Prioritizing habitat restoration for endangered salmon: Getting the biggest bang for your buck

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Human Dimensions Program Review

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NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Photo: https://tau0.files.wordpress.com/2011/11/wenatchee_river_winter_morning.jpg

Preliminary results – do not cite or circulate

Restoration of endangered salmon habitat

- Hundreds of millions of dollars spent annually on stream restoration and monitoring for ESA-listed salmon in PNW

- Restoration projects are often misaligned with the biological needs of ESA-listed salmon at the subwatershed scale
  (e.g. Barnas et al. 2015)

➢ *GOAL: Present a straightforward method for evaluating restoration alternatives at the subwatershed scale.*

Photo: NOAA

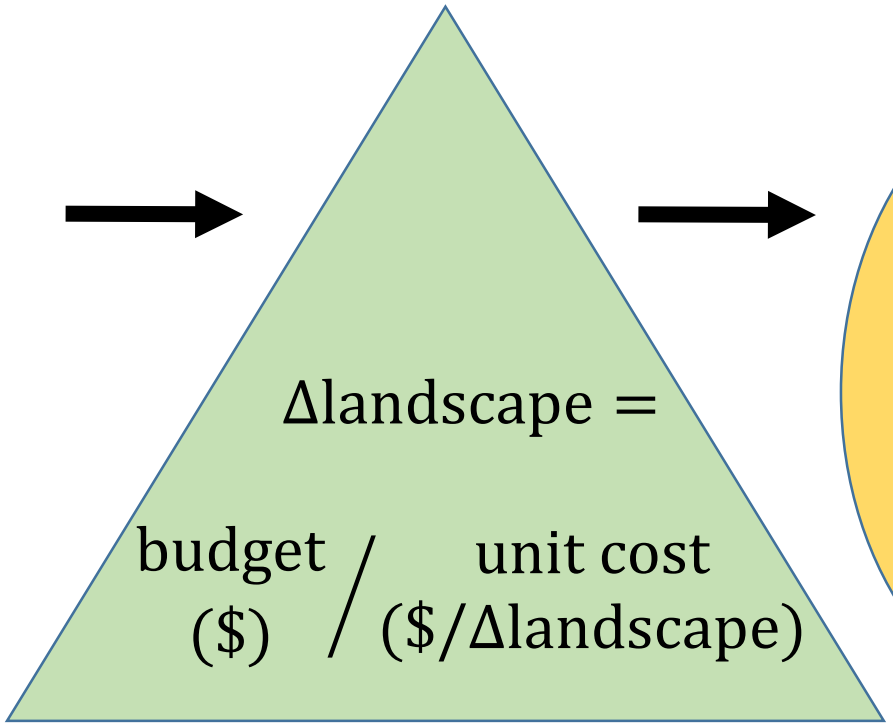
Cost effectiveness analysis for habitat restoration

1. **Define Restoration alternatives**
2. **Calculate change in landscape**
3. **Translate landscape change into additional spawners**
4. **Bang for your buck**

Define baseline conditions and alternative restoration actions

Set a common budget for all actions ($)

Determine the unit cost for each action ($/ Δ landscape)



Coupled biological models

Spawners/$

Case study: Upper Columbia River spring Chinook

Columbia River System:

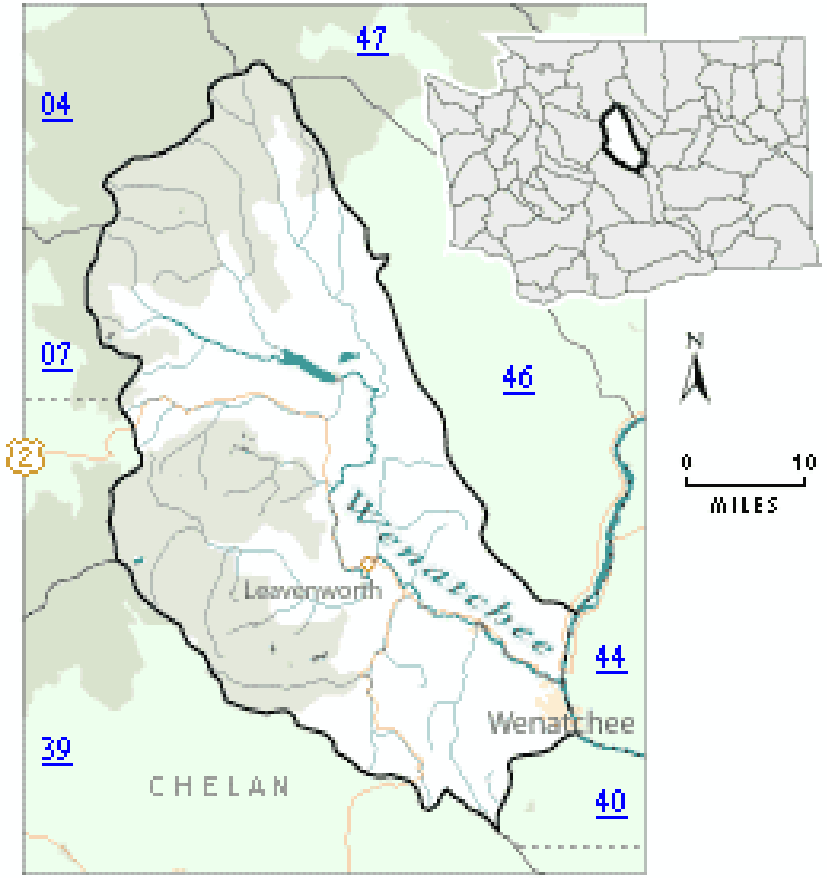
Source: https://www.nwcouncil.org/energy/powersupply/dam-guide

Anthropogenic impacts:

1. Hydropower
2. Hatcheries
3. Harvest
4. Habitat

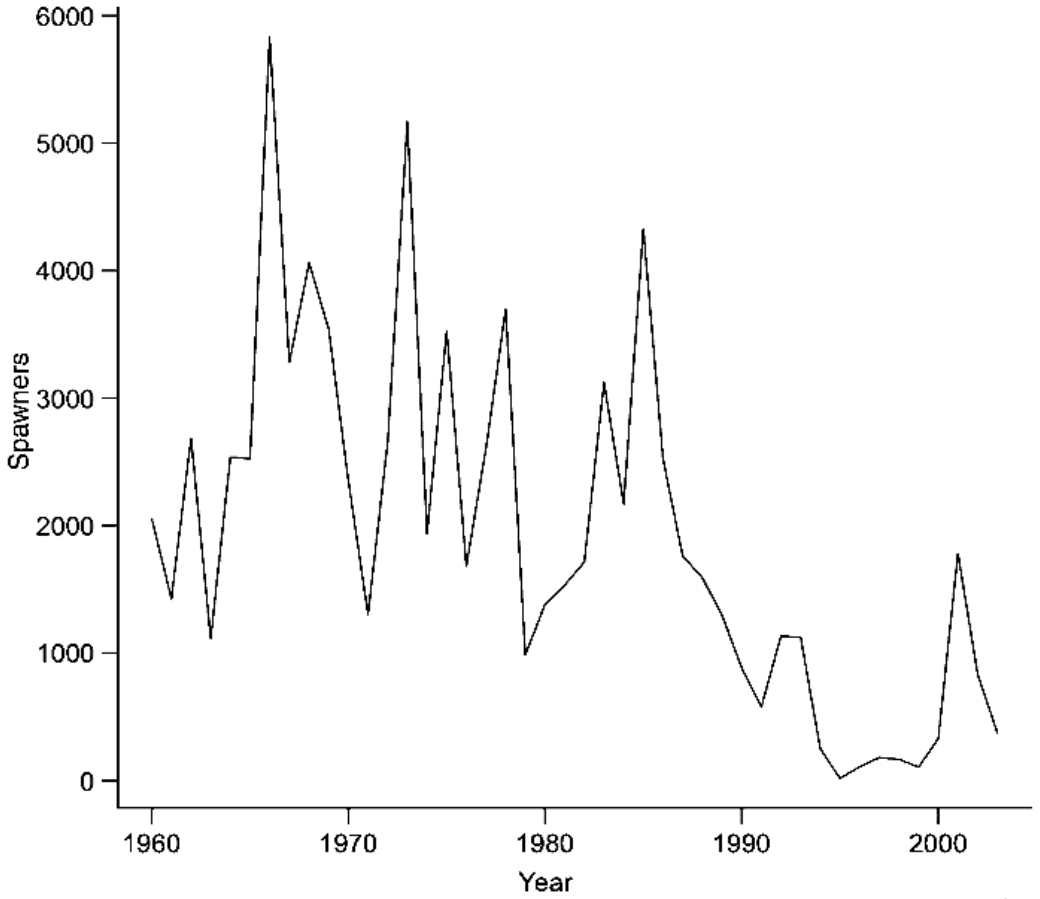
Case study: Wenatchee Basin spring Chinook

Wenatchee basin:



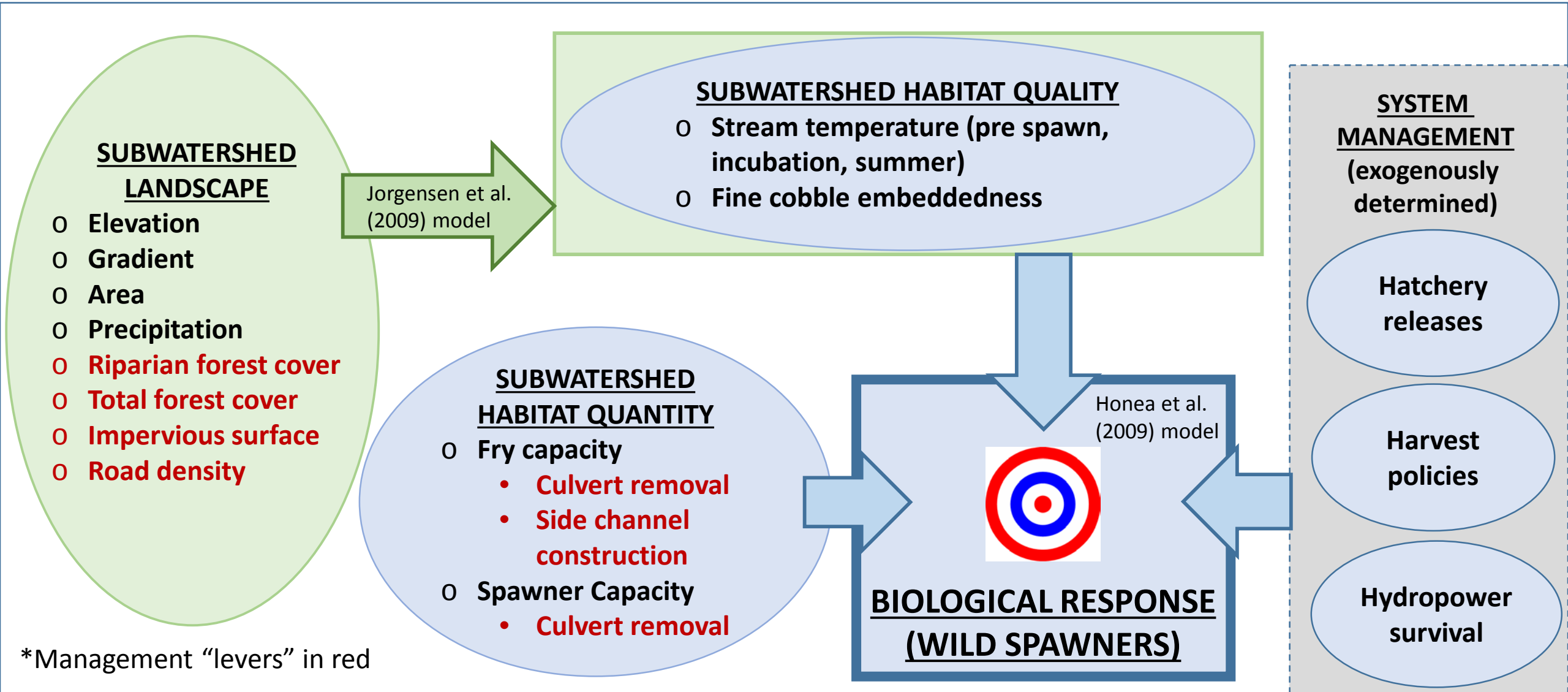
Source: http://www.ecy.wa.gov/programs/wq/tmdl/WenatcheeMulti/

Declining spring-run Chinook wild spawners:



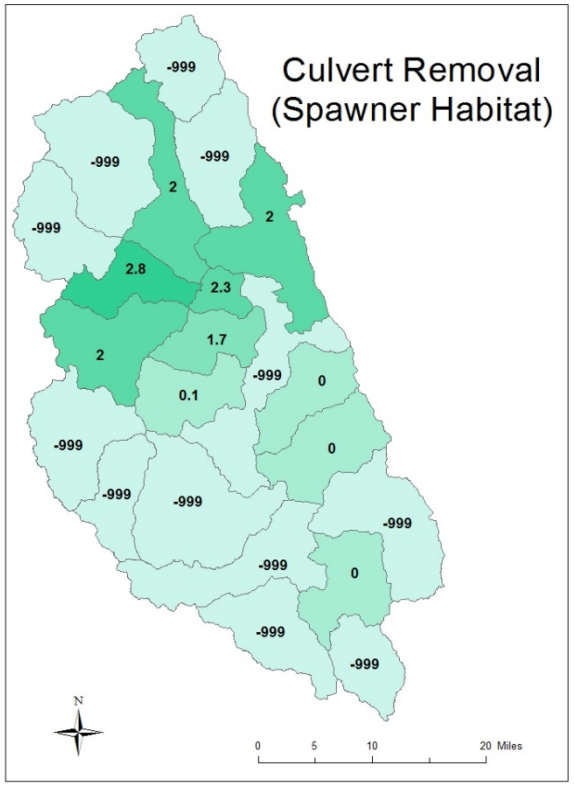
Honea et al. 2009

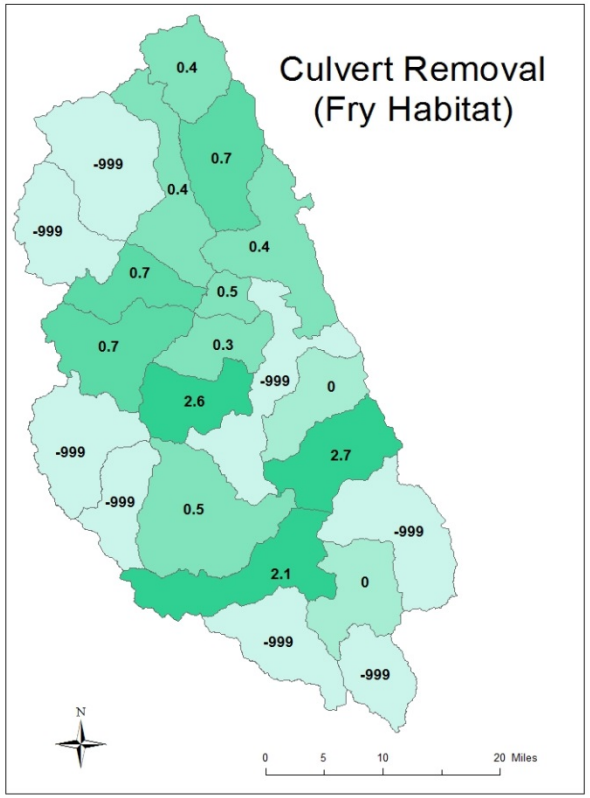
Coupled biological models connect restoration to Wenatchee wild spawners

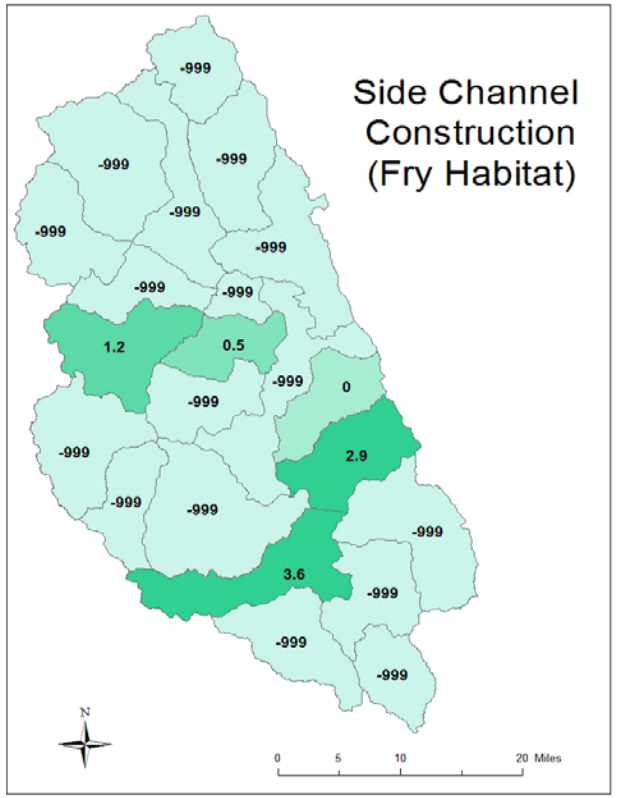


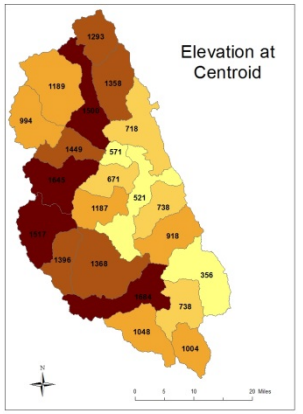
*Management "levers" in red

Cost effectiveness varies spatially and across recovery actions

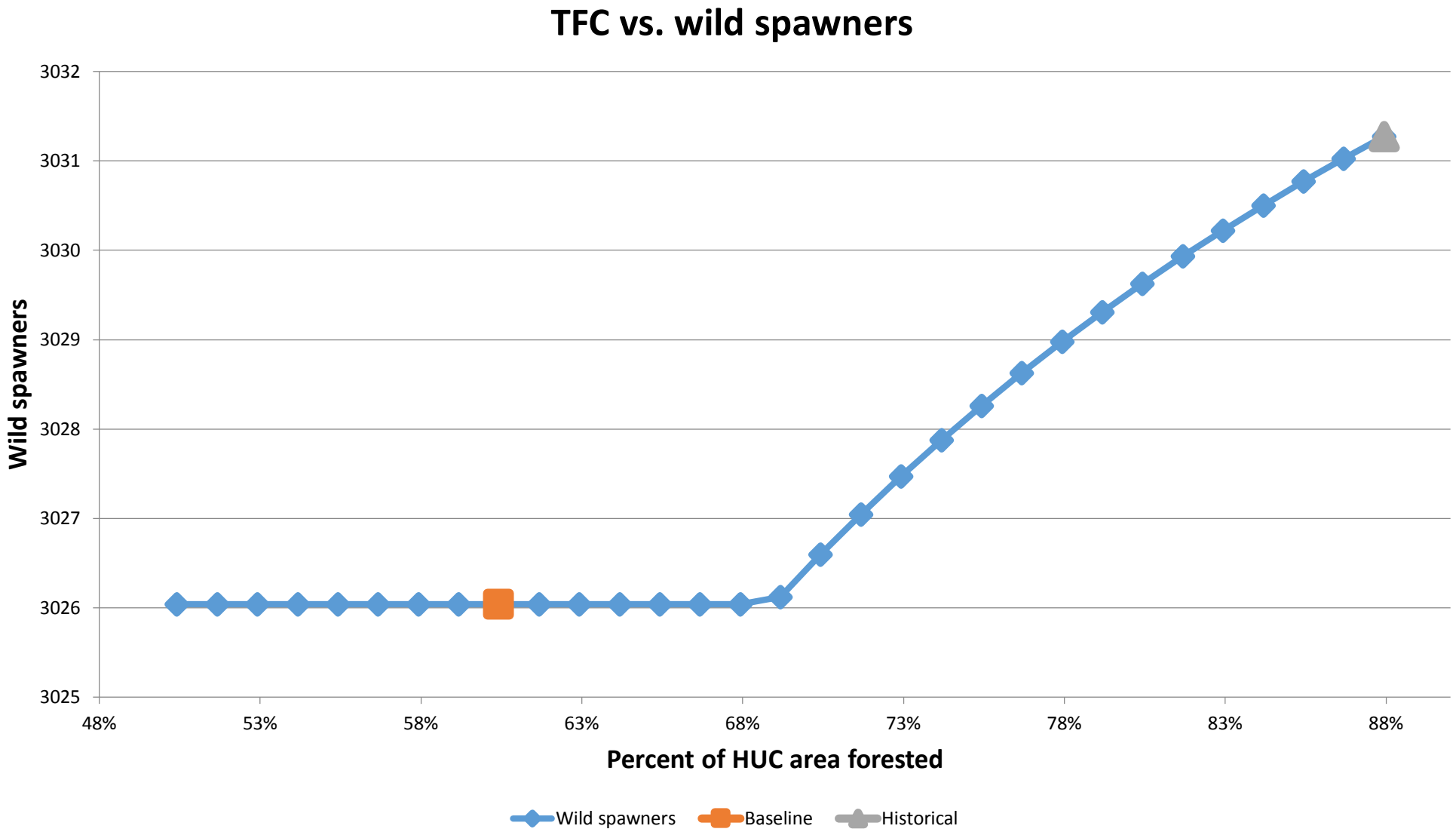




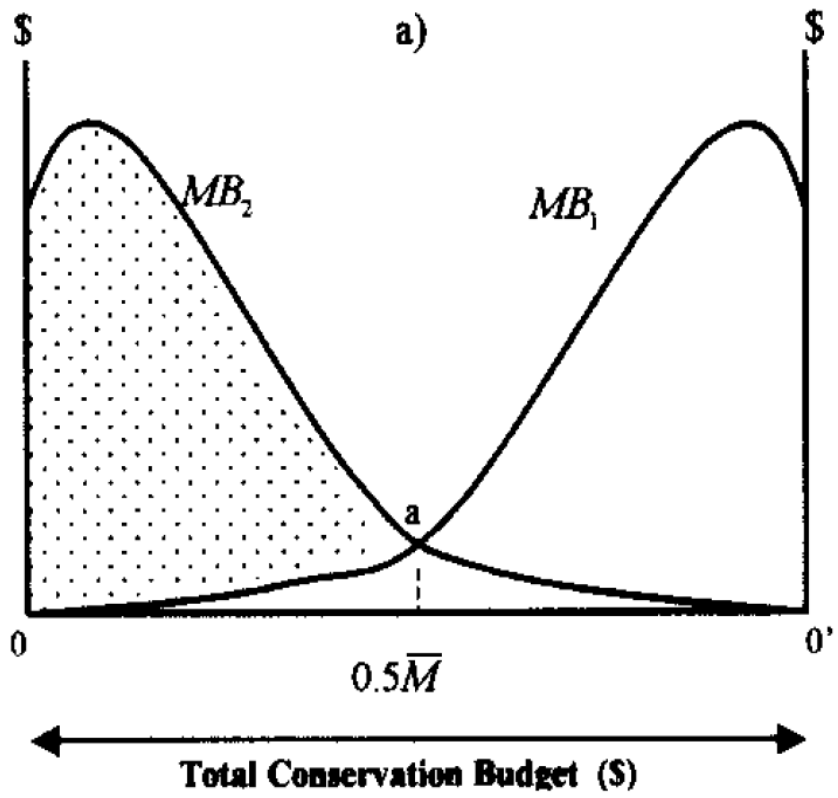


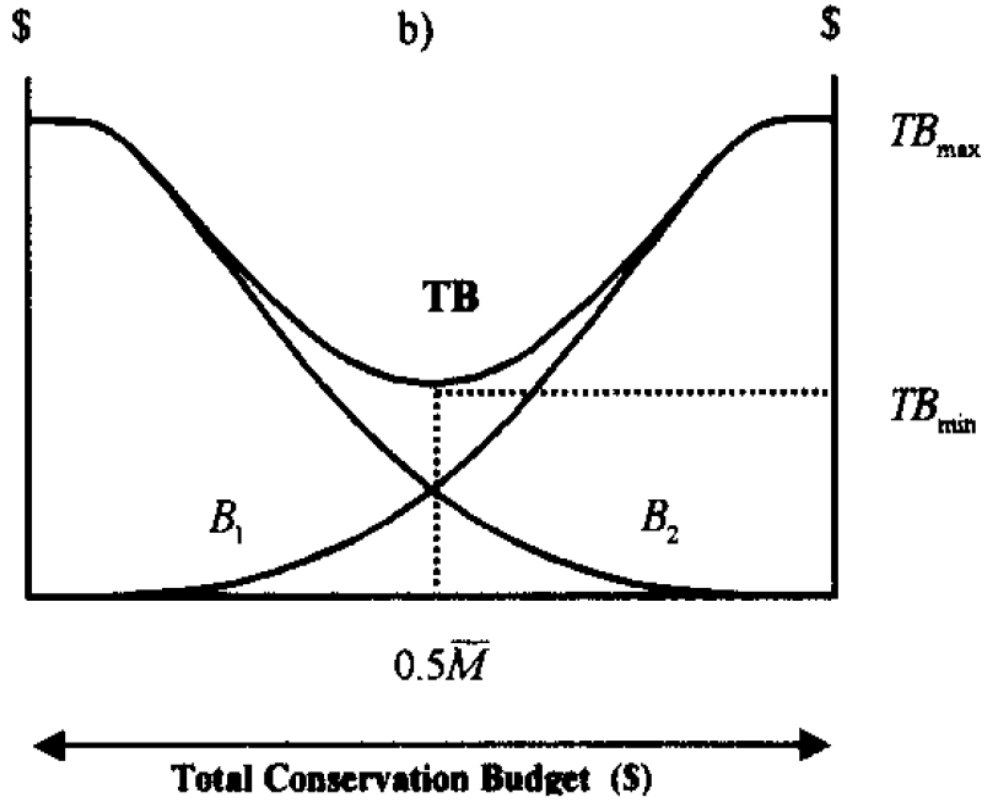


Ecological thresholds



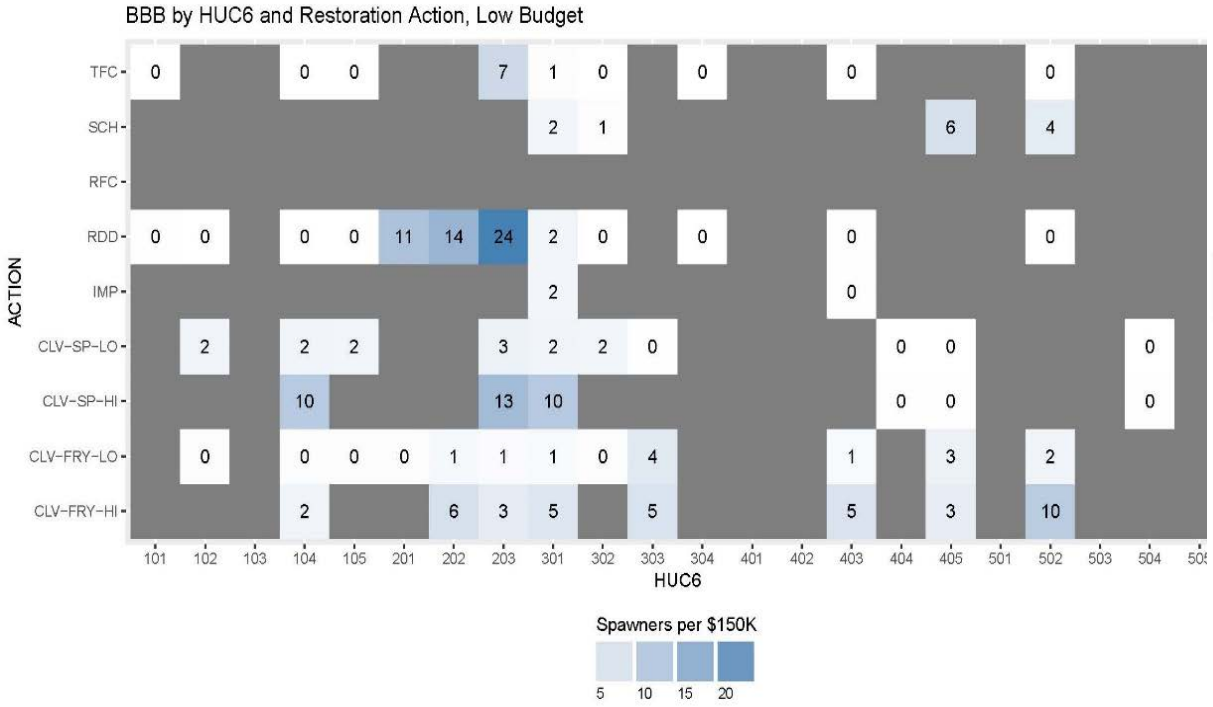
Threshold effects under politically acceptable allocation of restoration budget (Wu et al. 2003)



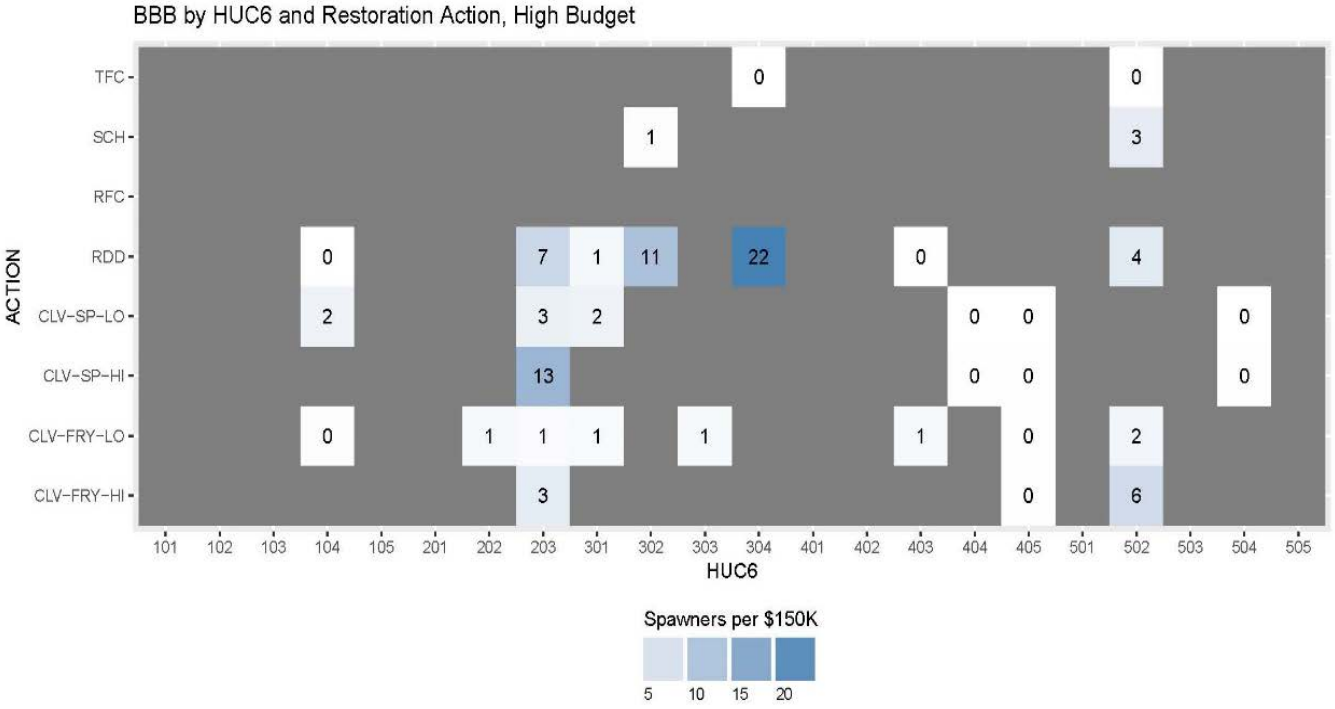


Results across project budget/scale

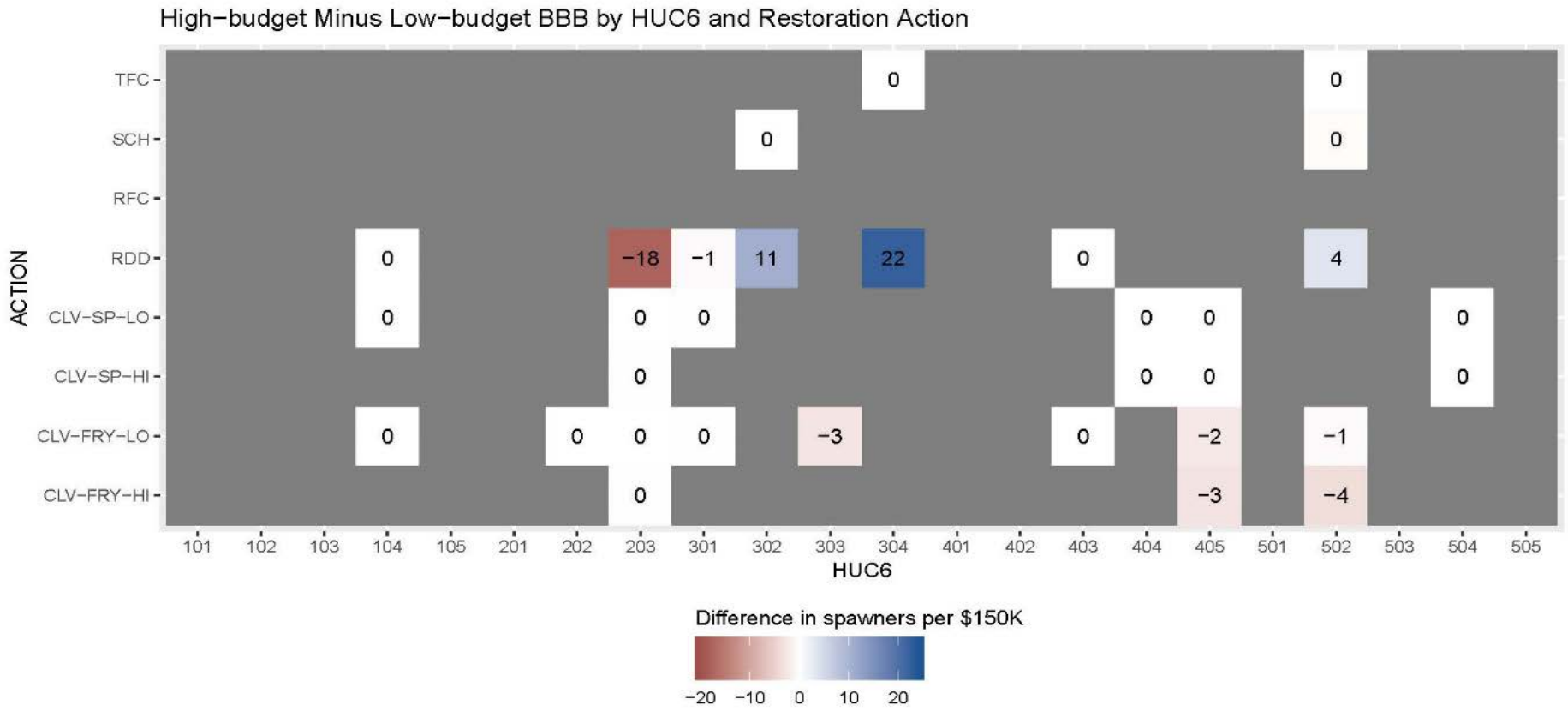
$150K Budget



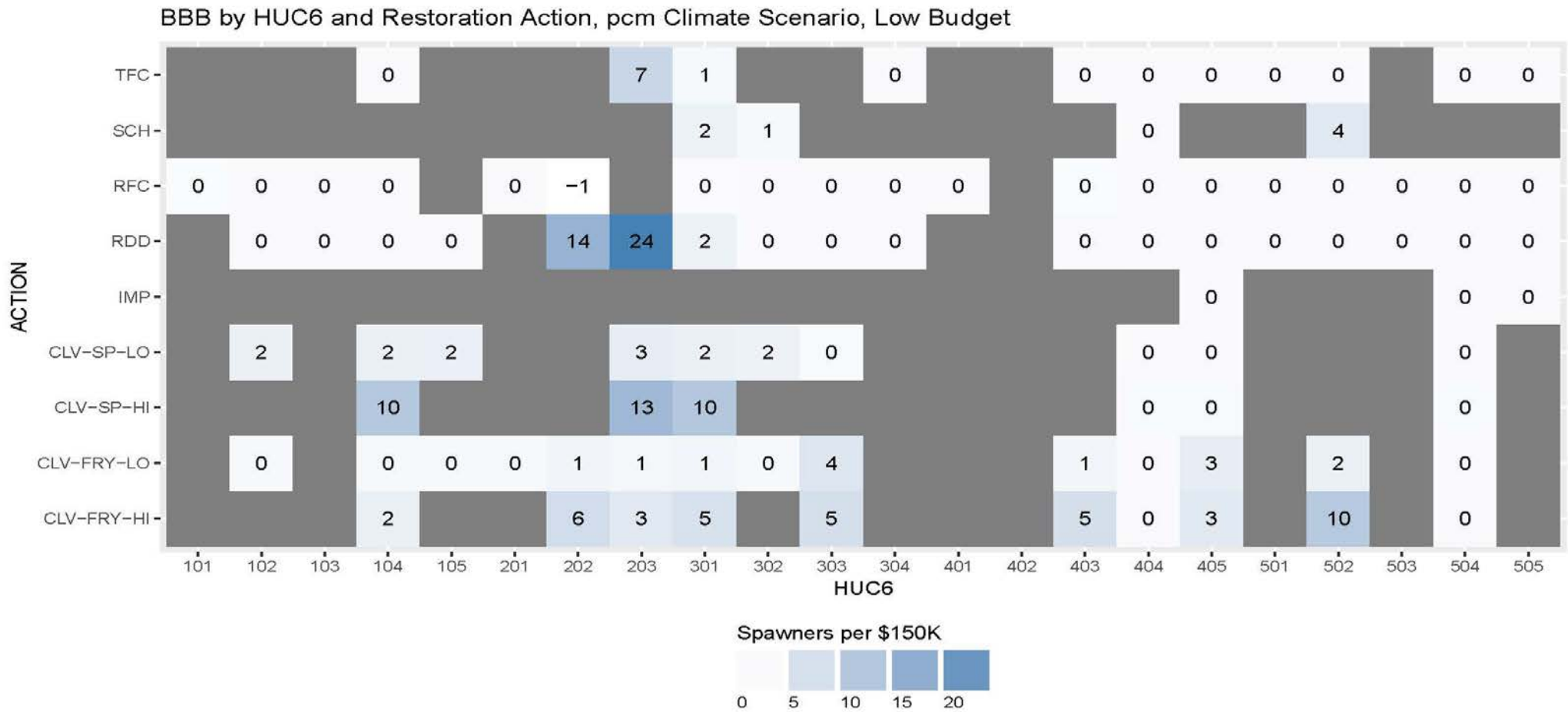
$2.4M Budget



Results across project budget/scale(cont.)



Results under climate change scenarios



Ongoing work:

1. Characterizing and reducing uncertainty

2. Consideration of the timing of costs and biological response

3. Investigating the drivers of project costs

4. Dynamic prioritization of restoration projects chosen over time (e.g. Messer et al 2016)
   - Stochastic recovery objectives
   - Optimal control
   - Portfolio selection

5. Cost effectiveness analysis of data collection allocations

6. Replicating in other environments (e.g. lowland estuaries)

Questions or comments?