Wolverine Inventory and Conservation in the Southern Coast Mountain Ranges: Year 2 report

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Wolverine M04 visits a monitoring station near Truax Creek

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Executive Summary

This large-scale collaborative inventory project is providing information on the distribution, abundance, and composition of wolverines (*Gulo gulo*) across the southern Coast Mountain Ranges. Data generated form this inventory will begin to effectively address threats and know where to best implement conservation actions for this important population of wolverines. This project will contribute considerable information to the development of a South Chilcotin - Coast Mountain Conservation Plan for Wolverines. This work fulfills a high priority activity identified in the FWCP-Coastal Cheakamus Action Plan (page 11, Table 1) and a medium priority activity in the Bridge/Seton Action Plan (Page 13, Table 1). Work during 2015-16 focussed on conducting inventory of wolverines in the Bridge River and Cheakamus River watersheds along with developing targeted extension programs.

We established wolverine monitoring stations at 18 sites in the Bridge River and 3 sites in the Cheakamus River drainages and captured 63,948 images at the 21 monitoring stations during the monitoring period between January and April 2016. We detected wolverines at 14 of the 21 sites (67%) during remote camera monitoring. Fishers (*Pekania pennanti*) were detected at 6 sites, and Pacific martens (*Martes caurina*) were detected at 15 sites. Photographs of wolverines that we collected suggest that multiple individuals were occurring at several survey sites in both watersheds. Based on a cursory assessment of chest pelage patterns, we may have detected at least 18 wolverines in the Bridge River and 7 wolverines in the Cheakamus River watersheds during the 2 years of monitoring, which is more than would be expected based upon the provincial estimate for these areas. Genetic analysis conducted on hair samples collected in the Bridge River watershed indicated that 10 wolverines (4 F, 6 M) were detected at 12 different sites during 2015 sampling.

With the help of an extension specialist, we developed and delivered a number of key extension materials for the wolverine program during 2016. These included public information brochures, targeted presentations to government planners, trappers, and St'át'imc communities. Interest in and support for the project has been very high, with many community members expressing appreciation that work is being conducted on this poorly understood carnivore.

Activities in the upcoming year (2016-17) will focus on genetic fingerprinting of the hair samples collected to date, analysis and preparation of occupancy models and density estimates for the watersheds, and continued delivery of the extension program to identified audiences.

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Introduction and Background

Wolverines (*Gulo gulo*) are iconic denizens of wilderness. The species is well known as an important predator in wild areas and is a significant indicator of pristine wilderness conditions and intact predator-prey ecosystems throughout western Canada. Wolverines are a species of conservation concern, being classified as Special Concern by both the Committee on the Status of Wildlife in Canada (COSEWIC 2003) and the Conservation Data Centre (BCCDC 2013). The species is also ranked as priority 2 by the provincial Conservation Framework for actions to prevent species and ecosystems from becoming at risk. In addition to their aesthetic and ecological value, wolverines are also a highly prized segment of the fur harvest in British Columbia, with an average pelt price of $270 (North American Fur Auctions 2013). Wolverines are distributed throughout northern British Columbia, but their distribution south of about 54° N latitude is primarily constrained to remote mountain ranges (Lofroth and Krebs 2007). The population of wolverines that occupy the Coast Mountain Ranges between Squamish and Lillooet likely represent the extreme southwestern occurrence of the species in the province.

This population of wolverines is important for a number of reasons. It is comprised of the South Chilcotin Ranges and Squamish-Lillooet wolverine population units, of which the South Chilcotin Ranges unit is potentially at risk because of unsustainable harvest (Lofroth and Ott 2007). The larger southern Coast Mountain population is of international significance because it a likely linkage, and thus an important genetic connection, to the recovering Threatened population of wolverines in the North Cascades region of Washington State. Being restricted to the southern Coast Mountain Range, this population occupies a relatively narrow peninsular extension of the much broader northern wolverine populations. This likely makes the population more vulnerable than others in the province because there are no large populations to the east, south, and west to “rescue” it should a decline occur.

This population faces a variety of increasing threats that may put its persistence at considerable risk. Past work has shown that wolverines are sensitive to a variety of human disturbances (Krebs et al. 2004, Krebs et al. 2007, Heinemeyer and Squires 2012). Along with major highways, the development of hydro-electric reservoirs by BC Hydro in the Bridge and Cheakamus watersheds likely created substantial connectivity barriers and resulted in considerable productive habitat loss. This is most evident with the creation of the Carpenter and Downton reservoirs, which likely reduced the permeability of this landscape to wolverines and may have resulted in reduced gene flow and resultant impaired population health. In a broader context, the multi-use landscape of the southern Coast Mountain Ranges has other substantial human-development pressures including mineral exploration and development, motorized and non-motorized recreation, and forest management. As such, this population is exposed to increasing and evolving levels of human use in the backcountry, which may be exposing the wolverine population to unsustainable levels of disturbance. Furthermore, increased access provided by resource and recreational developments may expose resident wolverines to higher levels of mortality risk associated with both incidental and targeted fur harvest (Ministry of Forests, Lands and Natural Resource Operations [FLNRO] Regions 2 and 3, respectively), road-related mortalities (Krebs et al. 2004), and displacement caused by human activities. Climate change is a significant emerging threat to

wolverines because the species is closely tied to a narrow range of bioclimatic conditions (i.e., consistent snow into mid-May; Copeland et al. 2010) that are predicted to decrease in extent in the future.

Although significant threats face this population, very little is known about its size, distribution, trends or basic ecological relationships of wolverines in this region. Because of the unusual juxtaposition of windward and leeward mountains, the wolverines in the southern Coast Mountain Ranges occur in a wider array of biogeoclimatic zones than elsewhere, likely exploit substantially broader and different prey communities (including anadromous salmon), and are exposed to more diverse and intense threats than many other studied populations. As a result, their population and individual responses to human alterations of the landscape are likely different than other areas. These significant gaps in our understanding hamper our ability to mitigate negative disturbances and ensure population sustainability.

Goals and Objectives

A reliable inventory of the wolverine population is a critical first step in addressing the knowledge gaps that limit our ability to ensure population sustainability. We are conducting an inventory of the population of wolverines in the Bridge and Cheakamus rivers in collaboration with the St'át'imc Nation to provide information on the distribution, abundance, and composition of wolverines in watersheds affected by hydro-electric developments. This, along with an assessment of human activities and threats facing wolverines in these watersheds, will provide the data needed to begin to effectively address threats and know where to best implement conservation actions. These activities compliment on-going and proposed inventories being conducted in the Squamish and Upper Lillooet watersheds by FLNRO. Information from this highly collaborative inventory and assessment project will direct and prioritize follow-up research and extension activities, which would likely form the basis of future proposal.

This project has the following objectives:

1. Document and characterize human activities and threats facing wolverine population in the southern Coast Mountain ranges by the end of 2016.
2. Assess occupancy and abundance of wolverines in the Bridge and Cheakamus watersheds by the end of 2016.
3. Assess functional connectivity within the population of wolverines in the southern Coast Mountain assessment area by the end of 2016.
4. Assess gaps and barriers in understanding of ecological relationship that hinder management for sustainable populations by the end of 2016.
5. Develop key partnerships among government, First Nations, recreation, industry, trapper, and naturalist club communities to build support for sustainability of the southern Coast Mountain wolverine population and engage these potential project partners to ensure that future project direction support their specific information needs by the end of 2015.

Study Areas

We surveyed for wolverines in 2 watersheds of the larger Southern Coast Mountain Ranges project area (Fig. 1). The Bridge River watershed covers 4,750 km², occurs on the lee side of the Coast Mountain Range, and has climate that ranges from wet, cold and mountainous in the west to very dry hot grasslands at the eastern edge. The Bridge River watershed includes the Leeward Pacific Ranges, Central Chilcotin Ranges, and Southern Chilcotin Ranges ecosections. This is an exceptionally diverse watershed, containing Interior Mountain-heather Alpine, Engelmann Spruce-Subalpine Fir, Montane Spruce, Interior Douglas-Fir, and Ponderosa Pine biogeoclimatic zones. The Cheakamus River watershed covers 1,175 km² and comprised of the Southern Pacific Ranges and Eastern Pacific Ranges ecosections. This watershed is typical of coastal rain-forests in British Columbia, being comprised of Coastal Western Hemlock, Mountain Hemlock, and Coastal Mountain-heather Alpine biogeoclimatic zones.

Human-caused disturbance in the study areas is diverse. Hydroelectric developments that occurred in the valley bottoms of both the Bridge and Cheakamus rivers watersheds have created large reservoirs that flooded considerable area of riparian forest. Both watersheds have been exposed to extensive forest harvesting, which has resulted in a mosaic of structural stages throughout each area. Mineral exploration and development has also occurred in both areas, with active mines in the Bridge River watershed. Both areas have roads bisecting them; however Highway 99 that runs between Vancouver and Whistler through the Cheakamus River watershed has high volumes of high-speed traffic, particularly on weekends (average volume = 11,641 vehicles/day, median speed = 94 km/h; Ministry of Transportation and Infrastructure 2015). The primary road in the Bridge River watershed connects Lillooet with the communities of Bralorne, Gold Bridge, and Gun Lake and is a mixture of gravel and pavement; it likely has <200 vehicles per day of traffic travelling at <80 km/h (R. Weir, pers. obs.). Both motorized and non-motorized back-country recreation occur throughout both areas, although Cheakamus River watershed, with its close proximity to Whistler, Squamish and Vancouver, sees considerably more use than the Bridge River watershed.

Methods

Assessment of Landscape Disturbance

We are characterizing human developments in the Bridge and Cheakamus watersheds using a variety of spatial and non-spatial data. We are using digital road network spatial data combined with vehicular traffic data to identify and assess the potential disturbance, barriers to gene flow, and mortality sources caused by roads. We are using Vegetation Resources Inventory spatial data, along with non-spatial data provided by forest management plans to identify and characterize patterns of forest management in the 2 watersheds. We are characterizing urban development by evaluating Official Community Plans and other Regional District planning documents. We are liaising with FLNRO and Environmental Assessment Office staff to collect information on current and proposed major projects occurring in the 2 watersheds.

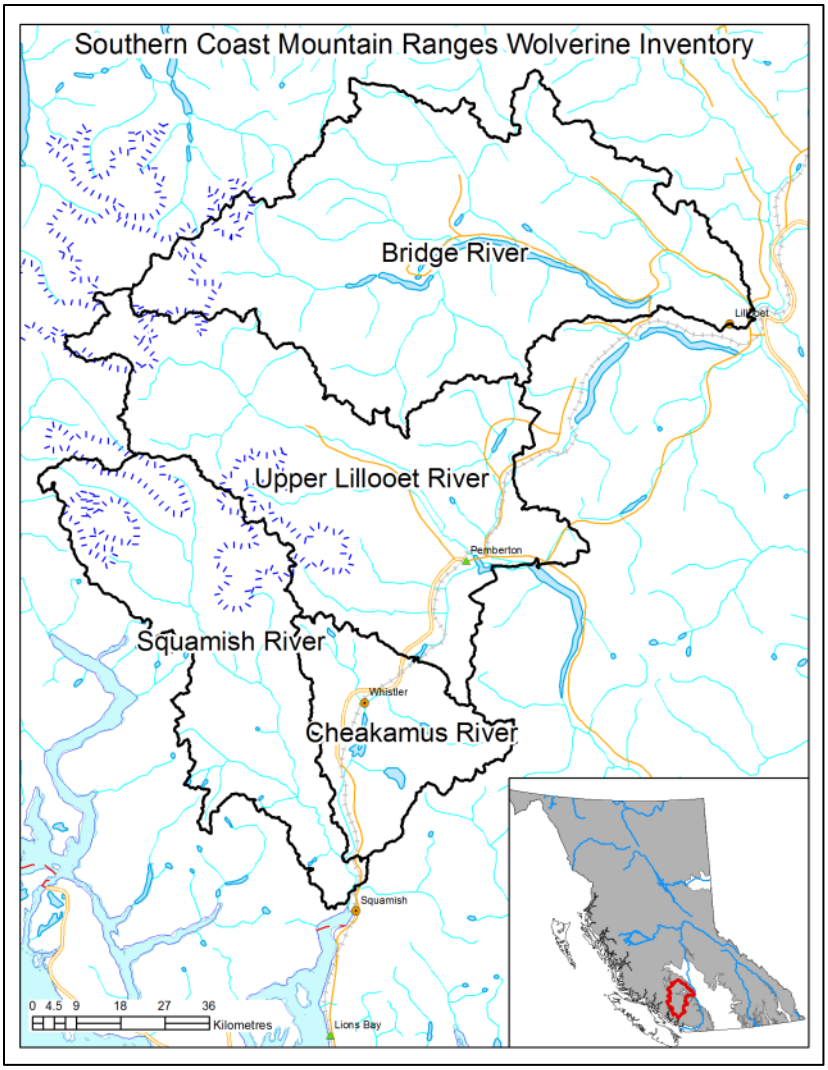

Figure 1. Watersheds of the Southern Coast Mountain Ranges being surveyed for wolverines. This current study is being conducted in the Bridge River and Cheakamus River watersheds, with concurrent surveys being conducted by the Ministry of Forests, Lands and Natural Resource Operations (Cliff Nietvelt, R.P.Bio.) in the Squamish and Upper Lillooet River watersheds.

During the course of field surveys (see below), we recorded the density of encounters with back-country recreationalists during remote-camera and genetic surveys to estimate disturbance caused by recreational activities such as ATVs, snowmobiles, hiking and skiing.

Wolverine Inventory

We used infra-red remote cameras and hair-snares at baited sites to collect information on free-ranging wolverines that lived in each watershed. Each watershed was partitioned into 12 x 12 km cells that approximate the size of an adult female wolverine home range. We sampled 41 cells among the 2 watersheds using random sampling; we sampled half of the cells during 2014-15 and the remainder were sampled in 2015-16 (Figs. 2, 3).

In each cell, we established a monitoring station at a site likely to see activity from wolverines. At these stations, we deployed an infra-red motion-activated digital camera (Reconyx PC900) and 12 hair snares attached to run poles following the methods of Magoun et al. (2011) to collect image data and genetic material from wolverines that visit the sites. We also added 2 loops of barbed wire along the run pole to collect hair from wolverines passing through to the snare array (sensu Nietvelt 2014). We executed 3 detection sessions to enable occupancy and abundance estimation. Sites were accessed by snowmobile where possible, and helicopter where ground access was not feasible. Sites were visited every 21-30 days to rebait, rescent, ensure proper camera function, change memory cards, and collect hair from the snares.

We sent 212 hair samples collected in 2015 to Wildlife Genetics International for species screening and genotyping of wolverine and fisher samples. We had each wolverine sample genotyped at 17 microsatellite loci and each fisher samples genotyped at 15 loci. This genotyping is consistent with and complement other inventories of wolverines currently underway elsewhere in BC, including the FWCP-Columbia funded project underway in the Selkirk Mountains of south-central BC.

Extension

Extension activities during Year 2 of this project focussed on providing interim reports and updates on progress to communities and identified target audiences. Specific groups that we targeted were St'át'imc communities, the local communities, local and provincial trappers, government biologists and planners.

Results

Wolverine Inventory

We established monitoring stations at 18 cells[1] in the Bridge River and 3 cells in the Cheakamus River drainages between January and May 2016. Stations were operational for between 87 and 106 days ($\bar{x}$ = 94 d, SD = 5).

We captured 63,948 images at the 21 monitoring stations during 2016. In the Bridge River watershed, Pacific martens (*Martes caurina*) were the most commonly detected species, accounting for 6,374 photographs (Table 1), with images of wolverines being captured 6,367 times. We also detected fishers (*Pekania pennanti*) frequently (2,112 photographs). Other species that we detected in 2016 included ermines (short-tailed weasels; *Mustela erminea*), lynx (*Lynx canadensis*), grizzly bears (*Ursus arctos*), red squirrels (*Tamiasciurus hudsonicus*), American black bears (*Ursus americanus*), flying squirrels (*Glaucomys sabrinus*), moose (*Alces alces*), Clark's nutcrackers (*Nucifraga columbiana)*, and gray jays (*Perisoreus canadensis*).

[1] Including a second year of sampling at cell 14-6 during 2016.

Table 1. Detections of wolverines, fishers, and other species at 33 monitoring sites (cells) in the Bridge River watershed, 2015 and 2016.

	2015		2016		Total #	
Species	Cells detected	Photos	Cells detected	Photos	cells detected	Total # photos
Wolverine	13	10,737	12	6367	25	17,104
Fisher	3	3707	6	2112	9	5,819
Marten	15	8823	12	6374	26	15,197
Ermine			1	43	1	43
Lynx	1	116	1	49	2	165
Bobcat	1	46			1	46
Coyote	1	2			1	2
Wolf	1	1			1	1
Grizzly bear	2	124	1	1,406	3	1,530
American black bear	0	0	1	105	1	105
Red squirrel	4	54	11	443	15	497
Flying squirrel	1	15	1	10	2	25
Moose	2	105	1	2	3	107
Clark's nutcracker	1	15	3	30	4	45
Gray jay	4	40	2	27	6	67
Raven	2	5			2	5
Stellar's jay	1	23			1	23
Total		**23,814**	**51**	**16,968**		**40,782**

Across the 2 years of sampling, we collected wolverine images at 25 of 33 cells in the Bridge River watershed and at 6 of 8 cells in the Cheakamus River watershed during remote camera monitoring (Figs. 2, 3). Photos of fishers were collected at 9 cells in the Bridge River watershed, and Pacific martens were detected at 26 of 33 cells in the Bridge River watershed and 5 of 7 cells in the Cheakamus River watershed. We documented 155 visits[2] by wolverines, 136 visits by fishers, and 690 visits by Pacific martens to the monitoring stations in the Bridge River Watershed. The highest number of visits by wolverines to the Bridge River stations (71 of 155 visits; 46%) occurred during the third session of sampling (March-April). The number of visits to the stations was slightly higher in the second year of sampling, but more cells were surveyed during this time (2015 = 71 visits at 16 cells; 2016 =84 visits to 18 cells). In the Cheakamus River watershed, wolverines were the most commonly detected species, along with Pacific martens and bobcats.

Photographs of wolverines that we collected suggest that multiple wolverines occurred at several survey sites in both watersheds. In the Bridge River area, photographs of the chest pelage patterns indicate that at least 3 wolverines were using the same site within a 7-day period in early March 2015 (Appendix 1). In the Cheakamus River watershed, at least 5 uniquely patterned wolverines were detected at a

[2] Series of photographs that were separated by ≥60 minutes were considered to be independent visits.

single site. More detailed analysis of the pelage patterns will be conducted during 2016-17 to add data to the occupancy model and abundance estimate.

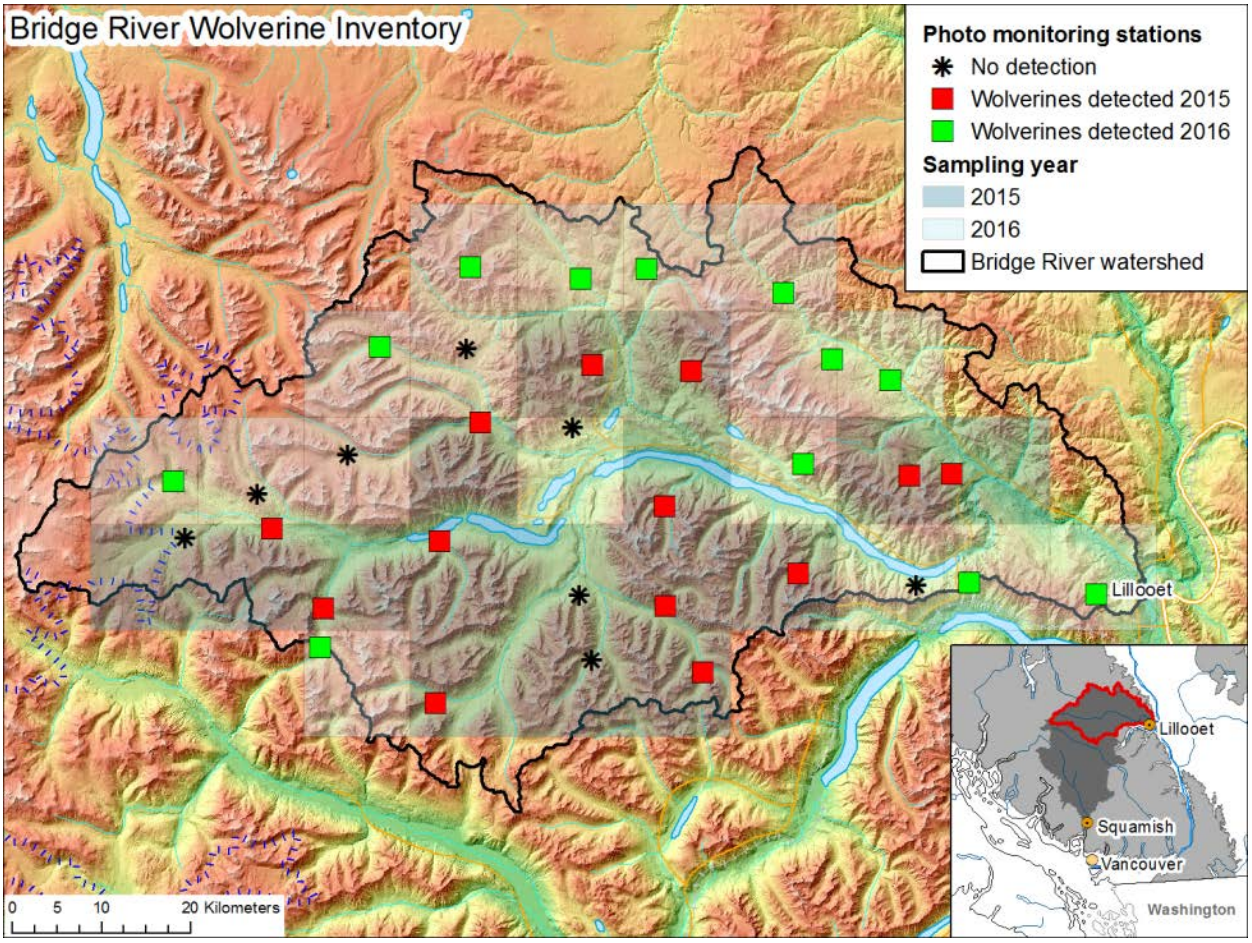

Figure 2. Photo detections of wolverines at monitoring stations in the Bridge River watershed, 2015-16. Inset map show location of watershed relative to others in the Southern Coast Mountain Ranges monitoring area (dark grey shading).

We collected 212 hair samples in 2015 and 198 samples in 2016 at the 33 hair-snare stations in the Bridge River watershed. Of the 212 samples that were collected in 2015, 110 hair samples were confirmed from wolverines, with another 19 samples from fishers. These 110 wolverine samples were from 10 individuals (4 F, 6 M; Fig. 3) and the 19 fisher samples were from 3 individuals (1 F, 2 M). Several wolverines were detected at multiple monitoring stations. Wolverine M04 was originally detected in 2012 at 2 monitoring stations associated with an environmental assessment for an independent power project being built on the Upper Lillooet River and subsequently detected in our surveys in 2015 (> 52 km between samples).

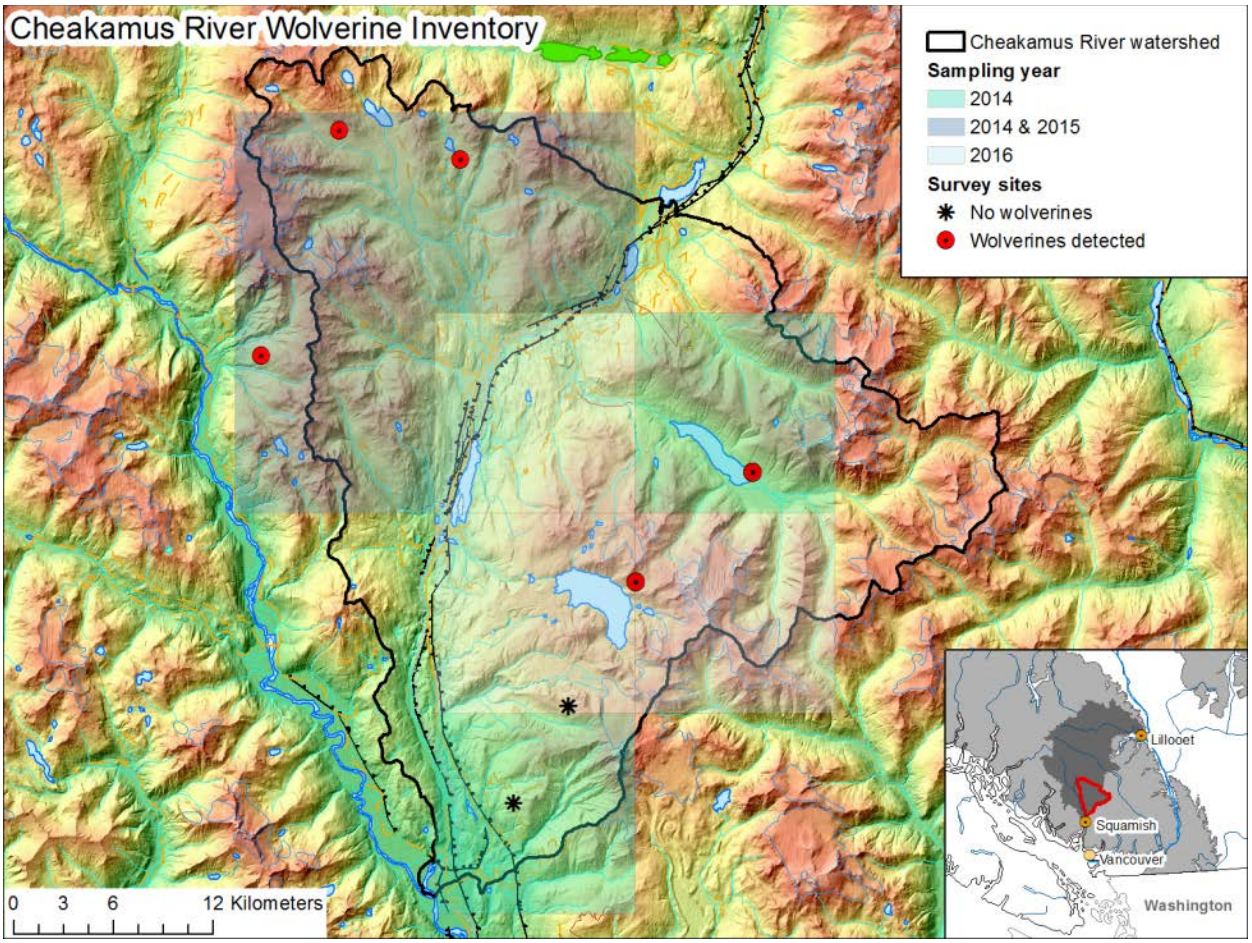

Figure 2. Photo detections of wolverines at monitoring stations in the Cheakamus River watershed, 2014-16. Inset map show location of watershed relative to others in the Southern Coast Mountain Ranges monitoring area (dark grey shading).

Extension Activities

We produced the following targeted extension materials and activities for this project during 2015-16:

1. Information brochures on wolverines and their ecology to distribute during field-work and at open houses (Appendix 4).
2. Press releases and project updates sent to St'át'imc communities newsletter (St'át'imc Unified Press) and BCTA magazine.
3. We gave a successful presentation to the P'ep'igl'ha Council (Lillooet) in November 2015 (Fig. 4). The presentation was widely advertised within local First Nations communities and approximately 30 people attended, and included a presentation by Larry Davis about his fisher den box trial that is currently underway in the Bridge River watershed.
4. Updates on the project were provided to the Lower Mainland local of the BC Trappers Association (BCTA) in Surrey, as well as to the Annual General Meeting of the BCTA in Prince George in April 2016.
5. An update presentation on the project was provided to Ministry of Forests, Lands and Natural Resource Operations and BC Parks staff in Kamloops in July 2015.

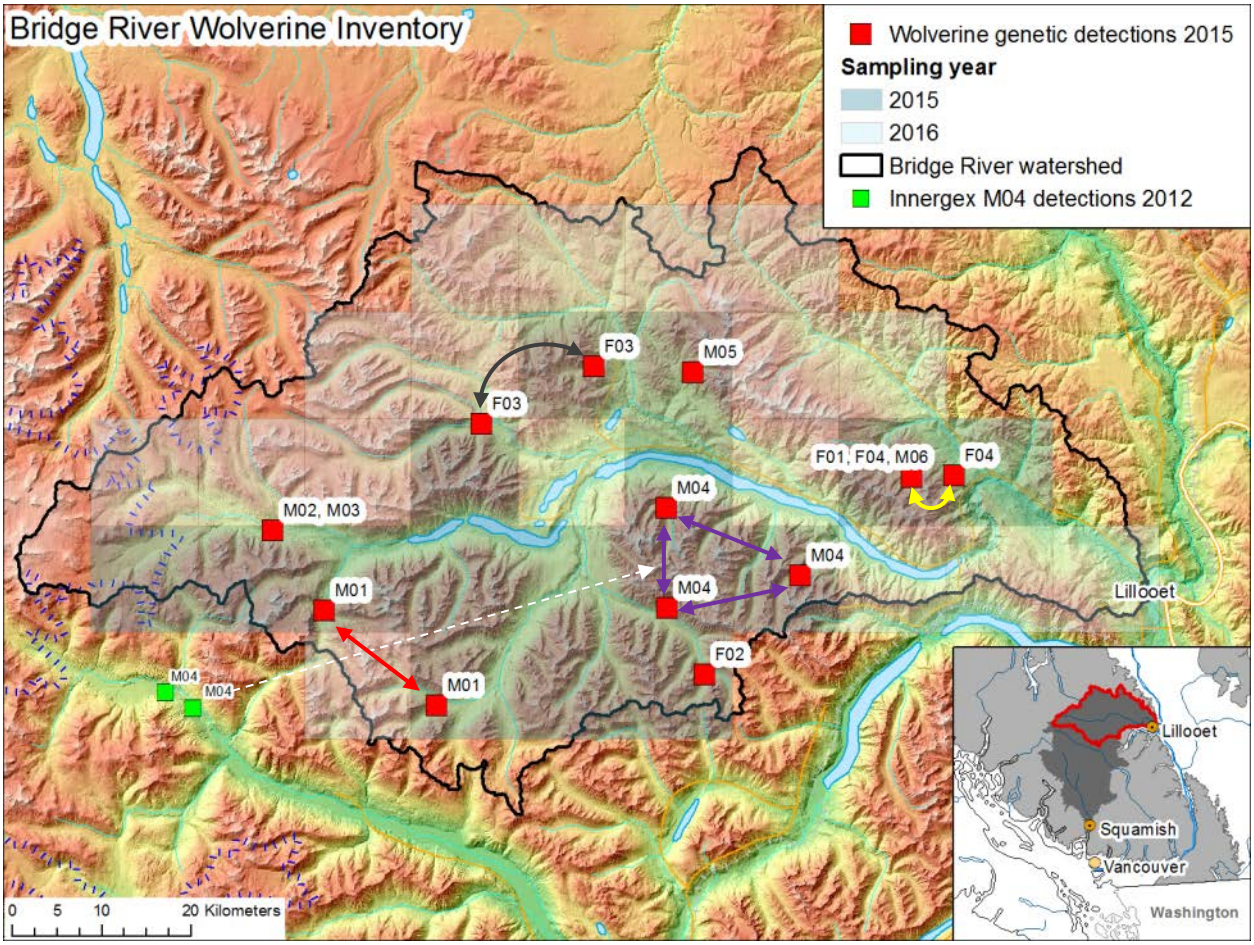

Figure 3. Genetic detections of 10 wolverines (4 F, 6M) in the Bridge River watershed during sampling conducted in 2015. Lines between detections show movements of wolverines that were identified at more than one monitoring station.

Figure 4. Presentation on the wolverine inventory delivered to the P'ep'igl'ha Council in November 2015 in Lillooet.

6. In June 2015, Cliff Nietvelt gave a public education presentation at the Sea to Sky Gondola in Squamish. This event was co-sponsored by the Sea to Sky District of the Ministry of Forests, Lands and Natural Resource Operations and the Sea to Sky Gondola. Hundreds of visitors and tourists saw the exhibit and discuss wolverine ecology and conservation.

Discussion

Wolverine Inventory

We detected wolverines at most of the survey sites that we had operational in both the Bridge River and Cheakamus River watersheds. Some visits were detected only by camera and no hair samples were collected. This occurred because either the wolverine did not investigate the run-pole and pass by the hair snaring devices, or the alligator clips or barbed wire failed to grab hair as the animal went past the snaring array (Fig. 5). Interestingly, the survey site that collected photographs of 3 different wolverines (Appendix 1) had only 1 wolverine detected through genetic fingerprinting.

Based on a cursory assessment of chest pelage patterns, we may have detected at least 18 wolverines in the Bridge River and 7 wolverines in the Cheakamus River watersheds during monitoring. Although it is too early to predict the density of wolverines, it is likely that their density is above that predicted by Lofroth and Krebs (2007), which predicted 2 wolverines/1000 km² in the Bridge River watershed and 0.3 wolverines/1000 km² in the Cheakamus River watershed.

Extension Activities

Our extension programs have been met with enthusiastic interest from the St'át'imc community, naturalist clubs, and trappers organizations. Our tri-fold brochure was well received and distributed throughout the South Coast Mountain Ranges study area, including at regional and district offices of the Ministry of Forests, Lands and Natural Resource Operations and to members of the public that we encountered while conducting field work.

Figure 5. Examples of hair samples collected using the alligator clip (a) and barbed wire (b) snaring techniques.

Future Work

Activities in this 3-year project focus on conducting inventory of wolverines in the Bridge and Cheakamus watersheds and compiling baseline information on human activities and threats, which will then be used to guide future information-collection and extension activities. Field data collection occurred during Jan-May of 2015 and 2016, with analysis and deliverable production occurring during 2016-17. The following tasks are expected to be completed in 2016-17:

1. Genetic fingerprinting of samples collected in Jan – Apr 2016 should be completed by November 2016.
2. A detailed analysis of chest patterns of wolverines that visited each site is still to be completed. This information, along with the genetic fingerprinting, will form a specific input into the occupancy model and spatial explicit capture-recapture model analyses that will be completed in 2016-17.
3. Continued delivery of extension program, including updates on the project to local trappers, BC Trapper magazine, St'át'imc community members, Lillooet Naturalist Society, Bridge River Valley Community Association, and regional wildlife programs.
4. Assess occupancy and abundance of wolverines in the Bridge and Cheakamus watersheds by the end of 2016.
5. Assess functional connectivity within the population of wolverines in the assessment area by the end of 2016.
6. Assess gaps and barriers in our understanding of ecological relationships that hinder sustainable populations by the end of 2016.

Acknowledgements

This Project is funded by the Fish and Wildlife Compensation Program –Coastal on behalf of its program partners BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and the public, who work together to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams. Additional funding for the Southern Coast Mountain Ranges Wolverine program is provided by the Ministry of Forests, Lands and Natural Resource Operations and Habitat Conservation Trust Foundation, with considerable in-kind support provided by the Ministry of Environment, Ministry of Forests, Lands and Natural Resource Operations, and St'át'imc Government Services.

Many people and organizations contributed to the completion of the work to date. Howie Shields and Travis Peters were instrumental in helping get the Bridge River monitoring sites built, monitored and collected. Sue Senger of the St'át'imc Government Services helped coordinate Bridge River field staff and provided support for the project. Eric Lofroth, Craig Baillie, Jill Matlock, and Helen Davis all helped with the monitoring of the many sites at some point over the winter (Fig. 6). Phil Harrold and Yoann Guidi safely flew field crews to the backcountry sites of the Bridge River and Steve Hall provided the best field camp we've ever worked at. Many thanks to Chris White and Steve Rochetta for helping establish and monitor sites in the Cheakamus River watershed.

Figure 6. Many field staff and volunteers helped establish and monitor the survey sites throughout the Bridge River watershed in 2016.

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Confirmation of FWCP Recognition

This Project is funded by the Fish and Wildlife Compensation Program –Coastal on behalf of its program partners BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and the public, who work together to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams. Additional funding for the Southern Coast Mountain Ranges Wolverine program is provided by the Ministry of Forests, Lands and Natural Resource Operations and Habitat Conservation Trust Foundation, with considerable in-kind support provided by the Ministry of Environment and St'át'imc Government Services.

FWCP-Coastal was highlighted as the primary funding source for our project in all press releases, extension materials, and presentations (e.g., Fig. 7).

Figure 5. Slide used during presentations identifying project partners and funding sources.

Appendix 1 – Examples of patterns in chest pelage among presumed 3 different individuals detected at the same monitoring station.

Appendix 2 - Non-target species recorded at monitoring stations

Pacific marten

Moose


2015-02-22 5:53:53 AM M 4/5 -5°C
15-11 MOHA
RECONYX

Bobcat


2015-02-18 5:30:52 PM M 1/5 4°C
13-7 NOEL CK
RECONYX

Lynx

Fisher