

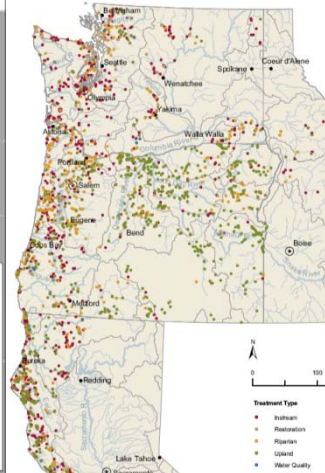
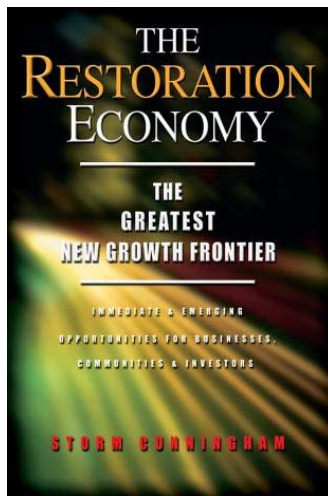
# Monitoring and Evaluating Effectiveness of Regional River Restoration Programs: Lessons from Western U.S.



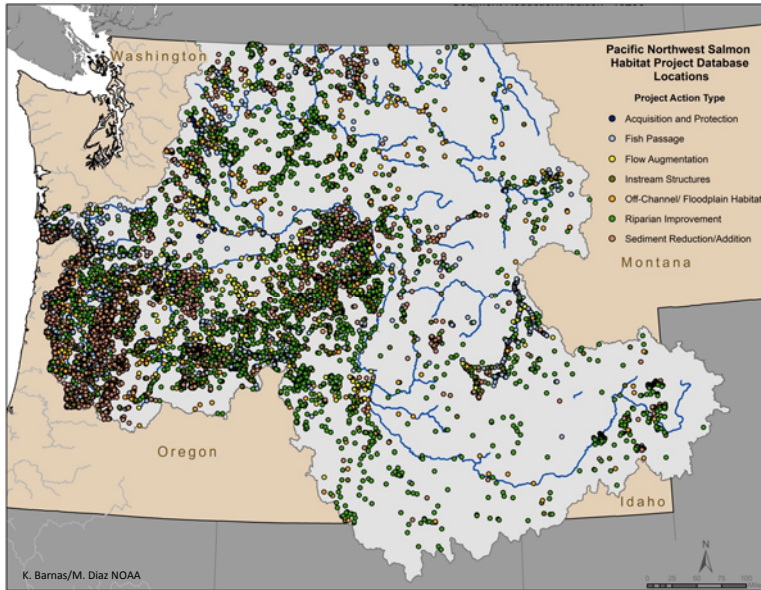
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## Billion Dollar Industry



# Columbia Basin Projects



# Reconnect Isolated Habitats



## Riparian Restoration Techniques



## Roads, Hydrology & Sediment Delivery

Urban Roads



Forest Roads



## Floodplain Restoration



## Instream Habitat Improvement

- Logs, woody debris, boulders and weirs
- Gravel addition
- Brush and Cover structures
- Beaver enhancement/reintroduction



## Monitoring and Evaluation?

- Less than 10% of all projects receive monitoring
  - Often compliance or implementation monitoring not effectiveness
- Historically effectiveness monitoring and evaluation at project level
  - Inefficient
  - Data often can't be combined
  - Program or regional evaluation?



## Today's Goals

- Approaches for evaluating regional restoration programs
  - “Programmatic evaluation”
- Examples of each of these
  - Goal/question
  - Level of inference
  - Pros and cons
- Lessons learned
  - Recommendations



## Steps in Designing a Monitoring Program

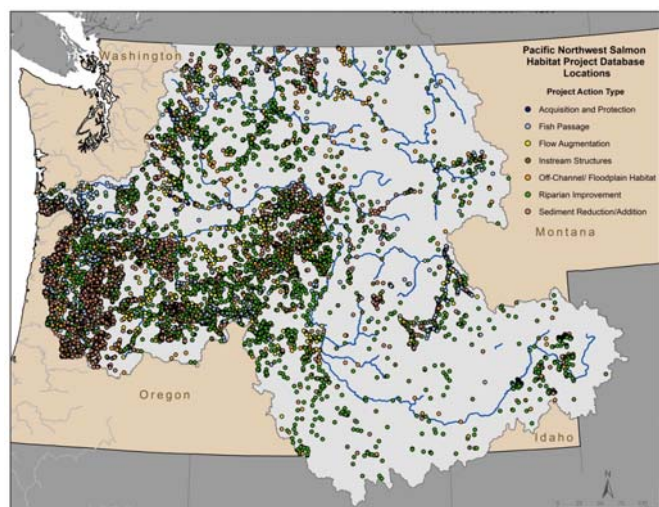
- Define project goals and objectives
- **Define questions/hypotheses**
- **Define scale**
- **Determine monitoring design**
- Select parameters
- Spatial and temporal replication
- Selecting sampling scheme/protocol
- Implement monitoring



From Roni 2005. 2013

## Programmatic M&E Questions

1. What is the effectiveness of different restoration types across a region on habitat and biota at the reach scale?
2. Why are some projects more successful than others?
3. How can results be used to guide future restoration?

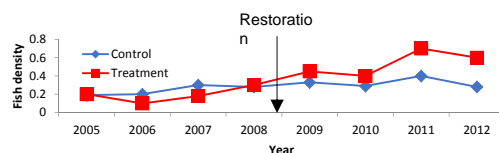
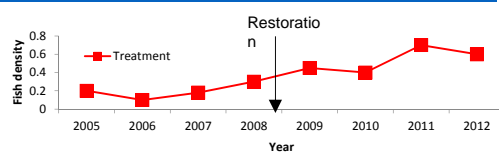


## Approaches for Programmatic Evaluation of Restoration

- Case study
- Compendium or Meta-analysis
- Multiple Before-After Control-Impact (MBACI)
- Extensive Post-Treatment (EPT)
- Hybrid MBACI and EPT
- Intensively Monitored Watersheds (IMW)\*

## Experimental Designs

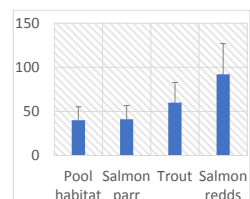
- Before-After (BA)
- Before-After Control-Impact (BACI)
- Extensive Post-treatment (EPT or CI)



Control



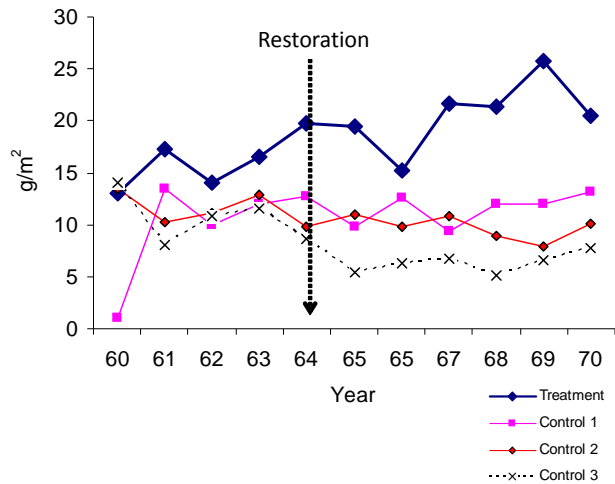
Treatment



## Case Studies

- Evaluate effectiveness of specific restoration project
- Inference
  - project
- Pros and cons
  - + feasible, interannual variability
  - - not broadly applicable, long-term

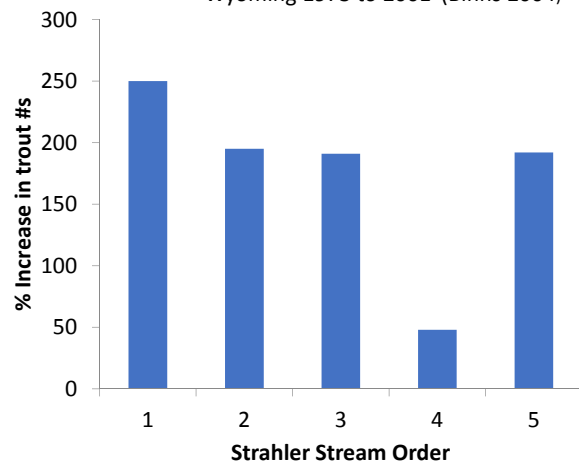
Hunt 1974. Brook trout response in Lawrence Creek, Wisconsin



## Compendium or Meta-Analysis of Case Studies

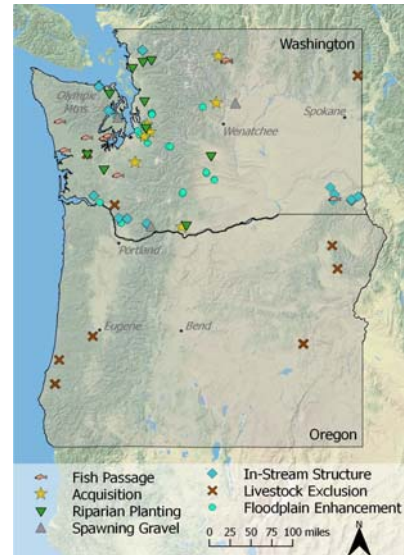
- Compilation regional case studies
- Inference
  - Project, program (region)
- Pros and cons
  - + potentially broadly applicable
  - +,- data collected by many groups
  - Sites not representative
  - Analysis can be difficult

Wyoming 1973 to 2001 (Binns 2004)

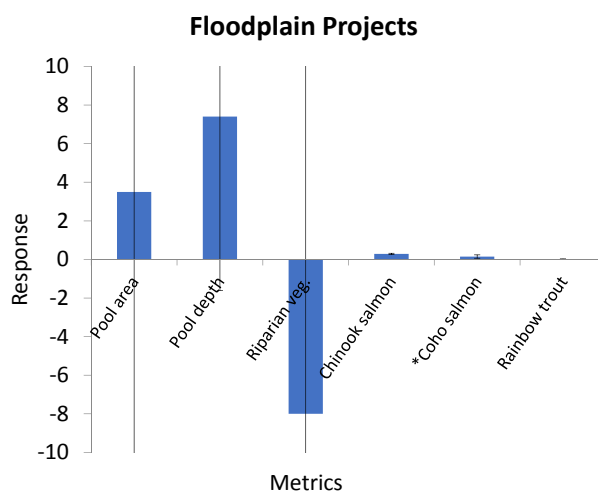


## Multiple BACI

- Evaluate a representative sample of projects before and after restoration
- Inference
  - Project & program (region)
- Pros and Cons
  - + Results are broadly applicable
  - + Info projects are successful or not
  - + Info on interannual variation
  - Logistically difficult to implement
  - Requires long-term commitment
  - Difficult to modify design once initiated



## Washington/Oregon Salmon Recovery Program

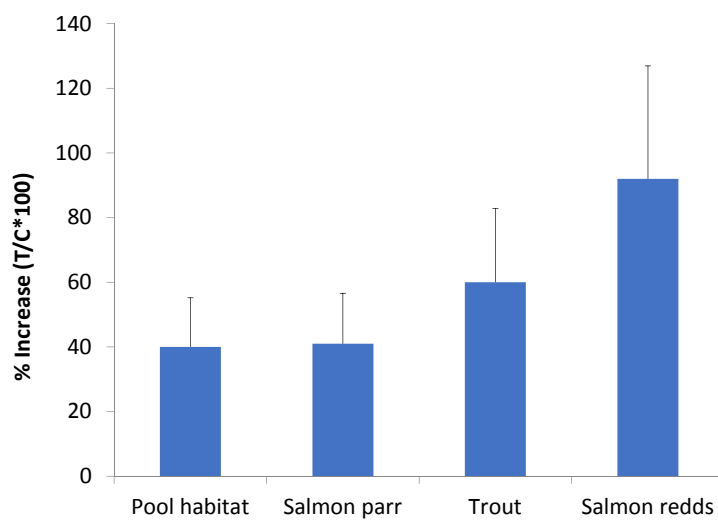


## Extensive Post-Treatment

- How effective are particular types of restoration actions or a regional program?
- Inference
  - project type or program (region)
- Pros and cons
  - + Broadly applicable results
  - + Info on why projects successful
  - + Provides results relatively quickly
  - Requires large # of completed projects
  - Can't determine effectiveness of individual project



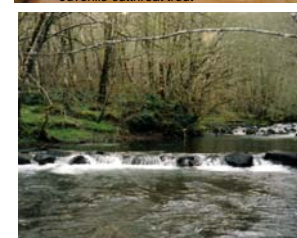
## Average Response to Boulder Placement



Juvenile coho salmon

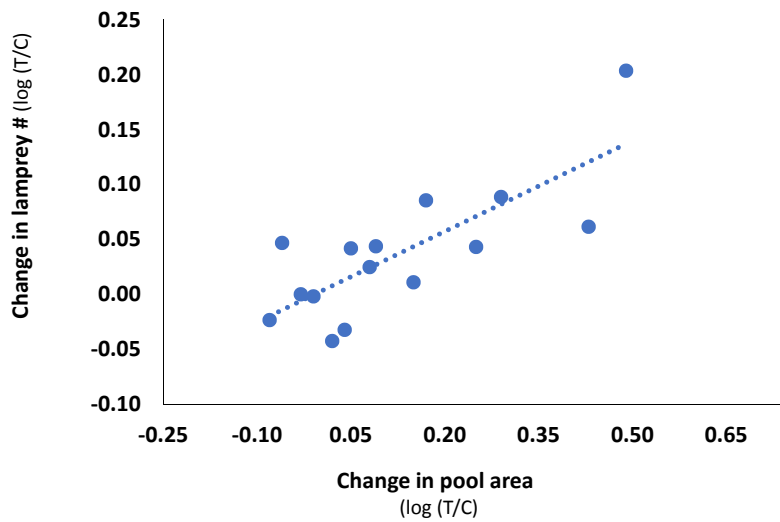


Juvenile cutthroat trout



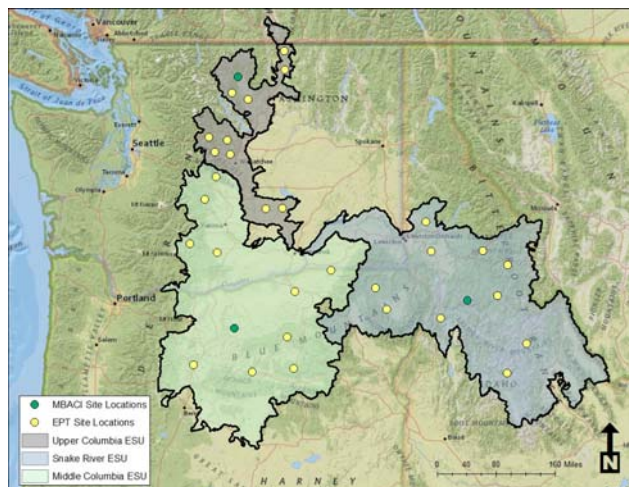
Roni et al. 2006, 2008

## Spatial replication of EPT allows correlation other factors



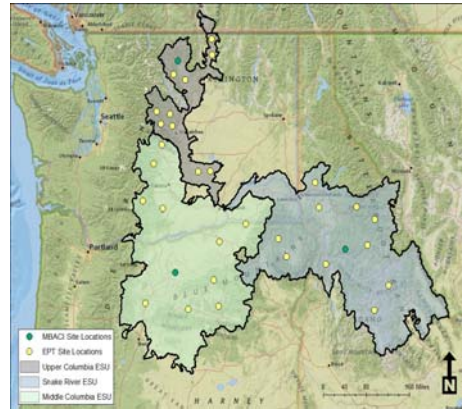
## Hybrid Approaches

- Combination of BACI case studies and post-treatment on other sites
- Monitor some metrics using MBACI and some post-treatment



## Summary

- Several different programmatic or regional approaches
- They all have pros and cons
- Some have proven difficult to implement
- So which is best?.....depends upon:
  - questions & goals
  - no. type, number and scale
  - level of spatial and temporal inference
  - cost and resources
  - when do you want results?



## Summary of Pros and Cons

Strength	Case study	Meta-analysis	MBACI	EPT	Hybrid
Interannual variation	X	X	X		
Info on why projects effective		X	X	X	X
Broadly applicable			X	X	X
Length monitoring (yrs)	10+	10+	5+	1-3	3+
Cost (low, medium, high)	L	M	H	M	M
Inference* (Project, Program)	P	P, PG	P, PG	PG	PG

## Recommendations Based on U.S. Experience

- Some type of hybrid approach most practical
- Many large programs in US have failed because
  - Poor design and monitoring implementation
  - Poor selection of controls
  - Inadequate monitoring protocols
  - Poor data management
  - Changes in restoration design
  - Too many different groups collecting data
- Programmatic approach to M&E requires
  - Extensive coordination
  - Oversight by third party



## Questions?

