, we expect to see wildlife making more use of them and adjacent areas. As construction continues on the first wildlife overpass, we will continue to pay especially close attention to wildlife activity nearby, including monitoring efforts after completion (expected in 2019).

The work of Conservation Northwest staff, interns, volunteers and partners through the Citizen Wildlife Monitoring Project increases our understanding of wildlife on Washington landscapes and in the transboundary regions of Washington and British Columbia. Not only does visual wildlife documentation influence research and policy decisions, these animal images create a narrative and face for our wildlands that informs and inspires both project participants and the public. The Citizen Wildlife Monitoring Project emphasizes the importance of monitoring and conservation efforts to ensure a stable future for wildlife species that call the Northwest home.

PROJECT OVERVIEW

Over a decade ago, Conservation Northwest began using citizen science as a way to advance our mission to protect, connect and restore wildlands and wildlife from the Washington Coast to the British Columbia 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, genetic sample collection, and snow tracking to document the presence and behavior of rare and sensitive species, as well as the presence of common species in locations strategically important for landscape connectivity. 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 the fisher, gray wolf, grizzly bear, Canada lynx, and wolverine;
4. To facilitate the exchange of information about wildlife, including data from monitoring efforts, between public agencies, researchers, conservation organizations, and interested individuals.

Due to the number of partners in the Cascades Ecosystem, CWMP operates through a collaborative effort between Conservation Northwest and Wilderness Awareness School. Throughout each monitoring year, Conservation Northwest acts as the Project's administer, fiscal sponsor and volunteer coordinator for all efforts, as well as leading remote camera monitoring and equipment management. Wilderness Awareness School provides in-kind and financial support to the Project for activities associated with the I-90 Corridor, as well as important training resources and venues. Previously, the I-90 Wildlife Bridges Coalition also supported the Project. That coalition, administered and sponsored by Conservation Northwest, concluded its work at the end of 2017.

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 Interstate 90 (typically December-March). At the culmination of each project, a monitoring report is prepared and made public through Conservation Northwest's website (www.conservationnw.org/wildlife-monitoring/). This report focuses on our results from the 2017 remote camera monitoring year. Separate snow tracking reports are available on our website.

In 2017, we concentrated our study area in two distinct landscapes – the Cascade Mountains in Washington and the transboundary mountain ranges of northeast Washington and southern British Columbia, specifically the Kettle River Range and the Rossland Range. Within the Cascade Mountains, we have divided our study area into three regions:

1. Washington's North Cascades: North of I-90 to the U.S.-Canada border (North Cascades)
2. I-90 Corridor: Between Snoqualmie Pass and Easton along Interstate 90
3. Washington's South Cascades: South of I-90 to the Columbia River (South Cascades)

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 2017, our monitoring objectives were to:

1. Monitor the recovery of gray wolves (*Canis lupus*) in the Cascade Mountains, with a particular focus south of Interstate 90 in the Southern Recovery Zone identified by Washington's Wolf Conservation and Management Plan (Wolf Plan). Our 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, primarily through "hair snags".

3. Document grizzly bears (*Ursus arctos*) or other rare carnivores in the federally-designated North Cascades Grizzly Bear Recovery Zone, approximately from Interstate 90 north to the U.S.-Canada border.

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

4. Observe the behavior and presence of all wildlife species in key habitat connectivity areas along Interstate 90 between Snoqualmie Pass and Easton, 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 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 pups born back in Washington in over 70 years, Conservation Northwest has played a major role in 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 and the Touchet pack in late 2016[4]. WDFW updated their 2016 Annual Report in March of 2017 to reflect the state's most up-to-date wolf count, with a minimum of 115 wolves calling Washington state home at the end of 2017[5]. In addition to shaping wolf policy in Washington and leading the Range Rider Pilot Project, through the CWMP, Conservation Northwest carries out monitoring efforts, the results of which are 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.[6] 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, geographically distributed across the three regions. Additionally, each recovery zone must have at least four breeding pairs for three consecutive years. As of 2017, none of Washington's 20 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 2017, CWMP focused its wolf monitoring efforts on detection south of I-90 in the state's designated 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.[7] They prefer alpine and subalpine environments where snow packs persist into late spring. Perhaps

---

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

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

[5] https://www.fws.gov/wafwo/articles.cfm?id=149489625

[6] 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).

[7] 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-

because they live in these harsh environments where food is scarce, wolverines are extremely mobile carnivores with large home ranges between 100 km² to over 900 km². This means they typically live in low densities across large landscapes.[8] After near eradication from the lower 48 states in the early 1900s, wolverines have begun to recover in areas such as the North Cascades, and, since 2005, state researchers have identified more than a dozen individual wolverines. Much is still unknown about these rare and elusive species, and the 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.[9] In response to the negative finding from USFWS, conservation groups have filed a lawsuit against the government to continue to pursue protection, citing habitat loss due to climate change and other factors[10]. 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 2017 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.
3) Collect genetic data through hair samples to help identify individual wolverines at all of our wolverine monitoring locations.

In 2017, our wolverine monitoring continued in the Chiwaukum, Chiwawa, and Union Gap survey areas where our remote cameras have contributed to individual wolverine documentation over the course of multiple years. We also established locations at Alaska Lake (I-90 Corridor) in response to high reliability sightings and Ethel Lake (Chiwaukum) by guidance of our Advisory Council. To ensure that our efforts add to existing research, we

---

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.

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

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

[10] 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

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*) 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[11]. In 1997, the North Cascades, along with five other recovery zones, was identified as a key area for recovery of the endangered bear species and designated as a federal Grizzly Bear Recovery Zone.[12] Now, 20 years after the recovery plan was written, the National Park Service and the U.S. Fish and Wildlife Service are in the midst of an important public process to explore options for recovering grizzly bears in the North Cascades.[13]

Despite anecdotal reports of grizzlies in the North Cascades and recent confirmed sightings in British Columbia, no population or individual has been confirmed in the Washington portion of the ecosystem since 1996[14]. Based on expert opinion and a database of sightings, the U.S. Fish and Wildlife Service believe there are fewer than 10 grizzly bears remaining in Washington's North Cascades ecosystem[15]. As of 2012, the British Columbia Ministry of Environment estimates there are six grizzly bears in the Canadian North Cascades[16].

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)[17]. 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 restoration 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

---

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

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

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

[14] http://wdfw.wa.gov/conservation/endangered/species/grizzly_bear.pdf

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

[16] 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

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

model created by CCCP and the sampling method they employed based on the "hair corral" described by Kendall and McKelvey (2008).[18] 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 passage.[19] In an effort to create a more permeable interstate, the Washington State Department of Transportation (WSDOT) 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[20].

Our project has worked in concert with WSDOT and Western Transportation Institute for close to a decade to monitor wildlife activity along I-90 within the project area, with support from the I-90 Wildlife Bridges Coalition. 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 2017 monitoring season, the wildlife underpasses at Gold Creek and Rocky Run were complete and habitat restoration within and adjacent to the crossing structures was underway. 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 2019[21]. Our goals for CWMP in 2017 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, as well as Conservation Northwest's I-90 Wildlife Corridor Campaign and Central Cascades Watersheds Restoration programs.

TRANSBOUNDARY LYNX MONITORING

Washington is home to one of the largest populations of Canada lynx in the continental United States.[22] Much like the history of wolverines in our state, lynx were targeted in the fur trade in the 1800s and early 1900s, and

---

[18] 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.

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

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

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

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

trapping 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.[23] Researchers have documented the dispersal of lynx across the Canadian border in northeastern Washington.[24] 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 mountain ranges in Washington and southern British Columbia. These efforts are aimed at documenting the presence of lynx and collecting genetic information on individuals outside of ongoing agency research in the Cascade Mountains.

The major objectives for 2017 lynx monitoring in British Columbia were to document the presence of lynx in the transboundary Kettle River Range between British Columbia and northeast Washington and to collect genetic data from hair snags placed at each remote camera installation. Working towards these goals, we aim 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 Dr. Lui Marinelli and students from Selkirk College in British Columbia, who maintained three lynx monitoring installations in Rossland Range, BC using CWMP cameras. These cameras, installed in October of each year, run through the winter and provide us with a look at transboundary species detections north of the border. Additionally, our project volunteers installed and maintained eleven camera installations on the Washington side of the border, providing support and supplementing a larger lynx monitoring effort led by Dr. Dan Thornton and his Mammal Spatial Ecology and Conservation Lab at Washington State University.

METHODOLOGY

CWMP is a volunteer-based project supported by Conservation Northwest staff, contractors, 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.[25] Additionally, motion-triggered cameras

---

[23] 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.

[24] 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.

[25] 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.

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

In 2017, we concentrated our study area in two distinct landscapes – the Cascade Mountains in Washington and the transboundary Kettle River Mountain Range of northeast Washington and southern British Columbia, including the Rossland Range in B.C. Within the Cascade Mountains, we have divided the study area into three regions:

1. Washington's North Cascades: North of Interstate-90 (North Cascades)
2. I-90 Corridor: Between Snoqualmie Pass and Easton along I-90
   Washington's South Cascades: South of I-90 (South Cascades)

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.

(Washington: Smithsonian Institution Press, 1996).

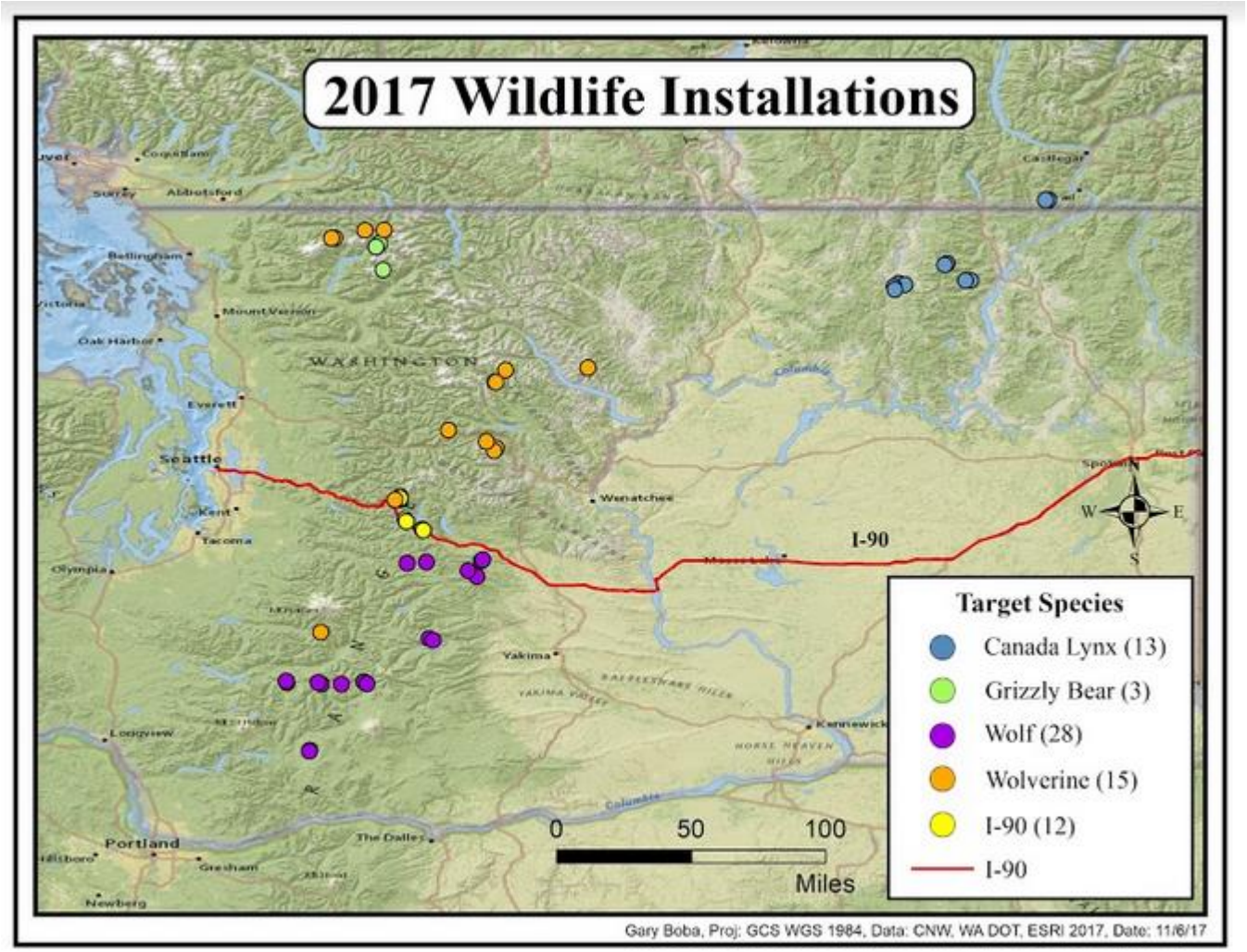


Figure 1: Locations of all 2017 camera installations specified by target species: Canada lynx, grizzly bear, I-90 wildlife corridor, wolf, and wolverine.

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 2017 field season, our volunteers placed 72 unique camera installations at 30 survey areas throughout our study area in the Cascade Mountains and in the Kettle River Mountain Range. Each survey area had between one and eight discreet camera trap installations spread out spatially and/or temporally throughout the survey area. Based on guidance from our Advisory Council we had eight survey areas for wolves, eleven targeting wolverine, two for grizzly bear, five targeting multiple species along I-90, and four 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. The application of scent lure or bait in our project adheres to guidelines established by our Advisory Council. 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.[26] Scent lure mimics this natural mode of communication and acts as an attractant, bringing individual wildlife to the remote camera installation. No artificial attractants are used for the I-90 Corridor where the proximity of the installation is close to the roadway and we do not want to attract wildlife towards the road.

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 & Appendix VII). In addition to scent attractants, wolf sets focus on travel such as junctions between game trails and closed or lightly traveled roads. Generally, two cameras are placed within a designated survey area, which can range in scale from ten to several hundred square miles, spaced far enough apart to potentially capture different individual animals (spacing varies depending on the target species or monitoring goals for the survey area), and potentially moved over the course of the year to increase the area surveyed.

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 snares, 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 blaze. Wild bait (deer, elk, etc., often from road killed animals) 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 five gun brushes attached horizontally. This belt is attached just below the run-pole around the tree. In the field, if photographs from remote cameras indicate the target species has visited the site, hair samples are removed from the gun brushes using latex gloves and are immediately sent for lab analysis.

---

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

Installations targeting lynx on the Washington side of the border have transitioned Dr. Dan Thornton's large scale detection protocol that was designed for lynx monitoring which took place over the summer of 2017 (Appendix V). This has been a recent change from the national lynx detection protocol developed in 1999 by McKelvey still being utilized in British Columbia (Appendix VI). In addition to having remote cameras, these installations are also equipped with hair snares and scent stations designed to attract lynx for DNA analysis. A special mixture of glycol, glycerin and beaver castoreum is used at scent stations set up as recommended by McKelvey et. al.

During the 2017 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.

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 and the Advisory Council for confirmation and further communication.

The priority listing for our 2017 season is as follows:

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

Level 2
Cougar
Marten
Mountain goat

Level 3
Beaver
Black bear
Bobcat
Coyote
Elk
Hoary marmot
Mule deer /White-tailed deer / Black-tailed deer

Moose
Porcupine
Raccoon
Striped Skunk/ Spotted Skunk
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

Of note: while not one of our priority species, the Virginia opossum is a non-native mammal which we have detected over the years at various locations, and we have included it where detected.

RESULTS AND DISCUSSION

During the 2017 monitoring season, volunteers collected data year-round with the majority of the cameras deployed from May through October. Over the course of the season, CWMP project volunteers established and maintained 30 survey areas with 72 sites. These survey areas were defined through communications with Conservation Northwest program staff and scientists, our Advisory Council and distributed 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—a measure of evenness of distribution of different species, population size—or species absence. Rather, our data focuses on species richness, the number of different species counted within an ecosystem or area, which has invaluable applications to the conservation and management of rare and sensitive species in Washington. 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.

Results for this year are organized by target species, as in 2015 and 2016. The number of discrete remote camera installations at each survey area and the total number of trap nights, or 24-hour monitoring periods, is presented below as an index of relative survey effort in each area, this year we have added an overview of our program effort and percent of the total for the entire project (Table 1, Figure 2).

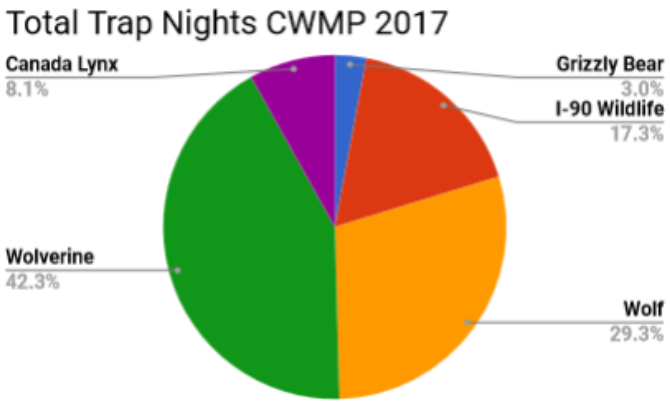


Figure 2: Total trap nights for CWMP by target species and percent of overall effort.

Total Trap Nights CWMP – 2017	
Grizzly Bear	280
I-90 Wildlife	1638
Wolf	2775
Wolverine	4004
Canada Lynx	768
Total Trap Nights	9465

Table 1. Total Trap nights for all target species survey areas in 2017.

GRIZZLY BEAR

This season two survey areas in the North Cascades were maintained for detecting grizzly bears with an additional goal of detecting the presence of any other rare carnivores such as gray wolves in the North Cascades (Figure 3).

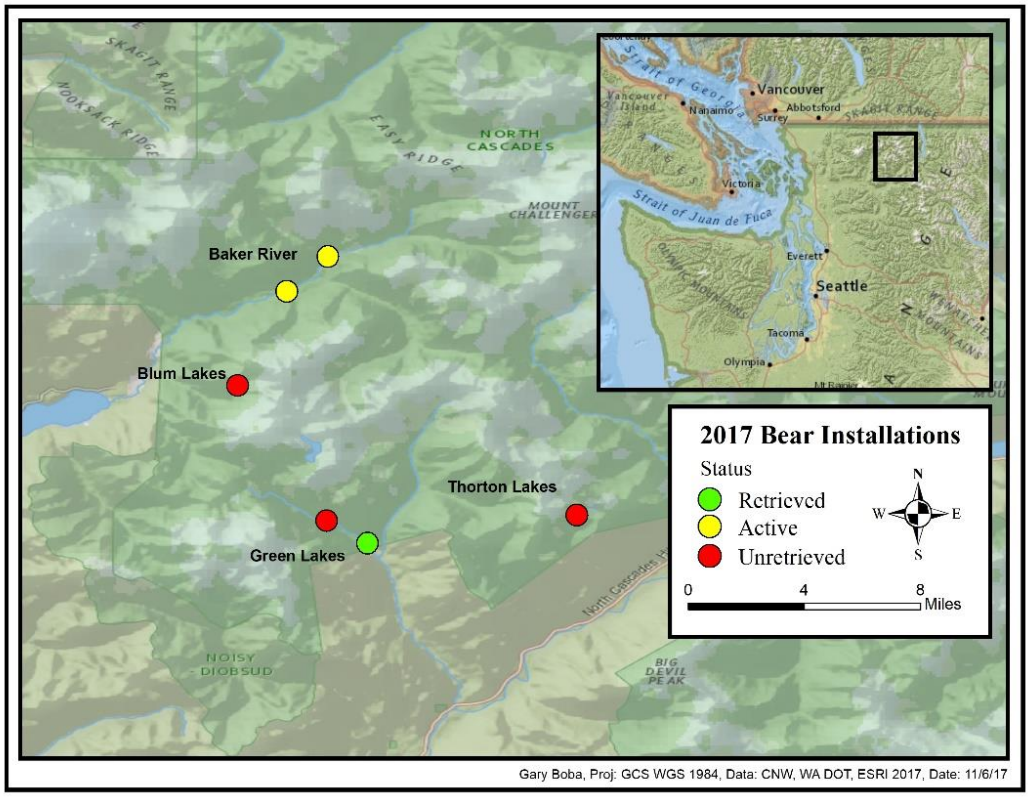


Figure 3: All grizzly bear installations for 2017 were located within the North Cascades National Park.

The Baker River survey area had two installations and volunteers revisited the site once, shortly after the initial set-up. Data will be incoming in the summer of 2018, once accessibility has improved. Volunteers retrieved the Green Lake camera, which was installed in 2015 and remained active for 267 days before the batteries died. Three cameras have been out for multiple seasons; two from the 2015 season (one at Thornton Lake and one at Green Lakes), and one from the 2016 season (Blum Lakes). No photos have been received from these cameras,

though we are hopeful that retrieval missions this spring or summer will be successful as Green Lakes was this past year. 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 locations have posed to our volunteers in the past have led to more careful thought on placement and team commitment prior to some camera installations. For 2017, limited effort of four installations, 280 trap nights and 3 percent or our total effort was focused on camera traps set to detect Grizzly bears in the North Cascades Complex (Table 2, Figure 2).

Table 2. Grizzly bear survey area information, including duration of monitoring and number of installations.

Grizzly Bear Camera Survey Areas 2017						
Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Baker River	NCNP	2	2017/09/03	2017/09/16*	13	Grizzly Bear
Green Lakes	NCNP	1^	2015/07/18	2016/06/23**	267	Grizzly Bear

^One camera still on the landscape, no data received, *last revisit date, cameras still active, **retrieved in 2017

Four species were detected at Green Lake and during the short interval at Baker River: black bear, bobcat, coyote, spotted skunk, and many detections of snowshoe hare and smaller mammals (Table 3). Our cameras at Blum Lake, Thornton Lake and a 2nd at Green Lake set prior to the 2017 season have not yet been retrieved. Retrieval is expected during summer 2018.

Table 3. Number of detection events by species at grizzly bear survey areas.

Species Detection Events at Grizzly Bear Camera Survey Areas 2017					
Species Priority	Level 3				
Survey Area	**Black Bear**	**Bobcat**	**Coyote**	**Spotted Skunk**	**Snowshoe hare and smaller mammals**
Baker River	2				
Green Lakes	5	8	1	1	54

GRAY WOLF

There were eight survey areas that followed our species specific protocols for detecting gray wolves, all were located south of I-90 (Figure 4). Our monitoring efforts dedicated to detecting wolves consisted of twenty-nine installations and a total of 2,775 trap nights making up for 29 percent of the 2017 monitoring season (Table 4, Figure 2).

While no wolves were detected in this region, a fisher was captured on camera at Blue Lake Ridge and images have been shared with our project partners involved in recent fisher reintroduction efforts. Mountain lions were seen at seven of the eight survey areas. Twelve level three species, including black bear, bobcat, coyote, elk, mule deer, both striped and spotted skunks, porcupine, raccoon, snowshoe hare and smaller mammals, livestock and

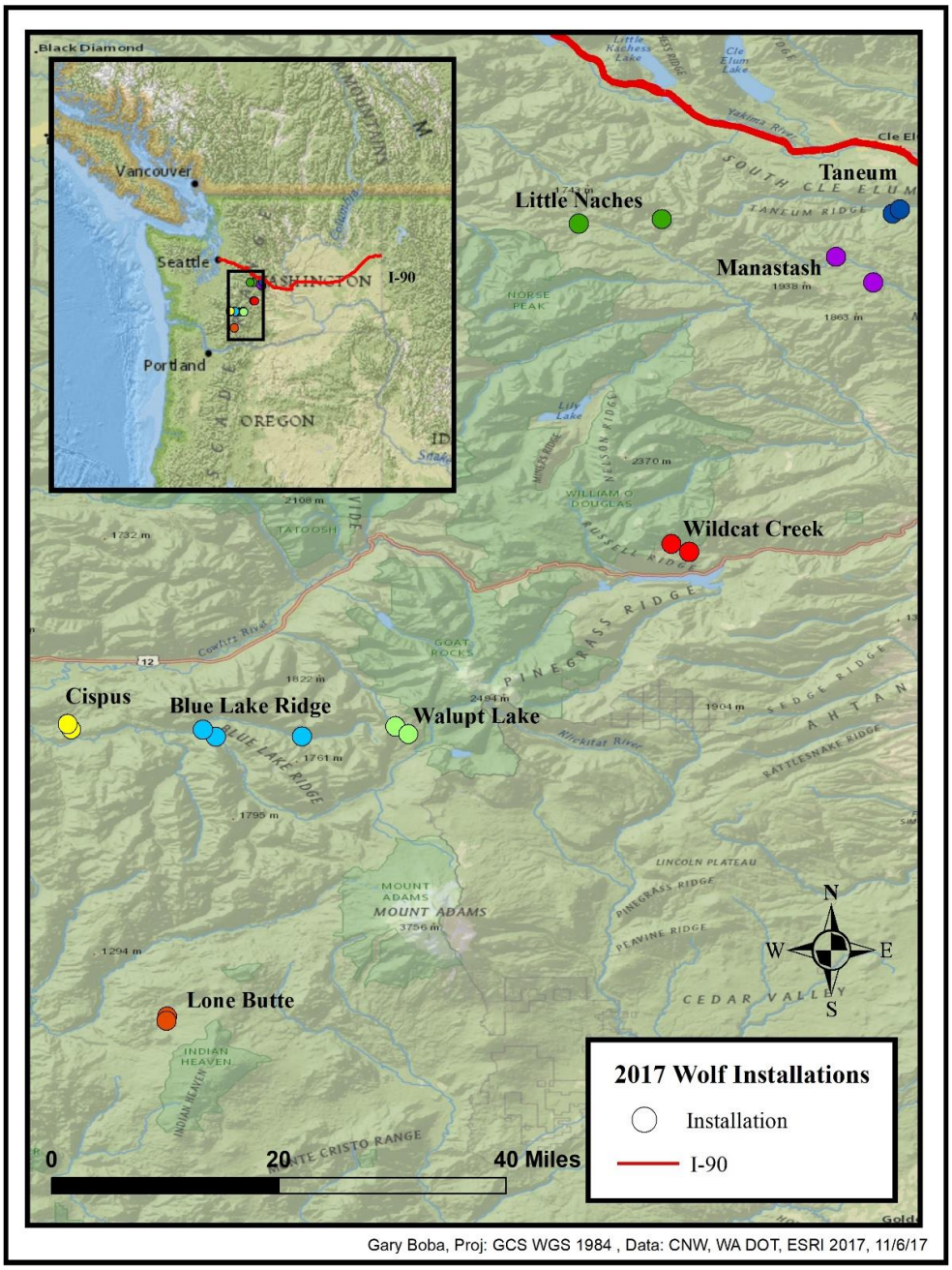


Figure 4: All gray wolf installations for 2017 were located south of the I-90 Corridor.

human (non-volunteer) (Table 5), were detected during the season. Of these species, Blue Lake Ridge detected eleven, nine were observed at Cispus and Little Naches, and eight at Manastash and Taneum. At the Blue Lake Ridge survey site, one Virginia opossum was detected and it is noted that while this species is not one of our priority species, the presence of a non-native species has been recorded.

Table 4. Information for all wolf survey areas, including duration of monitoring and number of installations. ^Denotes the first date photos were received from survey areas left active over the winter. *Denotes the last date photos were checked, but survey area was not uninstalled.

Wolf Camera Survey Areas 2017						
Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Blue Lake Ridge	GPNF	3	2016/11/04^	2017/10/08*	728	Gusto
Cispus	GPNF	3	2016/11/20^	2017/08/13	435	Gusto
Little Naches	OWNF	5	2017/06/11	2017/10/08	238	Gusto
Lone Butte	GPNF	3	2017/06/11	2017/09/10	164	Gusto
Manastash	OWNF	3	2016/10/29^	2017/10/22	679	Gusto
Taneum	OWNF	3	2017/05/25	2017/10/16	143	Gusto
Walupt Lake	OWNF	4	2017/06/03	2017/10/07	182	Gusto
Wildcat Creek	OWNF	6	2017/06/07	2017/10/11	206	Gusto

Table 5. Number of detection events by species at wolf survey areas. *Species of skunk include; ~Striped, **Spotted

Species Detection Events at Wolf Camera Survey Areas 2017														
Species Priority	Level 1	Level 2	Level 3											
Survey Area	Fisher	Mountain Lion	Bobcat	Black Bear	Coyote	Elk	Mule Deer	Skunk*	Porcupine	Raccoon	Virginia Opossum	Snowshoe Hare and smaller mammals	Livestock	Human (non-volunteer)
Blue Lake Ridge	1	17	41	37	13	44	125	5**		3	1	39		10
Cispus		4	5	7	37	6	31	2~				2		42
Little Naches		3	20	1	18	45	23		3			16		14
Lone Butte		4		8	5	160	17					34		12
Manastash		12	18	11	62	35	11					77		18
Taneum		7	1		1	12	7	2~				5		14
Walupt Lake			4	4	9	16	24					6		
Wildcat Creek		3		3	5	45	3					5	58	1

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 (immediately east of Snoqualmie Pass), at milepost 54, and Easton, at milepost 70 (Figure 5). The I-90 survey areas in 2017 monitored previously established priority areas within close proximity to the freeway and wildlife crossing structures that have been completed, are under construction or have been planned as part of the I-90 Snoqualmie Pass East Project. Four of the survey areas (Gold Creek, Price Creek and Crystal Springs, and Easton) are in wildlife travel corridors leading to these crossing structures. These installations, established in the I-90 Corridor, detect general

wildlife movement and presence in relation to the wildlife crossing structures. Our efforts totaled twelve discreet locations being monitored and 1,638 trap nights accounting for 17.3% of our monitoring efforts (Table 6, Figure 2).

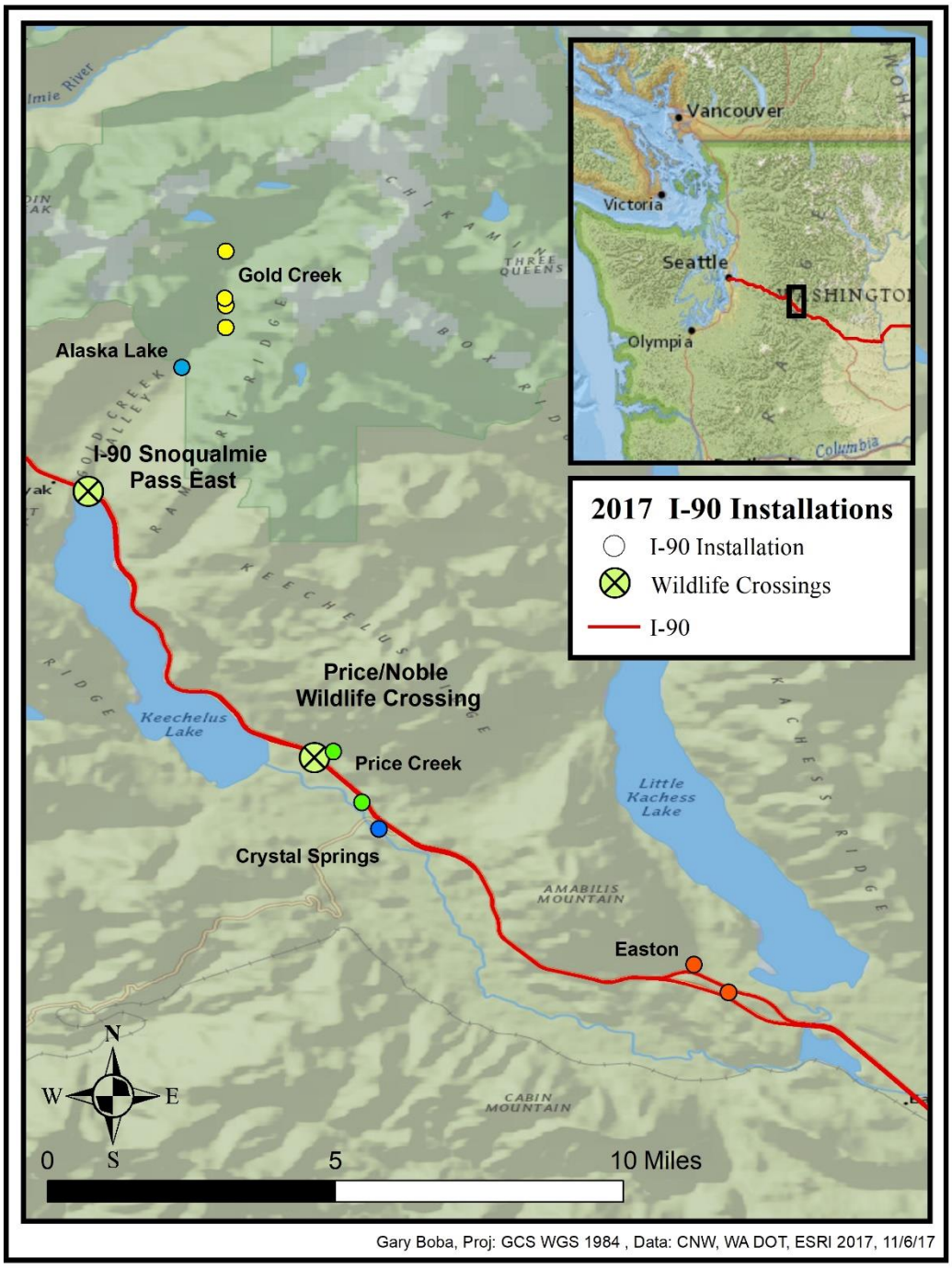


Figure 5: All general wildlife installations for 2017 were located between Hyak and Easton on the I-90 Corridor.

Table 6. Information for all I-90 survey areas, including duration of monitoring and number of installations. ^Denotes the first date photos were received 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 2017						
Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Alaska Lake	MBSNF	1	2017/01/20^	2017/05/25	125	None
Easton	OWNF	3	2017/01/07^	2017/09/06*	823	None
Gold Creek	OWNF	5	2017/06/04	2017/10/2	240	Gusto
Price Creek	OWNF	2	2017/06/04	2017/11/21	340	None
Crystal Springs	OWNF	1	2016/09/25^	2017/01/13	110	None

Over the course of the season, mountain lions, a level two species, were detected at both Gold Creek and Price Creek. Seven level three species, including black bear, bobcat, coyote, elk, mule deer, snowshoe hare and smaller mammals, and human (non-volunteer) were detected. All species were seen at Easton except the detection of a mountain lion (Table 7).

Table 7. Number of detection events by species at I-90 survey areas.

Species Detection Events at I-90 Camera Survey Areas 2017								
Species Priority	Level 2	Level 3						
Survey Area	Mountain Lion	Bobcat	Black Bear	Coyote	Elk	Mule Deer	Snowshoe Hare and smaller mammals	Human (non-volunteer)
Alaska Lake				5			51	3
Crystal Springs		3			1	1		1
Easton		6	2	9	17	17	15	13
Gold Creek	2		11	2	3		8	1
Price Creek	1			1	79	47	4	

WOLVERINE

Our wolverine survey areas this season spanned throughout Washington's North and South Cascades, both east and west of the Cascade Crest (Figure 6).

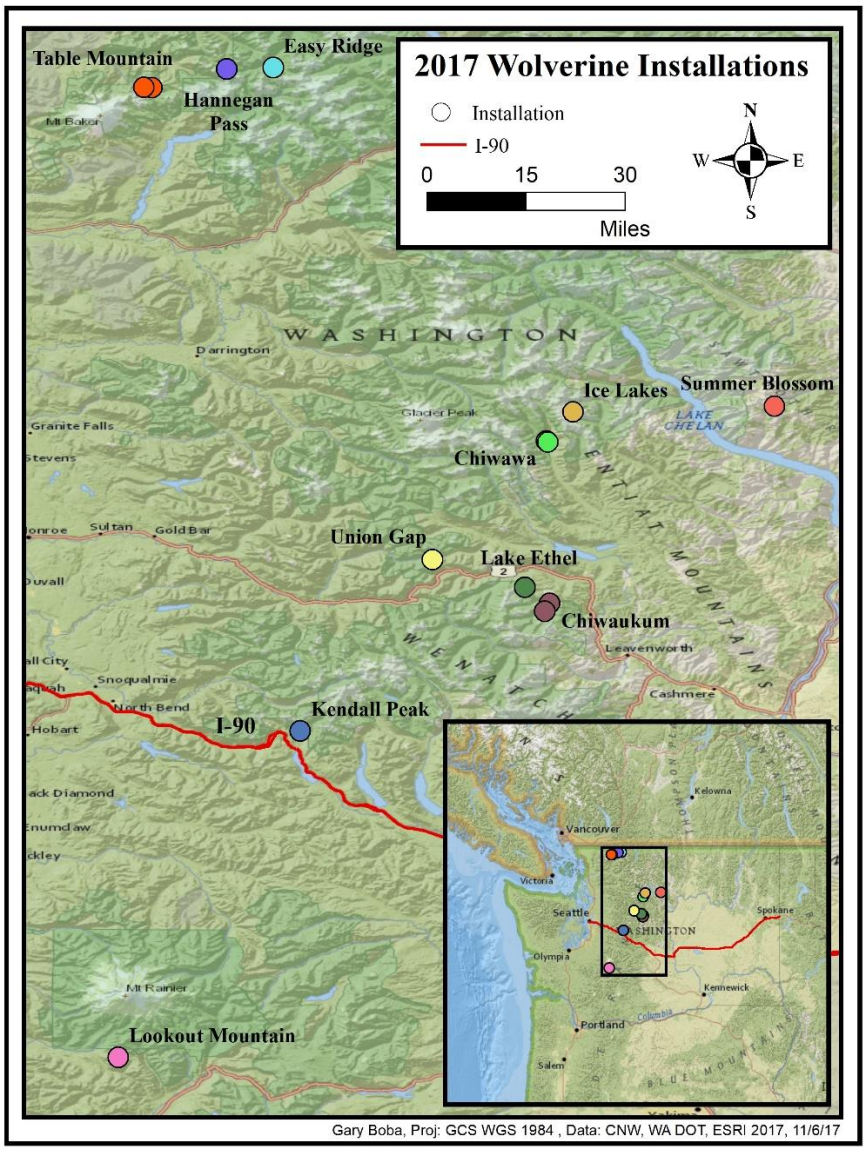


Figure 6: All wolverine installations for 2017 spanned between the Mount Baker Snoqualmie National Forest in the southwest and northwest to the Okanogan Wenatchee NF east of the cascade crest, to the North Cascades National Park in the northeast.

The wolverine monitoring included 11 distinct installations, 4004 trap nights, making up 42.3 percent of our total monitoring efforts for the year (Table 8, Figure 2). Four of our eleven wolverine survey areas were active all year in 2017: Chiwaukum, Union Gap, Lookout Mountain, and Ice Lakes. The Ice Lakes camera had not been visited since 2015, due to complications with access in 2016 due to wildfires, but was discovered active by our volunteer team and with 8 separate wolverine detections over the course of the monitoring period. Volunteers have re-baited and serviced the cameras. Numerous wolverine survey areas are currently being maintained over the winter season from 2017-2018. These active sites include: Chiwaukum, Union Gap, Lookout Mountain, and a Kendall Peak, and Lake Ethel.

Table 8. Wolverine survey area information, including duration of monitoring and number of installations. +Denotes a survey area without a run-pole installed. ^Denotes the first date photos were received in 2017 from survey areas left active over the winter. *Denotes the last date cameras were checked, but survey area was not uninstalled. ~Cameras active over multiple years, data received in 2017.

Wolverine Camera Survey Areas 2017						
Survey Area	General Region	# of Installations	Installation Date	Removal Date	Total Trap Nights	Lure
Chiwaukum	OWNF	2	2016/12/04^	2017/09/10*	560	Gusto / Bait
Chiwawa	OWNF	2	2016/11/24^	2017/9/07	574	Gusto / Bait
Hannegan Pass+	NCNP	2	2017/08/26	2017/10/29*	64	Gusto / Bait
Ice Lakes~	OWNF	1	2015/06/19	2017/07/23*	765	Gusto / Bait
Kendall Peak+	MBSNF	1	2017/01/11^	2017/08/15*	145	Gusto / Bait
Lake Ethel	OWNF	1	2017/06/03	2017/10/18*	137	Gusto / Bait
Lookout Mountain	MBSNF	1	2016/10/29^	2017/10/28*	364	Gusto / Bait
Mountaineer Creek (Multi-St)	OWNF	1	2016/11/25^	2017/02/25	92	Gusto / Bait
Summer Blossom Ridge~	OWNF	1	2015/06/28	2017/09/25	820	Gusto / Bait
Table Mountain	MBSNF	2	2017/07/30	2017/10/15*	154	Gusto / Bait
Union Gap	OWNF	1	2016/11/19^	2017/10/14*	329	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 photographs animals head-on, on the run-pole. For run-poles that have been elevated to accommodate for winter snowpack, the height differential between ground level and run-pole can sometimes be over 10 feet. Since two cameras are running simultaneously, 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. Two survey areas did not have run-poles established; Hannegan Pass and Kendall Peaks had one camera each. The Ice Lakes and Summer Blossom Ridge cameras were installed in 2015 and data was collected in July and September, respectively, with both cameras still operational and detecting species presence.

Our cameras detected wolverines at Ice Lakes and a fisher at Lookout Mountain, both level one species. The Ice Lakes camera, which has detected wolverines in past years, was active from June of 2015 to July of 2017 and recorded eight separate detections, one with two individual wolverines passing through the site together. The wolverine detections at Ice Lakes spanned over four days in August 2016, in September a month later, again in December of 2016, and two visits eleven days apart in July of 2017. Because the site had not been rebaited in some time, the desired behavior needed to obtain photographs of an individual's unique chest blaze pattern or the act of rubbing on a hair snag for genetic samples were not achieved.

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, means that hair samples must be collected on frequent intervals to obtain a quality sample and put in desiccant to dry and preserve the sample from

degradation [27]. In areas with high detection rates of target species, like Ice Lakes, we will be developing a plan for volunteers to visit the site more frequently or have a backup team that can revisit the site.

Table 9. Number of detection events by species at wolverine survey areas.

Species Detection Events at Wolverine Camera Survey Areas 2017												
Species Priority	**Level 1**		**Level 2**		**Level 3**							
Survey Area	**Wolverine**	**Fisher**	**Mountain Lion**	**Marten**	**Bobcat**	**Black Bear**	**Coyote**	**Moose**	**Elk**	**Mule Deer**	**Snowshoe Hare and smaller mammals**	**Human (non-volunteer)**
Chiwaukum			1	67	10	49	9			32	193	
Chiwawa				40		31				11	77	
Hannegan Pass				8		1					7	
Ice Lakes	8		1	4		1				25	42	
Kendall Peaks				250		6					1	11
Lake Ethel			1			7	2		2	1	1	
Lookout Mountain		1	1	2	3	11	10		6	3	154	
Mountaineer Creek (Multi)				149								
Summer Blossom Ridge				9	1	3	1	3		7	71	1
Table Mountain				6		18				1	4	
Union Gap				383		2				2		

Marten and mountain lion, both level two species, were detected at ten and four of the eleven wolverine survey areas, respectively (Table 8). Eight level three species, including black bear, bobcat, coyote, moose, elk, mule deer, snowshoe hare and smaller mammals, and human (non-volunteer) were documented at the wolverine survey areas (Table 9). Marten, black bear, and snowshoe hare and smaller mammals were the most frequently detected across all wolverine survey areas, which is a similar trend as in past years (Table 9).

CANADA LYNX

Out of our four survey areas, three were located in northeast Washington's Colville National Forest and one was located on the British Columbia side of the border in the Rossland Range, part of the larger Monashee Mountains (Figure 7). Volunteers maintained eleven distinct camera installations on the Washington side of the border

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

throughout the monitoring season and data was shared

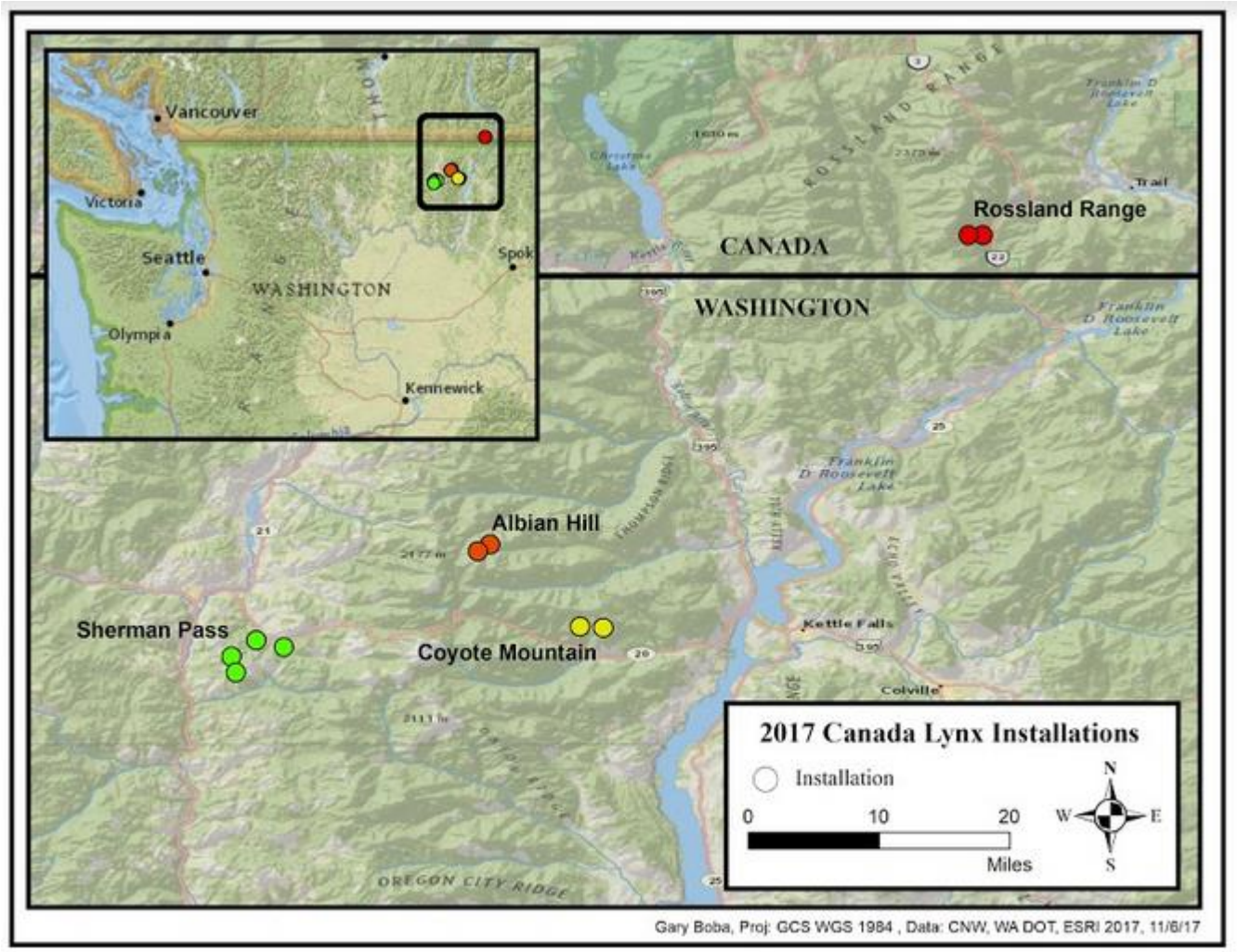


Figure 7: All Canada lynx installations for 2017 spanned from the Rossland Range to the North in British Columbia to the Kettle Range in the United States.

Table 10. Lynx survey area information for thirteen camera installations.

Canada Lynx Camera Survey Areas 2017						
Survey Area	**General Region**	**# of Installations**	**Installation Date**	**Removal Date**	**Total Trap Nights**	**Lure**
Albian Hill	**CNF**	**3**	**2017/06/20**	**2017/10/22**	**182**	**None**
Coyote Mountain	**CNF**	**4**	**2017/06/11**	**2017/10/07**	**236**	**None**
Rossland Range	**BCRR**	**2**	**2016/10/23**	**2017/01/14**	**166**	**Lynx**
Sherman Pass	**CNF**	**4**	**2017/06/14**	**2017/09/14***	**184**	**None**

* last revisit date/ no photos from removal date 10/14/2017

from two camera installations located in the Rossland Range in British Columbia, totaling 8.1 percent or our overall effort with 768 trap nights (Table 10, Figure 2). Our partners in BC have detected Canada lynx consistently each monitoring year since 2015 (Table 11). Our program compliments larger efforts of those researching the

transboundary Canada lynx population. We look forward to receiving updates from our collaborators at Washington State University researching the Canada Lynx population in Washington state and the researchers at Selkirk College working on better understanding the lynx population within the B.C. Kettle and Rossland mountain ranges.

Of note are the gray wolf detections at the Sherman Pass and Albian Hill survey areas (Table 11). A pair travelling together, one collared and one non-collared were captured on camera, as well as two other detections of single wolves. 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 have focused our wolf monitoring efforts.

Table 11. Number of detection events by species at lynx survey areas.

Species Detection Events at Lynx Camera Survey Areas 2017												
Species Priority	**Level 1**		**Level 2**	**Level 3**								
Survey Area	**Wolf**	**Canada lynx**	**Mountain Lion**	**Bobcat**	**Black Bear**	**Coyote**	**White-Tailed Deer**	**Mule Deer**	**Moose**	**Striped Skunk**	**Snowshoe Hare and smaller mammals**	**Human (non-volunteer)**
Albian Hill	1		2	20	12	8	4	10	2		17	14
Rossland Range		1					4	3	1		36	
Sherman Pass	2			10	3	18	12	5		10	108	2
Coyote Mountain			5	9	15	8		29	11	1	265	123

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 2018 remote camera monitoring season are to:

1. Assess monitoring efforts for grizzly bears and other rare carnivores in the North Cascade Ecosystem. Evaluate volunteers and teams' ability and commitment to long, arduous, off trail navigation and site access, and commitment to retrieving these cameras. 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, establish alternate team members that can assist

in maintaining a site if target species are present. 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 recognizing key areas for potential sample collection and having a backup team that can visit specific sites if needed.
13. Advise 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.

ACKNOWLEDGEMENTS

We appreciate supportive grants from WDFW ALEA Cooperative Grants Program, Norcliffe Foundation, Deacon Charitable Foundation, Lucky Seven Foundation, and an anonymous foundation that supported CWMP in 2017. This project would not be possible without your generous support.

We are also very grateful for the following individuals who adopted teams for the 2017 season: Barbara Hawkins and Jeff Daffron. We appreciate your support!

We would like to thank the individual advisory council members, specific survey area advisers, and project collaborators for the talent, time, and guidance they provided:

(Cascades Carnivore Project) Jocelyn Akins;

(Colville National Forest) Chris Loggers;
(BC Ministry of Forests, Lands and Natural Resources) Aaron Reid;
(Gifford Pinchot National Forest) Carol Chandler, John Jakubowski;
(Mt. Baker Snoqualmie National Forest) Sonny Paz, Jesse Plumage;
(North Cascades National Park) Roger Christophersen, Regina M. Rochefort, Ph.D.;
(Okanogan-Wenatchee National Forest) Monte Kuk, Patty Garvey-Darda, Joan St. Hilaire, Matt Marsh, Jesse McCarty, Jo Ellen Richards, John Rohrer, Aja Woodrow, Don Youkey;
(PNW Research Station, USDA Forest Service) Keith Aubrey, Cathy Raley;
(US Fish and Wildlife Service) Gregg Kurz;
(WA Conservation Science Institute) Bill Gaines;
(WA Dept. of Fish and Wildlife) Dana Base, Scott Becker, Ben Maletzke, William Moore, Annemarie Prince, Trent Roussin, David Volsen, Scott Fitkin;
(WA Department of Transportation) Kelly McAllister, Mark Norman, Josh Zylstra;
(Washington State University) Dr. Dan Thornton;
(Western Transportation Institute) James Begley, M.S.;
(Western Wildlife Outreach and BearTrek) Chris Morgan;
(Woodland Park Zoo) Robert Long.

We would like to thank Dr. Lui Marinelli of Selkirk College and his students; Graham Collingwood, Paige Mansveld, and Heather Shaw for their work throughout the 16'-17' winter season and Evan Dux, Laura Caruth, Mackenzie Gibson, Michael Haig for their work during the 17'-18' winter. Your partnership has extended our Canada lynx study area into British Columbia, thank you for being involved!

We would like to acknowledge the huge amount of effort our project interns contributed throughout the 2017 season, who's dedicated, detailed work this program depends upon; Tanner Humphries, Sydney Romero, Jason McCue, Abbey Allen, and Gary Boba, we wish you the best in your future endeavors!

We would like to thank our volunteers, whose hard work in and out of the field made this season possible:

Team Leaders: Brooke Bogart, Brooke Nelson, Cara Stoddard, Cathy Clark, Cathy and Drew Gaylord, Chad Maurer, Chase Gunnell, Dave and Debbie Rodenhizer, Doug Stevens, Gail Pethe, Guthrie Schrengohst, Haley Watson, Jack McLeod, Jim Clark, Justin Bohling, Katie Remine, Manoj Sarathy, Matt Uyttendaele, Melinda Mast, Mike Prince, Morgan Thompson, Paul Jensen, Peter Loft, Sandra Becka, Steve Taber, Sydney Romero, Tanner Humphries, and Todd Daniels.
Team Members: Alberto Chavez, Aneesh Tantri, Anne Whitfield, Ava Benami, Ben Prom, Bill Whipple, Bob Swann, Brett Rodenhizer, Bryan Torrel, Carson Schnelz, Cate Burnett, Cathy Clark, Chance Erikson, Chris Kuntz, Christina Burress, Christine Phelan, Dax Anderson, Dusty Cavaliere, Erin Tudor, James Ciesluk, Jasper McCrutcheon, Jayna and Niko Bohling, John Kuntz, Jonathan Dent, Kelli Young Beach, Kelly Frazee, Keri Young, Kristian Boose, Kurt Kiefer, Larry O'Neil, Lela Work, Lorinda Flikkema, Mary Williamson, Melissa Rienstra, Nancy Wagley, Patricia Miller, Patrick McCrutcheon, Patrick McGee, Paul Ryhajlo, Paula Hungar, Rick Szeliski, Rusty Thurman, Ryan Logan, Selena Nuutinen, Simha Venkataramaiah, Steph Williams, Steve Santamaria and Tom Stonehocker.

We have many volunteers and active supporters who contribute their time and expertise in various ways throughout the course of the program and the potential to miss people ever looms. Thank you to any we may

have missed!

REFERENCES

Aubry, Keith B., 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: 2147, 2007.

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

Brittell, J.D., R.J. Poelker, S. J. Sweeney, and Gary M. Koehler. *Native Cats of Washington, Section III: Lynx*. Unpublished. Olympia, WA, USA: Washington Department of Fish and Wildlife, 1989.

Froschauer, Ann (2015). Service Confirms New Wolf Pack in North-Central Washington. *U.S. Fish and Wildlife Service.* http://www.fws.gov/news/ShowNews.cfm?ID=3A72EB23-A4B7-EDB5-C7BD1CE75668DED6.

Kendall, K.C., and K.S. McKelvey. “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. 2008.

Koehler, Gary M., Benjamin T. Maletzke, Jeff A. Von Kienast, Keith B. Aubry, Robert B. Wielgus, and Robert H. Naney. “Habitat Fragmentation and the Persistence of Lynx Populations in Washington State.” *The Journal of Wildlife Management* 72, no. 7: 1518–1524, 2008.

Long, R.A., J.S. Begley, P. MacKay, W.L. Gaines, and A.J. Shirk. *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. 2013.

Poole, Kim G. “Dispersal Patterns of Lynx in the Northwest Territories.” *The Journal of Wildlife Management* 61, no. 2: 497–505, 1997.

Schlexer, Fredrick V. “Attracting Animals to Detection Devices.” In *Noninvasive Survey Methods for Carnivores*, by Robert A Long. Washington, D.C.: Island Press, 2008.

Servheen, Chris. "North Cascades ecosystem recovery plan." In *Grizzly bear recovery plan:* U.S. Fish and Wildlife Service. Missoula, MT 1997.

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

United States Fish and Wildlife Service. 2015. *U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form.* http://ecos.fws.gov/docs/species/uplisting/doc4748.pdf

Washington Department of Fish and Wildlife. 2012. Grizzly Bear (Ursus arctos horribilis). *Endangered Species Annual Report.* http://wdfw.wa.gov/conservation/endanger*ed/species/grizzly_bear.pdf

Wemmer, Christen, Thomas H. Kunz, and Virginia Hayssen. "Mammalian Sign." In *Measuring and Monitoring Biological Diversity.*, by Don E Wilson, F. Russell Cole, James D. Nichils, Rasanayagam Rudran, and Mercedes S. Foster. Washington: Smithsonian Institution Press, 1996.

Wiles, Gary J., 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.

Yasuda, Masatoshi. "Monitoring Diversity and Abundance of Mammals with Camera Traps: A Case Study on Mount Tsukuba, Central Japan." *Mammal Study* 29, no. 1: 37–46, 2004.

APPENDIX I: North Cascades Grizzly Bear Recovery Zone

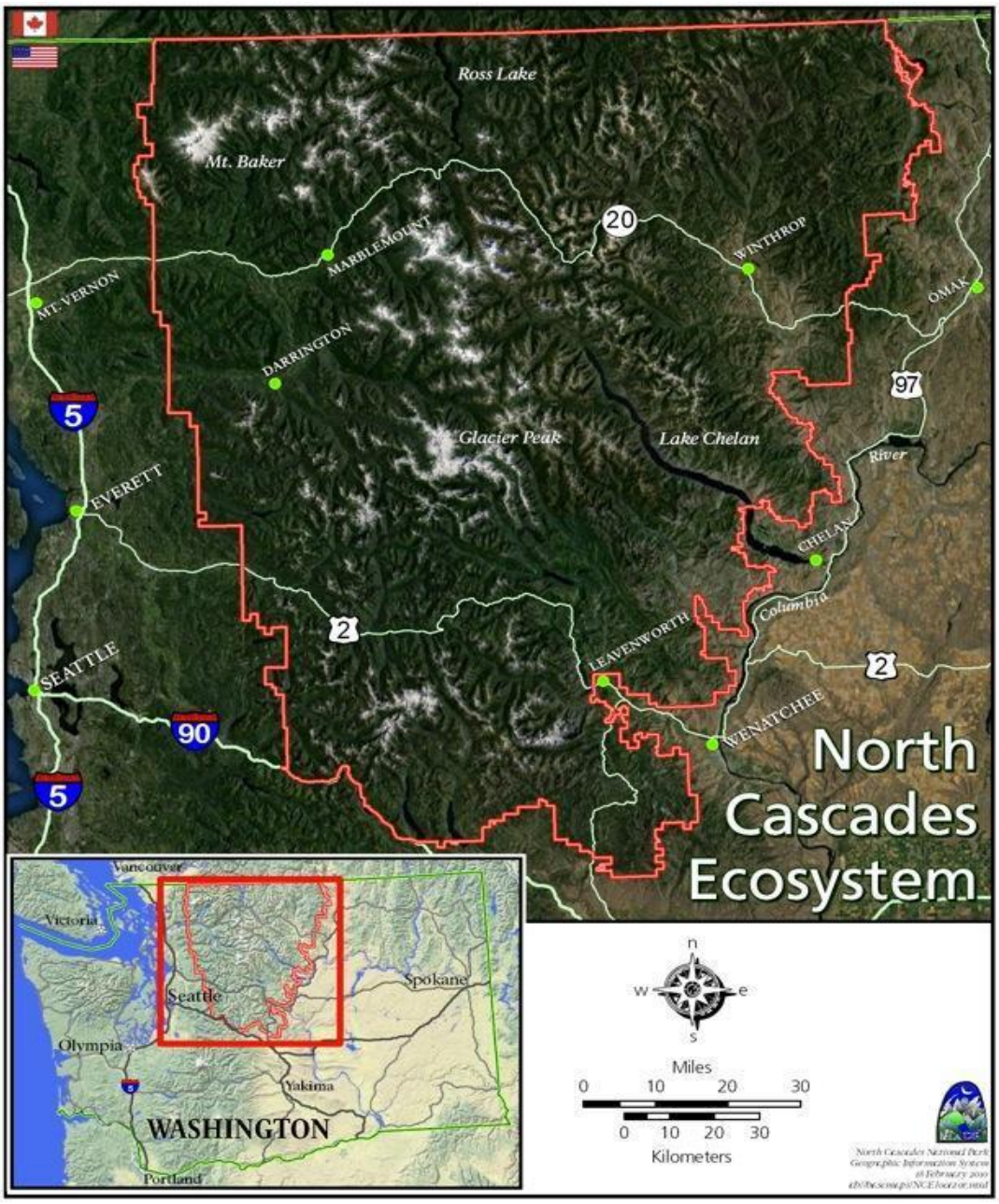


Photo from Western Wildlife Outreach http://westernwildlife.org/our-work/north-cascades-grizzly-bear-recovery-area/

APPENDIX II

Remote Camera Trap
Installation and Servicing Protocol

Citizen Wildlife Monitoring Project

2017 Field Season

Prepared by:

David Moskowitz

Alison Huyett

Contributors:

Aleah Jaeger

Laurel Baum

This document available online at: https://www.conservationnw.org/wildlife-monitoring/

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest and Wilderness Awareness School

Contents

Field Preparation

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

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

3. Know your site: familiarize yourself with your location, the 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 contact at Seattle Office: Laurel Baum (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/drive/folders/0B1ppDLoUmp4nczI2ZzExSVAxS1E

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/at_download/file

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 location out of the line of sight from major trails and/or roads.

Trail Sets: If you are 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, in addition to using a lock box and python lock, consider trying to set the camera below or above head height so it is less visible. Setting it in a location that doesn't draw attention to it can also help with keeping it concealed from people.

Lighting: For best results, consider how the light may affect the photos. Shadows and changes in lighting can trigger the camera. Note that pointing the camera in a north-south direction often offers the best results.

Visual Obstructions and False Triggers: Look for a clear site or one that you can easily clear so that the camera's view is not 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. This can otherwise produce false triggers resulting from wind or 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 in front of it. Cameras are often mounted pointing too high, so aim on the low side.

Once you have the camera in position, use bungee cords or camera straps and your python lock 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. Try to anticipate spring snowmelt and changing conditions in many locations (this step may need to be repeated during future camera checks).

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 test images. 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.

For cameras without a test function, turn on the camera and walk in front of it, making sure to cover as much ground as possible. Then open the camera and see what is captured in the photo frame. **Be sure to replace the memory card back in the camera and turn it back on, and place a lock around the camera or through the lockbox containing the camera.**

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 in order to get a photo of the camera team visiting the camera. Before leaving a newly set up or serviced camera trap, once again step in front of the camera in order to capture a photo of the 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 and time, team leader name, latitude, longitude, altitude, and attractant used. Stand in front of the camera for 10 seconds to make sure a clear photo is captured. All of this information will help us ensure that we are

able to keep track of where images have come from. To avoid glare and to ensure that what you have written is clear, please stand approximately five feet in front of the camera and use gray paper and a thick, black marker to fill in the information.

Data Sheet: Make sure your GPS unit is set to report coordinates in **decimal degrees** and record the GPS coordinates (use Datum WGS 84, lat/long coordinates in **decimal degrees**) on your data sheet if this is a camera installation/move or if they were not recorded previously. Carefully fill out all of the other information requested on the data sheet. Include relevant notes about the location and details about access 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 (more than 100m away from original location) this is considered a new installation. 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) counts as the same installation. Carefully record the specific name of each individual installation on the data sheet. 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 with previous camera visits to double check the title of the installation if you have any questions.

General location-year installed-installation number	Example: Rainier-2016-1
General location	This title is provided to you by Conservation Northwest when you are issued 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 a location, surveyor flagging tape can be used to guide you. Do not rely on this as your only means of finding your camera again 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 one tree and a rock, log or other feature that 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 the breeze. The other tree or landscape feature is for spreading the lure on and can be any size. However, make sure it is large/sturdy enough 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, attracting animals from a longer distance.

Trapper's lures: When applying the highly concentrated trapper's scent lures (those in small bottles) remember that a little goes a long way. Simply use a branch dipped into the bottle for application, and put 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 into the bark, but do remember moderation.

With fish oil, fish fertilizer, or oil from a sardine can, you can apply the scent more liberally. Try pouring some at varying heights on the tree trunk, 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 cropping or only capturing portions of animals. Full view of an animal's features is often needed to ensure species identification. Make sure that the attractant is only applied on surfaces within the camera's view so that wildlife spending time sniffing are captured on the camera. Set the camera, and then trigger it and review the images in order 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 itself. 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 lure, treat it as you would treat food. Store it away from your camp, ideally hung from a tree just like you would hang food in bear country.

Make sure to record the exact name(s) 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 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 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 the wildlife captured on camera. 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 it according to the **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 crosscheck with the date/time on the photos when we download them in the office*). If the camera does not trigger, your batteries may already have died or your memory card is full.

2. Unlock the cable lock 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 model user guides are below and on our website. Hard copies of user manuals are made available to team leaders and stored in the office)*.

4. If appropriate for your camera trap, apply lure and install bait according to your specific site instructions. *Every site has unique directions, so be sure to understand and follow yours*. Please remember that a very little amount of lure goes a long way, and that too much 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 capture a "camera check" image, which will act as a reference for the survey period between camera checks. Hold a sheet of paper up with all the information mentioned above for index photos.

After your Camera Trap Check

Email a brief report of your visit to your team and cc Laurel Baum (lbaum@conservationnw.org). 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 immediately upon return and cc: lbaum@conservationnw.org. Please pass on any information about the site to your team members, even if it is not as critical as the examples listed above. 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.

Review, tag, and upload the photos from retrieved memory cards to Google Drive (online photo sharing service) and fill out an online data form (see instructions for both below). You also have the option of returning the memory card(s) and data sheet(s) to your team leader or the nearest Conservation Northwest office ASAP. That way we can get the photos from your camera downloaded, reviewed, and stored in our database. Indicate how data is being returned to Conservation Northwest on your data sheet in case the images and the data sheet are separated.

Cameras should be checked roughly once each month throughout the season, depending on the camera location and accessibility. Your team leader will schedule camera checks to ensure that sites are being maintained regularly.

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, snowpack 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. Sites that have been very active with a variety of other carnivore species might encourage you to leave the camera trap where it is currently located. Sites that have had very low activity might be worth relocating. Other factors to take into consideration may include an abundance of other promising locations to monitor, or conversely, the current location appearing to be the best 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 you submit. See above for guidelines about labeling discreet installations. If you are using the coordinate-recording feature on a remote camera, be sure to reset the coordinates to the location of your 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/2017fieldteamphotomanagementguidelines). Below is a synopsis of this process. Refer to full document for details.

Process Remote Camera photos: Review and tag photos in Windows Photo Gallery, Picasa, or Iphoto

Windows Photo Gallery

Use Windows Photo Gallery if you use a Windows PC computer and have not previously downloaded

Picasa

1. Download photos to your computer.
2. Open Windows Photo Gallery. Navigate to the folder containing recently imported photos by using the pane on the left side of the program.
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 you are 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 to delete at once when in the screen with rows of thumbnails.

4. Update the "Descriptive tags" feature to tag all photos with species ID using the labeling conventions guidelines. This feature can be found in the pane on the right side of the program. You can tag multiple photos at once by selecting as many as you want to tag, and then updating the "Descriptive tags." The program automatically updates and saves photos with new tags.

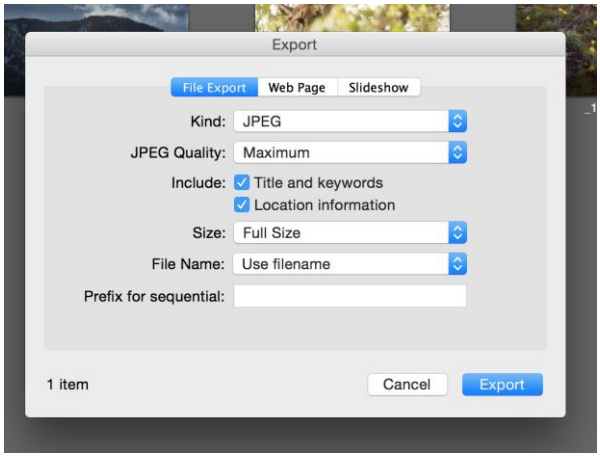
Picasa

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. Follow step three above.

4. Use 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. You can tag multiple photos at once by selecting as many as you want to tag in the screen with rows of thumbnails and then adding a tag.

Iphoto

1. Import photos into Iphoto.
2. Follow step three above.
3. Use the "Keyword" feature to label the species in all the photographs. You can batch-enter keywords to save time, by selecting multiple images at once in the gridview.
4. Once all photos are labeled, export them into a folder on your desktop or directly onto Google Drive. When exporting images from Iphoto to send to Conservation Northwest, be sure to select the following settings (see image below of export dialogue box).



Upload Remote Camera Photos to Google Drive

1. Each time you upload new photos from a camera check you will need to create a folder in Google Drive for each camera you check (most teams will have two camera sites).
2. Navigate to Google Drive either through an internet browser or through the app on your desktop.
3. Create a folder within your Google Drive account. The folder will need to be labeled as such:

Site-Year-Installation #_XXX (previous visit date)-XXX (current visit date)

Example: Mt. Rainier-2015-1_12AUG2016-30AUG2016

And for second installation in that area:

Mt. Rainier-2015-2_12AUG2016-30AUG2016

4. 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: “runpole” and “vicinity”.
    a. Create a "site location" folder.
    b. Since there are two cameras installed at the same site, create two folders within the "site location" folder.
        - Example of “site location” folder:
          Mount Baker-2015-1_12April2016-5May2016.

    c. The first folder within the “site location” folder should be labeled "runpole" and should contain the photos from the camera that is set facing the runpole.

    d. The second folder within the “site location” folder should be labeled "vicinity" and should contain the photos from the camera that is set up to record the entire site scene.
5. Add all of the photos from your camera check into the appropriate folder.
6. Once all of the photos have been added to the folder, “share” the folder with wildlifemonitoringproject@gmail.com. To do this you can “right click” on the folder name and select “Share” in the popup menu. Then add the email address there. Hit save.
7. If applicable, you can include a note in each camera folder (via Word document or Google text document) for any instances of runaway photo-taking from false triggers, or other relevant issues. Place this document in the folder with the applicable photos.
8. Once photos are completely uploaded to shared folder, email wildlifemonitoringproject@gmail.com informing us that the photos have been uploaded.
9. If you are having trouble uploading photos or have any questions contact Laurel Baum (lbaum@conservationnw.org).

Other general field photos

If you have relevant general field photos from your camera outing you can share them with the project in the same way as above. Upload any relevant photos you take with your own digital camera of the site/route to site/wildlife tracks and sign, etc. into a folder and share it with wildlifemonitoringproject@gmail.com. Label it with the site name, date of visit, and the title, “General Field Photos”. (***Example “Mt. Rainier-General Field Photos- 8_30_2016”***)

Label photos as best you can prior to uploading them 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 the metadata of individual photos, CNW will be able to access this information.

Enter data into online Remote Camera Check Data Form

All data from each camera installation, check, location change, and removal needs to be filled out on your CWMP Field Data 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. This data form needs to be filled out for each camera every time you visit it!

Notify Conservation Northwest once you have uploaded your photos

Once photos are completely uploaded to the shared folder, email wildlifemonitoringproject@gmail.com to let us know.

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.

All photos taken by cameras owned by the CWMP are owned by the non-profit organizations sponsoring this effort. We strongly recommend that any cameras not owned by CWMP but contributing to our effort 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 findings.
- If you feel you have captured a photo of your target species, you can upload it to Google Drive and alert our staff OR email it directly to our staff. Photos can be emailed simultaneously to lbaum@conservationnw.org and jwatkins@conservationnw.org (to ensure that even if one of us is on vacation they are viewed).
- Selected photos are shared on our website and results are reported in our volunteer e-newsletter. Requests for any photographs can be made through our program to lbaum@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 share and discuss all results. At that time, all results, with the exception of details of camera locations, are public information.

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 2017:

Project Coordinator: Laurel Baum, lbaum@conservationnw.org or 206-637-9747 ext 201; Project Director: Jen Watkins, jwatkins@conservationnw.org or 206.940.7914

Wildlife Track and Sign Documentation

It is not uncommon for the animals we monitor 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 may be from 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 of the presence of our target species.

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 document 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 a photo looking directly down at track to reduce distortion. Include two scales, preferably rulers, one running lengthwise and the second running widthwise. Collapsible ski poles with visible cm calibrations also work.

Track patterns, trails, and other signs

Include a scale of some sort. This may mean you leave 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 a picture looking directly down at the trail to reduce distortion. If this is impossible due to the size of the 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 pictures of people looking at the tracks or sign, or pictures that show the tracks in the context of the location they are found to accompany the detail pictures.

Trailing and Specimen Collection (Optional/Recommended)

Assuming time and safety permit, attempt to follow the animal's 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 that you have photo-documented, carefully collect the specimen following the same guidelines laid out for our camera traps (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. Strong evidence may solicit a hasty follow-up response in the area of discovery which might include setting up/resituating remote cameras and hair snags, or follow-up tracking surveys.

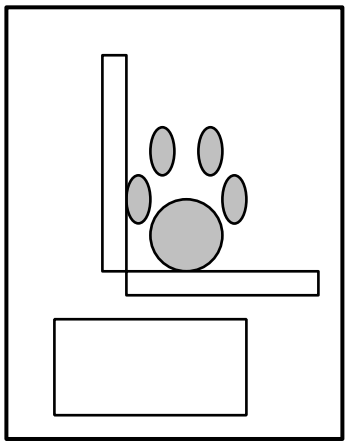
Acknowledgements

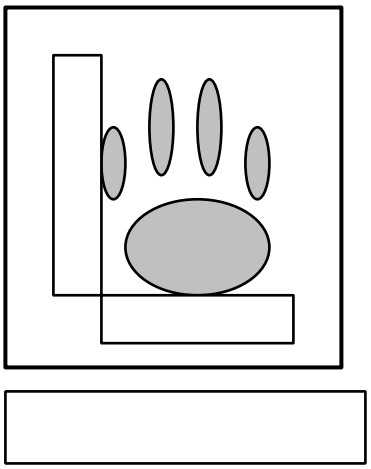
The field methods documented here represent the work of many individuals over the course of the years this project has been underway. Many thanks to all of the past CNW staff and project volunteers who have written, revised, or offered feedback on this and past versions of this document. A special thank-you 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:

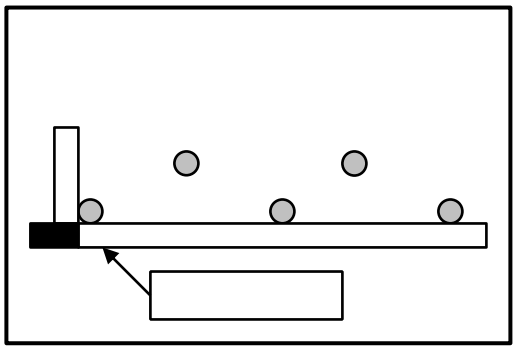
1. Take photo looking directly down on track to reduce distortion.
2. For close up photographs, fill the entire frame with the track and measuring devises
3. Include two scales, preferably rulers, one running lengthwise, the second widthwise.
4. Take at least one picture of the track that includes a 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.

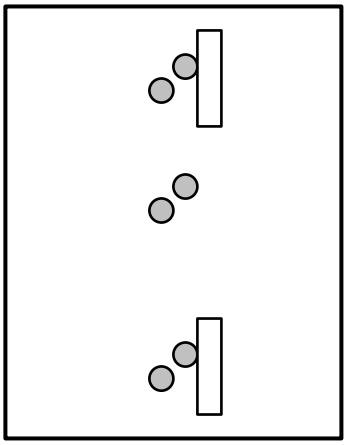




PHOTOGRAPHS OF GAITS/TRAIL PATTERNS

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: https://www.conservationnw.org/wildlife-monitoring/

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest and Wilderness Awareness School

Contents

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.

References

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.

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.

Moskowitz, D. 2010. Wildlife of the Pacific Northwest. Timber Press, Portland Oregon.

North Cascades Grizzly Bear Recovery Team. 2004. Recovery plan for grizzly bears in the North Cascades of British Columbia.

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

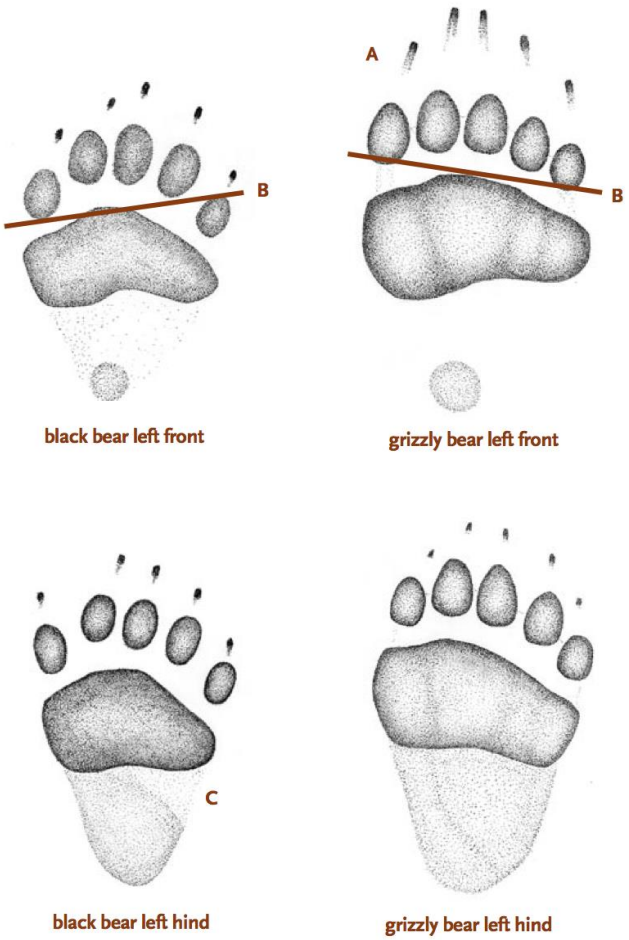


Figure 3. (Left) Comparison of black and grizzly bear tracks (source: Moskowitz 2010)

Key features distinguish black and grizzly bear tracks: **A** Claws on front tracks are usually longer then the length of the associated toe and significantly longer then the 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 beaar 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.

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

Photo 3. (Below Right) 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.

Literature cited:

Aubry, K.B., J. Rohrer, C.M. Raley, R.D. Weir, and S. Fitkin. 2012. Wolverine distribution and ecology in the North Cascades Ecosystem – 2012 Annual Report (November 21, 2012). < http://wolverinefoundation.org/resources/research-reports/ >

Copeland, J. P., K. S. McKelvey, K. B. Aubry, A. Landa, J. Persson, R. M. Inman, J. Krebs, E. Lofroth, H. Golden, J. R. Squires, A. Magoun, M. K. Schwartz, J. Wilmot, C. L. Copeland, R. E. Yates, I. Kojola, and R. May. 2010. The bioclimatic envelope of the wolverine (*Gulo gulo*): do climatic constraints limit its geographic distribution? Canadian Journal of Zoology 88:233–246.

Magoun, A. J., C.D. Clinton, M.K. Schwartz, K.L. Pilgrim, R.E. Lowell, P.K. Valkenburg. 2011. Integrating motion-detection cameras and hair snags for wolverine identification. Journal of Wildlife Management 75:731-739.

APPENDIX V

Camera-trapping protocol for large-scale lynx camera survey- summer

PI: Dan Thornton/Travis King (WSU)

This document available online at https://www.conservationnw.org/wp-content/uploads/2018/01/Lynx-Camera-Trapping-Protocol_DT.pdf

Collaborators: Scott Fitkin/Jeff Lewis/Ben Maletzke (WDFW); John Rohrer/Jesse McCarty/Matt Marsh/Don Youkey/Monte Kuk (USFS), Scott Fisher (WADNR), Aleah Jaeger/Dave Moskowitz (CNW)

This document will serve to provide guidance on camera placement and data recording for the WSU-led lynx camera survey in the Okanogan. Because such a large amount of ground will be covered, I am placing a premium on ease of camera placement. In addition to this document, there are data sheets which will be used to record pertinent data for each camera that is placed in the field.

Cell selection: Cameras will be placed in 40km^2 hexagonal cells, which simulate the lower-end estimates of female lynx home ranges in the state. I will provide a list and map of cells that were randomly selected for sampling to each collaborator for their area. If a particular cell cannot be sampled (e.g., lack of permission, not enough time to reach the cell given time constraints), please select the nearest cell that can be sampled.

Placing the camera: Within each 40km^2 grid, 4 cameras will be placed along movement pathways that include roads, abandoned roads, two-tracks, hiking trails, or ridgelines. During camera work in the Loomis State Forest and Black Pine Basin, we have had good success detecting lynx along major movement pathways. Thus, I expect it should be fairly easy to quickly access a number of locations in each grid cell. Please do **not** put cameras out on small game trails, off trail, or in other areas that don't represent major movement pathways – detection rates will drop dramatically. Cameras within each grid cell should be spaced 1 km apart at a minimum (if possible) to increase coverage of the grid cell. This restriction doesn't hold between grid cells – thus, a camera placed at the western edge of grid cell A that is less than 1km from a camera placed at the eastern edge of grid cell B is OK. If, due to access or other restrictions, cameras must be placed closer than 1 km apart, that is OK – it is more important to get the full complement of cameras out in the grid cell than to follow any minimum spacing rules (**the grid cell will be the unit of analysis**). As the main goal of this work is lynx detection, cameras should be placed above 1000m (~3900 feet) elevation where possible, and in forested areas. Again, if this is not possible due to access, lack of high elevation sites, or other restrictions, placing cameras at lower elevations or open habitats is acceptable. Ideally, more than one type of movement pathway should be used for camera placement in each grid cell (e.g., 1 cameras placed on larger roads, 1 on smaller roads, and 1 on a hiking trail or abandoned logging trails), but again, this may not be possible in all cells. I leave it to the discretion of the individual putting cameras out to choose appropriate locations, given the restrictions mentioned above. I will provide a map and UTM coordinates of ***potential*** camera locations in each grid cell, but leave it to the discretion of the individual putting cameras out whether or not to use these potential sites.

Setting the camera: For summer deployments, cameras should be placed approximately knee height (38-48cm/15-19inches) and aimed perpendicular to the road/trail. The trail area immediately in front of the camera should be cleared of vegetation/grasses, as this will obstruct camera images, and may also trigger the camera. In addition,

please be sure that there is no vegetation in front of the camera, or near the camera that may grow to obstruct the camera during the 30-60 day period it will be out. Taking care to ensure proper set up is key, particularly if cameras cannot be checked for long periods of time. Cameras should be set to record a burst of 4 images on each detection, with a one minute delay between successive triggers. If a camera model being used doesn't have this option, that is OK, but it must be noted on the data sheet. If placed in areas where theft is a possibility or that will have lots of human traffic, then cameras should be placed in such a way to make them less visible as much as possible (e.g., slightly set-back from the travel pathway), without compromising image quality, field of view (camera can 'see' across the entire trail), and infrared sensor detection. ***Please use the test function on the camera to make sure the camera-trap has a decent cone of detection, both in length and width, in relation to the trail where movement will occur***. Python cable locks should be used to secure cameras in all areas, although these are a visual deterrent only, and will not stop a committed thief. Cameras should be left to run for **at least 60 days**. If possible, a 30-day check for camera functionality should be performed. During this check, the camera should be checked for sufficient battery life, position, and functionality, and the SD card swapped out, or the image data downloaded. ***Remember to make sure the cameras is turned on prior to leaving the area!!***

*Note: We have not found baiting with scents to be particularly effective in improving lynx detection at cameras. Given that scented pads also add the complication of needing to set out and refresh baits, I have elected **to not use** scented baits as part of this protocol.

Data management: When cameras are initially set out, please record all relevant data on the "Camera Set-up" data sheet.

At the 30 or 60 day check, please download all image data to a folder labeled with the name of the camera, and whether or not this is a 30day_1st, 30day_2nd , or 60day_download. Thus, the name of a folder that was downloaded after a 30 day check might be CamID_234_30day_1st. A folder of images that was downloaded after the second 30 day check, might be CAmID_234_30day_2nd. A folder of images that was downloaded after 60 days (there was no 30 day check) would be labeled as CamID_234_60day. I with provide an external hard-drive for image storage, although I recommend saving the image folders to at least two separate locations (the external hard drive and a local computer). If the SD card is not going to be reused, images can be left on the card (in addition to being downloaded to a computer), and the card left in the camera. If the SD card is going to be redeployed, please erase the images before redeployment. I will engage with each of you to obtain the SD cards and/or image folders upon completion of the 90 day sampling period.

APPENDIX VI

National Lynx Detection Protocol

Kevin S. McKelvey

James J. Claar

Gregory W. McDaniel

Gary Hanvey

July 29, 1999

This document available online at https://www.conservationnw.org/wp-content/uploads/2018/01/National-Lynx-Detection-Protocol.pdf

Purpose

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

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

Efficacy. Even if sampling is representative, if detection rates are too low, the method will fail the test of efficacy. To address this, we tested 5 commercial scent lures on wild lynx in Canada to determine which lure produced the highest detection rate. While all lures were "hit" by lynx, one lure, a combination of beaver castorium and catnip oil was twice as effective as the others. Additionally, we made use of transects to sample lynx in Canada. Over a 2-4 week period, we had hits on nearly half (35/78 = 45%) of these 5-station line transects. Based on these results, we use line transects and the most effective lure.

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

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

Details

Broad decisions concerning where to sample

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

As was mentioned above, managers can decide where to sample, but our recommendations are generally to sample in cover types and areas which there is some evidence of historical lynx occurrence. Maps of broad cover-types associated with historic lynx occurrence are available for the contiguous US. These

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

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

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

Working in conjunction with other survey efforts

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

Non representative placement of transects, or even individual scent stations can sometimes provide useful information. For instance, if a lynx is known to exist within a specific drainage, one might want to specifically sample the drainage to try to determine whether the lynx is still present, or to obtain a

sample of its DNA for research purposes. Similarly, scent stations can be used as a double-sampling method to directly validate snow tracks (as camera sets have been used in the past). These non-representative surveys, however, are entirely exterior to the National Survey Protocol, and we are doing no testing which can directly be used to indicate their efficacy. Additionally, as mentioned above, these data are extremely limited in their utility. They cannot, for instance, be used to infer anything about habitat relationships, the spatial extent of a local population, or the absence of lynx within a specific area. We therefore strongly recommend that these methods only be used to answer very specific questions in very specific areas. In most cases, laying a grid of transects across an area of interest will provide more usable information and is a better allocation of resources.

Selection of sites and station positions

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

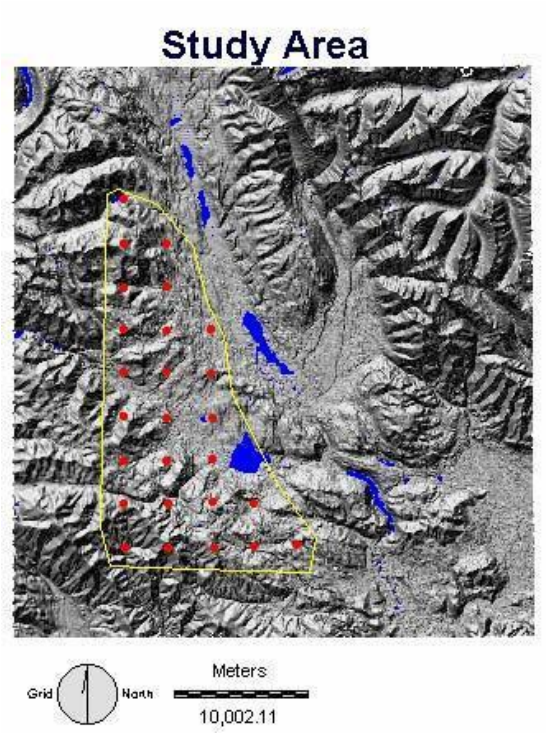


Figure 1. Example demonstrating placement of sites. Yellow line is area of interest. Red symbols are location of sites with 2-mile spacing.

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

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

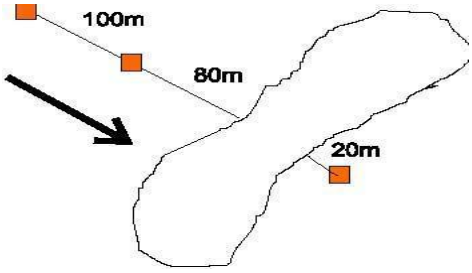


Figure 3. Example showing a transect crossing an open area. One hundred meters were measured between 1st and 2nd station; then 80 m was measured from 2nd station and edge of an open area. The open area was crossed without measuring distance and 20 m was measure.

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.

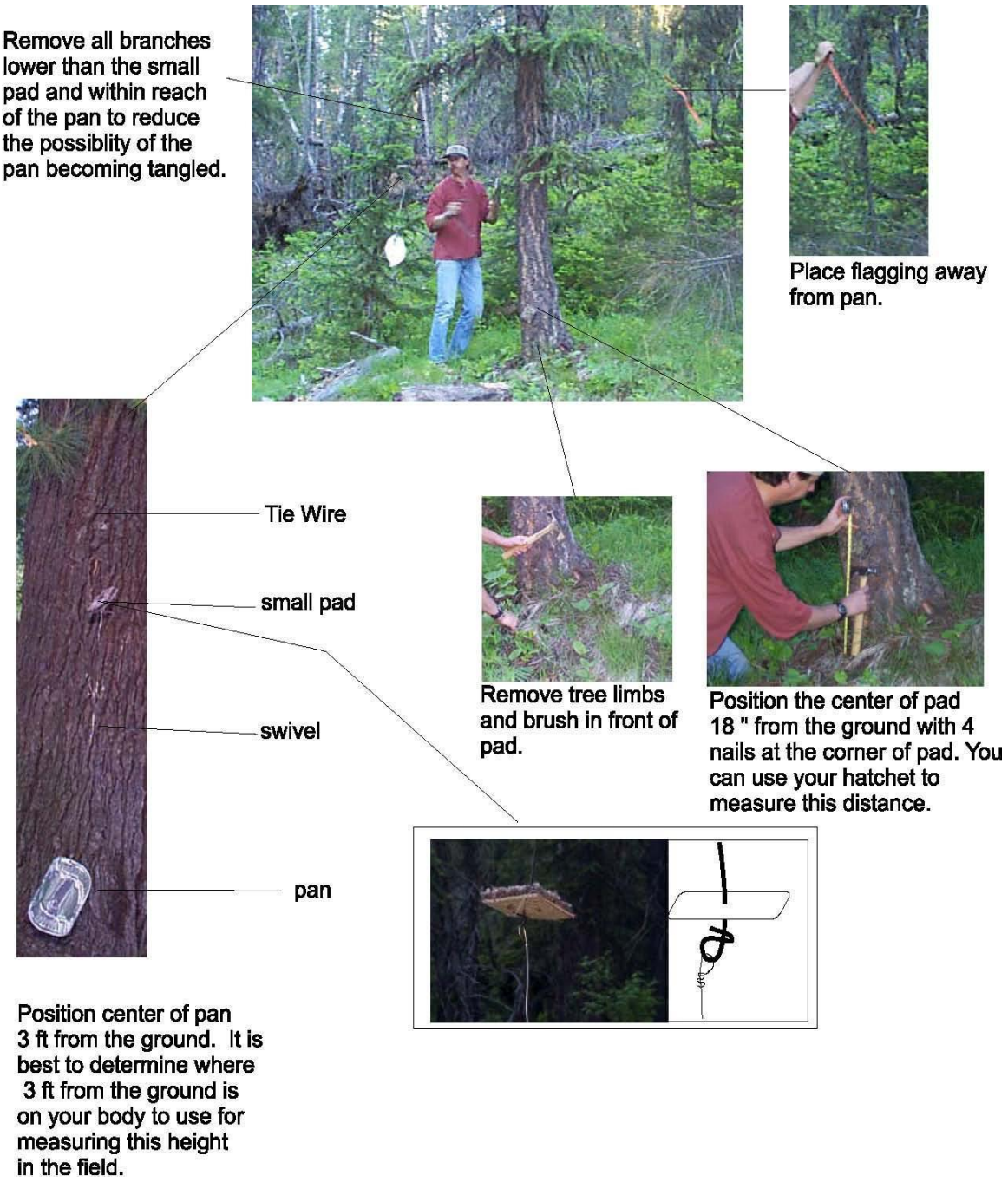


Figure 4. Construction of a scent station. Clear branches away from the pie-pan so that it will not get tangled. Place flagging near the station so you can easily relocate the site. Do not hang flagging on the same branch as the pie-pan because the pie-pan will get tangled with the flagging. Using permanent 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.

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.

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.

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.

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 6. Sprinkle dried catnip over bait on hair-snares

Habitat Measurements

Record topographic features using a clinometer for slope and a compass for aspect. Make sure your compass has been adjusted for declination between true and magnetic north (declinations are provide on USGS topographic maps). Provide elevation at stations using the most accurate source available. Record over-story species and a visual estimate of over-story cover within approximately 30 ft of station. Likewise, provide understory shrub species and a visual estimate of shrub cover within approximately 30 ft of stations. Give a visually estimated dbh of a typical over-story tree species.

Safety Precautions

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

Checking stations for lynx hair

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

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

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

APPENDIX VII

Wolf Remote Camera Traps:

Scouting Guidelines and Installation Protocol

Citizen Wildlife Monitoring Project

Prepared by

David Moskowitz

and

Alison Huyett

This document available online at: https://www.conservationnw.org/wildlife-monitoring/

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest and Wilderness Awareness School

Contents

Introduction

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

Wolves are wide-ranging species whose home range can vary considerably based on seasonal changes in prey species distribution, snow conditions, and human activity on the landscape. On a day-to-day scale, they will often travel many miles in a single night. On the broadest scale, young adult wolves typically disperse from their natal home range and travel up to hundreds of miles before localizing and establishing a new home range for themselves. Young non-resident animals that have not set up a home range may pass through an area and never return to it. Because of these features of wolf biology,

pinpointing a specific location to detect the species over the course of even several months can be very challenging. Even with reliable sightings and track and sign evidence, the past presence of a wolf in a specific location is not a guarantee that the animal will return there any time soon, if at all.

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

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

Wolves have excellent vision and an exceptional sense of smell. Their sense of smell and social nature can be used by researchers to elicit curiosity and territorial responses to help attract wolves to camera trap locations or slow them down during their travels to enable photo documentation by remote cameras. However, wolves are notoriously skittish and can be very wary of unusual scents, especially if they have had negative encounters with humans and traps.

Camera Trap Site Selection-General Location

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

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

Once these general locations have been identified and a field team is assigned to the area, a specific

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

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

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

Preparation for the Field

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

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

In the Field

Wolves often use roads, human trails, and game trails along streams, wetlands, through mountain passes or along ridgelines to travel through their home range. Roads that are used infrequently by people are often particularly sought out by wolves (Fritts et al 2003). Wolves leave recognizable tracks and scats along these travel routes. Walk, bike, or drive as much of the road and trail system within the targeted area as possible, focusing specifically on areas that had been identified as promising based on

habitat and putative sightings. While exploring these area, search for tracks, scats, and other signs of wolf presence (see below). Areas with a concentration of sign would help narrow down where to locate a camera trap. If no sign is detected, scouting will allow the team to view a variety of options for setting camera traps before selecting the best option.

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

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

Camera Trap Set Types

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

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

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

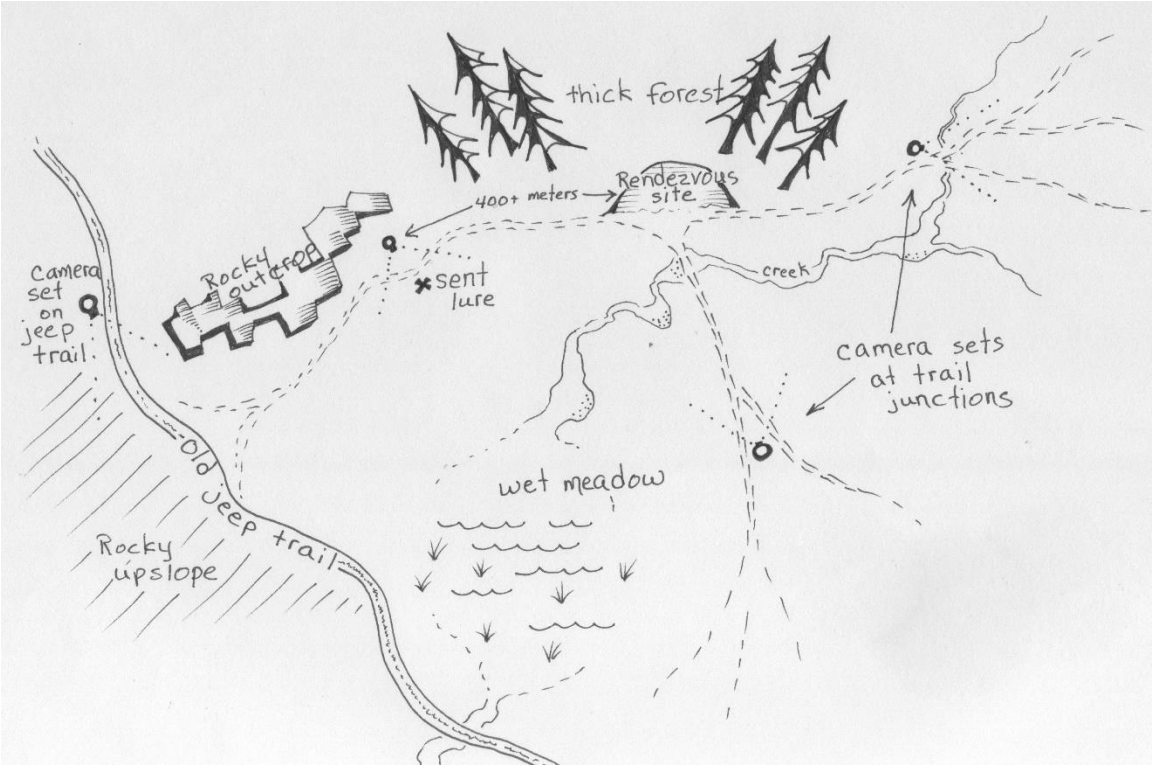


Figure 7. Overview of possible locations for remote camera traps for wolves, focusing on game trails and lightly traveled or gated roads. Illustration by Jenn Wolfe.

Use of Imported Attractants

A variety of scent attractants can be used to draw wolves in front of your camera or get them to pause as they travel through the field of view of the remote camera. These include scent lures such as Gusto and other trapper's lures (see Table below). Bait, an actual food item, such as a deer carcass can also be used. Use of imported baits has a variety of ethical issues that must be considered as well as research permitting requirements. As such, importing of baits for remote camera traps targeting wolves for CWMP is typically not done. However, use of existing "bait" found on site, such as a deer carcass discovered in the area targeted for monitoring can be an excellent attractant.

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

human scent in conjunction with scent attractants.

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

Table 1 Attractants available for use by CWMP Camera Trap teams for wolf sets.

Trail Sets

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

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

While trail and road junctions often attract attention from wolves as a location for scent marking, at other times, wolves will avoid actual junctions and "cut corners" from one trail or road to the other. Because of

this, setting a camera trap on a trail before a likely corner cut might help catch wolves on the travel route. Alternately, the use of a scent attractant on a camera set on or near a trail or road junction designed to elicit a intra-species communication response could be effective at bringing wolves all the way to the junction and encouraging the animal to come into the field of view of the camera.

Trail Set Without Additional Attractant

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

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

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

Trail Sets with Artificial Attractant

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

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

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

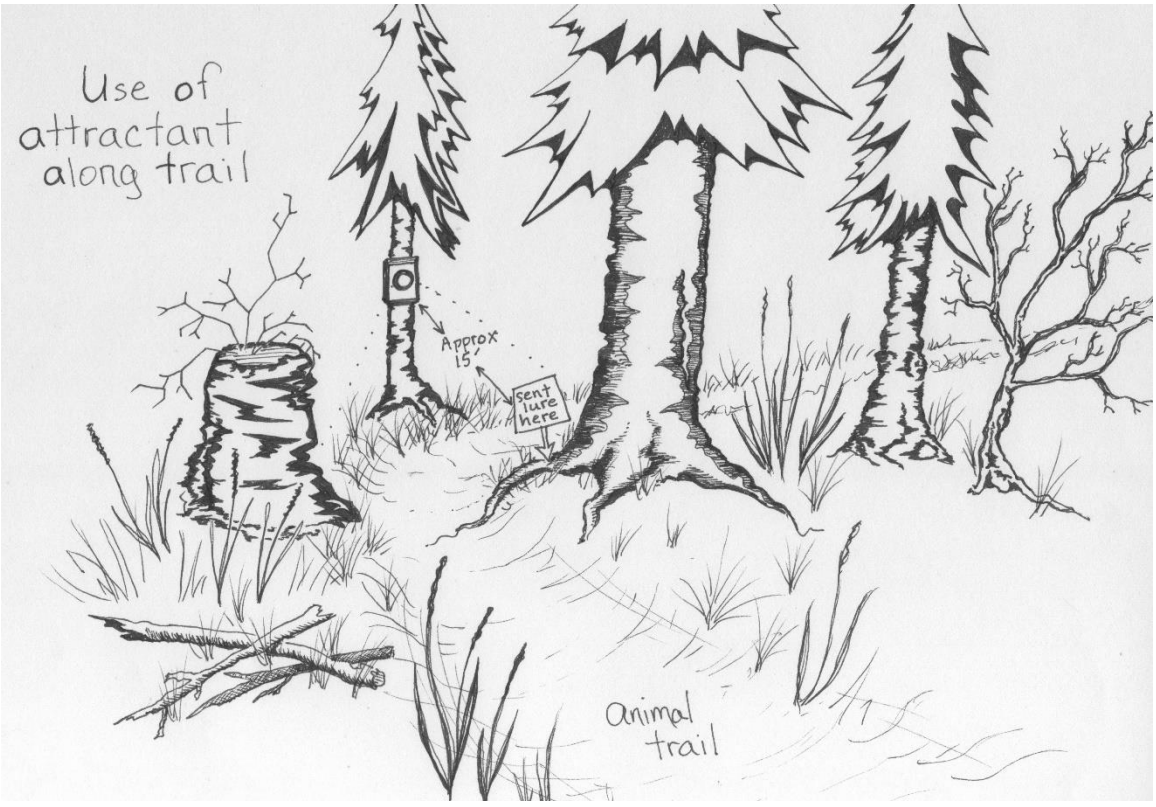


Figure 8. Remote camera trap set along a game trail incorporating a scent lure. Note the camera is looking down the trail rather than just across it. This should increase the amount of time an animal ends up in the view of the camera. Illustration by Jenn Wolfe.

Figure 9. Camera set along a route often used by humans. Illustration by Jenn Wolfe.

Figure 10. If the camera is set to view the road or trail, setting it below head height and with branches that partially obscure it from the view of a walking or driving human can help reduce likelihood of detection by passing people. Illustration by Jenn Wolfe.

Natural Bait: Found Carcass or Other Food Source

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

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

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

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

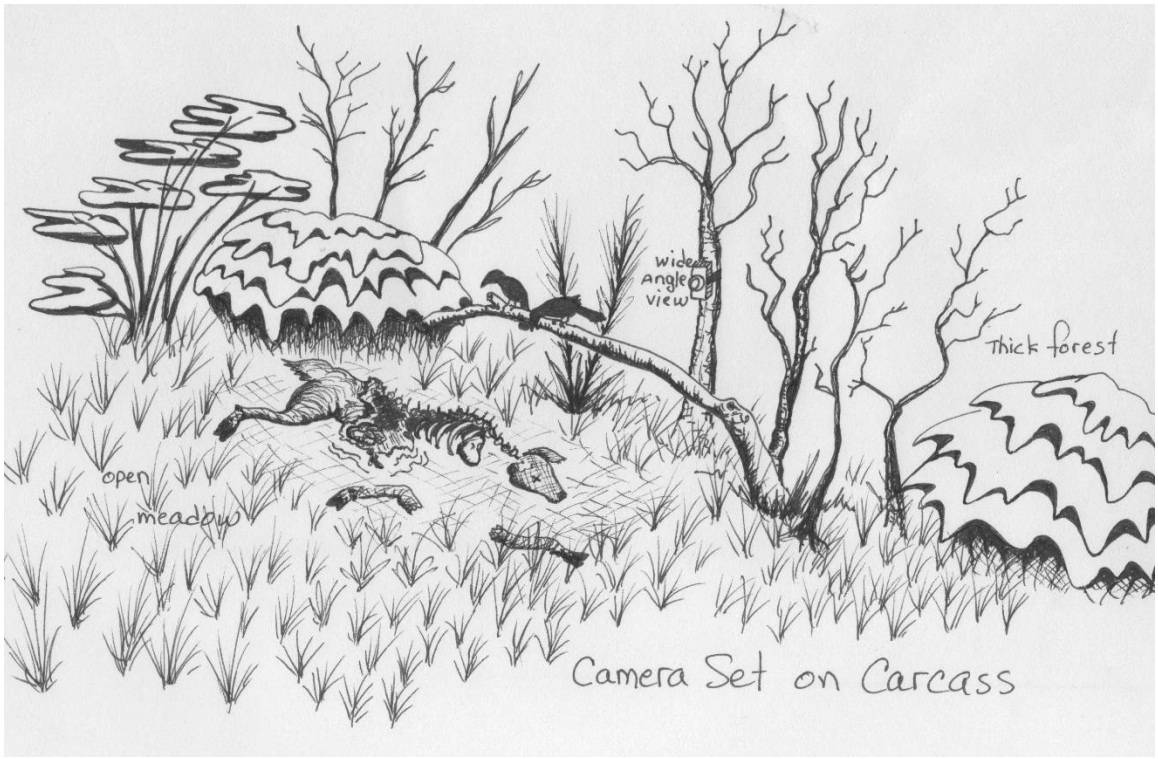


Figure 11. Remote camera trap set on a found carcass, set to view carcass on possible approach routes to carcass. Illustration by Jenn Wolfe.

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

Besides a simple carcass, other locations that may attract wolves include bone yards where hunters or

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

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

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

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

Potential Den and Rendezvous Sites

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

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

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

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

Consider creating a trail set on routes leading into a den or rendezvous location. For potential rendezvous locations, setting a camera trap that observes the meadow or clearing and adding a scent lure in the proximate area can both cover the general area and attempt to draw wolves into close proximity to guarantee they trigger the camera. Rendezvous locations often have carcasses in the vicinity. These carcasses could be used for camera traps as described previously.

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

Managing Multiple Camera Traps In One Area

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

If there in compelling evidence of recent wolf activity in a specific location you may be directed to place both camera sets in relatively close proximity, such as along two different trails or roads within a small area. More typically you will be assigned a larger general area to monitor. As such, in order to cover as

large an area as possible, remote camera traps should be set up at least 1 kilometer apart from each other. Barring compelling circumstances to move a camera quickly, camera traps should be left installed for at least one month.

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

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

Considerations for Documenting Breeding Status and Numbers

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

Resident versus transient wolves

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

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

Breeding Status

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

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

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

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

Pack Size

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

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

Acknowledgements

Thanks to Gabe Spence (Twisp Washington), Ray Robertson (Carlton, Washington), Aja Woodrow (United States Forest Service), Robert Long (Woodland Park Zoo, Seattle Washington), and Adam Lieberg (Northwest Connections, Swan Valley Montana) for offering their thoughts on this topic. Thanks to Jenn Wolfe for donating her time to produce the camera trap design illustrations in this document.

References

Ausband, D. E., M. S. Mitchell, K. Doherty, P. Zager, C. M. Mack, and J. Holyan. 2010.

Surveying predicted rendezvous sites to monitor gray wolf populations. *Journal of Wildlife Management* 74: 1043–1049.

Fritts, S. H., R. O. Stephenson, R. D. Hayes, and L. Boitani. 2003. Wolves and humans. In Mech, L. D., and L. Boitani, eds. 2003. *Wolves: Behavior, Ecology and Conservation*. Chicago: University of Chicago Press.

Kreeger, T. J. 2003. The internal wolf: physiology, pathology, and pharmacology. In Mech, L. D., and L. Boitani, eds. 2003. *Wolves: Behavior, Ecology and Conservation*. Chicago: University of Chicago Press.

Long, R. A., P. MacKay, W. J. Zielinski, and J. C. Ray, editors. 2008 *Noninvasive survey methods for carnivores*. Island Press, Washington, D.C.

Trapp, J. 2004. Wolf den site selection and characteristics in the northern Rocky Mountains: a multi-scale analysis. Master's thesis, Prescott College.

Washington Department of Fish and Widlife. 2011. Final environmental impact statement for the wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

Appendix 1: Wolf Tracks, Scats and Sign

Follow guidelines laid out in the General Remote Camera Protocol Document for photo-documenting potential tracks and signs of wolves found while in the field. Below are details for distinguishing wolf tracks and signs to keep an eye out for while scouting for where to set up camera traps.

Field teams should consider carrying a field guide to help distinguish wolf tracks and signs in the field. Western Wildlife Outreach has an online description available at: http://westernwildlife.org/gray-wolf-outreach-project/signs-of-wolves/.

Footprints

Potential wolf tracks are often encountered in the field but can be hard or impossible to definitively differentiate from domestic dog tracks and, while larger, can resemble coyote prints. Overall, wolf tracks are large, much larger than coyote tracks and larger than all but the largest breeds of dogs.

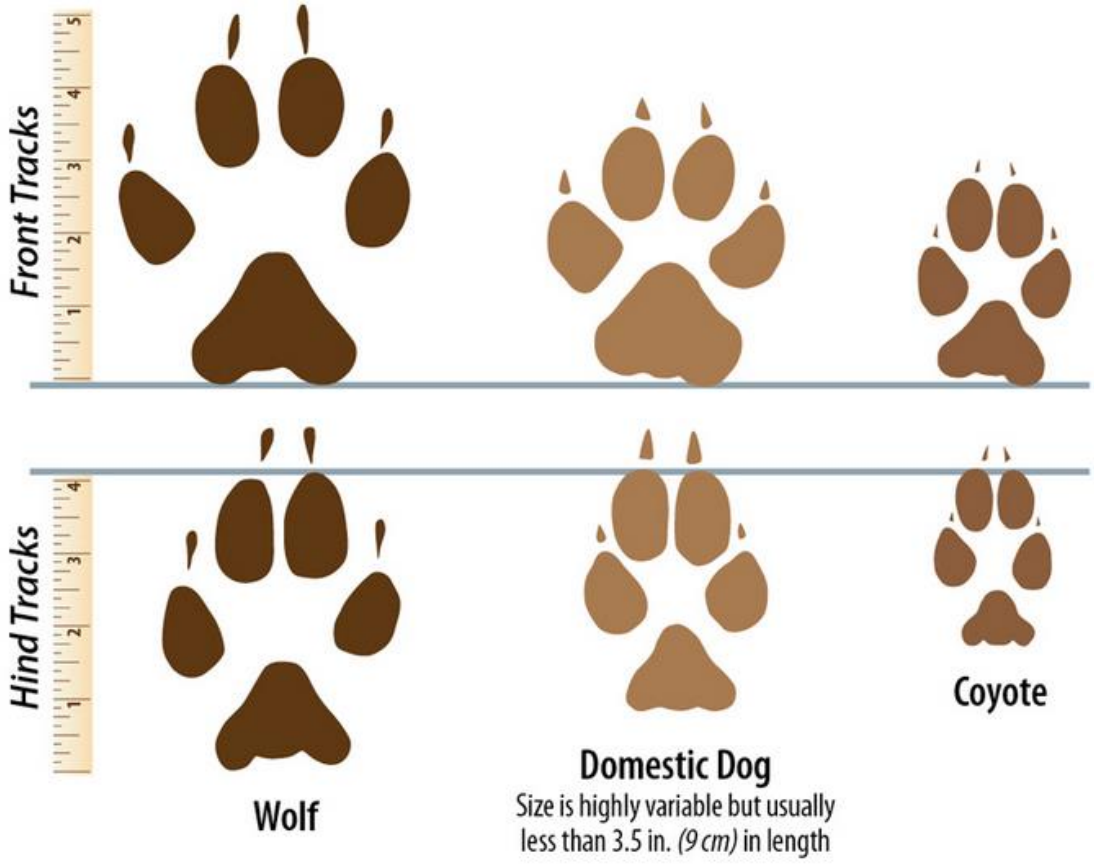


Figure 12. Comparison of wolf, domestic dog and coyote tracks. (Diagram by Western Wildlife Outreach. Track illustrations by David Moskowitz)

	Front Length	Front Width	Hind Length	Hind Width
Wolf	11.0 cm (8.9-12.8)	9.8 cm (7.8-12.4)	10.1 cm (8.6-11.6)	8.2 cm (6.8-9.8)
Coyote	6.7 cm (5.4-7.8)	5.3 cm (4.2-6.3)	6.1 cm (4.4-7.5)	4.6 cm (3.5-5.4)
Dog	Highly variable	Highly variable	Highly variable	Highly variable

Table 2. Comparison of wolf and coyote measurements (Moskowitz 2010). Domestic dog measurements vary widely and can overlap with both wild canid species.

Scat

Wolves often deposit their scats on roads and trails. Fresh scats are often quite strong smelling. As wolves consume little or no plant material contents are typically entirely animal tissue.

Photo 6. Wolf scats are tubular and typically 1-1.5 inches in diameter. Photo by David Moskowitz

Photo 7. Some wolf scats are twisted in appearance. Scats are often filled with deer or elk hair. Photo by David Moskowitz

Feeding sign

Photo 8. Ungulate carcasses consumed by wolves often have long bones that have been cracked. Jagged bone fragments are often also found. The parts of the carcass may be spread out over a large area. Photo by David Moskowitz.

Appendix 2: Specific equipment for field teams setting wolf camera traps

See also general list of equipment for remote camera teams (available online at: http://www.conservationnw.org/files/2014cameragearchecklist.pdf). In addition to these items the following may be useful in setting camera traps for wolves.

- Paper copy of this document
- Print outs of maps and emails about sighting locations and recommendations for potential camera set locations.
- Appropriate transportation: vehicle capable of driving the forest roads you will be traveling on. For travel on gaited roads a mountain bike maybe useful for scouting and accessing remote cameras.
- Field guide and identification materials to help identify wolf tracks and sign.

APPENDIX VIII

Wolverine Remote Camera and DNA Traps: Scouting Guidelines and Installation Protocol

Citizen Wildlife Monitoring Project
April 2017

Prepared by

David Moskowitz
Laurel Baum
Chase Gunnell

This document available online at: https://www.conservationnw.org/wildlife-monitoring/

Citizen Wildlife Monitoring Project partner organizations: Conservation Northwest and Wilderness Awareness School

Conservation Northwest
Keeping the Northwest Wild

WILDERNESS AWARENESS SCHOOL

Contents

Introduction

Once shot on sight, trapped and poisoned as vermin, wolverines were thought to be locally extinct in Washington by the 1930s. But in recent years *Gulo gulo*, a member of the weasel family the size of a small Labrador retriever, has been making a comeback in the North Cascades under state protections from hunting and deliberate trapping. Genetic data from "hair snares" has linked Washington's resurgent population to wolverines in Canada.

Today biologists believe Washington's North Cascades wolverine population is estimated to be less then 40 animals (Inman 2013), with only around 300 wolverines remaining across the lower 48 states (USFS 2013). A lone wolverine was also documented north of Mount Adams and in the Goat Rocks Wilderness area repeatedly between 2009 and 2012, and a separate animal was documented in 2016 (CCP 2016), but no wolverine population has been confirmed in Washington south of I-90.

Though wolverines are renowned for being bold and ferocious, they are primarily carnivorous scavengers, feasting on a wide variety of foods, including carrion from winter-killed deer, elk and mountain goats. They will also hunt small mammals, including pikas, marmots, ground squirrels, porcupines and snowshoe hares, as well as eat bugs, berries, eggs and roots. Wolverines are generally extremely wary of people and do not pose a risk to hikers or backcountry travelers.

Though they're making a comeback in our region, these elusive creatures have slow reproductive rates and are highly dependent on protected mountain habitats, large wild territories, and a deep snowpack that persists well into the spring for their breeding dens. While they occupy an important niche in the mountain ecosystem, wolverine populations are slow to recover from threatened levels, and are notoriously difficult to study.

There are several goals of CWMP's wolverine camera trapping and genetic sample collections for wolverines. With the current distribution of wolverines not clearly defined in the region, CWMP deploys camera traps in areas where the current presence of a wolverine population is unknown to

ascertain the presence of animals in these areas and, if detected, collect genetic samples to understand their relationship to known populations in the region.

Additionally, CWMP maintains ongoing monitoring stations in the southern portion of the North Cascades Ecosystem in an attempt to document unique individuals from this population through genetic samples and photographs which display unique identification features on the chest of individual wolverines. Finally, as a citizen science project, this monitoring program aims to educate and engage citizens of the region in research and conservation of this sensitive species and the habitat it occupies.

Safety Considerations

Because many wolverine survey areas are in remote roadless and trail-less high elevation locations, volunteers with sufficient general backcountry skills are required for these installations. Additionally, for winter monitoring, some locations may present significant avalanche hazards. As with all of our volunteers, CWMP recruits individuals with sufficient skills to comfortably carry out the field tasks and helps identify the field hazards that maybe present for volunteers but does not train or evaluate volunteers stated skill set.

Wolverine habitat overlaps significantly with grizzly bear and black bear habitat and survey tasks such as traveling through the backcountry with bait and powerful scent attractants could theoretically increase the chances of an encounter with a bear by field teams. CWMP provides all field teams with bear spray and training on how to use it and manage bear encounters.

When ever in the field in bear country, especially when carrying attractants or searching for natural attractants, field teams should carry bear spray in a readily accessible location (e.g. on your hip) and be trained and prepared to use it. A group of people is less likely to be accosted by a bear. Making noise and keeping at least one person assigned to be a lookout can help reduce the likelihood of surprising or being surprised by a bear.

Camera Trap Site Selection-General Location

CWMP maintains a series of established monitoring locations in the North Cascades Ecosystem where wolverines have been documented repeatedly over the past several years. New installations are established in other areas in an attempt to document the species in new locations in the region.

For new installations, CWMP project leadership identifies a general location for camera traps to be installed. Once in the field, field teams must select the microhabitat location appropriate for establishing the camera trap. These installations are selected based on recent sighting reports (of tracks or actual animals) provided by the public, the Washington Department of Fish and Wildlife

(WDFW), and the United States Forest Service (USFS), along with models that predict high quality wolverine habitat in the region. CWMP's project advisory board also further helps refine target locations for camera trap installations.

Research on the preferred habitat from the North Cascades has confirmed findings from elsewhere in western North America. Wolverines activity is strongly associated with locations which maintain snowpack into late spring. In the Washington Cascades, where most of CWMP's survey work is carried out, this is high elevation subalpine and alpine habitats, much of it in steep mountain terrain, primarily roadless. Because of this accessing camera trapping locations for wolverines comes with significant logistical and sometimes safety issues for field teams.

Preparation For the Field

Prior to heading into the field, review maps of the area including the general location you are targeting for your camera trap, material on wolverine tracks and signs, and guidelines for setting a camera trap (see below). Field teams are provided with maps along with all of the field equipment needed for installations. Be sure to plan enough time for your trip to allow for getting to the general location, an appropriate amount of time to scout for setting camera traps and then actually setting cameras. Successful camera traps often require a significant amount of time scouting in order to locate the specific location to set them.

Collect all of the field equipment needed for the trip (see list below). Test remote cameras, ensure that memory cards are empty and batteries are full. Ensure that you know how to use the cameras and set cameras to the projects recommended settings. If there have been specific locations to target for scouting or setting your cameras, enter these coordinates into the GPS unit. Prepare your bait as appropriate. This may include drilling a hole in the marrow bone, or pre-rigging bait with wires to secure it to a tree in the field.

In the Field

For new installations, once you have navigated to the general location to set your camera trap you must select the specific location to set the camera trap. If possible look for landscape features that will naturally funnel movement of animals, such as a pass on a mountain ridge, a well used game trail, a stand of mature trees surrounded by meadows or brush and forests right along the edge of treeline. Other things that might attract the attention of a wolverine on the landscape include marmot colonies, locations used heavily by mountain goats, and the carcass of any animal in appropriate habitat.

Look for tracks and signs that could be wolverine (see appendix below). Be sure to document it if you do and use it to help understand how the animal may have traveled across the landscape to help you decide on a location for an installation.

Be sure you are at least 200 meters from any human used road or trail and 500 meters from a campground. Follow the guidelines provided for the specific camera trap set you are constructing (see below) to ensure you have the appropriate tree configuration.

Figure 1 Classic wolverine habitat in the North Cascades of Washington in summer. Photo by David Moskowitz.

Camera and DNA Trap Set Types

Conservation Northwest deploys two different camera and DNA trap set types for wolverines. For short term monitoring, such as following up on reports of tracks in areas where the presence of wolverines has not been established, a more simple baited station with a single camera is constructed. For ongoing monitoring of a location where we have had detections of wolverines in the past, a more elaborate run-pole set up is deployed which increases the odds of capturing photographs which help identify and differentiate different individual wolverines through photographs.

Short term installations

These installations follow the guidelines established in the *Coordinated Multi-state Wolverine Baseline Sampling* (Multi-state Wolverine Working Group, 2015) document. All teams will be provided with this document as a reference. The document will be annotated to reflect some minor variations for the specifics of CWMP's project.

Bait and scent lure is applied to a tree. A DNA collecting gun brush belt is attached to the tree below the attractant and a camera is placed on an adjacent tree to capture visitors to the attractant.

Figure 2 Short-term camera trap set up. A gun brush belt is attached to the tree and bait is secured above this so that animals seeking to access it must pass the gun brushes. Camera is set up to capture the base of the tree as well as the bait to ensure animals that visit the station but do not climb the tree are documented.

Long term installations: Run poles

Run poles are established and maintained following the protocols developed by Aubrey and Raley (2013) which field teams are provided with and trained in.

Run poles involve construction of a horizontal beam ("run pole") out from a tree which a wolverine will walk out on to investigate an attractant hung above the end of it. A camera is set to photograph the animal at the end of the run pole when the animal is facing the camera in hopes of capturing an image of its chest blaze. A hair snagging device is attached to the tree below the run pole or on the pole itself. A second camera is attached to another tree which photographs the ground below the run pole and attractant to capture images of any animals that visit the set but do not go out on the run pole.

Figure 3 Image of a wolverine captured on the "vicinity" camera set up to capture images of animals that visit run pole stations without going onto the run pole.

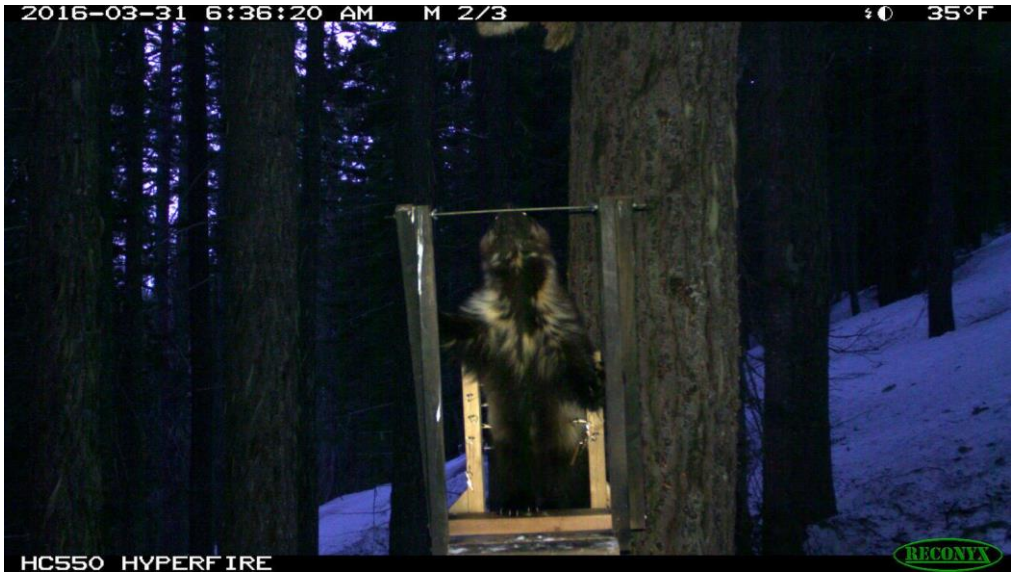


Figure 4 Photo of a wolverine captured on a run pole, clearly showing chest blaze which can be used to identify individual animals.

Attractants

Attractant	Type	Producer	Use Notes
Caven's Gusto	Scent lure	Minnesota Trapline Products	Long range attractant, primarily designed for mustelids.
Imported bait	Bait	NA	Typical bait items include: deer quarter, marrow bone procured from a butcher, rack of ribs, half of a beaver carcass.
Found carcass	Bait	NA	Ideal if one is located in the field. If location is not ideal, can be dragged to a location that works better for a camera trap. Drag route may act as a scent trail the target species might detect and follow into camera trap. Use caution in handling and working around carcasses in regards to disease transmission and bears.

Table 1 Attractants available for use by CWMP Camera Trap teams for wolverine sets.

Natural Bait: Found Carcass or Other Food Source

Wolverines are exceptionally efficient scavengers. Because of this, found carcasses on the landscape, no matter what their origin, make an excellent attractant for a remote camera trap. Carcasses may be the result of predation by wolves or mountain lions, animals wounded but not retrieved by human hunters, malnourishment, road kill, or other causes. While a carcass will be the strongest attractant when they are fresh, wolverines will at times inspect or return to remains a month or more after they have been on the ground and been reduced to little more than bones and scraps of hide.

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

If a carcass is detected, observe the vicinity carefully and approach the location slowly. When inspecting a carcass or setting up a camera trap around a carcass be efficient and spend as little time in the vicinity as possible. There are several safety considerations that are important in conjunction with fresh carcasses on the landscape. While mountain lions and wolves are typically retreating in the presence of humans around carcasses, black bears and grizzly bears are both

attracted to carcasses and can be aggressive in defending these carcasses from intruders (such as citizen scientists!). Additionally, dead animals can be vectors of human disease.

Camera traps on a carcass can be created where the carcass is found or the carcass can be relocated to a spot more conducive to the trap. Road killed deer could be dragged off of the road to a more secluded location where detection by humans will be less likely. Carcasses found far from cover and trees can be dragged to a spot where a camera can be attached to a nearby tree (conversely, a structure such as a log can be dragged to the carcass location to attach a camera to). Dragging the carcass to a new location will create a sent trail which a wolverine can follow to find the carcass.

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

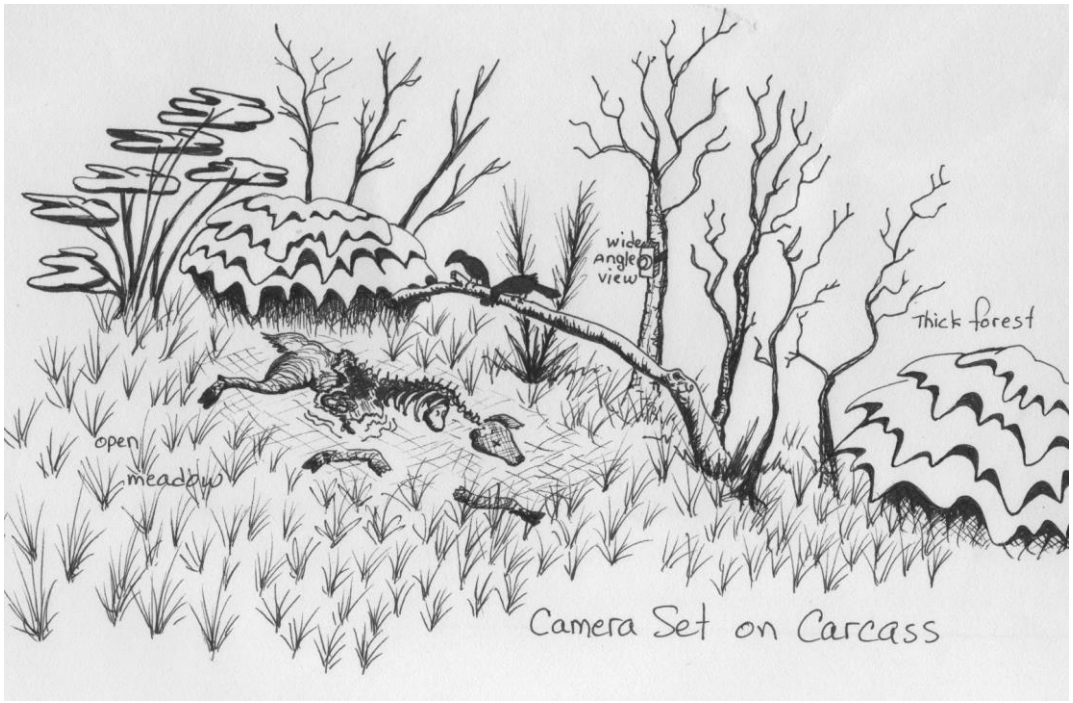


Figure 5. Remote camera trap set on a found carcass, set to view carcass on possible aproach routes to carcass. Illustration by Jenn Wolfe.

Figure 6 Wolverine documented by a camera trap set up on a moose carcass discovered by skiers on the eastside of the North Cascades. Photo by Steph Williams, Drew Lovell, and Ray Robertson

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

Genetic Samples

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. 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 in the methods document for run-pole camera traps. 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). DNA samples deteriorate over time, so checking cameras on a regular interval of 4 weeks and collecting samples into dry and breathable receptacles will help to provide a potentially viable sample to our partners.

Managing Multiple Camera Traps In One Area

Camera teams are typically assigned two cameras. For run pole installations, both camera are used on the single set. For transient installations, teams will set up two distinct camera traps. These traps should be at least 2 km from each other. CWMP staff will help identify the distinct general locations for a team to target for installation that is both valuable from a monitoring perspective and practical from a logistical one.

Any installation should be left up for at least 1 month. It is not uncommon for a wolverines to go several months before returning to a specific part of its home range. However, based on a field teams evaluation of the results of an installation and additional evidence they have collected in the field about ideal location, after a month an installation can be disassembled an new one established elsewhere in the general location targeted by the team if deemed appropriate. If successful at documenting a wolverine, a transient installation could be converted into a long term one.

References

Aubry, K. B. and C. M. Raley. 2013. Run-pole Camera Station Protocol Developed by the North Cascades Wolverine Study(NCWS) and Modified for General Use by Others. Pacific Northwest Research Station. Olympia Washington.

Cascade Carnivore Project. 2016. Second wolverine is detected in southern Washington. Project blog. http://cascadescarnivoreproject.blogspot.com/2016/07/2nd-wolverine-detected-is-southern.html. Retrieved May 6, 2017.

Inman, R. M. et al. 2013. "Developing priorities for metapopulation conservation at the landscape scale: Wolverines in the Western United States." Biological Conservation. 166 (2013) 276–286

Multi-state Wolverine Working Group. 2015. Coordinated Multi-state Wolverine Baseline Sampling in Montana, Idaho, Wyoming and Washington: Standard Operating Procedures for Camera DNA Stations.

United States Fish and Wildlife Service. 2013. Wolverine Fact Sheet. https://www.fws.gov/mountain-prairie/factsheets/Wolverine-122010.pdf. Retrieved May 6, 2017.

Appendix 1: Wolverine Tracks, Scats and Sign

Follow guidelines laid out in the General Remote Camera Protocol Document for photo-documenting potential tracks and signs of wolverine found while in the field. Below are details for distinguishing wolverine tracks and signs to keep an eye out for while scouting for where to set up

camera traps. Field teams should consider carrying a field guide to help distinguish wolverine tracks and signs in the field.

Footprints

Potential wolverine tracks are often encountered in the field but can challenging to differentiate from other large carnivores such as wolves, mountain lion and lynx. Their tracks are also commonly confused with snowshoe hare and hoary marmot tracks.

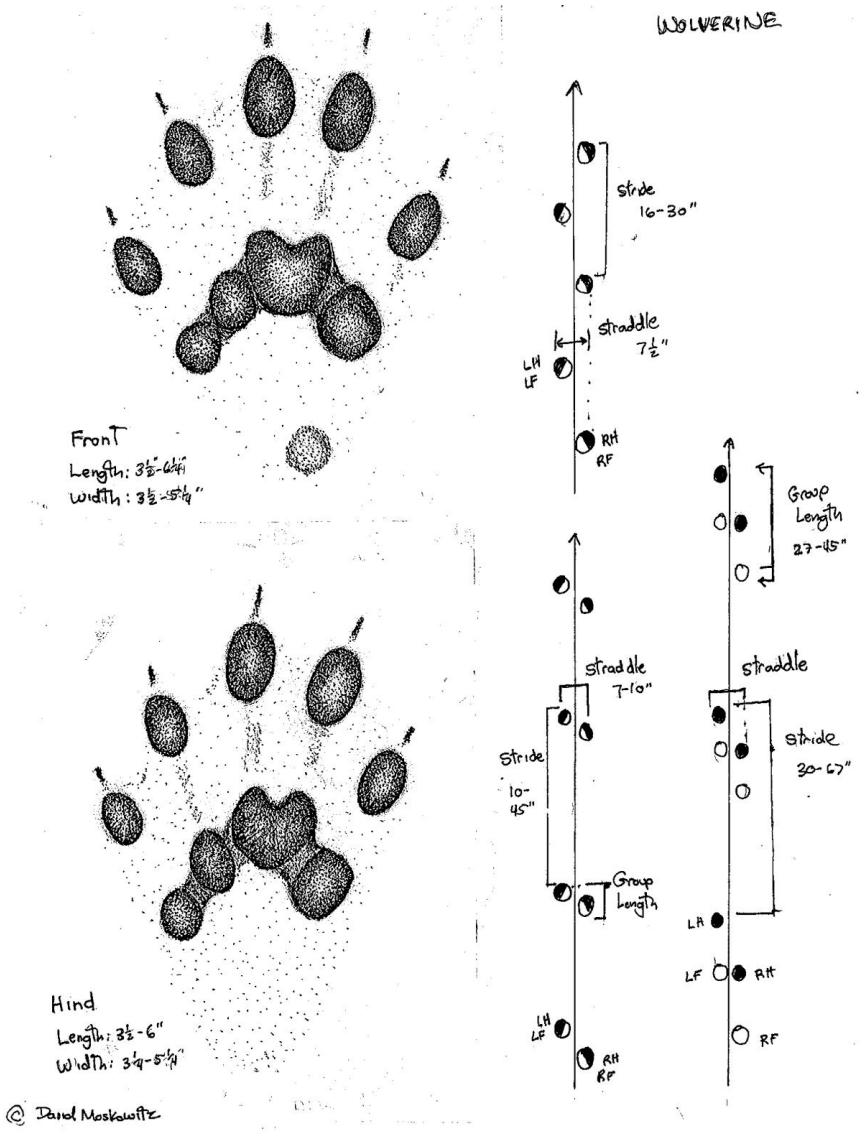


Figure 7 Wolverine tracks and track patterns

Figure SEQ Figure * ARABIC 5 Wolverine tracks in snow. Photo by David Moskowitz

Figure SEQ Figure * ARABIC 3 Wolverine track in mud. Note that the smallest toe, on the inside (left) of the track registers lighter then the other four toes, which is common in wolverine tracks in non-snow substrates. Photo by David Moskowitz

Figure SEQ Figure * ARABIC 3 Wolverine tracks in the 1-2-1 pattern which is used commonly when the animal is moving on firmer substrate. Photo by Forest McBrian.

Figure SEQ Figure * ARABIC 5 Wolverine track in snow. Photo by Brian Booth

Figure SEQ Figure * ARABIC 6 Wolverine trail. Photo by Brian Booth.

Figure SEQ Figure * ARABIC 7 Photo of wolverine track. This is the classic angled pattern of 2 tracks which is commonly used by wolverines in deep snow. Photo by Brian Booth.

Scat

Wolverine scats can appear very similar to other similar sized carnivores such as coyotes and badgers.

Figure 14 Wolverine scat. Photo by David Moskowitz

Figure 15 Another presentation of wolverine scat. Photo by David Moskowitz

Feeding sign

Wolverines have powerful jaws and can break even the largest bones of hoofed mammals. Carcasses that have been fed on by wolverines will often be characterized by lots of bone fragments. Wolverines can also dig large holes in the snow and dirt in their search for food.

Figure 16 Mountain goat bones consumed by a wolverine. Photo by David Moskowitz

Appendix 2: Specific equipment for field teams setting wolverine camera traps

See also general list of equipment for remote camera teams (available online at: http://www.conservationnw.org/files/2014camerageararchecklist.pdf). In addition to these items the following may be useful in setting camera traps for wolverines.

- Paper copy of this document and the appropriate camera trap set up guidelines for a run-pole or transient installation.

- Print outs of maps and emails about sighting locations and recommendations for potential camera set locations.
- Appropriate transportation: vehicle capable of driving the forest roads you will be traveling on.
- Bait and scent attractants.
- Bear spray for non-winter field work.
- Appropriate navigational and safety equipment for field conditions (GPS unit, avalanche equipment, etc).
- Field guide and identification materials to help identify wolverine tracks and sign.