Wildlinks 2013:

A Workshop Of The Cascadia Partner Forum

Summary Report

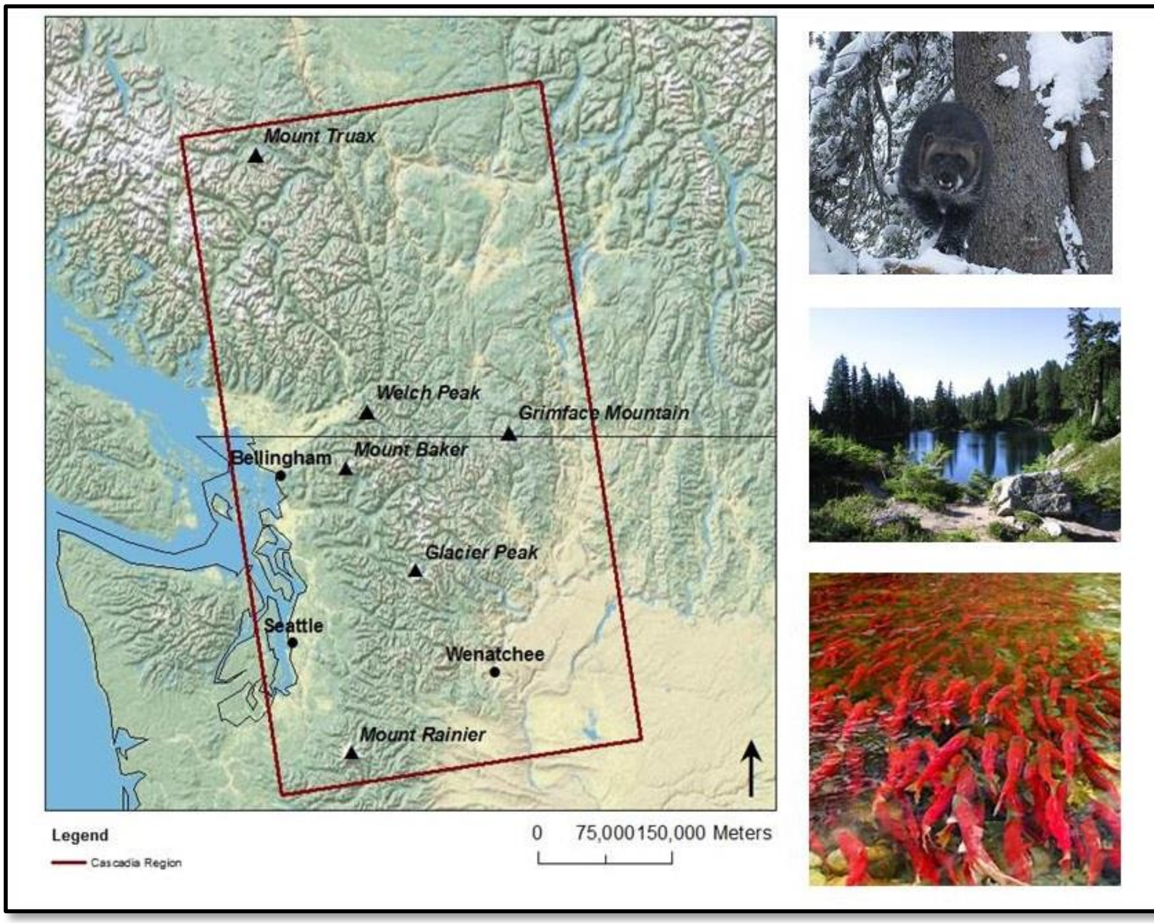

Photo credit: Map of Cascadia Partner Forum boundary, Cascades wolverine (Conservation Northwest), View of Cascades from Pacific Crest Trail (Tory Stevens), Fraser River Sockeye Salmon (Ministry of Environment)

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Prepared by
Jonathan Bepple
MSc Student
Complex Environmental Systems Lab
University of British Columbia - Okanagan Campus
complexity.ok.ubc.ca

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Introduction to WildLinks

WildLinks is a conference comprised of a unique collection of stakeholders. Members of this gathering have come together out of the need for a communal approach to addressing priority ecological and environmental issues in the Pacific Northwest. *WildLinks* was initiated by Conservation Northwest, originating in an organic manner. The catalyst of this meeting is a need for discussions about the interconnectedness of our landscape and of individual research and conservation efforts within it. These discussions allow for knowledgeable individuals from a range of backgrounds to collaborate across borders and disciplines on priority issues at a scale that matches the problems at hand.

For the past seven years *WildLinks* has brought together federal agencies, state and provincial government, researchers, invested private entities, tribes and First Nations, NGO's, and interested individuals from a specific landscape together to learn from each other and coordinate efforts. In the past two years, the gathering has focused on the transboundary Cascades ecosystem between Washington and British Columbia. Due to a federal government shutdown in the United States that overlapped the conference timing this year, employees from federal agencies including the US Forest Service, National Parks, and US Fish and Wildlife Service were unable to attend. Despite these missing voices, partners that could attend stepped forward to ensure the agenda progressed and objectives of the event were met.

In 2013 this conference expanded its scope from one revolving around large landscape planning for terrestrial species and habitat connectivity, to one focused on large scale processes, climate adaptation for aquatic and terrestrial species and systems, cross-boundary and cross-disciplinary coordination, and lessons learned from implementation of adaptation actions across this landscape. Welcoming comments were made by Rob Edward, Chief of the Lower Similkameen Indian Band that emphasized that scientific conservation planning cannot be effective without incorporating First Nations knowledge. Considering the connections between First Nation communities themselves and between their culture and the health of the landscape were also identified as necessary elements of holistic conservation. *See full agenda in Appendix 1.*

The event functioned as a workshop for the Cascadia Partner Forum[1], which grew from the proceedings of *WildLinks 2012*.Last year's conference identified the need for a dedicated network of individuals who could carry forward discussion, coordination, and implementation actions on some of the transboundary issues that were being identified at these yearly meetings. Having such a group is instigating capacity building and collaboration to move from conceptual planning to on the

[1] Cascadia Partner Forum, http://www.cascadiapartnerforum.org

ground action, while bringing lessons from the ground back into landscape planning discussions. By approaching regional issues under an umbrella network, we can reduce duplications of effort and facilitate more holistic conservation action.

The five objectives of the conference were to:

- Re-engage partners throughout Cascadia and connected ecosystems to the progress of the Cascadia Partner Forum, and initiate discussion on the future of this forum
- Gain local expertise and contribution to North Pacific and Great Northern Landscape Conservation Cooperatives regional planning efforts
- Share information on adaptation related efforts in the transboundary region that are underway or upcoming to increase coordination and involvement, while providing time and space to further these efforts while we are all together
- Facilitate an access management dialogue that defines why this cross-discipline issue is related to adaptation planning, how people within Cascadia are addressing it, and identifies priorities for continuing to address the issue
- Continue building a network of practitioners working on building resiliency into the species and ecosystems of Cascadia and connected ecosystems

The Cascadia Partner Forum

Formed by practitioners in Washington and British Columbia's Cascade mountains in the summer of 2012, the Cascadia Partner Forum fosters a network of natural resource practitioners working with the Great Northern[2] and North Pacific[3] Landscape Conservation Cooperatives to build the adaptive capacity of the landscape and species living within it.

The US initiative of Landscape Conservation Cooperatives (LCCs)[4], now a Canadian endorsed effort, seeks to coordinate planning and management of landscapes from the scale at which climate change and large scale ecological processes occur. The North Pacific LCC (NPLCC) incorporates the coastal Cascadia landscape west of the mountain range crest, while the Great Northern LCC (GNLCC) encompasses the eastern portion of our transboundary region from the crest to the inland.

Both LCCs work to identify scientific and conservation needs, share information, and improve coordination within their landscapes. Thus, a Partner

[2] Great Northern Landscape Conservation Cooperative, http://greatnorthernlcc.org/
[3] North Pacific Landscape Conservation Cooperative, http://www.northpacificlcc.org/
[4] USFWS Landscape Conservation Cooperatives, http://www.fws.gov/landscape-conservation/lcc.html

Forum enriches the efforts by improving synchronization across these two LCCs that divide Cascadia along the Cascade mountain crest while linking these regional efforts to practitioners on the ground. The Cascadia Partner Forum aims to bridge the needs of decision makers and practitioners within Cascadia to the resources already available, while highlighting these needs to the LCCs. Resources already available include both scientific and traditional knowledge, lessons learned from efforts already conducted, tools, and people and organizations to assist in accomplishing work.

Following the 2012 *WildLinks*, where the need and opportunity of a partner forum emerged, a foundational pilot council was created to establish and define the Cascadia Partner Forum concept. The council included representatives from state, federal, and provincial governments, a private foundation, and NGO's. Four objectives were established for the pilot year of this effort from fall 2012-fall 2013:

1. Identify and prioritize science and management needs and the resources available to address these needs to increase Cascadia's adaptive capacity
2. Highlight successes and challenges of implementing new adaptation actions
3. Improve communication and expand implementation of new approaches and ideas
4. Showcase and direct focus on Cascadia's unique landscape

The pilot council collaborated during bi-monthly calls to discuss priority issues for this transboundary landscape with standing agendas that included information sharing on climate adaptation related efforts throughout Cascadia, updates from both Landscape Conservation Cooperatives, presentation on a timely climate adaptation project within or overlapping Cascadia, and coordinated learning on selected priority adaptation topics.

At the conclusion of the pilot year for this partner forum, this year's *WildLinks* conference provided an opportunity to present the body of work from the past twelve months to attendees and gain their feedback on the future of this effort. Attendees were asked to reflect on the information shared and discussions facilitated over the 2-day conference organized by the forum to answer:

Did this new Partner Forum add value to the conservation efforts in Cascadia? Should work continue in this same format or is there another way that we can come together and begin more effectively managing our landscape in a collaborative way?

Engaging from the ground up with Landscape Conservation Cooperatives

The Great Northern Landscape Conservation Cooperative

Figure 1: Map of Great Northern LCC coverage area

The Great Northern Landscape Conservation Cooperative (GNLCC) was one of the early adopters in the LCC program. The GNLCC is a partnership that works across boundaries and jurisdictions to facilitate regional conservation at an ecologically appropriate scale. Members are engaged in collaboration through data sharing, capacity building, and through the construction of partner forums such as the Cascadia Partner Forum. The GNLCC represents the eastern crest of the Cascade Mountains and as such Cascadia straddles both the GNLCC and the North Pacific LCC (NPLCC).

Four component groups of the LCC work towards the goals of maintaining large, intact, and permeable landscapes, preserving ecologically conducive hydrological regimes, and promoting disturbance regimes that sustain ecosystem integrity. The steering committee, advisory team, science community, and partnership community that make up the GNLCC all contribute to the more holistic management practices that the group promotes.

Development of a science plan by the GNLCC is underway, and provides an opportunity to practitioners on the ground to conduct transboundary planning for 29 conservation targets. The plan identifies the need and a standardized approach to establish conservation objectives for each of the 29 conservation targets, classify threats in the region and conceptualize the relationships between these threats, conservation targets, and potential mitigation actions. This planning is not only to occur at the regional scale for the entire GNLCC, but also by each Partner Forum at a finer scale for the relevant conservation targets to their landscape. Once this has been done, gaps in data can be found that can be ameliorated to address clear, quantifiable conservation needs linked to a collaborative strategy.

In line with the messages echoed at *WildLinks* this year, the GNLCC has recognized the need to transition from objectives set for single species, to more broadly applicable ecosystem metrics. By improving and standardizing the metrics we use, conservation results will become more directly comparable and collaboration will be facilitated at a wider cross-border scale.

The North Pacific Landscape Conservation Cooperative

On the western face of the Cascade Mountains the NPLCC encompasses the more coastal ecosystems in Cascadia. Development of structure, function, and objectives of the NPLCC followed the methodology of the GNLCC. Differences arose between the LCCs reflecting the unique needs and values of their individual landscapes. The goals of the NPLCC are complimentary to the GNLCC, while their objectives are centralized around the tenants of identifying landscape level conservation needs and maximizing the availability, visibility, and utilization of data to promote informed decision making.

Figure 2: Map of geographic coverage of North Pacific LCC

A meeting in Victoria in September 2013 brought together provincial ministries, aboriginal leaders, and locals together to discuss the NPLCC structure and introduce NPLCC members to British Columbia. The NPLCC is composed of a steering committee, partnership liaison subcommittee, a science and traditional knowledge subcommittee, and a communications and outreach subcommittee.

Their science and traditional knowledge subcommittee have put the NPLCC's science plan for 2013-2016 forth. Priority topics that were identified include mitigating changing: hydrologic regimes, forest related air temperature and precipitation, sea levels and storms that affect estuaries and shorelines, and invasive species.

Currently the group is in the process promoting the LCC to engage partners and begin building a transboundary network. Improved collaboration will help identify further priorities and assist in updating the NPLCC's strategic and annual work plans.

Providing practitioner feedback to the LCCs

Attendees were divided into 6 breakout groups by clusters of GNLCC Conservation Targets to provide feedback to the LCCs .

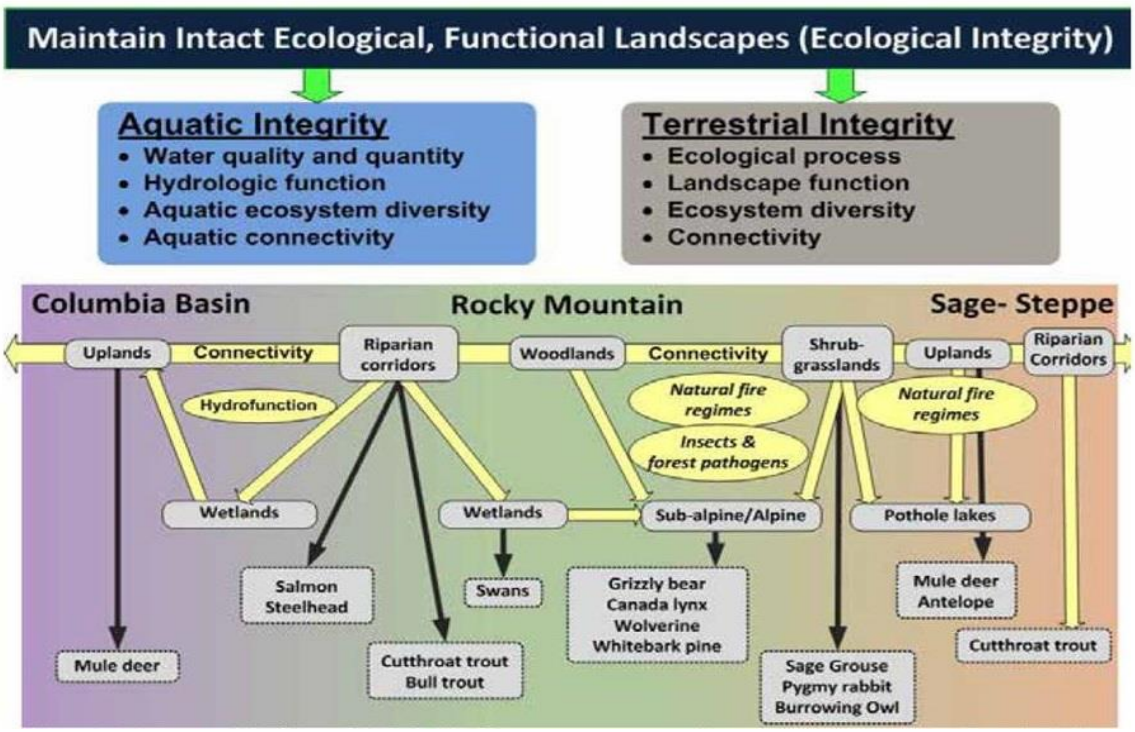


Figure 3: Goals and conservation targets of the Great Northern LCC organized by relevance to existing Partner Forums. Note Cascadia Partner Forum did not exist when this was developed, so discussions today if the Partner Forum continues would amend this graphic.

Leaders of each group were asked to facilitate a conversation that began with general feedback for the LCCs based on the information provided in the presentations then addressed the following actions for their set of conservation targets:

- Link the Conservation Targets for your group to one or more goals of the GNLCC and as relevant the NPLCC. If your target is a species, make specific note of your targets range and conservation requirements, and if it depends on landscapes within one or both of the LCCs.
- Establish goals for each conservation target. Consider whether there are already established goals to define "success" in conserving and managing this

target (i.e. recovery plans, management plans), spatial scale of goals (i.e. Cascadia wide versus sub-regions within Cascadia), whether you can set these goals if they do not exist, or what process would need to occur to establish them.

- Identify metrics for this conservation target to measure progress toward achieving the goal.
- List the threats impacting each conservation in Cascadia currently and in consideration of changing climate conditions.
- Explain the relationship between this conservation target and the other 29 targets (species, habitat types, and ecosystem processes).
- Outline the necessary conservation actions to be taken to reach the stated goal for this conservation target, and what limitations exist that prevent implementation of these actions (i.e. science gaps, capacity, funding, policy, communications, etc). Identify any conservation actions already underway within Cascadia.
- Note special considerations that should be kept in mind regarding a specific conservation target (i.e. scale, complicating factors, etc).
- What organizations, individuals, and existing networks should be a part of the development and/or review of any further planning and implementation of a shared science plan for this conservation target within Cascadia?

Notes summarizing the feedback from each breakout group are included in Appendix 3.

Focusing on priority issues within Cascadia

In its initial pilot year the Cascadia Partner Forum chose to establish an initial set of priority adaptation issues to focus knowledge gathering, coordination, and attention towards to increase our understanding of the full landscape. The forum's Pilot Council selected these issues based on criteria that considered timely importance within Cascadia, relevance to climate adaptation planning, and level of existing transboundary coordination. The priority topics for 2013 were:

1. Iconic species: wolverine and sockeye salmon
2. Ecological connectivity
3. Water
4. Access management

A team of three fellows were hired from Washington and British Columbia to write an overview introduction to this transboundary region, then develop reports on each of the priority topics. They aggregated relevant, region specific information on the priority topics and presented their findings in a series of reports to the pilot council that are available on the forum's website[5].

At the conference a presentation was selected for three of the four priority topics to share with the larger Cascadia network updated information on the status, ongoing research and efforts, and climate sensitive topic considerations. The priority issue of Access Management was addressed through a full-day workshop, discussed later in this report.

Iconic Species: Wolverine

Wolverines (*Gulo gulo*) were chosen by the Partner Forum as Cascadia's terrestrial iconic species for many reasons. Not only is the wolverine a charismatic mesocarnivore, with its individually diagnostic throat and chest blaze and diminutive size, but it is also an ideal species to increase the coordination of conservation efforts across various boundaries in the Cascadia region.

Wolverines are found in both the United States and Canada. Their transboundary habitat necessitates coordinated management of the species. In line with *WildLinks* objectives, improved management of this transboundary species' habitat benefits from a strengthening of communication between countries. This species further embodies an ideal iconic species for Cascadia because it is currently undergoing a shift in habitat into the northern Cascade Range, from which it was extirpated during the 1900s. Additionally, genetic evidence indicates that the wolverine was extirpated from the entire western contiguous United States during that time. Many extirpated areas have since been repopulated by dispersals from Canada, showcasing the adaptive capacity of this species.

Figure 4: Researchers with the North Cascades Wolverine Project check a wolverine trap in the field. Credit: K. Aubry

With current conservation work and research underway, and further work planned for the future, the wolverine ties into the LCC mandates of identifying existing on-the-ground work that can be highlighted to land managers to promote

[5] Cascadia Partner Forum, http://www.cascadiapartnerforum.org/priority-issues/

coordination. At *WildLinks* this year, Scott Fitkin of Washington Department of Fish and Wildlife discussed some of the current wolverine research and monitoring underway in the Cascadia region.

In the fall of 2005, Dr. Keith Aubry of the U.S. Forest Service's Pacific Northwest Research Station and his team (including Scott Fitkin) began capturing and collaring wolverines to assess their distribution, population status, and ecology within the North Cascades Ecosystem. In what is planned to be a 10-year study ending in 2015, this team is live-trapping wolverines and using satellite-based radiotelemetry tags to monitor their movements.

Wolverines are captured in live-traps that are built using on-site materials. The low tech, localized construction of traps is vital to the feasibility of this study because the trapping locations are in remote habitats that are difficult to access. Adding to the difficulty of capture, live-trapping occurs during the winter when this mountaintop ecosystem is entrenched in snow. Each trap is fitted with a sensor which remotely notifies researchers once a trap has been triggered. Upon recovery of a trapped wolverine, Aubry's team sedate the creatures, take photographs, make measurements, attach radiocollars, and collect tissue samples. Tissue samples are used to genetically profile the population to investigate their genetic affinities and patterns of connectivity with other populations.

Radio collars are used to track the movements of each tagged wolverine remotely via satellite. The data collected from tracked movements is used to delineate activity areas and locate reproductive dens. These data are supplemented with run-pole remote camera stations that provide additional information on animal movements within the study area.

Results to date indicate that wolverines have large activity areas. Males in the study area have activity areas that range up to 1,200 mi^2 (~3,100 km^2), whereas females have activity areas up to 800 mi^2 (~2,070 km^2) in size. Female activity areas appear to contract in years when the female is raising kits (baby wolverines). Wolverine activity areas occur almost entirely within the wolverine's bioclimatic envelope, which means that they typically reside in high-elevation areas that hold snow until the end of the wolverine denning period in mid-May.

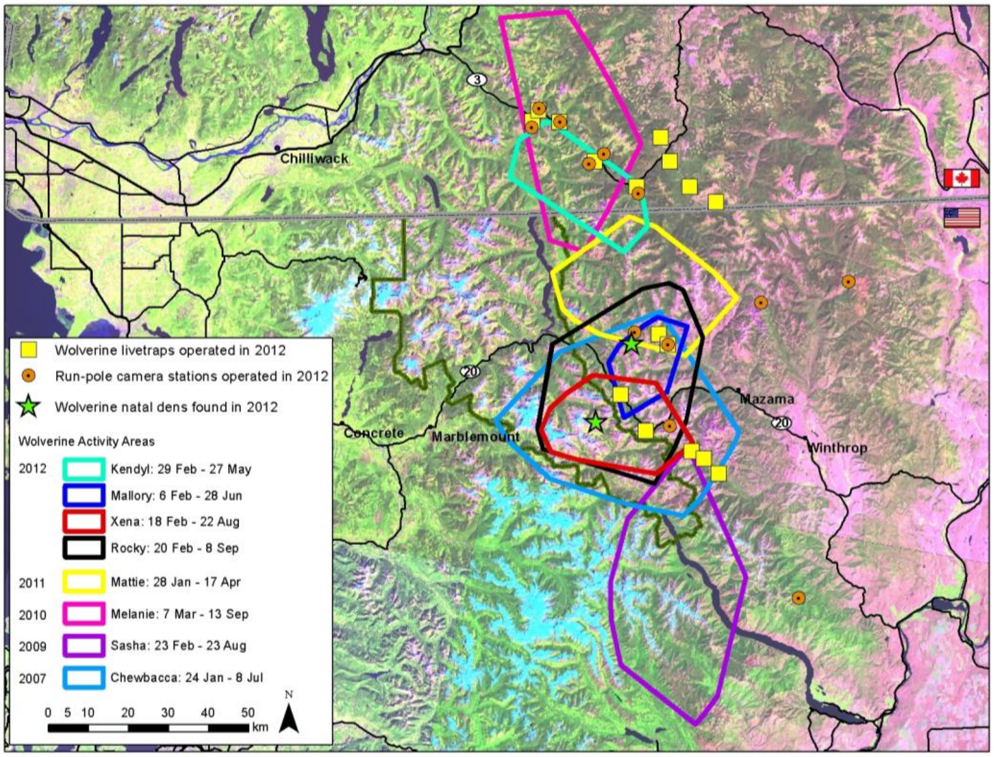


Figure 5: Example activity areas of 8 wolverines in the Cascadia region. Credit: K. Aubry and C. Raley

DNA evidence gathered during this research is being compared to historical samples and is providing insights into the genetic and distributional history of the wolverine in North America. Analysis of historical specimens shows that the wolverines that currently reside in the study area are genetically distinct from those that occupied the area in the latter 19th and early 20th centuries. These results suggest that wolverine populations were extirpated from the contiguous U.S. (which comprised the southern ice-free refugium during the last glaciation) during the 20th century.

The northern portion of their historical range in the western U.S. (the North Cascades and the northern Rockies) has since been recolonized by Canadian populations, resulting in the loss of genetic characteristics that were unique to the southern populations. So far, this recolonization process has not yet brought wolverines back to California, Utah, or Colorado, despite their occurrence in those areas historically.

Recognizing that recolonization events have occurred in the past that greatly affected the genetic diversity of this species, it is important to track ongoing range shifts and expansions. Documentation of range shifts will allow for the assessment of temporal trends in distribution and abundance. Aubry's team is partnering with Dr. Robert Long of the Woodland Park Zoo to begin work on a long-term monitoring program that uses non-invasive and less labor-intensive methods than live-trapping and radiotelemetry.

The inaccessibility of the terrain that wolverines occupy makes surveying over large areas and for extended periods of time difficult. Noninvasive approaches to obtaining genetic and distribution data can ease these difficulties. Methods such as hair snares and remote cameras have benefits over live-trapping for long-term studies, but still provide some challenges. With most monitoring occurring during the winter, even traveling to mountaintop survey sites to collect hair samples or replace batteries can be a labor intensive and potentially dangerous endeavor. To improve the efficacy of survey efforts, Long and his team began work in the summer of 2013 to develop an effective monitoring procedure that could be used during the summer months, when access is available to much of the North Cascades.

Previous attempts at summer monitoring often led to interference from bears that would destroy baited monitoring sites. Long and his team identified the need for a bear-resistant monitoring station that would attract wolverines and minimizes bear visits. During their first summer of work in 2013 the team constructed 16 baited, low-scent, hair snare/remote photography sites to collect data. Over the summer, only 1 wolverine was sampled from these 16 sites. Despite using low-scent lures, a number of bears were still attracted to the sites.

Even though the team was unsuccessful at attracting many wolverines or eliminating bear visits, this pilot year was still considered a success as no sites were destroyed by bears. In upcoming years, the team plans to increase survey intensity and use different baits and scent lures in an effort to attract more wolverines. As these methods are refined, the future for a cost-effective and noninvasive long-term monitoring program for wolverines in the North Cascades becomes more and more realistic.

Iconic Species: Sockeye salmon

The Partner Forum selected sockeye salmon as a natural choice to be the aquatic iconic species for Cascadia. Sockeye are ideal as a focal species for conservation for both scientific and cultural reasons. Their habitat is expansive and as such their life cycles tie together diverse landscapes. Sockeye are also charismatic and an integral part of the culture of the Cascadia region.

Sockeye salmon, like the majority of Pacific salmon species, are an anadromous fish. This means that they transition from freshwater to saltwater as juveniles and then back to freshwater as adults to spawn. This specialized life history, along with sockeye's ability to mate only a single time in their life, makes this species potentially sensitive to a wide range of environmental and human induced stressors. Uniquely, sockeye are the only salmon species to spawn in lakes. The long-distance migration of these animals, their unique life history, and their distinctive habitat requirements makes sockeye salmon ideal candidates for conservation efforts.

Beyond just conservation, sockeye salmon have cultural significance to the communities of the Pacific Northwest. Sockeye salmon are a staple of many native communities' diets and culture. Their distinctive ruby red and emerald green spawning coloration has earned the sockeye a place in native cultures for millennia. Today, the sockeye is still strongly associated with the culture of the region and plays an important economic role as a stock harvested and managed by both the U.S. and Canada.

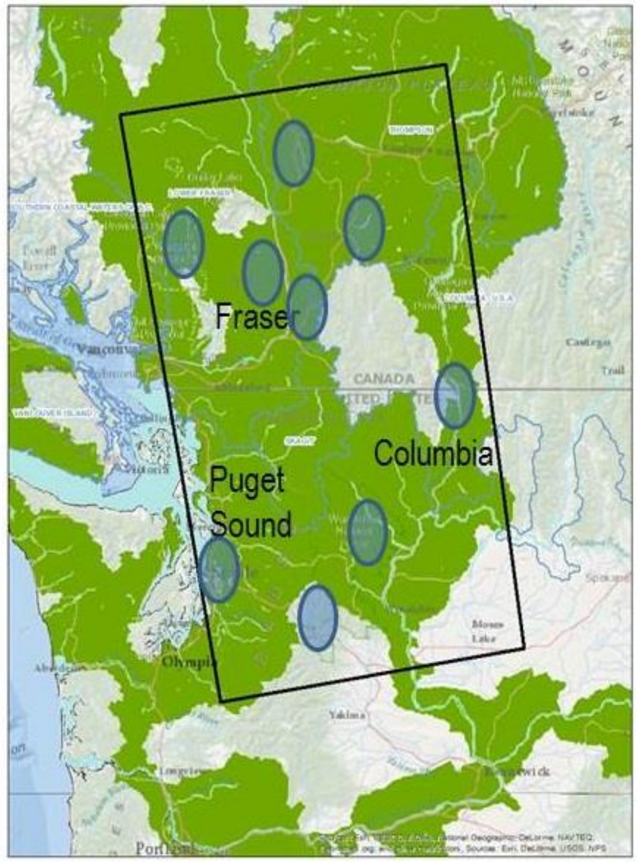


Figure 6: Sockeye distribution in Cascadia with major populations in the Columbia River (Osoyoos, Wenatchee, Yakima), Fraser River (Shuswap, Harrison, Adams)Puget Sound- Georgia Basin. Credit: G. Maier

Greer Maier from the Upper Columbia Salmon Recovery Board (UCSRB) presented at *WildLinks* on sockeye population trends, impacts of climate change, and current mitigation efforts being undertaken by UCSRB and others to benefit the species.

The Upper Columbia Salmon Recovery Board was formed in Washington in 2005. As a result of new legislation under the Endangered Species Act, locally driven recovery boards were created to govern on-the-ground conservation action. The UCSRB consists of three county commissioners and two tribal leaders. The Board supports three major programs: river restoration, science, and forest health. One of the main products to come out of the UCSRB efforts is the recovery plan for the listed spring Chinook salmon and steelhead in the Upper Columbia. The UCSRB also works to conserve and restore habitat for non-listed salmon species like sockeye across their species ranges.

Sockeye salmon are distributed throughout the Cascadia region. The species is found within the Columbia and Fraser rivers, in addition to the Puget Sound and Georgia Basin. Population trends in the Upper Columbia and Fraser rivers show fluctuations between low and high return years. Although raw numbers are large, with returns in the Fraser in the millions, there is evidence to suggest that the overall productivity of the Fraser populations is declining. Large increases have been seen in the past five years in the Columbia populations due to recent collaborative management efforts in the Okanagan River (see Okanagan Fish Water Management Tool case study).

The Snake River population of sockeye salmon found in Cascadia is federally listed as endangered in the U.S. This stock is supplemented by hatcheries but still remains at low abundance and is a small contributor to the overall numbers of salmon in the Columbia River system.

Population improvements across the Pacific Northwest are largely due to successful management efforts. The declines noted in many of large sockeye salmon populations in North America are not fully understood but appears to be driven, at least in part, by climate change.

Effects of Climate Change on Sockeye Salmon

Changes in minimum flow:	Decreases of 10-75% in monthly minimum flows in the West Cascades and increases of >10% in minimum flows in the East Cascades will affect adult migration and juvenile rearing by modifying the size of habitable zone within a lake habitat.
Changes in maximum flow:	Predicted impacts of climate change are variable between watersheds. Increasing maximum flow in winter and spring will increase egg scouring and fry mortality.
Changes in temperature:	Thermal stress can result in upwards of 30% mortality of returning adult Fraser sockeye. Increasing temperatures will increase thermal stress on returning adults and result in higher mortality. The effect of increasing temperature on the size of habitable zone within a lake will affect salmon at all lake-dwelling life stages.
Changes in snowpack:	Less snowpack in Cascadia will result in more rain dominated watersheds and higher flow periods in the winter/spring and longer low flow periods in the summer.
Changes in ocean conditions:	Increases in ocean acidification, algal blooms, and ocean temperature will affect marine-dwelling salmon habitat and prey availability. This can be particularly damaging to young salmon transitioning into ocean habitat.

At the species level sockeye are vulnerable because of their unique life history. Sockeye transition between habitats in small streams, to large rivers, to estuaries and then to the ocean and back again. Populations in the Okanogan basin have to migrate over 500 miles (800 km) to and from the ocean and have to cross nine mainstream dams on the Columbia River both on their outmigration and their migration back to their spawning grounds. Their sprawling range has the potential to expose them to a wide variety of stressors and conditions.

At a population level, sockeye salmon that are in small or isolated lakes are more susceptible to stress from climate change. If a vulnerable population encounters difficult conditions in a year, it is possible to lose large portions of the entire cohort. Reduced numbers of returning salmon in the years following mass cohort mortality can affect the viability of the population.

Life history traits can vary between populations and this variation can play a role in the vulnerability of each population. For example, salmon returning at the beginning of summer appear to be more adaptable to changing temperatures than those that return between late summer and early fall. Factors such as preferred marine habitat type and rearing lake depth can additionally affect the vulnerability of a population. With so many dynamic conditions influencing the adaptability of a population, the individual assessment of each population is necessary to determine the true potential impacts of climate change on the species as a whole.

As variable as the watersheds that sockeye call home, diverse research of climate change mitigation options for sockeye is occurring across Cascadia. Reintroduction programs are currently underway in both the Yakima and Okanagan/Okanogan basins in an attempt to once again facilitate viable populations in these systems. Research at the UCSRB is assessing how forest health and canopy type can affect the amount of snowpack in an area and secondarily the downstream flow that affects salmon habitat. The National Oceanic and Atmospheric Administration (NOAA) is assessing a variety of habitat restoration efforts, from fish passages to nutrient enrichment, and their potential for reducing climate change effects on river system dynamics. Beaver reintroduction is currently being used in the Methow watershed to mediate stream flow and temperature for salmon. Finally, the Okanagan Nations Alliance is collaborating on an Okanagan Fish Water Management tool (see case study) to improve Okanagan sockeye populations and manage stocks while taking into consideration the priorities of a range of different stakeholders.

Ecological Connectivity

Ecological connectivity is a priority issue that has drawn attention both at previous year's *WildLinks* and from the LCCs. Connectivity is an important conservation issue that will become increasingly pertinent as aquatic and terrestrial ecosystems adapt to a changing climate. Fragmentation of a connected landscape can lead to the delineation of what was once a contiguous habitat, resulting in populations becoming split into smaller component subpopulations. Smaller population size in turn leads to a higher vulnerability of extinction.

In Cascadia, important aquatic and terrestrial habitat connections stretch across the United States and Canada border. Therefore, management of habitat connectivity benefits from increased collaboration between state, provincial, and federal governments along with land managers on both sides of the border. Strong cross-boundary collaboration has occurred in recent past, and is increasing through efforts addressing terrestrial connectivity in this region. Some of these efforts have been highlighted through presentation at this year's conference.

Wildlife require the ability to move between habitats to find food, mates, and homes on a daily, seasonal, and generational basis. Habitat fragmentation can hinder this ability and this hindrance can be exacerbated by a changing climate. Climate change is expected to reduce the suitability of species' historical habitat and cause species to move along spatial and temporal climate gradients as temperature increases. Warmer climates will likely result in species within Cascadia moving their ranges north or potentially west to cooler climates. The fragmentation of movement corridors along these climate gradients could result in species being less well equipped to adapt to climate change as they are unable to transition to more suitable habitats.

Joanne Schuett-Hames of the Washington Department of Fish and Wildlife, Tory Stevens of the BC Ministry of Environment, and Rachel Holt of Veridian Ecological presented on a transboundary collaboration between the Washington Wildlife Habitat Connectivity Working Group (WHCWG)[6] and the newly established BC Connectivity Collaborative (BCCC).Presenters highlighted existing work in the transboundary region between Washington and British Columbia along with key findings summarized in a report released in 2013[7]. Additionally, the group spoke to collaborations that are just beginning to further our understanding of the current terrestrial habitat connectivity condition and potential future condition in consideration of climate change.

The WHCWG formed in 2007 under the leadership of the Washington Departments of Transportation and Fish and Wildlife, and has functioned as an open collaborative science-based effort to produce tools and analyses that identify opportunities and priorities to providing habitat connectivity in Washington and surrounding habitats.

The BCCC is still in its infancy but is a needed addition to compliment the WHCWG (in existence since 2007) as transboundary landscapes are addressed. Tory Stevens encouraged attendees to help develop the BCCC through engagement, and proposed an initial goals for the including establishing a formal network connecting interested researchers, individuals, and groups that are concerned about connectivity but may not be aware of each other's efforts. In its first year the main objectives of the group are to aggregate a balanced group of individuals that represent the range of interests on both sides of the border and pull together the relevant data for a transboundary connectivity analysis. Secondarily the group

[6] Washington Wildlife Habitat Connectivity Working Group, http://www.waconnected.org
[7] Washington Connected Landscapes Project: British Columbia – Washington Transboundary Habitat Connectivity Scoping Report, August 2013, http://waconnected.org/wp-content/uploads/2013/09/Transboundary_finalreport_august2013.pdf

hopes to hold workshops to start identifying the needs of stakeholders and practitioners with regards to changing climate.

Analysis of connectivity is dependent on the scale at which you are assessing. Individual species can be assessed for their response to fragmentation. Doing such an assessment and preserving the habitat linkages for each species in Cascadia would be infeasible. To assess connectivity at a broader scale, one can evaluate multiple species concurrently.

In the *Washington Connected Landscapes Project: Statewide Analysis*, the WHCWG separated 16 focal species into three guilds (shrubsteppe, montane, and generalist) based on shared patterns of linkage networks. Aggregating species with similar connectivity patterns helped highlight critical linkage pathways and display how the conservation of one species could secondarily benefit others.

An additional complimentary approach was also undertaken, entitled Landscape Integrity, which analyzed the connections between the most ecologically intact portions of the landscape. In the transboundary region between Washington and British Columbia, interpretation of all connectivity products from the statewide analyses identified three subregions that contained important linkages between substantial habitat concentration areas that warranted a closer look: North Cascades-Coast, Okanagan-Kettle, and Columbia-Selkirks.

These transboundary collaborative bodies are working together to initiate two efforts in the coming year(s): a finer scale analysis of the Okanogan-Kettle subregion and interpretation of climate information to inform land management identified needs.

Last year, attendees of *WildLinks* emphasized the need for finer scale information on habitat connectivity in the transboundary region to inform on the ground work and greater interpretation of products that are already in existence.

Responding to input from partners on the ground and findings from numerous studies, a finer scaled analysis is being undertaken in the transboundary Okanagan-

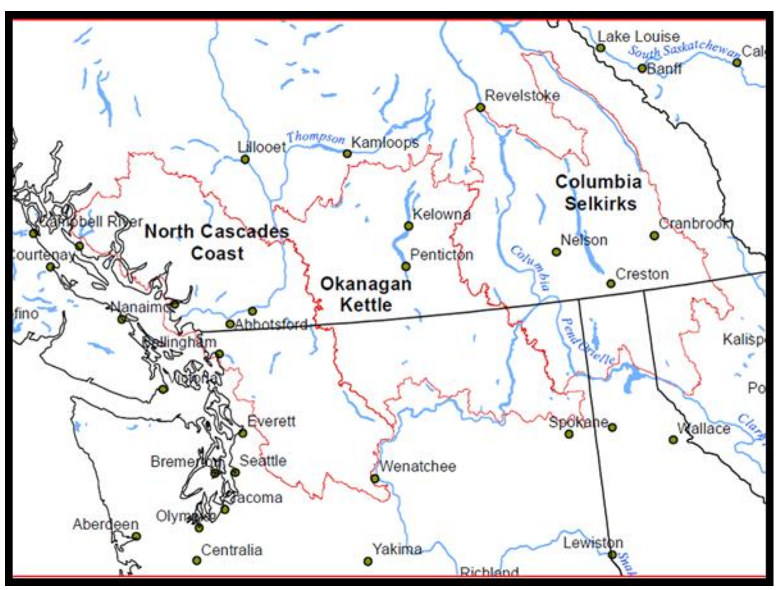


Figure 7: Three transboundary subregions identified by the Washington Wildlife Habitat Connectivity Working Group for further analyses in coordination with British Columbia

Kettle subregion of British Columbia and Washington. This finer scale habitat connectivity analysis will identify opportunities to maintain and restore a connected network of habitats in this geography east of the Cascades crest.

Numerous studies including those of the WWHCWG point to both east-west and north-south linkages important to maintaining a connected network of habitat within and between the Cascades and Kettle mountain ranges for species ranging from sharp-tailed grouse and mule deer to Canada lynx. In British Columbia these linkages are important for some of their countries most vulnerable species, as the Okanagan is home to many species that are not found elsewhere in the country.

Recent analysis of cougar gene clusters in Washington and Southern BC indicates that barrier effects in this landscape may affect even highly mobile species such as cougar. Some landscape features such as the Okanogan River may have always presented resistance to movement, while transportation corridors such as Highway 97 and Route 3 represent more recent barriers to migration. A transboundary team led by Joanne Schuett-Hames and Rachel Holt will work with practitioners, modelers, species experts, and interested parties on both sides of the border to develop a methodology for conducting these analyses and present findings in a final report with associated maps and data layers.

Simultaneously, Meade Krosby from the University of Washington and chair of the Climate Change Subgroup of the WHCWG is leading a multi-scaled set of climate and connectivity planning efforts throughout the transboundary region of British Columbia and Washington that will purposefully overlap with the Okanagan-Kettle subregion. This effort was presented on and is discussed in the Access Management section of this report, as it will be working with stakeholders throughout the transboundary region to bring climate and connectivity science to inform specific land management questions including access management.

WildLinks 2013 attendees that were interested in the work being conducted in the Okanagan-Kettle subregion by the WHCWG and BCCC were asked to attend a working lunch meeting on the first day of the conference. Over 20 individuals attended and were introduced to each other and current members of both connectivity working groups. Attendees discussed their background and work in the landscape, and in what capacity they felt they could be most useful to development of analyses in the transboundary region.

Water

Water is a fundamental element that connects and shapes terrestrial landscapes. The diverse topography of Cascadia is molded by meandering rivers and mammoth glaciers that shape some of the most variable ecosystems in the Pacific Northwest. Water is critical for the lifecycles of not only many organisms but also the people that call this landscape home. Streams provide not only habitat for spawning sockeye salmon but also act as a source of drinking water, power generation, irrigation, and a source of recreational actives for humans to enjoy.

The transient nature of water makes it a vehicle for cross jurisdictional management and coordination. Flows traverse community and national borders much like the ecosystems that they are found within. Interconnectedness between water, an ecosystem, and the ecosystem's component species necessitate appropriate water management for effective ecosystem management.

The effective management of water is contingent upon our predictive capacity with regards to how hydrology is changing and how climate change will affect the future water dynamics in the Cascadia region. At *WildLinks* this year Markus Schnorbus of the Pacific Climate Impacts Consortium (PCIC) presented the results of modeling work that assesses the regional impacts of climate change on hydrology. The presentation discussed results from modeling done at PCIC that assesses effects on the northern portion of Cascadia in combination with results from the Climate Impacts Group (CIG) which assesses the southern portion of our region. The combined results, which derive from somewhat different modelling assumptions and approaches, provide a qualitative assessment of the effects of climate change on hydrology in the trans-boundary Cascadia region.

To model hydrology effectively there must first be a climate model that can represent the predicted future climate of an area. These are constructed at a much broader scale than is directly useable at a regional level. International predictions of emissions and their impacts on climate are modeled to produce global climate change

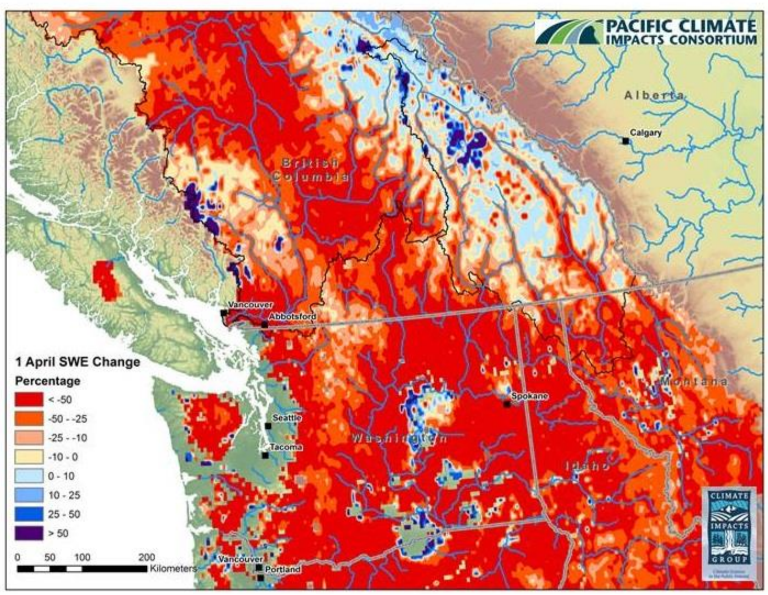


Figure 8: April 1st Snow Water Equivalent Change 2040s/2050s A1B, Median/Average Change combining results from PCIC and CIG. Credit: M. Schnorbus

Question and answer between Marcus Schnorbus and event attendees:

Q: Are you looking at water temperature?
A: In the short term, no. Long term plans include incorporating water temperature into modeling but this is likely more than a year away.

Q: What are some of the differences between PCIC and CIG? How are you working to standardize modeling practices to make them more directly comparable?
A: PCIC and CIG have fundamentally different stakeholders and objectives. Talks have begun to try and collaborate more between groups. There is interest in potentially having overlapping methods or assessment areas so that results could be more directly comparable. These efforts will likely bear fruit in a year or greater.

Q: With variable results between CIG and PCIC models (fall runoff results) does this not show that there is either great uncertainty in the results or at least some place where the groups could come together and better parameterize these models?
A: Variable results are likely a result of the uncertainty associated with model building. Neither group did anything inherently wrong but instead made different assumptions, parameterizations, objectives, used different global climate models, and summarized their own models differently, leading to different end results.

Q: Will advancement in the timing of peak flows have an effect on mountain pine beetle?
A: At a local level there could potentially be an effect. Generally though the areas which will have the strongest changes in stream flows are generally distinct from the arid plateaus that pine beetle populate thus is it expected that there will be little landscape level effect of mountain pine beetle.

scenarios of temperature and precipitation. Results from global climate models, which provide very coarse results, are then downscaled to the regional context. Once downscaled, climate model generated data is input into regional hydrology models to assess the impact of climate change on regional hydrology.

PCIC's regionally scaled models produce results for three levels of emissions: low, medium, and high. At all levels of emissions temperature is predicted to increase across the study area by the middle of the century. Climate change effects on precipitation are more variable between emission levels, seasons, and across landscapes. Models assessed hydrological changes using a variety of common metrics are as follows (see next page):

Metrics Used to Assess the Effect of Climate Change on Precipitation:

1. Snow/Rainfall Ratios – A measure of the proportion of precipitation that falls as snow or liquid precipitation from October to March
    a. As temperature increases, the proportion of precipitation that falls as rain will increase. Areas that once had snow dominated precipitation regimes will transition to rainfall dominated regimes. These results coincide with elevation and become visually apparent as increases in elevation of the snowline

2. April 1st Snow Water Equivalent – A metric of how much snow accumulates over the wintertime
    a. Increasing temperature and more winter precipitation falling as rain will lead to a decrease in April 1st SWE in the majority of landscapes by the mid-21st century. In mountain ranges where elevations are sufficiently high there may be increases in April 1st SWE above the snowline.

3. Runoff Change – A measure of how much water is flowing out of the mountaintop snowpacks
    a. Spring (March – May): Due to decrease in snowpack at lower elevations, runoff will decrease at low elevations. At higher elevations that have retained snowpack, streamflow will increase due to the occurrence of earlier melt runoff.
    b. Summer (June – Aug): Reduced snowpacks and maximum shift to increased flows in the spring will lead to decreases in summer runoff for the majority of the region
    c. Fall (Sept – Nov): Climate change effects on fall runoff are potentially more variable. Results from models by PCIC and CIG are contradictory. Variations in modeling results are likely a result of varying assumptions and calibrations of the models.
    d. Winter (Dec – Feb): More precipitation will fall as rain during the winter and as such the run off is predicted to increase

4. Discharge Projections
    a. Skagit River: Temperature increases will lead to streamflows that are increasingly dominated by fall and winter storms inputs as opposed to traditionally being dominated by snowpack runoff.
    b. Similkameen River: Changing climate is projected to lead to higher winter discharge, an earlier onset of spring freshet runoff and a longer dry period in the summer
    c. Fraser River: Much like the Similkameen, spring freshet runoff will occur sooner with a prolonged summer low flow period by midcentury.

Access Management

Access management has arisen as a priority within Cascadia to address in adaptation planning for species and ecosystems across disciplines and borders. Defined as the system of road and trail infrastructure that provides the option for managers and the public to access landscape, access management has become a timely need for managers to address across our public lands. Due to the scale of the issue, the Cascadia Partner Forum Pilot Council decided to focus initial discussions of access management on roads.

Roads of all kinds from highways to gravel single lane routes provide valuable access to the landscape of Cascadia. Access is needed for land and species management, recreation, and enjoyment. Roads can also pose natural resource risks to the landscape from reducing watershed health and secure habitats for wildlife to providing vectors that facilitate the spread of invasive plants.

Identifying a balanced sustainable road system that provides needed access to our landscape while ensuring healthy watersheds and habitats is a priority for practitioners throughout Cascadia that has been identified through previous *WildLinks* gatherings, the North Cascades Adaptation Partnership[8], and independent land managers. The accurate identification of a road system as sustainable must consider climate change.

A workshop during the second day of this year's *WildLinks* aimed to set a context for the current condition of Cascadia, define why road management is important in adaptation planning across disciplines, develop the climate sensitive management questions that should be considered in access management planning, review the policies within Cascadia to address access management, and present case studies of access management planning within the Cascadia landscape.

[8] North Cascadia Adaptation Partnership, http://www.northcascadia.org/

Figure 9: Graphic displaying the network of roads in Cascadia with all types of roads weighted the same as red linear lines to show only the extent of the current network based on 2010 data layers.

Setting the context

The mileage of roads on the Cascadia landscape have left an impressive footprint that often outsizes the budget of land managers and presents natural resource risks. The individual impact of each road segment on natural resources varies greatly by its type, use, location, design, and condition. Roads on this landscape vary from 6-lane interstates that carry tens of thousands of vehicles a day to closed natural resource roads that remain in storage for a future need while experiencing no current use. Many tools to address natural resource risks presented by a road segment are available ranging from retrofits to the road (i.e. culvert upgrades) to re-location to closure to decommissioning

Importance of access management planning across disciplines

Wildlife

Access to the diverse ecosystems across the Cascadia landscape, in the forms of roads and trails, can affect and fragment wildlife populations. Construction of infrastructure can result in direct mortality of species, habitat loss, it can change species interaction around road systems, and result in the mixing of competing species that would not have naturally interacted. Bill Gaines of Washington Conservation Science Institute presented at *WildLinks* on some of these interactions between wildlife and access management followed by potential implications for management and conservation.

The interactions between access infrastructure and wildlife have the potential to produce compounding influences on the impacts of climate change. As climate changes, species may attempt to transition to areas that have climates more similar to what they are adapted for. The North Cascades are likely going to become a refuge for species that seek a cooler climate. If infrastructure is not managed properly there may be barriers that prevent species' distributional shifts.

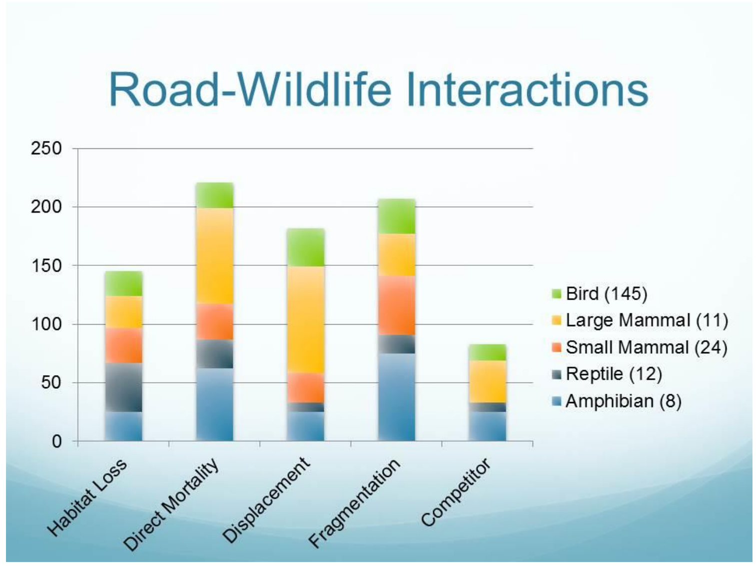


Figure 10: Summary of scientific studies by species groups on road-wildlife interactions. Credit: B. Gaines

The way in which roads change the competitive interactions between species may also be amplified by changing climates. Invasive species may be able to gain access to advantageous landscape via the road networks and cause additional stress on systems affected by climate change. The effect that both roads and climate change have on habitat connectivity is of major concern to land managers that are attempting to facilitate conservation in the region.

The Okanogan-Wenatchee National Forest has over 9,000 miles of roads ranging from user created roads to major arterials. Land managers of the Okanogan-Wenatchee National Forest are addressing the interacting effects of these roads and climate change on resident wildlife at two scales. Provincial and state level planning occurs through the Forest Plan Revision[9]. This land management plan sets direction for the national forest covering 4 million acres of the east Cascades for the 15-20 years including guidance for addressing the impact of roads on terrestrial habitats.

A literature review was conducted by the planning team to synthesize a living, dynamic database of the information and data currently available on the interaction and impacts between specific wildlife species and roads. The literature review includes analyses for existing road density and recommendations for desired future road density levels for intact wildlife security habitat and key connectivity areas. Using road density as a metric allows managers to quantitatively set scientifically informed objectives that increase the availability of habitat and

[9] Okanogan-Wenatchee and Colville National Forest Plan Revision, www.fs.usda.gov/detail/okawen/landmanagement/planning/

permeability of landscapes for wildlife through the management of Forest Service roads.

The Forest Plan Revision also provides the opportunity to compliment the infrastructure upgrades that facilitate passage of wildlife over and under highways. Investments made by the Washington Department of Transportation, such as installing guiding fencing that direct wildlife towards connectivity structures, ensures that adjacent habitat managed by the national forest complements the purpose of these structures. One example of this is the habitat managed by the Okanogan-Wenatchee National Forest directly adjacent to investments being made through the I-90 Snoqualmie Pass East Project[10].

At a more localized scale, individual watersheds are assessed through landscape evaluations that are part of the Okanogan-Wenatchee Forest Restoration Strategy[11]. This forest-wide policy establishes that all actions implemented on the forest must work to restore ecological process, pattern, and function of the landscape to increase its resiliency to disturbances including those brought on by a changing climate. These landscape evaluations assess how aquatic ecosystem and road interactions, wildlife habitat, vegetation patterns, and fire risk have changed compared to past trends.

Assessments of interaction between roads and aquatic systems are a measure of aquatic connectivity. These assessments do not yet incorporate projected changes to hydrology but provide data on existing key intersections where restoration efforts can be targeted.

Wildlife is assessed at the watershed scale through detailed reviews of focal species and comparisons of landscape configurations to reference conditions. Maps of historic landscapes are reconstructed at the Forestry Sciences Lab in Wenatchee for comparisons to the current environment. Modern and historic maps are assessed for the spatial arrangement and size of broad habitat types. Land managers can synthesize estimates of fragmentation change by comparing existing landscape patterns to past conditions and future estimates. Combining this data with the assessment of road and stream interactions provides an integrated watershed level assessment that can be utilized at the restoration-project level.

[10] I-90 Snoqualmie Pass East Project, http://www.wsdot.wa.gov/Projects/I90/SnoqualmiePassEast/
[11]

Key Considerations for Future Work

- Standardization of the definition of access infrastructure will improve data quality in surveys and strengthen the capacity for collaboration across borders.
- Consistent assessment methods across landscapes will improve the compatibility of results
- A process is needed that can identify priority landscapes and projects *across* watersheds
- Working towards a common set of indicators will reduce costs and allow for larger scale assessments of ecosystem health
- Expansion of the range of metrics used to make road assessments is necessary to make surveys as biologically relevant as possible

Engineering and Infrastructure

Climate change mitigation is an issue of concern for more than just the natural environment. The infrastructure that radiates across Cascadia is at risk from the effects of climate change. Direct influences such as changes in precipitation lead to increased erosion, while indirect stressors such as changes in human use will affect society's ability to facilitate the wide range of benefits that ample access provides. Ronda Strauch of the University of Washington presented this year on the impact that changing climate may have on the access infrastructure of the Cascadia region.

Figure 11: Example of a landslide impacting roadway in Cascadia

Impacts from climate change are already occurring in the region and in some cases, they can be extensive. For example, in 2006 a storm that unleashed 18 inches (45cm) of precipitation over 36 hours atop Mount Rainier National Park resulted in a 6-month park closure and damages that exceeded $36 million.

High elevation, steep topography, and extensive river systems make access difficult in the Cascadia region. Threats to adequate transportation are numerous in a landscape such as ours, ranging from landslides, river migration, erosion, and avalanches. Primary drivers of impacts to roads and trails were determined from climate model projections and expert knowledge from scientists and resource managers during multi-agency workshops. Future hydrologic regimes for the region developed by the Climate Impacts Group were simulated with forcing data from Global Climate Models to project snow, extreme streamflow and flooding, and landslides using soil moisture as a surrogate metric. These hydrologic projections were overlaid with data on roads and trails using GIS spatial analysis, to assess potential impacts of changing climate on infrastructure.

Collaboration in Action

To help address the effects of climate change on ecosystems, the North Cascadia Adaptation Partnership (NCAP) was created in Washington as collaboration between federal forest and park agencies managing 6 million acres of contiguous land in the North Cascades. This group assesses the effects of climate change on natural and cultural resources, including access management, and developed science-based adaptation strategies. The region of influence for the partnership includes Mount Rainier National Park and North Cascades National Park Complex, and the Okanagan-Wenatchee and Mount Baker-Snoqualmie national forests. More information can be found on their website[1]

Hydrologic models of the area estimate a 32% decline in snowpack in the North Cascades by the 2040's. This will affect the rate at which snowpack melts and is predicted to result in snow melting early through the entirety of the North Cascades. In particular there is predicted to be larger changes on the west side of the Cascades as temperature there is currently closer to the threshold when precipitation falls as rain versus snow. Spatially explicit estimates of snowmelt change can be used to prioritize trail maintenance and construction projects for areas where climate changes are likely to produce the strongest effects.

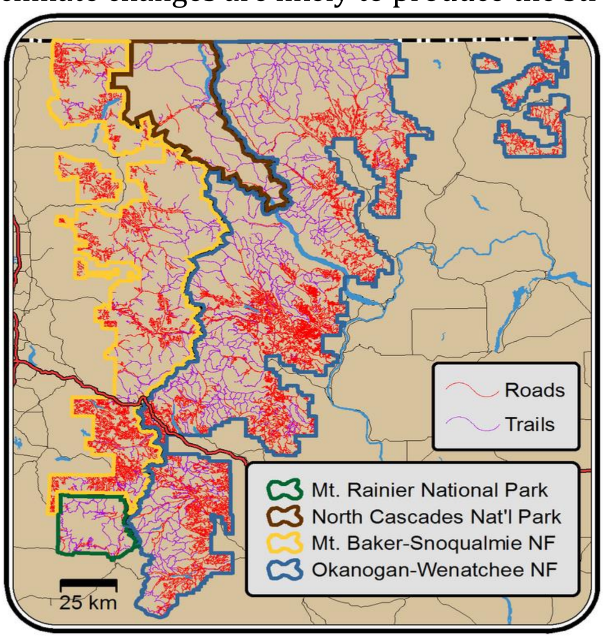


Figure 12: Roads and trail network in two National Forests and two National Parks in Washington. Credit: R. Norheim (CIG)

Flooding is expected to occur more frequently throughout the Cascades as a result of climate change. Peak flows that previously occurred once in 100 years are predicted to be double the flows by the 2080s in some watersheds in Cascadia. In addition to greater flooding, higher amounts of precipitation falling as rain is predicted to result in higher soil moisture during the cool season. Increased soil moisture is linked to increased occurrence of landslides and is therefore used to estimate landslide risk. Results show mixed increases and decreases in soil moisture across the region by the

2020s, but these results transition to largely increases across the landscape by the 2040s and especially by the 2080s.

Although the strength and direction of effects of climate change have some uncertainty surrounding them, it is apparent that climate change will modify the way we manage our access infrastructure. To maintain access to and within the Cascadia landscape, management should anticipate, plan, and act in response to the projected changes and impacts.

The vulnerability assessment and adaptation strategies developed from the NCAP[12] collaboration can be utilized for a number of applications across the landscape. These potential application include: recreation & transport planning, restoration planning, minimum roads analysis, emergency response & safety management, maintenance prioritization, infrastructure design, monitoring & research, education & funding, and as a driver of collaboration & partnerships. Implementation or improvement of these applications will increase the resistance and resilience of the landscape and infrastructure to climate change.

Access Management and Hydrology

Robin Pike from the BC Ministry of Environment (BCMoE) discussed the influence of roads on watershed hydrology. He reviewed the history of varying road construction methods in BC and outlined some of the potential legacy issues. In general, compacted surfaces of roads and ditch lines can interrupt and redirect downstream water movement. This can lead to a concentration of flows into natural drainage channels, inter-basin diversions, faster stream network response, and ultimately, changes to the size and timing of flows entering downstream aquatic ecosystems.

Figure 13: Roads can intercept and redirect water, concentrate flows and be a source of fine sediment that can affect aquatic ecosystems. Images: R.G. Pike.

Altering peak flows and concentrating flow volumes can lead to increased erosion potential and release of sediment into waterways, subsequently reducing water quality. Fine sediment can be added to aquatic ecosystems through chronic surface erosion (e.g., from ditch lines and road surfaces) in response to precipitation

[12] North Cascadia Adaptation Partnership, http://www.northcascadia.org/

events or episodic mass movements such as landslides that contribute both fine and coarse sediment. Importantly, road networks can increase the connectivity of aquatic environments to sediment sources, which has the potential to increase the amount of sediment entering aquatic ecosystems.

Post-harvest assessments of stream and aquatic habitat conditions led by Peter Tschaplinski (BCMoE), under the Forest and Range Evaluation Program, have shown roads to be the most frequent source of impacts, occurring in 70% of all affected stream reaches, eclipsing the frequency of all other impact sources (such as riparian harvesting). Road surface erosion and/or transport of eroded materials (fines) from hill slopes to streams at crossings has been found to be the most frequent road-related source of fine sediments to streams.

Increases in stream temperatures can affect species metabolic rates, biologic activity, decomposition and alter the distribution of aquatic species that have preferred temperatures for spawning, rearing and migration. Compacted road surfaces and ditch lines can also act as pathways for chemicals such as fertilizers, herbicides and fire retardants. Because roads are well connected with natural drainage channels, chemicals have a direct pathway into aquatic ecosystems. Creating buffer zones around roads and streams during chemical applications can reduce the potential loading.

The effect of any particular road on a hydrological system is dependent on the proximity to hydrologic features, construction methods/materials, road density, hydrologic regime, maintenance practices, and climatic variability and change. Climate change is likely to induce an increase in the frequency of extreme events that may increase rates of erosion and could lead to infrastructure failures (e.g., culverts) if design criteria are exceeded.

Sediments Effects on Aquatic Habitat

- reduced fish egg and alevin survival
- decreased abundance / diversity of prey species (benthic invertebrates)
- impeded feeding / predation by fish and other visual predators
- impeded respiration in fish species
- filled interstitial spaces in the streambed (reduced habitat), and reduced connectivity between main-channel habitats and tributaries/off-channel valley bottom habitats

Remediation of roads has been largely successful but further work is needed. Continued restoration of legacy impacts, deactivation of roads, and separation of natural and road drainages will reduce impacts of roads on hydrologic networks. Appropriate road planning and maintenance schedules are necessary preventative measures to ensure the long-term viability of access. Evolving engineering practices continue to reduce future impacts. Restricting use of roads or changing access practices will also reduce the potential effects of roads on aquatic environments and improve the adaptive capacity of the landscape.

Management Policies in BC

The fact that access management is a far ranging issue is apparent in the current state of legislation governing the matter. Roughly 13 pieces of legislation throughout BC in some way influence access management but they are often too specific to address the full breadth of drivers that influence access management. Don Gosnell discussed the need for an overarching piece of legislation and authority to properly address access management and its developing role in conservation of the Cascadia landscape.

Currently the BC Ministry of Forests, Lands, and Natural Resource Operations (FLNRO) is undergoing the 3rd iteration of an attempted unified Road Act. In the 1990s the first attempt at such a piece of legislature failed due to the political environment at the time being opposed to the idea of incorporating access management in legislation. A second attempt in 2008 failed due to insufficient consultation with the land managers and stakeholders.

A third attempt at drafting a Road Act is currently underway. Don and his group are attempting to align the values and goals of multiple interest groups by ensuring improved transparency and opportunities for feedback in the drafting process. The Natural Resource Road Act project launched a website aimed at informing the public about early work on the project and getting feedback about priority issues from the range of sectors, public and private, that are affected by resource road legislation.

Don believes that adequate and integrated management of resource roads could mitigate upwards of 80% of the issues that users have identified. Without proper guidelines or legal power, discussions on access management are often stagnant as different interest groups are unwilling to compromise.

Over 4000 responses to the NRRA online survey, including 90 written submissions helped inform on some of the most common complaints regarding resource roads, their maintenance, and closure. The most frequent complaints were regarding:

- Road deactivation without warning
- Loss of high value access
- Too much motorized access
- Lack of consideration for multiple uses of roads
- Inadequate maintenance
- Safety concerns
- Competing, incompatible uses

The NRRA project is profiling current access management planning and assessing what components are existing legislation. The land use regulatory tool box could for example, delegate access management authority at the local level, rather than centralized in Victoria as is now the case now, to encourage community participation at appropriate temporal and spatial scales. Such authority could be tied to consultation with affected parties and a more holistic application of management practices.

Appropriate access management planning could help bridge the gap that currently lies between high level strategic planning and operational decision making. Legislative power at this intermediary level could help translate land use objectives into binding strategies that apply to all resource road use.

Other initiatives besides the NRRA may help facilitate an appropriate regulatory tool if this third iteration of the Road Act is unable to meet the required needs. Work on managing cumulative effects in the northeast (see Tulameen Cumulative Effects project case study on page 33), early stage strategic resource management planning, or changes to the Land Act could all incorporate an integrated access management policy or tool to improve conservation management at large. Limited provincial capacity to initiate access management planning in a known barrier to this goal but meetings such as *WildLinks* help synthesize good information and initiate critical collaborations that are the first steps to effective revision of access management planning.

Don highlighted some local strategies that are on the cusp of initiating local access management planning such as the Comox Valley Conservation Strategy, the Bulkley Valley Recreation Access Management Plan and the Kootenay Region Recreation Access Plans.

Question and answer between attendees and Don Gosnell

Q: Is there a written Natural Resources Road Act in draft form that is waiting for politicians to pay attention to?

A: We are in the process of drafting one now. The NRRA will be ready for introduction in the legislature in the spring of 2015.

Q: If there was little political will to do this sort of work in the past, how did the NRRA process start?

A: This project started as a desire to unify many pieces of legislation and the benefits of incorporating access management came out of this.

Management Policies in Washington

To provide context on some of the legislation related to access management in the US, Cynthia Wilkerson, formerly with The Wilderness Society, discussed the direction of road system management in Washington under the new Travel Rule. Management of access in over 14,000 mi^2 (36000km^2) of national forest lands in Washington is overseen by the United States Forest Service (USFS). The USFS zones the land into wilderness zones (governed by the 1964 Wilderness Act), roadless zones (governed by the 2001 Roadless Rule), and roaded zones (governed by the 2005 Travel Rule).

The 2005 Travel Rule that governs the roaded areas of the national forests in Washington consists of three major subsections. Subpart A governs the selection of the National Forest Transportation System network, which is the basic road network needed to reach key points of interest in the state. Subpart B guides which roads, trails, and areas are designated for motor vehicle use while subpart C is meant to regulate over-snow vehicle use. It should be noted that off-road vehicles are not prohibited in the roadless zone of USFS lands.

National Forest Transportation Systems are deteriorating in Washington but must be managed and maintained as the types of uses of these roads expand. Subpart A of the Travel Rule is meant to find an affordable, reliable, safe, and balanced road system through the national forests that can be sustained into the future to provide access that is consistent with natural resource management goals in Washington. Analyses, which are to be completed by all national forests by 2015, will assess and report on the state of problems, opportunities, and priorities of the forests' road systems.

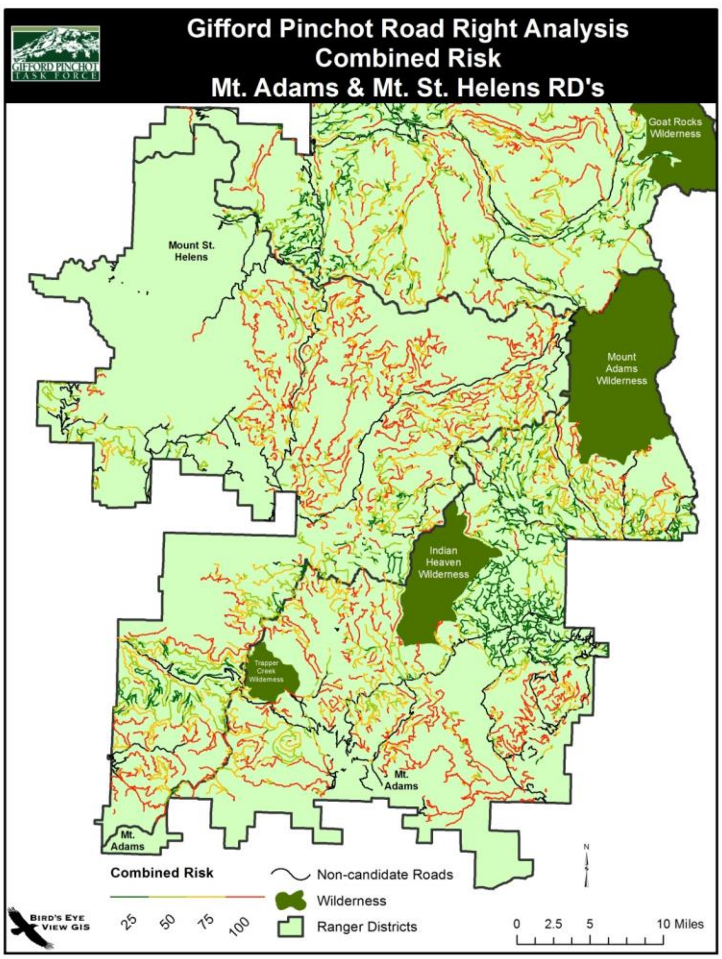


Figure 14: Road Right analysis results Mt. Adams and Mt. St. Helens . Source: C. Wilkerson

Two of Washington's national forests are taking a holistic forest-wide approach to road assessment. Public engagement is being emphasized during this process and programs such as Working Together for a Healthy Chewuch, in the Okanogan-Wenatchee National Forest, are providing opportunities for extensive public outreach and feedback. Tools being used to assess roads in National Forests across the country include NetMAP and RoadRight. NetMAP (an internal USFS tool) analyzes each road segment and categorizes them based on separate risk and need scales while RoadRight (a tool developed by The Wilderness Society) maps points of interest, identifies key roads to connect those points, and assesses the impacts of the remaining road to identify priority segments.

The determination of which trails should be available for motor vehicle use in subsection B has been the first subsection of the Travel Rule addressed by the national forests in Washington. The Okanogan-Wenatchee National Forest will release their assessment in 2014, while the Mount Baker Snoqualmie National Forest has a completed version of this subsection currently available online. Once the designation of usable routes is complete, online maps of the available route system will be updated annually to keep the public informed of changes to route access.

One major change instituted by the completion of subpart B of the Travel Rule is the designation of all motorized routes/trails as closed unless signage states that they are open. This reversion of the traditional practice of requiring signage to designate a closed route/trail will reduce the workload of USFS official in charge of signage and compliance.

Subpart C, governing over-snow vehicle use is still in preliminary stages for Washington national forests. The USFS will begin facilitation of this part of the process by September 2014 through the creation of rules to govern drafting of this section by the national forests.

Completion of new legislation and the maintenance of Washington's road system require adequate financial support. Unfortunately, funding of access management has been declining in Washington. Region 6 of the USFS jurisdiction, which includes Washington and Oregon, has had its budget reduced to $17 million of funding in 2012 compared to $90 million that was available in 1990. Offsetting this change in funding, since 2008 Congress has made an additional $270 million nationwide available via the Legacy Roads and Trails initiative. Although this initiative is valuable, it only addresses <5% of the road system, leaving a significant portion still in need.

Ensuring there no duplication of previous efforts can help to reduce program costs. Current forest plans, restoration strategies, and wildlife policies that touch on some of the issues that broad scale access management will address have already produced maps highlighting key access areas. The alignment of state natural resource and fish and wildlife departments' goals with access management issues mean that initiatives such as the Department of Natural Resource's Recreation Planning are great opportunities to incorporate proper access management values into other state mandated initiatives. Analyses beyond these, ranging from elk habitat suitability assessments to road density maps, help to begin identifying some of the priority roads throughout Cascadia. By taking a more holistic approach to road management, affordable, reliable, safe, and realistic road networks can be successfully managed into the future.

Keys to Successful Access Management:

- Proactive and inclusive outreach
- Building relationships and trust with public
- Facilitating the shared commitment of holistic management
- Have resource based suitability analysis with buy in
- Framing the social component so all users see themselves in the process

Case studies of access management planning at various scales from Cascadia:

Watershed scale: Assessing Cumulative Effects in the Tulameen watershed

British Columbia is working towards a province-wide adoption of a standardized cumulative effects analysis (CEA) framework to access grizzly bear habitat fragmentation and road interactions. The BC Ministry of Environment (BCMoE) is linking with the Interagency Grizzly Bear Committee to create a homegrown, cross scale, practical approach to CEA. Standardization of a CEA framework will lead to more accessible collaborations across landscapes and lead to improved grizzly bear management and increased adaptive capacity of the species. A pilot project in the Thompson-Nicola region of Tulameen is one of the small initiatives that will begin shaping this province wide process.

Roads can lead to bear mortality through increased direct human-animal interaction, indirectly through separation from critical habitat, and additionally through cumulative effects roads have with other stressors. Modeling the cumulative effects that are impacting grizzly bears requires that some component of bears be linked to a measurable benchmark which can be quantitatively modeled.

New benchmarks such as the “accessibility” metric are being developed to supplement existing benchmarks and improve habitat suitability models. Dr. Clayton Apps is refining an “accessibility” metric model of how far human populations are willing to travel to a location they intend to return from the same day. By modeling how humans use the landscape in this way, land managers will be able estimate the number of land users that utilize road networks based on the roads' proximity to high density cities and towns.

Benchmarks can be set by assessing ecosystem components important to grizzly bears, identifying related processes, selecting an appropriate indicator, and determining the ecologically relevant benchmark. An example of this process is as follows:

Component	Process	Indicator	Benchmark
Habitat condition	Resource roads degrade suitability	Road density and traffic volume	<0.6km/km^2 road density – <10 vehicles/week
Population size	Increased human-bear interactions impact population	Number of bear conflicts and mortalities	0 conflicts or interactions

In the assessment of connected habitats, road density is an oft used metric that can produce peninsulas or islands of "connected habitat" that are of no real functional value to bear populations. A proposed refinement of the definition of roadlessness and the usage of it as an improved benchmark for connectedness could produce more realistic estimations of functional habitat. The Tulameen pilot project modeled roadless patches with incremental increases in the size requirements for roadlessness classification. It was found that increasing the minimum area of roadless area required to be classified as roadless lead to qualitatively more realistic functional bear habitat estimates. By redefining roadlessness as a patch of habitat >10km^2 with no usable roads, there were significant smoothing of habitat edges and reductions in non-functional pieces of habitat.

Within the next year the Tulameen pilot project is working to refine possible CEA frameworks to assess cumulative effects at a finer, project level scale. Introductions of habitat mapping that incorporates protein requirements for bears and interactions with cattle and recreational roads users will broaden the cumulative effects that can be modeled. Determining mortality sources at a finer scale will further improve the applicability of these standardized assessments at a project level. Once this model has been refined, the pilot project team will deliver their CEA tool to land managers and educate them on its use and utility.

In the longer term the team will begin to inventory roadless, suitable habitats and prioritize high value areas for incorporation into management plans. Road inventories will be continued, potentially through the use of remote sensing, and the team plans to improve the accessibility of this dataset to facilitate improved collaboration. Linking with related groups such as the Cross Border Carnivore Group will help the standardization process and lead to potential project expansion into more of the North Cascades.

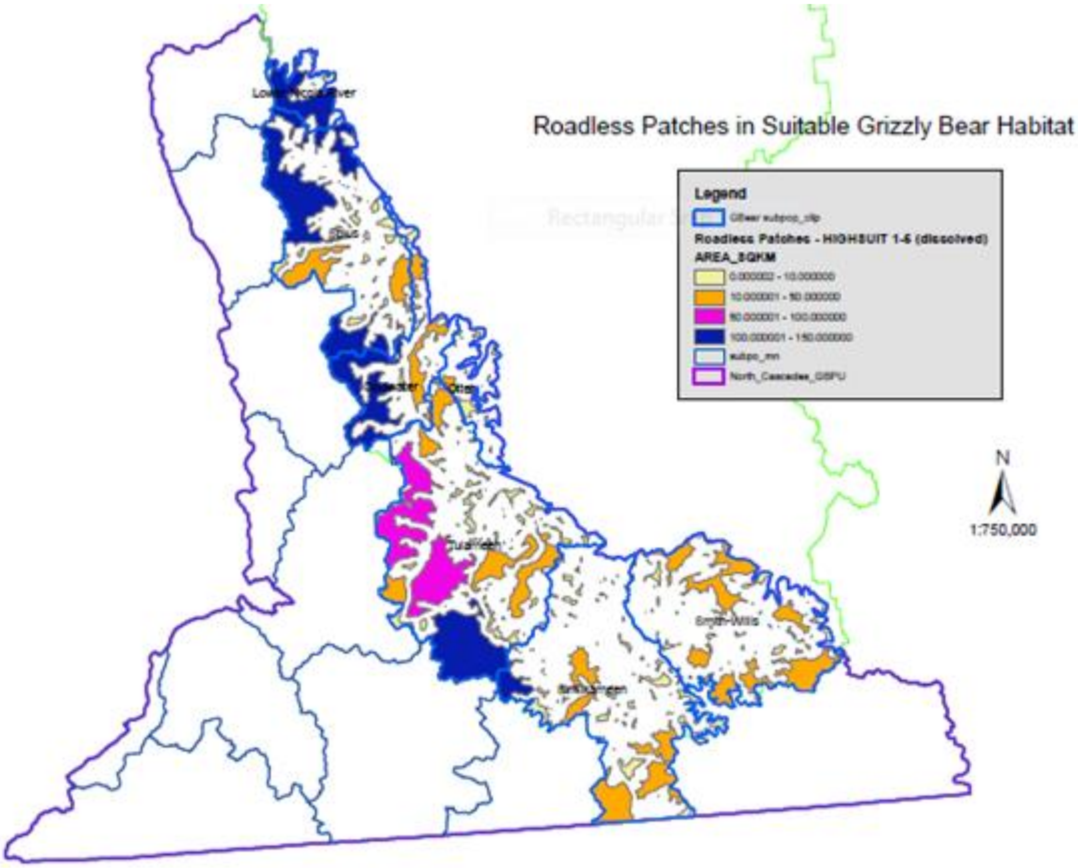


Figure 15: Map of roadless habitat of variable sizes in the Tulameen area. Credit: S. Lee (BC FLNRO)

Finally, the pilot team recognizes the need for an effective education plan for their products. Public education will be important to explain the justification for any bear related road closures to improve compliance. Education about CEA will ensure land managers are informed about the developed tools and their potential utility in habitat suitability assessments across the province and potentially across the border.

Statewide scale: WA Vulnerability Assessment and adaptation planning for state highways

In 2011 the United States Federal Highway Administration selected five pilot locations to test their climate risk assessment model. Washington State was the largest test location and represented the only statewide analysis out of the pilot projects. Granting of $189,500 in federal funding and an equivalent amount of staff time from the state department facilitated Washington's statewide access management analysis.

Washington's State Department of Transportation (WSDOT) utilized climate projections from the Climate Impacts Group's *The Washington Climate Change Impacts Assessment* to assess the risks to statewide infrastructure. By incorporating existing climate change data, available asset inventories and evaluation tools, and 14 replicated workshops across the state, the WSDOT was able to rank each state owned road segment and identify both vulnerabilities and areas of resilience.

WSDOT's field staff and technical experts were asked to rank access infrastructure qualitatively on a scale from 1 to 10 based on how critical that section was to connecting state infrastructure. A rank of 10 designated critically important roads such as interstate highways. Participants were then asked to rank sections based on how impacted they would be by predicted climate change. These data from the 14, four-hour workshops resulted in the assessment of all state highways, maintenance sheds, ferry terminals, airstrips, and state owned railways. Generally speaking, high vulnerability areas tended to be identified in mountains, along glacier fed rivers, and low elevation floodplains. Findings from these assessments can be found on WSDOT's website.

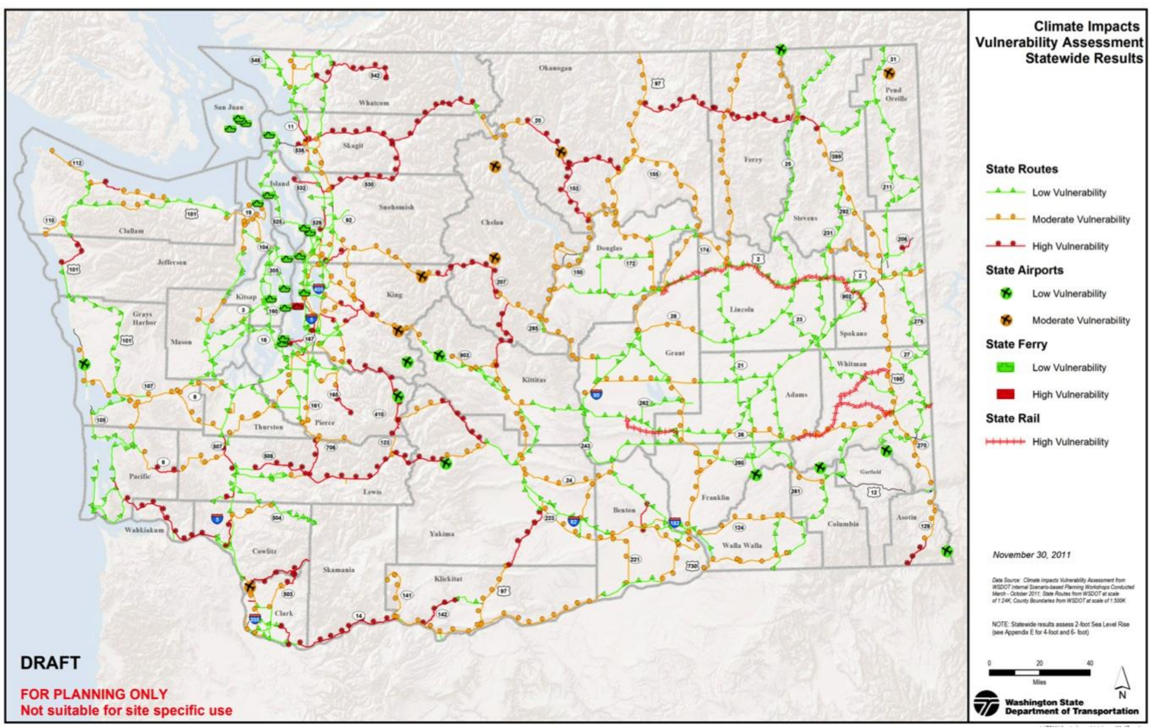


Figure 16: Draft results of WSDOT assessment on infrastructure vulnerability. Source: C. Roalkvam

Many new transportation construction projects (like bridges and highways) are intended to last 75 – 100 years. The results from these analyses are already providing insight to strengthen WSDOT's future work. Current work focuses on educating staff across all programs in the agency on how to use the information. Operations are adjusting their approaches from the planning and design stage, through construction, and into maintenance by accounting for expected impacts from extreme storms and potential vulnerabilities due to climate change.

A second pilot project in the Skagit Basin is aimed at providing a more detailed assessment of a wider range of infrastructure. By partnering with Skagit County and the US Army Corps of Engineers, the WSDOT will utilize an additional $260,000 in funding to estimate climate impacts on local and travel road systems, particularly focusing on flood hazard reduction, requirements for emergency responses, and opportunities to enhance resilience.

Looking forward, the agency seeks to integrate climate change resiliency with other objectives such as improving habitat connections for fish and wildlife, stream bank protection and storm water management. Asking the “climate question” can help frame long-term solutions that provide multiple benefits. More immediately the agency has examples where improving the stream passage under the road not only benefited fish populations but also secondarily benefited deer by providing safe passage under the crossing highway.

The WSDOT hopes to maintain and improve its strong asset management system and continue to promote existing programs that produce a range of benefits such as the fish passage habitat connectivity projects. Improved collaboration and increase public outreach have shown clear benefits to the WSDOT’s process across these projects.

Integrating climate change and connectivity science to inform transboundary access management in British Columbia and Washington

Historic connectivity analyses do not incorporate the dynamic effects of climate change, yet changing environmental conditions will play a key role in the future effectiveness of connectivity conservation. Two major considerations that climate change necessitates for connectivity management is the facilitation of climate-induced species range shifts and the maintenance of connectivity as environments change.

The Transboundary Climate-Connectivity Project aims to develop management strategies to maintain and enhance transboundary ecological connectivity in the face of climate change. The project will achieve this by applying existing information to assess the impacts of climate change on habitat connectivity, and working with practitioners to develop strategies for addressing these impacts.

Available information include coarse filter analyses of habitat connectivity along climatic gradients, analyses of the effects of changing climate on the habitat connectivity of individual focal species, and a range of climate impacts models for the Northwest. By gathering input on stakeholder needs and currently available analyses, project partners will work towards developing science-based plans that will provide managers with the information needed to integrate climate change into their connectivity management decisions.

A set of three nested partnerships will produce results at three different, but connected scales. At the broadest scale, managers of BC FLNRO, BC Parks, National Park Services, and USFS lands in an area from the western coast to the Kettle Valley region will be partnered with climate- and connectivity- scientists to help incorporate climate change and connectivity into access management planning. At a finer resolution the WHCWG and the BCCC will work together with scientist partners to incorporate climate change into their connectivity analysis of a region from the Okanagan to Kettle valleys. Finally the Okanagan Nation Alliance and the Colville Confederated Tribes will be partnering with scientists to assist with climate-connectivity assessments on planning at the local scale of reserve/reservation lands and the much larger scale of traditional lands.

The scientific partners will remain constant at each scale of analysis, and will guide the partnership through a three-step process. First the collaborators will identify current practitioner management goals and objectives around connectivity conservation. Then the scientific partners will attempt to identify existing climate-impacts and climate-connectivity models that may impact these goals. Finally, partners will design practitioner specific plans and approaches for addressing these potential impacts.

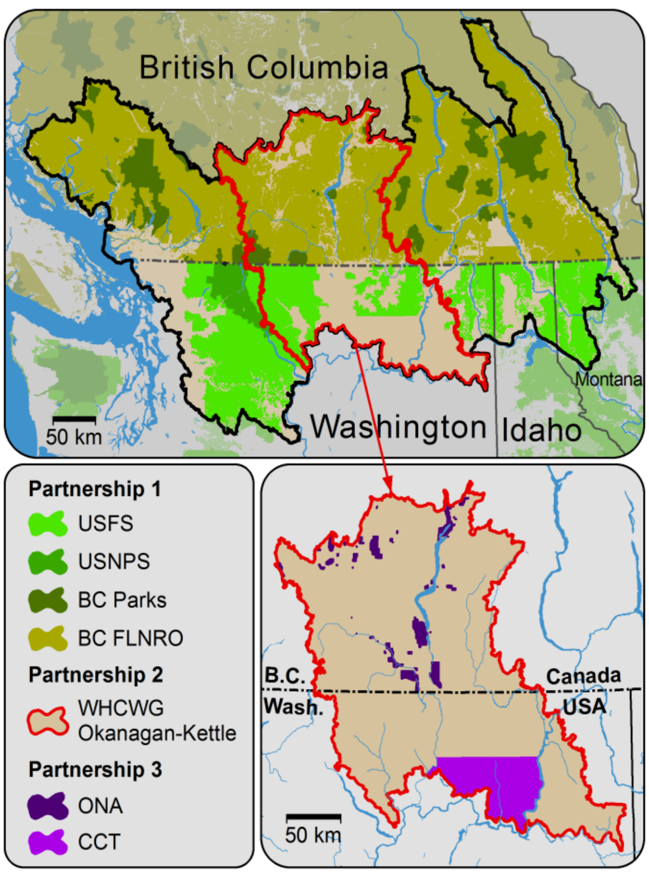


Figure 17: The three nested scales of partnership in the transboundary region. Credit: M. Krosby and R. Norheim

Over the course of the next year and a half two workshops will be held with the partnered groups to facilitate discussion on scientific needs of the partners, followed by periods of collaborative analysis. This will culminate into final products being released in the spring of 2015.

Anticipated Results of Climate Connectivity Science-Practitioner Partnerships

- Science based, practitioner-driven conservation plans, maps, and data
- Increased capacity for participant practitioners to manage for connectivity and climate adaptation
- Development of a framework to facilitate effective science-practitioner partnerships
- Identification of remaining information gaps and future research

Question and answer between attendees and Meade Krosby

Q: Will this work be all terrestrial?
A: Currently this is unclear but this will depend on the partners. If the practitioner chosen scope includes aquatic habitat, scientist partners will attempt to facilitate aquatic tools and analyses

Cascadia species and ecosystems adaptation planning and coordination in action

Side meetings occurred during the conference hosted by practitioners in attendance to further information sharing, planning, and discussion on specific adaptation related efforts.

Planning for analyses: Landscape integrity modeling for Okanagan-Kettle subregion habitat connectivity analyses

In a breakout session after the first day of discussion at *WildLinks*, Tory Stevens and John Pierce led a discussion on landscape integrity modeling of the Okanagan-Kettle region. The pair facilitated a discussion on finer scale assessment using lessons learned from a larger scale statewide initiative in Washington and a mapping project that built a crucial habitat map for the west.

Landscape integrity modeling is fundamentally different than ecological integrity modeling because the former does not include biological factors in the determination of an integrity score. Ecological integrity uses a wide range of indicators that are aggregated into an "ecological scorecard" which allows for landscapes to be ranked and conservation goals to be set quantitatively for each landscape rank independently. Although ecological integrity is a desirably thorough metric, it requires too detailed of an analysis to be applicable at a large scale.

For landscape wide assessments and products like the completed crucial habitat map (which incorporates data on integrity, critical terrestrial and aquatic species, and ecosystems of concern) requires a functional surrogate of ecological integrity. The removal of biotic factors from the assessment makes landscape integrity a more accessible metric. Landscape factors tend to have more consistently utilized metrics than biotic factors, which facilitates better wall-to-wall data availability at the scale of transboundary landscapes. Despite not including biological factors in an analysis of landscape integrity it has been shown that high values of landscape integrity coincide with high values of ecological integrity, thus it is an appropriate surrogate measure for conservation at large.

The Washington Wildlife Habitat Connectivity Working Group (WWHCWG) has developed an approach to assessing landscape integrity at the statewide scale. Recognizing that landscape integrity is an inverse to human footprint metrics, the WWHCWG's first step to analysis was to use human footprint metrics to assign integrity scores and identify large intact blocks in the landscape. Then a resistance layer was incorporated into the model to account for the variable ways that organisms move through the landscape. This resistance layer was informed using work on focal and concern species in the area to create a composite metric of resistance. Finally, the group uncovered landscape integrity corridors by modeling the connections between large intact blocks using a cost-weighted distance analysis method which incorporated resistance to movement.

Discussions around how the statewide assessment could be used to inform an Okanagan-Kettle regional project centered on issues of scale and applicability. The statewide assessment identified only large intact areas that exceeded 10,000 acres except in coastal regions were this threshold was lowered to 1,000 due to lack of larger intact lands. This point brought up two considerations for an Okanagan-Kettle project. Firstly, the definition of the size of intact land to be considered is likely to change based on the scale of the project. Secondly, the threshold for intactness can change within a project dependent on what areas stakeholders think should be considered and conserved. In a landscape as heterogeneous as the mountaintops and valley bottoms in the Okanagan-Kettle, variable thresholds of assessment may be necessary for different habitat types.

Tory Steven proposed an example of a scenario in which variable scales of connectedness may be necessary for implementation of landscape integrity analysis results. She suggested using available BEC data in the Okanagan to stratify landscape integrity assessments based on elevation gradients. In this region there is far greater connectivity at higher elevations than at the valley bottom and so an assessment that does not separate results based on elevation gradients may not be useful for determining landscape corridors for valley bottom species such as threatened snakes. Although riparian landscape connectivity was not assessed statewide, it may be a useful inclusion in smaller scale assessments which are more likely to find ubiquitous datasets.

A landscape integrity assessment of the Okanagan-Kettle would produce a model that could be utilized at a cross-regional district/county level to create broad landscape conservation targets. Although this does not provide project-level information, an Okanagan-Kettle project would help define a landscape wide, long-term conservation strategy. Such an assessment is intermediate in scale, lying between statewide assessments and regional district/county level assessments and providing direction at a larger, but still localized scale

Sharing tools: Okanagan Fish Water Management

Sockeye salmon are an integral species of the Cascadia landscape. Overfishing and habitat destruction have led to an overall decline in stocks and the remaining viability of only two of 8+ historic populations in the Columbia Basin. The Okanagan and Wenatchee basins' populations remain at a viable size but have been subjected to local extirpation events such as the displacement of sockeye from Okanagan Lake. Tom Kahler of Douglas County PUD led a presentation and discussion on these populations and new water management tools available.

Currently the Okanagan population of sockeye primarily use Osoyoos Lake as a nursery for rearing. Hydrological analyses show that Osoyoos Lake is right at the boundary of livable conditions for sockeye. With increasingly harsh living conditions in Osyoos Lake it becomes important to make further upstream locations such as Skaha and Okanagan Lake available to sockeye to facilitate climate gradient range shifts.

During sockeye migration up the Okanagan River, fish pass nine dams in the Columbia Basin. Even with consecutive dams as physical barriers to migration, juvenile and adult survival through the dams is above 95%. Each dam is used to regulate lake elevation, river flow, and in some cases water supply. Management rules set forth in the 1974 Okanagan Basin Agreement *Comprehensive Framework Plan* govern the water release patterns of these dams. The plan dictates the rules for multiple competing interests from flood prevention, to fish spawning, to recreation. Poor understandings of these governing rules and a lack of good data led many water managers to determine release rates based on past experience and rules-of-thumb instead of informed metrics.

A limiting factors analysis performed by the Okanagan Basin Technical Working Group (OBTWG) highlighted poor water management as a leading causes limiting the Okanagan population of sockeye. The analysis showed that of the 16 years reviewed managers had failed to meet target flows for sockeye migration in

13 of those years. To rectify these failures in flow management the OBTWG developed the Okanagan Fish-Water Management Tool (FWMT).

The FWMT is a set of five mathematical models that describe the biophysical interactions between climate, water, fish, and property. Real-time data is acquired from a network of stream and lake monitoring stations so that expected impacts of informed decisions regarding water release can be modeled. FWMT models can also be used to retrospectively and prospectively explore the interactions among climate variation, water supply, and fish populations.

Modeled interactions are governed by a set of rules that dictate flood protection needs, fisheries objective, and other uses. These rules are dynamic as needs of each user group changes through the year. This realistic approach to modeling competing interests allows the FWMT to more efficiently find an optimal solution to dam release patterns compared to rule-of-thumb methods.

In 2006 a storm in late-January appeared to be threatening to scour sockeye redds. Rule-of-thumb management would have considered this a crisis but the FWMT was able to accurately predict that the scour threshold would not be surpassed and avoided unnecessary mitigation efforts. In 2009 the FWMT accurately predicted a late September temperature-oxygen crisis in Osoyoos Lake that would have left no habitable zone for sockeye. As a result of this prediction water managers we able to conserve additional water in the summer and release a pulse of water from Okanagan Lake into Osoyoos Lake to prevent uninhabitable conditions.

From 2008-2012 the average number of returning sockeye salmon have reached 206,000 per year. This represents a drastic improvement from the 1977-2007 average of 30,000 salmon per year. Further indication that the FWMT has been the source of this positive trend comes from comparisons with the Wenatchee population of salmon. Although historically the Okanagan represented ~56% of the total sockeye run in the Columbia Basin, since 2008 the Okanagan population now constitutes ~90% of the Columbia Basin population. During this period of improvement for the Okanagan population, the Wenatchee population has remained at consistent historical levels.

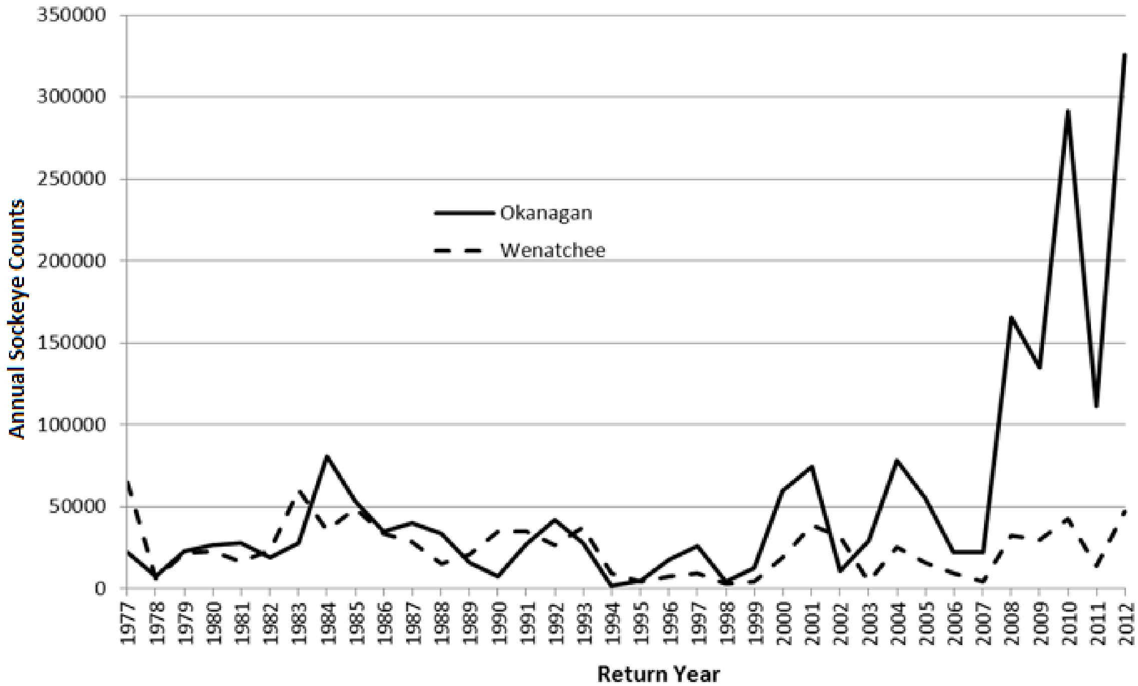


Figure 18: Annual sockeye return rates for Okanagan and Wenatchee basin Salomn in the Columbia Basin. Credit: T. Kahler

With climate change strengthening the need for effective fish and water management, tools like the FWMT become increasingly advantageous. Climate change may result in extreme summer temperatures that lead to bimodal runs for sockeye migrations. Utilization of the FWMT allows for proper management of a number of competing interest and has showcased its ability to improve the adaptive capacity for not only sockeye but also the Okanagan landscape.

Fostering transboundary collaboration: Cascades Carnivore Working Group annual meeting

Initiated in spring 2012, the Cascades Carnivore Working Group convened during a side meeting at this year's WildLinks for their annual check-in. One year previous at the 2012 WildLinks[13], this working group prepared a list of actions under three categories for the following species: grizzly bear, wolf, lynx, wolverine, fisher, and cougar. The categories of priority actions and issues for each species were: 1) Information sharing, 2) Monitoring and Research, and 3) Conservation and Recovery Efforts.

[13] 2012 WildLinks General Technical Report, Andrea Lyons: : http://www.conservationnw.org/what-we-do/wildlife-habitat/wild-links-2012/wildlinks-2012-general-technical-report.

In preparation for this year's WildLinks a progress report was prepared by a University of Washington undergraduate indicating the status of all previously identified action items, and a list of newly identified efforts and needs for each species.[14] Information was exchanged to update coordination and planning for each priority species, and a fully updated progress report will be prepared in 2014 to guide the next annual gathering.

Below are updates for species discussed based on notes captured during the meeting. A majority of these species were discussed previously in the event through presentations, breakout groups, and side meetings so a future status report will synthesize all of these updates and report on progress towards each.

Grizzly bear

- Information sharing:
    - Formalize data managers- action was completed and a database is up and running
    - Spatial inventory of roads- in progress, needing road data collection including inventory North of Manning Park
- Monitoring:
    - Bear sighting protocol- in progress, 1 year to finalize. Need to run sighting data through protocol and revise classifications
    - Ecosystem surveys using cameras and snags- dropping item as a priority
    - Black bear competition - not a priority at this time
    - Stable isotope and diet survey - not a priority at this time
    - Historical genetic info - in progress, awaiting results from anomaly bear sample
    - Carrying capacity assessment - Unknown for an update
    - Livestock/bear interactions - new priority that has been identified. Need ranchers that are supportive of recovery plan and best management practice plan
    - New genetic methods for contemporary/historic samples - new priority that has been identified. Need funding, genetic samples, and academic support. Hope to produce improved methods for determining immigration rates, genetic drift, and population history
    - Reanalysis of mark-recapture data - new priority that has been identified. Need funding and time
- Conservation/Management/Recovery Efforts:
    - Review of conservation efforts and recovery plans - in progress but currently on hold. Both WA and BC are waiting for environmental impact study in WA, and planning in BC. Hope is that concurrent assessments in both WA and BC will occur

[14] Transboundary Cascades Carnivore Working Group: Species Needs Update Report, September 2013, Connie Combs

    - Best management practices for ranching

Wolf

- Information sharing:
    - Genetic information sharing still needs improvement. Samples have not all been sent for analysis, and there has been a stalemate on DNA analysis. Information is helpful in DPS discussions. Scott is to write the group about what samples he wants to clarify and direct this effort.
    - Mapping of wolf packs – no wolves are collared in British Columbia, so data on their movements is not available. Need to collar wolves in BC to better understand their range, movements, and ecology to compliment WA data.
    - Share BC conflict data, spatial data – there is a new website www.wildsafebc.org with incident reports
    - BC Wolf Management Plan is not complete, but is close to completion. Continued need to share as soon as completed.
- Monitoring:
    - Genetic research – may be dropped as group priority. Need for samples as discussed above will be clarified.
    - Non-lethal management of conflicts. Conservation NW has done work in WA, as has the state. No specific documents exist, but there have been landowner and range rider agreements. Continue to report results and import lessons learned from other areas to guide efforts.
    - Ecology of wolf population – Wolves are radio collared in WA but no one is currently tasked to analyze full results in an ecology study. It is an amazing data set to work with for research, but funding is needed. University of WA is to look at conflict issues, so there is potential to discuss additional research with them using this data.
- Conservation/Management/Recovery Efforts:
    - In WA the Conservation and Management Plan is intact, and monitoring wolf packs continues. Breeding pairs will determine status, but no packs have established south of I-90 to date.
    - Discussion on potential for federal delisting on US side of the border.
    - Discussion on impact of the recovery of wolves on focus, resources, and social issues impacting the other species this group works on.
    - In WA there is a new funding source to help with wolf conservation and management that should be coming from specialized license plate sales.

Lynx

- Information Sharing:
    - Genetic data exchange - In progress, but BC reported not much harvest so they will talk with trappers.
    - BC Lynx Management Plan is in development and to be completed in 2014, still a priority to share upon completion.

    - WA lynx assessment is complete but unreleased. Will be shared as soon as possible.
- Monitoring:
    - WA to BC movement patterns, study in progress as telemetry data is being collected
    - Long term prey monitoring, in progress with UBC graduate student work
    - UBC student thesis is addressing the responses to fire and beetle impacts on habitat
- Conservation/Management/Recovery Efforts:
    - Align goals and frameworks of US and BC plans

Wolverine

- Information Sharing:
    - Report prepared for Cascadia Partner Forum by intern Brynn White in 2013 outlines an update of research effort, science gaps, and conservation issues based on interviews with members of this group from both sides of the border. http://cascadiapartnerforum.org/wp-content/uploads/2013/07/Wolverine_BArborico_6.2013.pdf
    - Google groups with documents may serve as a better format for information exchange on this species.
    - Still a need to develop a genetic profile of the transboundary population including a strong interest for genetic samples from the BC coastal region through the Cascades.
- Monitoring:
    - North Cascades telemetry project will continue in 2014, with new work as discussed on Day 1 of the event initiating by Robert Long of Woodland Park Zoo to develop summer remote camera protocols.
- Conservation/Management/Recovery Efforts:
    - Discussion on potential listing of the species in the US due to impacts of climate change.

Fisher

A change in format of discussion for Fisher facilitated a presentation from Jeff Lewis of WA Department of Fish and Wildlife on the species.

A historical review of fisher populations indicates their close habitat association with temperate forest ranges. Their historical range contracted to only 6 populations in the US, which prompted 38 reintroductions from 1947-2012. The result of the translocation reintroductions have been an expanded range for the species. In 2008, Washington reintroduced fishers to the Olympic Peninsula and now is looking to repeat that in the Cascades.

In Washington recovery efforts recognized fisher as a state endangered species with three recovery areas: Olympics, Cascades, and the Selkirks. Successful reintroduction efforts would result in a down-listing of the species conservation status. The Cascades recovery area is split in half into southern and northern recovery regions. A draft implementation plan for fishers is available for review, and a NEPA effort has been initiated for reintroduction efforts in the Cascades including a public scoping.

Cascades reintroduction is a cooperative effort between Rainier National Park, North Cascades National Park, and the state. It is not expected that reintroduction of fishers would have any negative impacts to other species. A conservative model was utilized to identify suitable habitat with a strong focus on identifying source habitats for reintroduction.

Habitat is more contiguous in the southern portion of the Cascades, and reintroduction efforts are specifically looking for large areas of habitat with relatively few highways. The quest for habitat with few highways comes following the death of 7 fishers that were lost on highways in the Olympic Peninsula following reintroduction.

The NEPA process will only cover release in the national parks, with coordination from BC partners to collect fishers for reintroduction efforts. There is limited access to suitable habitat in the northwest portion of the northern Cascades as they straddle Highway 20, while the south Cascades ranked higher for feasibility lending itself to the first reintroduction. The plan is to eventually release fishers into both the north and south Cascades over the course of 3 years at the cost of $550,000. The estimated cost is for reintroduction alone, but further follow-up monitoring of populations with radio transmitters is additionally needed.

Acknowledgements

The author of this report would like to thank Conservation Northwest for holding this conference and all of the sponsors who made this event possible. A special thanks goes to Jen Watkins of Conservation Northwest for her help in formulating the appendices and her helpful collaboration throughout the writing of this summary report. Additional thanks goes to those that were kind enough to provide feedback and guidance on various subsections of this report.

Appendix 1: Agenda

Wild Links Briefing:
A cascadia partner forum workshop
October 16-17, 2013

Meeting Objectives:

- Re-engage partners throughout Cascadia and connected ecosystems to the progress of the Cascadia Partner Forum, and initiate discussion on the future of this forum;
- Gain local expertise and contribution to North Pacific and Great Northern Landscape Conservation Cooperatives regional planning efforts;
- Share information on adaptation related efforts in the transboundary region that are underway or upcoming to increase coordination and involvement, while providing time and space to further these efforts while we are all together;
- Facilitate an access management dialogue that defines why this cross-discipline issue is related to adaptation planning, how people within Cascadia are addressing it, and identifies priorities for continuing to address the issue;
- Continue building a network of practitioners working on building resiliency into the species and ecosystems of Cascadia and connected ecosystems.

Wednesday, October 16th, 2013

Pre-event:

- 8:00-9:30 AM, Alpine Meeting Room. Working Breakfast (complimentary coffee and breakfast provided) - Transboundary Climate-Connectivity Assessment - Setting the Stage, hosted by Meade Krosby.
- Registration Open, Tamarack Room (main meeting room)

10AM Welcome message from Rob Edward, Chief, Lower Similkameen Indian Band **and Opening Remarks** from mitch friedman of Conservation northwest

10:30AM – 11:00PM Cascadia Partner Forum: Setting the context

- Objectives for this workshop – Jen Watkins, Conservation Northwest
- Review and update since last WildLinks - Tory Stevens, BC Parks
- Looking ahead, seeking feedback – Andrea Lyons, Okanogan-Wenatchee National Forest

11:00- 12:30PM Cascadia Partner Forum Priority Issue Highlight Presentations

- Transboundary Cascades wolverines: Keith Aubry, Pacific Northwest Research Station and Robert Long, Woodland Park Zoo
- Hydrology and water –Markus Schnorbus, Pacific Climate Impacts Consortium
- Sockeye Salmon – Greer Maier, Upper Columbia Salmon Recovery Board
- Transboundary Habitat Connectivity Analyses – Climate and Current Condition: Washington Wildlife Habitat Connectivity Working Group and BC Connectivity Collaborative

12:30 – 1:30PM COMPLIMENTARY LUNCH PROVIDED (CASCADE ROOM)

· Working lunch side meetings pre-scheduled:

- Okanogan-Kettles Subregion Connectivity Analysis team meeting – hosted by Joanne Schuett-Hames and Rachel Holt. Alpine Meeting Room.

1:30 – 2:15PM NORTH PACIFIC LANDSCAPE CONSERVATION COOPERATIVE UPDATE AND IMPLEMENTATION STRATEGY: PRESENTATION AND GROUP FEEDBACK

2:15 – 3:45 PM GREAT NORTHERN LANDSCAPE CONSERVATION COOPERATIVE SCIENCE PLAN: PRESENTATION AND CASCADIA PARTNER FORUM REVIEW

- Overview of purpose, status, and content of draft Great Northern Landscape Conservation Cooperative Science Plan. Sean Finn, Great Northern Landscape Conservation Cooperative
- Facilitated full and small group review of plan, goals, and Conservation Targets relevant to Cascadia landscape.

3:45-4PM DAY 1 FULL GROUP CONCLUSION

4PM – 6PM BREAK FOR ATTENDEES:

- Take a walk, catch up on work, or attend/create a side meeting discussion.
- Side meetings pre-scheduled include:
  - Transboundary Cascades Carnivore Working Group, Similkameen Meeting Room – hosted by Rich Weir, Ministry of Environment
  - Landscape Integrity Modeling for the Okanagan-Kettle sub-region of the transboundary work, Alpine Meeting Room - Tory Stevens and John Pierce

6PM: HOSTED HAPPY HOUR AND DINNER IN WINDY JOE'S HALL

THURSDAY, OCTOBER 17TH, 2013

7:00AM TO 8:00AM COMPLIMENTARY BREAKFAST (CASCADE MEETING ROOM)

8:00 – 3PM CASCADIA ACCESS MANAGEMENT WORKSHOP (TAMARACK MEETING ROOM)

8:00 – 8:45: INTRODUCTION: Setting the Cascadia stage – why is Access Management a priority issue to address in light of natural resources management today and in adaptation planning for species and ecosystems?

- Regina Rochefort, North Cascades National Park
- Patrick Daigle, Ministry of Environment, Emeritus

8:50 – 10:20am: PANEL PRESENTATION AND DISCUSSION: NATURAL RESOURCE ISSUES FACILITATED BY DAVE PETERSON, PNW RESEARCH STATION: How does Access Management affect various natural resources and management needs, and how do we think about it in terms of impacts of climate change on those resources? What are the climate sensitive questions for each resource that should be addressed in access management planning?

- Engineering, road vulnerabilities - Rhonda Strauch, University of Washington
- Terrestrial wildlife considerations – Bill Gaines, Conservation Science Institute
- Hydrology – Robin Pike, Ministry of Environment

10:20 – 10:35am – BREAK

10:35am to 11:35am: **ATTENDEES: PANEL PRESENTATION AND DISCUSSION: ACCESS MANAGEMENT POLICIES** FACILITATED BY CHRIS TUNNOCH, MINISTRY OF FORESTS, LANDS, AND NATURAL RESOURCE OPERATIONS:

- British Columbia's Resource Roads Act - Don Gosnell, FLNRO
- Access Management Policy Overview for Washington – Cynthia Wilkerson

11:40am to 12:40pm: **COMPLIMENTARY LUNCH PROVIDED** (CASCADE MEETING ROOM)

- Lunch work meetings pre-scheduled will have rooms assigned at the beginning of the meeting

12:45pm – 2:30pm: **PANEL PRESENTATION AND DISCUSSION: CASE STUDIES** FACILITATED BY JOE SCOTT, CONSERVATION NORTHWEST.

- Vulnerability and Adaptation Planning – Carol Lee Roalkvam, WA Dept. of Transportation
- Tulameen Cumulative Effects Analysis – Tony Hamilton, Ministry of Environment
- Access Management Planning in light of climate change – Jack Oeflke, North Cascades National Park
- Transboundary connectivity planning in light of climate change - Meade Krosby, University of Washington

2:30 – 3pm: **WRAP-UP FULL GROUP DISCUSSION** FACILITATED BY BILL GAINES, CONSERVATION SCIENCE INSTITUTE. What are the opportunities and challenges seen by the group for moving forward access management planning on this landscape, how can we address them? What are some short-term upcoming opportunities to forward this discussion? Identify the challenges that need greater definition to seek solutions.

3PM: WORKSHOP CONCLUDING COMMENTS AND IDENTIFICATION OF NEXT STEPS LED BY JEN WATKINS, CONSERVATION NORTHWEST

** ON DAY 2, A SIDE MEETING WILL CONTINUE FOR THE OKANOGAN-KETTLE TRANSBOUNDARY HABITAT CONNECTIVITY ANALYSIS IN THE ALPINE MEETING ROOM.

A GENERAL TECHNICAL REPORT SUMMARIZING THE PRESENTATIONS, DISCUSSION, AND KEY FINDINGS FROM THE MEETING WILL BE PREPARED BY JON BEPPLE.

THANK YOU TO OUR EVENT SPONSORS:

NORTH PACIFIC LCC, SEATTLE CITY LIGHT, WASHINGTON WILDLIFE HABITAT CONNECTIVITY WORKING GROUP, AND WILBURFORCE FOUNDATION

MORE INFORMATION ON THE CASCADIA PARTNER FORUM IS AVAILABLE AT [WWW.CASCADIAPARTNERFORUM.ORG](http://www.cascadiapartnerforum.org)

Appendix 2: Attendee List

__Name, Affilitation__

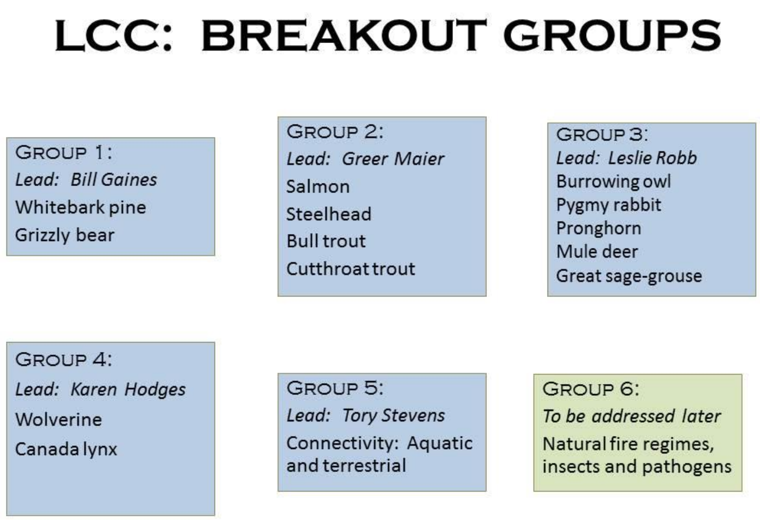
Denise Antoine, St'at'imc Government Services
Keith Aubry, PNW Research Lab
Paul Balle, Woodland Park Zoo
Jon Bepple, Student and former Cascadia Partner Forum fellow
Nora Billy, St'at'imc Government Services
Gwen Bridge, Lower Similkameen Indian Band and Gwen Bridge Consulting Ltd.
Barbara Christensen, Conservation Northwest
Holly Clermont
Jenny Coleshil, Granby Wilderness Society
Brian Cosentino, WA Department of Fish and Wildlife
Patrick Daigle, formerly Ministry of Environment
Jim Davis, Skagit Environmental Endowment Commission and American ALPS
Paul DeBruyn, Washington Department of Fish and Wildlife
Scott Denkers, Hope Mountain Center
Loren Everest, Mount Baker Snoqualmie National Forest
Sean Finn, Great Northern Landscape Conservation Cooperative
Meghan Fisher, Okanagan Nation Alliance
Scott Fitkin, WA Department of Fish and Wildlife
Mitch Friedman, Conservation Northwest
Bill Gaines, Conservation Science Institute
Don Gosnell, Ministry of Forests, Lands, and Natural Resource Operations
Karl Halupka, US Fish and Wildlife Service
Tony Hamilton, Ministry of Environment
David Heflick, Conservation Northwest
Karen Hodges, University of British Columbia Okanagan
Rachel Holt, Veridian Ecological
Alison Huyett, Conservation Northwest and Washington Wolf Coalition
Francis Iredale, Ministry of Forest, Lands, and Natural Resource Operations
Kodi Jo Jaspers, Colville Confederated Tribes
Darwyn John, St'at'imc Government Services
Wayne Kasworm, US Fish and Wildlife Service
Rudy Kehler, Skagit Environmental Endowment Commission
Gregory Kehm
Meade Krosby, University of Washington
Susan Latimer , Okanagan Collaborative Conservation Program
Jeff Lewis, WA Department of Fish and Wildlife
Robert Long, Woodland Park Zoo
Andrea Lyons , Okanogan-Wenatchee National Forest
Paula MacKay
Greer Maier, Upper Columbia Salmon Recovery Board

Chris Marx, Conservation Northwest
Yolanda Morris, Wilburforce Foundation
Garth Mowatt, Ministry of Forests, Lands, and Natural Resource Operations
Cliff Neitvelt, Ministry of Forests, Lands, and Natural Resource Operations
Jack Oeflke, North Cascades National Park
Lael Parrot, University of British Columbia
Al Peatt, Bearfoot Resources Ltd
Alison Peatt, Bearfoot Resources Ltd
Dave Peterson, Pacific NW Research Lab
Rose Picinni, Colville Confederated Tribes
John Pierce, WA Department of Fish and Wildlife
Michael Proctor
Cathy Raley, Pacific NW Research Lab
Aaron Reid, Ministry of Forests, Lands, and Natural Resource Operations
Carolina Restrepo Tamayo, Okanagan Collaborative Conservation Program
Carol Lee Roalkvam, WA Department of Transportation
Leslie Robb
Regina Rochefort, North Cascades National Park
Marcus Schnorbus, Pacific Climate Impacts Consortium
Joanne Schuett-Hames, WA Department of Fish and Wildlife
Joe Scott, Conservation Northwest
Sue Senger, St'at'imc Government Services
Andrew Shirk , University of Washington
Peter Singleton, Pacific NW Research Lab
Tory Stevens, BC Parks
Ronda Strauch, University of Washington
Paula Swedeen
Ron Tressler, Seattle City Light
Chris Tunnoch, Ministry of Forest, Lands, and Natural Resource Operations
Carmen Van Bianchi, University of British Columbia Okanagan
Jen Watkins, Conservation Northwest
Rich Weir , Ministry of Environment
Dave Werntz, Conservation Northwest
Bryn White, South Okanagan Similkameen Conservation Project
Rich Whitney , Colville Confederated Tribes
Cynthia Wilkerson, WA Department of Fish and Wildlife
George Wooten, Conservation Northwest

** Note that due to the US federal government shutdown that was underway during the conference, federal employees from the US listed above were registered to attend but were not present at the event.

Appendix 3: LCC Breakout Results

Providing direct feedback from practitioners throughout Cascadia to the Landscape Conservation Cooperatives (LCCs) is an important function of the Cascadia Partner Forum. Attendees of WildLinks were divided into 5 breakout groups that were provided handouts detailing the North Pacific Landscape Conservation Cooperative and Great Northern Landscape Conservation Cooperative goals, objectives, and conservation targets.



The groups were to discuss and provide general feedback to the two LCCs, and then specifically address the following actions for the conservation targets within their group:

- Link the conservation targets for your group to one or more goals of the GNLCC and the NPLCC;
- If your target is a species, make specific note of your target's range and conservation requirements, and if it depends on landscapes within one or both of the LCCs;
- Establish goals for each conservation target. Consider whether there are already established goals to define "success" in conserving and managing this target (i.e. recovery plans, management plans), spatial scale of goals (i.e. Cascadia wide versus sub-regions within Cascadia), whether you can set these goals if they do not exist, or what process would need to occur to establish them;
- Identify metrics for this conservation target to measure progress towards achieving the goal.

- List the threats impacting each conservation target in Cascadia currently and in consideration of changing climate conditions;
- Explain the relationship between this conservation target and the other 29 targets (species, habitat types, and ecosystem processes)
- Outline the necessary conservation actions to be taken to reach the stated goal for this conservation target, and what limitations exist that prevent implementation of these actions (i.e. science gaps, capacity, funding, policy, communications, etc);
- Identify any conservation actions already underway within Cascadia. Note special considerations that should be kept in mind regarding a specific conservation target (i.e. scale, complicating factors, etc).
- What organizations, individuals, and existing networks should be a part of the development and/or review of any further planning and implementation of a shared science plan for this conservation target within Cascadia?

This appendix does not quote any particular attendee, but rather summarizes notes taken by notetakers at the event capturing the discussion. These notes from the discussion of each breakout group and their report out to the full group are summarized below:

Group 1: Whitebark pine and grizzly bear

Discussion highlights shared by the group:

Photos: Grizzly bear documented by remote camera in 2010 in British Columbia Cascadia region (FLNRO), Close-up of whitebark pine in Rainier National Park.

- Move towards standardization of data collected
- Roads/human caused mortality are barriers to conservation for grizzly bears
- Conservation of grizzly bears and their habitat requirements provides a strong connectedness to other targets
- Need to build political will to address
- Draft whitebark pine plan in British Columbia that establishes threats/targets

Detailed notes on overall discussion:

- Although grizzly bear is a conservation target of the GNLCC, the Cascadia population on both sides of the border is dependent on habitat in the NPLCC as well. This should be a shared conservation target in this landscape.
- Due to the wide ranging nature of grizzly bears and their habitat requirements this conservation target is linked to GNLCC goals 1 and 2 very strongly, while there is relevance to Goals 3 and 4 in managing their habitats and food chains. NPLCC goals seem very aquatic focused, so feedback to potentially expand them to a clearer terrestrial habitat goal as well that could encompass this species. Whitebark pine links to GNLCC goal 1 and 4.
- Species goals in Cascadia can be tied to transboundary recovery and planning efforts in the North Cascades Grizzly Bear Ecosystem, as well as in British Columbia in population management units connecting the Cascades ecosystem to the coast. Look to existing plans, updates of plans, and standing groups such as the North Cascades IGBC and Cascades Carnivore Working Group.
- Conservation threats for grizzly bear include directly mortality, small and isolated populations, lack of political will for recovery, roads, habitat fragmentation.
- Conservation actions include recovery planning including EIS on the US side, education and outreach, completion and integration of whitebark pine plans in WA and BC with implementation to follow, updated habitat surveys including roads layers. More to be addressed in discussion tomorrow of Cascades Carnivore Working Group.

Group 2: Salmon, steelhead, bull trout, and cutthroat trout

Discussion highlights shared by the group:

- These GNLCC conservation targets had strong relation to the NPLCC aquatic and water based goals and link to GNLCC Goal 1, 2, and 3 while there are impacts of Goal 4 related to aquatic health.
- Aquatic connectivity is not only the ability of the steam to be connected to

Photos: Coho salmon (FWS), Bull trout (FWS), Cutthroat trout (FWS), Steelhead (NOAA) its floodplain, but the important upstream/downstream connectivity of habitats to support a full system;

- Key to all species is the need to ensure sufficient water to support entire life cycle;
- Key threats relate to competing water interests and managed vs unmanaged systems – dams

Detailed notes on overall discussion:

- Something missing from the NPLCC and GNLCC goals that was presented regarding aquatics was sediment. Climate change and land use changes both have sediment playing a role. Sediment is the primary pinch point for aquatic habitat.
- For all these fish species a goal could be: Viable populations that can withstand changes or challenges. In setting that we need to define viable populations or viable habitat
- Considerations on metrics – measuring success:
    - In measuring the progress or retreat from the goal, there is a challenge of producing models that will work for all species as each specific one has different habitats.
    - Iconic species of fish are monitored quite well, but the non-iconic species are not well documented or monitored. Canadian federal government focuses on commercial fisheries, while British Columbia government focuses on recreational fishing stocks.
    - What measurements are used today by agencies and species plans to determine population viability?
    - Bull trout suitability projections can be shocking based on stream temperature alone
- How do we learn to prevent future legacy issues?
- Outside of these targets alone, see that the overall LCC goals speak to the importance of improving and maintaining habitat for a diverse group of aquatic species – this is important.
- Conservation threats: Forest management, land use change, diversions, extractions, point or non-point pollution, climate change, invasive species
    - Locations makes all the difference when it comes to disturbance.
    - Dams, harvesting are also challenges
- Conservation actions:
    - Improve forest health conditions, which generally lead to healthier waterways.

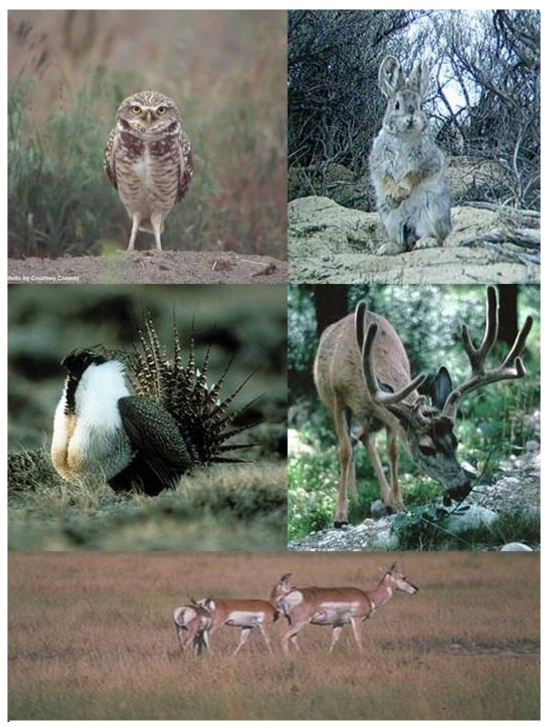
- Identify those water tributaries, streams, rivers, etc that are most in need, almost a triage approach, those that are too far gone be left and those that can be saved or improved be proactive
- Recommendation to get the US Forest Service, US and State Fish and Wildlife, and British Columbia together to cooperate and share waterway analyses already in existence in order to decide the priorities
- Potentially one target should be focused on education in order to reach the public with the idea that groundwater and surface water are interconnected and not separate entities.
- Investigate changing forest rotation change from a shorter model to a longer term model, applying new methods to forest rotations.

- What metrics can be used for structuring hydrologic goals and targets? Fish targets at certain times of year, velocity of water, depth, flow rate, width
- The major threats: blockages, dams, roads, connectivity limitations, climate change (water resources and shifting seasons)
- Note more active in managing the already regulated flows

Group 3: Burrowing owl, pygmy rabbit, pronghorn, mule deer, and sage grouse

Discussion highlights shared by the group:

- Education – Across all targets a need was identified to increase education on how important private lands are for these targets to maintain and sustain species



Photos: Burrowing owl (C. Conway), Pygmy rabbit (WDFW), Sage grouse (WDFW), Mule deer (WDFW), Pronghorn (Yakama Nation)

Using sage-grouse as a first example target:

- This species is not relevant in the NPLCC landscape, so no association with those goals.
- Sage grouse is associated with GNLCC goals 1, 2, and 4
- States have a sage grouse recovery plan. In BC, sage grouse are extirpated from their range. Birds were moved west of Osoyoos decades ago, but did not survive. BC may not have goals for conservation because of the extirpation, but there

are goals and metrics for Cascadia within the WA State plan.

- Conservation threats:
  - One threat for sage grouse in Douglas County of Washington is on the private lands, where we are so dependent on voluntary conservation easements for habitat security.
  - Another threat is the security of population is dependent on people keeping land use practices in line with grouse needs.
  - Human population expansion, habitat loss and fragmentation
  - Loss of genetic diversity
  - Fire suppression
  - Lack of nesting habitat
- The conservation of sage grouse overlaps with the GNLCC Conservation Targets pygmy rabbit, burrowing owl, and some mule deer.
- Conservation actions could include incentives to keeps private land suitable for grouse and conservation of key lands with habitat (i.e. acquisition or easement).
- The GNLCC should recognize that there is already a plan in place for sage grouse to work from, as well as a state working group. Sage grouse are present, need conservation in other areas.
- Contributions to the GNLCC science plan for this species should include people that are already stakeholders in the processes above.

Mule deer:

- Mule deer are relevant to all 4 of the GNLCC goals. The hydrologic regimes goal is important for mule deer because water presence and wet/dry salt licks are necessary for mule deer. Little ponds may provide mineral lick that is essential but water body must be certain size to be protected.
- A current provincial goal is 20 bucks to 100 does. Most data comes from hunters. Not sure if recovery plan in in place.
- For metrics and measuring success, aerial surveys are used to count deer populations. Can look at fecundity, % of twins. Unsure on hard targets. Connectivity of migration routes.
- Conservation threats include industrial development, barriers to migration, predation, fire suppression causes more shrubs which favors white tail.
- Conservation actions should include maintaining winter near or within corridors.
- Future discussions and planning should include Western States Elk/Deer Working Group and Southern Interior Mule Deer Working Group, Mule Deer Foundation.

Burrowing Owls and Pygmy Rabbits:

- Arid Lands Initiative (ALI) has similar focal species to this discussion, so contact them for specific people to further planning with. ALI has done a lot of leg work with these species so build off of all of that.
- Plan to tie into Washington Wildlife Habitat Connectivity Working Group's Okanogan-Kettle analysis for any tie or consideration for connectivity of these species.
- BC Burrowing Owl Recovery Team
- Review Habitat Conservation Plans that may be in place.

Pronghorn were reintroduced by Yakama Nation on their land, look there for associated conservation goals and planning around that effort.

Group 4: Wolverine and Canada lynx

Discussion highlights shared by the group:

Photos: Wolverine and Canada lynx (USFWS)

- Differences in species management between Washington and British Columbia based on overall population distributions in the state versus the province is an issue that needs to be addressed. On British Columbia side of the border there is harvest management of these species in the transboundary region, while Washington has protected status for both species based on low population levels dependent on the transboundary region.
- British Columbia is lacking data sets and population information on both species in the transboundary region including genetic profiles. Not consistent with approaches in Washington, although there are examples of projects stretching collaboratively across the border.
- Need to understand how wolverines are distributing across border in US, interested in extent of recovery, reproduction, and if populations are viable for long-term conservation.
- US needs Canada as a continued source for both species.

Details from discussion:

- Conservation goals: Keeping lynx and wolverine on the landscape is relevant to multiple GNLCC goals including:
    - Goal 1 – both use large landscapes and fit this goal with specific habitat requirements
    - Goal 2 – mobility is important for them and their food webs
    - Goal 4 – ties to lynx more than wolverine, due to their utility of disturbed areas as forage. Ideas of lynx using disturbed areas isn't well substantiated by the literature potentially so follow up on this in future planning.
- Cascadia wolverine population depends on NPLCC landscape as well, can the NPLCC adopt this as a conservation target for this landscape?
- Lynx currently have multiple research efforts underway, mainly from the US side.
- Conservation framework has wolverine and lynx, no identified goals or standards though.
- Wolverine are proposed for federal listing, if that occurs there will be conservation goals associated. Already listed at the state level.
- National forests have goals and guidelines for listed species, as do the parks.
- BC – Conservation Assessment for lynx
- Need transboundary coordination for both of these species
- Set a goal: Mobile species need transboundary access and transboundary management. We want to set transboundary goals, need further discussion with involved scientists. In setting goals consider:
- Metrics could be measured in distribution, survey data, and population levels.
- Conservation threats include:
    - Different management and views of these species on either side of the border
    - Information gaps and poor data for both species for full understanding – need to fulfill and build off existing work
    - Highway corridors
    - Habitat barriers (and bunnies for lynx)
    - Fire suppression – lack of natural fire and extent of impact from burns (link this to a better scientifically supported threat)
    - Ski area development (wolverine)
    - Climate change (associated with listing for wolverine)
    - Human recreation use
    - Trapping

- Relations to other conservation targets of the GNLCC would be clear following completion of this planning effort
- Limitations of action or setting goals:
    - BC needs better data: resources to collect data, capacity, $
    - WA management between BC source populations and WA. South Cascades wolverines stable or transient? Great interest in better understanding genetic profile of the wolverine population connection northwestward to the BC Coast and south of I-90.
    - Standardized monitoring for BC & WA, upgrade standards.
- For further planning engagement should include Cascades Carnivore Working Group folks, scientists, government, researchers, First Nations, transportation managers.
- There are relationships to consider such as riparian/drainages for lynx, fire regimes maybe for lynx.

Group 5: Aquatic and terrestrial connectivity

Discussion highlights shared by the group:

- Public education – importance of private lands to connectivity
- Co-benefits – when doing something do what is good for a number of species (i.e. riparian buffers)
- Cumulative effects – landscape level there are so many players it's hard to know what all is going on, identify landscape level values

Photo: River otters moving through a culvert under Interstate 90 in Washington's Cascade Mountains (Western Transportation Institute)

Details of discussion:

- Terrestrial connectivity doesn't seem clearly recognized as a goal of the NPLCC, seems more aquatic. There is strong aquatic connections between NPLCC and GNLCC goals for aquatic connectivity, but could more effort be made to make the terrestrial connectivity a clearly recognized shared goal?
- GNLCC goal number 2 clearly identifies these targets
- Recovery Plans
    - In BC there is land use planning direction that includes connectivity and biodiversity plans. Still a barrier for buy in however and use of the tools, no obligation.

    - Example: fish barriers in WA need to be addresses, measurable success where direction is tied to an outcome
    - Example: Mule deer migration corridors equal PHS priority habitat
    - Washington Wildlife Habitat Connectivity Working Group has summarized potential use of science linked to existing plans and direction for WA.
- Metrics
    - Metrics: % of the landscape. Measure how the landscape changes over time, use human footprint.
    - Spatial scale is important, and use of multiple scales in looking at these issues.
    - How do we define connectivity? This is a key starting point, getting everyone on the same page about what we would measure. Multiple values and definitions in this term.
- Conservation barriers and threats: Lack of incentive to act, invasive species, land use change, roads, changing environments (including climate), lack of community awareness, access to science/knowledge, jurisdiction.
- Tools: Public outreach, user friendly science, voluntary incentives for making choices that benefit connectivity, strategic user services
- Connectivity targets: Highest importance is removing barriers (especially when you can overlap goals with an existing project)
- Recap: Key points included public education, seeking co-benefit projects, and cumulative affects