Setting conservation priorities in a changing climate: New tools for identifying and connecting climate refugia.

Carlos Carroll, Klamath Center for Conservation Research
Actionable science to help land managers strengthen climate resilience and enhance adaptive capacity.
AdaptWest
Conservation planning for climate adaptation

✓ Datasets.
✓ Publications.
✓ Applications.

http://adaptwest.databasin.org
The AdaptWest project team

- Carlos Carroll, Klamath Center for Conservation Research
- Josh Lawler, University of Washington
- Julia Michalak, University of Washington
- Scott Nielsen, University of Alberta
- Andreas Hamann, University of Alberta
- Diana Stralberg, University of Alberta
- Dave Roberts, University of Alberta
- Brad McRae, The Nature Conservancy
AdaptWest leverages global change products for use in regional analyses.

**Global**
- NASA
- GCRP

**Continental**
- USGS Geo Data Portal
- ADAPTWEST
- USFWS LCCs

**Regional**
- USDA Forest Service Forest Plan Revisions

**Local**
How do we make sense of the variety of data and link it to ecological processes?
Placing the data in context

**Complexity & Uncertainty**

**Breadth vs. Detail**

**Coarse vs. fine-filter**
Multi-track coarse/fine-filter approach:

**Why use coarse-filter targets?**
Lack of information about most species

**Why use fine-filter targets?**
Coarse-filter surrogate imperfectly protects individual species
Finding a balance: Conserving the actors and the stage

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: The Year in Ecology and Conservation Biology

Fine- and coarse-filter conservation strategies in a time of climate change

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Identifying refugia

Julia Michalak - Identifying climate refuges and disappearing climates in North America's protected areas

Diana Stralberg - Identifying locations and drivers of multi-species macrorefugia for North American trees and birds
Refugia are key to promoting climate change resilience

Internal refugia

External refugia/climate corridors
Different types of diversity data prioritize different parts of the landscape.
Climatic metrics: Forward vs. backward velocity

\[ v = \frac{\min(d)}{\Delta \text{time}} \]
Zonation, a software tool for systematic conservation planning

https://www.helsinki.fi/en/researchgroups/metagroup-population-research-centre/software#section-14300
Network of potential refugia identified from diversity and velocity data
The question of scale: Micro- and macro-refugia
Multi-scale network of conservation priority areas

- Representation targets (land facets)
- Spatiotemporal metrics (velocity)
- Spatial metrics (topodiversity)

Macroscale  Mesoscale  Microscale
Identifying climate corridors

Meade Krosby - Getting species from here to there: A review of connectivity modeling approaches for climate adaptation

Caitlin Littlefield - Connecting current and future suitable climates to facilitate species movement under climate change
Omniscape:
New climate connectivity software maps areas needed for species to track shifting climates.
Climate corridors identified from least-cost paths

Climate change velocity underestimates climate change exposure in mountainous regions

Solomon Z. Dobrowski & Sean A. Parks

MED = 397 km
Velocity = 4.4 km yr

ED = 294 km
Velocity = 3.3 km yr

MCE: 83.5 °C

Mean annual temp. (reference period)
High
Low

Path 1
Path 2

End-1
End-2
Start-1
Start-2

MED = 397 km
Velocity = 4.4 km yr

ED = 294 km
Velocity = 3.3 km yr

MCE: 83.5 °C
Placing the data in context

• What does each type of data tell us?
• Do different datasets suggest similar or contrasting priorities?
• Qualitative insights are as important as what specific places are identified.
• Each planning process may identify different priorities from the same datasets.
• Planners should use tools that allow priorities to be identified based on multiple goals.
For more information and to get involved:

• Visit http://adaptwest.databasin.org

• Follow @adaptwest on Twitter for updates on newly available data and webinars

• Contact via email: carlos (at) klamathconservation.org
THE END
AdaptWest provides access to diverse types of data but also helps place the data in context.
AdaptWest is a new spatial database designed to help land management agencies and other organizations implement strategies that promote resilience, protect biodiversity, and conserve natural resources in the face of a changing climate.
Refugia may differ between coarse-filter and fine-filter targets

Coarse-filter (non-species-specific):
Climate-data-based refugia
Physical-habitat-based refugia (topodiversity, land facets)

Fine-filter (species-specific):
Species-niche-model-based refugia
Focal-species-habitat-based refugia
**Method**

<table>
<thead>
<tr>
<th>Climate based analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data inputs:</td>
</tr>
<tr>
<td>- Current climate</td>
</tr>
<tr>
<td>- Projected future climate</td>
</tr>
</tbody>
</table>

**Local neighborhood statistic**

- Local climatic velocity $^{1,2}$
  - Time 1 $\rightarrow$ Time 2
  - $\text{temporal} / \text{spatial}$
  - Climate

**Global nearest-neighbor search**

- Analog-based climatic velocity $^{3,4}$
  - $\frac{d}{\Delta \text{time}}$

**Distribution based analyses**

- Data inputs:
  - Current species distributions
  - Projected future species distributions

**Bioclimatic velocity** $^4$

- $\text{temporal} / \text{spatial}$

**Biotic velocity** $^5$

- $\text{Biotic velocity}$
  - $\frac{d}{\Delta \text{time}}$
What can AdaptWest data inform?

- State Wildlife Action Plans
- MFLNR-BC climate adaptation metrics for broad management regions
- Okanogan-Wenatchee Forest Plan Revision – 4 million acre forest plan

Too coarse-resolution to be useful except to give broader context

- Mt Baker/Snoqualmie National Forest Sustainable Roads process
- Teanaway Community Forest Trust – 20,000 hectares
AdaptWest provides access to diverse types of data

But also helps place the data in context
A suite of velocity metrics allows comprehensive threat assessment

- **Forward velocity**
  - Threat to species (biotic velocity)
  - or populations (climatic velocity)

- **Backward velocity**
  - Low threat

- **Threat to ecosystems**
  - Low

- **Threat to ecosystems and species/populations**
  - High
Topodiversity

- Resolution-dependent
- May be based on elevation or more complex metrics (heat load, etc.)
- May highlight montane areas that are already well-represented in protected areas.
Forward climatic velocity for Cascadia

- Highest in alpine and interior areas.
- Lowest on mid-elevation slopes.
Backward climatic velocity for Cascadia

- Highest in interior areas.
- Lowest in upper montane areas.
Backward climatic velocity

Incorporates effects of broad-scale climate systems.
AdaptWest data:
Applications by US and Canadian agencies