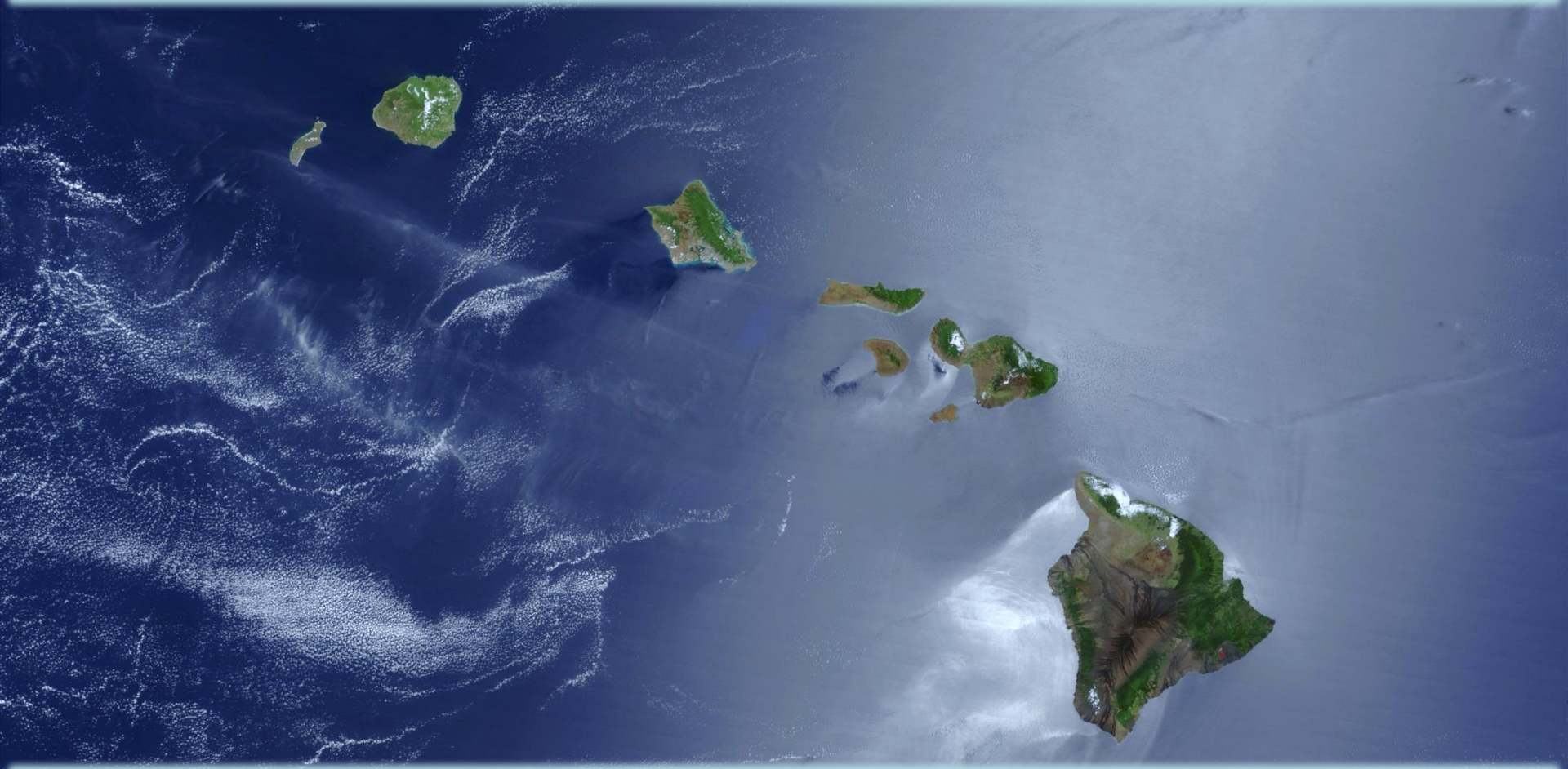
Spatial prioritization of Hawaii's stream ecosystems for native species conservation in the context of changing climate



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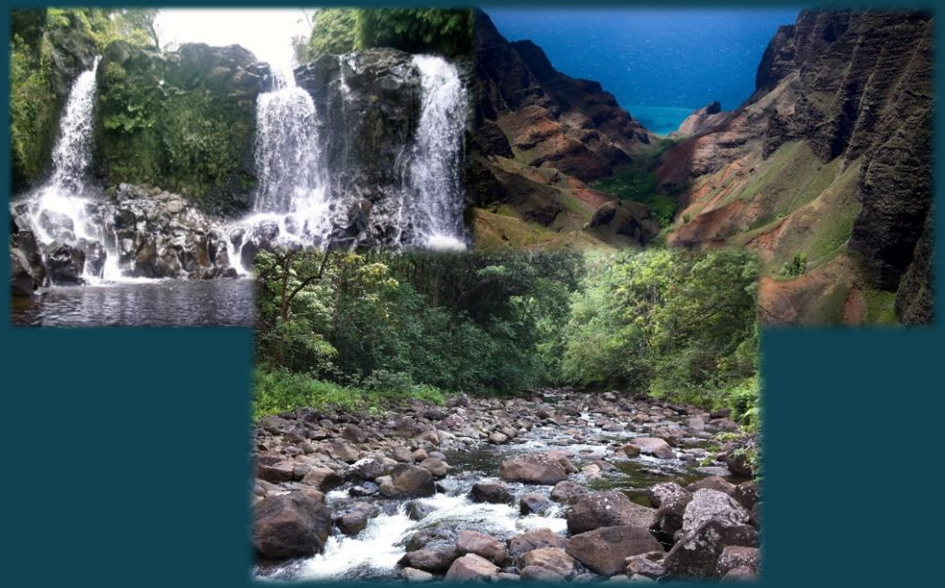
1 School of Natural Resources, University of Missouri, Columbia, MO
2 Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI
3 U.S. Fish and Wildlife Service, Honolulu Hi

Conservation in an era of global change

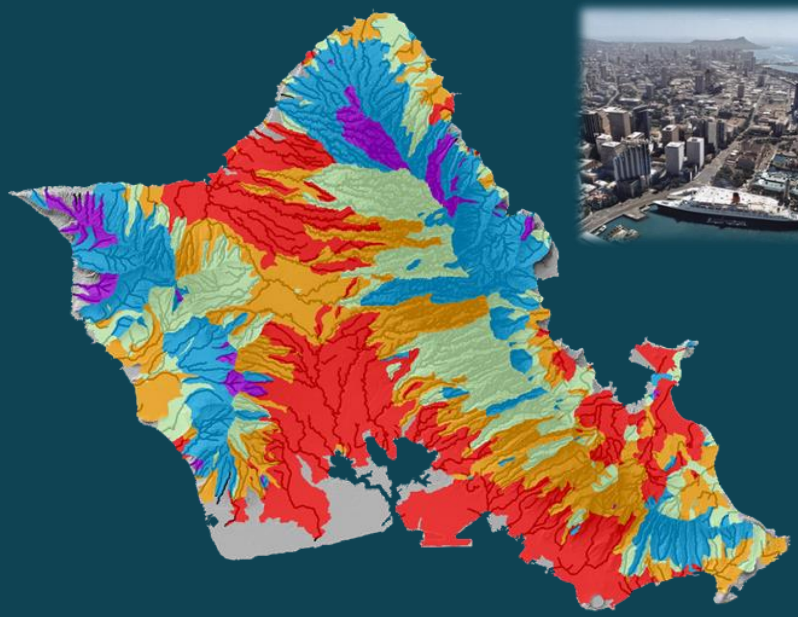
New conservation strategies should incorporate knowledge on effects of climate change Palmer et al., 2009; Zeigler et al., 2012

- Proactive approaches to conservation

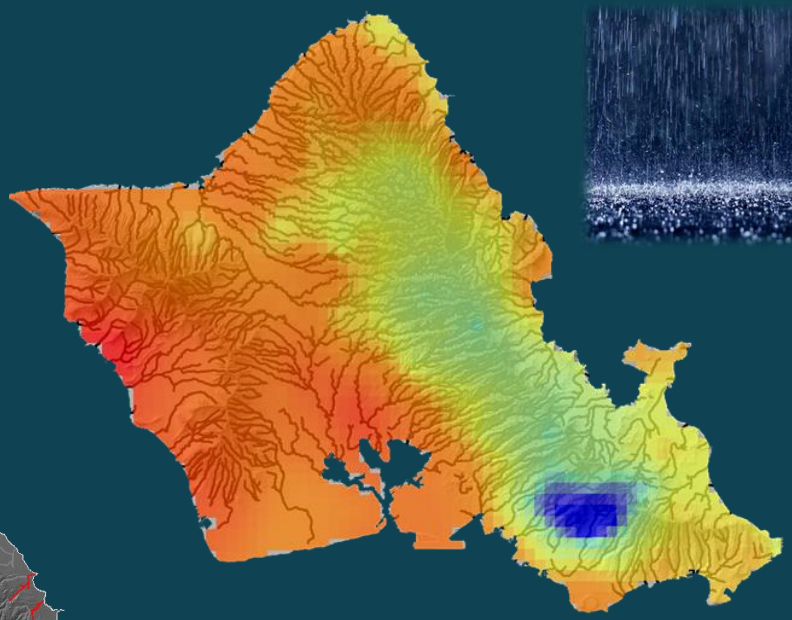
Difficult to implement over large regions with complex patterns in stream habitat, habitat condition and projected climate effects



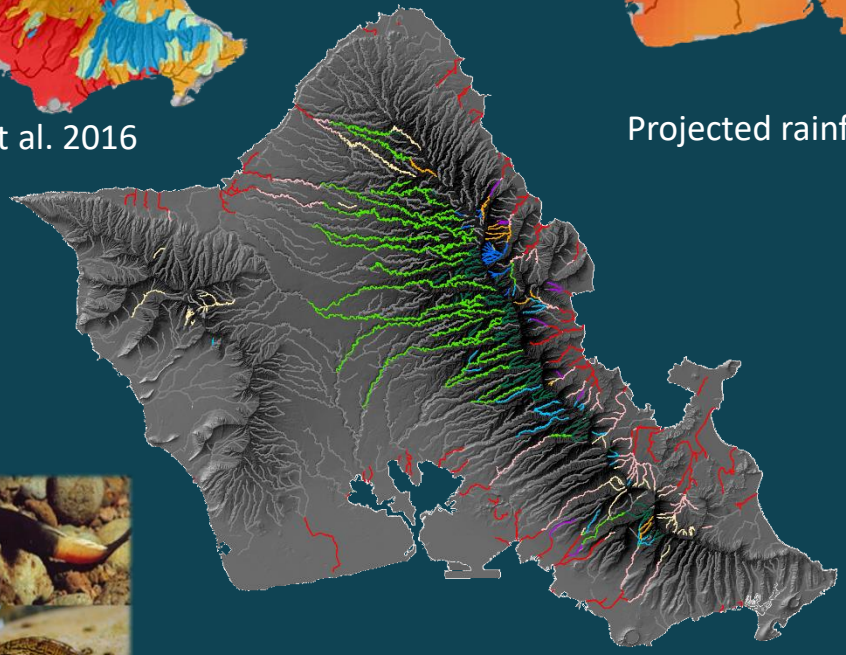
Development of island-wide products to aid conservation prioritization



Habitat condition scores, Crawford et al. 2016



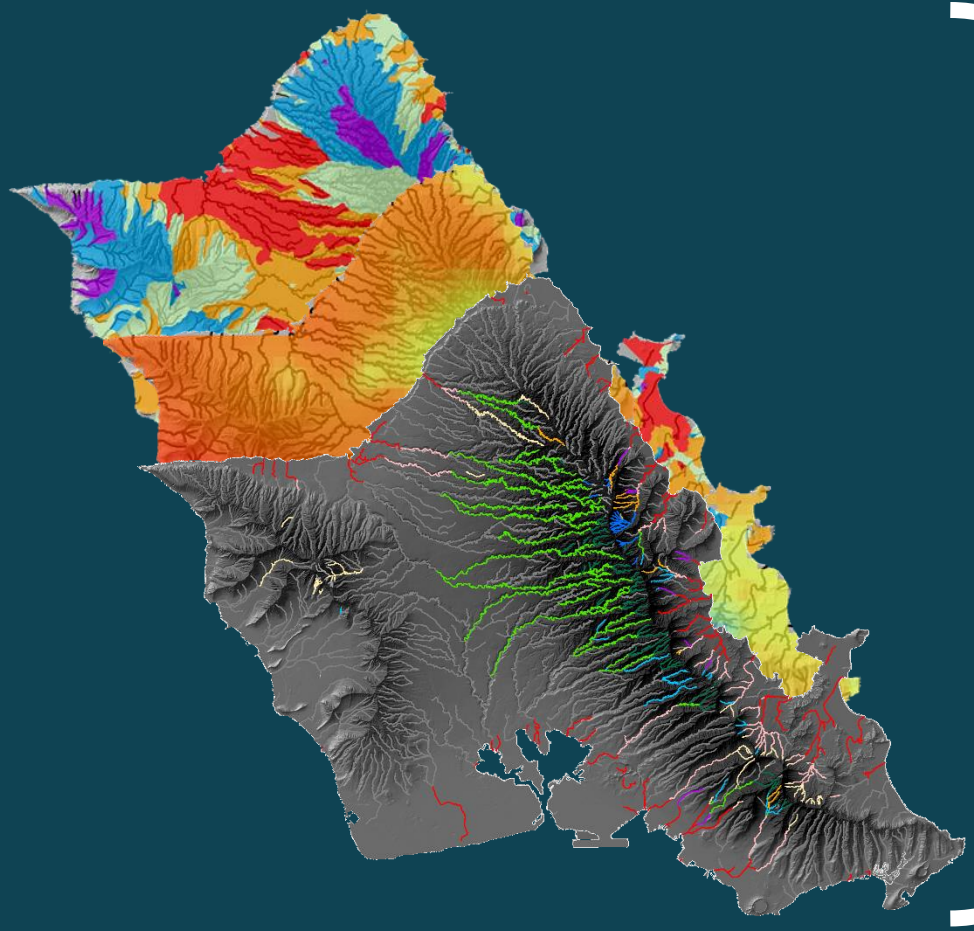
Projected rainfall, Timm et al. 2015



Stream reach types, Tingley et al. in prep

Integration for prioritization?

How can these statewide datasets be used to aid in strategic conservation planning?



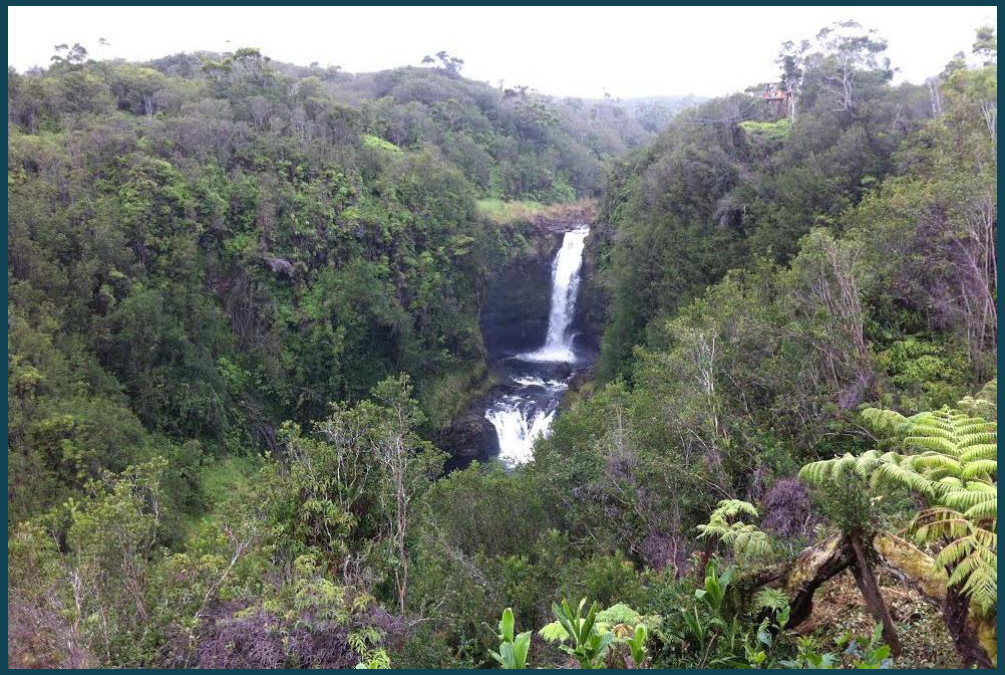
Current and future streams of high conservation value

HAWAII FISH HABITAT PARTNERSHIP

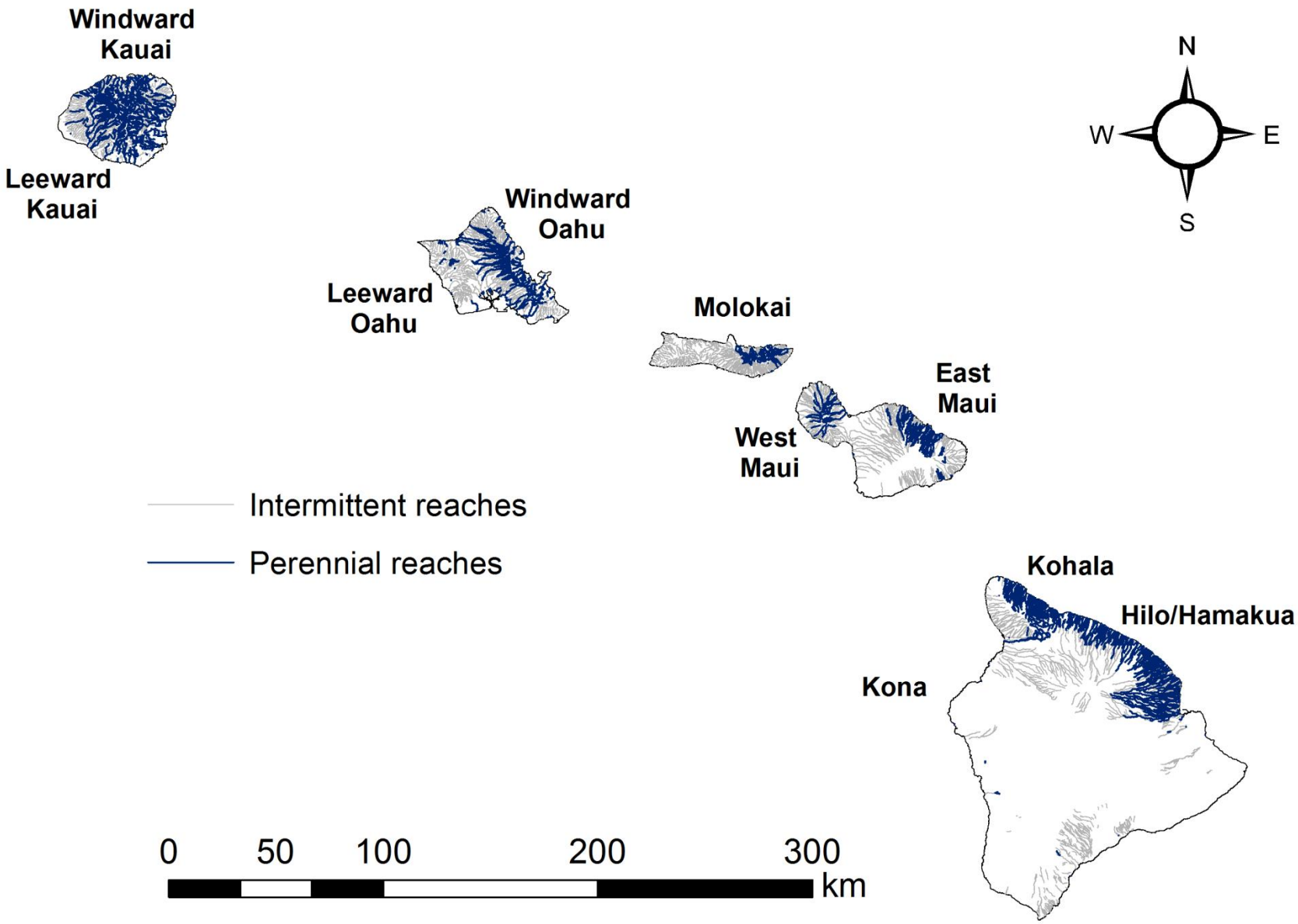
Goal

Incorporate projected climate data into a prioritization of stream habitats of the Hawaiian Islands for the conservation of native species

1. Identify areas of conservation value by considering both current and future characteristics of stream habitats
    - Map based output



Study area: Five largest Hawaiian Islands



Hawaiian streams

376 perennial watersheds
- Short (12 km longest)
- Many high gradient; waterfalls
- Highly variable streamflow

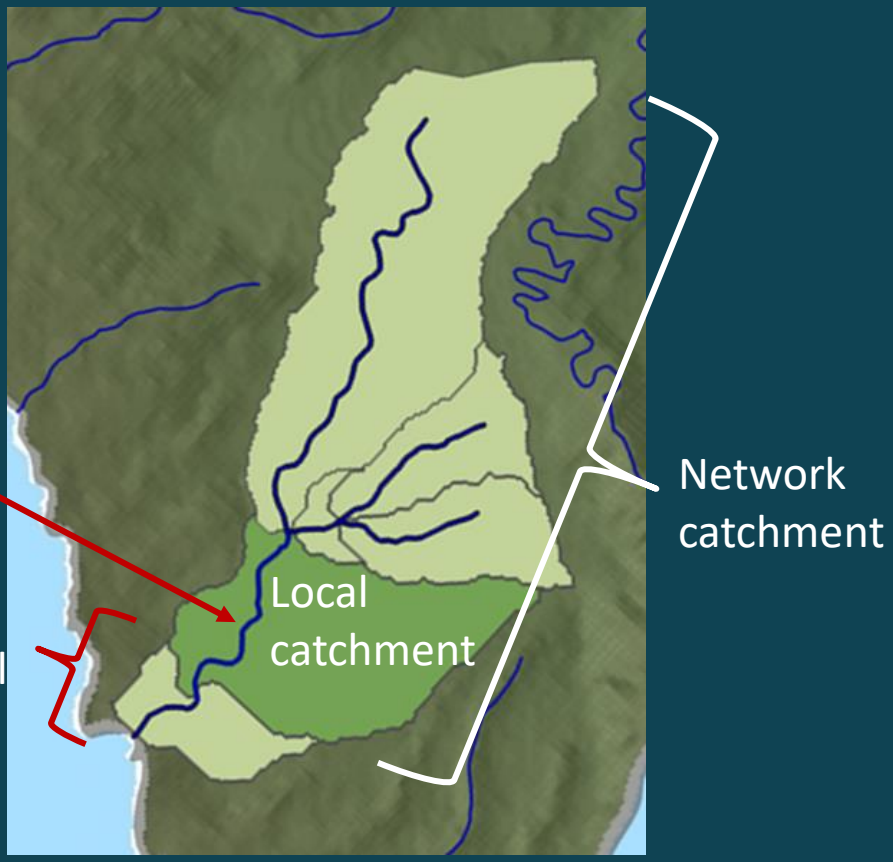
Big Island

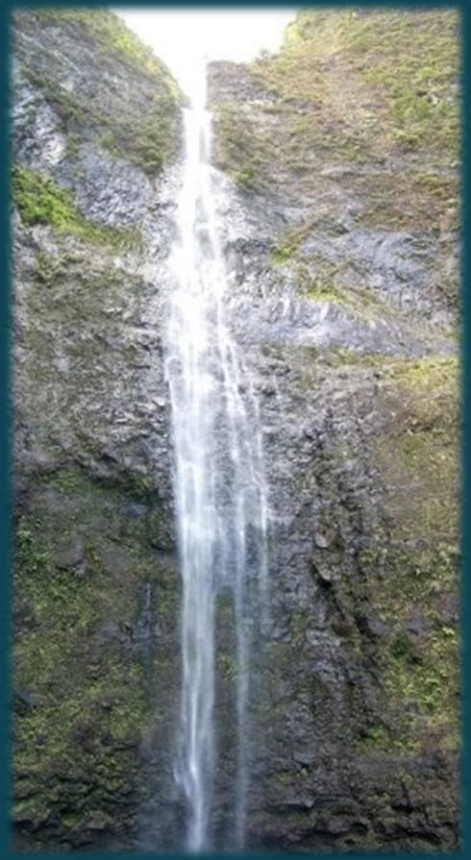
Kauai

Spatial framework

Analysis unit: stream reach

- Local, network, downstream catchments
- HFHP stream layer 1:24,000



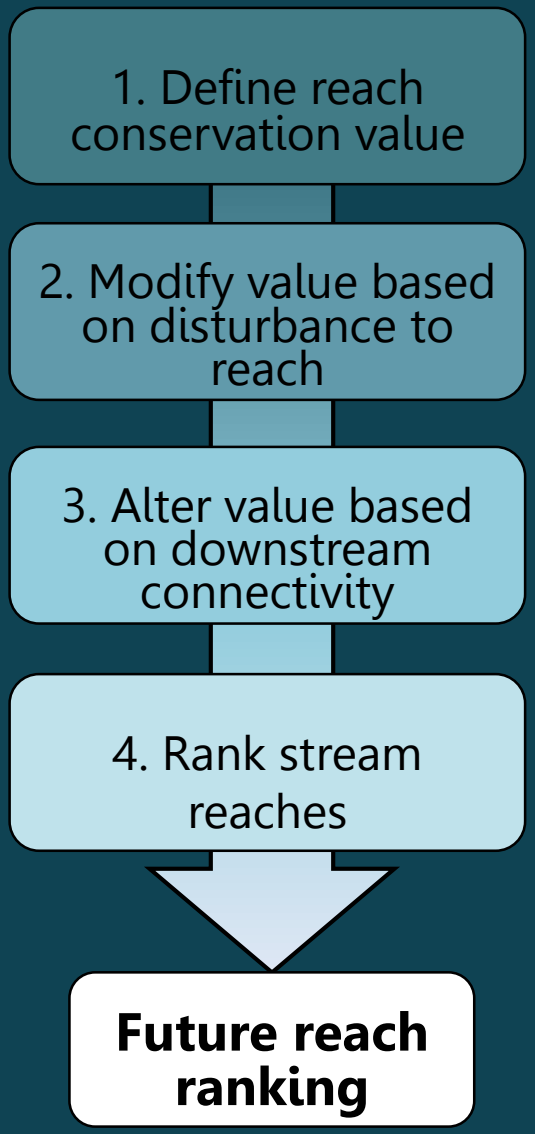


Prioritization method: Conceptual overview

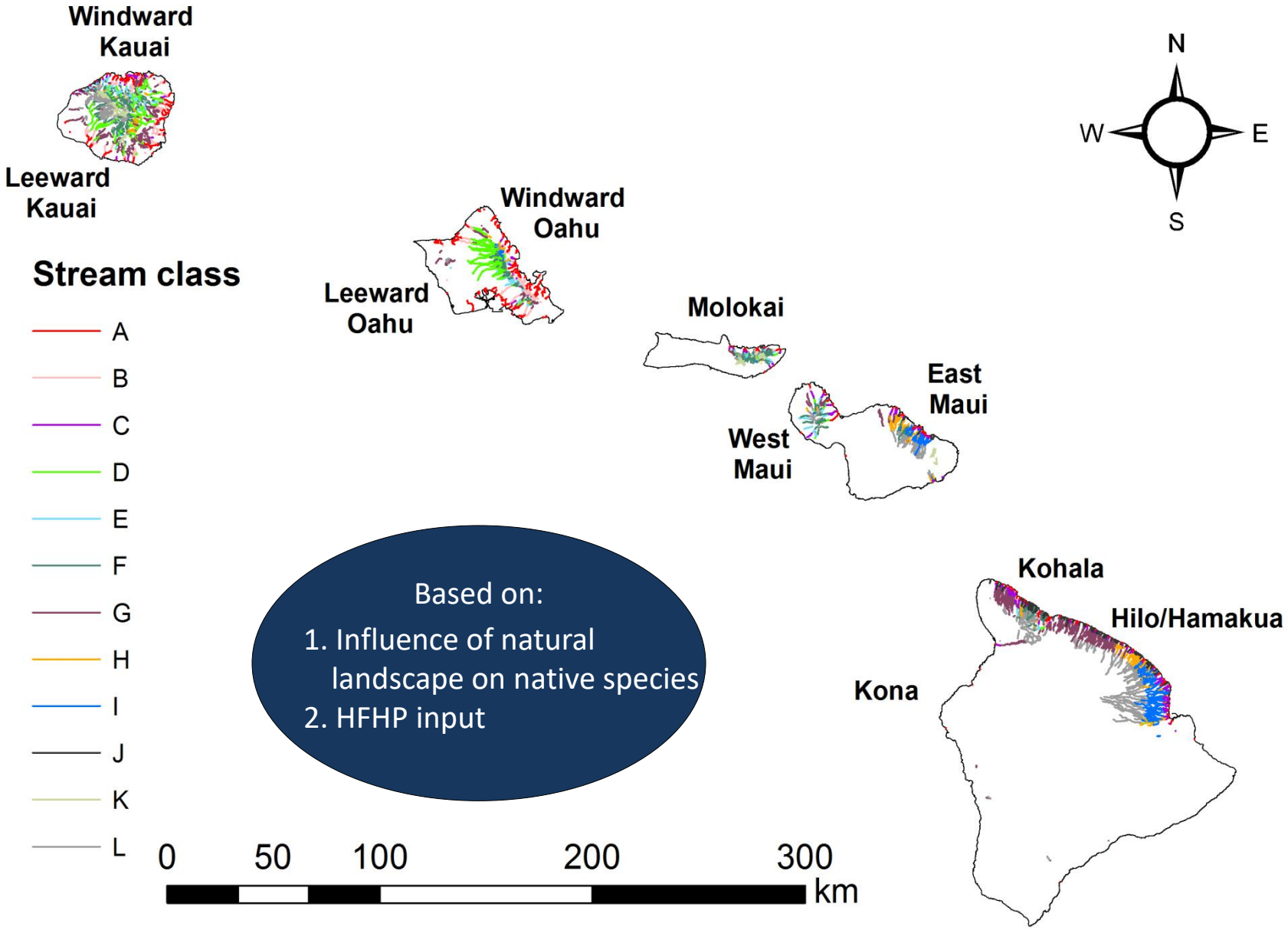
ZONATION
Conservation planning software

Iterative ranking of study units

1. Presence of "conservation features"
   - Unique habitat
2. Habitat condition or disturbance
3. Connectivity to other habitats



1. Define reach conservation value – Stream classes as conservation features



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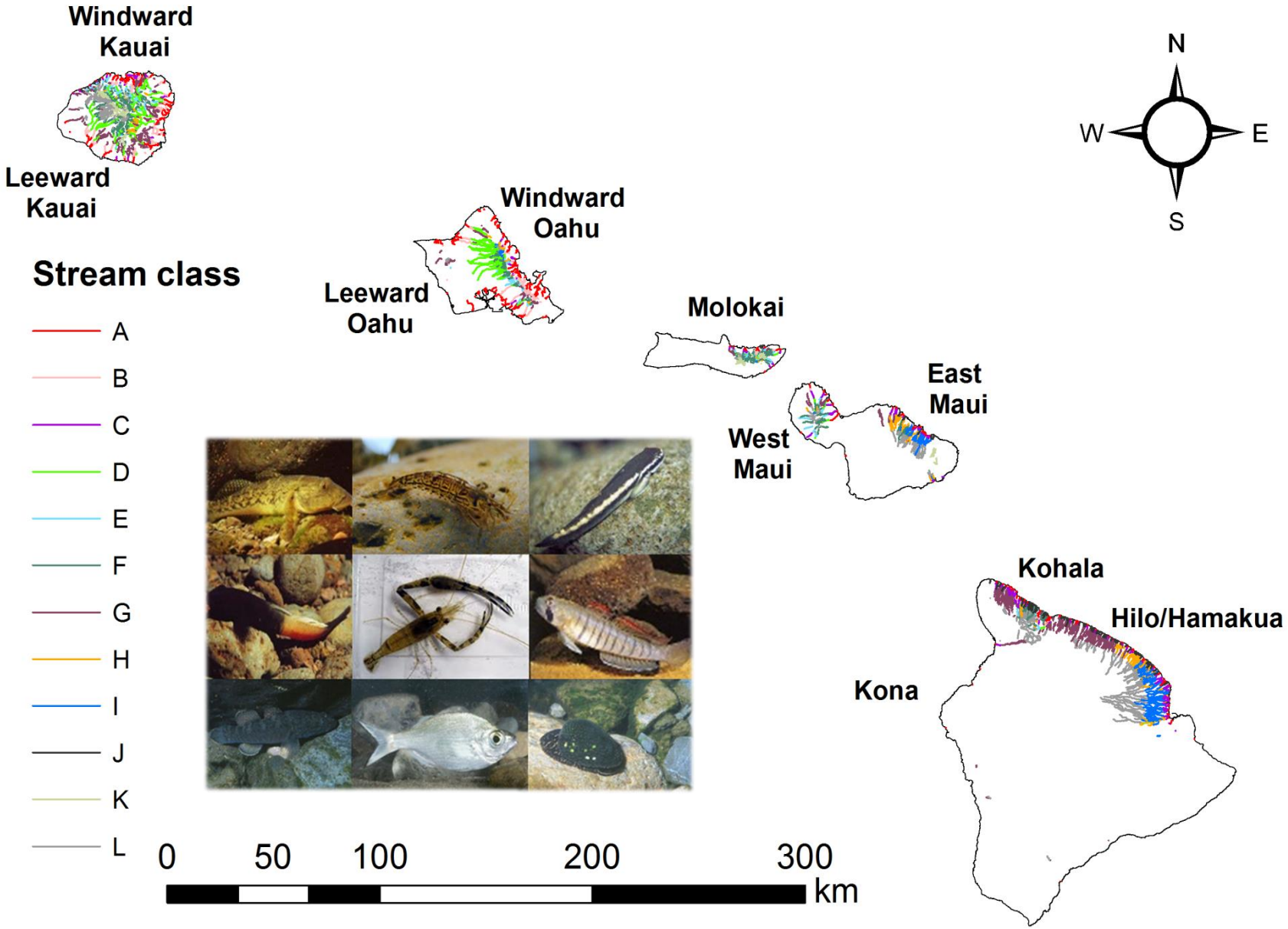
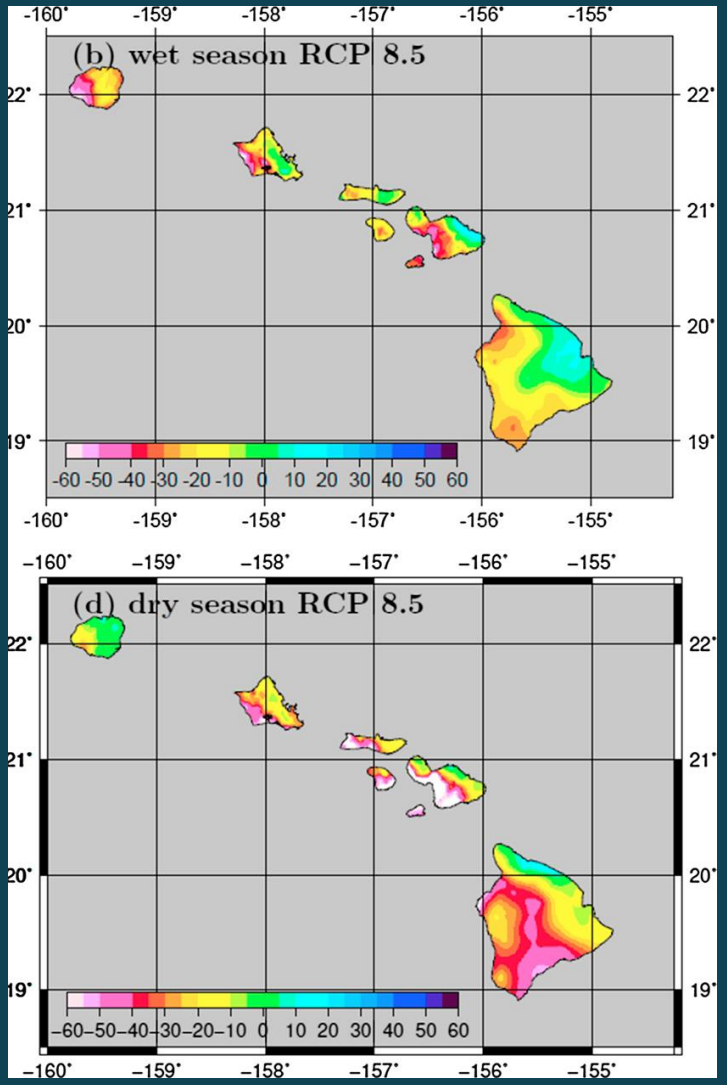


1. Define reach conservation value – Future classes given changes in rainfall

Reach classes under projected changes in mean annual rainfall

- 2 time periods*
  - Mid-century
  - Late-century
- 2 climate scenarios
  - RCP 4.5 - Medium emissions
  - RCP 8.5 - High emissions

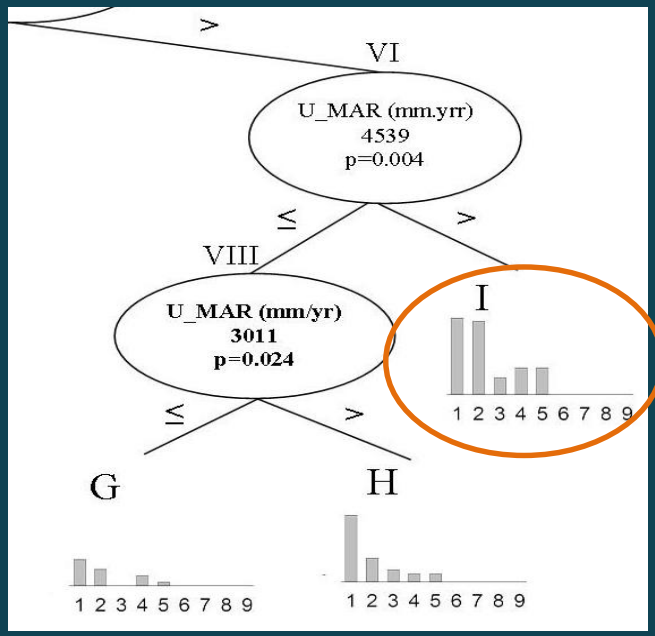
Representation of future ecological potential



*Updated Timm et al., 2015

1. Define reach conservation value – Ecological uniqueness based on classification

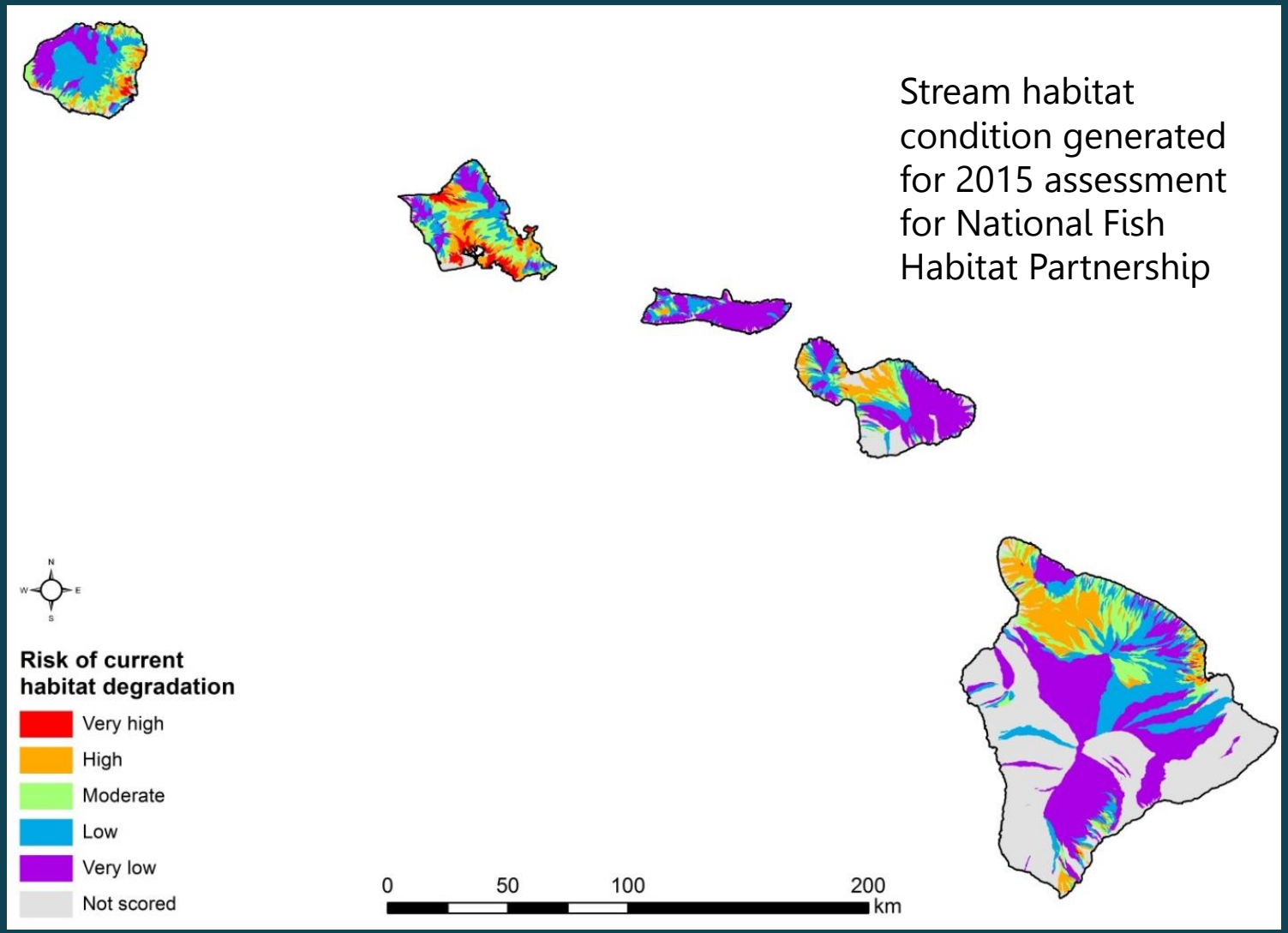
1. Prioritized unique habitat
2. Higher weighting for classes with many taxa
   - Taxa defined by prevalence in classes Lui et al., 2005



Output of stream classification

2. Modify value based on disturbance – Habitat condition score

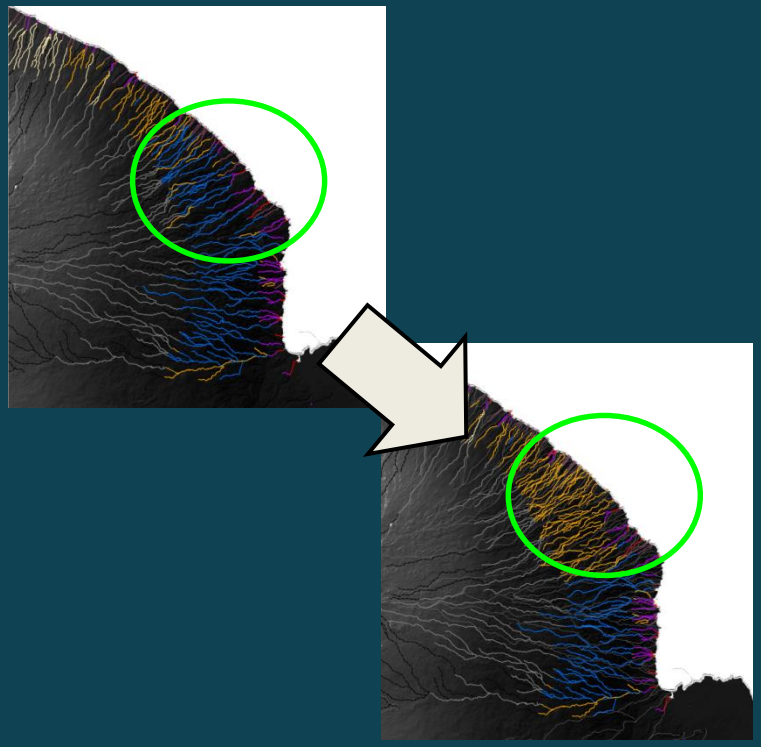
Reaches in poorer condition received lower habitat condition scores Crawford et al., 2016

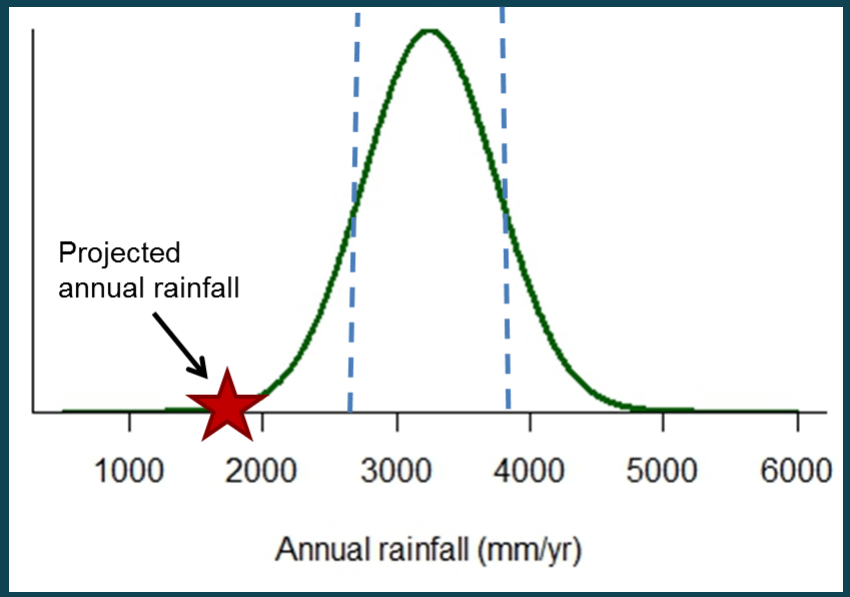


2. Modify value based on disturbance – Climate exposure score

Reaches received lower score if

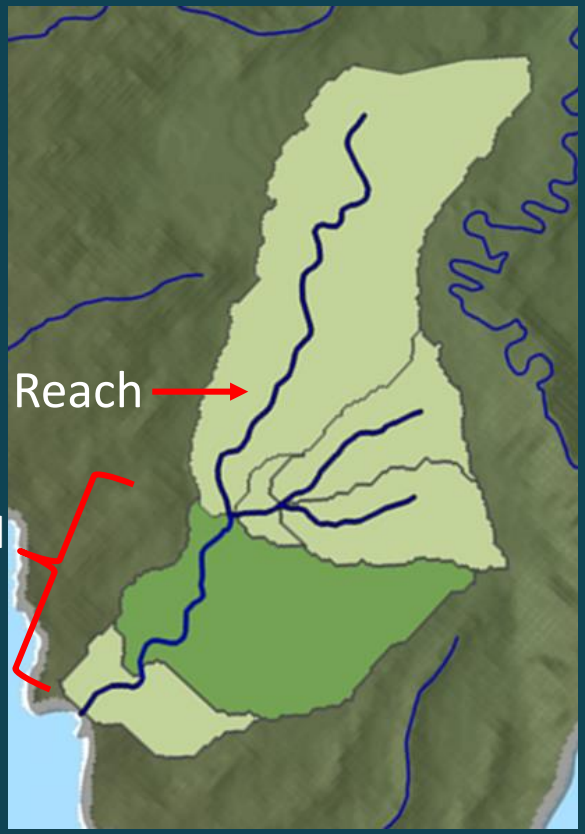
1. Changed class resulting from reduction in rainfall with changes in climate
2. Annual or dry season rainfall was projected to be one standard deviation or less from current rainfall





3. Alter conservation value based on connectivity to high value habitats downstream

Account for amphidromous life history of Hawaiian stream species



4. Rank reaches based on conservation value: Initial steps

Zonation scores each study unit (i.e., stream reaches) based on conservation value defined by input characteristics

Scoring occurs by an iterative ranking of every unit

- Units ranked 0 have the lowest value, units ranked 100 have the highest value

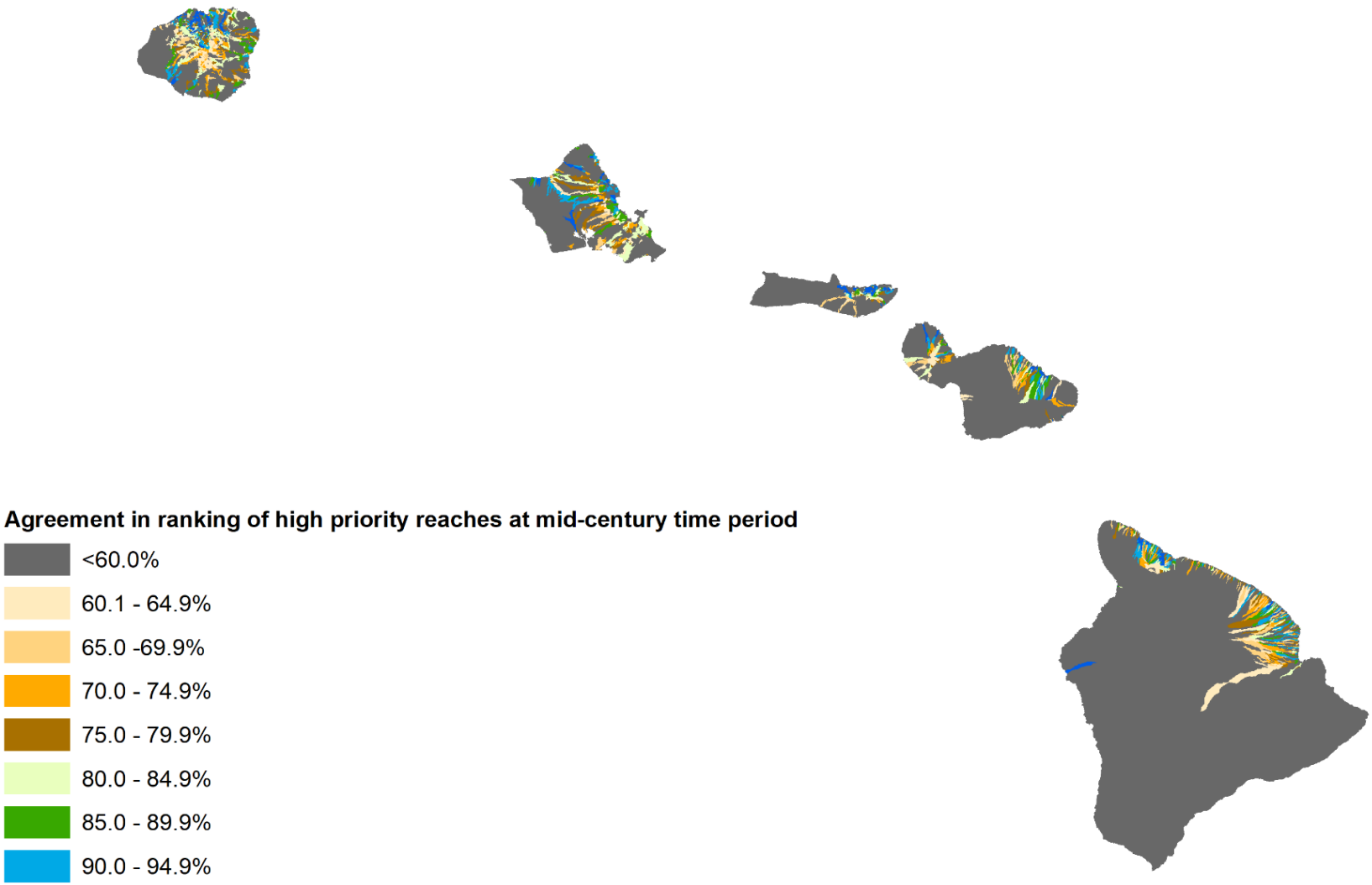
One current and **four** future rankings conducted

- 2 RCP scenario, 2 time periods

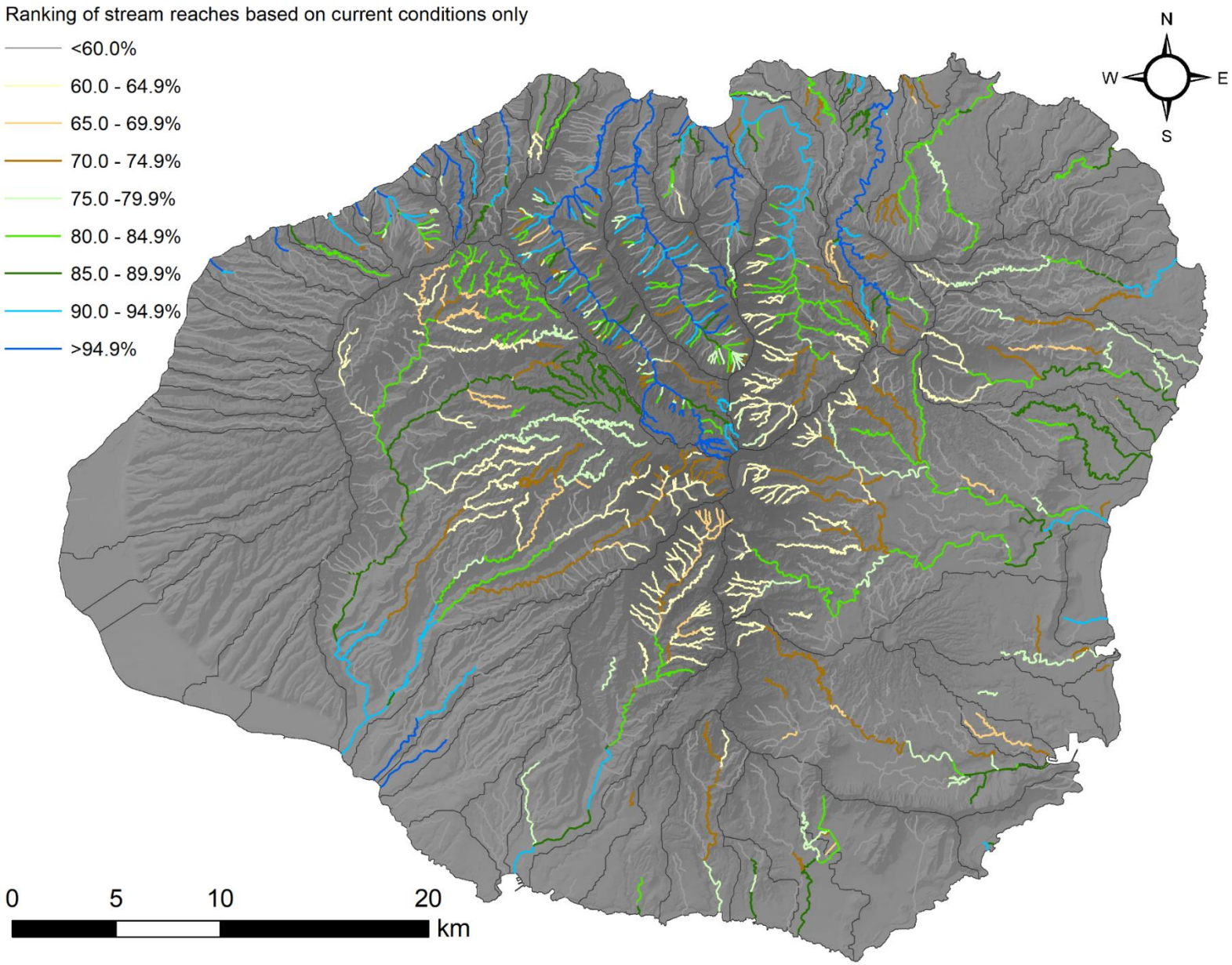
Assessed overlap in rankings for mid- and late-century

- Where are areas likely to have high value under either climate scenario?

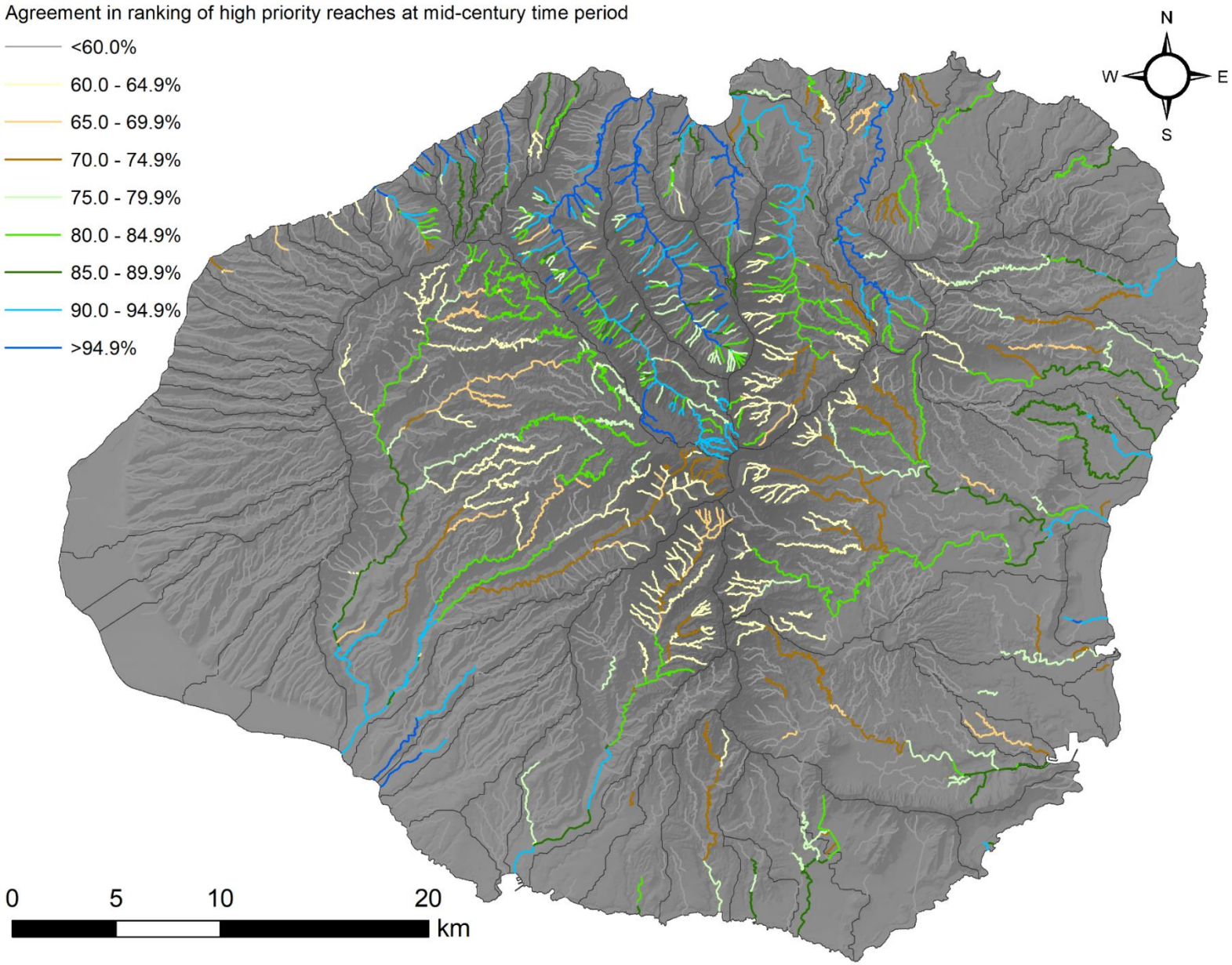
Areas of high conservation value: Mid-century



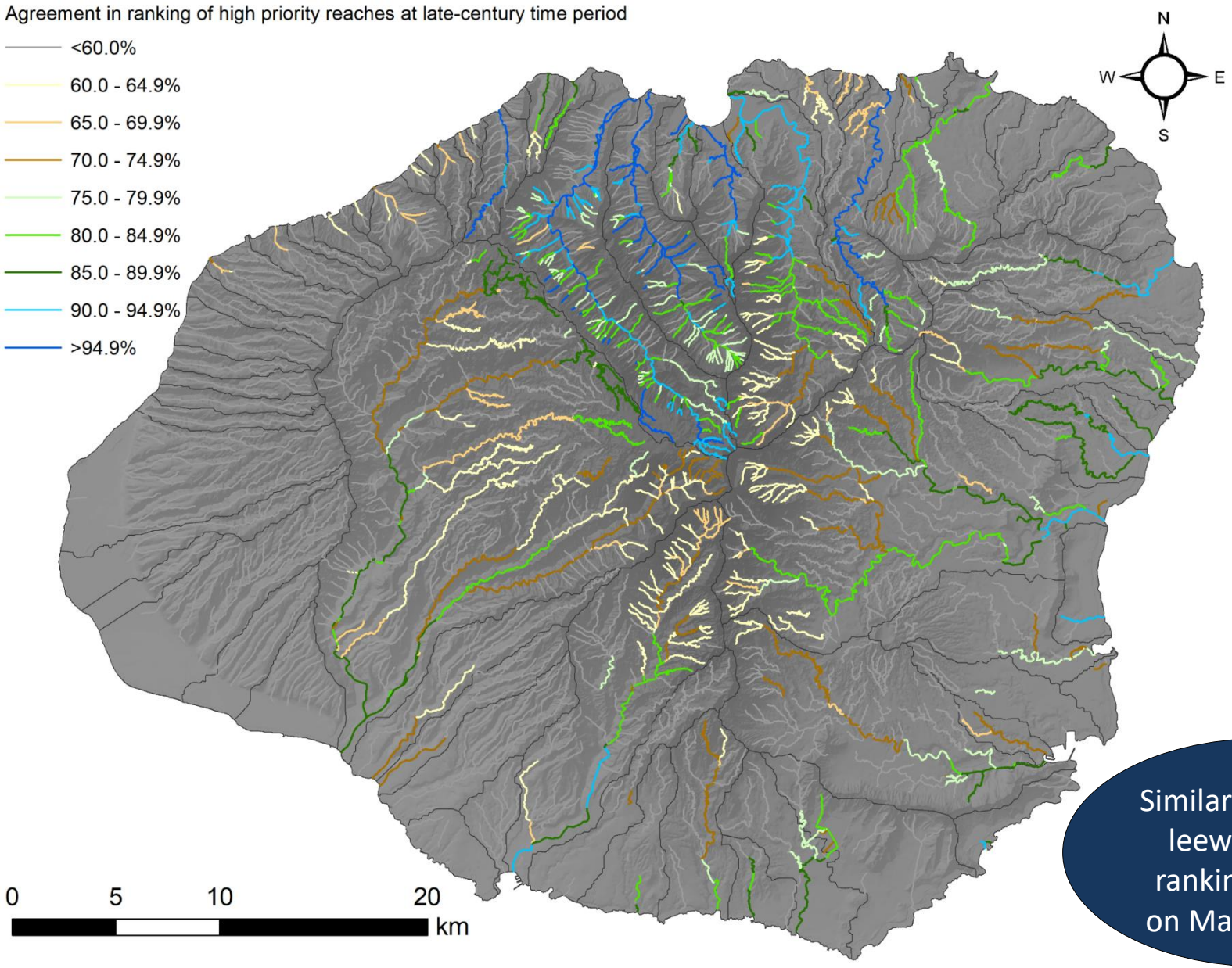
Areas of high conservation value: Current



Areas of high conservation value: Mid-century

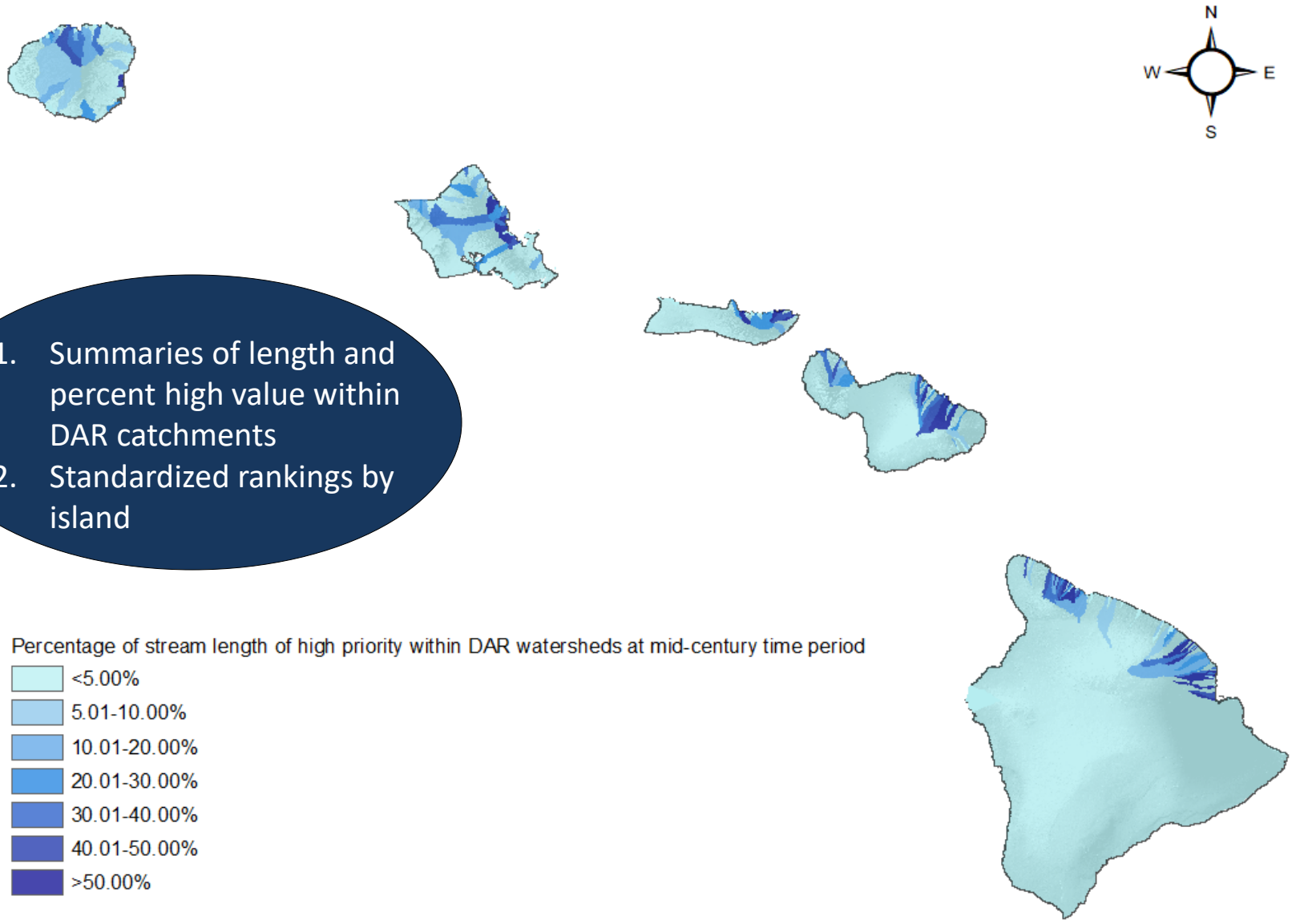


Areas of high conservation value: Late-century



Similar patterns of leeward reach ranking declines on Maui, Molokai

Summarization of results for strategic planning



Take home

Zonation allowed for improved understanding of spatial variation in climate change impacts on stream habitats

- Suggests many catchments currently of high conservation value will be resilient to changes in mean rainfall

Multiple time periods allowed for additional insight into effective conservation action

- Selection of strategic catchments; restoration vs. preservation
- Most effective when paired with local knowledge and understanding of climate projection uncertainty
- Can be updated as new datasets or information on climate effects become available

Acknowledgements

- Hawaii Fish Habitat Partnership
- National Fish Habitat Partnership
- Michigan State University
- US Fish and Wildlife Service
- Association of Fish and Wildlife Agencies
- USDA Forest Service
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