

Monitoring fish response to habitat restoration and mitigation: lessons from the Pacific Northwest at the reach, watershed, and regional scales



Phil Roni^{1,2}

¹Watershed Sciences Lab, Cramer Fish Sciences

²School of Aquatic and Fisheries Sciences, University of Washington

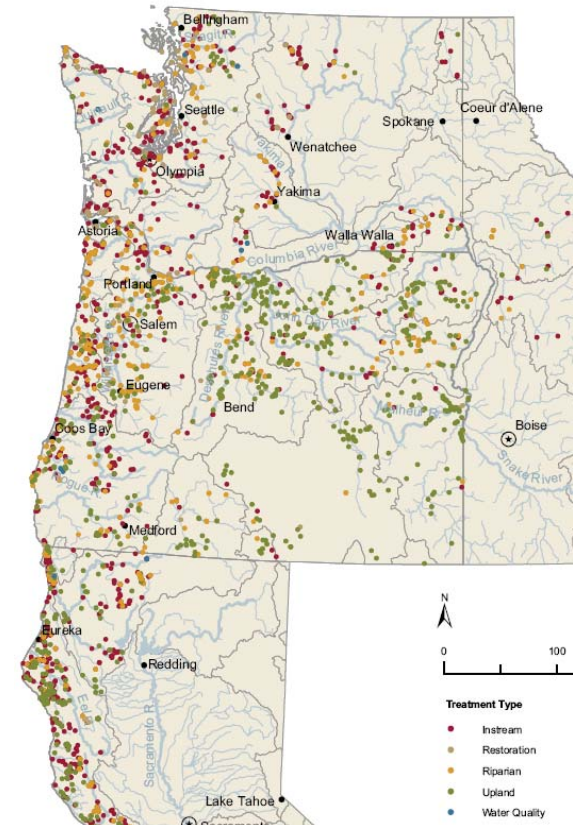
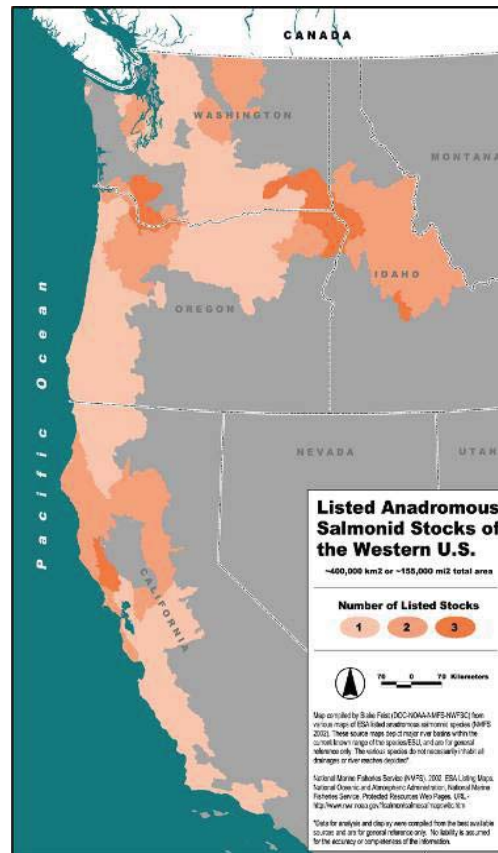
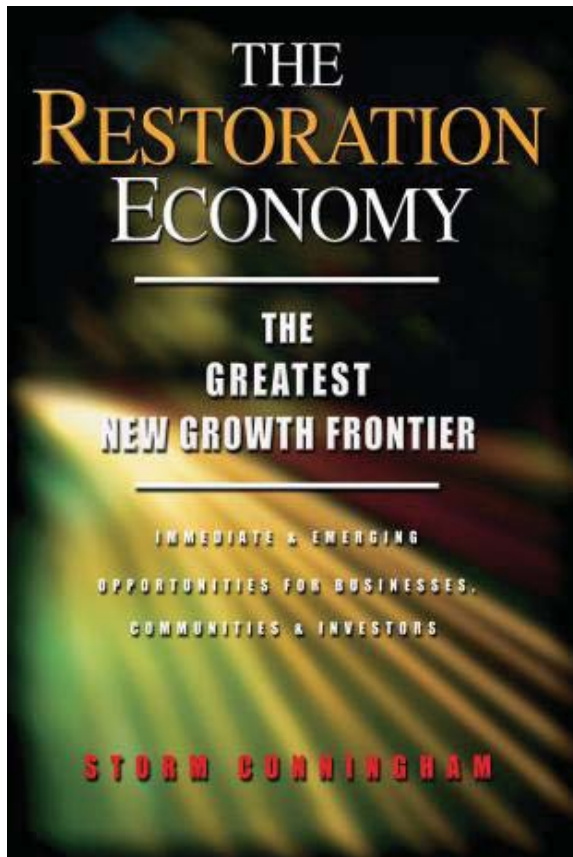


Objectives of Talk

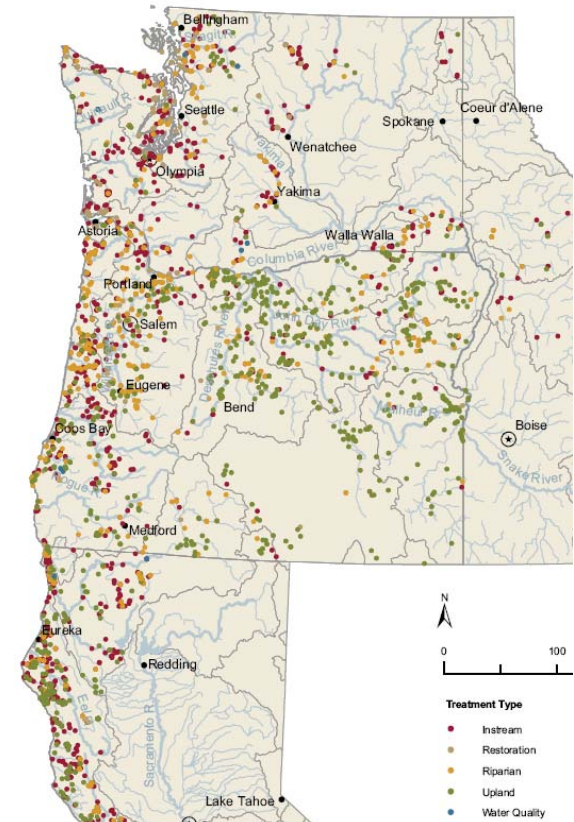
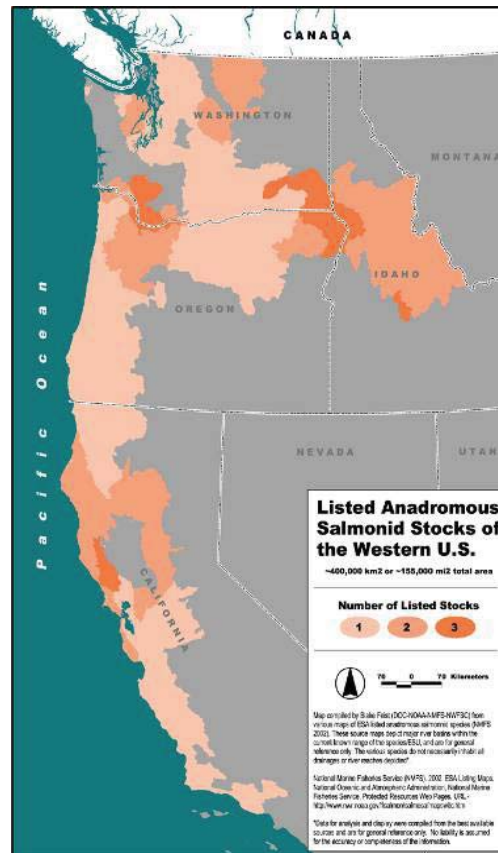
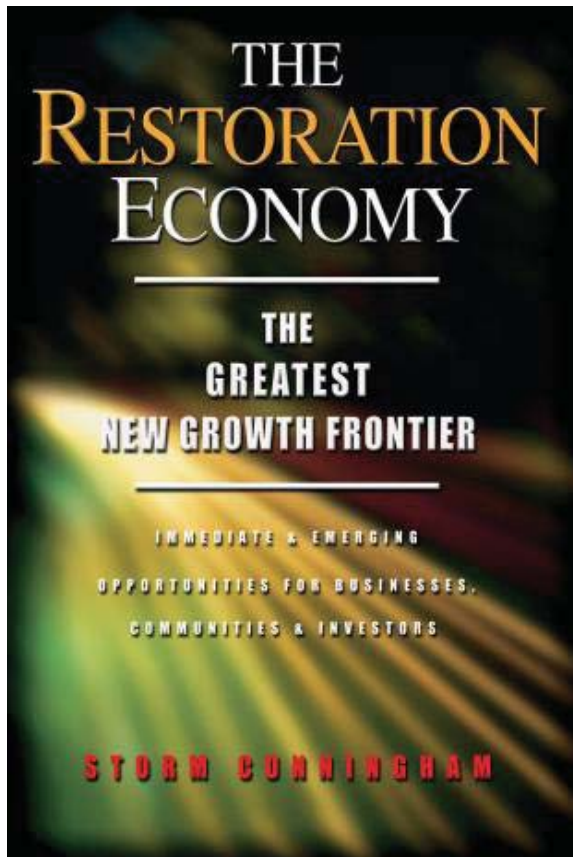
- Background on restoration in PNW/West Coast
- Examples of three major scales of monitoring and evaluation
- Strengths, weaknesses, and lessons learned
- Recommendations for future M&E of restoration and mitigation projects



Restoration in the Pacific Northwest



Percent of those \$\$s on M&E?



Monitoring and Evaluation

- **Status and trend**

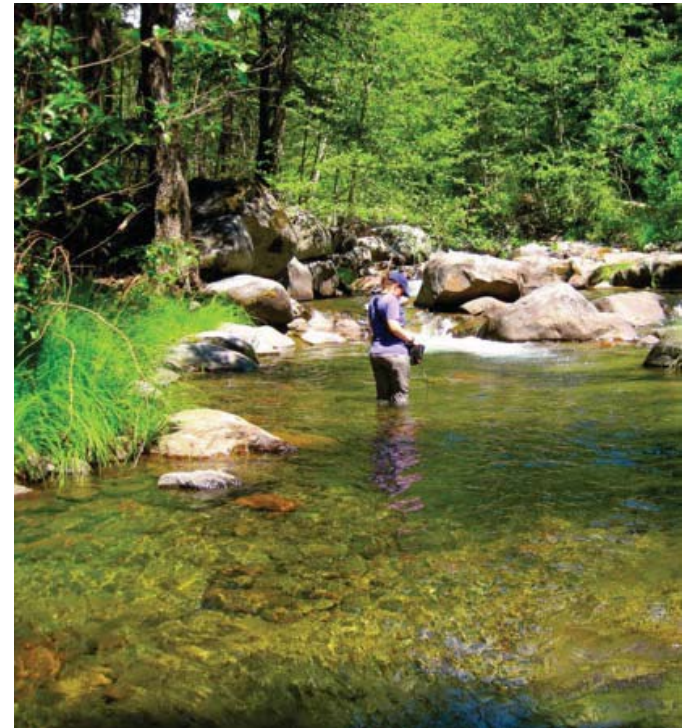
Annual measures of abundance, condition, etc.

- **Implementation**

Was project implemented as planned

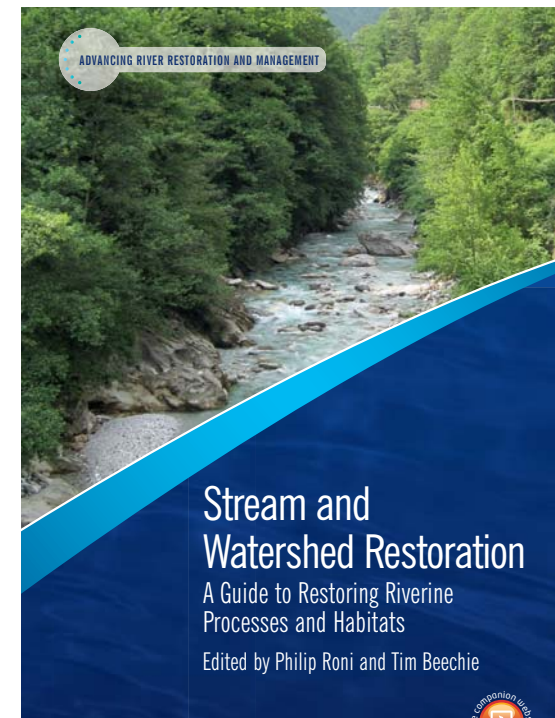
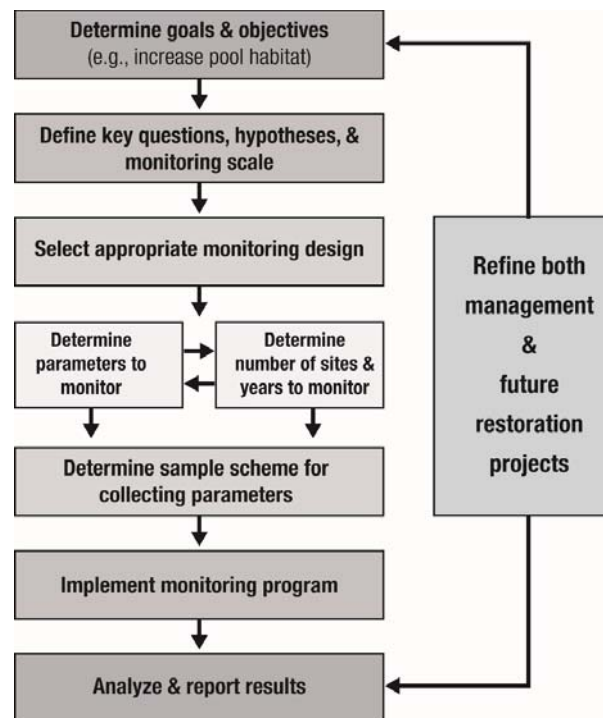
- **Effectiveness and validation**

Did projects have desired physical/biological effect
Experiments/hypothesis driven



Steps for Designing Monitoring & Evaluation

- Define project goals
- Define questions
- Define scale
- Determine monitoring design
- Select parameters
- Spatial & temporal replication
- Sampling scheme & protocol
- Implement monitoring



Questions/Hypotheses

Reach Scale

- **What is effect of project x on local conditions or fish abundance?
(individual project)**
- **What is effect of projects like x on local conditions or fish abundance?
(Region or restoration program)**

Watershed Scale

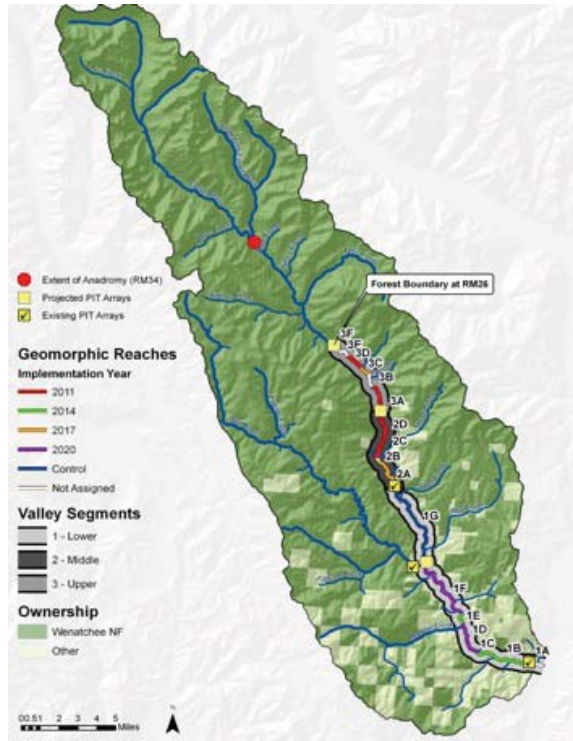
- **What is effect of a suite of projects on watershed conditions or a salmon population? (Watershed or basin)**

Monitoring Scales

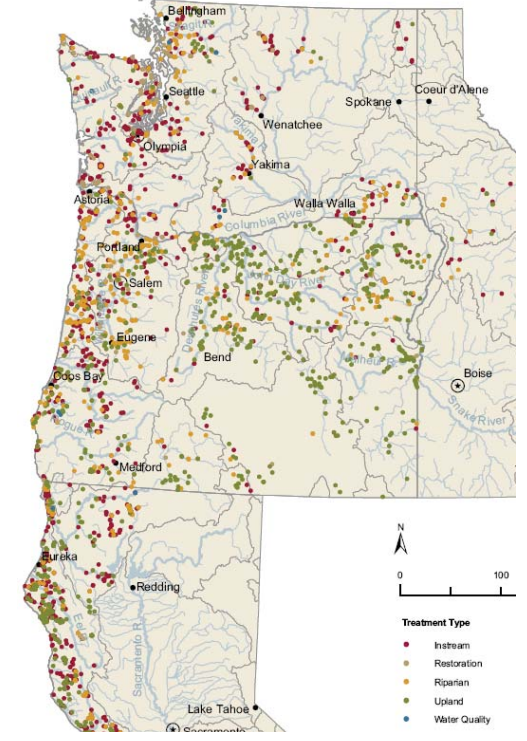
Scales: Reach



Watershed (Basin)

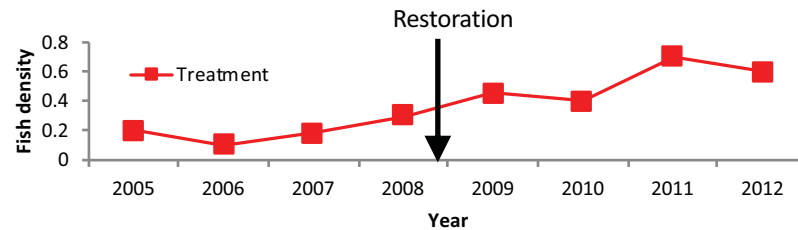


Region (Program)

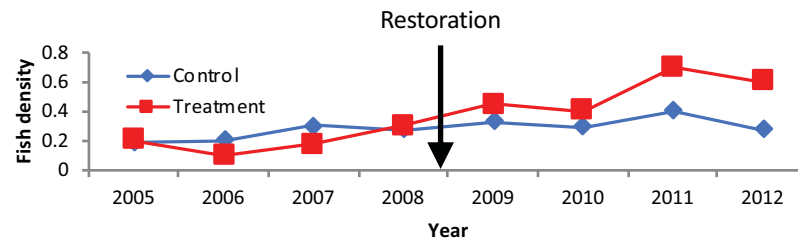


Major Monitoring Designs

- Before-After (BA)
 - Multiple BA



- Before-After Control-Impact (BACI)
 - Multiple BACI



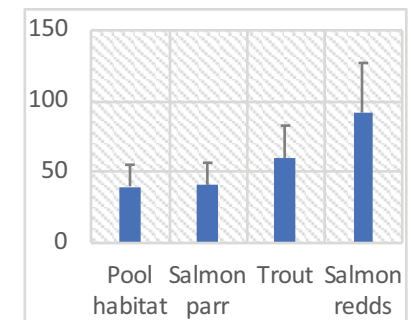
- Extensive Post-treatment (EPT or CI)



Control



Treatment



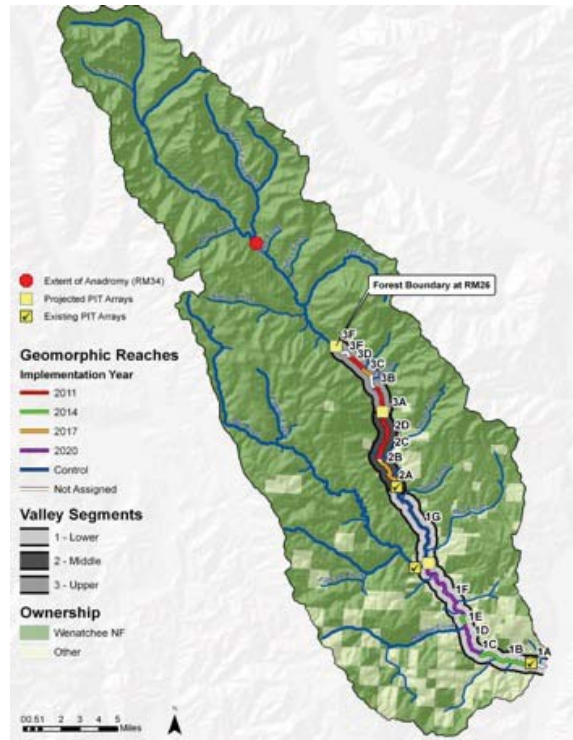
Monitoring Scales and Common Designs

Scales: Reach



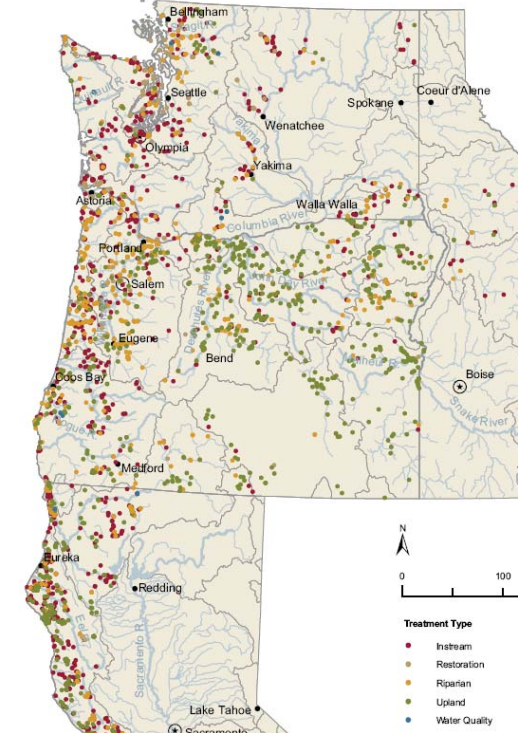
Designs: BA or BACI

Watershed (Basin)



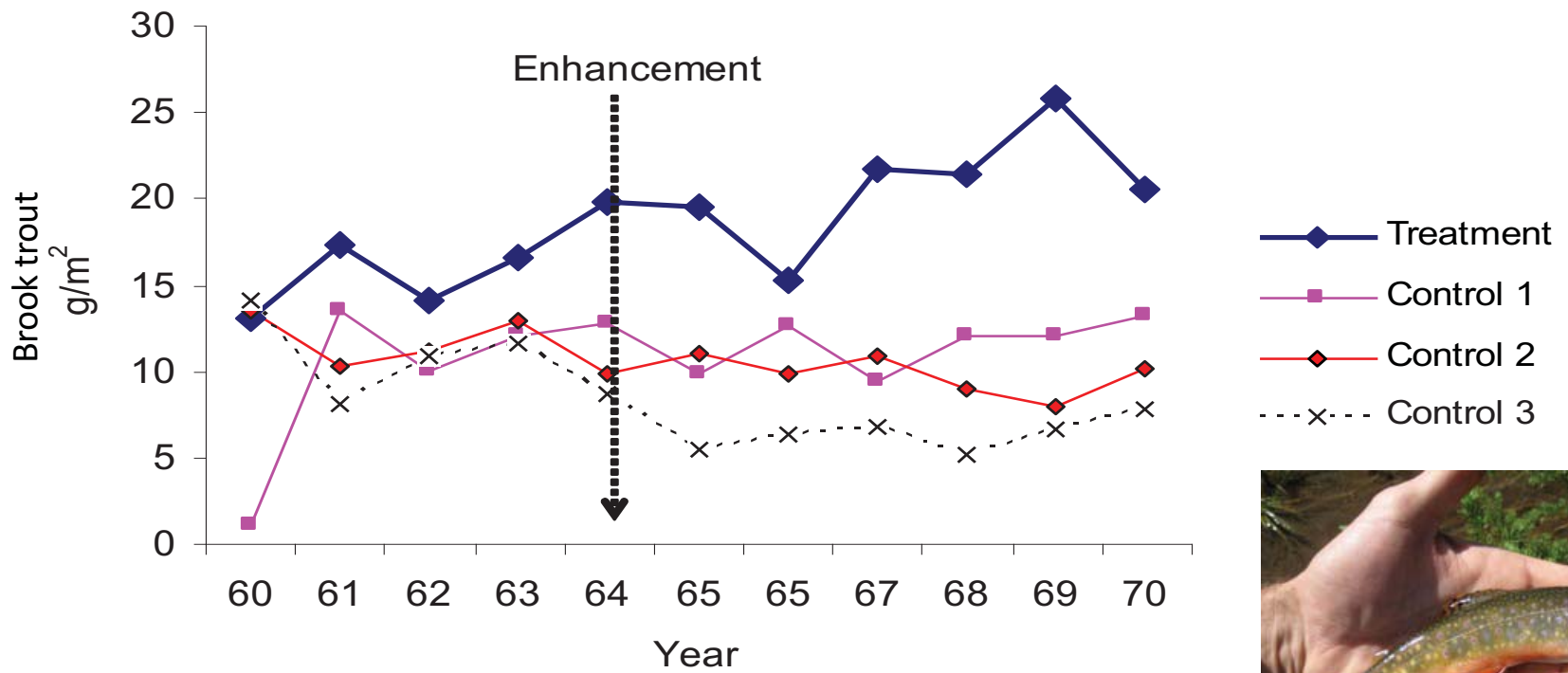
Designs: BA or BACI

Region (Program)



Designs: MBACI or EPT

Reach Scale - Single Project - BACI

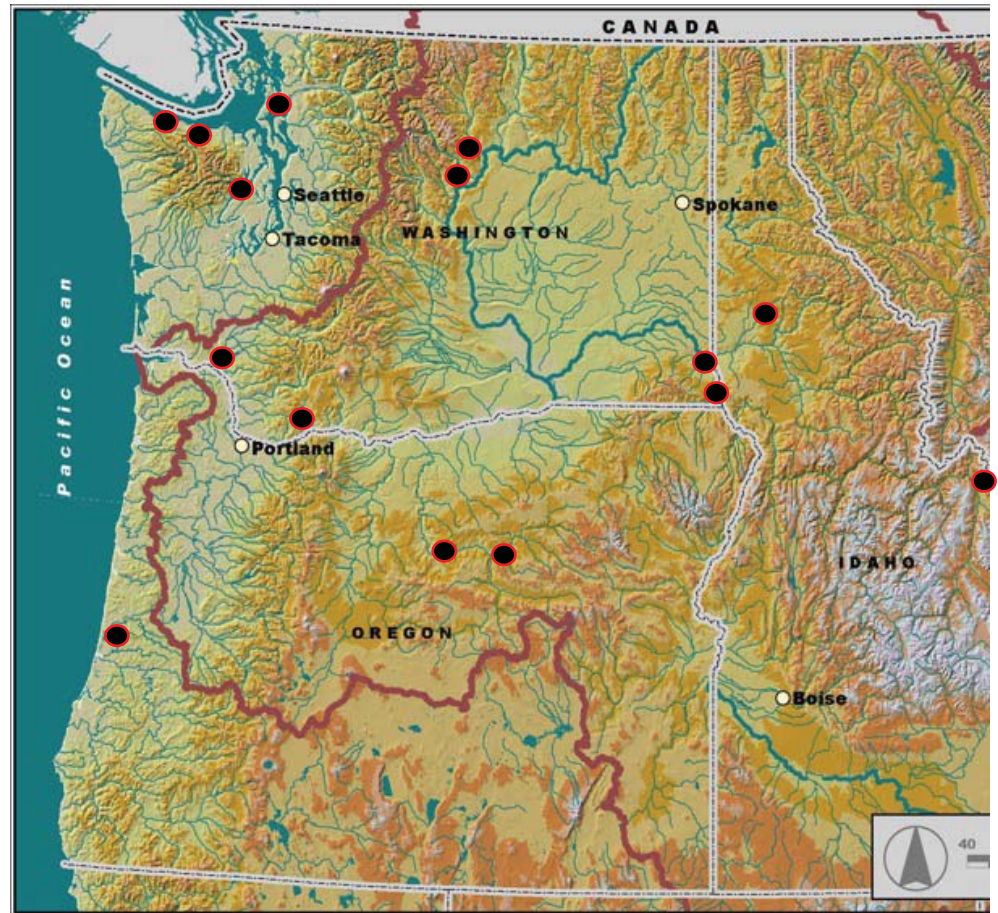
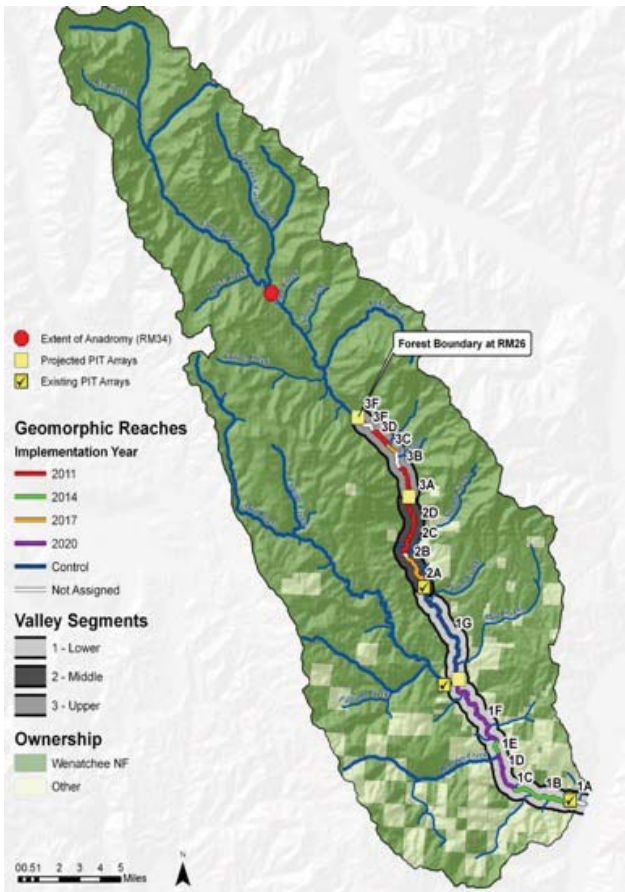


Hunt 1974. Brook trout response in Lawrence Creek



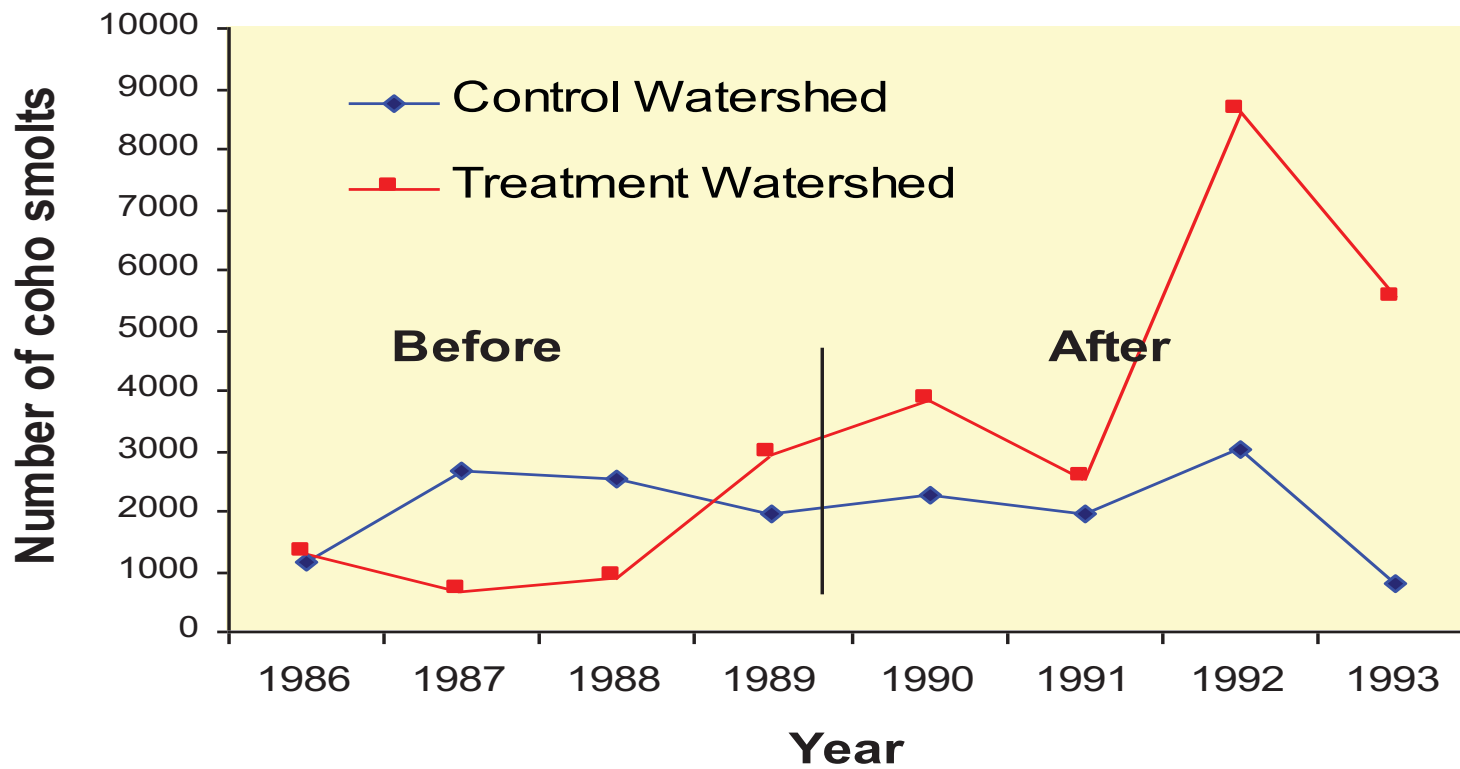
Watershed Scale- IMWs

(Intensively Monitored Watersheds)



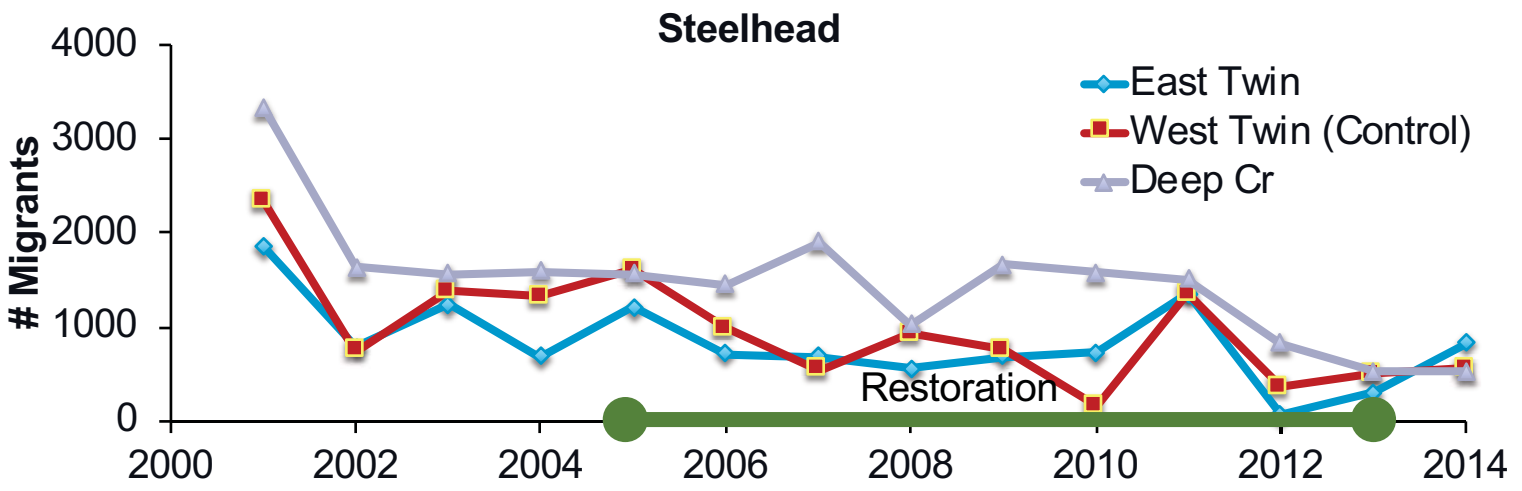
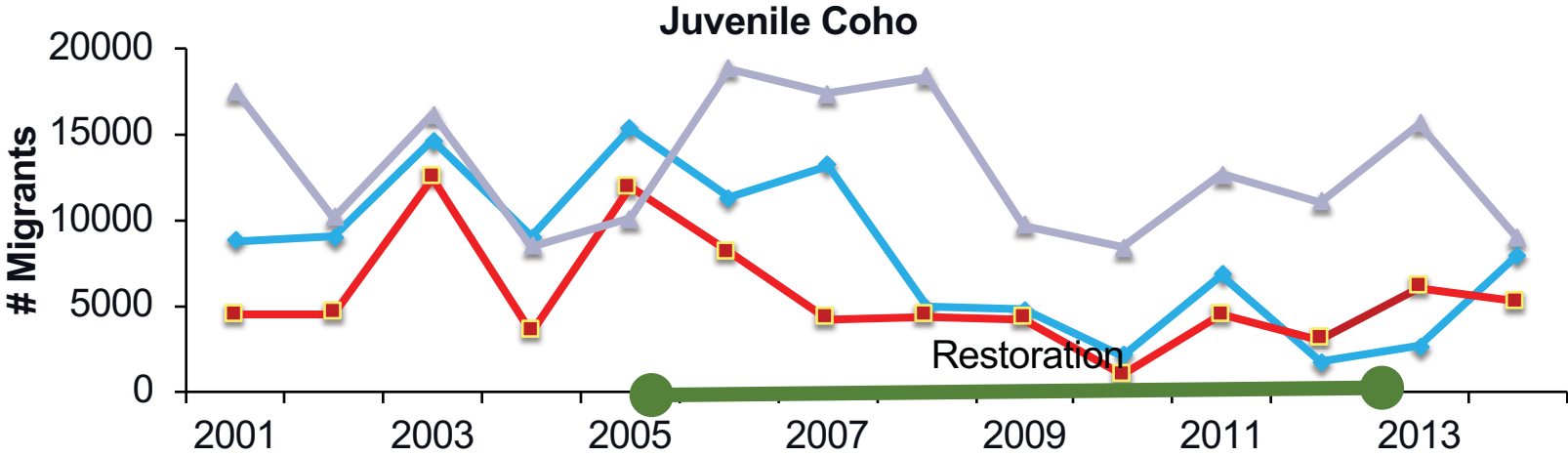
Alesea/Nestucca- IMW

(Intensively Monitored Watersheds)



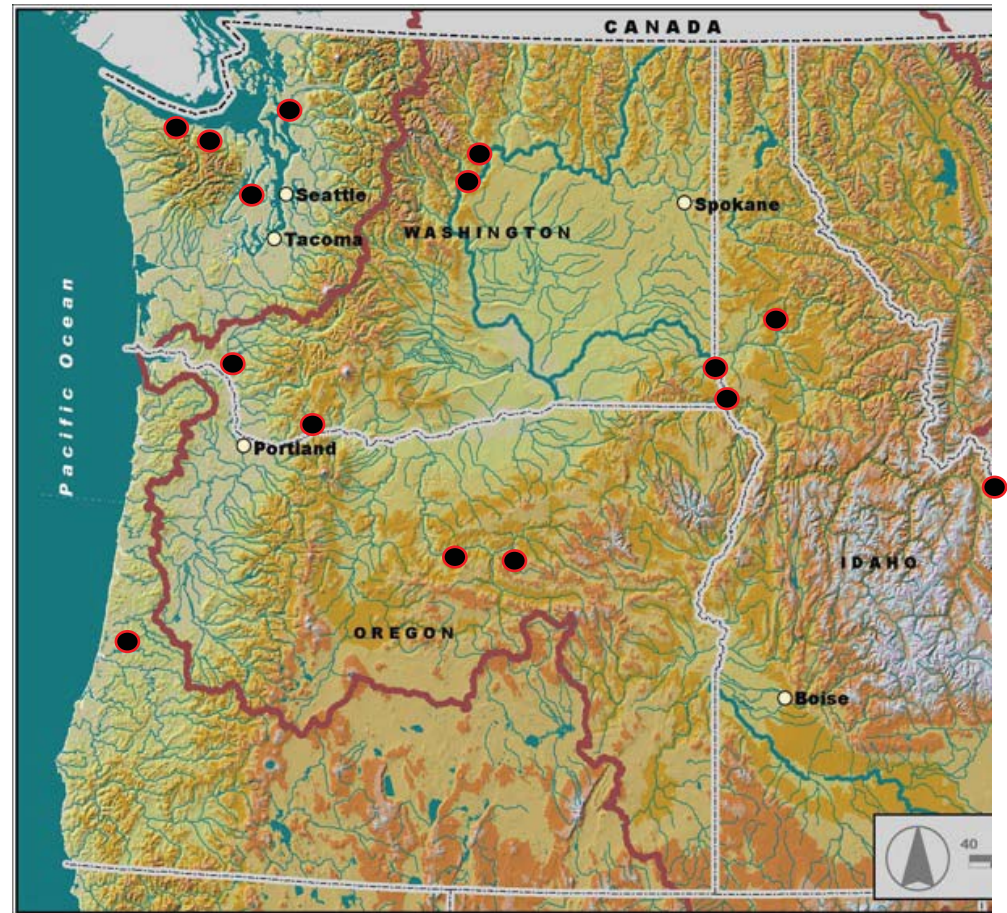
Solazzi et al. 2000

Strait of Juan de Fuca IMW - Results??



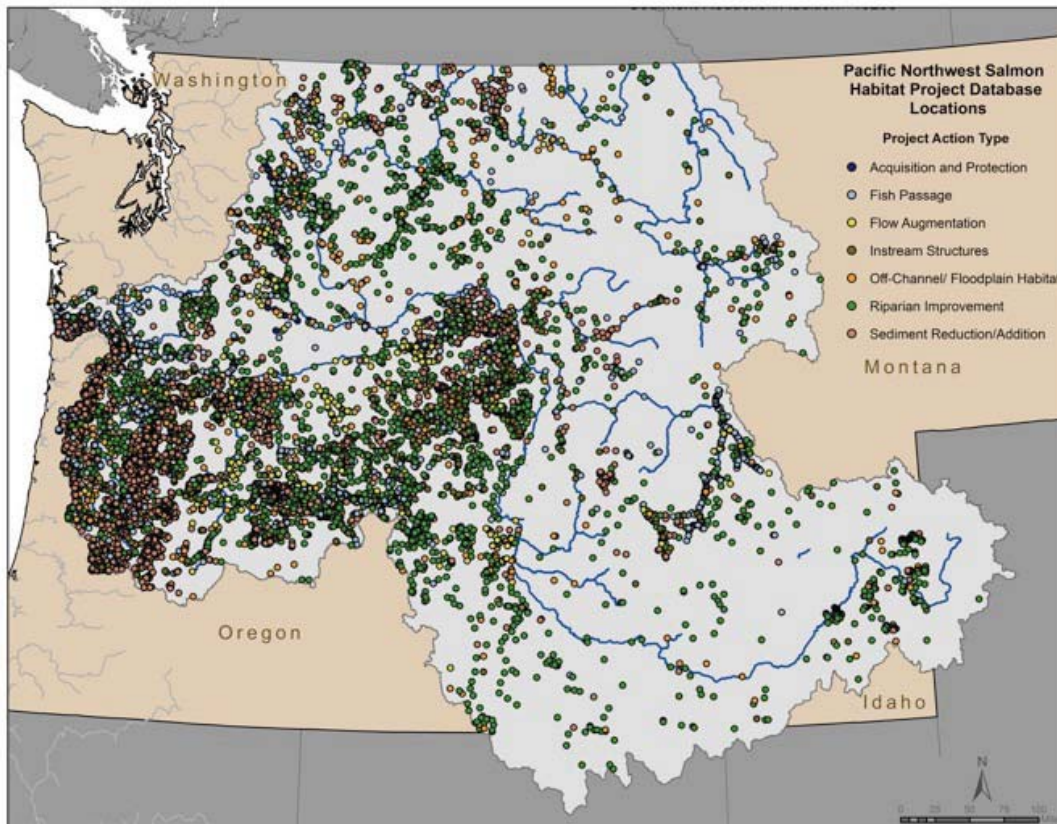
Watershed Scale - Challenges

- Most have not been successful
- Some design issues but
- Mostly Implementation
 - Timing of restoration
 - Field protocols
 - Coordination of monitoring
 - Data management
 - Data analysis
 - Data reporting
 - Funding
- Tractable on small watersheds

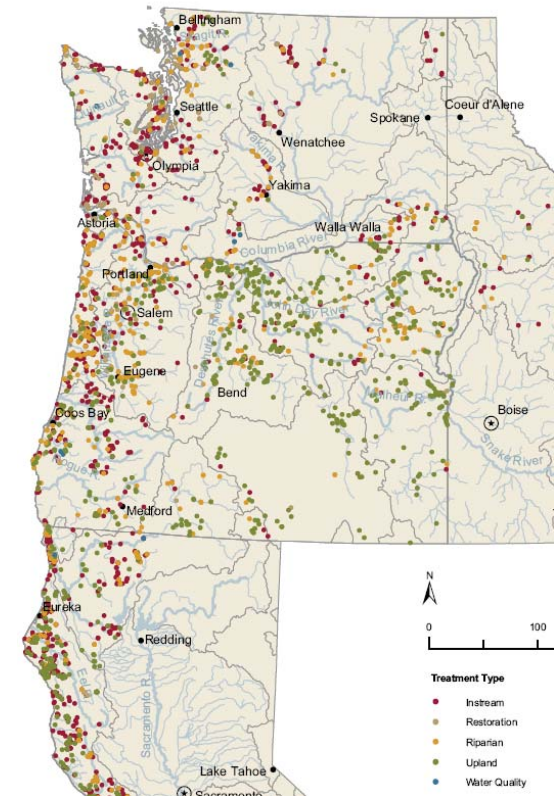


Region/Program Scale

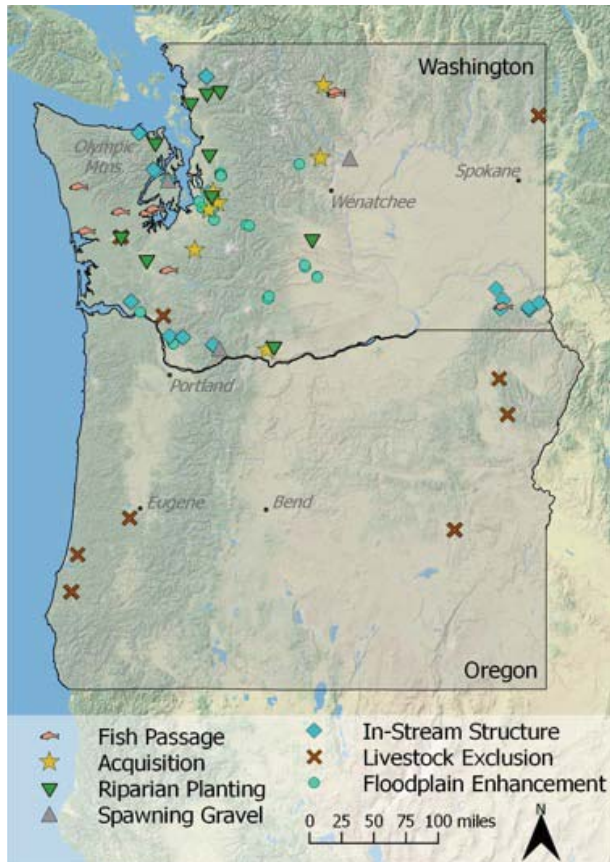
Columbia River Basin F & W Program



Pacific Coastal Salmon Recovery Fund



Region/Program – SRFB MBACI



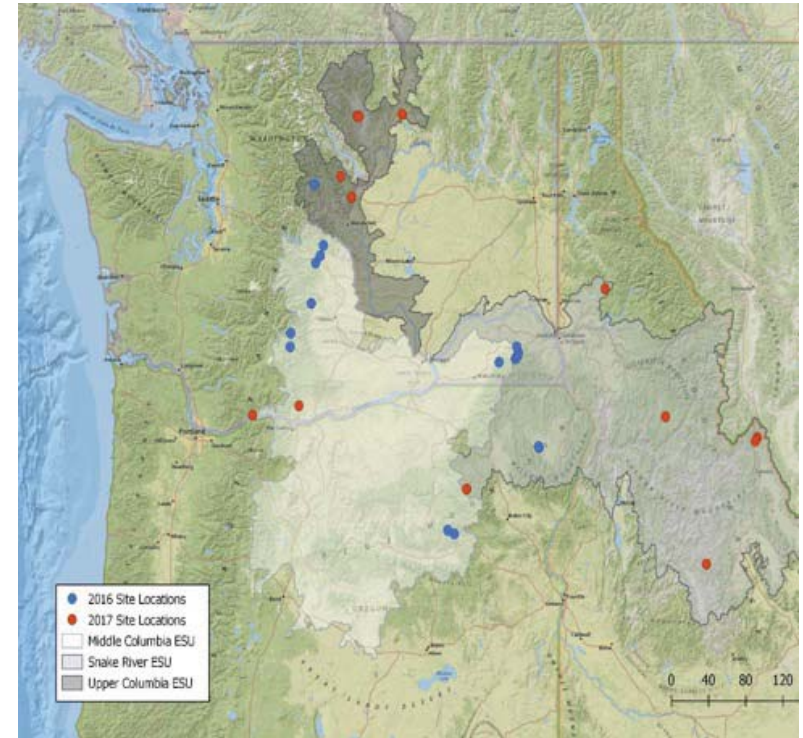
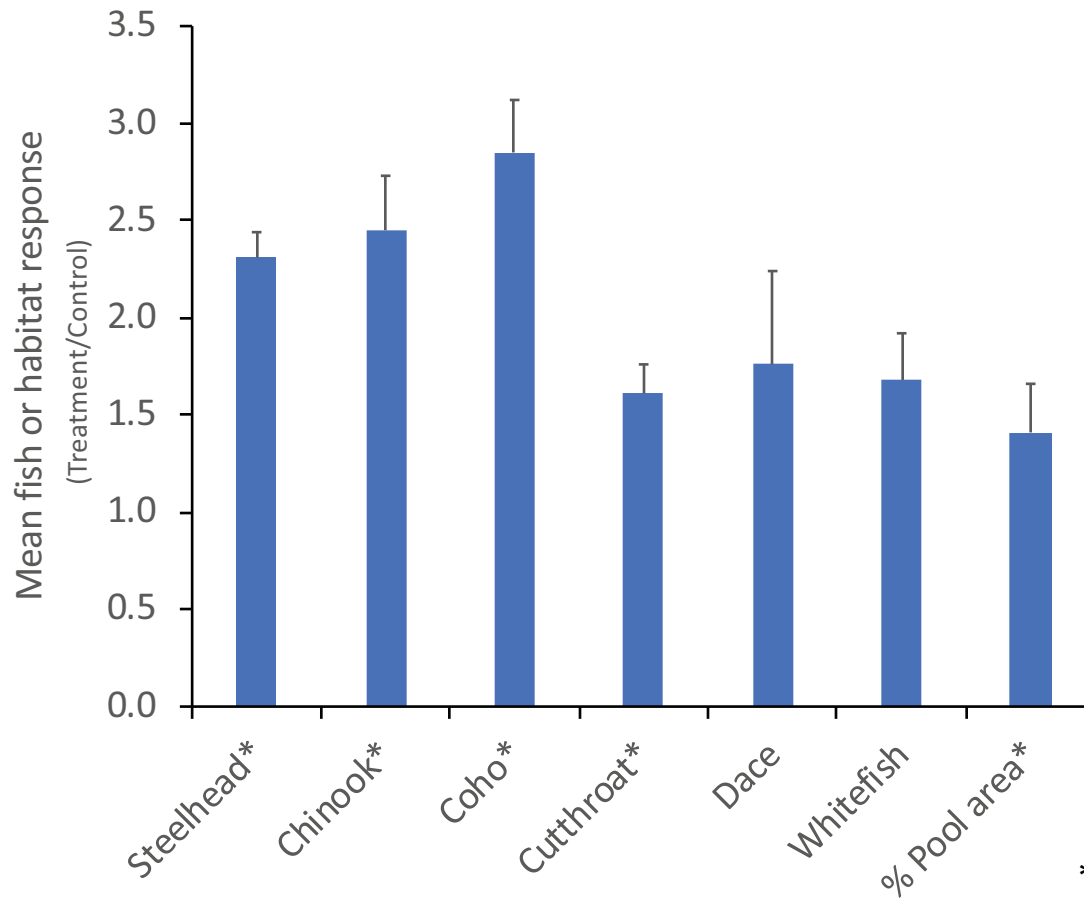
- Instream Structure Projects
 - 23 projects monitored
 - 1yr before, 1,3, 5, 10 yrs. after
 - 6 removed from analysis
- SRFB Protocols
 - Fish = snorkel surveys
 - Habitat modified EMAP
 - Habitat CHaMP 2012/13
- Analysis
 - **T-test**, regression, BACI mixed effects*

Region/Program – MBACI Results

	P –Value (t-test)
Metric	Year 10
Vertical pool profile area (m ²)	0.28
Mean residual profile depth (cm)	0.28
Log ₁₀ LWD volume (m ³)	0.003
Chinook density (fish/m ²)	0.56
Coho density (fish/m ²)	0.41
Steelhead density (fish/m ²)	0.16



Region/Program – BPA EPT Instream Structures



*significant increase < 0.05

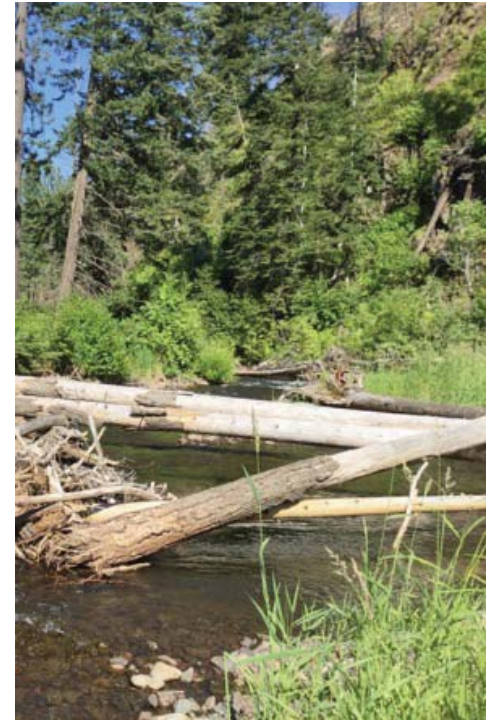
Lessons – IMW and Regional/Program

- 3 of 4 large regional programs have had challenges with
 - Goals and questions
 - Site selection
 - Protocols
 - Data collection
 - Restoration
 - Data management
 - Data analysis and reporting
 - Funding (though related to above)



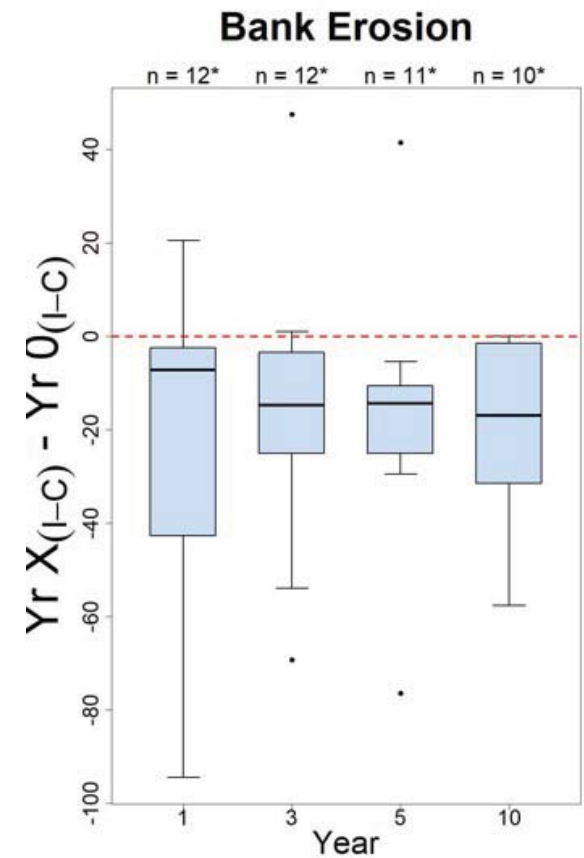
Lessons – IMW and Regional/Program

- Sites selection –
 - Detailed criteria for selecting treatments and controls
 - Crews need to be well trained in selecting controls
 - PI needs to be involved
- Protocols
 - Select metrics that respond to restoration action of interested
 - Develop and use protocols specific to these metrics
 - Beware of “off-the-shelf” protocols
 - DO A PILOT STUDY FIRST!
- Data collection
 - Specify window for data collection in study plan,
 - Ensure crews are well trained and understand ramifications of changes in protocols or study site locations
 - Limit number of contractors collecting data and other tasks



Lessons – IMW and Regional/Program

- Restoration
 - Annual coordination through life of monitoring
- Data management
 - Data management plan
 - Publicly accessible database
- Data analysis and reporting
 - Need simple straightforward analyses
 - Need to report data and stick to answering original question.
 - Standard scientific report is better than one with lots of pictures and tangential results
 - Periodic scientific review (monitoring panel or similar)



Summary

- Fish and habitat response can be monitored at multiple scales
- Some big successes.....and some big monitoring failures
- Some challenges are technical, but most implementation issues
- Emphasize need for attention to detail, staying on target, coordination, and following key monitoring steps

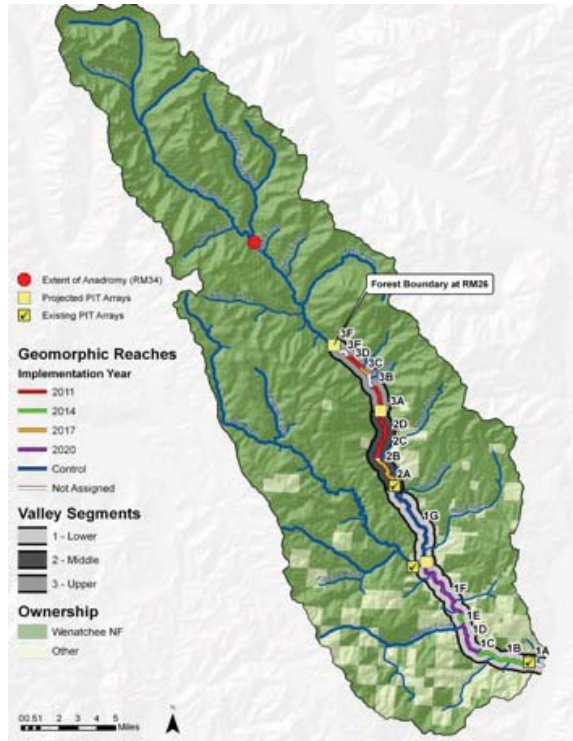
Questions?

Reach



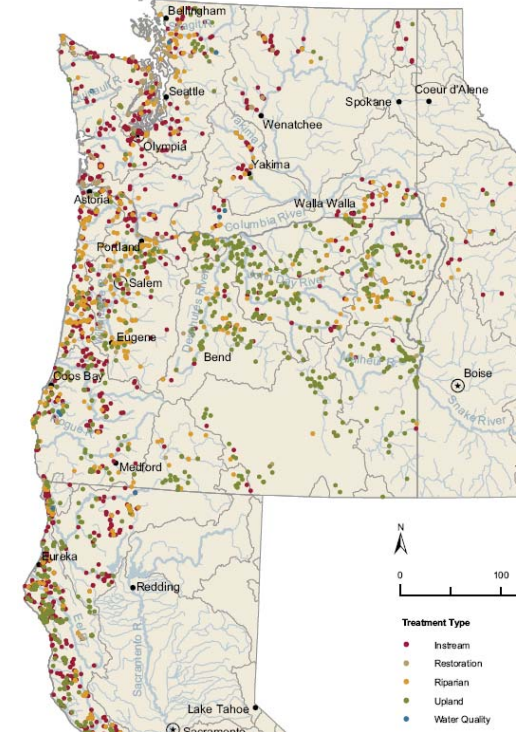
BA or BACI

Watershed



BA or BACI

Region



MBACI or EPT

EXTRA SLIDES

Lessons – IMW and Regional/Program

- Staying focused on question
- Site selection and appropriate treatment and controls
- Protocols
 - Data collection
 - Restoration
 - Data management
 - Data analysis and reporting

Reach scale examples – 2 slides

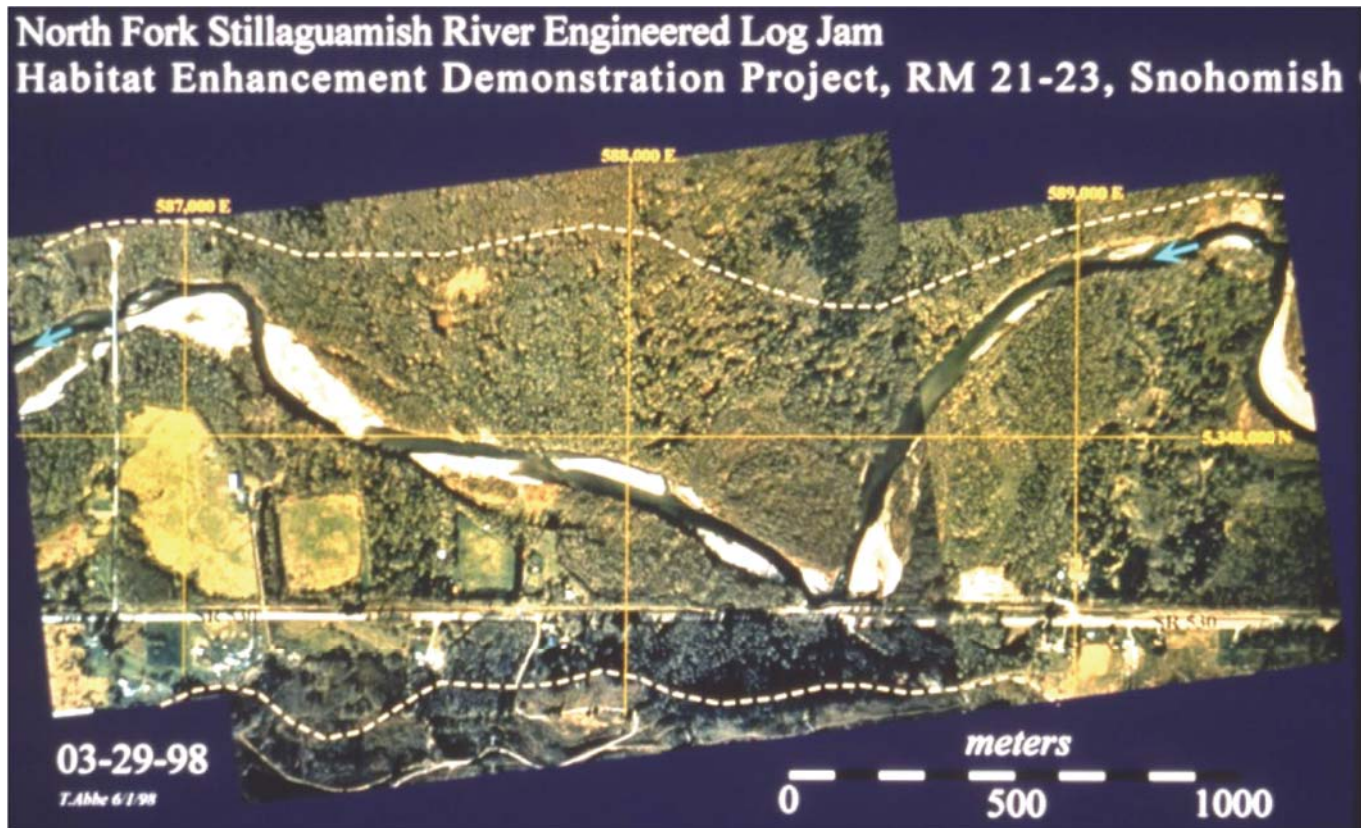
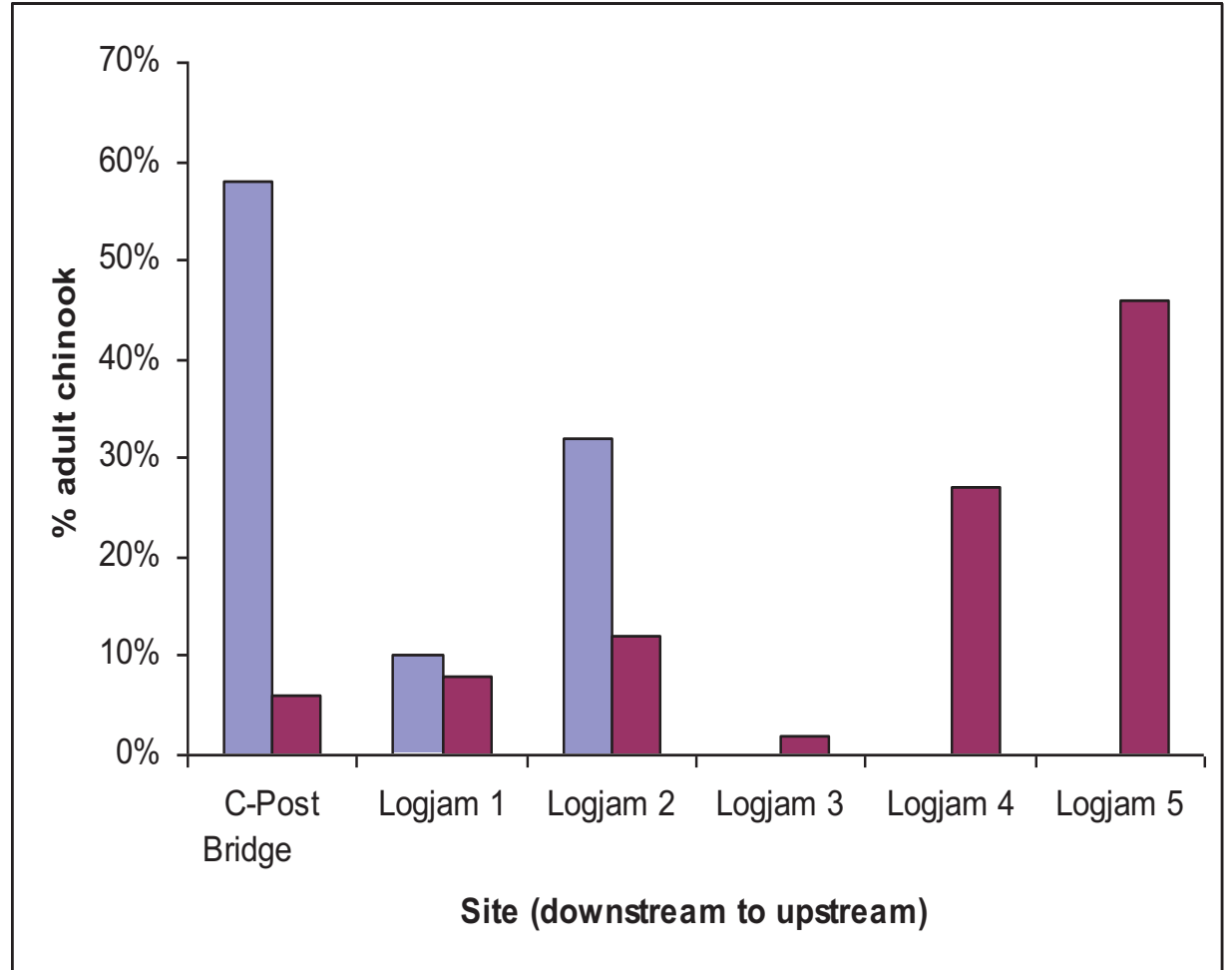


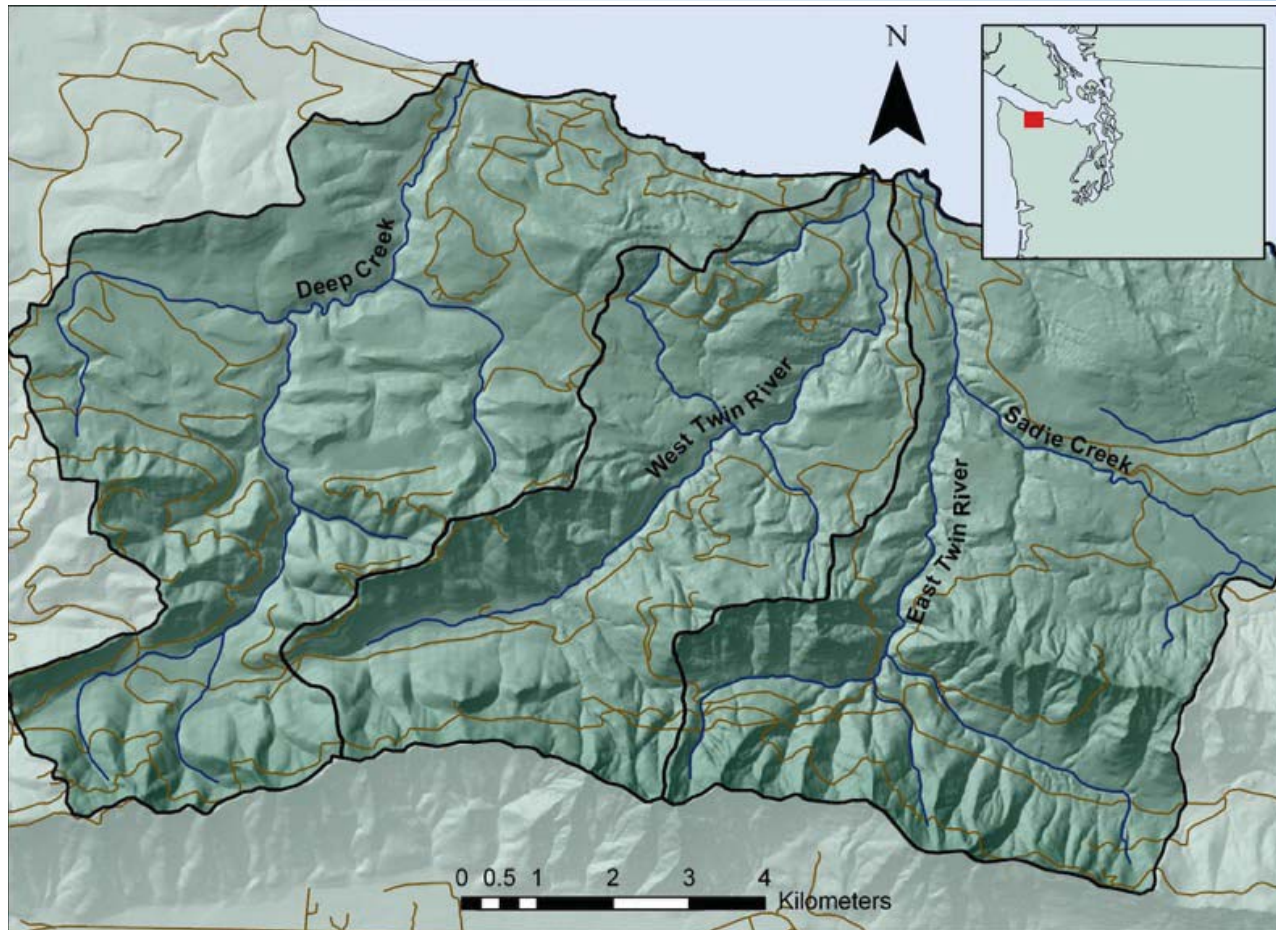


Photo: Mike McHenry and Roger Peters



Data – Pess et al. 2003

Strait of Juan de Fuca IMW



Map S. Baker