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

Robby Fonner, Jon Honea, Jeff Jorgensen, Michelle McClure, Mark Plummer

Western Forest Economists 2016 Meeting

May 3, 2016

NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Note: Preliminary results, please do not cite or circulate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.*

Cost effectiveness analysis for habitat restoration

1. **Define Restoration alternatives**

Define baseline conditions and alternative restoration actions

Set a common budget for all actions ($)

Determine the unit cost for each action ($/habitat)

Cost effectiveness analysis for habitat restoration

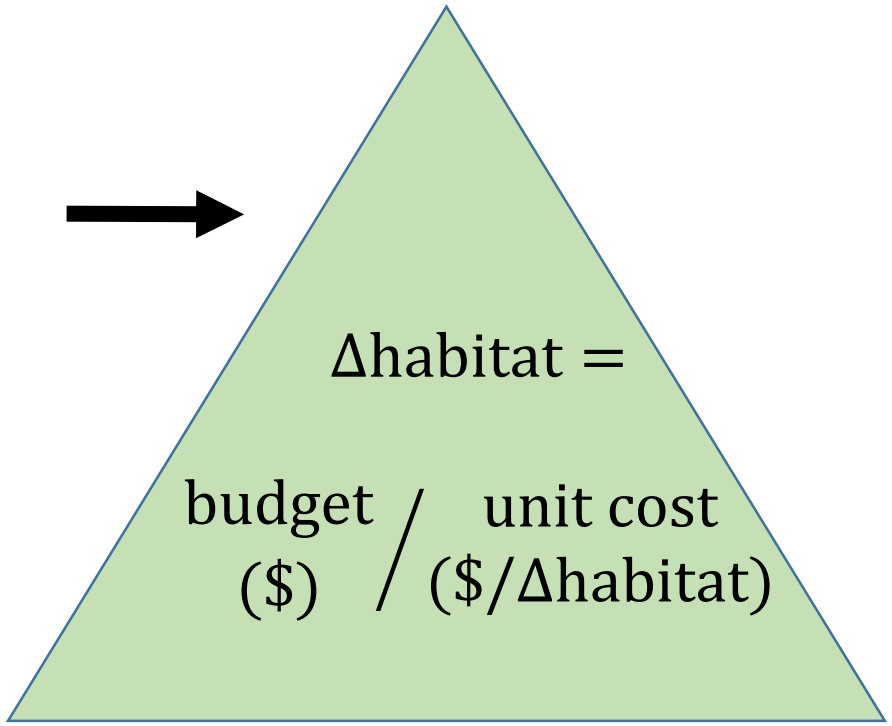
1. Define Restoration alternatives

Define baseline conditions and alternative restoration actions

Set a common budget for all actions ($)

Determine the unit cost for each action ($/habitat)

2. Calculate change in habitat



Cost effectiveness analysis for habitat restoration

1. **Define Restoration alternatives**

Define baseline conditions and alternative restoration actions

Set a common budget for all actions ($)

Determine the unit cost for each action ($/habitat)

2. **Calculate change in habitat**

$$\Delta\text{habitat} = \frac{\text{budget } (\$)}{\text{unit cost } (\$/\Delta\text{habitat})}$$

3. **Translate habitat change into additional spawners**

Coupled biological models

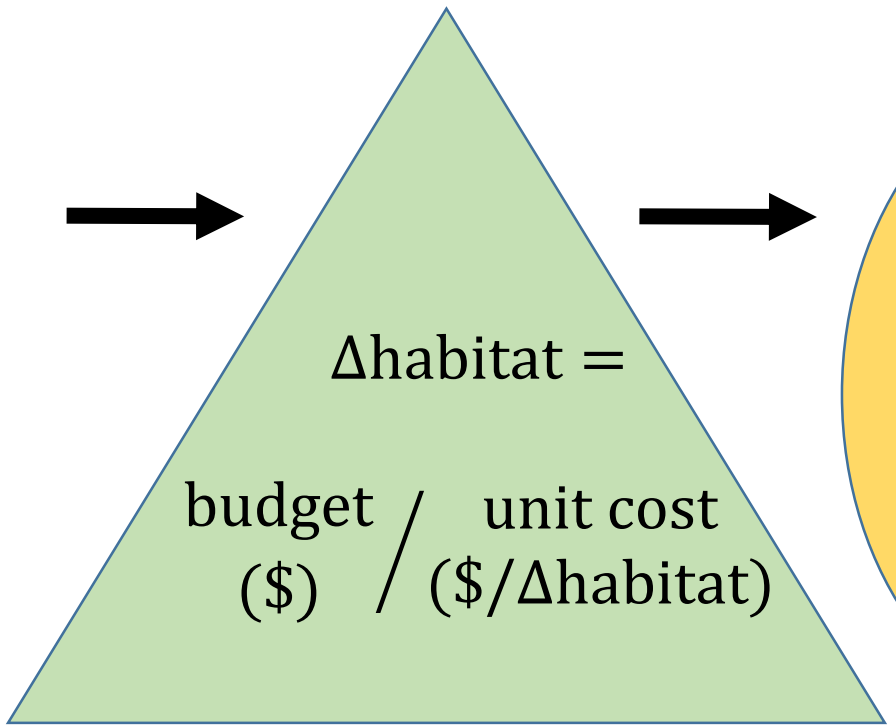
Cost effectiveness analysis for habitat restoration

1. **Define Restoration alternatives**
2. **Calculate change in habitat**
3. **Translate habitat 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 ($/habitat)



Coupled biological models

Spawners/$

Case study: Upper Columbia River spring Chinook

Columbia River System:

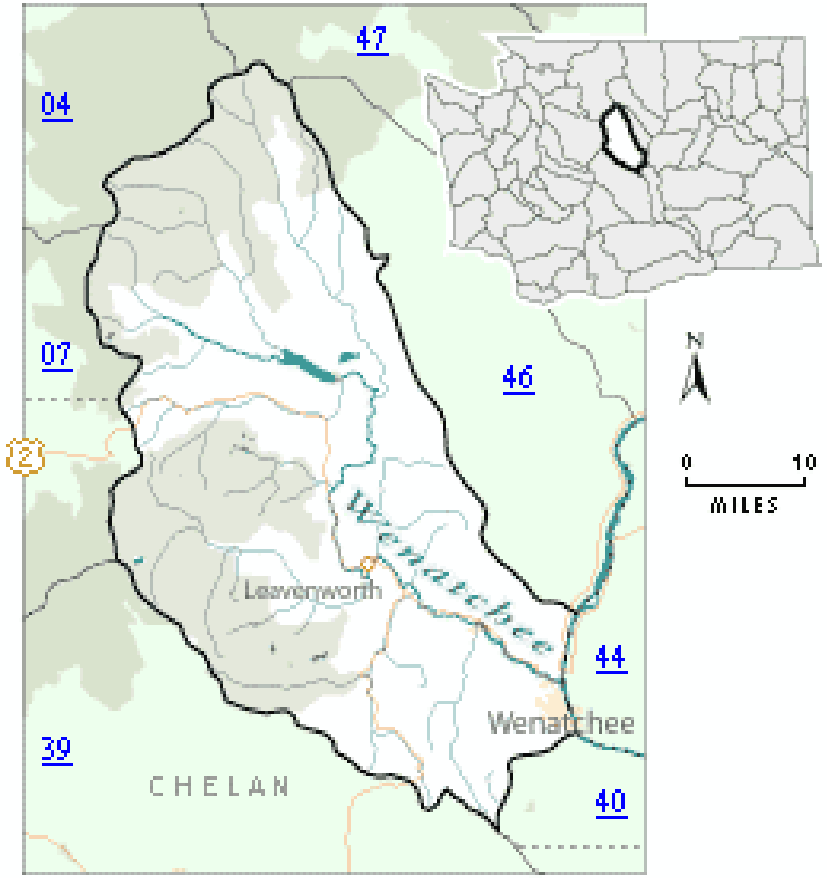
Source: https://www.nwcouncil.org/energy/powersupply/dam-guide

Salmon recovery depends on the 4-Hs:

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

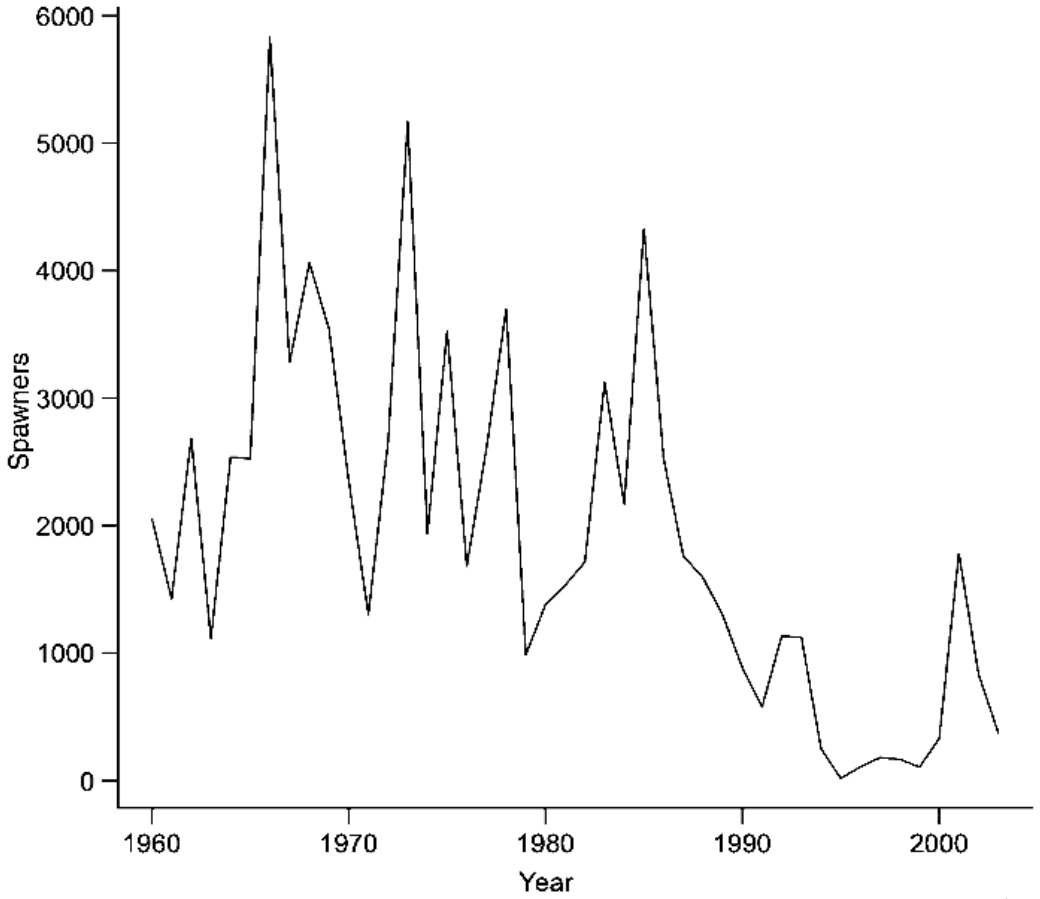
Case study: Wenatchee Basin spring Chinook

Wenatchee basin:



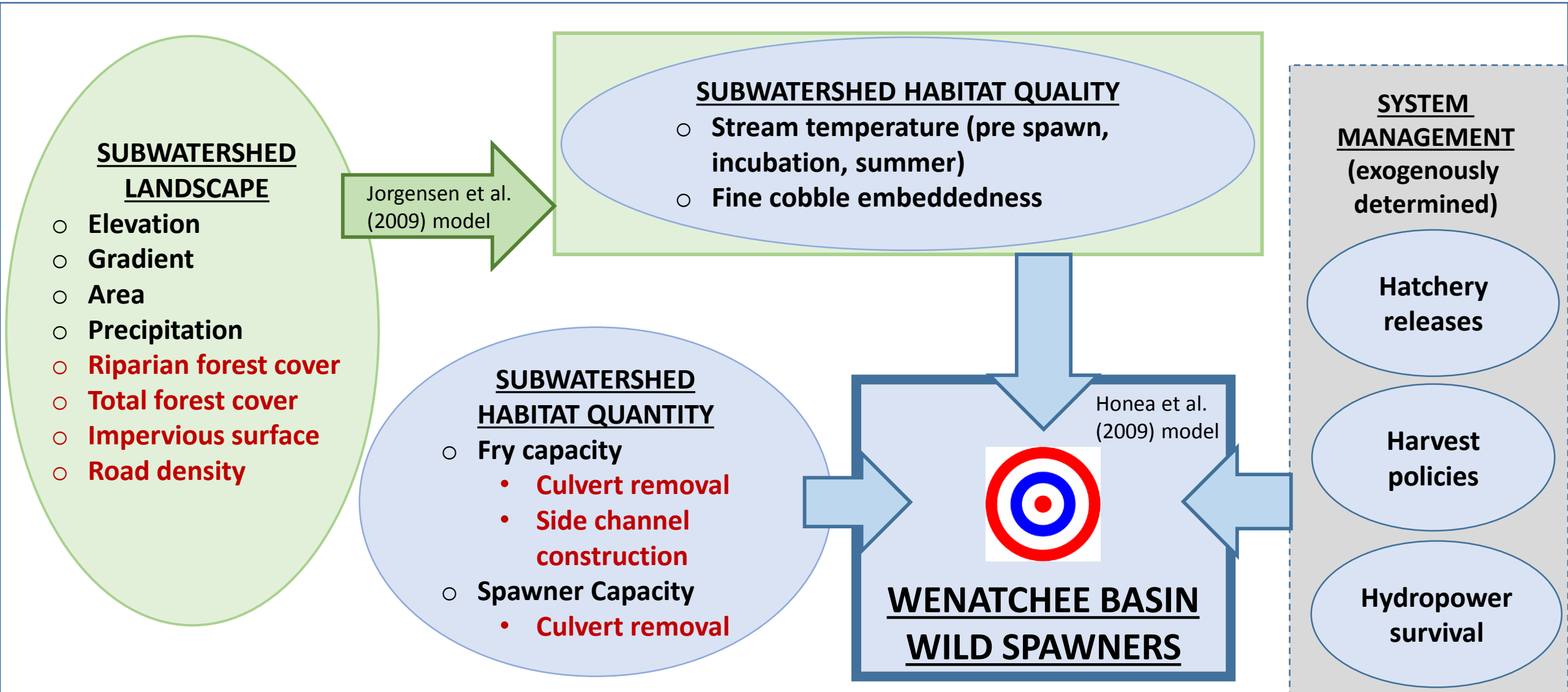
Source: http://www.ecy.wa.gov/programs/wq/tmdl/WenatcheeMulti/

Declining spring-run Chinook wild spawners:

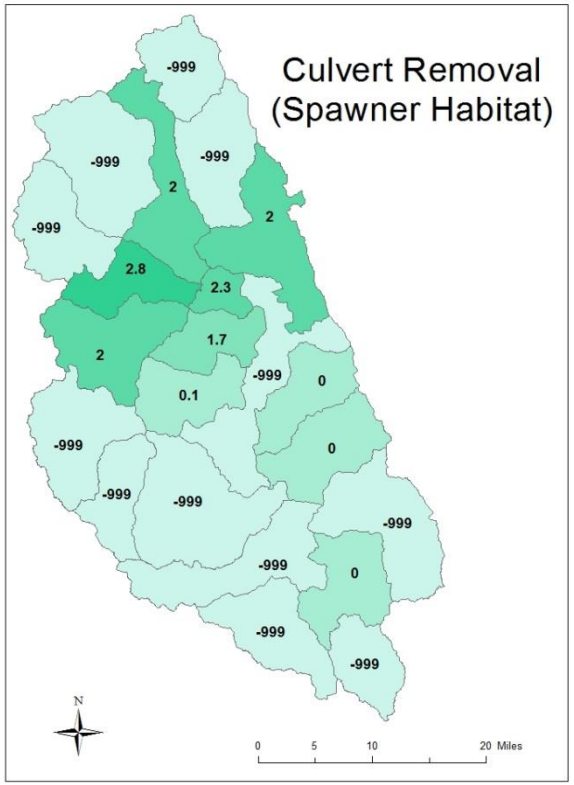


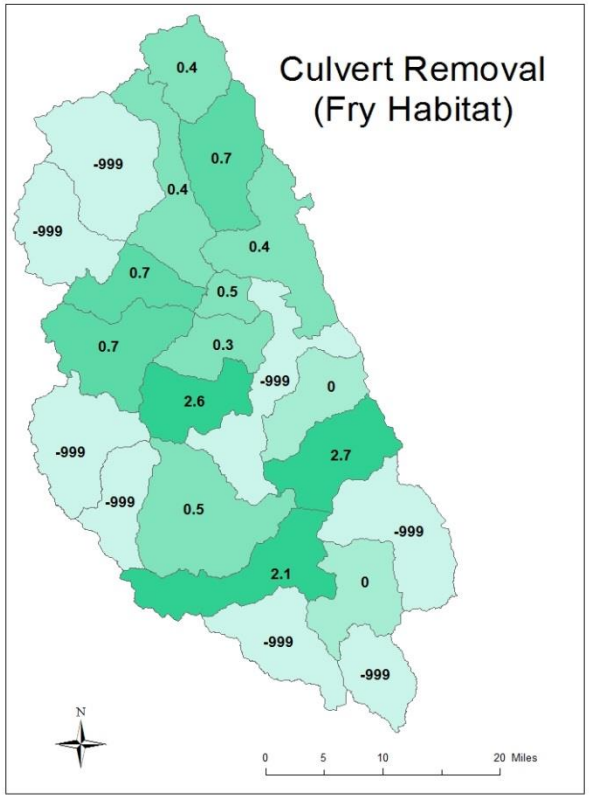
Honea et al. 2009

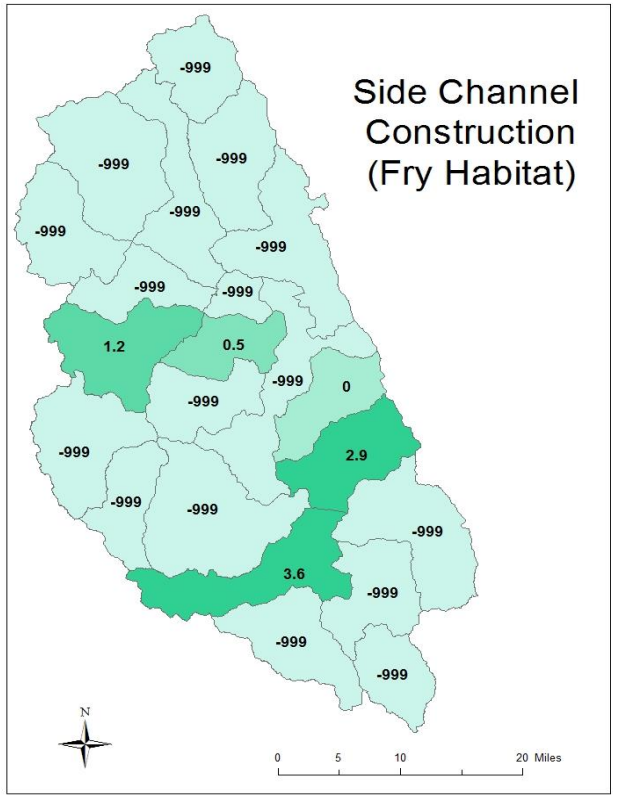
Coupled biological models connect restoration to Wenatchee wild spawners

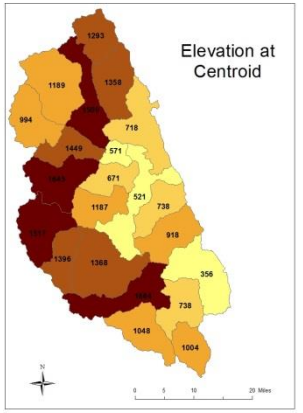


Effectiveness (spawners/$150K) habitat quantity restoration

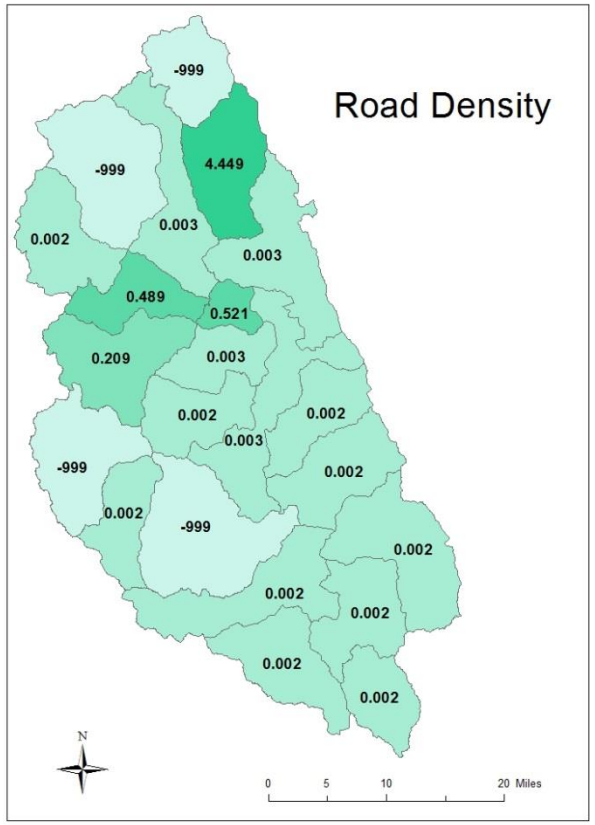


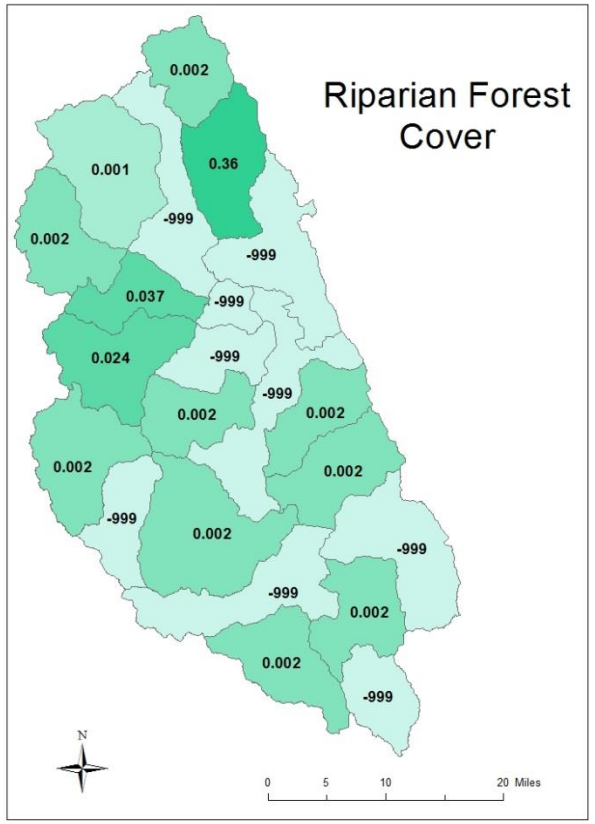


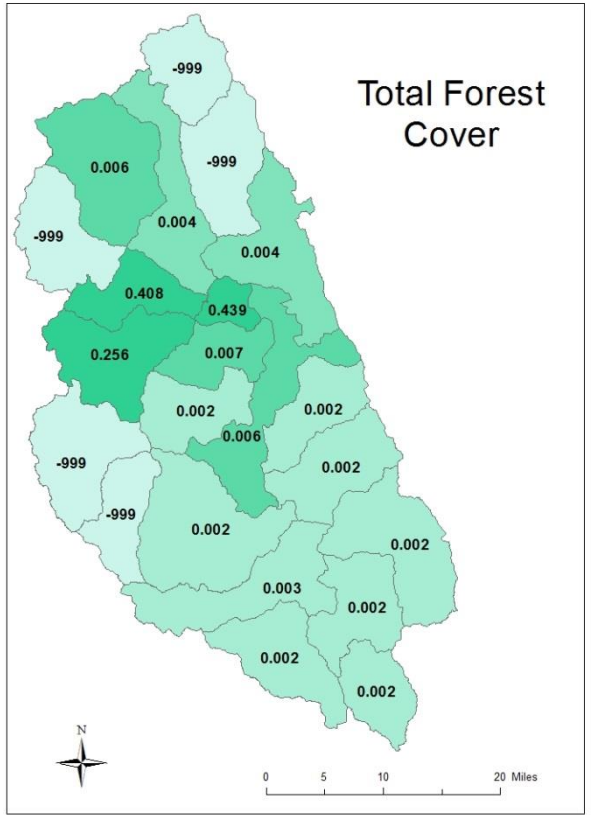


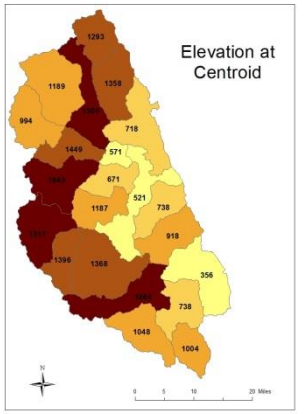


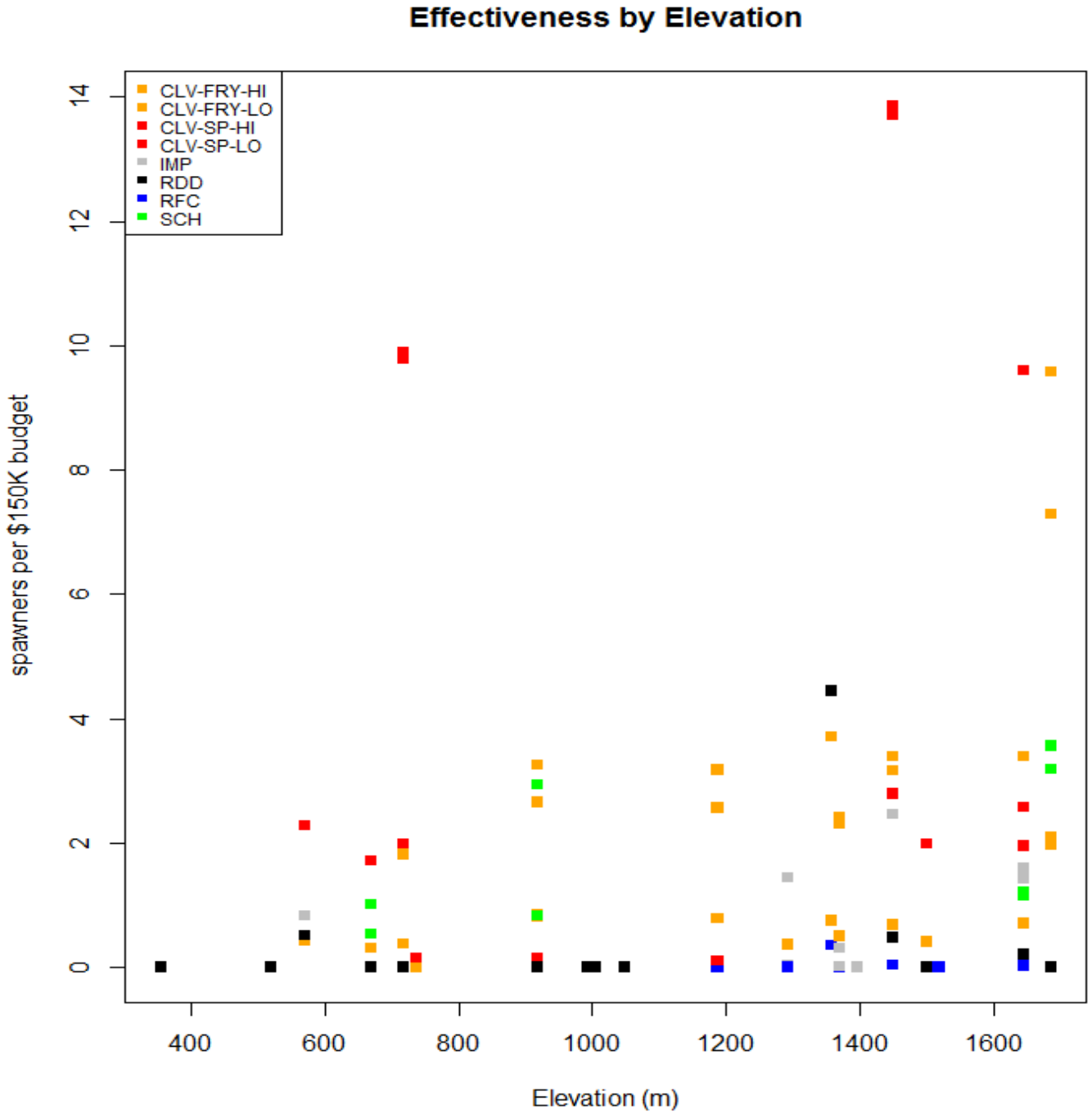
Effectiveness (spawners/$150K) habitat quality restoration

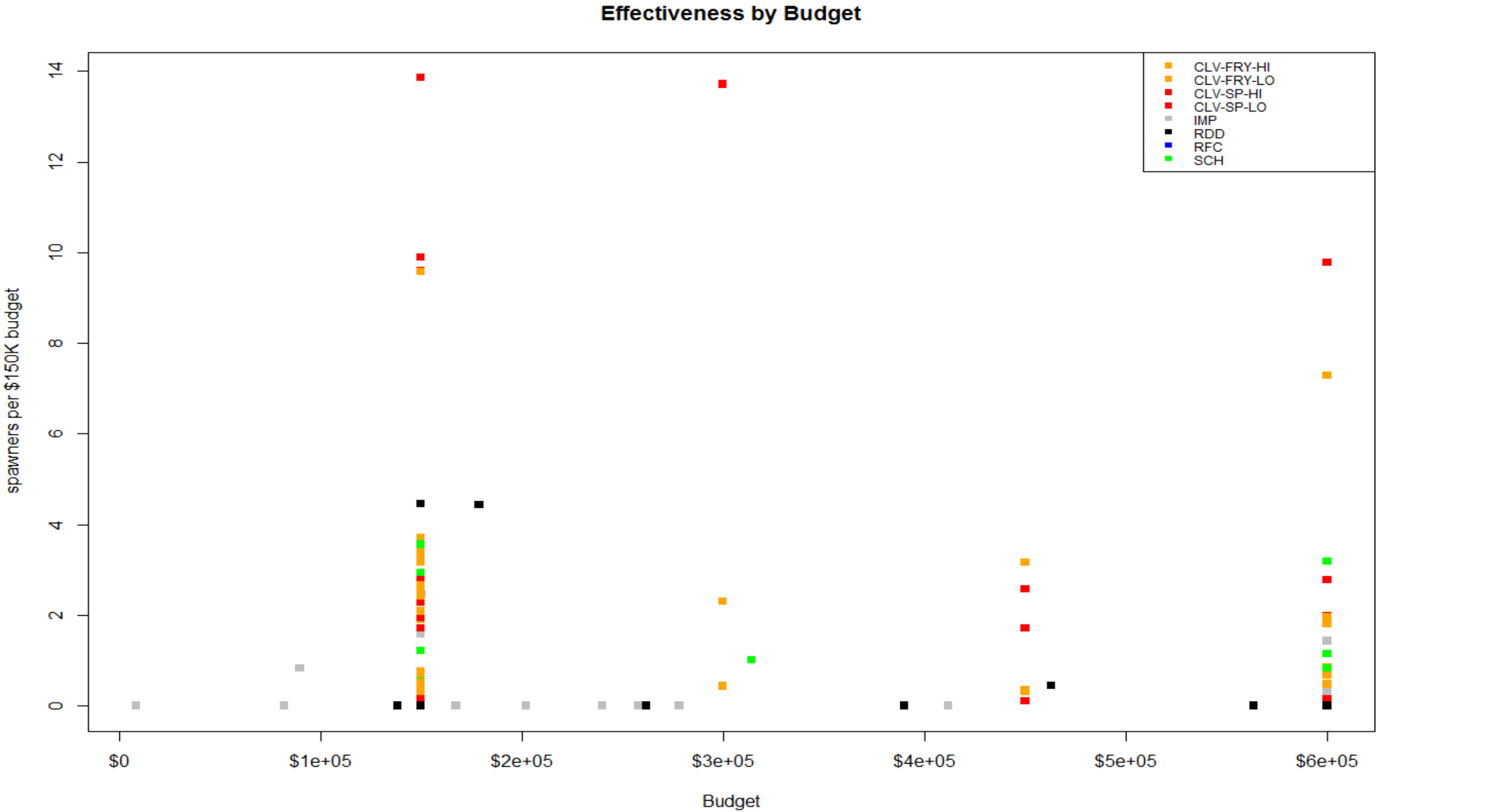




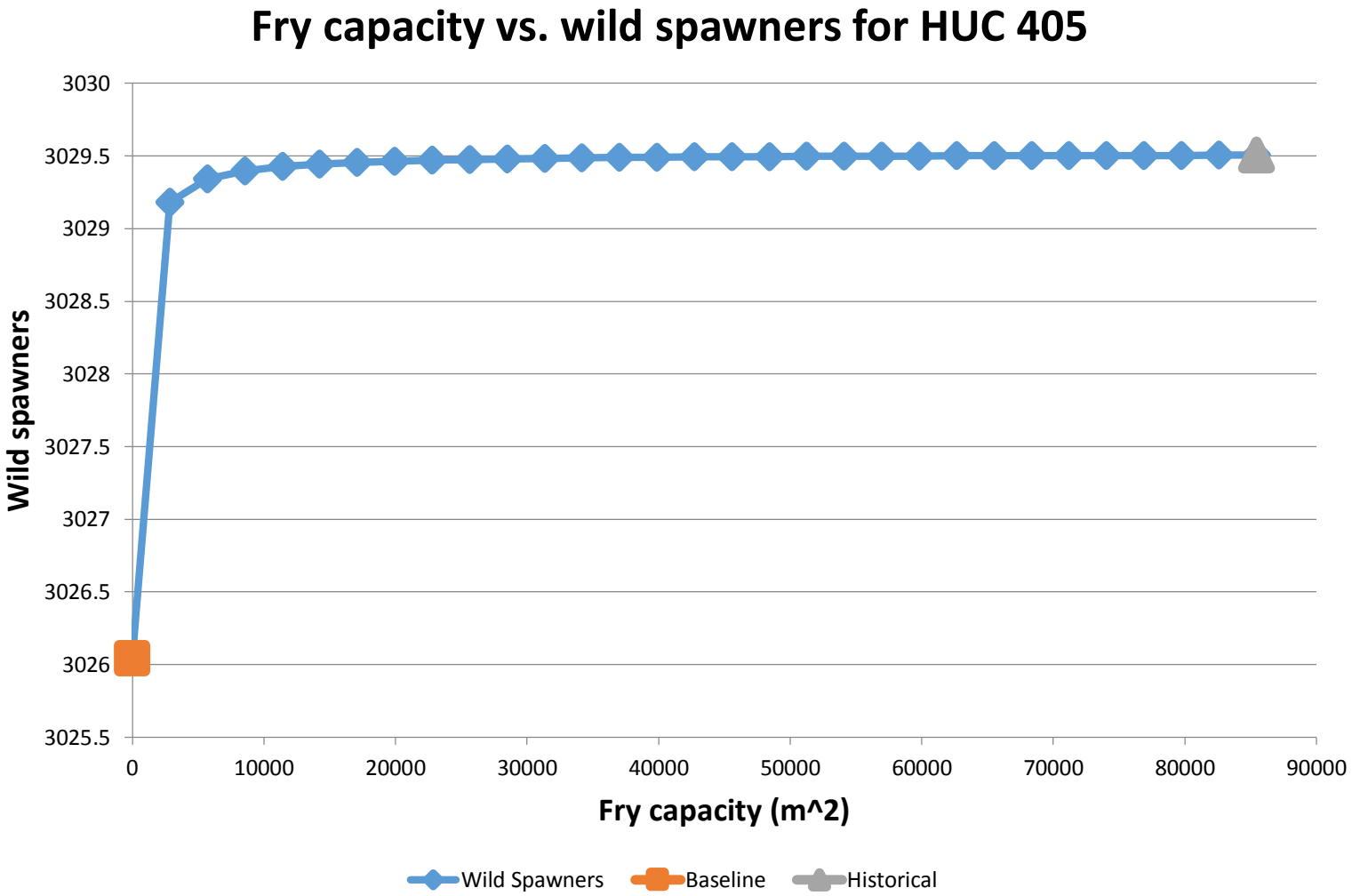


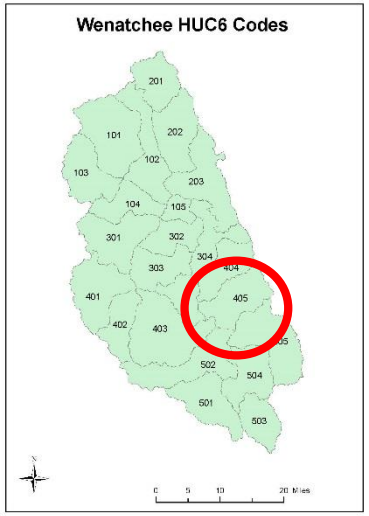



Effectiveness by Elevation
CLV-FRY-HI
CLV-FRY-LO
CLV-SP-HI
CLV-SP-LO
IMP
RDD
RFC
SCH
spawners per $150K budget
0
2
4
6
8
10
12
14
400
600
800
1000
1200
1400
1600
Elevation (m)

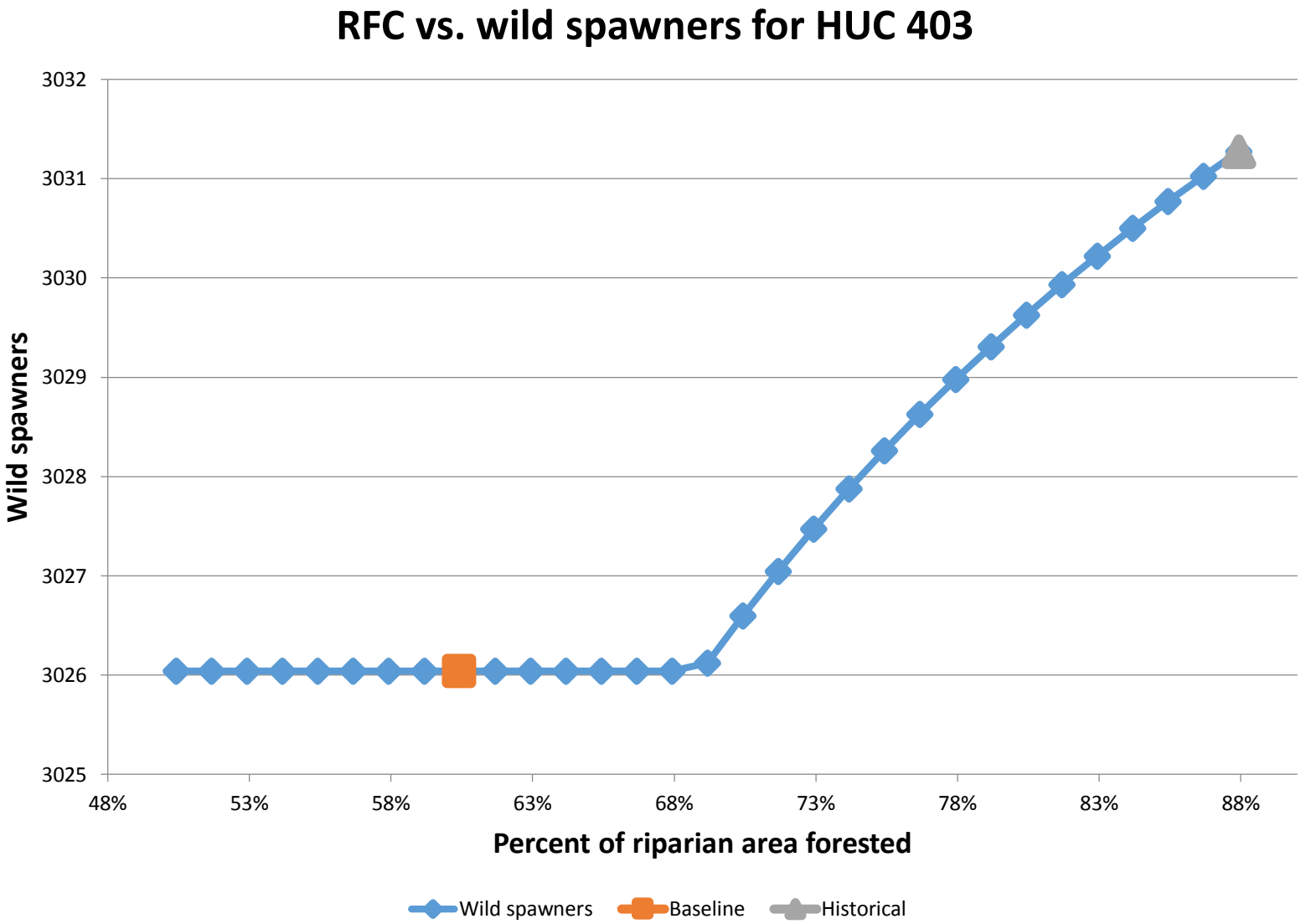

Effectiveness by Budget
spawners per $150K budget
0
2
4
6
8
10
12
14
$0
$1e+05
$2e+05
$3e+05
$4e+05
$5e+05
$6e+05
Budget
CLV-FRY-HI
CLV-FRY-LO
CLV-SP-HI
CLV-SP-LO
IMP
RDD
RFC
SCH

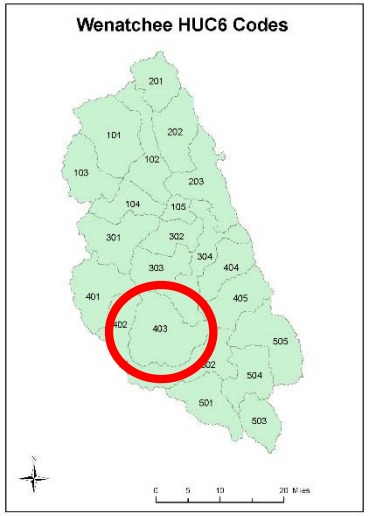
Effectiveness thresholds





Effectiveness thresholds





Ongoing work

1. Restoration effectiveness interactions (pairwise)

2. Uncertainty:
    - Environmental, biological, project, model
    - ***We are interested in capturing the relative uncertainty of population persistence across alternative restoration actions***

3. System management and climate change assumption sensitivities

4. Scaling up the analysis

Thank you!

I’m happy to take any additional questions at this time

Culvert pre-restoration

Post-restoration