

Assessing the Capacity of Refugia for Climate Adaptation Strategy: A Case Study on the Cascades Ecoregion

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ABSTRACT

Climate change refugia represent geographical spaces that are naturally buffered from the effects of macroclimatic changes to a certain extent due to their ecological and geological features, such as topography, specific species, and ecosystem services. Conserving spaces that have the potential to protect climate stability is a vital adaptation strategy to minimizing climate change impacts where possible. However, conserving these spaces requires research into how to identify regions that meet criteria with the potential to foster climate change refugia. Climate scientists have begun to develop various frameworks for identifying climate change refugia, which has provided important results. Some frameworks are discovered to favor different ecological and geological factors over others, while others remain unbiased. By analyzing climate refugia supportive features and discovering the extent to which the Cascades ecoregion is vulnerable to climate change as a case study, understanding how these spaces can be reflected in broader adaptation strategies within the U.S. is possible. This research can provide relevant guidance for the future identification of climate change refugia and their adaptive capacity in other regions.

BACKGROUND

The IPCC has recognized climate change refugia as having the potential to serve a short to medium term benefit for climate change management strategy, representing decades to a century, as climate changes over time will eventually overwhelm the ability of individual spaces to protect suitable microclimates (Morelli et. al., 2016). This theory fosters a sense of urgency that necessitates climate refugia research to occur now and on a large scale. climate scientists have turned to this theory to understand how refugia can be utilized as an adaptation tool to address threats from anthropogenic climate change. Conserving topographically diverse spaces, like the Cascades, that have the potential to support climate stability is a vital adaptation strategy for minimizing climate change impacts where possible. Additionally, understanding individual spaces' abilities to persist and adapt based on specific features of climate refugia has significant scientific implications as an Earth with a vastly different climate approaches.

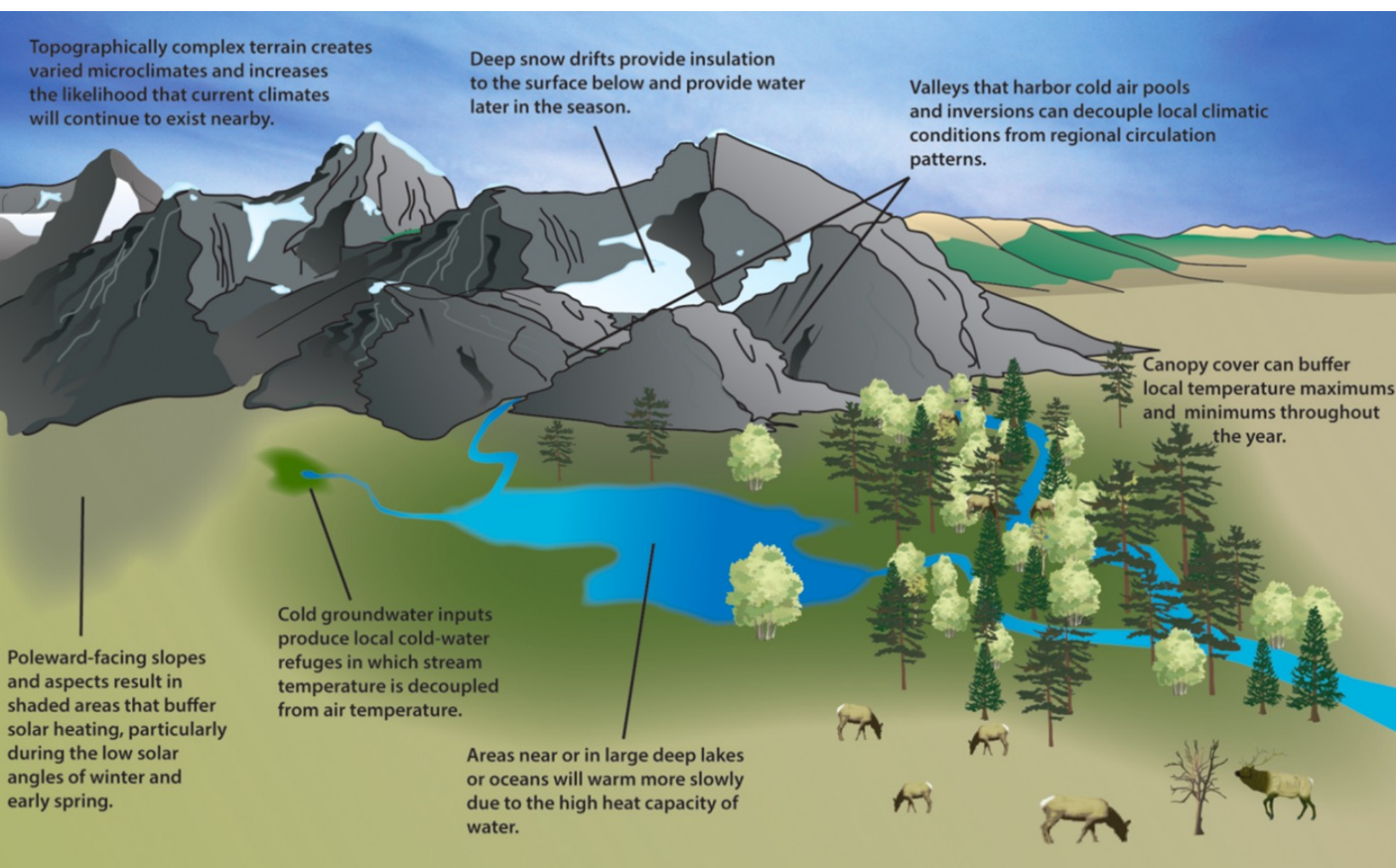


Figure 1: The diagram on the left illustrates several varieties of climate change refugia and their associated climate-buffering features, Source: USGS

METHODS

1. Spatial Extent of Research: North Cascades, East Cascades, and West Cascades

- Climate Vulnerabilities of the Cascades – Bibliographic Research
- USDA Study – North Cascades
- National Climate Assessment _ Northwest Study
- Oregon Conservation Strategy Studies – East and West Cascades

3. Prioritization

- Choosing areas to actively manage requires favoring select locations over others due to constrained resources
- Most resilient spaces with boundaries of research area have been sorted based on topography and protection status to find areas that are unprotected with refugia that align with the vulnerabilities of the region

2. Identification

- Refugia Research Coalition outlines mapping of terrestrial resilience of Western US
- Most resilient spaces within boundaries of the three ecoregions isolated for this study

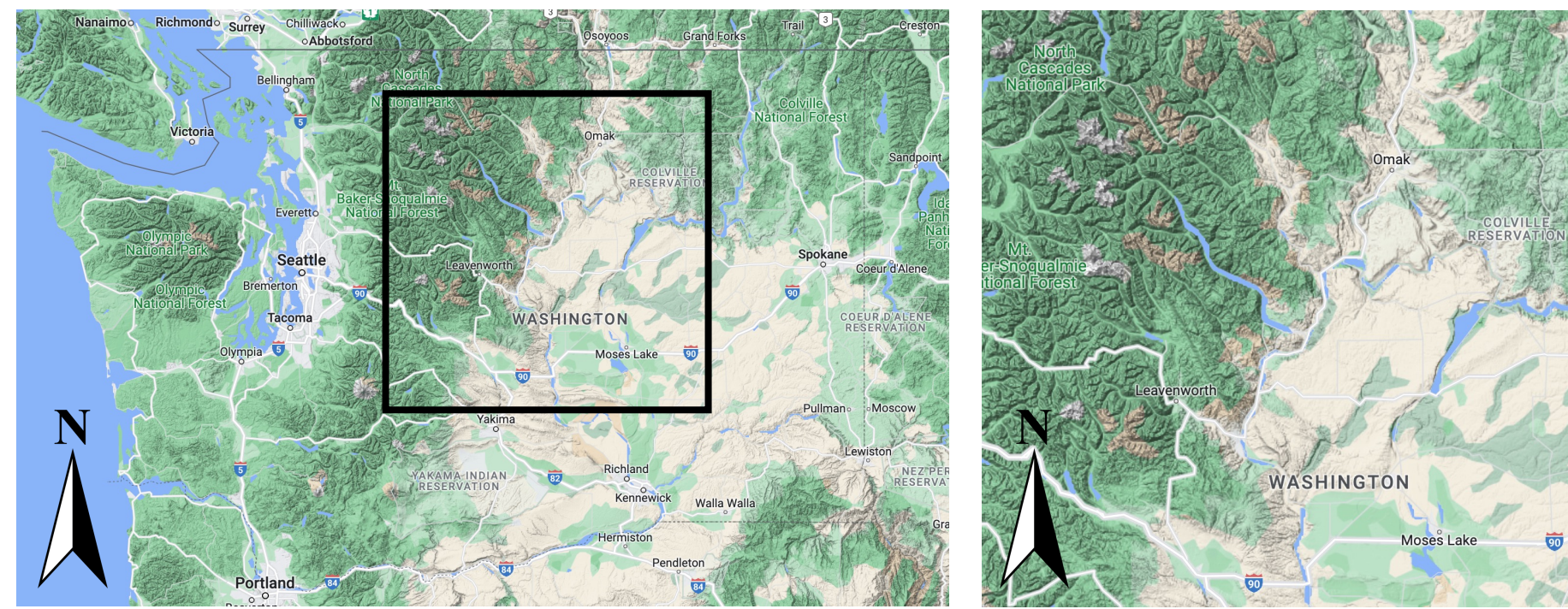
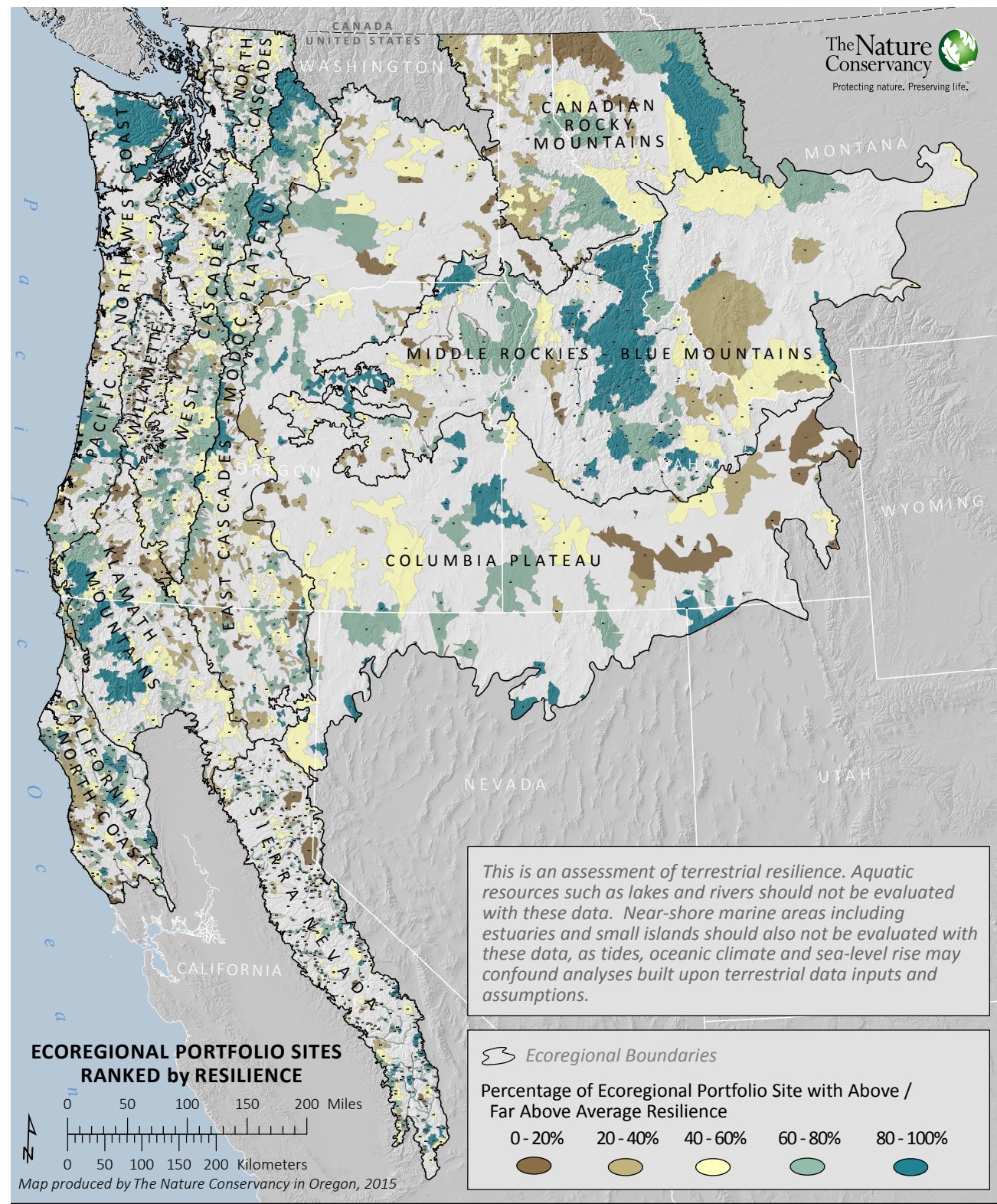
4. Management

- What practices will maximize the stability of this space?
- Economic/Resource Feasibility Analysis
- Implementation and Stakeholders

RESULTS

Ecoregion	Climate Risks	Topographies Favorable for Refugia
North Cascades	Loss of glaciers, increased soil erosion, and changes in snowmelt timing and amount, more frequent and severe fires potentially leading to shifts in dominant trees, changes in the structure and function of aquatic ecosystems	Whitebark Pine Forests, Cold Freshwater Habitat, Diverse elevations
West Cascades	Increased soil erosion, reduced streamflow, increased wildfire frequency, glacial retreat and erosion	Whitebark Pine Forests, Cold Freshwater Habitat, Diverse elevations
East Cascades	Increased drought frequency coupled with flooding from extreme rainfall events, decreased snowpack, species range shifts	Sage Steppe, Whitebark Pine Forests, Diverse elevations

Figure 2: The above table represents a condensed version of the climate vulnerabilities assessment conducted in part one of the analysis, based largely on USDA study

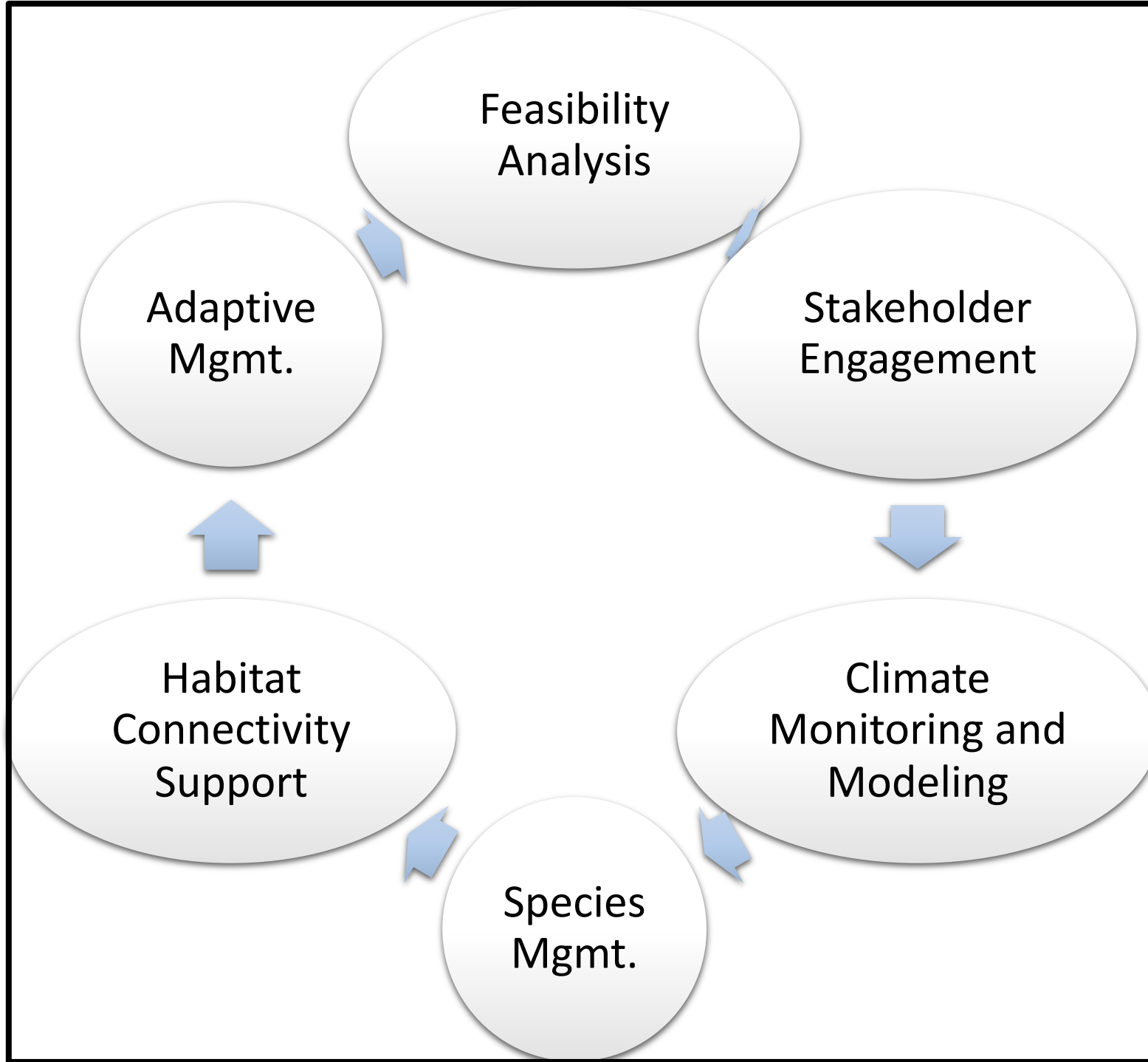


Figures 3, 4, and 5 (maps from left to right): Figure 3 represents the pacific northwestern US climate resiliency ranking, with most resilient and potential refugia in teal. For this study, the teal region in East Cascades has been prioritized for assessment due to high refugial capacity and its majority public ownership status. Figures 4 and 5 show the third part of analysis, the isolated area of high resilience on a topographic map. Sources: The Nature Conservancy, USGS Topographic Data

DISCUSSION AND CONCLUSIONS

- At this time, it's largely unclear whether a refugia management plan would be feasible in the Cascades ecoregion, specifically the Eastern Cascades, but if it was, it would look similar to the flow chart below (more detailed in paper)
- Going forward, a cost-benefit analysis of leasing land for extractive activity as well as using funding for near-term risk mitigation is necessary to understand feasibility

Figure 6: The flow chart to the left shows part four of the analysis, a high-level representation of the refugia management plan developed to potentially conserve the prioritized refugia of the East Cascades.



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