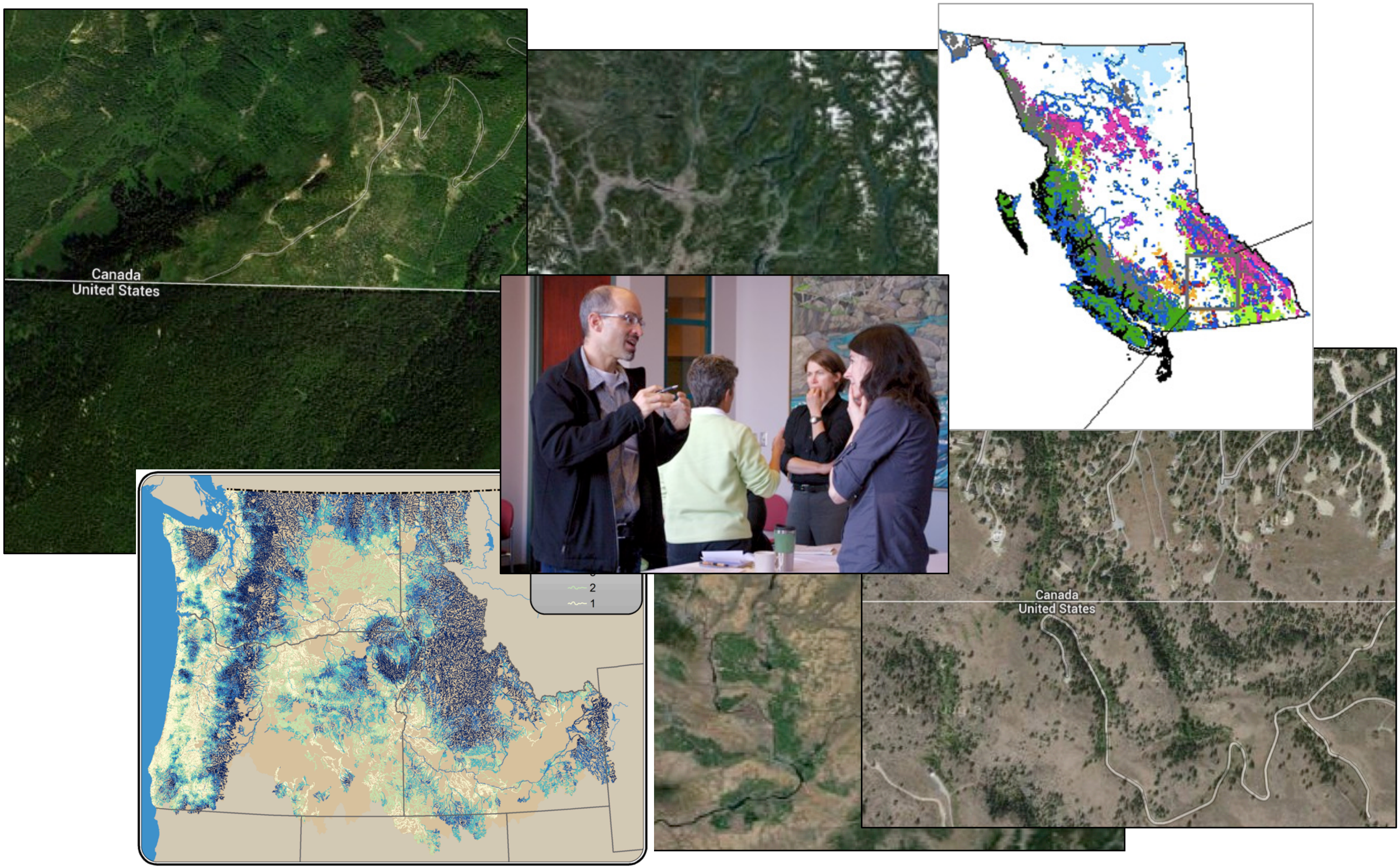
Transboundary Connectivity Conservation for a Changing Climate

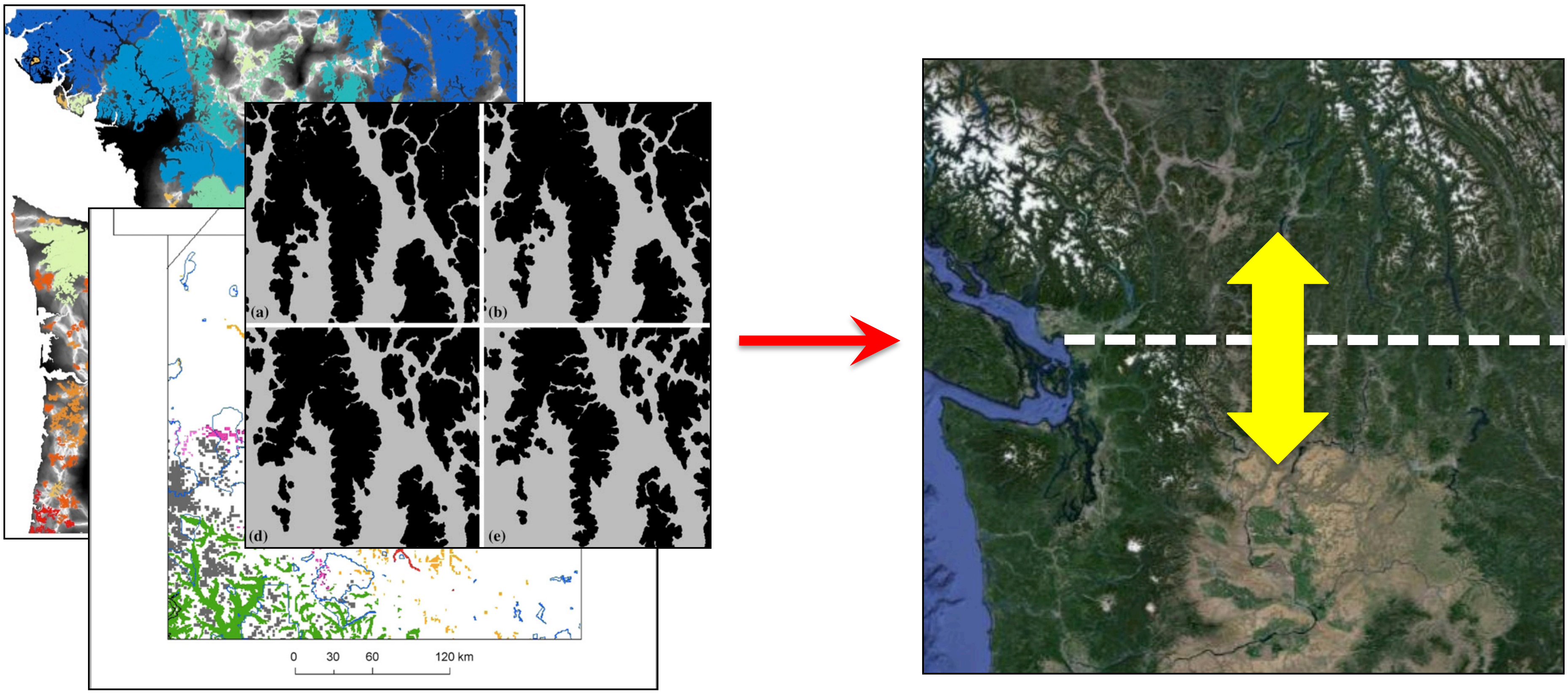
Meade Krosby
Climate Impacts Group, University of Washington
Northwest Climate Adaptation Science Center

Political borders can pose significant barriers to climate-driven movement of plants and animals

Political borders can pose significant barriers to climate-driven movement of plants and animals



Washington - British Columbia Transboundary Climate-Connectivity Project

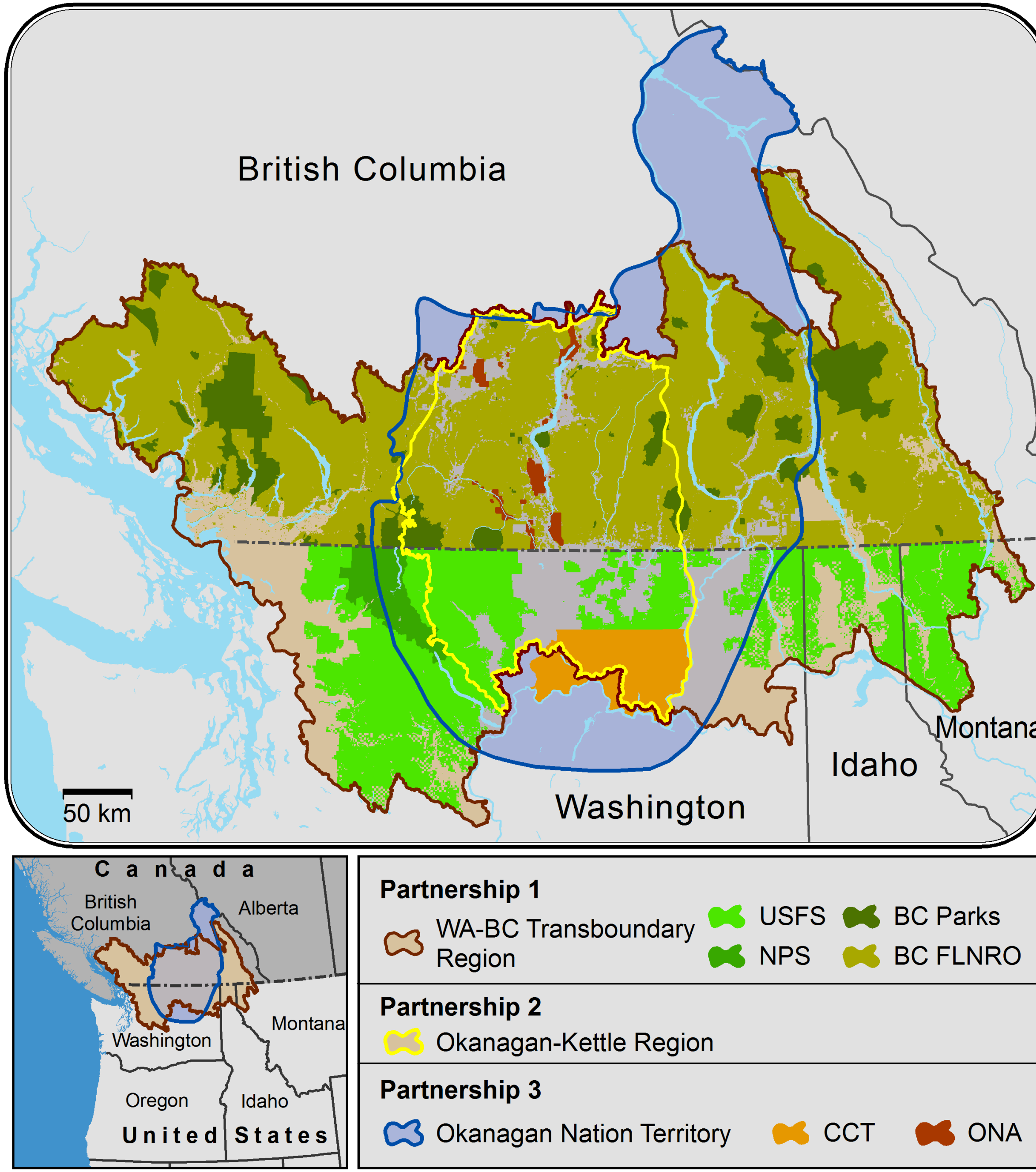


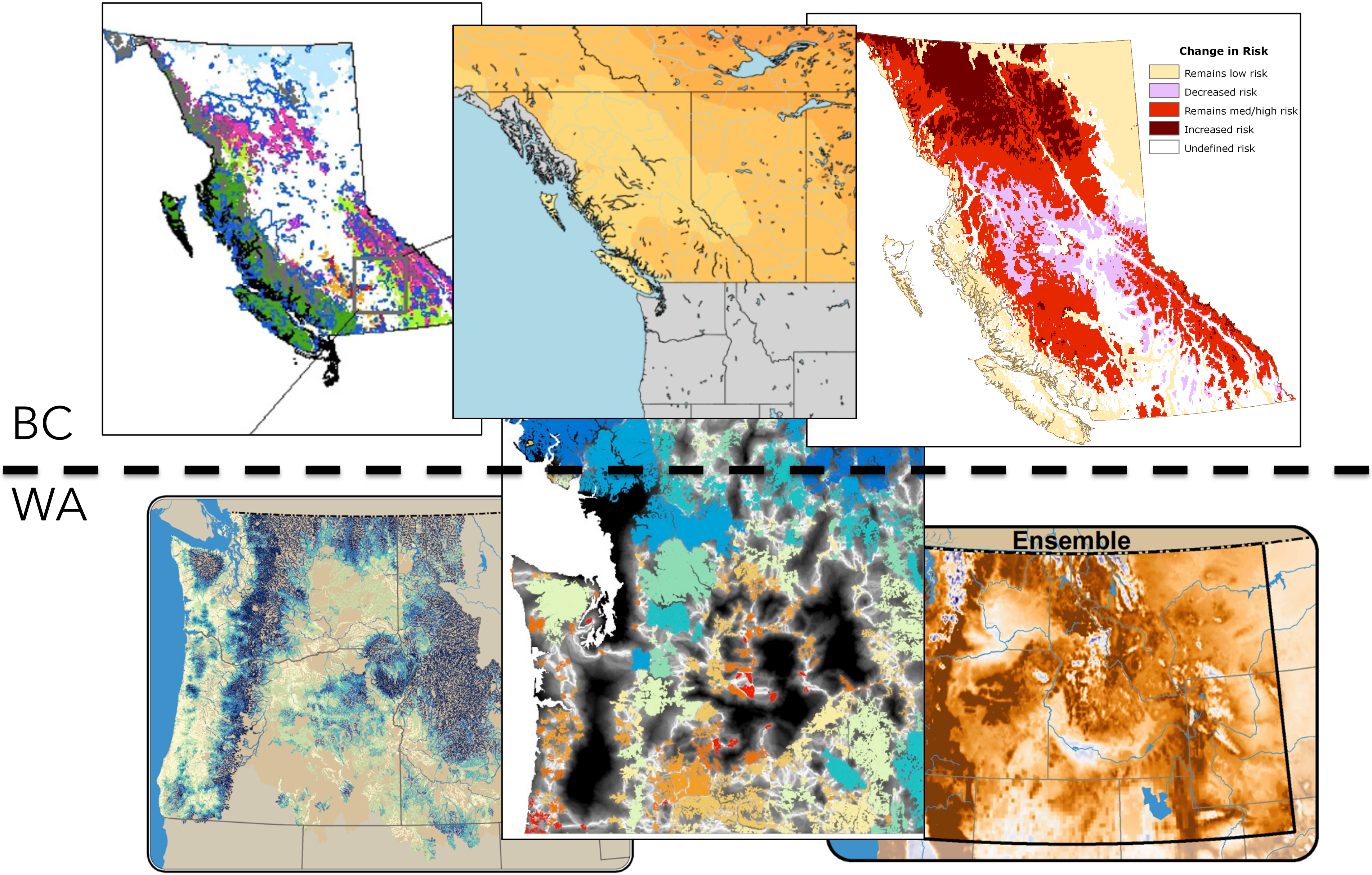
How can we use existing models to adapt connectivity conservation to climate change?

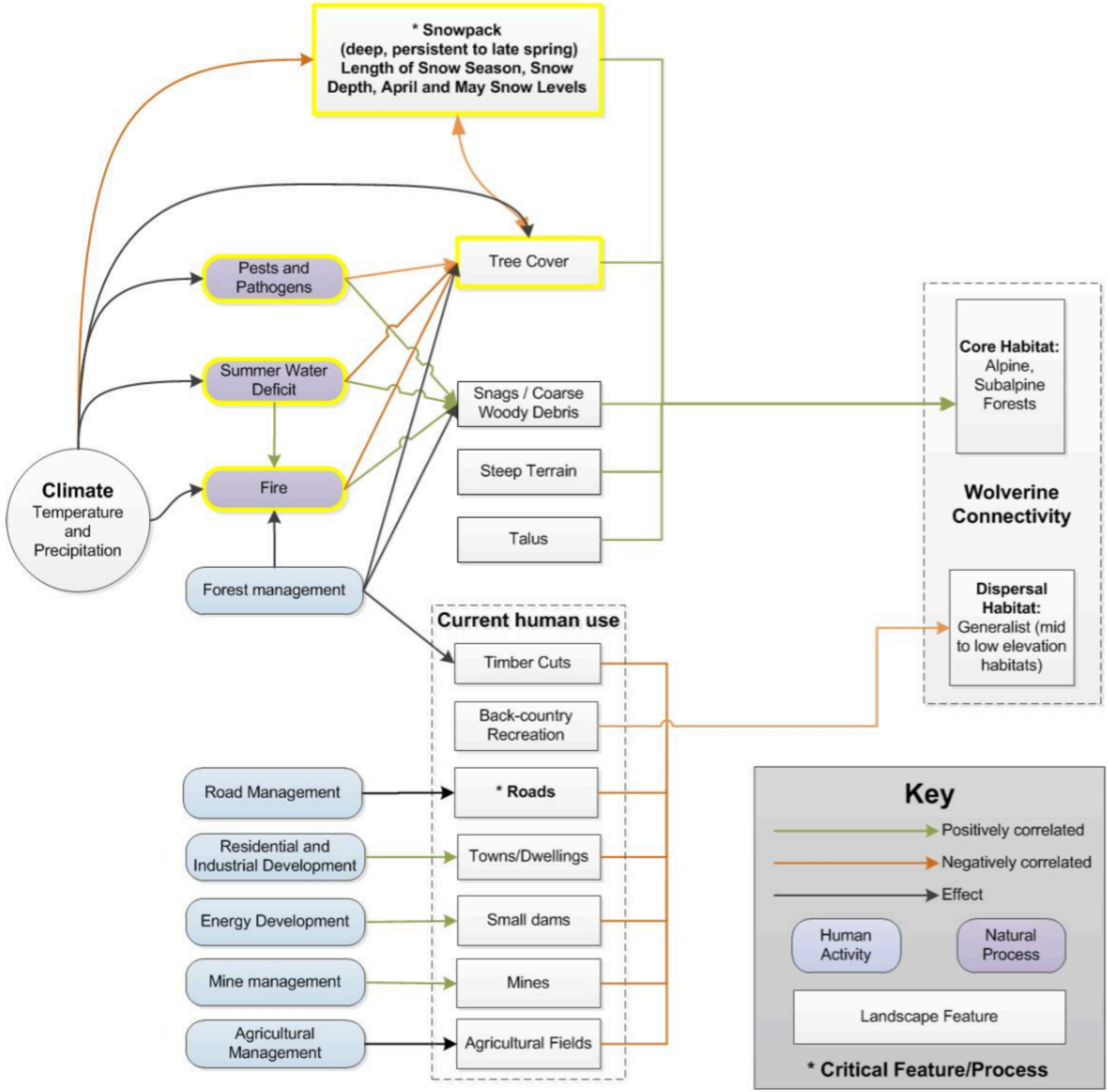
PACIFIC CLIMATE IMPACTS CONSORTIUM

W

CLIMATE IMPACTS GROUP

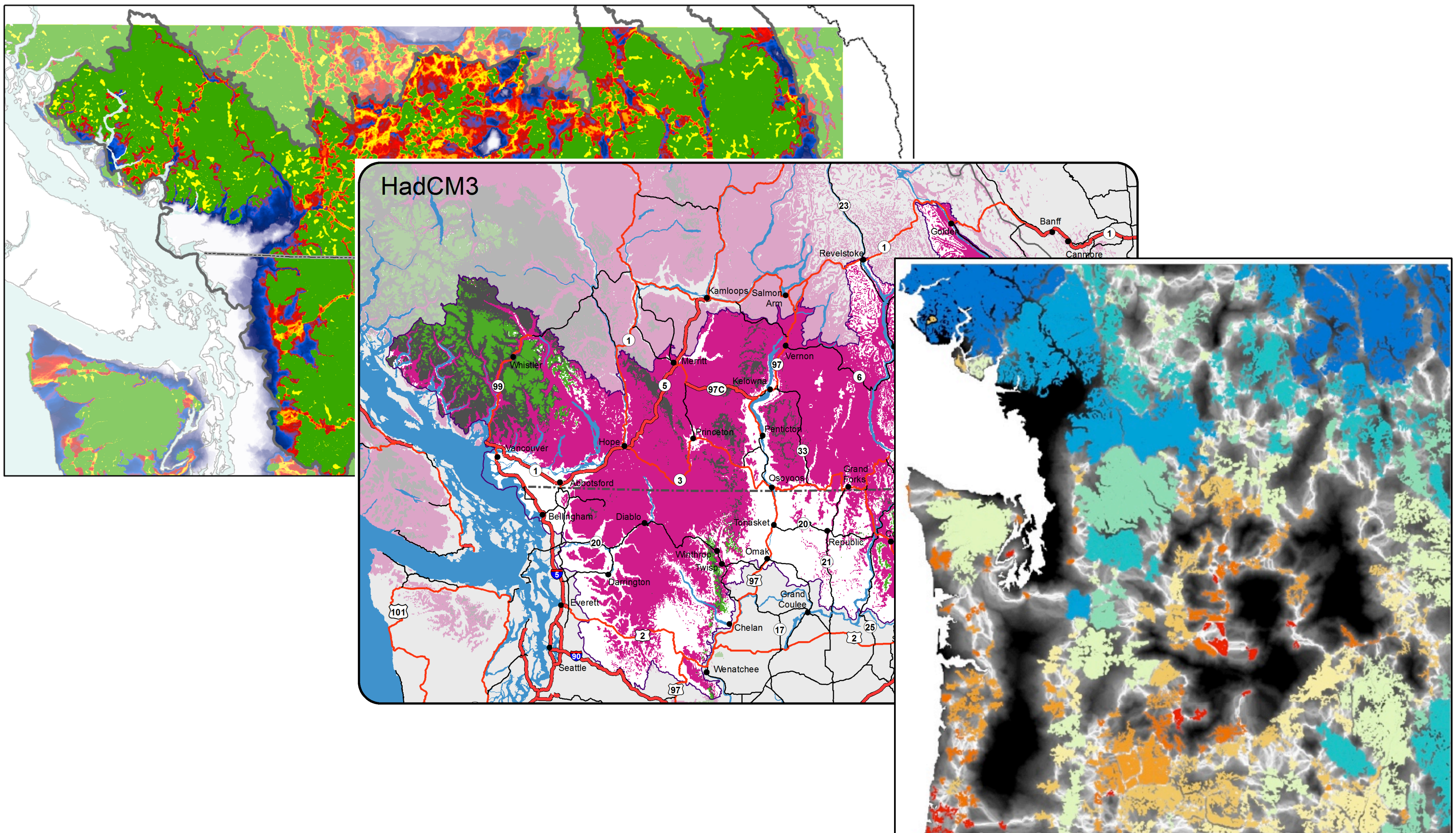



Change in Risk
Remains low risk
Decreased risk
Remains med/high risk
Increased risk
Undefined risk
BC
WA
Ensemble



* Snowpack
(deep, persistent to late spring)
Length of Snow Season, Snow Depth, April and May Snow Levels
Tree Cover
Pests and Pathogens
Summer Water Deficit
Fire
Climate
Temperature and Precipitation
Forest management
Snags / Coarse Woody Debris
Steep Terrain
Talus
Core Habitat: Alpine, Subalpine Forests
Wolverine Connectivity
Dispersal Habitat: Generalist (mid to low elevation habitats)
Current human use
Timber Cuts
Back-country Recreation
* Roads
Towns/Dwellings
Small dams
Mines
Agricultural Fields
Road Management
Residential and Industrial Development
Energy Development
Mine management
Agricultural Management
Key
Positively correlated
Negatively correlated
Effect
Human Activity
Natural Process
Landscape Feature
* Critical Feature/Process

Use connectivity and climate-relevant models to identify priority connectivity conservation areas




Protect Salmon
Preserve Habitat

Actions to address climate impacts on connectivity

Climate impact(s) addressed	ADAPTATION ACTION	Wolverine	Mountain Goat	White-tailed Ptarmigan	Whitebark Pine	Canada Lynx	American Marten	Black Bear	Mule Deer	Lewis's Woodpecker	Tiger Salamander	Bull Trout	Shrub-Steppe	Okanagan-Kettle
Increasing risk of wildfire	Using prescribed burns, thinning, and targeted fuel reduction to reduce the risk of catastrophic wildfires.	X			X	X	X	X	X	X		X	X	X
	Inco... rating projections and observations of climatic changes (e.g., earlier onset of fire season) to inform the timing of fire preve... n t...					X	X	X	X	X			X	X
	Using som...					X	X							
	Referencing ... ategies for managing fire risk.					X		X	X				X	X
Decreasing snowpack depth and duration	Increasing s... ment is unlikely to have a significant impact on habitat connectivity. Therefore, prioritize such efforts within important core habitat areas and corridors.	X				X	X							
	Ensuring that snowpack retention practices are compatible with other forest management practices that balance the need for fire and natural resource management with the need for sufficient horizontal cover.					X	X							
	Identifying and prioritizing areas where deep spring snowpack is most likely to persist in the future (e.g., north-facing slops and canyons).	X				X	X							
Changes in vegetation	Monitoring and responding to changes in vegetation (e.g., shifts in tree line, transition of shrub-steppe to other vegetation types, loss of forested corridors in low elevation valleys) that may affect habitat connectivity. Consider use of LIDAR remote sensing and other technologies yielding high resolution data.	X	X	X	X	X		X			X		X	X
	Mini... ing forest (or non-target tree) encroachment in key core habitat areas and corridors by mechanically removing invading trees or usi...			X	X								X	
	Developing ...												X	
Changes in invasive species	Incorporate ...												X	X
	In areas hea...												X	X
Changes in seed dispersal	Identifying and protecting stands that are large enough to attract seed dispersers and serve as a seed source				X									
	Identifying and protecting stands that could serve as links or stepping stones for seed dispersers moving among larger stands				X									
Increasing stream temperatures	Restoring riparian vegetation, which will help shade streams and reduce stream temperatures.											X		X
	Excluding cattle from riparian areas to prevent loss of vegetative cover.										X	X		
	Investigate the feasibility and benefit of manually transporting fish around thermal barriers in streams.											X		
Decreasing summer streamflows	Managing forests to maximize groundwater infiltration.											X		
	Using dam release events to maintain water levels and stream temperatures adequate for fish passage.											X		
	Identifying and mitigating barriers such as dams or poorly designed road crossings or culverts to promote fish passage.											X		

Prescribed burns

Monitoring changes in vegetation

Actions that enhance connectivity to facilitate species range shifts

Climate impact(s) addressed	ADAPTATION ACTION	Wolverine	Mountain Goat	White-tailed Ptarmigan	Whitebark Pine	Canada Lynx	American Marten	Black Bear	Mule Deer	Lewis's Woodpecker	Tiger Salamander	Bull Trout	Shrub-Steppe	Okanagan-Kettle
Geographic shifts in species ranges	Maintaining and restoring corridors between areas of declining climatic suitability and areas of stability or increasing suitability.	X	X			X	X	X		X	X	X	X	
	Evaluating the risks and benefits of manually transporting species to areas of projected stable or increasing climatic suitability.			X	X							X		
	Maintaining and restoring corridors that span elevation gradients (e.g., climate gradient corridors), to ensure that species have the ability to disperse into cooler habitats as the climate warms.	X	X	X	X	X	X	X	X	X	X		X	X
	Main[illegible]ing and restoring riparian areas, which span climatic gradients and are used as movement corridors by many species.					X	X	X	X	X				X
	Planning the ... low-elevation ...													

Corridors that span elevational gradients

Spatial priorities for implementing climate-connectivity adaptation actions

TOPIC ADDRESSED	SPATIAL PRIORITY	Wolverine	Mountain Goat	White-tailed Ptarmigan	Whitebark Pine	Canada Lynx	American Marten	Black Bear	Mule Deer	Lewis's Woodpecker	Tiger Salamander	Bull Trout	Shrub-Steppe	Okanagan-Kettle
Spatial Priorities for Implementation	Existing core habitat areas and corridors, which will be important for maintaining populations under current climate, and facilitating species response to future change. Pinch-points, barriers and restoration opportunities, and areas of high network centrality all offer potential priority areas for implementation.						x	x			x	x	x	
	Climate-gradient corridors, which may facilitate species dispersal into cooler habitats as climate warms.	x		x	x	x	x	x		x			x	x
	Climate-resilient core habit areas and corridors (i.e., those that are projected to remain climatically suitable).			x	x	x	x	x		x	x	x		x
	Ripa… areas, which currently act as species movement corridors, and also span climatic gradients, facilitating dispersal into coole… habit…					x	x	x		x				
	Cold-wate…													
	Ponds that a…													x
	Highways, e… (e.g., Highway 3 and Interstate 90), which may present barriers to climate-driven range shifts.													
	Low elevation valleys, particularly the Fraser River Valley and the Okanagan Valley. Connectivity Focus Areas offer key areas for implementation in the Okanagan Valley.	x	x			x		x	x	x	x		x	x

Climate-resilient core areas and corridors

Low elevation valleys

Appendix A: Climate impacts and adaptation actions for wolverine

Figure A.1. Wolverine.

The Washington-British Columbia Transboundary Climate-Connectivity Project engaged science-practice partnerships to identify potential climate impacts on wildlife habitat connectivity and adaptation actions for addressing these impacts in the transboundary region of Washington and British Columbia.[i] Project partners focused their assessment on a suite of case study species, a vegetation system, and a region chosen for their shared priority status among project partners, representation of diverse habitat types and climate sensitivities, and data availability. This appendix describes potential climate impacts and adaptation actions identified for the wolverine (*Gulo gulo*).

The wolverine is a highly mobile and wide-ranging carnivore.[2] Wolverines have a strong preference for landscapes with deep and persistent snowpack, and avoid human developments in their home ranges and during dispersal.[2,3] Wolverine can travel long distances and will move through a wide range of habitat types during dispersal.[2] In the transboundary region of Washington and British Columbia, the wolverine's primary alpine and subalpine habitat exhibits relatively high connectivity within the Cascade Range, but is fragmented regionally by both human factors (e.g., highways, towns) and natural factors (e.g., low elevation river valleys). Significant barriers to movement are presented by major highways, the Okanagan Valley, and the Fraser River Valley (Appendix A.1).[2]

Future climate change may present additional challenges and needs for wolverine habitat connectivity.[4-5] First, climate change may impact wolverine core habitat and dispersal corridors in ways that may make them more or less permeable to movement. Second, existing wolverine core habitat and corridors may be distributed on the landscape in ways that make them more or less able to accommodate climate-driven shifts in wolverine distributions. For such reasons, connectivity enhancement has become the most frequently recommended climate adaptation strategy for biodiversity conservation.[6] However, little work has been done to translate this broad strategy into specific, on-the-ground actions. Furthermore, to our knowledge, no previous work has identified specific climate impacts or adaptation responses for wolverine habitat connectivity in the transboundary region (but see McKelvey et al. (2011)[7]). To address these needs, we describe here a novel effort to identify and address potential climate impacts on wolverine habitat connectivity in the transboundary region of Washington and British Columbia.

Potential climate impacts on habitat connectivity

To identify potential climate impacts on transboundary wolverine habitat connectivity, project participants created a conceptual model that identifies the key landscape features and processes expected to influence wolverine habitat connectivity, which of those are expected to be influenced by climate, and how (Appendix A.2). Simplifying complex ecological systems in such a way can make it easier to identify specific climate impacts and adaptation actions. For this reason, conceptual models

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[i] This report is Appendix A of the Washington-British Columbia Transboundary Climate-Connectivity Project; for more information about the project's rationale, partners, methods, and results, see Krosby et al. (2016).[1]

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The Washington-British Columbia Climate-Connectivity Project

Created by Meade Krosby

Feb 25, 2016 (Last modified Feb 29, 2016)

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About

Maintaining and restoring ecological connectivity is the most frequently recommended climate adaptation strategy for biodiversity conservation. And yet, little guidance exists regarding where and how to enhance connectivity to facilitate climate-driven shifts in species ranges, or how to anticipate and address climate impacts to existing connectivity priorities. The Washington-British Columbia Climate-Connectivity Project engaged science-management partnerships to use existing climate and connectivity datasets to 1) identify potential climate impacts on wildlife connectivity in the transboundary region of Washington and British Columbia, and 2) identify specific climate adaptation actions to address negative effects. This gallery includes data and maps gathered or created as part of this project, and links to reports describing key impacts and adaptation actions for species and regions evaluated by project participants.

Tags

corridors, wildlife, british columbia, okanagan, climate change, washington, habitat connectivity, connectivity, future climate, landscape connectivity

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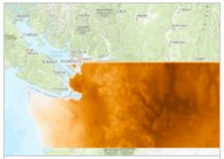
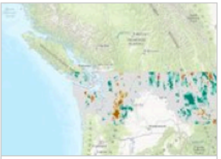
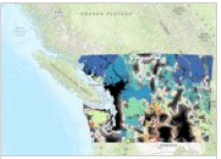
- **Black Bear** (15 items)
- **Bull Trout** (11 items)
- **Canada Lynx** (12 items)
- **Lewis's Woodpecker** (11 items)
- **Mountain Goat** (10 items)
- **Mule Deer** (11 items)
- **Tiger Salamander** (15 items)
- **White-tailed Ptarmigan** (10 items)
- **Whitebark Pine** (10 items)
- **Wolverine** (11 items)

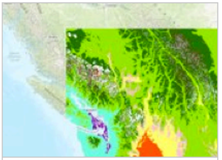
PDF
Appendix A. Wolverine.pdf

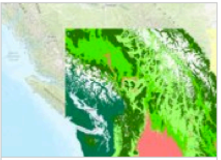

Dataset
Days with High Fire Risk (Energy Release Component, ERC greater than ...


Dataset
Summer (July-September) Water Deficit


Dataset
Change in the Probability of Mountain Pine Beetle Survival


Dataset
Climate-Gradient Corridor Network (Temperature + Landscape Integrity)

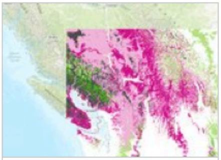

Dataset
Mechanistic Vegetation Model

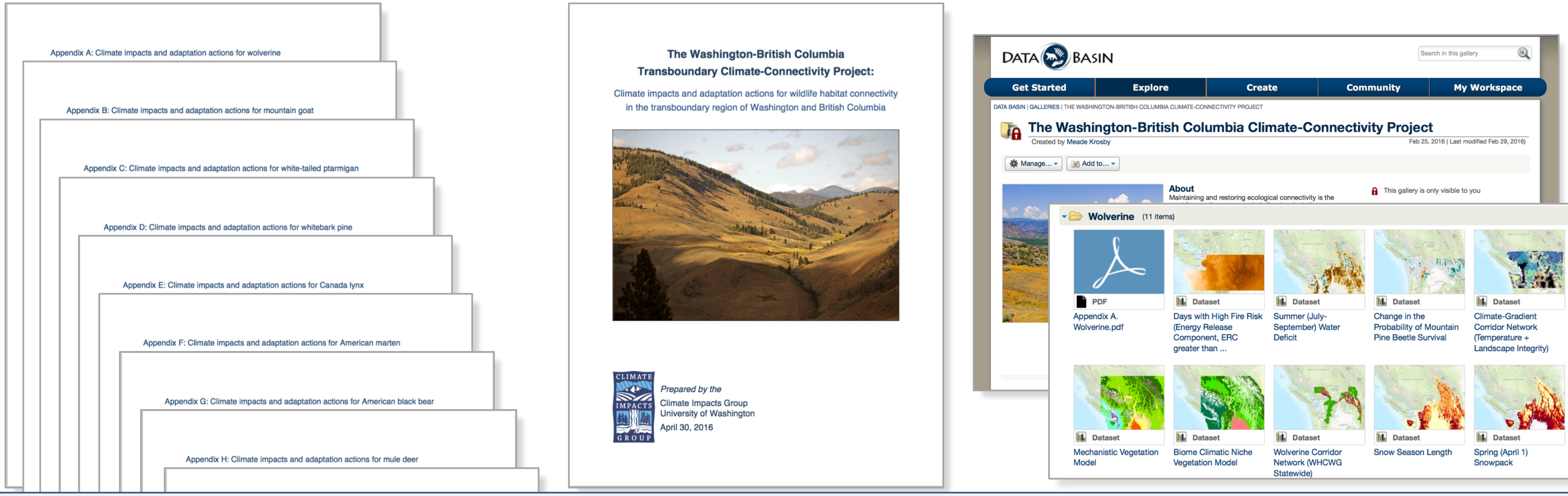

Dataset
Biome Climatic Niche Vegetation Model


Dataset
Wolverine Corridor Network (WHCWG Statewide)

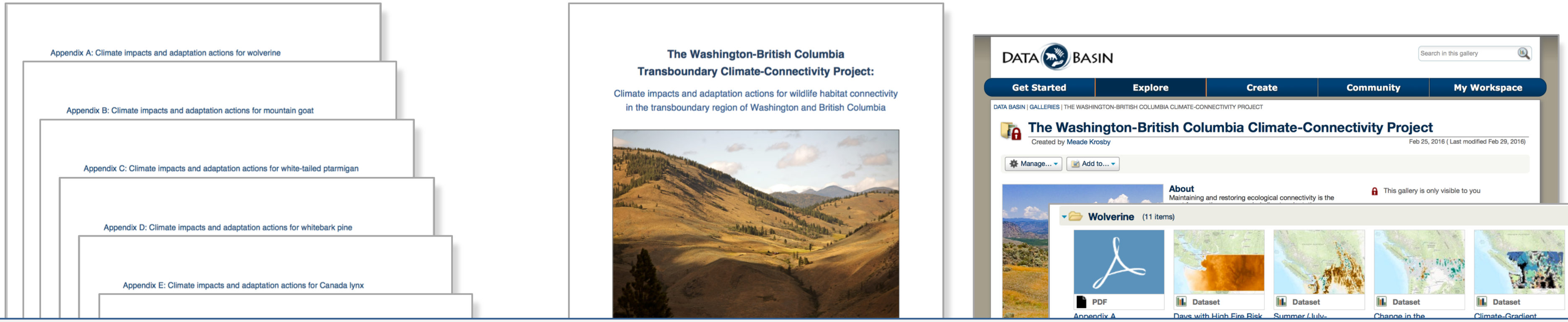

Dataset
Snow Season Length


Dataset
Spring (April 1) Snowpack


Dataset
Wolverine Climatic Niche Model



Models alone aren’t enough to inform decision-making



It was a success in building capacity + collaboration

Capacity + collaboration aren't the only barriers

Static models don't serve a rapidly changing world

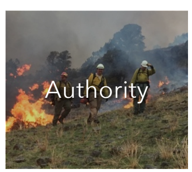
Cascadia Conservation Climate Adaptation Strategy

Land use decision-makers have the capacity to understand and plan for climate resilience

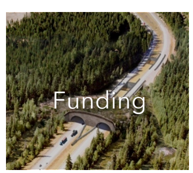
Land use decision-makers are coordinated across boundaries to support climate resilience

Land use decision-makers are motivated to support climate resilience

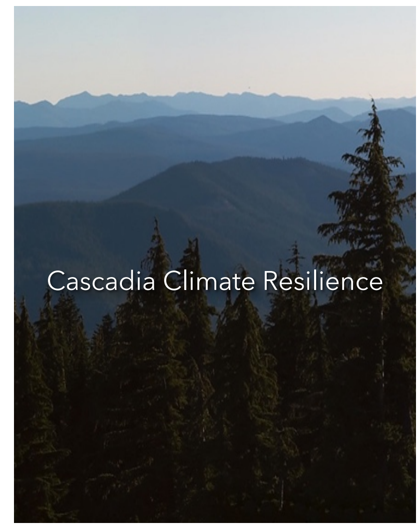
Land use decision-makers are empowered to implement decisions that support climate resilience



Land use decision-makers have sufficient funding to support climate resilience



Decision-makers are planning, implementing, monitoring, and evaluating conservation in ways and at scales sufficient to support the resilience of Cascadia's natural systems



Cascadia has natural systems that are resilient to the impacts of climate change

Cascadia PARTNER FORUM

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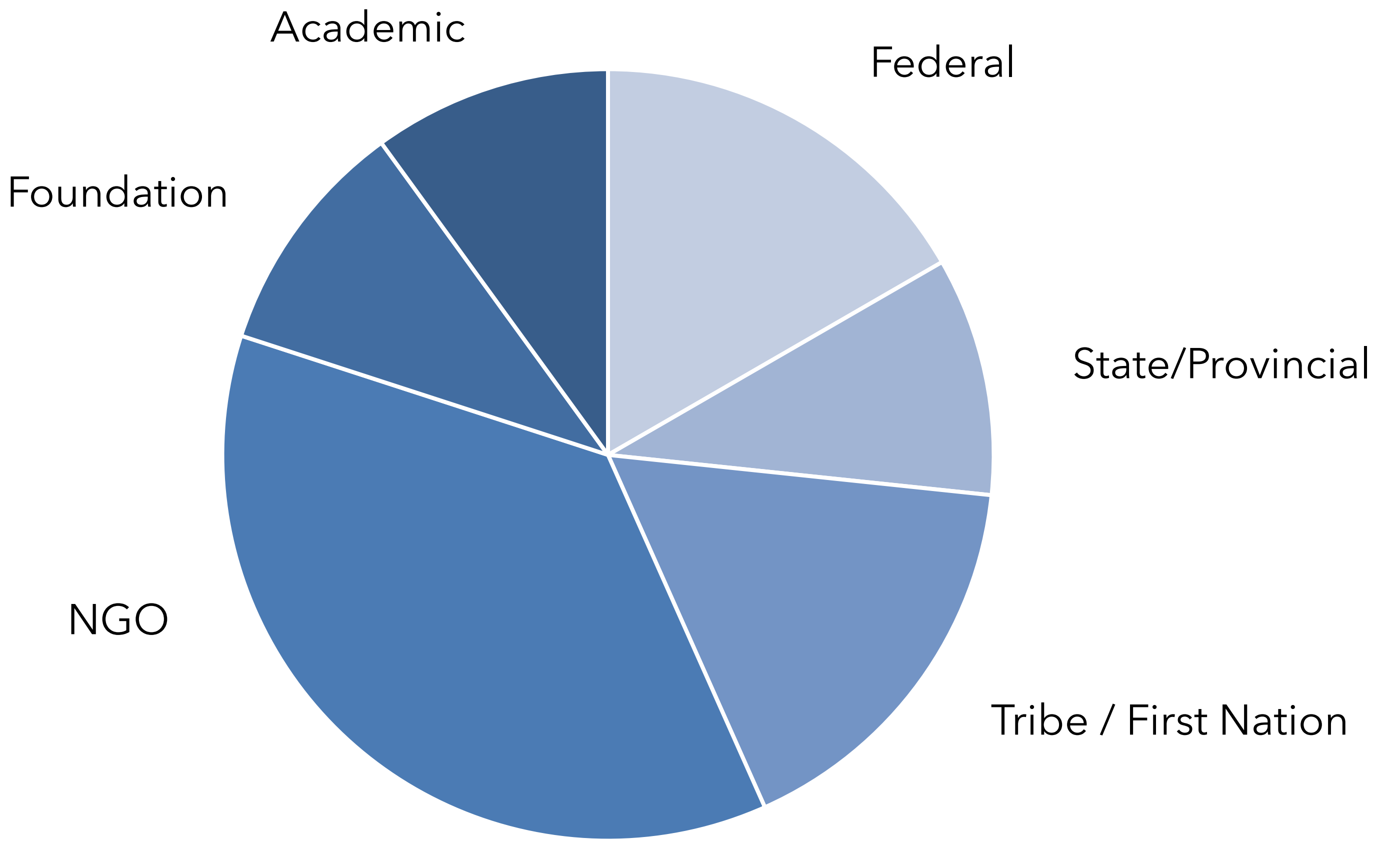
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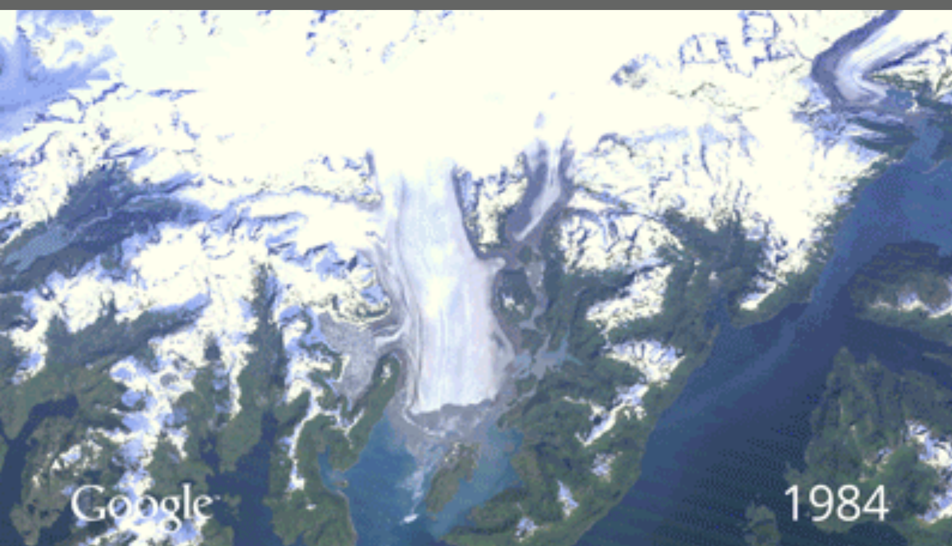
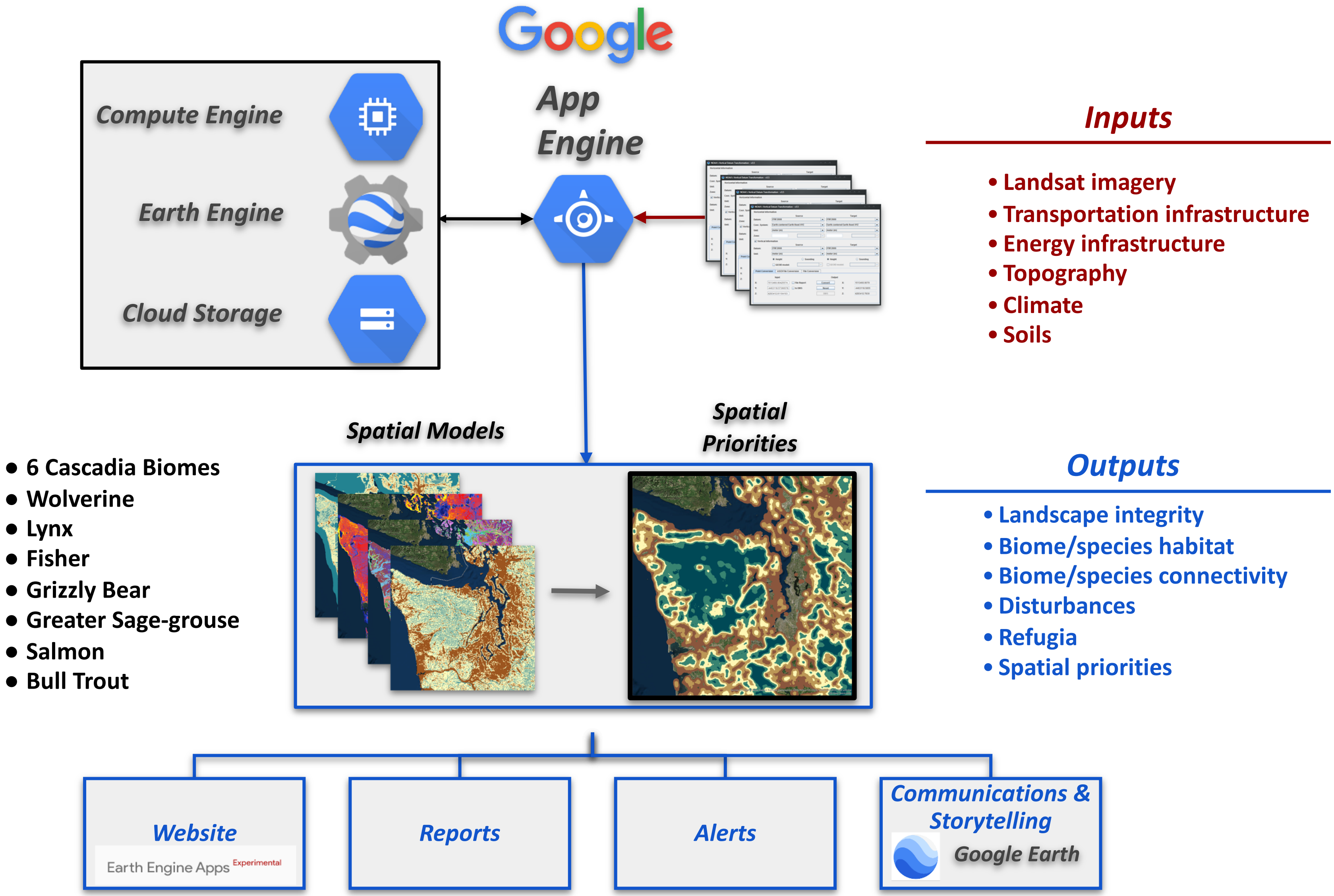
Las Vegas Urban Growth, 1986-2012

Brazilian Amazon Deforestation, 1984-2012



Columbia Glacier Retreat, 1984-2011

Saudi Arabia Irrigation, 1984-2012



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• 6 Cascadia Biomes
• Wolverine
• Lynx
• Fisher
• Grizzly Bear
• Greater Sage-grouse
• Salmon
• Bull Trout
Outputs
• Landscape integrity
• Biome/species habitat
• Biome/species connectivity
• Disturbances
• Refugia
• Spatial priorities
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Earth Engine Apps Experimental
Reports
Alerts
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British Columbia — Ministry of Environment

Forest Service, U.S. Department of Agriculture

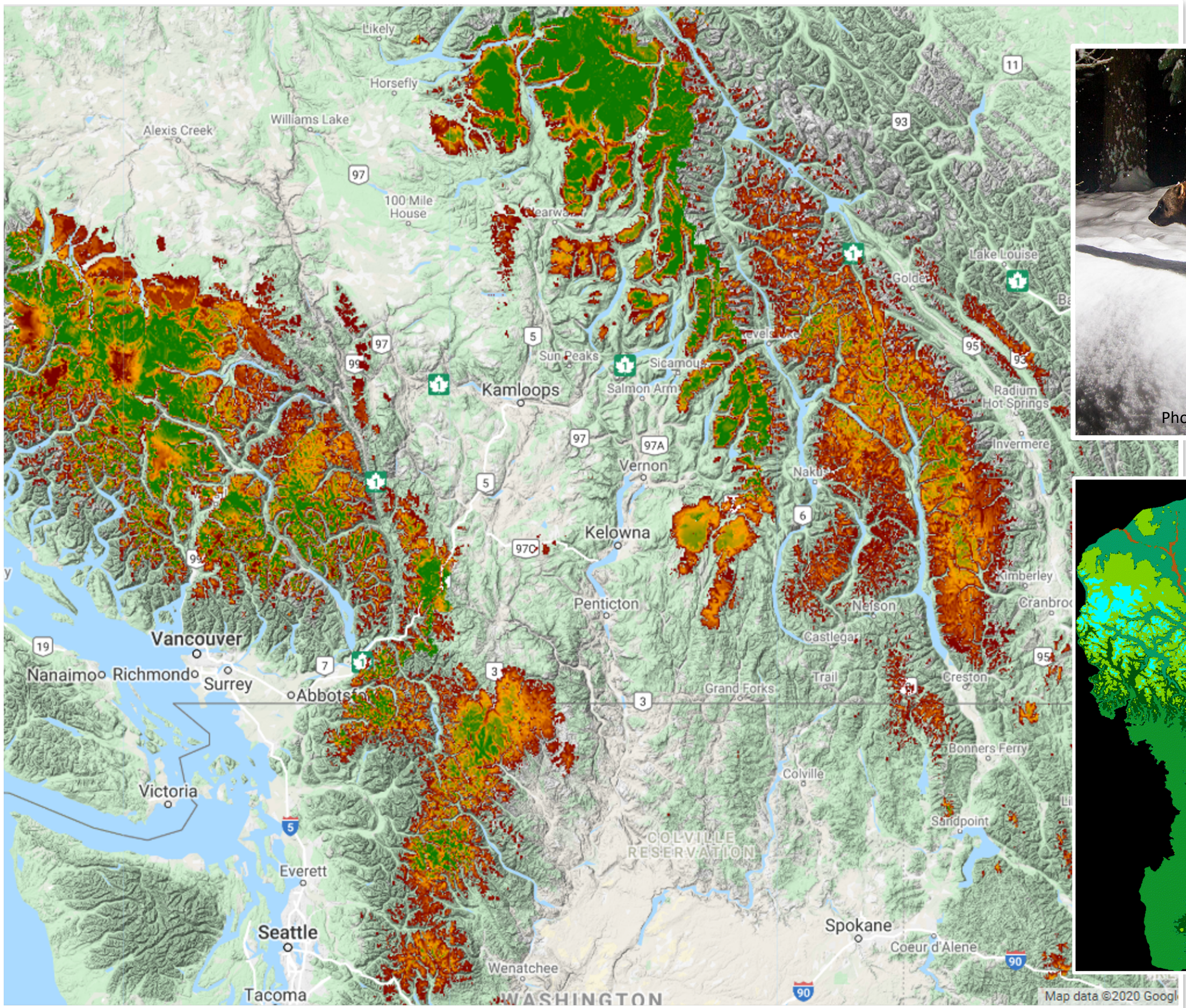
Washington Department of Fish and Wildlife

WSDOT

Washington State Department of Natural Resources

Woodland Park Zoo

British Columbia — Ministry of Forests, Lands, Natural Resource Operations and Rural Development



Likely
Horsefly
Williams Lake
Alexis Creek
100 Mile House
Kamloops
Sun Peaks
Salmon Arm
Vernon
Kelowna
Penticton
Nelson
Castlegar
Trail
Grand Forks
Creston
Kimberley
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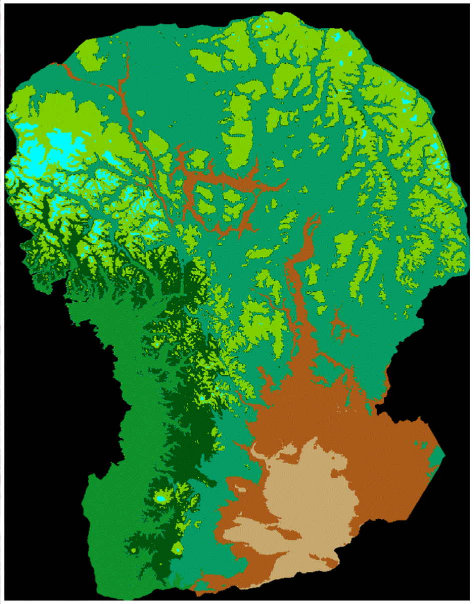

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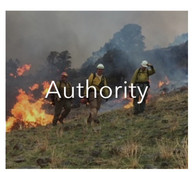
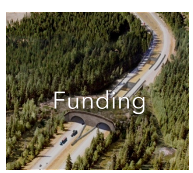
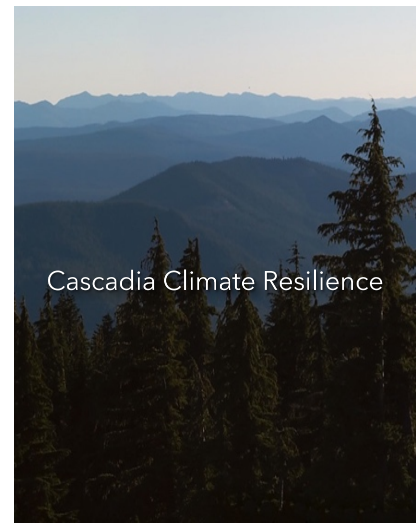


Land use decision-makers have sufficient funding to support climate resilience



Decision-makers are planning, implementing, monitoring, and evaluating conservation in ways and at scales sufficient to support the resilience of Cascadia's natural systems



Cascadia has natural systems that are resilient to the impacts of climate change

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Thank you!

mkrosby@uw.edu