Conservation Playbook 2.0

Sustainable management of native salmonids in a shifting climate: A landscape-scale blueprint for the Crown of the Continent

Developed from proceedings of the March 2018 native salmonid workshop held by the Crown Adaptation Partnership/ Crown Managers Partnership in Kalispell, Montana

September, 2018

Photo credit: U.S. Geological Survey, Department of the Interior/ USGS, U.S. Geological Survey

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Introduction

'*Taking action on climate change'* is a strategic initiative of the Crown Adaptation Partnership led by the Crown Managers Partnership, Crown Conservation Initiative, U.S. Forest Service's Northern Rockies Adaptation Partnership, and The Wilderness Society.

In 2013, we began working collaboratively with one another and partners throughout the landscape - state, federal, and provincial agency managers; Tribes and First Nations; non-profit conservation organizations; citizen groups; and universities - to advance Crown-wide climate adaptation projects on collaboratively-identified natural resource priorities through a re-granting initiative of Kresge Foundation funding through the Crown Roundtable.

Together, we seek to:

- Identify shared adaptation strategies that build resilience to current and protected climate change impacts to forests and watersheds, fish and wildlife in the Crown of the Continent;
- Coordinate multiple strategies at multiple scales to achieve borderless outcomes across the Crown;
- Identify and replicate examples of successful adaptation actions by managers across the landscape;
- Develop landscape-scale learning networks and adaptive management frameworks that identify and fill key information gaps.

Over the course of two days at our first 'Big Tent' workshop in February, 2014, we collectively identified a consistent framework for collaboratively addressing climate change across the Crown landscape.

Workshop participants suggested that the new 'Big Tent' model should include:

- coordination and work at the landscape-scale,
- use of the best available science as a basis for all recovery plans,
- diverse and inclusive collaboration,
- a solid understanding of the priorities and directives for each management jurisdiction in the Crown,
- Identification of effective management actions for native salmonids across jurisdictions,
- establishment of adaptive management frameworks, and
- engagement of a mixture of senior-level managers, middle managers, and on-the-ground biologists.

Next, we used extensive breakout sessions, followed by collaborative exercises to shorten the initial list of suggestions, to select the following seven natural resource priorities for coordinated work across the Crown moving forward:

1. Aquatic invasive species
2. Terrestrial invasive species
3. Native salmonids (bull trout and westslope cutthroat trout)
4. Five needle pines (whitebark pine and limber pine)
5. Forest carnivores (wolverine, lynx and fisher)

6. Prescribed fire in mixed severity fire regimes
7. Ecological connectivity

A native salmonid ‘Big Tent’ workshop based on the above ‘Big Tent’ framework quickly followed in November of 2014 after workshop participants voted to prioritize this natural resource first through an online survey; which was followed by a second ‘Big Tent’ workshop in March of 2018 to deliver new landscape-scale science and tools to managers; to assess progress made since the initial 2014 forum; and to develop a new ‘blueprint’ for the recovery of these iconic species based on new science.

Here, we summarize initial efforts to develop a Crown-wide restoration strategy and provide access to key resources as a key follow-up piece to our most recent native salmonid workshop in March of 2018.

How to use this Playbook

The goal of this Playbook is to share key informational resources, landscape-scale science, policy opportunities, jurisdictional mandates, on-the-ground restoration projects, partnership opportunities across the Crown, and – most importantly – the short list of Crown-wide priority management actions for native salmonids identified by all workshop participants at the 2018 gathering. We also provide a status update here of the progress (or lack thereof) for each of the priorities identified in 2014.

Our hope is that this document will allow us to collectively track progress on collaboratively identified priorities through time; and facilitate the development and use of new Conservation Playbooks at regular intervals for each of the natural resources chosen by managers during the March, 2018 Forum. As always, we welcome feedback and suggestions to help us improve these products!


Taking Action on Climate Change Adaptation:
Piloting Adaptation Strategies to Reduce Vulnerability and Increase Resilience for Native Salmonids in the Crown of the Continent Ecosystem

Final Workshop Report
November 18-20, 2014 - Kalispell, Montana

For all supporting materials, please see workshop website:
http://crownmanagers.org/adaptative-management

Funding generously provided by a grant from the Crown Roundtable/ Kresge Foundation through the Adaptive Management Initiative

Organized by:

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Resources

1. Vulnerability assessments

The vulnerability assessments included here were initially shared with workshop participants in 2014, and originated from two sources:
(1) a climate change gap analysis completed by Regan Nelson for the Crown Conservation Initiative in 2014 (available in its entirety here: http://www.crownconservation.net/publications/); and
(2) A vulnerability assessment completed by the Northern Rockies Adaptation Partnership in 2014 and published this year (Halofsky and Peterson, 2018).

Vulnerability assessments from the Crown Conservation Initiative gap analysis (suggested citation: Nelson, R. (2014). A Climate Change Adaptation Gap Analysis for the Crown of the Continent. Commissioned and published by the Crown of the Continent Conservation Initiative.):

Westslope cutthroat trout

While westslope cutthroat trout remain in only about half of their historic range, the Crown of the Continent ecosystem (CCE) still hosts large, connected core populations and thus represents a stronghold for this species west of the Continental Divide.[1-3] East of the Continental Divide, the range contraction has been more severe, and in Alberta westslope cutthroat trout are designated provincially as threatened. [4] Declines in westslope cutthroat trout populations throughout the CCE have been attributed to hybridization with non-native trout particularly rainbow trout, competition and predation with non-native fishes, habitat degradation and overfishing. [1-4] Climate change is likely to exacerbate the threats to westslope cutthroat trout persistence throughout its range, by creating habitat conditions that favor nonnative invasive species, while further limiting suitable coldwater habitats that the westslope cutthroat trout need to survive.[5]

Stream temperatures: Westslope cutthroat trout thrive in clear, coldwater mountain streams, and have been shown to have optimum growth rates at stream temperatures between 13-15°C. [6] Growth rates and fitness decline as temperatures climb above 15°C, and westslope cutthroat trout cannot survive over time in stream temperatures near or above 20°C. [6] For this reason, as temperatures warm under a changing climate, existing westslope cutthroat trout habitat networks in the Crown of the Continent will shrink.[7] Across the US range of all existing subspecies of cutthroat trout, habitat is projected to recede by 58%-65% due to climate change and linked interactions with other species. [7, 8]

Hybridization with invasive species: Westslope cutthroat trout are vulnerable to hybridization, or the interbreeding with nonnative rainbow and other subspecies of cutthroat trout. These resulting hybrid fish are fertile and can reproduce; subsequent gene mixing (or introgression) ahs the potential to lead to the "genomic extinction" of native westslope cutthroat populations. [3] Genetically pure populations of westslope cutthroat trout remain in less than half of their historic range. [1, 2] Some work indicates that hybridized populations may see dramatic reductions in fitness with introgression less than 20%. [3] Hybridization has been shown to spread in streams with warmer temperatures that are connected to streams containing hybrid populations, although there may be differential effects of climate change on some competitors, namely brook trout, that could increase westslope cutthroat trout resistance to hybridization. [3]

Rainbow trout, currently the most common invasive trout species to hybridize with cutthroat trout in the Crown of the Continent, maintain optimum growth rates at temperatures equal to and warmer than westslope cutthroat trout temperatures. [6] Rising stream temperatures will favor the expansion of rainbow trout further into cutthroat distributions, increasing the risk of hybridization and extirpation of westslope cutthroat trout populations. [9] Other invasive species, including brown trout, brook trout and smallmouth bass may also pose an increasing threat to westslope cutthroat trout persistence under climate change. [7, 9, 10] In the North Fork Flathead watershed, the percentage of streams that favor hybrids increased from 15% in 1978 to 33% in 2008. [11] Across the range of all interior subspecies of cutthroat trout, nonnative species were associated with a 33% reduction in cutthroat trout habitat, and were projected to further reduce suitable habitat by as much as 26% with future climate change. [7]

Population fragmentation: Loss of suitable habitat due to warming stream temperatures and invasion by nonnative species can fragment existing populations and reduce the extent of habitat networks supporting local populations, leading to loss of genetic diversity and increased vulnerability to large disturbances. [12, 13] Increasing the resilience of westslope cutthroat trout will require well-connected stream networks that support diverse life histories, spatial diversity, and robust gene flow across populations. Yet, connected systems can foster the spread of hybridization, dampening genetic diversity. [14] Managers have been working within this complicated paradigm for some time, and decision criteria have been developed to evaluate the trade-offs between isolation and connectivity. [12] Looking ahead, given the changes associated with a warming climate, the trade-off between isolation and building resilience will need even closer attention. In the Crown of the Continent, decision-support for such management decisions is being developed. [5]

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Bull trout

Bull trout thrive in cold, clear water. They are found in the deep pools of large rivers and lakes, and in cold mountain streams containing large wood and other complex cover that are well connected to the mainstem to accommodate spawning migrations. The Crown of the Continent Ecosystem (CCE) is one of the last remaining strongholds of the native bull trout, but even in this ecosystem, this coldwater fish faces numerous threats. The cumulative impacts of industrial and recreational activities that have degraded bull trout habitat, and competition from introduced fish species have negatively impacted CCE bull trout populations. In Alberta, more than half of core bull trout populations are diminishing in number and bull trout have declined to an estimated 31% of their former range, prompting the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to assess bull trout as "threatened" in 2012.([1]) In the US, bull trout have been listed as "threatened" under the Endangered Species Act since 1999.

Climate change is likely to pose serious challenges for bull trout recovery. Warmer stream temperatures, changes in water timing and quantity, increased number and intensities of flood and wildfire disturbances, and the spread of invasive species and diseases into bull trout habitat are new threats posed by climate change that will only amplify the existing challenges to Bull trout recovery throughout the Crown of the Continent.([2])

Stream Temperatures: Bull trout require cold water to complete critical phases of their life cycle, and have limited tolerance of warm stream temperatures. Above 16°C, bull trout can suffer reduced fitness and even direct mortality([3]), and the probability of bull trout occurring in streams with temperatures above 18°C is very low.([4]) Stream temperatures are expected to warm rapidly as a result of climate change in the 21st century.([5]) In many areas in the Crown, bull trout already inhabit the coldest streams, so warming stream temperatures are projected to lead to contractions within their range in the CCE, with no real options for range shifts.([6, 7]) Furthermore, increasing stream temperatures especially at lower or mid-elevation reaches can shrink local habitat stream networks and fragment connectivity among bull trout subpopulations, which could hamper genetic diversity and reduce the probability of persistence of remaining subpopulations.([8, 9])

Winter floods and high-flows: As temperatures warm, and precipitation falls more often as rain rather than snow, winter floods and scouring winter stream flows are expected to increase in many parts of the bull trout's range. ([6, 10]) Bull trout spawn in the late summer and fall. Their embryo deposits, called redds, can be destroyed during high water flows or winter flood events. As winter high-flows and floods increase under climate change, the loss of redds may reduce bull trout incubation success and reduce the probabilities of population persistence.([6, 11])

Wildfires: The number, severity, and extent of wildfires is increasing in the US and Canadian Rockies.([12, 13]) Wildfires can denude riparian areas, which can cause dramatic increases in stream temperatures.([7]) Wildfires can also lead to an increase in fine sediments in streams, through soil erosion from burned areas, which can reduce the quality of bull trout habitat.([10]) Finally, the loss of vegetation from fires can reduce nutrient availability in streams, which could affect fish productivity.([10]) Yet, wildfire is a natural and important ecosystem process that benefits stream habitat in the long-term. Efforts to bolster bull trout resilience through maintaining stream network connectivity is likely an effective strategy, as these trout species have evolved to recover from fire events.([10]) On the other hand, there is some evidence that post-fire rehabilitation efforts can actually impede fish recovery, so such actions should be applied cautiously in bull trout habitat.([10])

Invasive species and Disease: Nonnative, invasive trout species challenge bull trout recovery in several ways: they compete with bull trout for habitat and food, they eat young bull trout, and they can reduce genetic diversity through hybridization with bull trout.([14, 15]) Warmer stream temperatures may allow these invasive species to expand their current range and invade new reaches of mountain streams, increasing the pressure on bull trout.([15]) Warmer temperatures may also lead to an increase in disease and pathogens that could pose new threats for bull trout, although this is a research gap.([16])

Projections of suitable habitat under climate scenarios: Projections of suitable habitat for bull trout under various climate scenarios are quite bleak. Most recent analyses project a 36%-76% loss of spawning and rearing habitat, and a 58%-86% loss of foraging, migrating and overwintering habitat for bull trout under a 3-5°C temperature increase in the transboundary Flathead River Basin.([17]) A separate study projects a decrease in Idaho and Montana from a current habitat reach of 36,000km of streams, to less than 5,000km of streams by 2080, with relative high certainty that low to mid elevation streams will not be suitable for bull trout.([18]) These two estimates concur with earlier findings of dramatic losses in habitat, resulting in small mountain-top patches of remaining suitable habitat for bull trout throughout their range.([9]) The loss of connectivity associated with such predictions is likely to lead to a loss of resilience and a faster pace of local extinction for bull trout subpopulations than the simple loss of habitat length or area might suggest.([9])

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<u>Habitat, ecosystem function, or species</u>

Bull trout (*Salvelinus confluentus*), primarily the interior lineage. Populations may exhibit migratory or resident life histories. Migratory fish travel long distances as subadults to more productive habitats and achieve larger sizes and greater fecundity as adults before returning to natal habitats to spawn. Fish exhibiting resident life histories remain in natal habitats and mature at smaller sizes, though often at the same age as migratory adults. Adults spawn and juveniles rear almost exclusively in streams with average summer water temperatures <12°C (54°F) and flows greater than 0.034 m^3sec-1 (1.2 ft^3sec-1).

<u>Westslope cutthroat trout (*Oncorhynchus 9larkia lewisi*)</u>.

This taxon has a complicated lineage structure that can be roughly broken into a single lineage in the north and east that occupied and colonized river basins directly influenced by glaciation or glacial dams, and a southern and western group of several presumably older lineages in basins never directly influenced by glaciation. These fish also exhibit resident and migratory life history strategies. Spawning and juvenile rearing can occur in streams smaller (0.0057 m^3sec-1 [0.2 ft^3sec-1]) and warmer (up to 14°C [57°F]) than those used by bull trout.

<u>Yellowstone cutthroat trout (*O. c. bouvieri*)</u>.

This taxon has an unresolved distribution, because certain lineages are found in portions of the Bonneville basin, and represent the geologically driven seesaw of connectivity between the Bonneville and upper Snake River basins. Undisputed members of this taxon are represented by a single mtDNA clade found throughout the NRAP region in the Yellowstone and Snake River basins. Life histories, and presumably spawning and juvenile habitats, are the same as for westslope cutthroat trout.

<u>Broad-scale climate change effect</u>

The primary climate change effects are warming air temperatures and potential changes in the amount, timing, and type (snow versus rain) of precipitation. Depending on scale and location, these will generally combine to cause warmer water temperatures, earlier snowmelt runoff, earlier declines to lower summer baseflows, and downstream contraction of perennial flow initiation from headwaters. Depending on watershed elevation, the magnitude of peak flows could increase or decrease. At high elevations where snowmelt drives the flow regime, peak flows may occur several weeks earlier and be smaller than historical averages. At mid-elevations where stream hydrographs are transitional between snow and rain, peak flows may increase and could shift much earlier if rainfall becomes the predominant form of precipitation. More extreme climatic conditions may also occur more frequently and persist over longer periods, including higher peak flows from rain-on-snow events, higher temperatures, and longer, more severe droughts.

<u>Current condition, existing stressors</u>

Bull trout are listed as threatened under the U.S. Endangered Species Act (ESA). Their recent historical distribution has declined because of water development and habitat degradation (particularly activities leading to water temperature increases, but also cumulative losses of in-channel habitat complexity), elimination of migratory life histories by anthropogenic barriers, harvest by anglers, and interactions with introduced non-native fishes. With respect to the latter, this involves wasted reproductive opportunities with brook trout (*Salvelinus fontinalis*), competition, and predation (in streams, perhaps with brown trout [*Salmo trutta*]; in lakes, with lake trout [*Salvelinus namaycush*]).

Both subspecies of cutthroat trout have been petitioned under the ESA, but found not warranted for listing. The distributions of both species have declined substantially (>50%) in response to the same stressors affecting bull trout, although each subspecies appears to occupy a larger proportion of its historical habitat and is often found in larger populations at higher densities. Declines in response to non-native species can be more severe than in bull trout, perhaps because bull trout favor such cold environments that non-native species invasions are limited. Brook trout have replaced cutthroat trout in many waters in the NRAP region, disproportionately so in the upper Missouri River basin. These invasions seem influenced by the distribution of low-gradient alluvial valleys that may serve as nurseries for brook trout. Introduced rainbow trout (O. mykiss) have introgressively hybridized with both taxa of cutthroat trout at lower elevations (in warmer waters) across their historical ranges, although this is also true in areas where westslope cutthroat trout are sympatric with native rainbow trout (Clearwater River basin in Idaho, Kootenai River basin in Idaho-Montana). Lake trout have decimated local stocks of Yellowstone cutthroat trout in Yellowstone Lake.

<u>Sensitivity to climatic variability and change</u>

Bull trout evolved in western North America in interior and coastal basins exhibiting a wide array of flow characteristics and natural disturbance at scales from reaches to riverscapes. Nevertheless, habitats satisfying the restrictive thermal requirements of juveniles are rare, and little evidence exists for flexibility in habitat use. The length of connected habitat needed to support a bull trout population varies with local conditions, but current estimates suggest a minimum size of ~30–50 km (20–30 mi) to achieve a probability of occupancy of 0.9, contingent on water temperature, non-native species presence, and local geomorphic characteristics. Whether migratory life histories confer greater resistance to extirpation is uncertain.

Juvenile cutthroat trout occupy a broader thermal and stream size niche than do bull trout. They also appear to persist in smaller habitat patches. Nonetheless, they still require coldwater natal habitat patches exceeding ~5–10 km (3–6 mi) to have a high probability of persistence, and this value depends on non-native species presence and geomorphic conditions.

Expected effects of climate change

Warming temperatures will cause downstream boundaries of suitable thermal habitats to retreat upstream. Both species reproduce in some of the coldest streams in this region, thus opportunities to colonize waters that are currently too cold will be limited, especially for bull trout. The initiation and permanency of perennial flow will retreat downhill, and declines in summer flow will reduce habitat volume (and fish abundance) in perennial channels. The largest habitat patches will decline in size and may fragment into smaller patches. Small habitat patches may shrink below thresholds necessary to support a population. Invasive species more tolerant of warmer temperatures—brook trout, rainbow trout, brown trout, and possibly smallmouth bass (*Micropterus dolomieu*)—will encroach further upstream and depress or replace native salmonid populations.

Less water, hostile environments, and declining connectivity (e.g., from water development) would favor resident life histories, as would greater separation between spawning and adult growth habitats. Smaller populations of both species will be more susceptible to extirpation from local environmental disturbances (such as debris torrents following fire, or larger and more frequent floods). In addition, regional weather patterns are likely to synchronize population responses and vulnerabilities; in years of extreme drought and high summer water temperatures, populations in small habitats across the area may be at risk of extirpation.

Adaptive capacity

There is little evidence within fish species of rapid evolutionary adaptation to warmer water temperatures. Collectively, the genus *Salvelinus* is restricted to coldwater habitats throughout the Northern Hemisphere, often the coldest waters occupied by any salmonid fish. Although cutthroat trout can reproduce in warmer water temperatures, they are similarly constrained evolutionarily and are more exposed to non-native species in warmer areas.

Under circumstances in which migration is feasible, whether migratory or resident life histories are favored involves how fish metabolic rates, water temperature, and stream productivity interact to influence juvenile growth and adult survival. Which life history might be more successful as climate changes is unknown.

Risk Assessment

Global climate models project relatively consistent amounts of warming by the 2040s, but more variability by the 2080s because of uncertainties associated with future greenhouse gas emissions. As a result, bull trout populations are expected to decrease at most locations and be extirpated from some by 2040. Those trends may intensify by the 2080s, but with greater uncertainties as noted above. For cutthroat trout, future declines are expected to be less severe because this species can persist in smaller habitats and reproduce in warmer reaches. The distribution of both native species may be altered by responses of non-native fishes to climate change. Changes in winter flood frequency may limit habitat gains for brook trout, but most non-native species are expected to advance their distributions upstream to track warming environments.

Magnitude of effects
Moderate for bull trout by 2040s, high by 2080s; low for cutthroat trout by 2040s, moderate by 2080s.

Likelihood of effects
High for 2040s (all taxa), moderate for 2080s.

2. Compilation of climate adaptation strategies and tactics from previous planning efforts[1]

STRATEGY	TACTIC
Increase resilience of native fish populations to warming stream temperatures and flow changes	Identify and restore "warm-adapted" populations of native trout
	Replicate and supplement native fish populations
	Connect current populations with streams that are currently too cold (and may warm to suitable levels in the future)
	Consider limiting angler pressure on native fish in streams that are at or near temperature thresholds
	Establish large-scale reserves for long-term native cold-water fish conservation
	Conduct field experiments of fish-temperature relationships for multiple species and regions
	Monitor changes in stream temperature for fish distributions
	Understand and map where groundwater inputs are providing cold water
Increase resilience of native fish species by reducing barriers to movement	Replace or retrofit culverts that will not function well during future low base flows and flood periods
	Identify, prioritize, and remove barriers to native fish movements
	Minimize water diversions; where they exist, ensure fish ladders avoid entrainment of native trout
Increase population resilience by increasing native fish health	Increase public education to eliminate disease vectors
	Survey fish health conditions
	Direct treatment or removal of infected fish
Prevent / remove invasive non-native fish	Survey and map non-native species
	Combine non-native mapping with information on migration barriers
	Remove or control non-native fish species (electrofishing, chemical removal, genetic swamping, encouraging increased harvest of non-natives)
	Strategically use physical or electrical barriers to prevent further spread of non-native fish

STRATEGY	TACTIC
	Assess status of non-native fish more frequently to better detect changes in invasions (perhaps using citizen science)
	Model future changes in stream flow and habitat to anticipate future invasion hotspots
	Re-establish or replicate native fish populations in areas where non-natives have been removed or are effectively blocked by barriers
Increase spawning habitat resilience by restoring stream and floodplain structure and processes	Restore stream and floodplain complexity, ensuring adequate width-depth ratios and frequency of pools
	Provide alternative habitat for spawning
	Increase use of engineered log jams where feasible
	Prevent or remove aquatic invasive species
Increase habitat resilience by reducing threats from roads and infrastructure in the floodplain	Designate and restore natural floodplain boundaries
	Increase and/or reconnect floodplain habitat to streams and rivers
	Remove infrastructure from floodplains
	At the watershed scale, seek to minimize the cumulative effect of the road network on surface and subsurface flow.
Increase aquatic habitat resilience to low summer flows	Increase off-channel habitat and protect refugia in side channels
	Protect wetland-fed streams which maintain higher summer flows
Maintain/enhance riparian vegetation to shade streams and buffer warming stream temperatures	Reduce grazing pressure (e.g., reduce stocking rates, use rest-rotation systems, fence riparian areas, provide off-stream water sources, retire vacant allotments in priority fish areas, increase monitoring in priority areas to ensure good practices)
	Restore riparian vegetation in degraded areas
	Adjust which plants are used for riparian restoration to favor species that are better suited for future climate conditions
Maximize water storage and late season return flows to streams	Increase storage of water in floodplains by encouraging natural flooding and groundwater infiltration
	Reintroduce beaver and/or install artificial beaver-mimic dams where compatible with fish conservation goals
	Restore wetlands
	On regulated streams, pulse flows during critical times (e.g. lower flows coupled with high temperatures), sourcing from lower in the thermocline
Increase in-stream summer flows by reducing withdrawals	Increase efficiency of irrigation techniques
	Reduce summer withdrawals on USDA FS and NPS lands
	Consider alternative water supplies for USDA FS and NPS operations to retain in-stream flows
	Legally secure water rights/agreements for in-stream flow
	Reform water laws to enable increased acquisition of in-stream water rights
	Explore the use of water trusts/funds to increase investments in the protection of watershed health and function
	Increase efficiency of residential water delivery and use
	Extend voluntary drought-response plans where users reduce their water use during times of drought

STRATEGY	TACTIC
	Use water pricing to encourage water conservation
	Explore potential to combine sprinkler and flood irrigation to capture increasing spring floods (and recharge groundwater supplies) and then switch to more efficient sprinkler irrigation when stream flows are lower
Manage and reduce sediment generated by roads	Evaluate road system for sediment input
	Reduce sediment input to streams by replacing culverts, and relocating and decommissioning roads (e.g., in riparian corridors)
Reduce sedimentation associated with erosion and fire	Develop a geospatial layer of debris flow potential for pre-fire planning
	Restore and re-vegetate burned areas to store sediment and maintain channel geomorphology
	Include climate change projections in identification of potential streams for stream bank and upland erosion
	Inventory disturbed areas for candidate sites for riparian and upland vegetation restoration
	Manage fire and fuels with thinning and prescribed fire to reduce fire severity and extent; prioritize areas where a major fire event could wipe out priority populations
Monitor changes in aquatic food web dynamics	Assess food webs for baseline data
	Monitor food web dynamics for changes with warming
Develop a region-wide, spatially explicit climate adaptation strategy for focal fish species	Identify highest priority conservation and restoration sites for focal fish species
	In the highest priority conservation/restoration sites, survey and evaluate existing management to anticipate and plan for both potential conflict and opportunities for collaboration
Develop and implement coordinated fish monitoring strategy and database	Identify focal fish species spawning/rearing distributions, and create a monitoring network that can efficiently monitor if/when distributions shift or are lost
	Expand existing inventory/monitoring of native trout and develop a consistent, statistically based assessment of hybridization. Consider genetic rescue where feasible.
Engagement aimed at broadening the implementation of adaptation strategies for fish	Engage diverse water users to develop a holistic adaptation plan
	Engage NRCS in encouraging climate adaptation strategies on private lands

[1] Sources: 1) Miller, S., M. Cross, and A. Schrag. 2009. “Anticipating climate change in Montana: A report on a workshop with Montana Department of Fish, Wildlife and Parks focused on the Sagebrush-Steppe and Yellowstone River systems”. MT Fish Wildlife and Parks, National Wildlife Federation, Wildlife Conservation Society, World Wildlife Fund; 2) Cross, M., N. Chambers, L. Hansen, and G. Tabor. 2013. “Workshop Summary Report: GNLCC Rocky Mountain Partner Forum Climate Change and Cold Water Systems”. Wildlife Conservation Society, Center for Large Landscape Conservation, EcoAdapt, Great Northern LCC; 3) Nelson, R. 2014. A Climate Change Adaptation Gap Analysis for the Crown of the Continent. Commissioned and published by the Crown of the Continent Conservation Initiative; 4) Raymond, C.L., Peterson, D.L., and Rochefort, R.M. 20xx. Climate change vulnerability and adaptation in the North Cascades region, Washington. Gen. Tech. Rep. PNW-GTR-

xxx. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Xxx p. 5) Workshops held in October-November, 2014 by the Northern Rockies Adaptation Partnership: http://adaptationpartners.org/nrap/

3. Landscape-scale science

Over the course of the last four years, Clint Muhlfeld (of the U.S. Geological Survey Northern Rocky Mountain Science Center) and his colleagues have partnered with the Crown Managers Partnership to deliver the best available science on native salmonids – at the scale of the entire landscape- to managers on both sides of the international border. At the 2018 workshop, he was joined by his colleagues, Vin D'Angelo and Ryan Kovach (also from the U.S.G.S. Northern Rocky Mountain Science Center) in a joint presentation entitled," Crown vulnerability assessment tool and results for bull trout and westslope cutthroat trout."

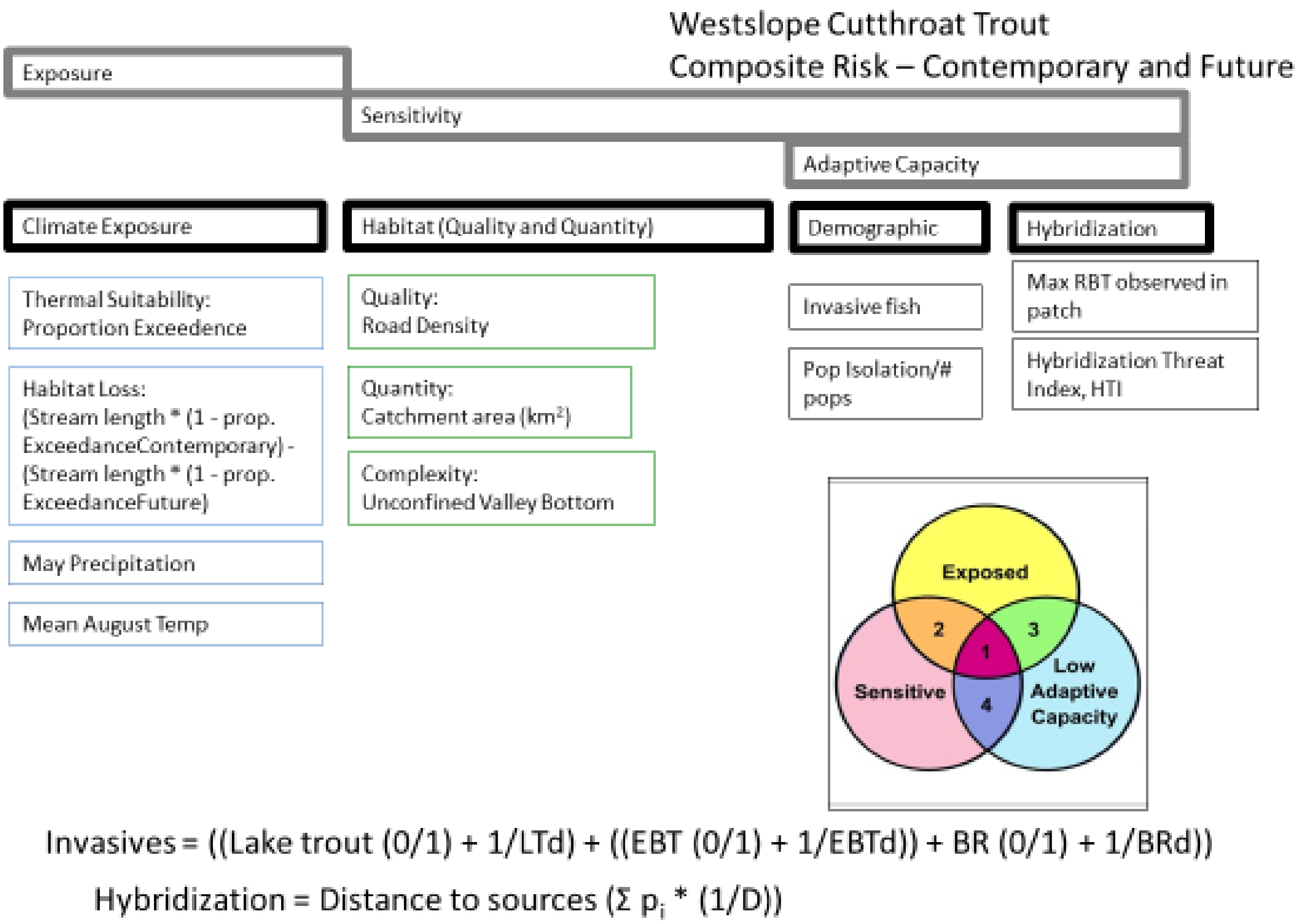
This presentation provided a deep dive into the threats and stressors underlying bull trout and westslope cutthroat trout vulnerability in the Crown. Using extensive, long-term empirical datasets and analyses, Clint reviewed impacts of the many threats facing native salmonids in this landscape. For example, climatic shifts and warming in the Northern Rockies are nearly double that of other parts of the world, leading to decreased snowpack and earlier spring runoff. These factors in turn threaten the aquatic ecosystems that the native salmonids depend on to be cold, clean, and connected. Non-native invaders are another highly significant threat to native salmonids. Clint added that our native salmonids have been able to adapt to climate change using their genetic diversity over geological periods of time, but that they still need help and intervention urgently right now if they are to persist on the landscape.

The greatest threats to these two species are habitat degradation and fragmentation, invasive species, over exploitation and climate change. The westslope cutthroat trout is a Species of Special Concern in Montana and British Columbia and is Threatened in Alberta, while the Bull trout is listed as Threatened in Montana, are a Threatened in Alberta, and are a Species of Special Concern in British Columbia.

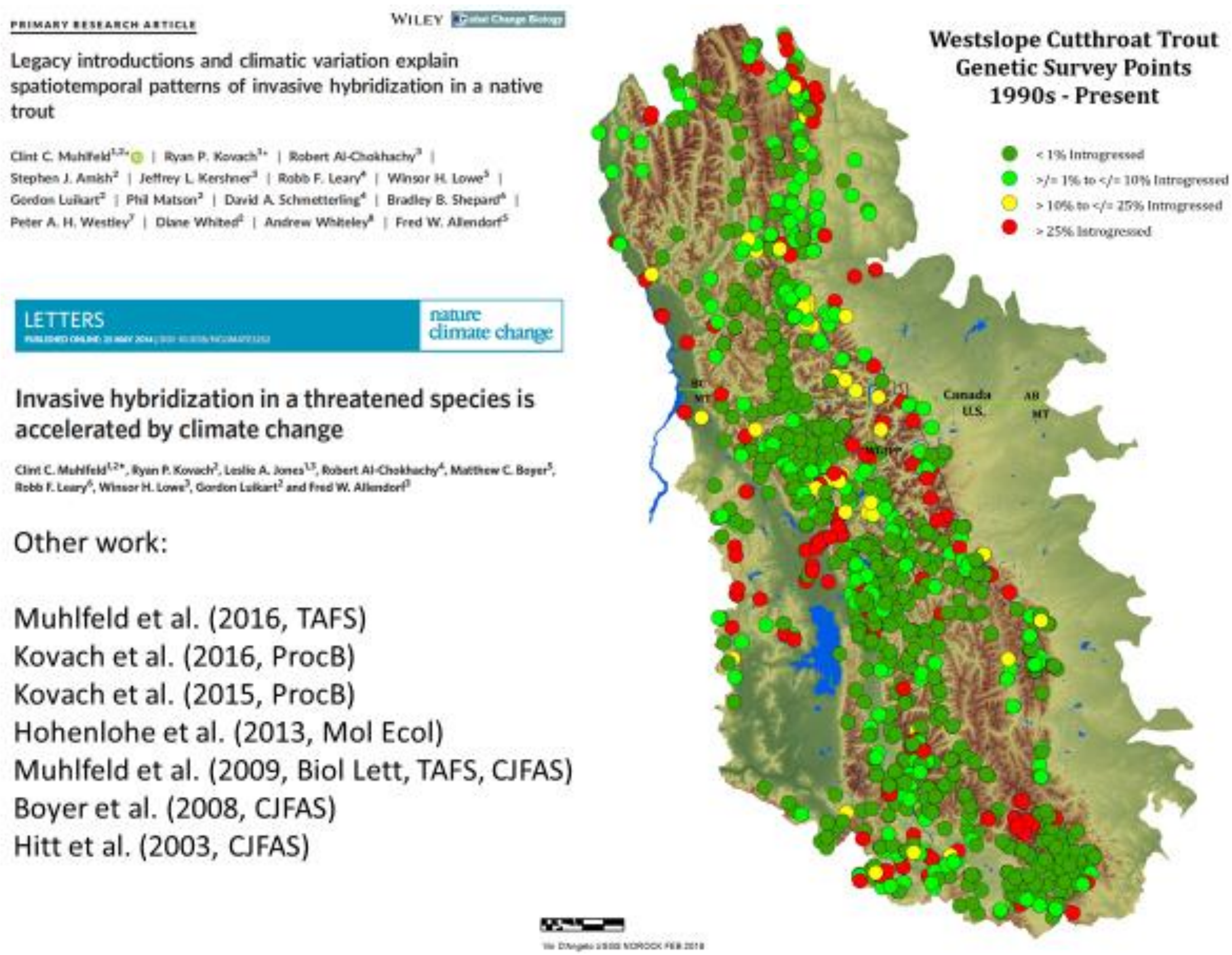
Clint and his colleagues have been working with managers to develop an adaptation management approach to do the following:

- Identify the management target
- Assess the vulnerability to the stressor
- Identify and prioritize management options
- Assess the risk of management options
- Implement management options
- Monitor, review and revise continuously

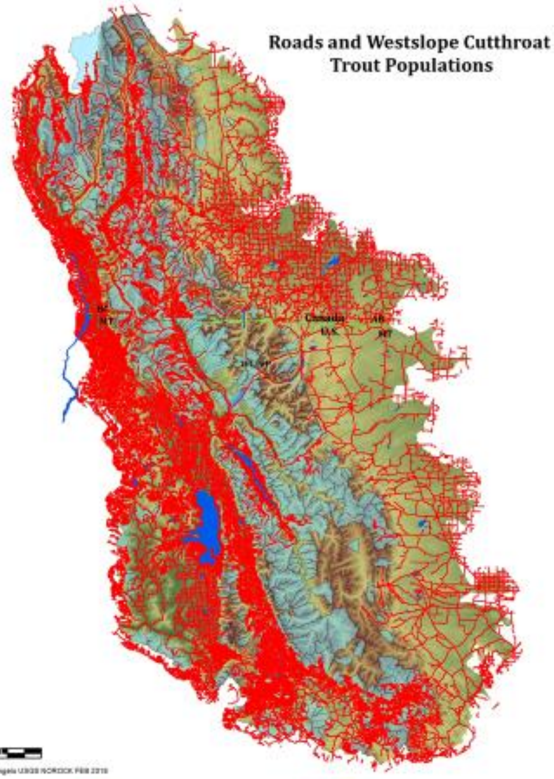
He ended the presentation by saying that exposure, sensitivity and adaptive capacity were used to form the framework of the vulnerability dataset in the following ways, but that he and his colleagues were open to suggested changes in their conceptualization of these categories if managers had different ideas or needs:



Lastly, Clint and his colleagues continue to regularly publish the results of their work and key components of the vulnerability assessment and threat analyses, summed up for invasive species' presence and impacts in the below slide as an example.



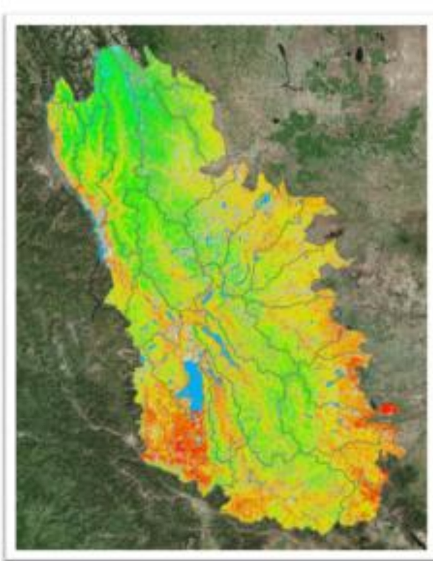
The importance of habitat fragmentation across the landscape received a great deal of attention along with other stressors like shifts in climate and resulting impacts on stream flows and temperatures during the hottest summer months (e.g. below slides).

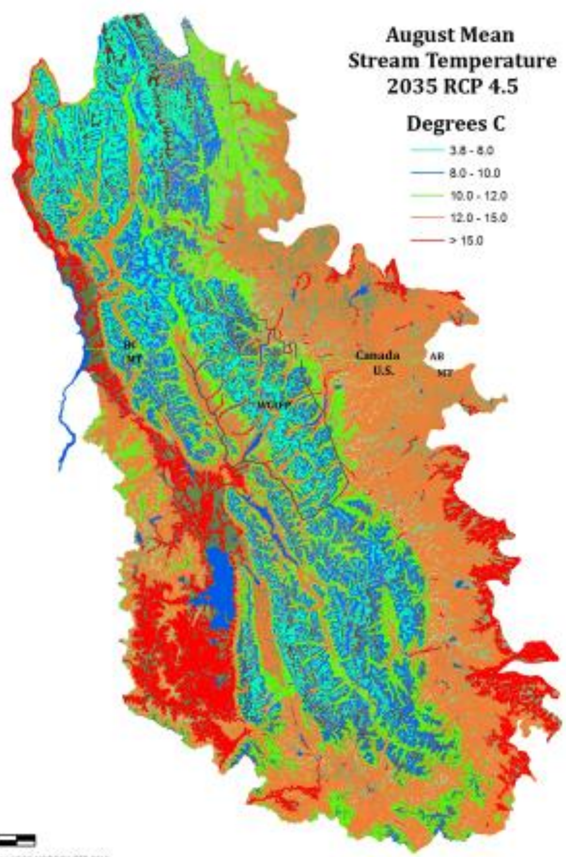


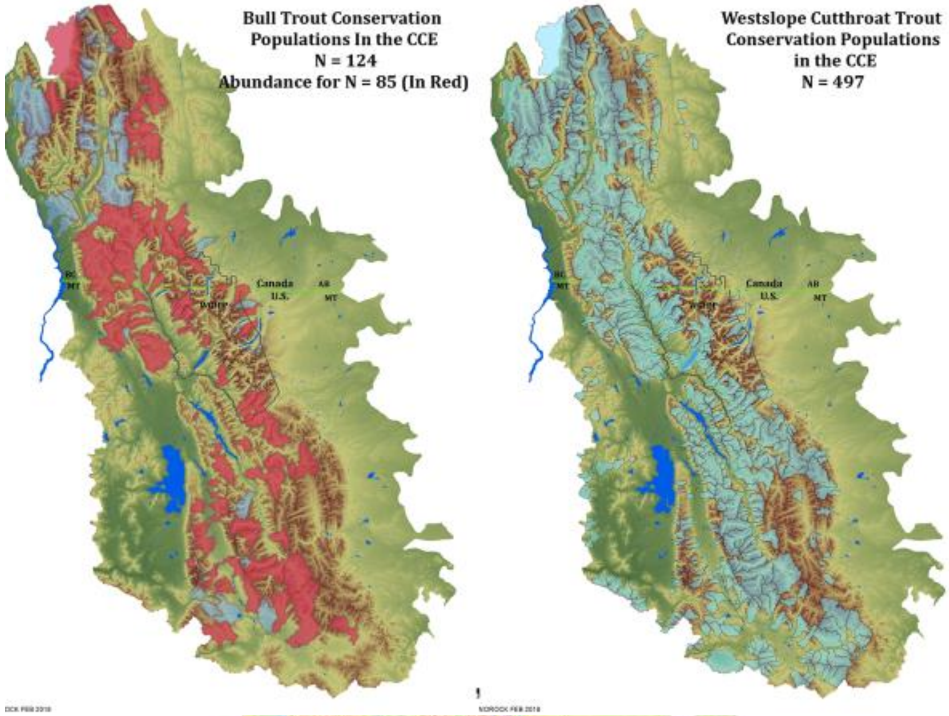
Climatic Change (2017) 144:641–655
DOI 10.1007/s10584-017-2060-7

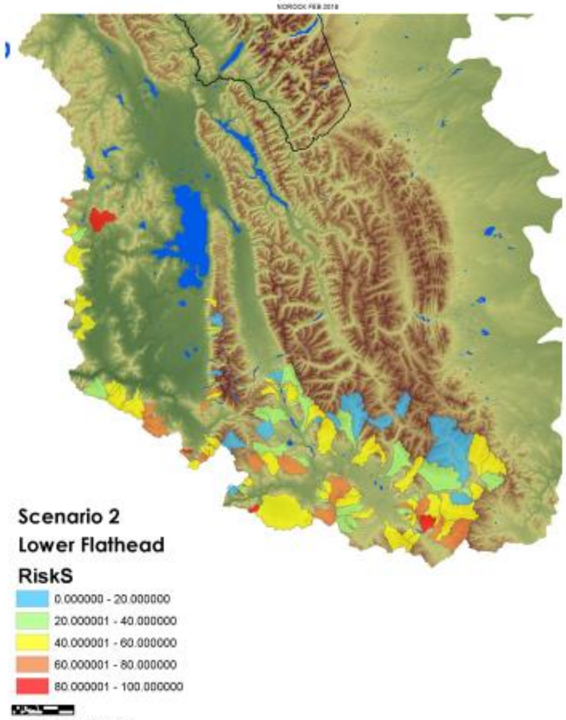
Projected warming portends seasonal shifts of stream temperatures in the Crown of the Continent Ecosystem, USA and Canada

Leslie A. Jones[1,2,3] · Clint C. Muhlfeld[1,4] ·
Lucy A. Marshall[5]





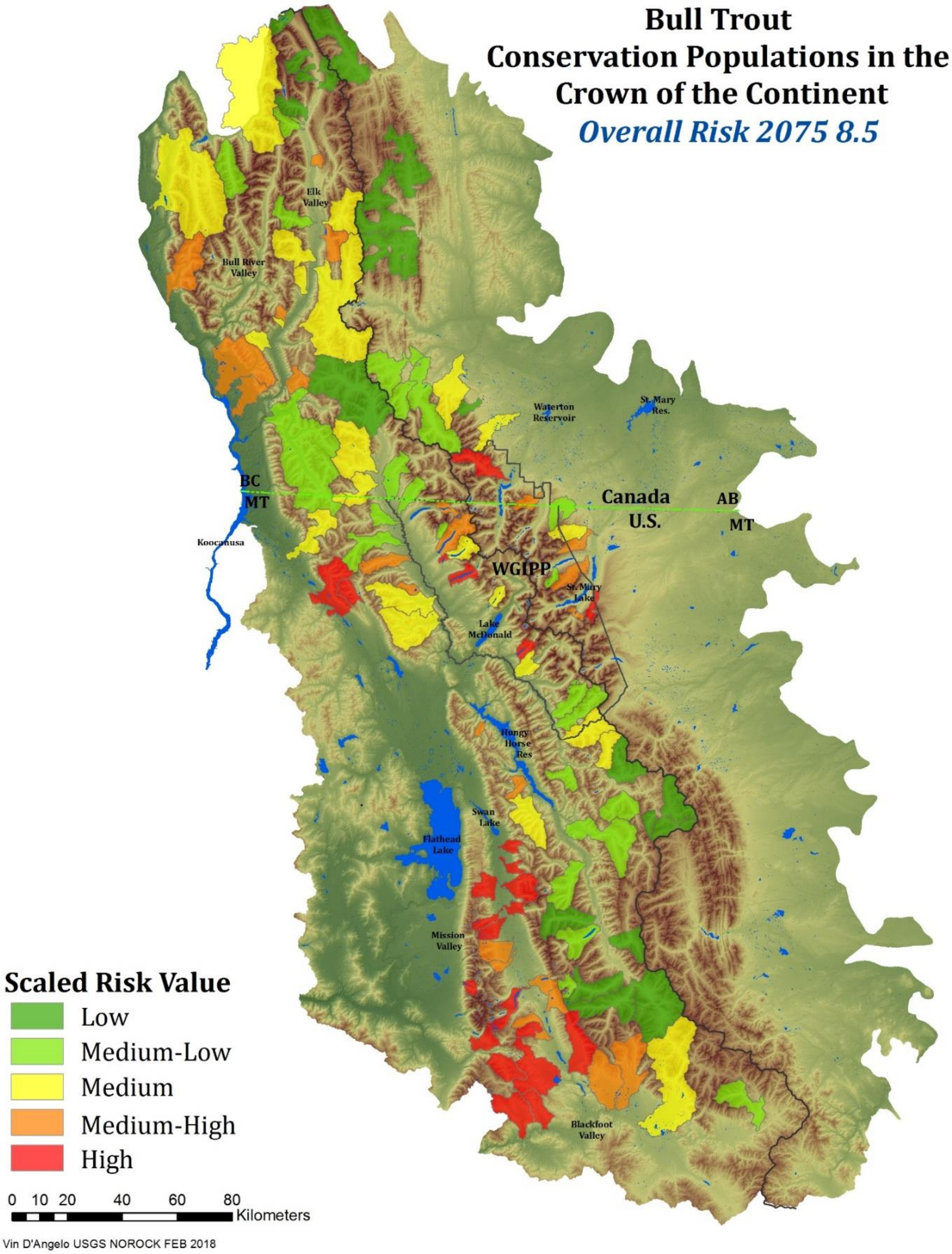


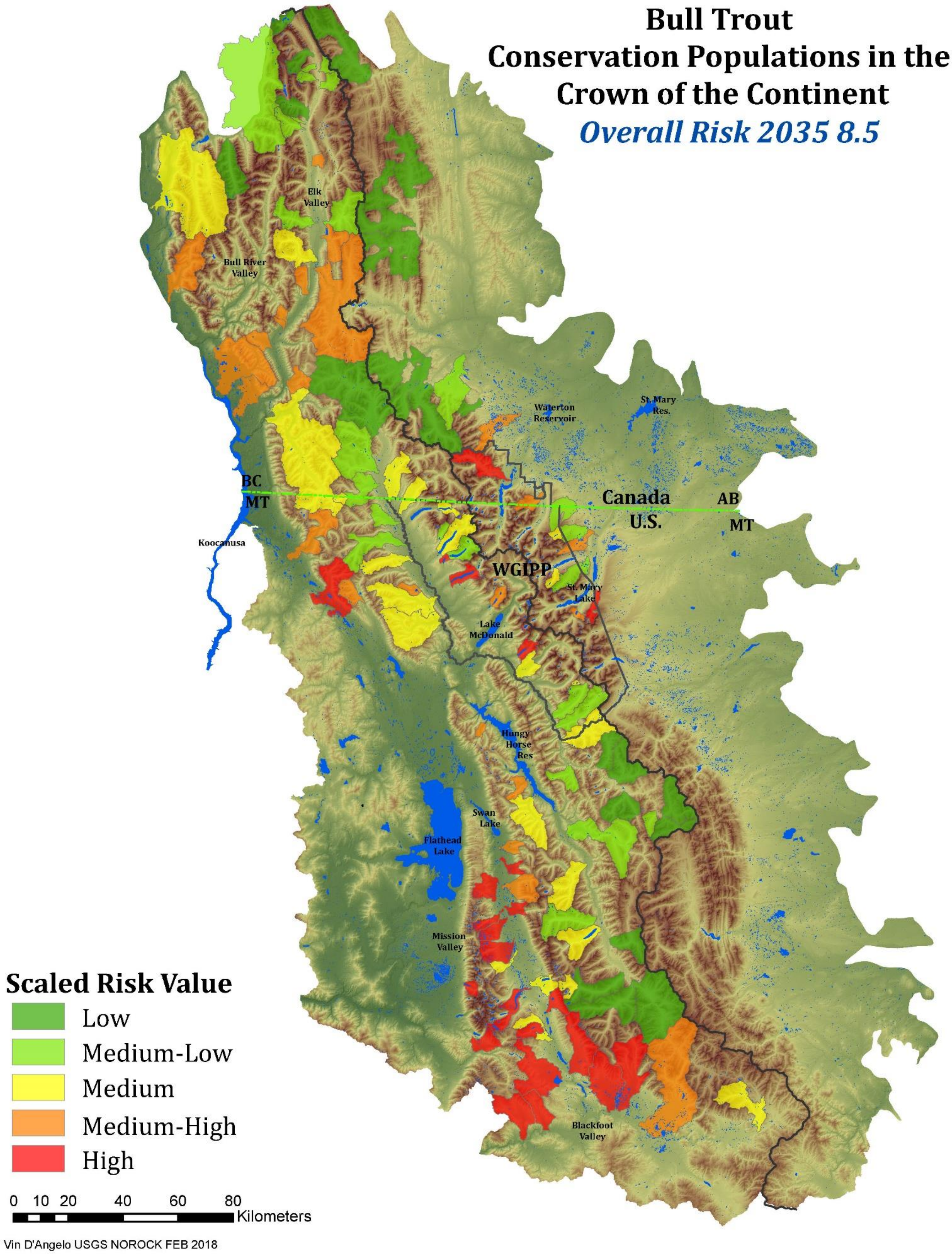


The talk ended with a call to action before revisiting the potential of the USGS's team's new SHEDS tool in facilitating the development of targeted management interventions across different jurisdictions, watersheds, and the entire Crown landscape moving forward.

We have included key slides from the presentation with the understanding that these are in the process of shifting as new information (like a trails layer for Alberta) is added at the request of workshop participants.

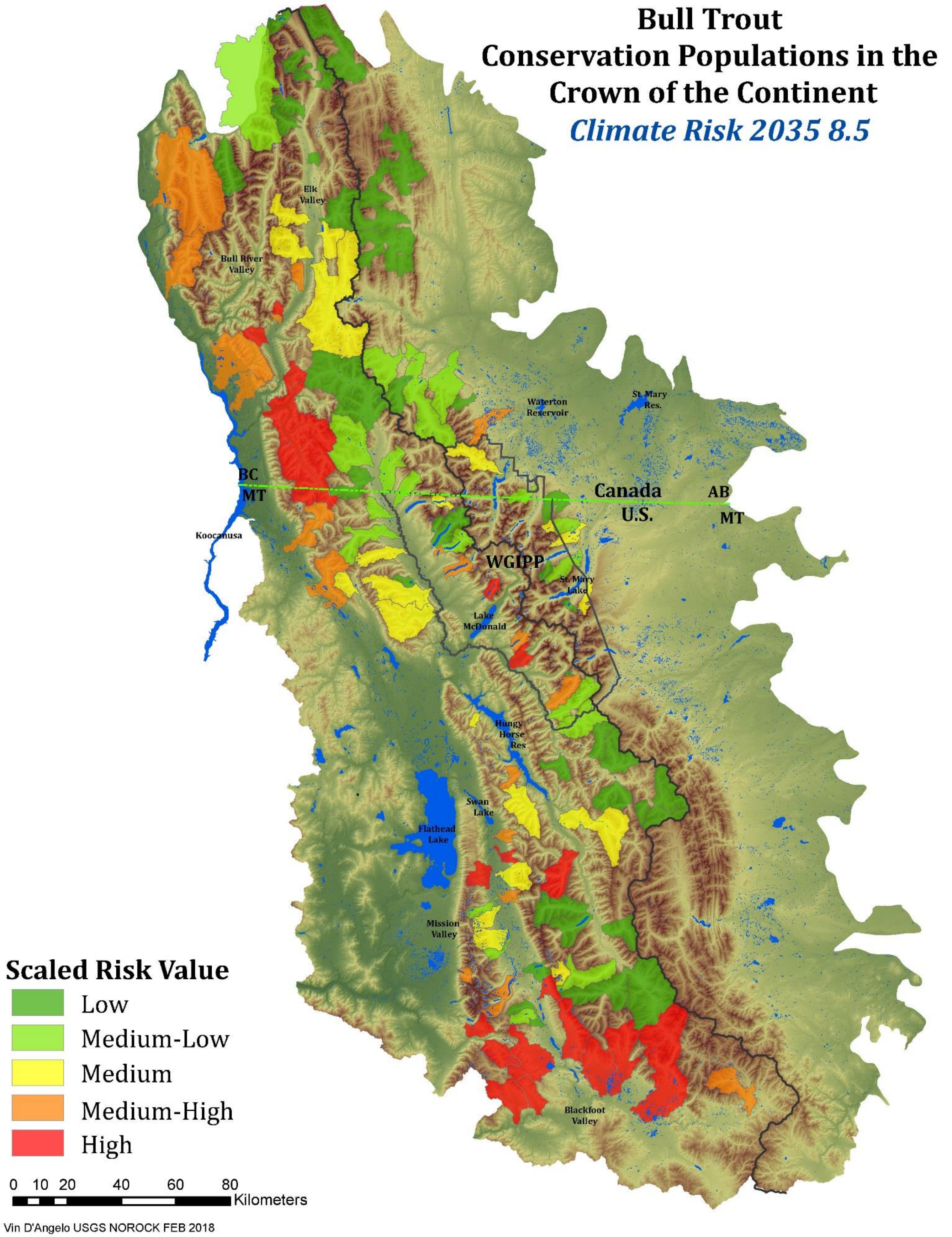
Map products from the Crown EcoSheds tool provided by U.S. Geological Survey scientists at the 2018 Crown Managers Partnership Forum.



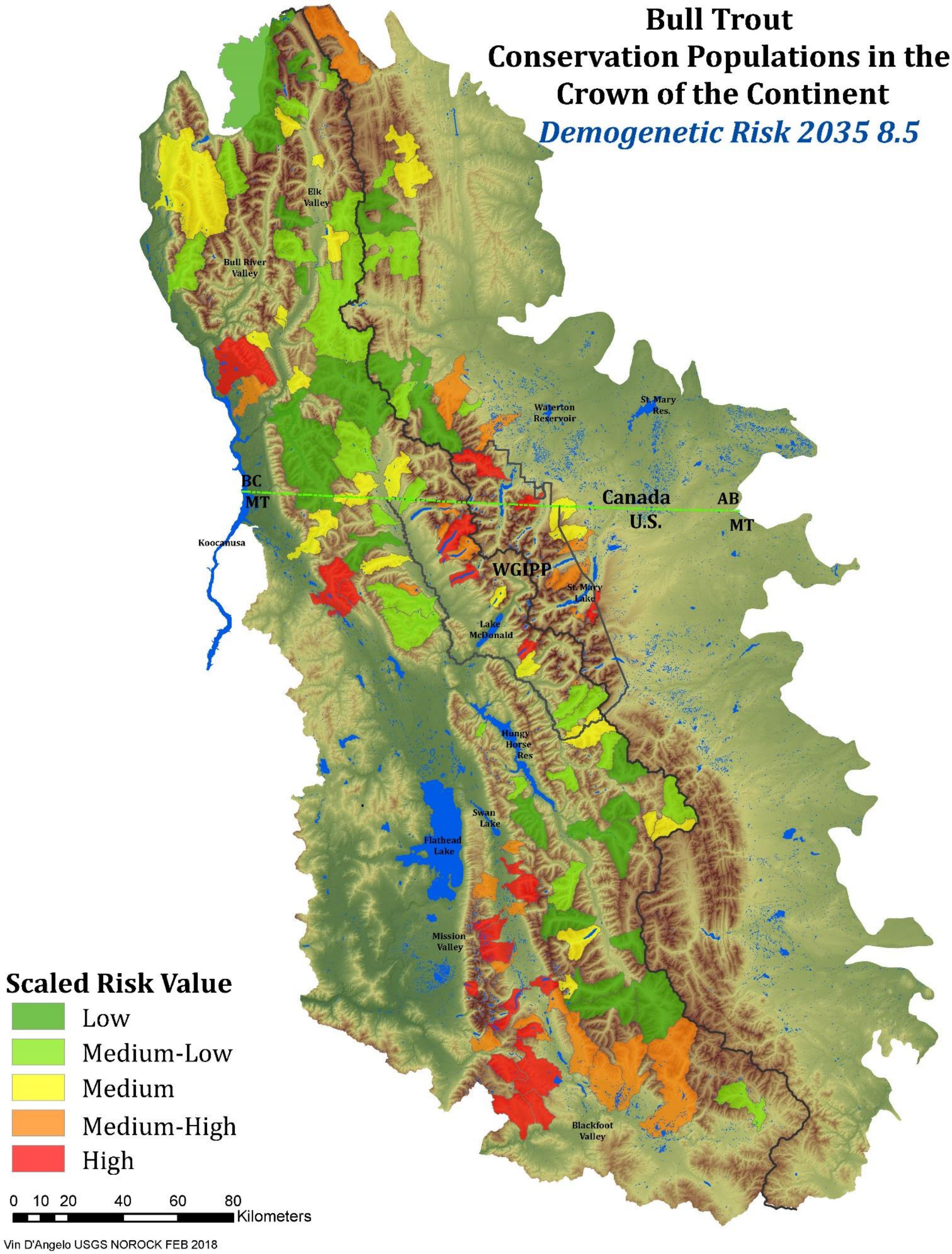


Bull Trout
Conservation Populations in the
Crown of the Continent
Overall Risk 2035 8.5
Elk Valley
Bull River Valley
Waterton Reservoir
St. Mary Res.
BC
MT
Canada
U.S.
AB
MT
Koocanusa
WGIPP
St. Mary Lake
Lake McDonald
Hungy Horse Res
Swan Lake
Flathead Lake
Mission Valley
Blackfoot Valley
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018

Bull Trout
Conservation Populations in the Crown of the Continent
Climate Risk 2035 8.5



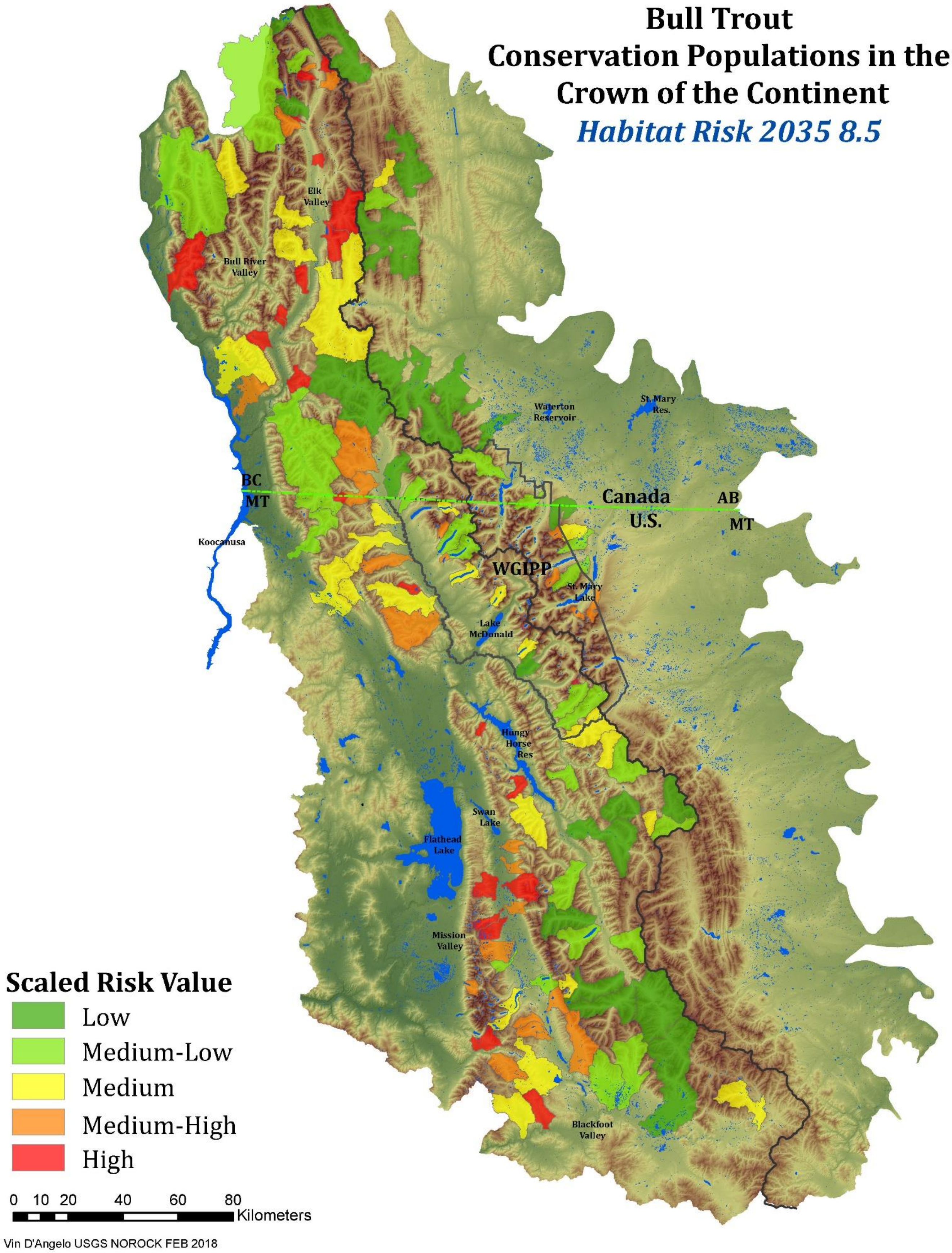
Vin D'Angelo USGS NOROCK FEB 2018

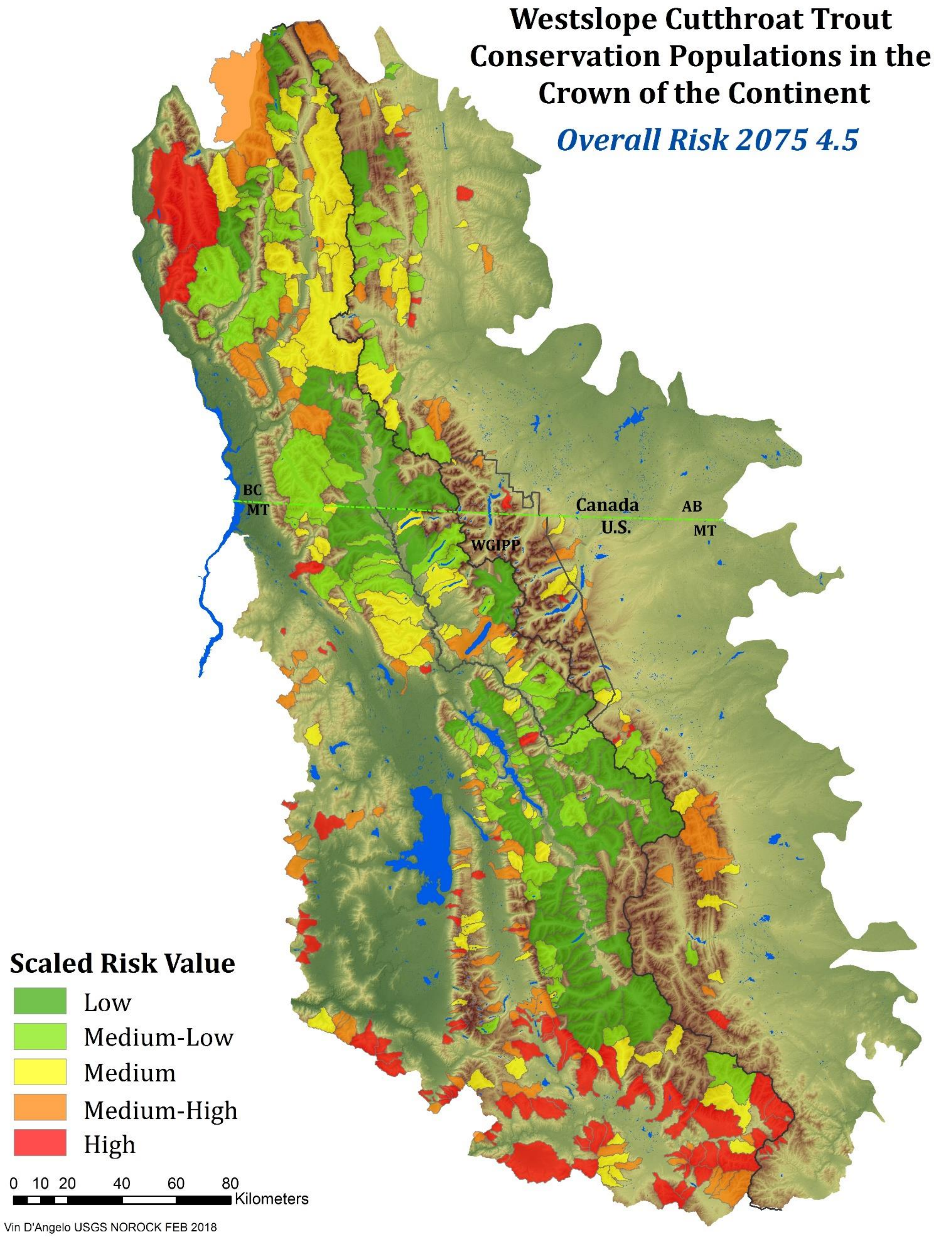


Vin D'Angelo USGS NOROCK FEB 2018

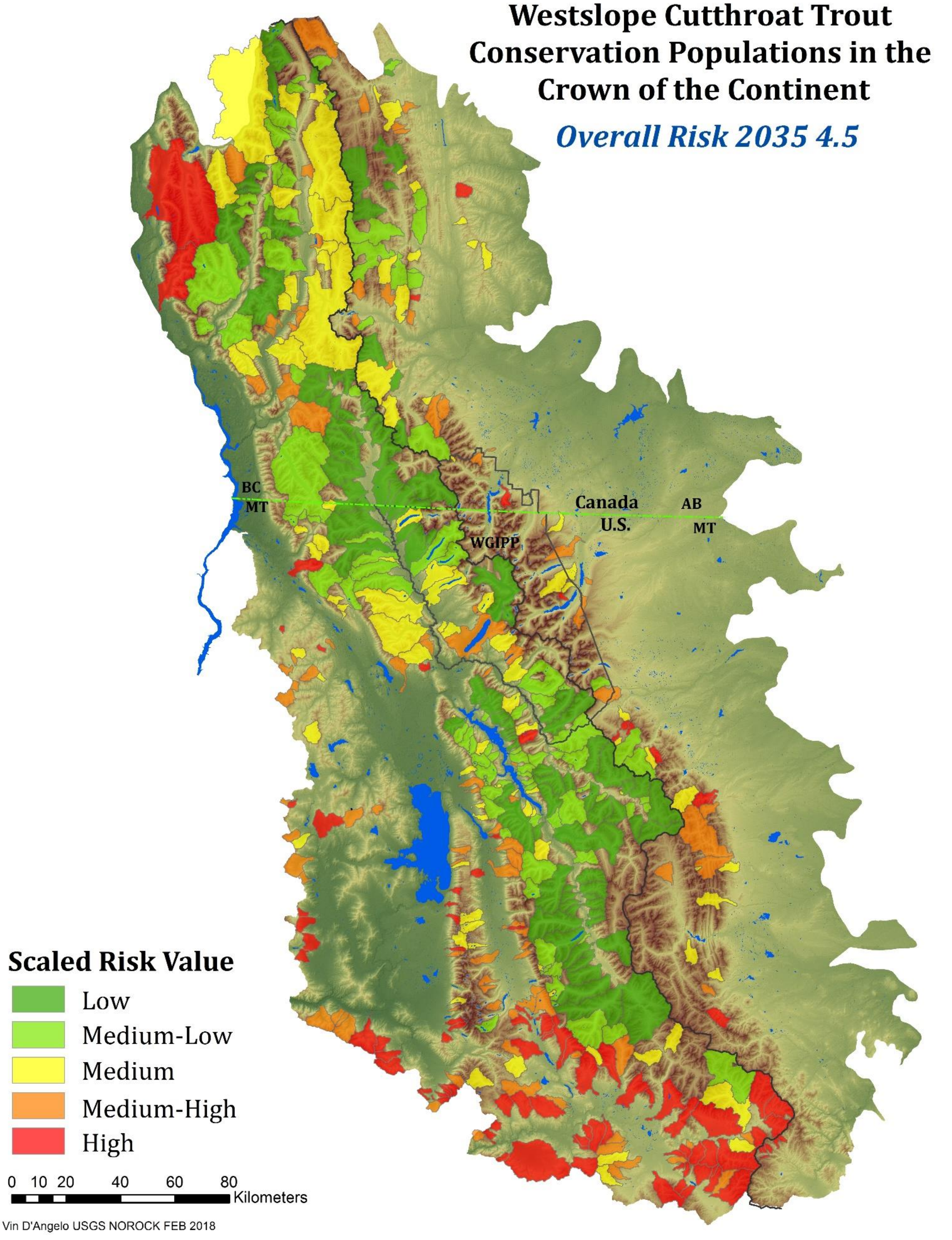
Bull Trout Conservation Populations in the Crown of the Continent

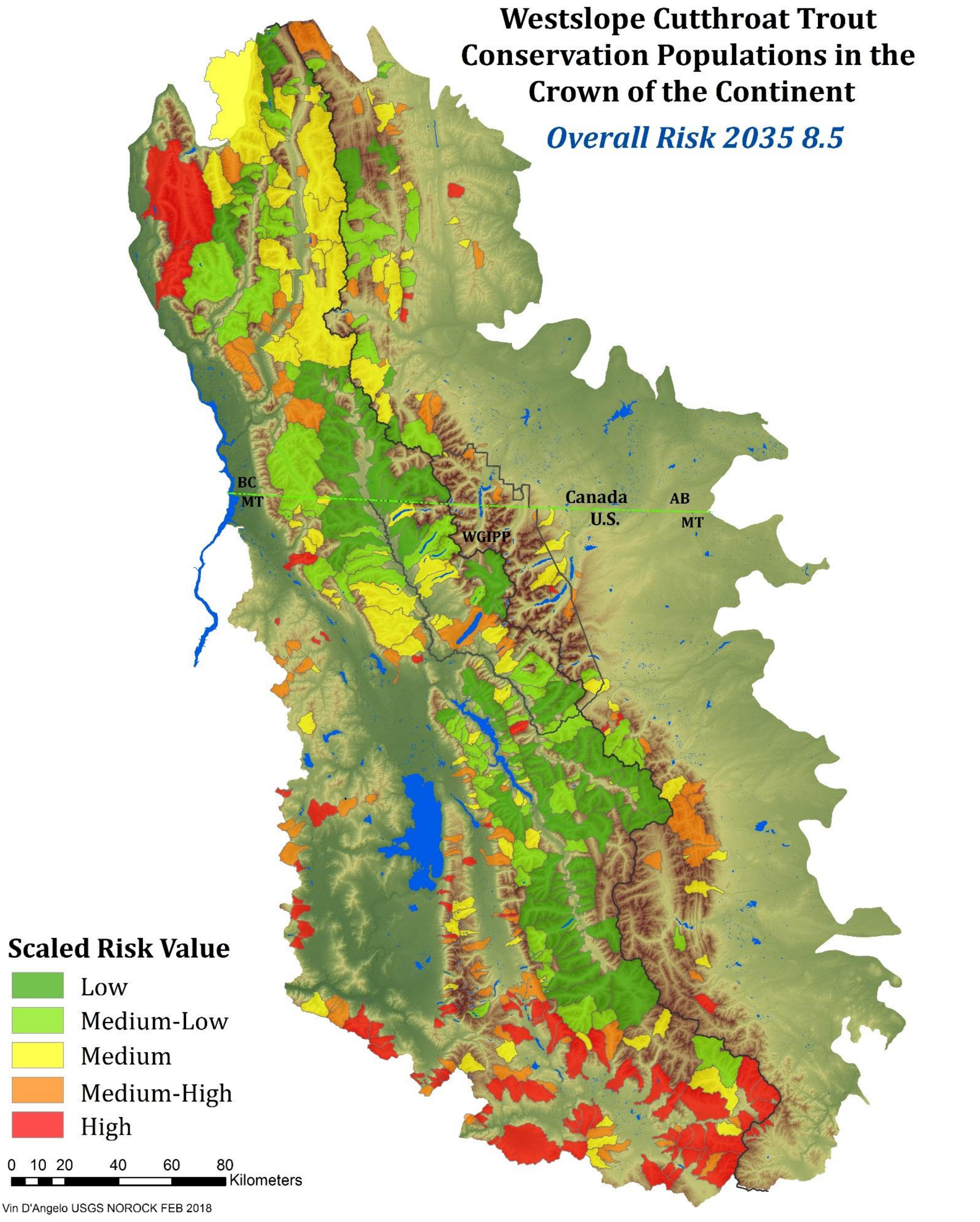
Habitat Risk 2035 8.5



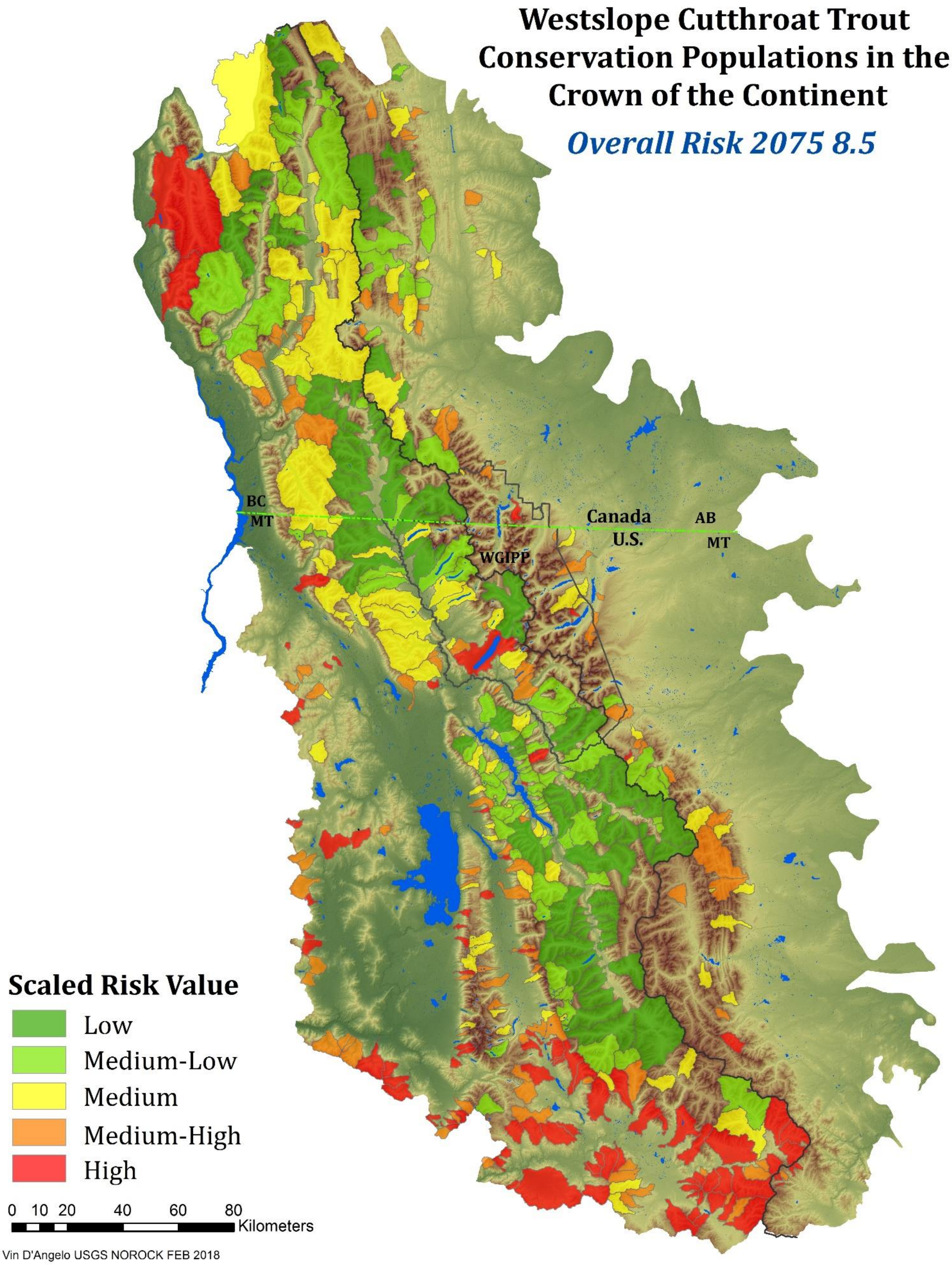


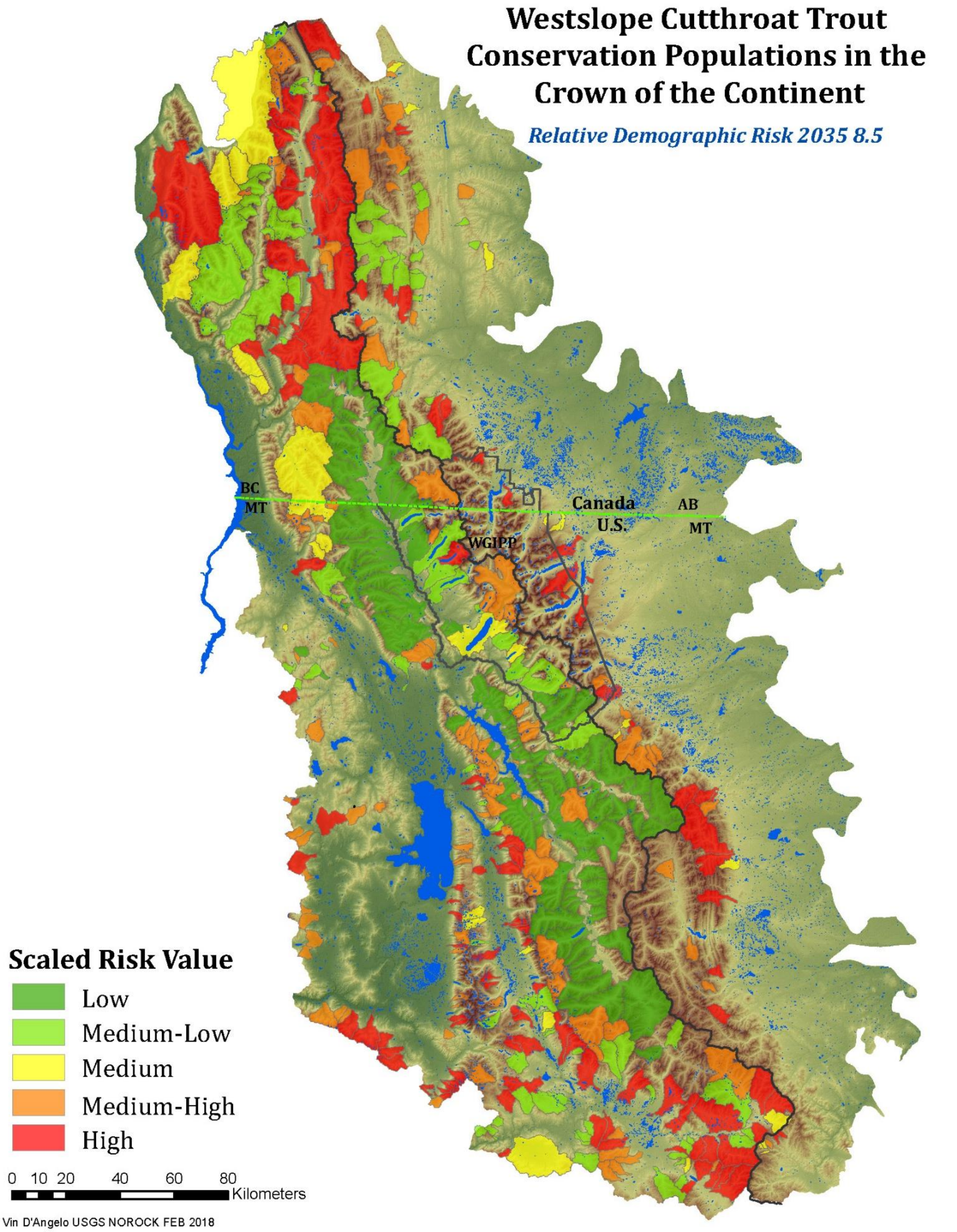
Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Overall Risk 2075 4.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018

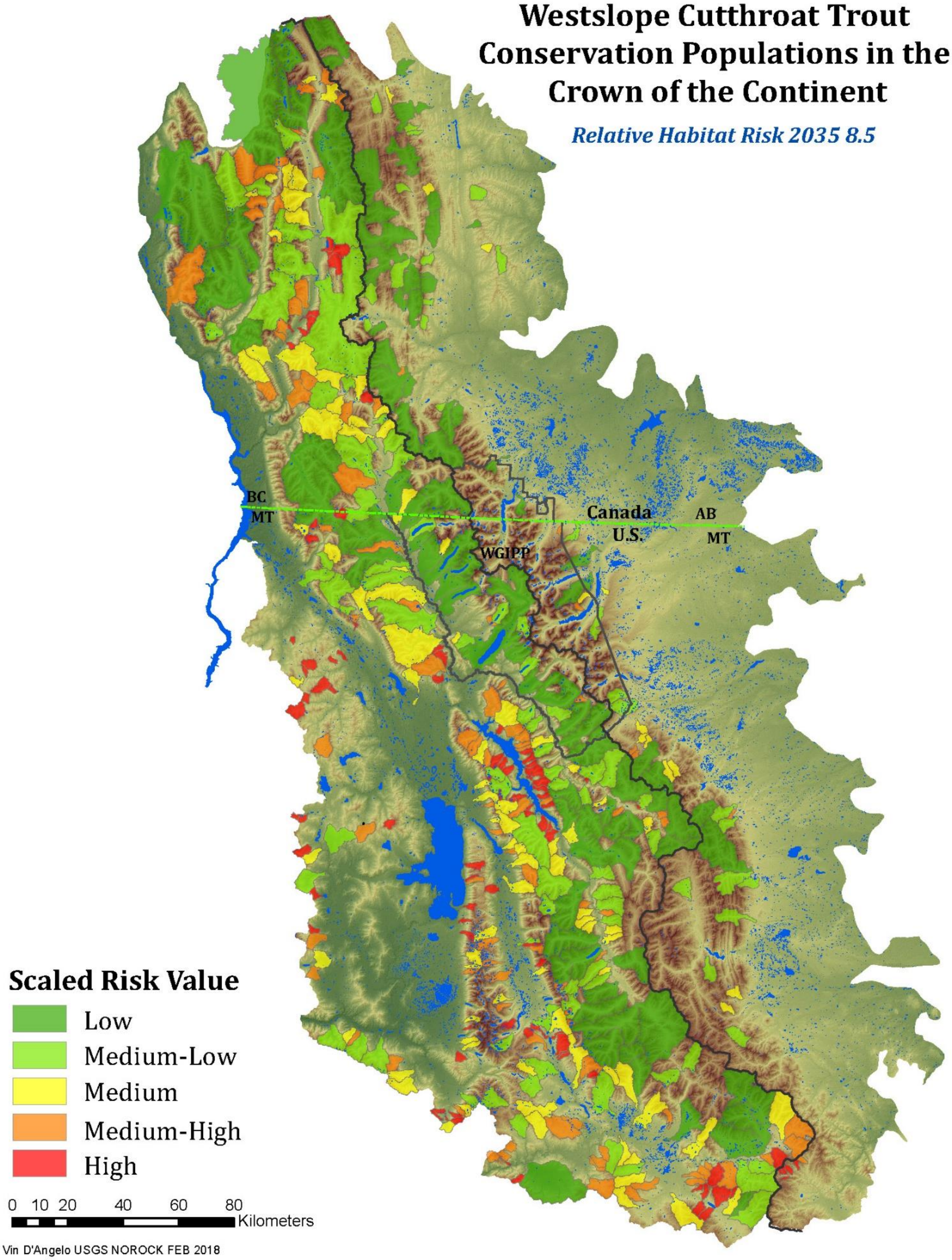

Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Overall Risk 2035 4.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018

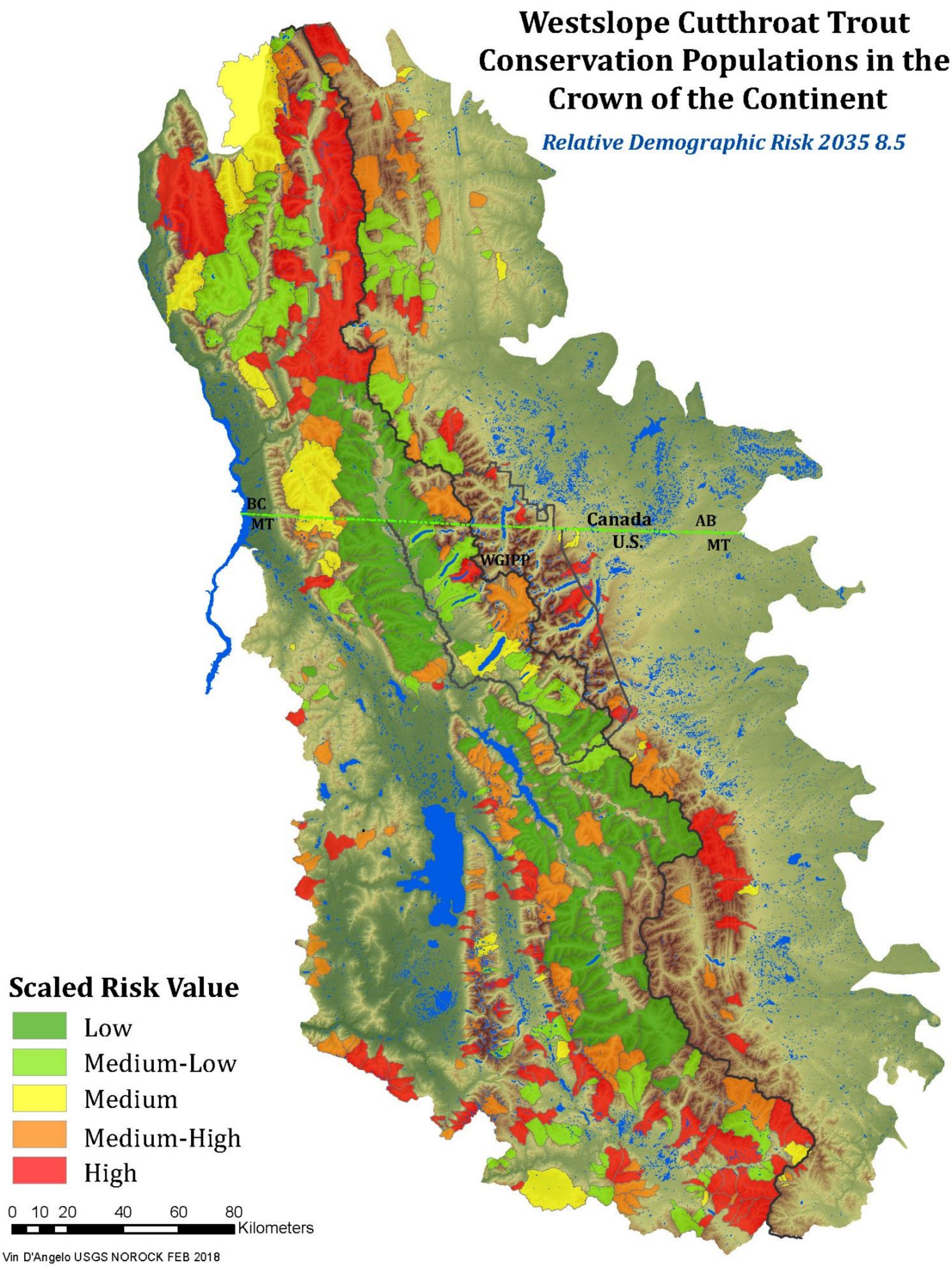


Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Overall Risk 2035 8.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018


Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Overall Risk 2075 8.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018


Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Relative Demographic Risk 2035 8.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018


Westslope Cutthroat Trout
Conservation Populations in the
Crown of the Continent
Relative Habitat Risk 2035 8.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018


Westslope Cutthroat Trout Conservation Populations in the Crown of the Continent
Relative Demographic Risk 2035 8.5
BC
MT
Canada
U.S.
AB
MT
WGIPP
Scaled Risk Value
Low
Medium-Low
Medium
Medium-High
High
0 10 20 40 60 80
Kilometers
Vin D'Angelo USGS NOROCK FEB 2018

4. Policy opportunities

The 2014 workshop featured a panel of experts from across the Canadian and American sides of the Crown of the Continent ecosystem who were able to highlight the major policies – state, federal, provincial, and tribal – that provide the basis for their management of native salmonids. By country, those policies are:

United States	Canada
Endangered Species Act (ESA)	Species at Risk Act (SARA)
ESA Bull Trout Recovery Plan	Fisheries Act
The Wilderness Act	Environment Protection and Enhancement Act
Northwest Power Act of 1980	Public Lands Act
National Forest Management Act and Planning Rules (1976)	Water Act
Critical Habitat for Bull Trout (2010)	Alberta Fishery Act
Collaborative Forest Landscape Restoration Act (2010)	Alberta Lands Stewardship Act
Forest Planning Rule (2012)	----
Confederated Salish Kootenai Tribes' Hellgate Treaty of 1855	----
Confederated Salish Kootenai Tribes' Fisheries Management Plan	----

5. Clarity around jurisdictional priorities

Similarly, another panel of Canadian and American experts clarified their jurisdictional mandates and the ways in which these mandates shape their work and management of native salmonids at the 2014 workshop. A summary, by management jurisdiction, includes:

Managing agency/ entity	Mandate
Canada and the United States	Multi-agency collaboration across multiple jurisdictions
Canadian Provinces	Management of fisheries populations
Canadian Federal government	Ultimately regulates fisheries habitat
Canadian and U.S. federal governments	SARA/ ESA require recovery plans; is illegal to damage critical habitat
Confederated Salish Kootenai Tribes, U.S.	Rights to allow CSKT to fish on Flathead Reservation along with jurisdiction and autonomy to set and regulate fish management on their lands
Glacier National Park; U.S. Dept. of Natural Resource and Conservation	Habitat Conservation Plans
Montana, Fish, Wildlife & Parks	Statute authority to manage fish in the state of Montana; protect native species for future generations; and improve hunting and fishing

U.S. Forest Service	Multiple use agency with mining, timber, recreation, and economic demands, along with mandate to maintain species habitat and diversity

6. Learning from managers: Prototype projects and management actions

Both the 2014 and the 2018 workshops included a particularly exciting set of talks and panel discussions focusing on examples of climate adaptation strategies and tactics for native salmonids across the region. Intentionally designed to maximize sharing of effective new prototypes and management actions for salmonids, each presentation was followed by discussion with workshop participants to maximize shared learning.

Given the importance of sharing lessons learned and facilitating discussions about the effectiveness of specific management strategies and actions over time, we have chosen to include summaries of this work from both the 2014 and 2018 workshops here.

2014 presentations included:

Brad Shepard (Wildlife Conservation Society), who shared a long-term approach underway in the Greater Yellowstone ecosystem by the Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group. Brad outlined the methods they used to define Geographic Priorities using the following methodology:

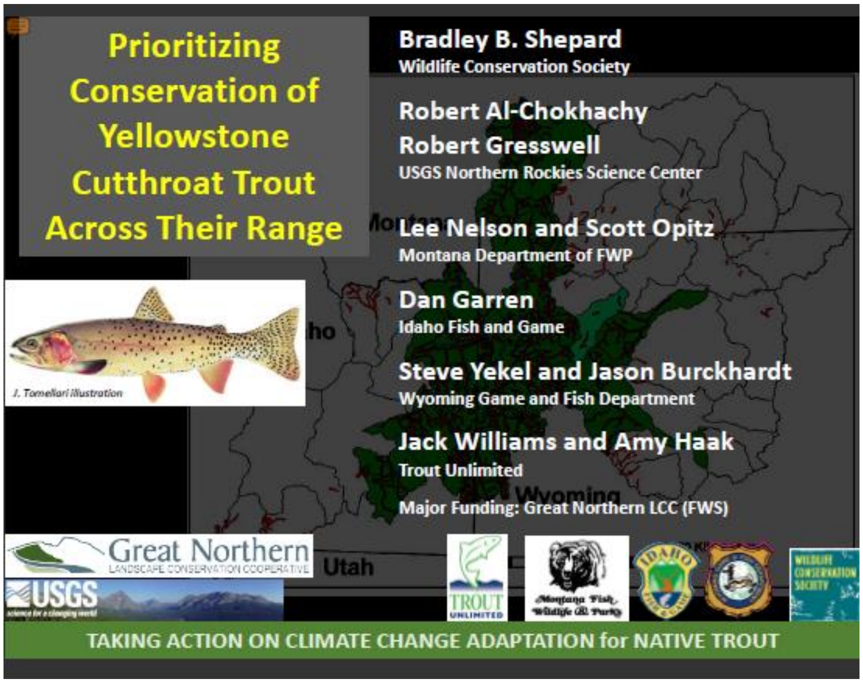
1. Identify Conservation Populations
2. Prioritize river basins
3. Prioritize populations
4. Identify threats
5. Prioritize actions

He noted that opportunity drives a lot of what can be done in the terms of conservation and consequently they developed the following Opportunity Criteria: (1) reduce threats to existing conservation populations; (2) take advantage of private landowner conservation; (3) develop local/regional support for conservation; and (4) develop a cost benefit analysis.

Their partnership also applied the Management Goals of Representation, Resilience and Redundancy to their collective work. Their Conclusions (see below slides) were:

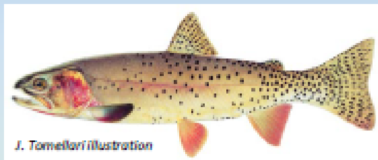
- Prioritize conservation across a species entire range
  - Must have both managers and field level biologists involved
  - Apply consistent criteria
- Use a hierarchical process (river basin, population actions)
- Nonnative species represent one of the biggest threats to Yellowstone Cutthroat Trout throughout their range.
- Crown is super critical for WSCT for both the US and for Canada; i.e. therefore every river basin in the CCE is a high priority;

- Crown is really critical in the US for bull trout, although the Crown portion of their distribution in Canada may not be critically important to Canadian managers because this species is so widespread across Canada.



Methods

ID Cons Pops → Prioritize Basins → Prioritize Pops → ID Threats → Prioritize Actions



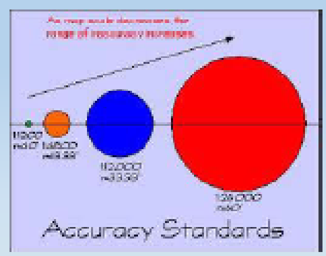
- Prioritization
  - Ecological
    - Representation
    - Resilience
    - Redundancy
  - Opportunity
    - Support
    - Expand or Secure

WILDLIFE CONSERVATION SOCIETY

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

WILDLIFE CONSERVATION SOCIETY

Broad Observations

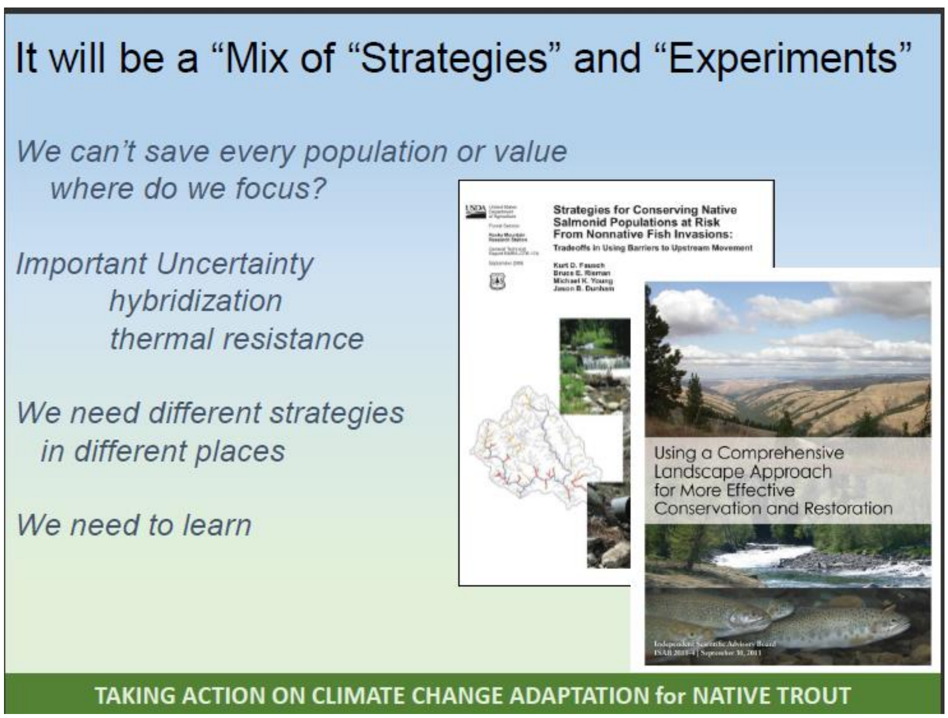


1. Scale matters
   - Space, time, taxonomic/ecological
   - Science and management
2. Manage uncertainty
   - Portfolio (diversity) *(Figge, Schindler, Haak and Williams)*
   - Information-based process
   - Learn from management
3. Different strategies for bull versus cutthroat
4. Commitment and collaboration
5. Prioritize

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Bruce Rieman (Clearwater Resource Council and an Emeritus U.S. Forest Service fisheries biologist) shared the following learnings and ideas:

- Vulnerability analysis and other new science tools are important but only one piece of the challenge. **Priority**= vulnerability x conservation value x feasibility
- Conservation values need to be clear they are at least three fold: evolutionary legacy; ecological function (role of species, ecological processes, evolutionary potential); and socioeconomic. Concern over hybridization is only one element
- Feasibility: What will it take to actually have an effect at the level of a complete population? (Can enough be done to be successful; can we afford it; can we focus in a few key populations rather that spreading our effort out; is it sustainable)
- Sustainability? Are natural processes being restored, are we creating populations that will be resilient or will we be committed to maintaining them into the future.
- Feasibility and Resilience have important tradeoffs with intentional isolation:
    - Do we increase productivity or reduce it?
    - Do we maintain spatial structure or reduce it?
    - Do we maintain or re-create life history diversity or reduce it?
    - Do we expand population sizes or reduce them?



Connie Simmons (Oldman Watershed Council) talked about ongoing efforts to:

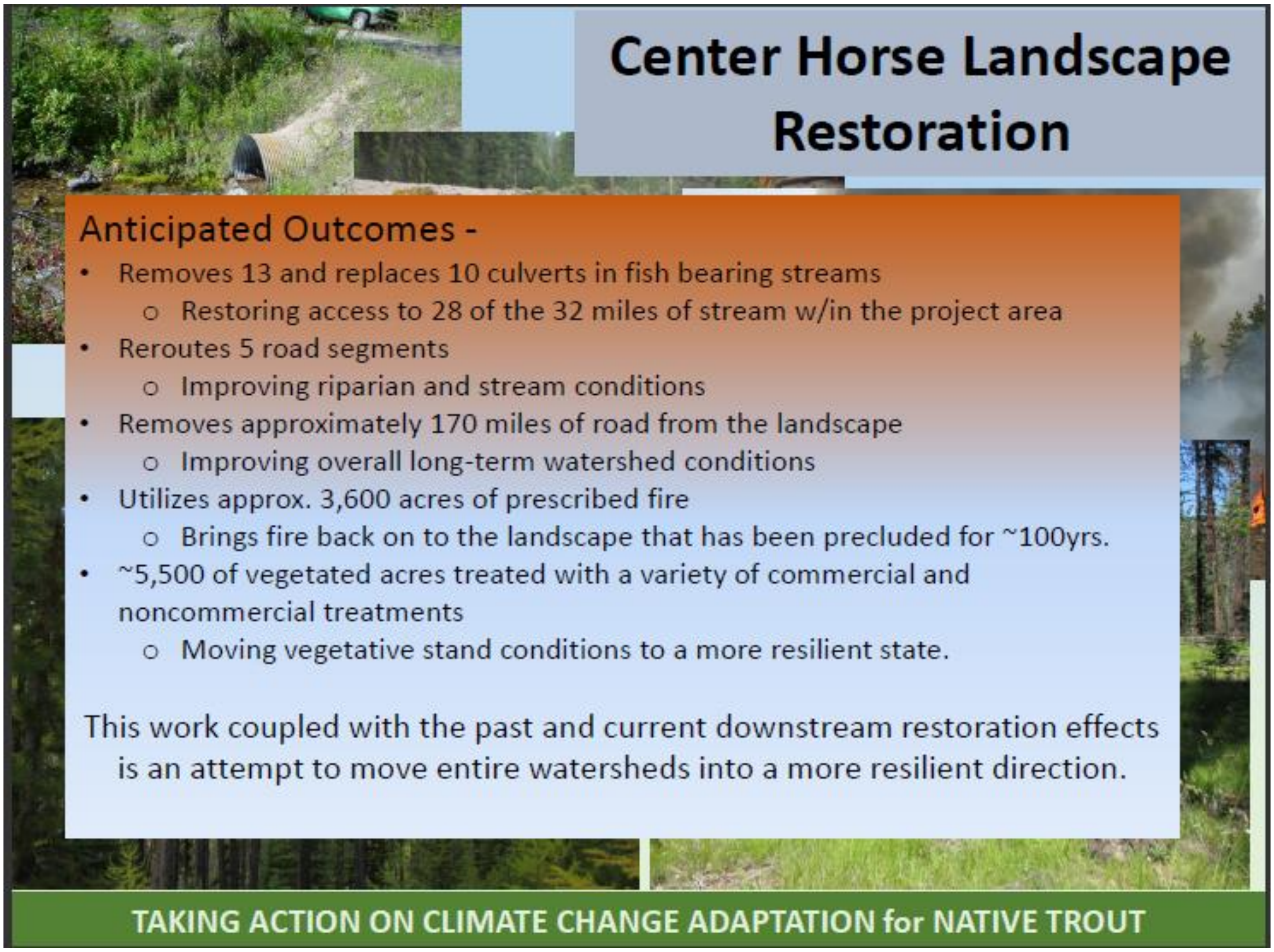
- Build community engagement, and bring collaborative partnerships together in the Oldman;
- Improve understanding and increase acceptance about what has to be done in headwaters;
- Ensure that public engagement occurs as a key part of these projects;
- With an ultimate goal of maintaining current and native fish populations and increasing their range, etc.

- Effectively and creatively address conflicts with the recreational community;
- She described their work to use Dutch Creek as an educational project to prototype solutions to these challenges.

Shane Hendrickson (U.S. Forest Service, Seeley Lake District) discussed the Center Horse Landscape Restoration: one project of the Southwestern Crown project under the federally-funded Collaborative Forest Landscape Restoration Program (CFLRP):

- This is a mid-scale planning effort: 60,000 acres;
- The Forest Service owns a lot of the headwater areas, but needs to collaborate;
- Cottonwood does not have a stable population of bull trout;
- Landowners have done a lot of restoration efforts below the forest boundary.
- This provides a window into the work that is already going on in the watersheds;
- Currently in middle of a National Environmental Policy Act (NEPA) process. Writing effects;
- Project goals include: improve and restore forest composition; improve restore fire adapted ecosystems; improve water quality, restore or enhance fish and wildlife habitat; decommission 170 miles of roads, upgrade culverts; reintroduce fire, road closures, thinning of forest (see below slide).

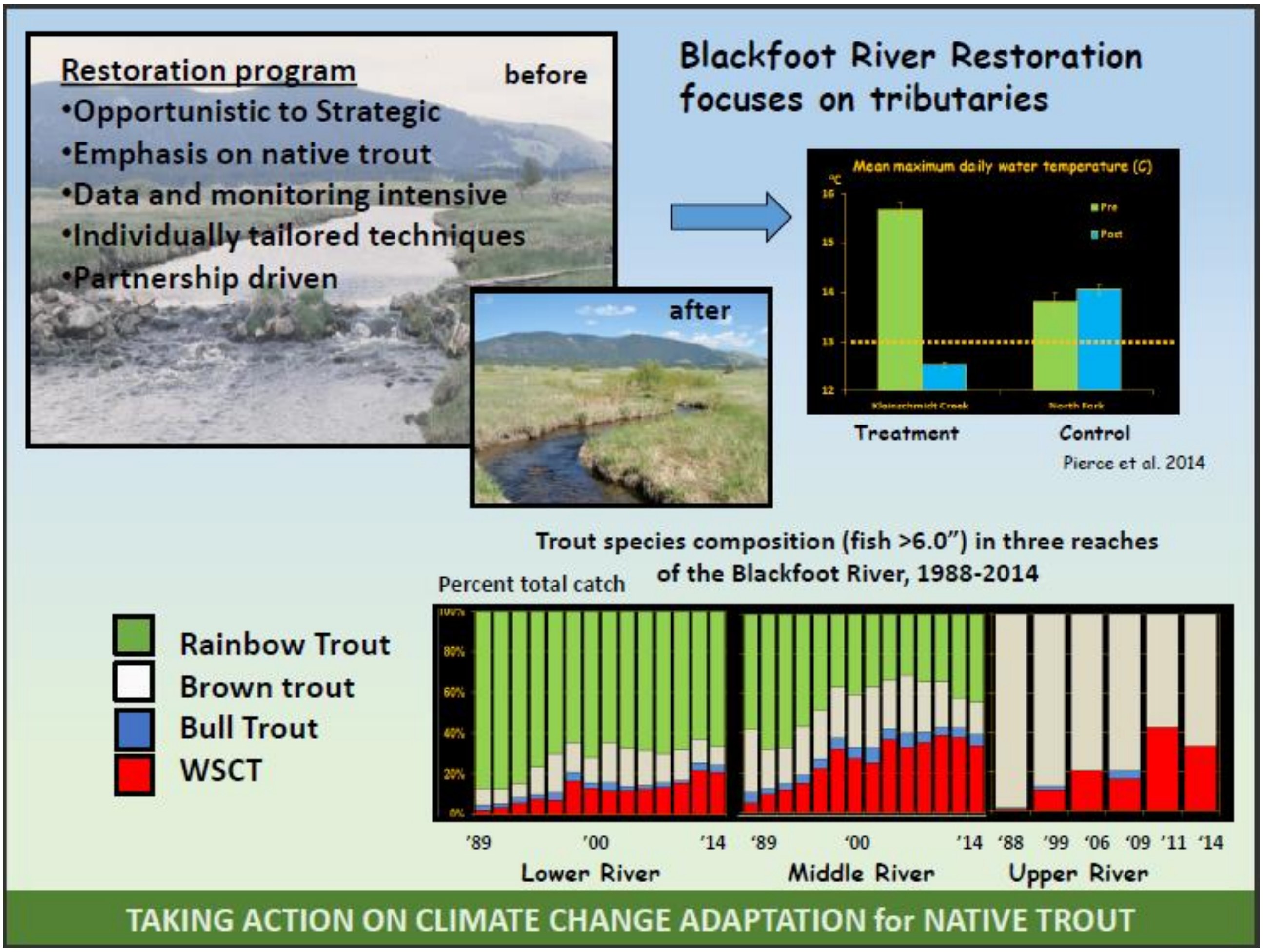
- Embedded in the landscape are important lands/salmonid habitat acquired by the Nature Conservancy through the Montana Legacy Project.



Ron Pierce (Montana Fish, Wildlife & Parks) talked about the results of decades of work and investment in the Blackfoot River Basin in Montana, where there are many partnerships with a long history of work together:

- The Plum Creek Timber Company is no longer a landowner in the Blackfoot due to the Montana Legacy Project;
- A basin-scale project for the Blackfoot River was initiated in 1988; the restoration program focused on:
    - native salmonids
    - conducting many surveys and collecting data with intensive monitoring;
    - was partnership driven;
- Outcomes included reconstructon of a spring creek using groundwater influence, which resulted in significant decreases in stream temperatures;
- Stream restoration and regulation occurred at the same time;
- WSCT habitat occupancy in this area went from 1% to 30-40% over time (see below slide);
- Nonetheless, upstream of private land, many hybrid forms of WSCT exist;

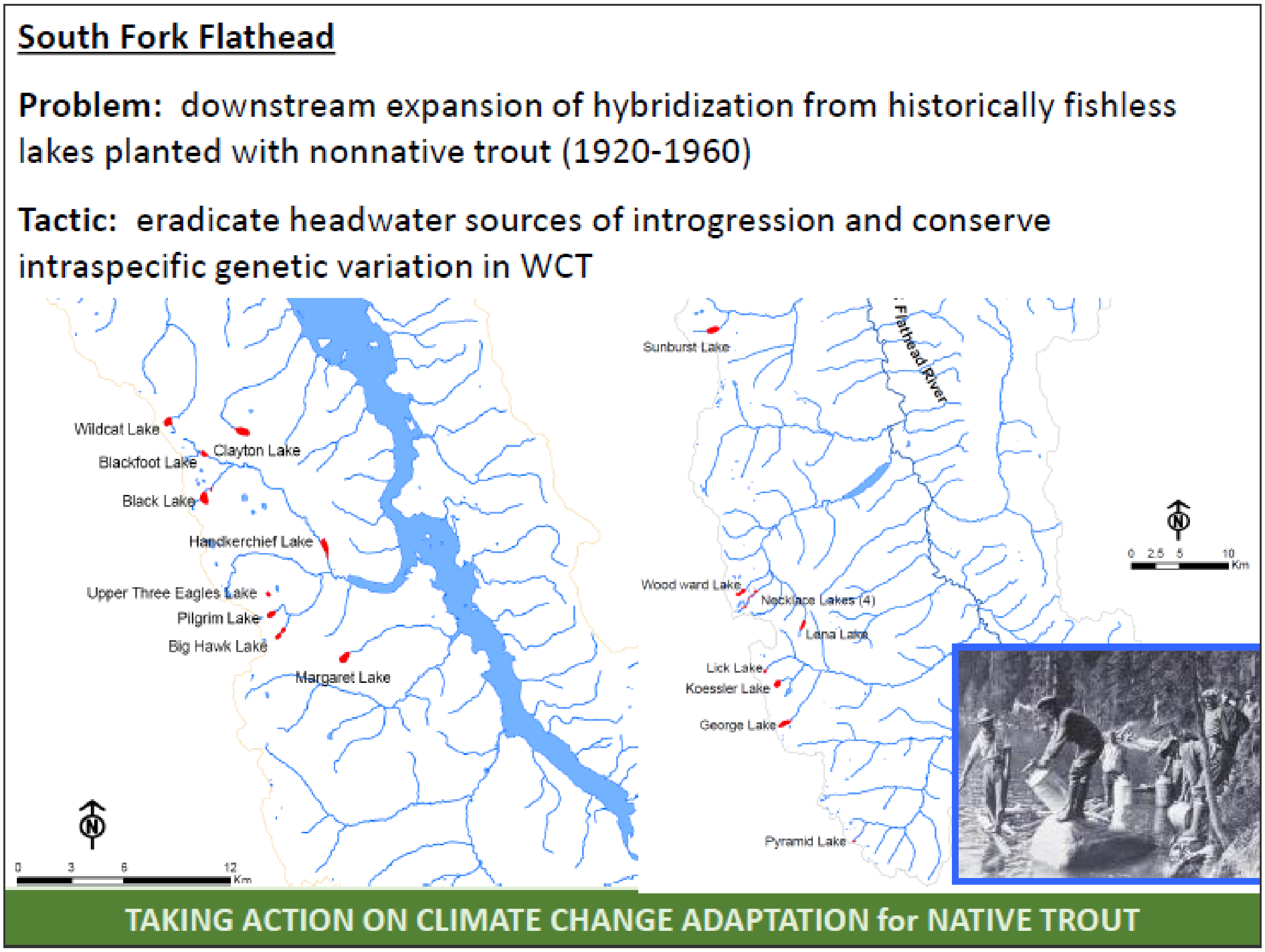
- This is the #2 migratory stream for bull trout in the basin but ends at a waterfall barrier - with great habitat upstream of the barrier.



Matt Boyer (Montana Fish, Wildlife & Parks) discussed some of their ground-breaking work on WSCT conservation in the Upper Flathead, which is an extremely high ecological priority for the agency:

- A substantial portion of the watershed lies within a designated Wilderness area (which significantly limits the types of management that can be used);
- Found a funding opportunity through Bonneville Power Administration;
- Good working relationships with partners were key;
- Were attempting to address an upstream expansion of rainbow trout hybridization with WSCT and subsequent loss of WSCT (i.e. genomic extinction). Tactic taken was mechanical removal of spawning adults and relocation to a closed-basin fishing pond;
- Documented a 60% decline in CPUE, a decrease in the rate of rainbow trout expansion, promoted population resiliency by maintaining watershed connectivity (keep migratory life history forms and allow for habitat re-colonization);
- South Fork Flathead: issue here was a downstream expansion of hybridization from a historically fishless lakes. Tactic was to eradicate headwater sources of invasives (see below slide).

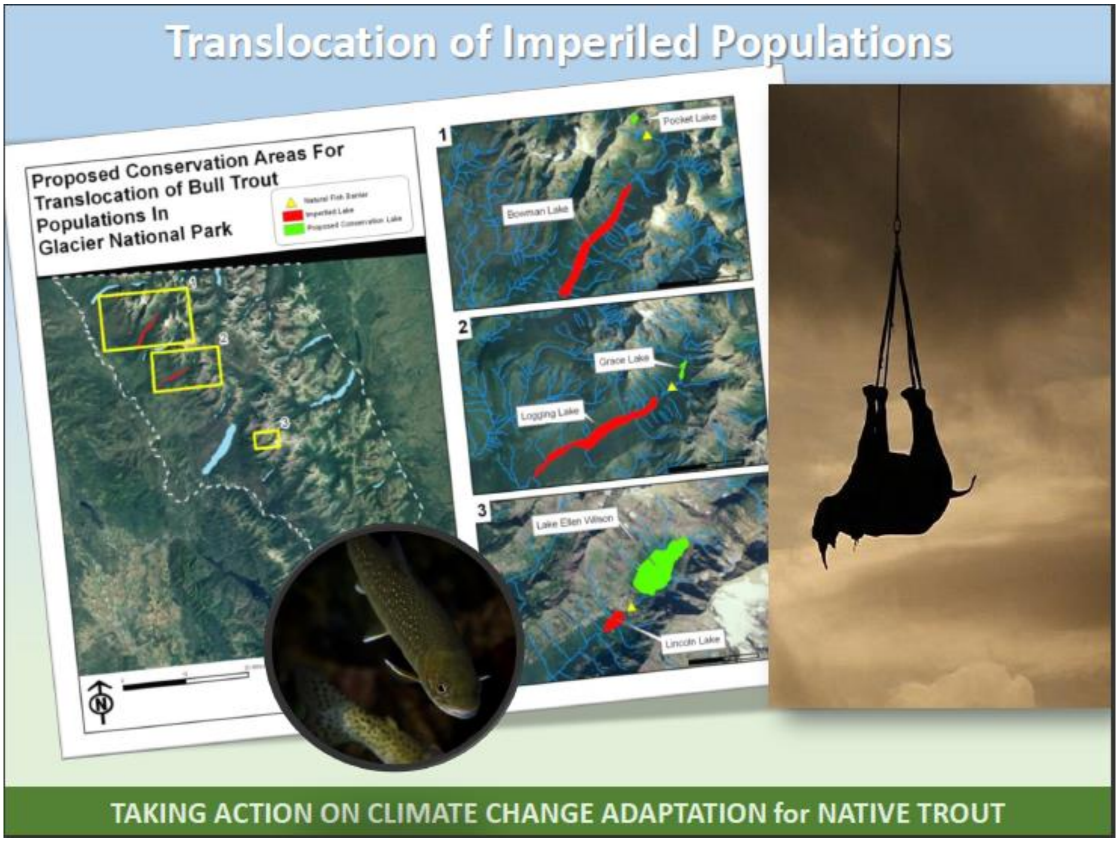
- Outcomes: Secure native WSCT population in headwater refugia, used multiple and genetically divergent source populations for restoration.
- Take home lessons included fact that habitat is extremely important. Adaptation strategies need to keep an eye on genetic conservation to promote adaptive capacity.



Chris Downs (Glacier National Park, National Park Service) discussed their work to manage the problem of invasive lake trout in Glacier National Park:

- 9 of 12 bull trout lakes in the Park have been invaded; 5 are secure;
- Lake trout are trumping climate change impacts in Glacier NP;
- Looking to create areas of refuge for bull trout. Rapid switch in the last 30 years;
- Successful lake trout suppression efforts in Quartz Lake. Has been done in Lake Pend Oreille;
- Need to realize costs of efforts. Getting better and putting more effort into catching lake trout; Harder to catch adult lake trout;
- Deep, cold systems with no place for the fish to hide. Need to hit from the juvenile and adult stages;
- Results: declining catch rates for lake trout overall, declining size structure of adult lake trout, and a record bull trout red count in 2014;

- Want to prevent any additional lake trout adult from entering the system;
- Work involves translocation of imperiled populations;
- Currently translocating juvenile bull trout in to Grace Lake. Suitable habitat for bull trout. This is a salvage operation (see below slide).



Finally, Lorne Fitch (Alberta Cows and Fish) talked about beaver reintroductions as tool for restoring steam habitat; which is known to reduce vulnerability and increase resilience to climate impacts:

- Beavers increase soil water interface and groundwater storage, enhance downstream flow, dampen flooding effects, alleviate downstream water temperature issues;
- But regional and local beaver populations are low;
- Beavers play a critical role as a keystone species of biological diversity;
- How can we move from a landowner-perceived problem to where a place where communities see beavers as an advantage: i.e. where can they be successfully re-located?
- Extremely important to explore habitat suitability before reintroduction efforts occur;
- Impediments to re-establishment of beaver on the landscapes include:
    - Population resistance
    - Landscape resistance – streams are incised, no woody vegetation, recurring drought or flooding, blockages, excessive stream gradients
    - Mortality resistance – high predation, road crossing mortality, predation and harassment from pets

- Social resistance- removal of dams and lodges, lack of tolerance, concerns over effects on fish. Beavers are often viewed as a nuisance and need a makeover of their image
- Policy resistance- lack of policy on beaver relocation,
- Beaver reestablishment must be part of a viable long-term restoration strategy.

2018 presentations included:

Ryan Kovach - *United States Geological Survey*
Ryan Kovach 's update focused on the data that he compiled and reviewed to inform the vulnerability assessment used in the SHEDS tool. He found that climate change plays a significant role in hybridization and that a decrease in May precipitation is linked to increasing hybridization of native salmonid species. This hybridization leads to a decline in the fitness of native trout in the wild. Ryan added that climate change is not the only negative factor affecting these fish populations, which also includes invasive fish species and the impacts on roads (through sediment) and habitat fragmentation. Bull trout have especially been negatively impacted by these factors because the most important variable for them is habitat availability. Between invasive fish taking over large portions of the bull trout's habitat, and roads frequently crossing streams and adding increased sediment loads to crucial bull trout habitat, the species is facing a significant suite of threats that have created real urgency in the need for immediate management interventions.

Question and answer session:
Q: Are you averaging out the most critical impacts? If you find a low habitat score, that will be the factor that kills the fish.
A: Everything will be ranked. You can see where the highest risks will be.

Q: What is the ability to expand the assessment outside of the Crown?
A: If there are data, it can be done.

Q: Population size is not included for cutthroat, why?
A: We do not have the data; but we could do this if we did.

Q: Have you documented the data gaps during your process?
A: We have a lot of good information but we will always have some data gaps. We are currently using Ryan's model to estimate the gaps.

Q: What is the smallest scale that the model is functional at?
A: This can be done at any scale.

Benjamin Letcher - *U.S. Geological Survey*
This presentation focused more heavily on the data used in the SHEDS tool. Letcher explained that the tool's purpose was to bring data sets and models to people in an interactive and easy to use way, which can then be used to prioritize areas for management. The key features of the tool were found to be spatial aggregation and filtering, as well as the ability to move from catchments up to the HUC 8 scale. The catchments, which are color coded by mean summer temperature, can be filtered based on

criteria that the user finds important, such as climate change effect or overall threat level. Letcher closed the presentation by saying that it is a work in progress, and that they still need to identify how variables change across patches, correlations among variables, and patches that meet the criteria but that they are looking forward to hearing managers' reactions and requests as they begin to test these tools out.

Sam Bourret - *Montana Fish, Wildlife and Parks*
Bourret's presentation focused on innovative and ground-breaking management projects around Flathead Lake that have been developed to protect and improve the survival of the Flathead westslope cutthroat trout. In the Flathead area, they have seen a decline in westslope cutthroat trout due to habitat fragmentation and hybridization. There is a current initiative to protect the south fork Flathead westslope cutthroat trout by removing non-native trout. They are also considering the use of piscicides and genetic swamping to wipe out these invasive fish. In the meantime, they are stocking genetically pure westslope cutthroat trout that have been taken from a local drainage tested for purity.

The key learnings from this work are three-fold. First, it is possible for native trout recovery to be achieved at a landscape scale, with the main ingredients of this scale of recovery effort being the use of adaptive management, a dedicated and passionate staff, and the development of extensive partnerships and collaborations. The second learning is that genetic conservation and angling can go hand in hand if fish are collected at the right time, and fish are stocked soon after the application of piscicides. Finally, it is vitally important to have public involvement to create ambassadors who educate the general public about threats and solutions to native salmonid recovery, dispel myths, and build support for potentially contentious projects.

Q. Genetic swamping was tried in many lakes, but some did not take. Do you know why this is?
A: We are trying to get a better understanding of why this did not work in those lakes, and believe that we will understand more over time.

Q: What is the rationale for anglers being allowed to fish before determining that there is a stable population?
A: We have been stocking with angler-ready fish and some juveniles, so have a variety. This has helped get the public on board with the use of piscicides to eliminate non-natives.

Ryan Kovach – *United States Geological Survey*
Ryan's presentation reviewed the efforts being made for the Westslope Cutthroat Trout in his area. He and his team are experimenting with genetic rescue with the hopes of alleviating the inbreeding depression as a path to increased persistence probability. The concerns associated with this are that it will lead to outbreeding depression and a loss of genetic distinctiveness. There is also the issue of the headwater trout being isolated and therefore inbred, so Kovach is trying to manage for that isolation. He believes that westslope cutthroat trout are ideal for rescue, and they will be monitoring these populations for growth and genetic variation. He stressed that this is a highly innovative and experimental management intervention that they are approaching with great care and thought, and by utilizing the principles and adaptive management.

Shane Hendrickson – *USDA Forest Service*
This presentation reviewed the mandate and formation of the Southwest Crown Collaborative (SWCC), and what has been achieved since then in terms of habitat restoration for native salmonids. The SWCC was formed from funds allotted from the Collaborative Forest Landscape Restoration Act in 2009 that specifically encouraged collaboration and holistic, integrated restoration projects on Forest Service lands. It allowed for budgetary requests of up to $40 million U.S. annually from 2009 to 2019, with funding to be used on projects on National Forest System land only. The SWCC's goal was to restore various natural resources with this money, of which $4 million U.S. could be spent annually on any one project.

SWCC moved forward with restoration projects including land acquisitions, aquatic fish passage, fish barrier installation, road decommissioning and obliteration, and streambank restoration. They have also implemented intensive monitoring around terrestrial impacts on in-stream health. The challenges for the SWCC include the fact that this funding ends next year, and that their restoration projects compete for priority with timber output, recreation, and fire suppression. Hendrickson rounded out the presentation by saying that they need to integrate into the larger social structure.

Q: How do you measure or restore watershed function?
A: Measure sediment, number of stream crossings, etc. Depends on the watershed and how close it is to being restored.

Craig Johnson – *Alberta Environment and Parks*

Craig Johnson with Alberta Environment and Parks gave on overview of the efforts being made with native trout recovery and management in Alberta. They are working on recovery plans for many of Alberta's native fish species, and trying to understand threats, as well as the strategies to mitigate those threats.

Non-native fish were stocked in Alberta early on, so one of the goals for Johnson is to determine where the hybridization levels are currently in light of that initial stocking. He also is hoping to get people comfortable with the idea of recovery stocking, which would require a negotiation of federal laws. The following needs and goals would significantly improve the potential for the recovery to succeed in his opinion:

- Work closely with partners in Montana
- Develop a Fish Sustainability Index
- Standardized fisheries management system
- Have a Species Recovery Plan

- Cumulative effects models
- Push the system where it is not support recovery of native trout
- Engage stakeholders to identify both problems and solutions
- Tackle problems in a systematic manner

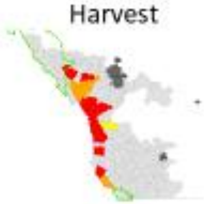
Threats, Mitigation & Tools

Threats

Mitigation of threats

The pieces we are working on

Harvest



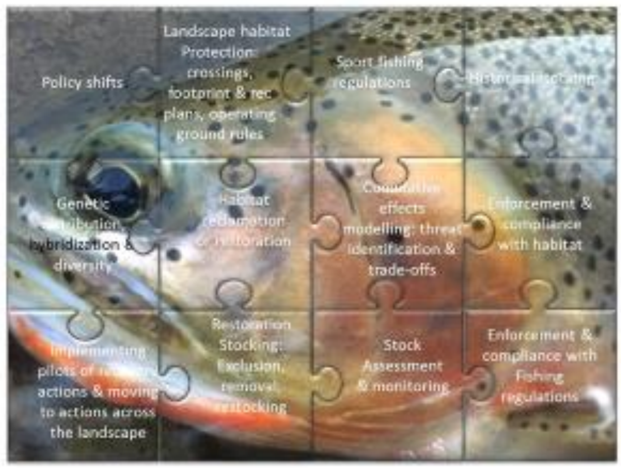
- Minimize mortality
  - angling closures
  - gear restrictions
  - seasonal restrictions
  - effort restrictions

Habitat

- Multiple threats
  - Increase/restrict fish passage
  - recreational access planning
  - forest management planning
  - reduction of sediment through backcountry trails, FISHES, etc.

Hybridization

- Slow, stop, or reverse hybridization
  - Increase/restrict fish passage
  - Barrier construction
  - Restoration Stocking
  - Changes to stocking policy

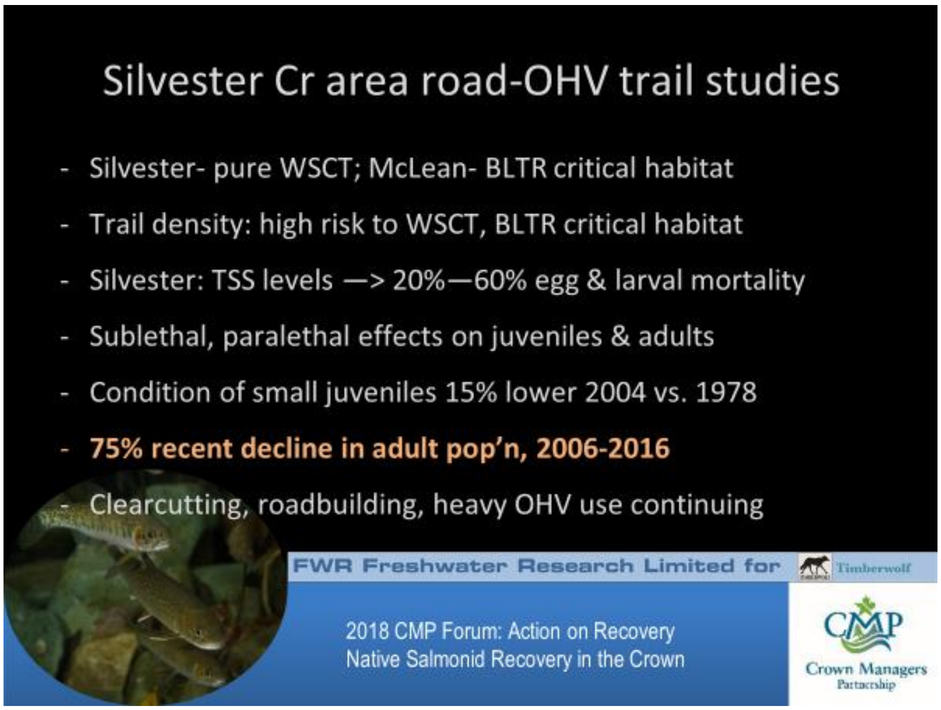


Westslope Cutthroat

Dave Mayhood – *Freshwater Research Limited*

Dave Mayhood gave his presentation on the westslope cutthroat trout recovery projects that Freshwater Research Limited is working on in the Crown. One project is examining the effects of OHV trails on streams, in particular, Silvester creek which is critical habitat for westslope cutthroat trout . The main takeaway from that study was that there is a 75% recent decline for westslope cutthroat trout adult populations in that OHV trail dense area due to trail use and density, clearcutting, and road building which is highly significant in terms of framing up the scale of the threat that massive increases in OHV use pose to native salmonid recovery – especially in Alberta.

Another project looked at the Even Thomas Creek population and found that it had been extirpated in 2017. They plan to take critical habitat threat surveys in the Alberta Native range, and create recovery strategies, action plans, and take legal action to support the native salmonids of the Crown.

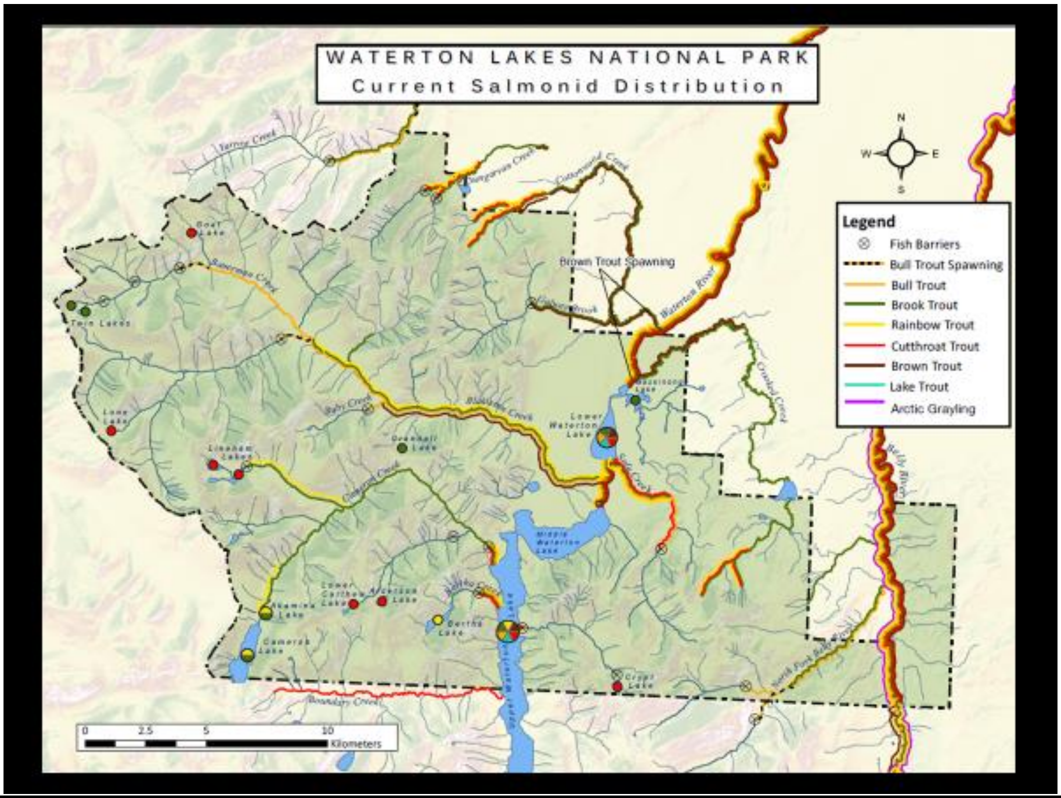


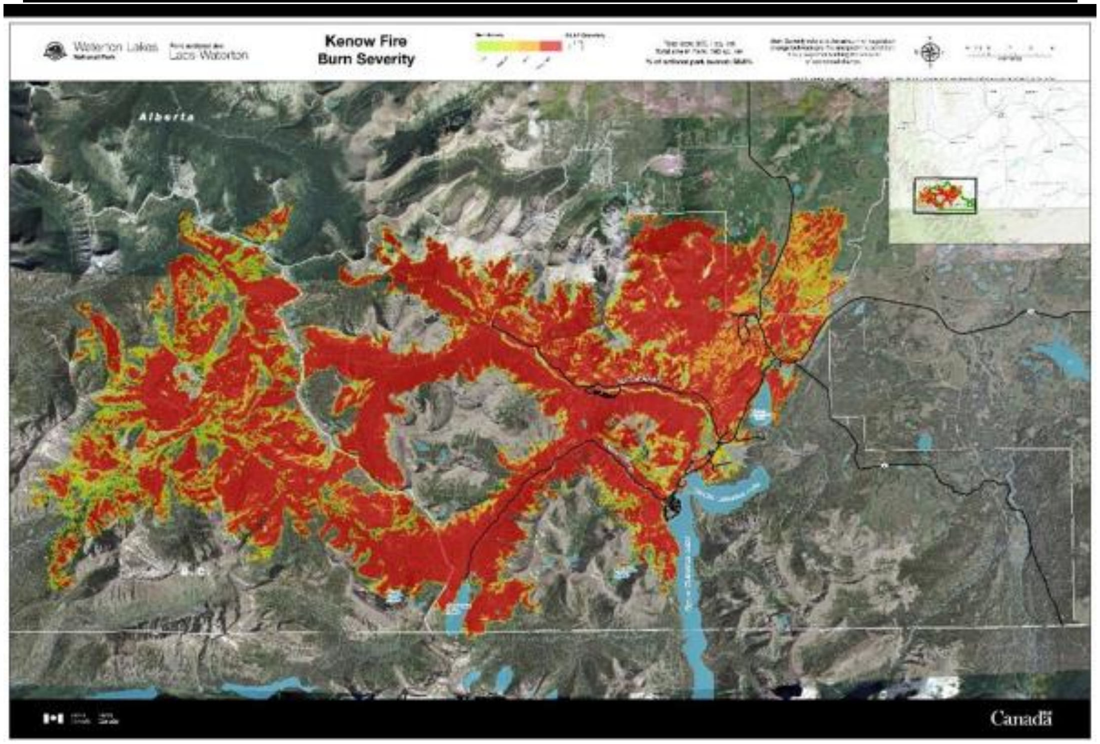
Barb Johnston – *Waterton Lake National Park, Parks Canada*

Barb Johnston gave an incredibly important and compelling overview of the current status of native salmonids in Waterton Lake National Park. Bull trout are almost entirely absent in the main stretch of the Waterton River, but there are some present in Blakiston Creek and the Belly River, while a conservation population of westslsope cutthroat trout persists in Goat Lake.

In 2017, the park was hit with the huge Kenow Fire, which has left much of the park heavily impacted. This was amplified by the fact that so much of the fire burned at high severity.

There are non-native fish present in the pristine habitat of the park, and there is talk of possibly removing them to make room for native salmonids that would thrive in the cold water there. The question becomes what management actions might be best to implement in which areas of the park, and in which order given the current status of native salmonid populations in the park, and the tremendous impacts of last year's fire season across the landscape. Barb stressed that they are in the process of beginning these conversations and that she was interested in hearing from workshop participants on these questions.





Ernest Watson- Fisheries and Oceans Canada
In his presentation, Watson gave an overview of the Species at Risk Act and how he is applying this Act to the populations of threatened and endangered salmonids in Alberta.

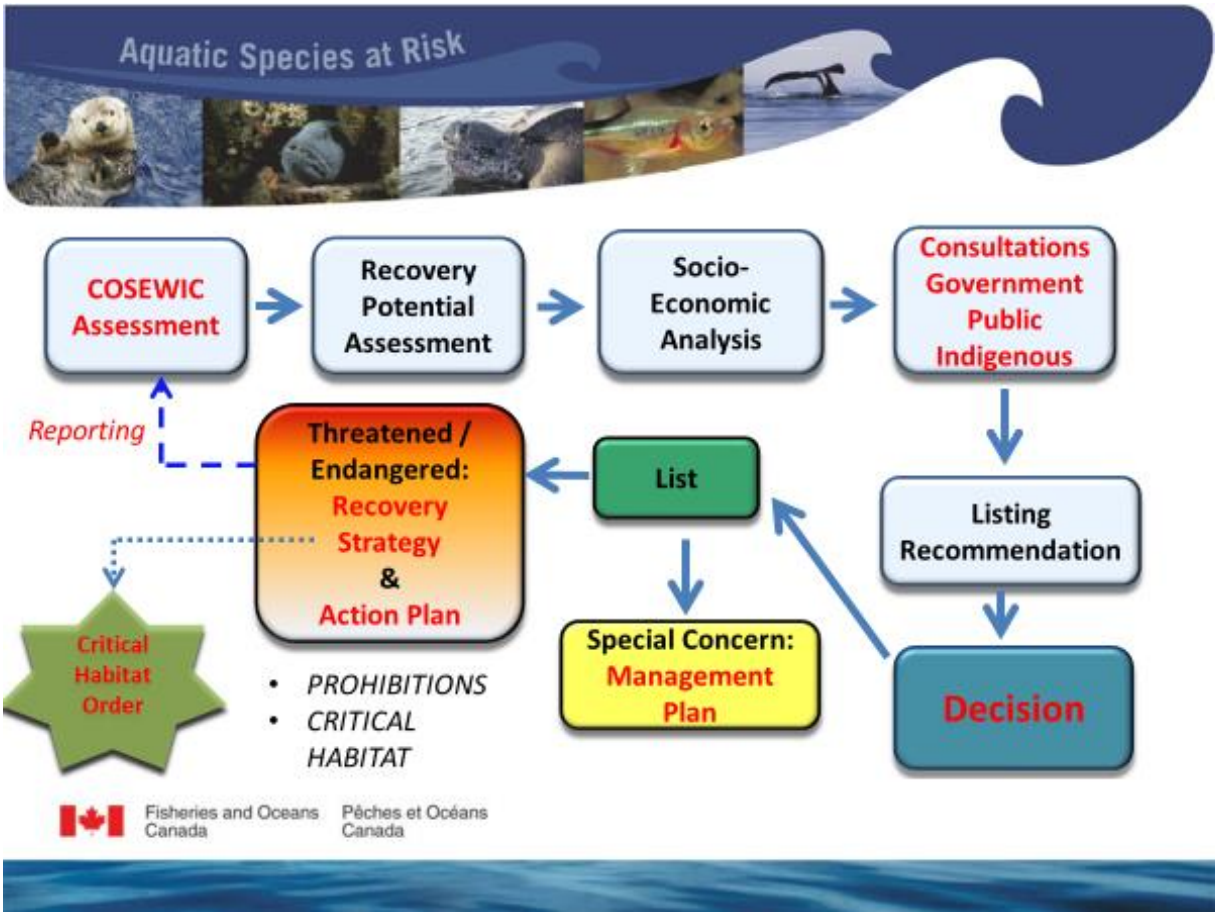
Fisheries and Oceans Canada, Parks Canada, Environment and Climate Change Canada all play a part in the protection of certain species under the Act, while Watson is responsible for species at risk.

He then reviewed the steps taken to decide whether or not a species should be listed as Threatened or Endangered.

Once a species is added to the listing, there are prohibitions in place to prevent killing, harming, possessing, and destruction of critical habitat. The westslope cutthroat trout is listed as Threatened, and in 2014, a multi-agency recovery team was established and a recovery strategy was developed.

The goal for that recovery effort is to protect and maintain a 99% pure species and re-establish pure populations. To support the goal, the Department of Fisheries and Oceans Canada will be doing the following:

- Analyzing tissue samples collected by Alberta Environment and Parks and reporting of genetic status
- Partnering in the development of genetic diagnostic markers
- Supporting AB Agriculture and Forestry's riparian assessment project
- Collaborating in the development of interpretive signage.



Bull trout have been assessed as a Threatened in Alberta, and managers anticipate using the provincial recovery plan to streamline the recovery plan and actions. They are currently developing eDNA markers and collection protocols for bull trout.

Lastly, Watson spoke briefly about Athabasca Rainbow Trout, which have been assessed as endangered in Alberta. They are working with Alberta to identify recovery habitat and historical habitat where there are near pure strains.

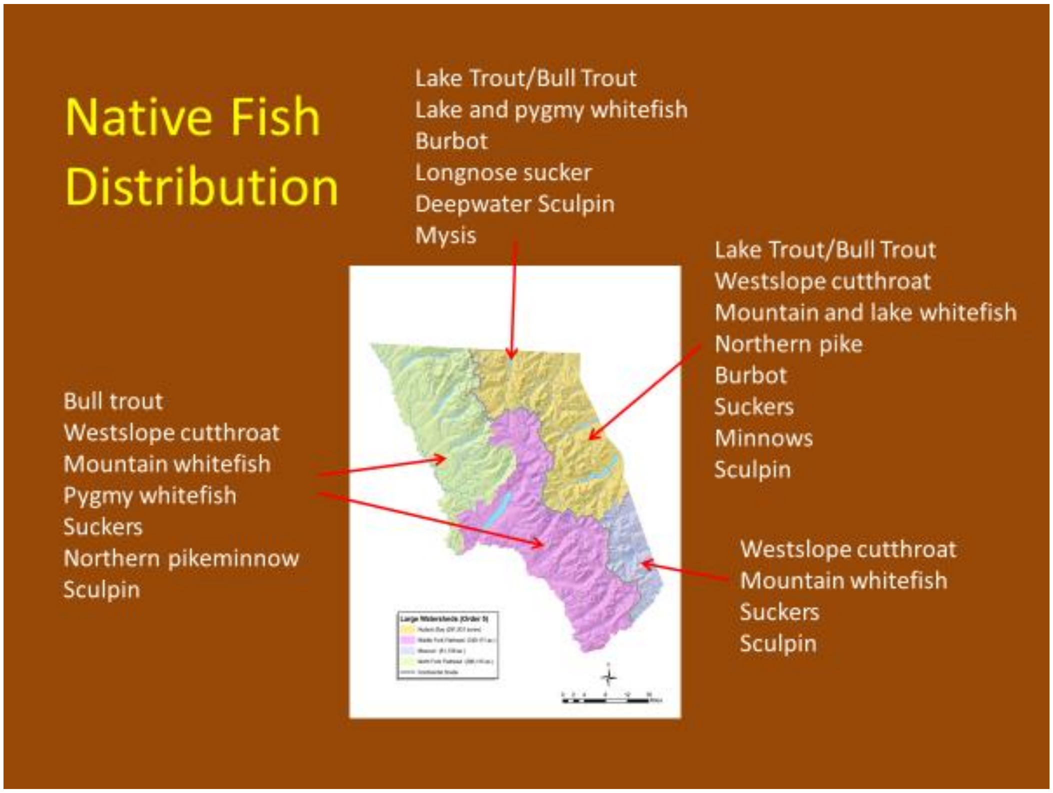
Paul Christensen – Alberta Environment and Parks

Paul Christensen gave an update on what Alberta Environment and Parks is doing to facilitate native trout recovery. Currently, they have a westslope cutthroat trout program and are working with the Athabasca rainbow trout and the Arctic Grayling. There is a lot of angling in Alberta due to large populations, rules on that are open, people come there from Montana and BC to take advantage of it which puts the native trout populations at risk.

They have been using a Fish Sustainability Index to determine suitability of watersheds for the at-risk populations. It also helps make recommendations on recovery actions and has been an inclusive and powerful communication tool.

Chris Downs – Glacier National Park

Chris Downs began his presentation with a background on historic native fish locations in Glacier National Park.



He stated that there will not be westslope cutthroat trout restoration in the Waterton drainage, as they were not naturally there historically and their presence now would be considered a climate change refugia project.

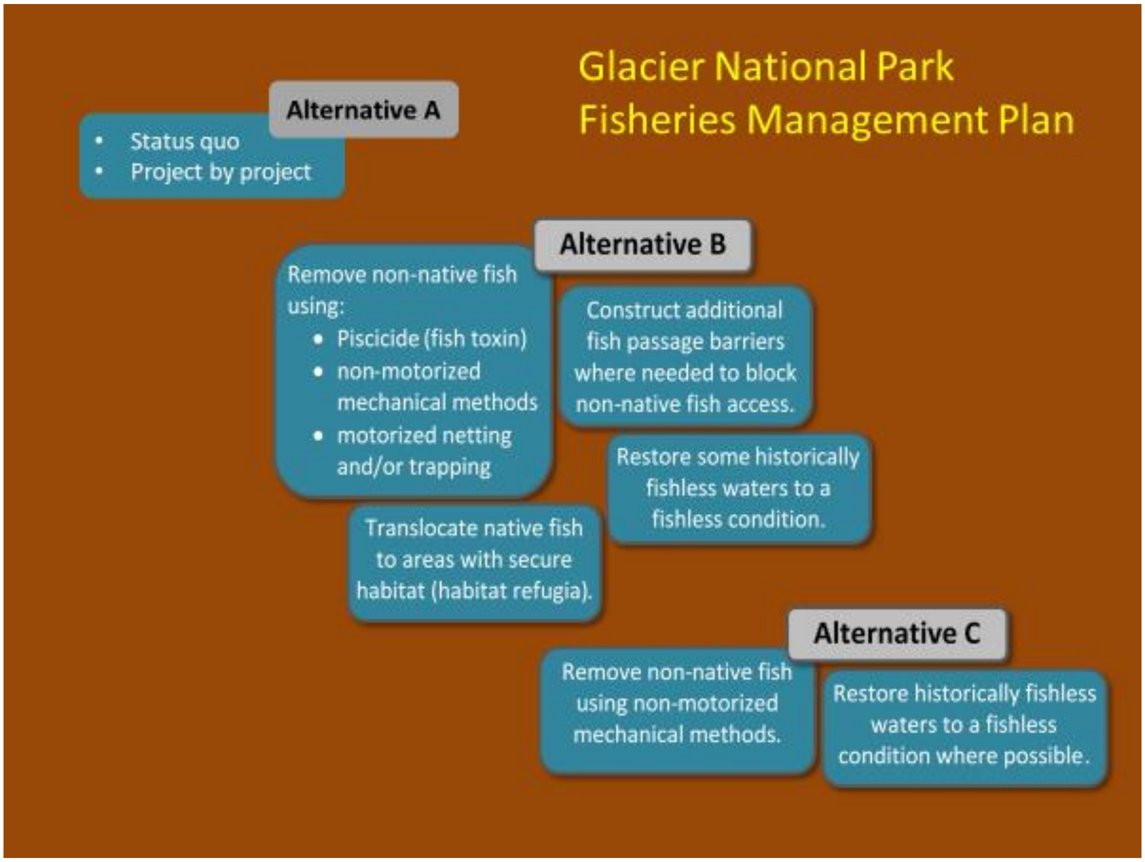
At the Park, they are using an adaptive management plan and an EIA for fisheries management, and believe that to responsibly manage, you need extensive knowledge of the area and the species you are managing to be successful.

The greatest threat to the fish populations in Glacier now is the St. Mary canal water diversion that goes to Canada from the park. There is no screen on the diversion and it has been found that they are losing 22,000 to 31,000 fish to it annually. This is a huge opportunity – and challenge – to change the trajectory of native salmonid recovery efforts in the Crown over the long-term; but is politically difficult: after more than a decade of dedicated work by a collaborative group on this topic, they have yet to break through in terms of finding a path to action with the support of local communities.

Chris then described the tools that are used to manage and conserve the fish populations in the park, which includes:

- Mechanical removal of non-natives in lakes using gill nets. Selective removal in streams, non-chemical;

- Construction of fish passage barriers in the back-country;
- Lake Tout removal and translocation;
- Egg take and conservation rearing.



7. Partnership opportunities and learning networks

Opportunities and learning networks across the Crown of the Continent include:

- Alberta Conservation Association
- Alberta Culture and Tourism
- Alberta Energy Regulator
- Alberta Environment and Parks
- Alberta Wilderness Association
- Big Blackfoot Chapter of Trout Unlimited
- Blackfeet Fish and Wildlife Department
- Blood Tribe Land Management
- Clearwater Resource Council
- Confederated Salish Kootenai Tribes
- Cows and Fish
- CPAWS Southern Alberta
- Crown Adaptation Partnership
- Crown Conservation Initiative

- Crown Managers Partnership
- Crown Roundtable
- Fisheries and Oceans Canada
- Five Valleys Land Trust
- FWR Freshwater Research Limited
- Glacier National Park
- Government of Alberta
- Hatfield Consultants
- Heart of the Rockies
- Millennium EMS Solutions Ltd
- Montana Fish, Wildlife & Parks
- Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group
- Municipal District of Ranchland
- Oldman River Chapter TUC
- Parks Canada
- Riversdale Resources
- Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project
- The Nature Conservancy
- The Wilderness Society
- University of Lethbridge
- University of Montana, Institute on Ecosystems
- U.S. Fish and Wildlife Service
- U.S. Geological Survey Northern Rocky Mountain Science Center
- Waterton Lakes National Park
- Wildlife Conservation Society

8. Identification of Crown-wide priorities for native salmonid at the 2014 Crown-wide workshop + summary of progress on each priority from 2014-2018

By the close of the 2014 workshop, the following short list of priorities for bull trout and westslope cut-throat trout had risen to the top after a ranking process. These included:

- On-the-ground projects that could be scaled up and applied more broadly across the Crown ecosystem, (#1-5);
- Identification of one new tactic that could be implemented as a prototype project (#6); and
- Opportunities for Crown-wide coordination on one climate adaptation tactic (#7-9).

Added to the below list is a brief summary of progress to date on each priority since the 2014 workshop (**as of July, 2018**).

<u>PROJECT #1</u>: Establish coordinated monitoring efforts across the Crown, including standardized protocols, objectives, and a common data repository for both fish populations and habitats.

<u>Progress to date</u>: Although components of this priority exist in the form of on-the-ground monitoring programs for portions of the Crown of the Continent landscape (e.g. Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project (CFLRP) for fish habitat; U.S. Forest Service PIBO monitoring for fisheries habitat), a set of standardized protocols and

databases for the entire Crown has not been created yet. Alberta has adopted the protocols with genetic assessment used in Montana and is currently doing genetic analysis at the University of Montana.
<u>PROJECT #2</u>: Secure the placement of fish screens on existing water diversions, including those on Saint Mary's River and the Belly River. *<u>Progress to date</u>*: Unfortunately, no progress has been made since 2014 – despite the potential for this project to keep thousands of native salmonids in the ecosystem annually - due to the challenges presented by the current implementation plan to pass the substantial costs of adding fish screens directly onto local communities.
<u>PROJECT #3</u>: Replicate, restore and/or translocate native salmonid populations to cold water refugia in priority transboundary watersheds East of the Divide (including the Oldman Watershed). *<u>Progress to date</u>*: No progress to date on this priority on the American side of the Crown. In Alberta, fisheries managers are developing restoration stocking methods and build stocks that can be used to replicate populations. Pilot locations are currently being explored and replication projects through restoration stocking being planned in 2019.
<u>PROJECT #4</u>: Improve and restore native salmonid habitat in headwaters by whatever suite of interventions are appropriate locally. *<u>Progress to date</u>*: **ONGOING**: The multitude of projects either underway or completed for this priority within the Crown continues to grow, necessitating the need for a data call – and subsequent database – of management actions. Examples to date include: (1) the Memorandum of Understanding between Montana and British Columbia that retired all existing mining claims on the B.C. side of the Transboundary Flathead; followed by efforts to establish Best Management Practices for any subsequent timber harvest in this crucial area; (2) multiple projects by the Southwestern Crown of the Continent CFLRP to improve fisheries habitat; (3) multiple projects by Montana Fish, Wildlife & Parks and the U.S. Forest Service in the Clearwater, Blackfoot, and middle fork of the Clark Fork; (4) a collaborative Rock Creek restoration in a climatically-vulnerable reach of the Oldman Watershed led by the Oldman Watershed Council; (5) Alberta has completed a land footprint management plan and recreation management plan for the Livingstone/Porcupine Hills lands as well as creation of the Castle Park. Through these plans and current work, fish habitat is being improved by managing linear footprint, limiting motorized recreational access, fish habitat improvements and placement of bridges on fish bearing water bodies.
<u>PROJECT #5</u>: Export successful bull trout translocation efforts piloted in the North Fork of the Blackfoot to other landscapes. *<u>Progress to date</u>*: **DEVELOPING**: A potential project – still in the planning stages -on the North fork of the Blackfoot is evolving in terms of interagency collaboration, bioassay tests to be completed this year, and-out year NEPA and MEPA evaluation of alternatives relative to native WSCT restoration - as well as the bull trout translocation aspect.

PROJECT #6: Re-establish beavers across the landscape: launch a pilot project that incorporates efforts to (a) reduce trapping of existing beaver populations (i.e. to facilitate successful dispersal events by existing populations), (b) identify policy avenues that can incentivize expansion of beaver populations in key watersheds, and (c) identify educational outreach opportunities for private landowners, agency staff, and fisheries managers (Stillwater, Montana, and Alberta).

Progress to date: **ONGOING IN ALBERTA, UNDER WAY IN MONTANA**: Extensive work by Cows and Fish in Alberta have included multiple workshops ("Beavers in Our Landscape") for the public; toolkits such as "Living with Beaver - Cows and Fish Workshop Options" and "An Overview of Beaver Management for Agricultural Producers - Decision Matrix Tool"; in addition to numerous other ground-breaking products (see 'What's New' on their website: http://cowsandfish.org).
On the Montana side of the Crown: the U.S. Forest Service and National Wildlife Federation held a two-day workshop on 2017 that focused on the science and outcomes of beaver translocation projects; with University of Montana professor Lisa Eby working in partnership with the Forest Service to better understand the science behind the use of beaver mimicry methodologies with regard to native salmonids. On-the-ground projects are currently in the works for Thompson Falls and on the Lolo National Forest that would apply lessons learned from extensive work and pilot projects by the Clark Fork Coalition in other areas of Montana.

PROJECT #7: Complete prioritization and mapping of conservation populations and key watersheds most critical to sustain native salmonids across the Crown given both existing stressors and climate change, and simultaneously work to identify and secure groundwater upwelling areas and potential coldwater refugia at fine scales.

Progress to date: **COMPLETED!** All of these analyses and data were shared with workshop participants at the second 'Big Tent' native salmonid workshop in Lethbridge in March of 2018. For much more detail, please see proceedings from the 2018 Forum on the Crown Managers Partnership website (http://crownmanagers.org/); or access the interactive web tool directly: http://ice.ecosheds.org/cce/

PROJECT #8: Implement strategic and coordinated suppression of invasive rainbow trout in the transboundary Flathead watershed; export best management practices to other locales;

Progress to date: **ONGOING**: on the American side of the Crown, for example, Amber Steed and Sam Bourret have been leading this work for Montana Fish, Wildlife & Parks that includes monitoring effectiveness of current methodologies (i.e. trapping and electrofishing removal) as well as evaluation of other tools (i.e. the use of barriers and piscicide). Existing data on effectiveness will be compiled and used as the basis of a strategic planning discussion of next steps.

PROJECT #9: Develop a set of consistent strategies for suppressing non-native fish species across Crown (e.g. prevention, monitoring, response, and enforcement) that is based on lessons learned about critical uncertainties and ecological function from ongoing projects; prioritize testing of these strategies in core areas and known cold-water refugia.

Progress to date: **DEVELOPING**: On the Montana side of the Crown, Montana Fish, Wildlife & Parks, the U.S. Forest Service and the University of Montana are collaborating on a westslope cutthroat trout genetic rescue project in the Missouri River drainage; while on the Canadian side of the Crown, Alberta is actively scoping non-native fish removal in key waterbodies as part of management actions to be implemented and piloted in 2019 and 2020.

9. Blueprint for action developed at the 2018 Crown-wide workshop on native salmonids

By the close of the 2018 workshop, participants had created two discrete lists of priority actions for bull trout and westslope cutthroat trout: one for the East side of the Continental Divide, and one for the West side.

As was the case with the last native salmonid workshop, these final lists were informed by panels and presentations during the workshop that focused on current examples of on-the-ground management actions intended to restore or protect native salmonids in the Crown, as well as discussions of challenges and barriers to restoration in specific areas. The final lists of priorities for bull trout and westslope cutthroat trout at specific locations include:

MANAGEMENT STRATEGY CODING		
Code	**Description**	**Detail**
A	Little or no management	Monitor infrequently; site characteristics exhibit high abililty to resist or adapt to stressors (or stressors are not primary factor)
B	Moderate management invention	Maintian or enhance XXX characteristics at these sites. Site Characteristics exhibit moderate ability to residet or adapt to stresstors (or stressors not primary factor)
C	High management intervention	Maintain or enhance XXX characteristics at these sites. Site characteristics exhibit low ability to resist or adapt to stressors (or stressors are not primary factor). BUT social, landscape, connectivity etc. characteristics of the site is importance for the XXX
D	Little to no management invention	Monitory infrequently or not at all. Site character istics exhibit low ability to resist or adapt to stressors (or stressors are not primary factor). And social, landscape, connectivity etc. of the characteristics of the site are NOT importance for the XXX.

***Westslope cutthroat trout priority actions* – West side of the Continental Divide**

Rank	Name/Site	Strategy assignment (Color code)	Management actions	Specific management actions/ relevant information	Hotspots of collaboration? High, medium, low
1	South Fork Flathead	A	Monitor	Consider autonomous eDNA Minor habitat Genetic Donor Stock	Easy to do, already set up
2	Middle Fork (same as NF)	B	Piscicide lakes w/Yellowstone Cutthroat Trout + selective isolation. Pike-BT suppression (Lake Trout NOP) Angling regulations	Remove Yellowstone Cutthroat Trout Selective isolation or non-DV watersheds Angling regulation for Pike, Lake Trout - suppression. Single lake- remove rainbow trout?, closures, tags-quotas	High
3	North Fork Flathead	B	Piscicide lakes w/Yellowstone cutthroat trout selective isolation. Pike-BT suppression (Lake trout NOP) Angling regulations	Remove Yellowstone Cutthroat Trout Select isolation or non-DV watersheds Angling regulation for Pike, Lake Trout - suppression. Single lake remove Rainbow Trout?, closures, tags-quotas	
4	Middle Kootenai	C	Habitat restoration Rainbow Trout suppression Angling effort?	Mining regulations?	
5	Swan		Relocation Isolate Fire Mitigation	Secure barriers Downstream, piscicides Prescribed burn Move fish to fishless waters	High
6	Blackfoot	C	Habitat restoration Relocation	Minimum restoration Water flows, screens, grazing restoration round work, conservation easements, Nevada Creek reservoir work Rainbow Trout suppression	High
7	Stillwater	C	Habitat Isolation	Fix roads Move fish downstream, expand	Low
8	Lower Flathead	C	Habitat restoration Water rights Suppression	Rainbow Trout suppression	Medium
9	Flathead Lake	C/D	Genetic rescue		

Westslope cutthroat trout priority actions – East side of the Continental Divide

Rank	Name/Site	Strategy assignment (Color code)	Management actions	Specific management actions/ relevant information	Hotspots of collaboration? High, medium, low
1	Upper Oldman	C	Upper Oldman-expansion of Non-native trout, -Close Oldman above Cache Creek Falls (changing/reduce angling effort) - Hybridization risk needs to be managed (suppress rainbow trout)		
2	Porcupine Hills	C	Hybridization risk, habitat (same as above).		
3	Crowsnest River	C	- increase population numbers, expand range + habitat recovery		
4	Crowsnest Pass area	C	Demographic and habitat Issues Maintain	Build some barriers. Address hybridization issues like restoration stocking. Reassess angling regulations for key stream segments. Some targeted restoration activities (trail reclamation).	Medium
5	Castle	C	- benchmark for intact & functioning pops – Lynx Creek - habitat restoration - removal of non-natives reclaiming crossings & installing barriers		
6	Highwood River	C	Renewal of non-native in areas	Habitat intactness can be improved relatively easily compared to other watersheds. Reduce/close fishing pressure in areas for Westslope Cutthroat Trout recovery	High: Anglers Transportation & industry Oil & gas wells Forestry & allotment Holders Private land covers Managing public land

7	Sheep-Highwood River/Little Bow	C	Demographic/habitat risk Protect/maintain existing Westslope Cutthroat Trout streams Address invasive & roads	High level of angling impacted Address Hybrids issue (restoration/stock) Habitat fragmentation & made sure barrier permanent	Medium
8	Willow		Removal of invasive & introduction of Westslope Cutthroat Trout, sediment control management of linear disturbance	Stacking of Westslope Cutthroat Trout in Chain Lakes and above	High Allotment & leaseholders Private land covers Managing public land
9	St Mary River	C	Demographic and habitat risk	Boulder Creek - Observe/monitor. Irrigation/in-stream flows in summer on main stem St. Mary River fish screens are critical ***	High
10	Waterton River	D/C	Given it's a national park, conservation should be #1 priority but recovery requires high intervention		
11	Two Medicine River	B	No- native removal is key	Midvale Creek - invasives	

Bull trout priority actions **– West side of the Continental Divide**

Rank	Name/Site	Strategy assignment (Color code)	Management actions	Specific management actions/ relevant information	Hotspots of collaboration? High, medium, low
1	Flathead Lake	C		Lake trout Suppression	
	Mission	C	Bull trout translocation		
2	Lower Flathead				
	Post	C		Very small population	
	North Jocko	C		Habitat irrigation	
	South Jocko	B	More primitive management		
3	Southfork Group 1	A			
	Bob Marshall Complex		No Action		

	Donahue,Young White				
	Gordon Creek; Spotted Bear		Bob Marshall		
4	Southfork Group 2	B			
	Sullivan		Road focus action		
	Wheeler				
	Wounded Buck		Culverts & roads		
5	Middle Fork Flathead	A			
	Bull Clack Straw		No actions for Bull Trout		
	Schacterlongm		Bob Marshall		
	Morrison, Grand				
6	Middle				
	Bear	B	Road Related actions		
	Minnco				
	Olue Park	A		Glacier NP	
	Nyack	B		Potential to net Harrison	
	Harrison	C		Lake Trout reduction	
	Lincoln	B		Nyack - Brook Trout issue	
7	Northfork Flathead	B			
	Quartz (Bowman's) Logging	C	Non-native fish removal		
	Upper Kintla	A			
	Trout Narrow	A			
	Lower Quartz	B			
	Kishneen	A			
	Big Creek	B/C	Trail	Forest Management Harvest	
	Coal Cyclone		Frozen Lake	Sediment and road issues	
	Red Meadow Whale				
8	Northfork Flathead Canada	B		Logging roads biggest Issue	
	Sage Couldrey				
	Howwell, North				
	Fork Kisaneen				

9	Stillwater				
	Swift & Stillwater	C		Forestry roads	
10	Swan				
	Linberg Lake	C		Lake Trout Removal	
	Holland Lake	C		Netting - suppression	
	Elk Coal Gem Sarp.	B/C		Road issue -small patch	
	Piper Lyon	B/C		Lower elevation, lake trout removal, Swan	
	Lost Goat	B/C			
11	Middle Kootenai				
	White	A			
	Lussier	B			
	Wildhorse	A			
	Elk Coal Gem Sarp.	B			
	Bull	B			
	Michel	B		Industrial activity in this area	
	Fording- not mapped or surveyed				
	Lizard Creek				
12	Blackfoot				
	Bold	D			
	Belmont	D			
	Placid	D			
	Marshal	C			
	West Fork of the Clearwater	C			
	East Fork of the Clearwater	B			
	Morrel	B			
	Cottonwood	C			
	Monture Creek	B			
	North Fork of the. Blackfoot	B/C			
	Landers	B			
	Arrastra	C		Two systems aren't mapped - light priority and	

				active not in fish & wildlife	

Bull trout priority actions **– East side of the Continental Divide**

Rank	Name/Site	Strategy assignment (Color code)	Management actions	Specific management actions/ relevant information	Hotspots of collaboration? High, medium, low
1	Highwood	B	Targeted/seasonal angling closures. Brock Trout removal Monitor logging. Assess risk based on FMP (stream crossings, buffer).	Potential expand current closures Maintain closures on Storm Creek etc.	Local knowledge ACA, AEP
2	Oldman	C	Angling limitations during spawn	Hidden Creek -trails -habitat/sediment	
	Upper Oldman	C	Reduce linear footprint	- Rec/Linear Management plans. Read Surveys, continued monitoring and expand. Measure angling effort.	
	Castle			**<u>Castle Area</u>** - Carbondale, w/s Castle etc. (integrated partially by Castle Park Plan)	
3	Waterton	D		Poaching/enforcement	
4	St. Mary				
5	Willow	D			
6	Waterton Lakes National Park	C	Non-native control. Increase connectivity. Restore native species Barrier installation/maintenance. Mechanical non-native removal	**<u>Drywood Yarrow</u>** Palmer Dam Beaver re-intro Drywood Yarrow. **<u>Blakiston</u>** Restore native populations **<u>N. Fork Belly</u>** maintain fish screens in diversion structures,	Drywood Yarrow watershed Landowners

				reduce out migrant losses. Monitor angling effort.	

Next steps

The development of Conservation Playbooks 1.0 and 2.0 for native salmonids is an ongoing experiment regarding the best way to share the development of exciting new science, interactive web tools for managers, and lessons learned for on-the-ground management actions in a one-stop-shop format. As always, the purpose is to create something that hopefully works for very busy people, so please be sure to reach out with any and all ideas, suggestions, and improvements (contact information below).

Acknowledgments and contact information

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- *Sasha Harriott* (Crown Managers Partnership)
- *Linh Hoang* (U.S. Forest Service/ Northern Rockies Adaptation Partnership)
- *Regan Nelson* (Crown Conservation Initiative)
- *Erin Sexton* (Crown Managers Partnership/ Flathead Biological Station)
- *Rob Simieritsch* (Crown Managers Partnership/ Alberta Environment and Parks)

For all supporting materials, please see CMP native salmonids web page:
http://crownmanagers.org/native-salmonids1/

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