Identifying Cascadia Conservation Priorities Under Climate Change

A memo to the Cascadia Partner Forum

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Introduction

Over the past century, the Pacific Northwest has experienced significant changes in climate, including warming temperatures and declining snowpack and summer stream flows. These trends are projected to continue over the coming century, along with warming summer stream temperatures, decreasing summer rainfall, and increasing wildfire. These changes are already affecting regional wildlife, including changes in species phenologies, interactions, and distributions. These changes are eventually expected to result in biome shifts and the emergence of novel ecological communities. Because of this, the Cascadia Partner Forum has recognized the strong need to revisit spatial conservation priorities for the Cascadia landscape (Fig 1.). Existing priorities reflect current patterns of biodiversity and assume static ecological communities; ensuring the resilience of regional biodiversity into the future will require priorities that account for the impacts of climate change.

Fortunately, recent years have seen rapid emergence of analyses that could be used to identify spatial conservation priorities for Cascadia under climate change. These include models of project future changes in climate and biotic distributions, as well as models that identify specific areas within the Cascadia landscape that are expected to promote biological resilience to future change (e.g., climatic refugia). However, the results of such analyses are, on their own, insufficient for setting conservation priorities. Below, we explain why, and offer a suggested approach for identifying spatial conservation priorities under climate change for the Cascadia landscape.

Suggested Approach

To effectively guide conservation decision-making, conservation priorities must be determined based on explicit conservation goals. Only with clear goals for what one would like to protect, what future condition one would like to see, and what one's conservation targets are can one appropriately interpret available information to identify conservation priorities. Is the goal to maintain current species assemblages? To maximize future biodiversity? To maintain ecosystem services? Each of these goals could lead to differences in which analyses one would use and how one would interpret them, resulting in different spatial conservation priorities.

Because of this, the most robust approach to identifying rigorous, actionable spatial conservation priorities under climate change for Cascadia would be to conduct a systematic conservation planning process based on the goals of Cascadia's conservation stakeholders. Such a process would require the convening of a multi-stakeholder working group, the identification of explicit conservation goals and targets for Cascadia in a changing climate, and the completion

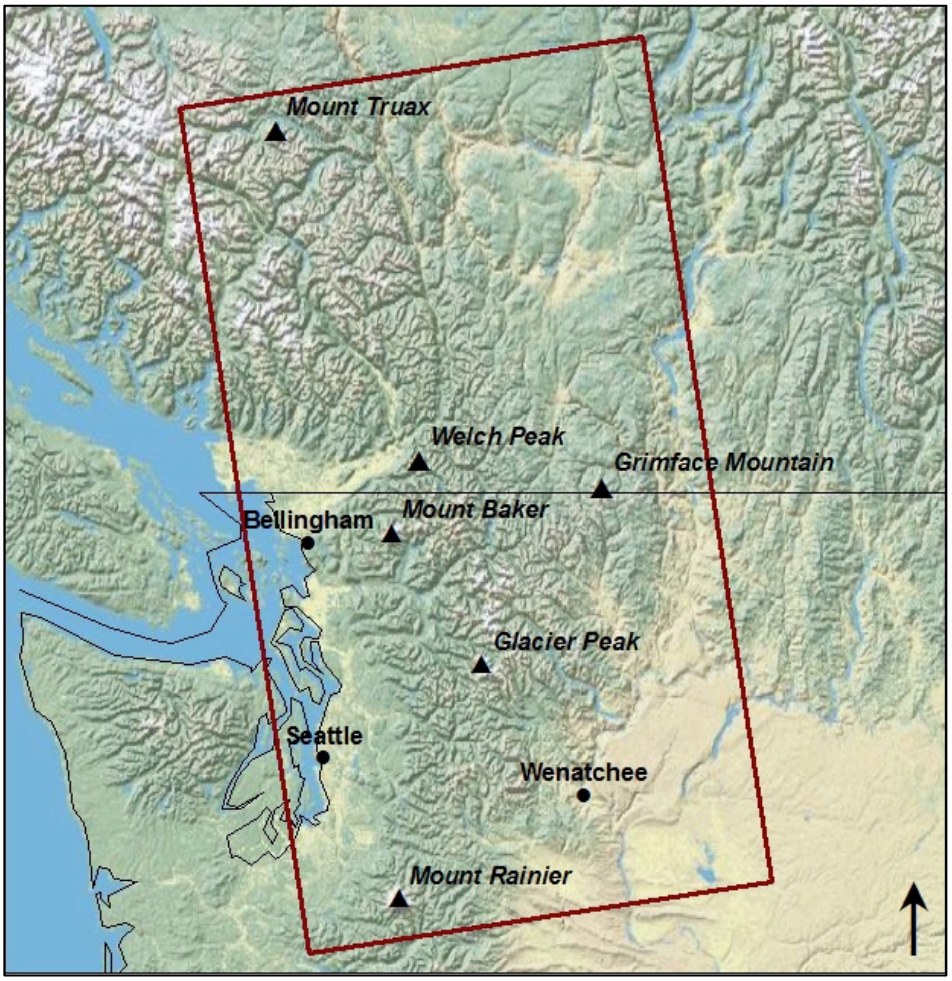

Figure 1. The Cascadia Partner Forum Landscape.

of a systematic conservation planning process that uses the best available information to identify spatial priorities optimized to meet specific conservation goals and targets.

This process should ideally be undertaken as a science co-production effort, completed via close collaboration between scientists and conservation decision-makers; such assessments ensure that results reflect the best available knowledge from both science and practice, and are more likely to be implemented because practitioners understand and support the assessment process and its products. The product of such an effort – a conservation blueprint – would promote conservation effectiveness by encouraging partners to leverage their individual conservation investments toward a shared vision for a resilient Cascadia.

Specific steps for completing this process may include:

1. Convening a working group of regional conservation scientists and stakeholders

The first step in collaboratively identifying spatial conservation priorities for Cascadia should be to convene a working group to complete the work. This working group should include not only diverse conservation practitioners and decision-makers from both Washington and British

Columbia, but also regional conservation scientists with the expertise to apply existing analyses and datasets to the prioritization process. Ideally, this working group should include participants spanning a range of career-stages and -seniorities to ensure that

2. Defining conservation goals

To identify conservation priority areas, the working group must first decide what conservation goals they would like to achieve. For example, do they want to:

- Maximize future biodiversity?
- Maintain current species assemblages?
- Ensure provision of key ecosystem services?
- Some combination of the above?

Each of these could lead to the identification of different priority areas. Knowing what goals they are trying to achieve will be critical to guiding the use of existing datasets and analyses in the prioritization process. For example, these analyses could be used to identify areas expected to see the least amount of climatic change, maintain existing biological communities, promote species range shifts in response to climate change, harbor the highest levels of future biodiversity, or maximize the provision of ecosystem services; appropriately interpreting these analyses depends on the identification of clear conservation goals and targets.

3. Conducting a systematic conservation planning process

Once conservation goals have been identified, conservation planning software such as Zonation (Moilanen et al. 2009) or Marxan (Ball et al. 2009) can be used to systematically identify spatial conservation priorities that have been optimized to best meet these goals. Such tools offer a rigorous means of applying existing analyses and datasets (rather than completing new analyses), and to identify key information gaps that could be used to set future research agendas. Because conservation decision-making occurs at a range of scales, conservation priorities should ideally be identified at a range of scales, e.g., the full Cascadia landscape, ecoregions, and watersheds. This process should also be considered iterative, with priorities updated and refined as conditions change and new information becomes available.

Areas that are identified as being valuable today and in the future, for a range of conservation goals and targets, and under a range of future scenarios, are likely to represent the highest conservation priorities (i.e., no-regrets areas). However, there are likely to be many areas that are important for achieving some goals but not others, or under some climate scenarios but not others. Developing a process for ranking locations that fall into these gray areas will be an important and challenging task.

A wide range of relevant analyses and datasets are available for use in a systematic conservation planning process for Cascadia. These include analyses that identify projected future changes in climate and impacts on biodiversity (e.g., future species distributions), as well as analyses that identify areas expected to promote biological resilience under climate change (e.g., climate corridors or refugia). We list some key examples of these in the next section.

4. Disseminating broadly and building capacity for blueprint use

Once Cascadia conservation priorities under climate change have been identified, resulting products should be made broadly available via a range of outlets, e.g., the Cascadia Partner Forum website and the online conservation database, DataBasin. Workshops and webinars should be offered to share results widely, and opportunities for hands-on training should be provided to ensure that potential users are able to access, interpret, and apply the results to their decision-making.

Key Existing Analyses, Datasets, and Resources

A wide range of analyses, datasets, and resources are available that could be useful in a Cascadia conservation prioritization process. The following list includes some key examples; this list is not meant to be comprehensive, but to highlight the range of available information.

Projected Future Changes in Climate

There are numerous regional tools and resources available that provide information on historical and projected future climate conditions (e.g., temperature and precipitation, snowpack, streamflow). Such analyses can be used, for example, to identify areas expected to see the least amount of future change (i.e., climatic refugia). Key existing resources for the Cascadia landscape include:

- AdaptWest. Available at: https://adaptwest.databasin.org/
- Integrated Scenarios of the Pacific Northwest Environment. Available at: http://climate.nkn.uidaho.edu/IntegratedScenarios
- Pacific Climate Impacts Consortium Regional Analysis Tool. Available at: https://www.pacificclimate.org/analysis-tools/regional-analysis-tool

WHCWG Climate-Gradient Corridors

The Washington Wildlife Habitat Connectivity Working Group conducted a series of analyses identifying climate-gradient corridors – linkages intended to promote species range shifts between warmer and cooler areas. Climate-gradient corridors connect core areas of high landscape integrity (i.e., areas with low levels of human modification) that differ in temperature by >1 °C, while minimizing major changes in temperature (e.g., crossing over cold peaks or dipping into warm valleys) and avoiding areas of human modification (e.g., cities, highways, farms) along the way. The WHCWG completed climate-gradient corridor analyses at both a "Statewide" scale (i.e., Washington and neighboring areas of British Columbia, Idaho, and Oregon; WHCWG 2011) and for the Columbia Plateau ecoregion (WHCWG 2013). Available at: http://waconnected.org

Riparian Climate-Corridors

This analysis identifies potential riparian corridors featuring characteristics expected to enhance their ability to facilitate range shifts and provide refugia (Krosby et al. 2014, 2015), including: significant temperature gradients, high canopy cover, large relative width, low exposure to solar radiation, and low levels of human modification. These variables were used to calculate a riparian climate-corridor index via a multi-scale approach that incorporates results ranging in

scale from local watersheds to the entire Pacific Northwest. The analysis identified the highest riparian climate-corridor index values for the full US Pacific Northwest, by ecoregion, and by watershed. The analysis does not extend into British Columbia. Available at: https://databasin.org/galleries/58411c761def4a54a477bebc48a57db1

TNC Resilient Sites

This analysis evaluated the representation of land facets (i.e., unique geophysical settings) and areas of higher than average climate resilience within The Nature Conservancy's existing Northwest conservation portfolio. Areas of high landscape resilience were identified as those with high microclimate diversity and landscape permeability, with results calculated for ecoregions and land facets, so that resilient sites were identified across geographically dispersed, representative occurrences of all geophysical settings. This analysis spans parts of the US portion of the Cascadia landscape. Available at: http://nature.ly/resilienceNW

NorWeST and Climate Shield

NorWest and Climate Shield offer key resources for identifying spatial conservation priorities for Cascadia's freshwater aquatic species and ecosystems, though the analyses are limited to the US only. The NorWeST website provides a stream temperature database and modeled current and future stream temperatures for a range of climate scenarios for streams and rivers across the western U.S. (Isaak et al. 2010). Available at: http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html. The Climate Shield analysis identifies areas projected to maintain native trout populations under future climates (Isaak et al. 2015). Specifically, the analysis identifies locations of cold-water refuge streams for native Cutthroat Trout and Bull Trout. Available at: http://www.fs.fed.us/rm/boise/AWAE/projects/ClimateShield.html

Pacific Northwest Vulnerability Assessment

The Pacific Northwest Vulnerability Assessment developed climatic niche models for hundreds of vertebrate species in the Pacific Northwest (Langdon 2013). Climatic niche models define the climatic conditions within each species' current geographic distribution, and then apply projected climate changes to identify where on the landscape those climate conditions are projected to be located in the future. The assessment also developed mechanistic models for regional vegetation systems (Shafer et al. 2015). In addition to climate, mechanistic models incorporate other important factors that determine vegetation (e.g., soil suitability, competition, and carbon dioxide fertilization). Both sets of analyses span the full Cascadia landscape, and can be used to identify areas that are expected to remain climatically suitable or become newly suitable for species or vegetation systems. Available at: http://climatevulnerability.org

Ecosystem Climatic Niche Models for British Columbia

This analysis provides climatic niche models to identify current and projected future areas of climatic suitability for 16 major ecosystem types; results are limited to British Columbia (Wang et al. 2012). Available at: http://www.genetics.forestry.ubc.ca/cfcg/ClimateBC40/Default.aspx

Conclusion

A systematic conservation planning effort – particularly if undertaken collaboratively by regional conservation scientists and decision-makers – would provide a powerful means of applying the significant body of available climate-relevant analyses to the identification of Cascadia conservation priorities under climate change. Such an effort would require large investments of time and funding to support the necessary leadership, facilitation, coordination, and technical expertise and capacity required. However, the result would be a rigorous, actionable conservation blueprint with the buy-in needed to ensure implementation, i.e., spatial conservation priorities that could effectively promote the long-term goals of Cascadia's conservation stakeholders.

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