

**Bill Bradbury**  
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Montana

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**Phil Rockefeller**  
Washington

September 4, 2013

## MEMORANDUM

**TO:** Full Council

**FROM:** Nancy Leonard

**SUBJECT:** What we know and do not know about salmon habitat restoration

Dr. Phil Roni is the Research Biologist/Watershed Program Manager at the Northwest Fisheries Science Center with NOAA Fisheries. His research team consists of about 20 scientists working on habitat science and watershed ecology, who for the last 18 years, have concentrated on evaluating various habitat restoration techniques and providing guidance on restoration prioritization and implementation. His work and expertise in the field of aquatic fish habitat restoration is recognized nationally and globally. The United Nations Food and Agriculture Organization (FAO) Fisheries Department sought out Dr. Roni to produce an FAO Fisheries Technical Paper in 2005 about the effectiveness and guidance for rehabilitation of freshwater ecosystems. The American Fisheries Society and the U.S. President also recognized him for his contributions to restoration science. He has published numerous papers on restoration including the books "Stream and Watershed Restoration: a guide to restoring riverine processes and habitat" (2013 Wiley-Blackwell) and "Monitoring Stream and Watershed Restoration" (2005 American Fisheries Society).

Jason Sweet is the manager of the Policy and Planning group within the Bonneville Power Administration's (BPA) Fish and Wildlife Division. He supervises a staff of professional biologists, engineers, and policy analysts whose work includes preparing biological assessments related to the operation of the Federal Columbia River Power System; analyzing and reporting on BPA's implementation of biological opinions for Endangered Species Act-listed salmonids; and helping implement BPA's broader fish and wildlife mitigation responsibilities under the Northwest Power Act, which covers non-ESA-listed fish and wildlife species in addition to listed species. In previous positions with BPA, Mr. Sweet worked on research, monitoring, and evaluation programs related to habitat restoration efforts. He was also BPA's technical lead for fish passage improvement to improve the survival of ESA-listed salmonids as they pass Columbia and Snake river dams. Prior to joining BPA, he worked in a variety of field-based jobs performing survival studies of fish passing Northwest dams and hydro-acoustic evaluations of a

wide variety of fish species throughout the Pacific Northwest and Alaska. He recently presented to the Council and the ISRP about Bonneville's programmatic approach to monitoring habitat actions and how the CHaMP, ISEMP, IMWs, and project level action effectiveness work integrate together (see January 8th FW Committee agenda for more details).

Dr. Roni will lead us in a discussion about the current state of knowledge about the effectiveness of salmon habitat restoration actions.

Dr. Roni and Jason Sweet will also briefly address the current efforts to refine action effectiveness monitoring under the Program.

# Effectiveness of Common Habitat Restoration Techniques

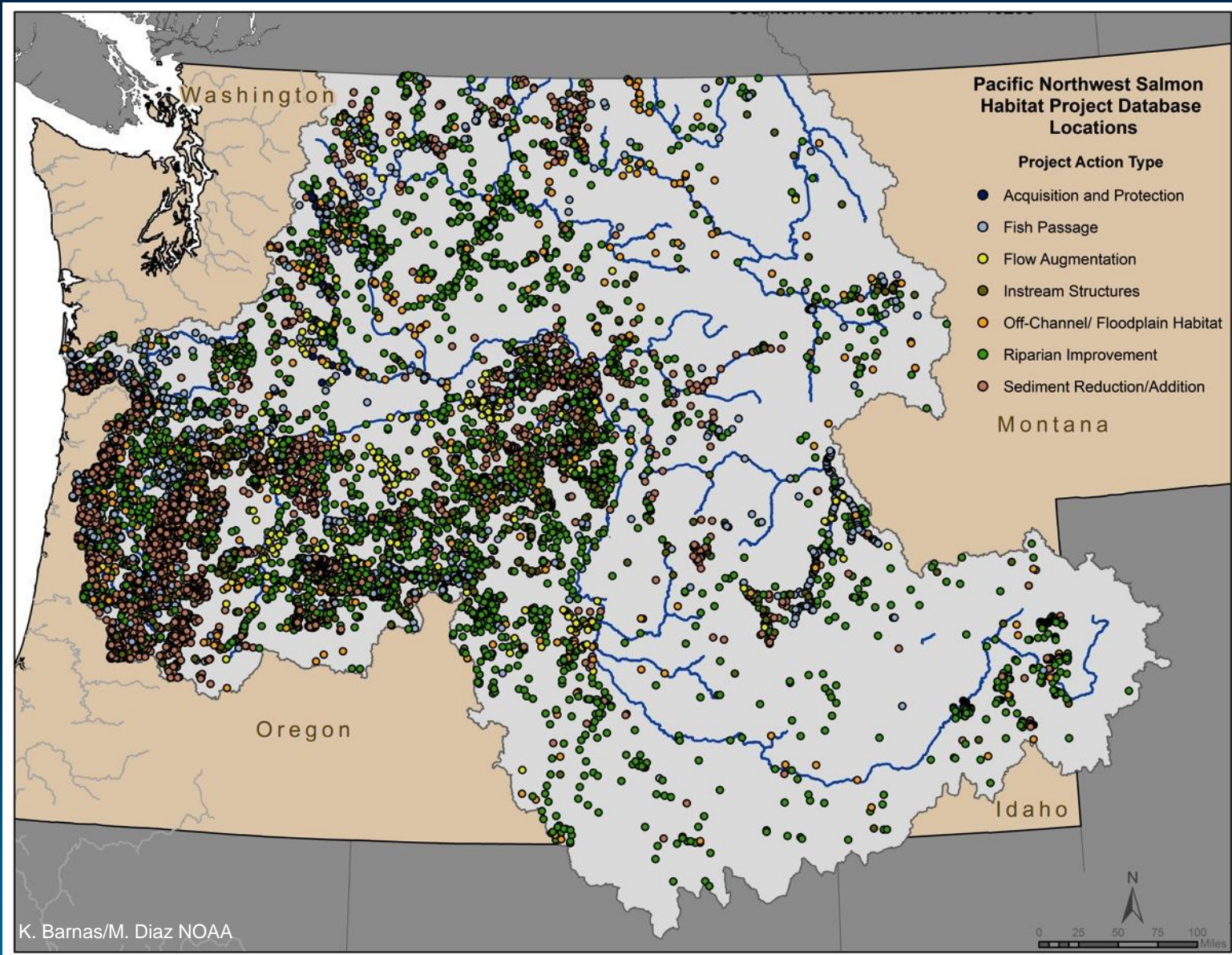


Phil Roni  
Watershed Program  
Northwest Fisheries Science Center  
Seattle, Washington




**NOAA**  
FISHERIES

# 1,000s of Projects Implemented



# Considerable Debate

- Physical response?
  - Biological response (fish)?
  - How much is needed?
  - Where is it effective?
- 

# Review of Literature

## Habitat rehabilitation for inland fisheries

Global review of effectiveness and guidance for rehabilitation of freshwater ecosystems

NO  
TECHNICAL  
PAPER  
484



## Global Review of the Physical and Biological Effectiveness of Stream Habitat Rehabilitation Techniques

PAUL RYAN\*, KAREN HANSEN, AND TIM BUCHANAN  
 National Center and Washington Administration District, Northwest Fisheries Science Center,  
 2725 Montlake Boulevard East, Seattle, Washington 98112, USA

**Abstract**—The degradation of inland aquatic habitats caused by decades of human activities has led to published studies of stream habitat rehabilitation techniques from throughout the world, leading to a growing body of information on the effectiveness of these techniques for improving physical habitat and increasing local fish abundance. However, the effectiveness of these techniques for improving physical habitat and increasing local fish abundance is not well understood. This review examines the effectiveness of stream habitat rehabilitation techniques for improving physical habitat and increasing local fish abundance. The review examines the effectiveness of stream habitat rehabilitation techniques for improving physical habitat and increasing local fish abundance. The review examines the effectiveness of stream habitat rehabilitation techniques for improving physical habitat and increasing local fish abundance.

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## A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds

PHILIP RONI\*, TIMOTHY J. BEECHIE, ROBERT E. BILEY,  
 FRANK E. LEONETTI, MICHAEL M. POLLOCK, AND GEORGE R. PESS  
 Northwest Fisheries Science Center, National Marine Fisheries Service,  
 2725 Montlake Boulevard East, Seattle, Washington 98112, USA

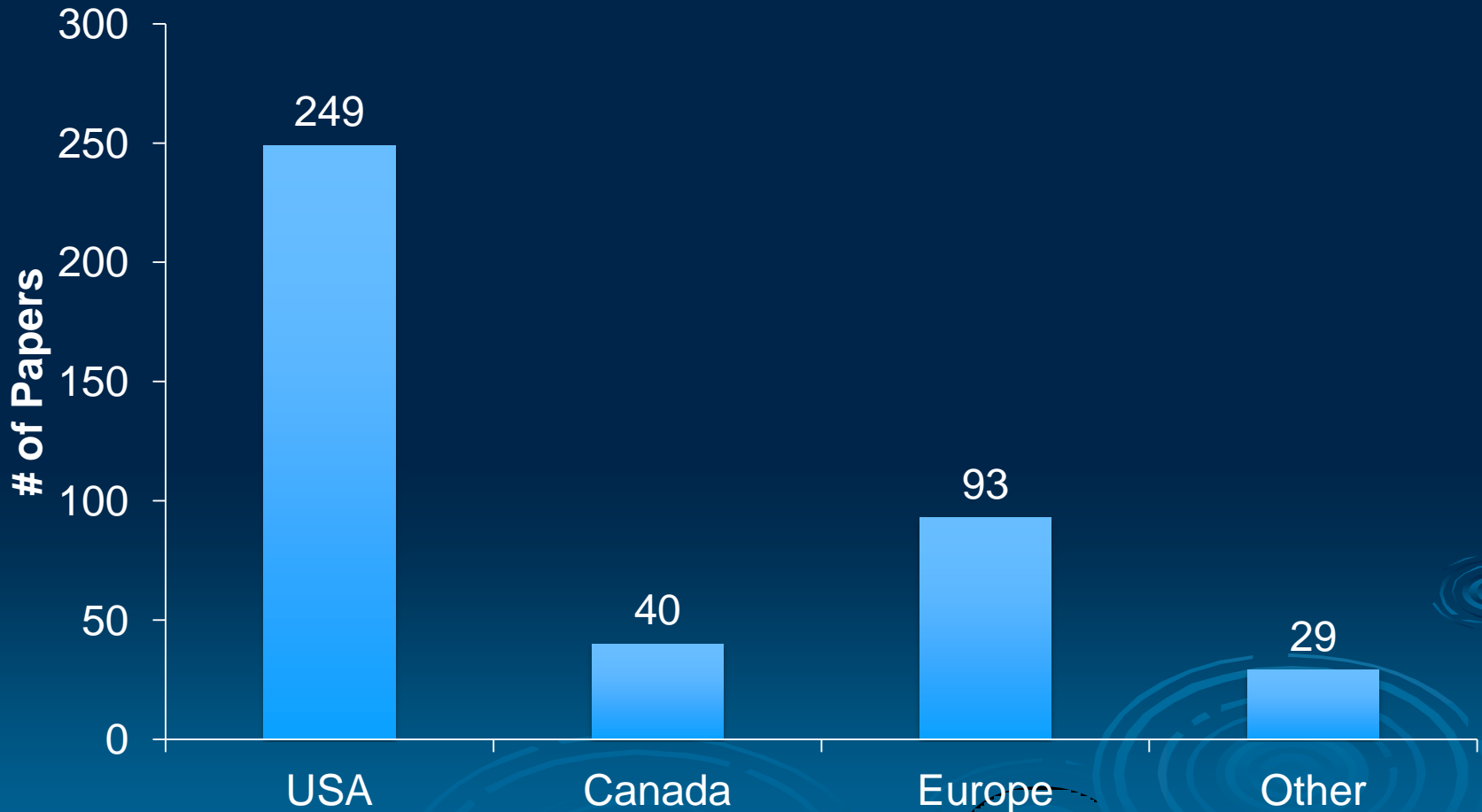
**Abstract**—Millions of dollars are spent annually on watershed restoration and stream habitat improvement in the U.S. Pacific Northwest in an effort to increase natural populations. It is generally accepted that watershed restoration should focus on restoring natural processes that create and maintain habitat rather than manipulating instream habitats. However, most project-based restoration is site-specific, that is, conducted on a short stream reach. To synthesize site-specific restoration techniques, we reviewed the effectiveness of various restoration techniques for improving physical habitat and increasing local fish abundance. The hierarchical strategy we present is based on three elements: (1) principles of watershed restoration techniques, (2) protecting existing high-quality habitats, and (3) current knowledge of the effectiveness of specific techniques. Following a watershed assessment, we recommend that restoration focus on reconnecting isolated high-quality fish habitats, such as instream or off-channel habitats and high-quality riparian areas. Restoration should focus on restoring natural processes (e.g., delivery and routing) and riparian processes through road decommissioning and maintenance within a basin has been restored, efforts should focus on restoring natural processes (e.g., delivery and routing) and riparian processes through road decommissioning and maintenance where short-term improvement in habitat are needed (e.g., habitat for endangered species). Comprehensive physical and biological evaluations of most watershed restoration methods

lack adequate guidance on when restoration or enhancement to complement or enhance existing techniques are most successful. It is often unclear how individual techniques might fit into a larger restoration and recovery of information on the effectiveness of stream habitat rehabilitation and enhancement (e.g., Frissell et al. 1991; Frissell et al. 1996). Unfortunately, habitat restoration techniques placement, riparian reconnection and reconnection of stream channels are highly debated (Reeves et al. 1997). Most physical restoration techniques, however, are highly debated (Reeves et al. 1997). Most physical restoration techniques, however, are highly debated (Reeves et al. 1997). Most physical restoration techniques, however, are highly debated (Reeves et al. 1997).

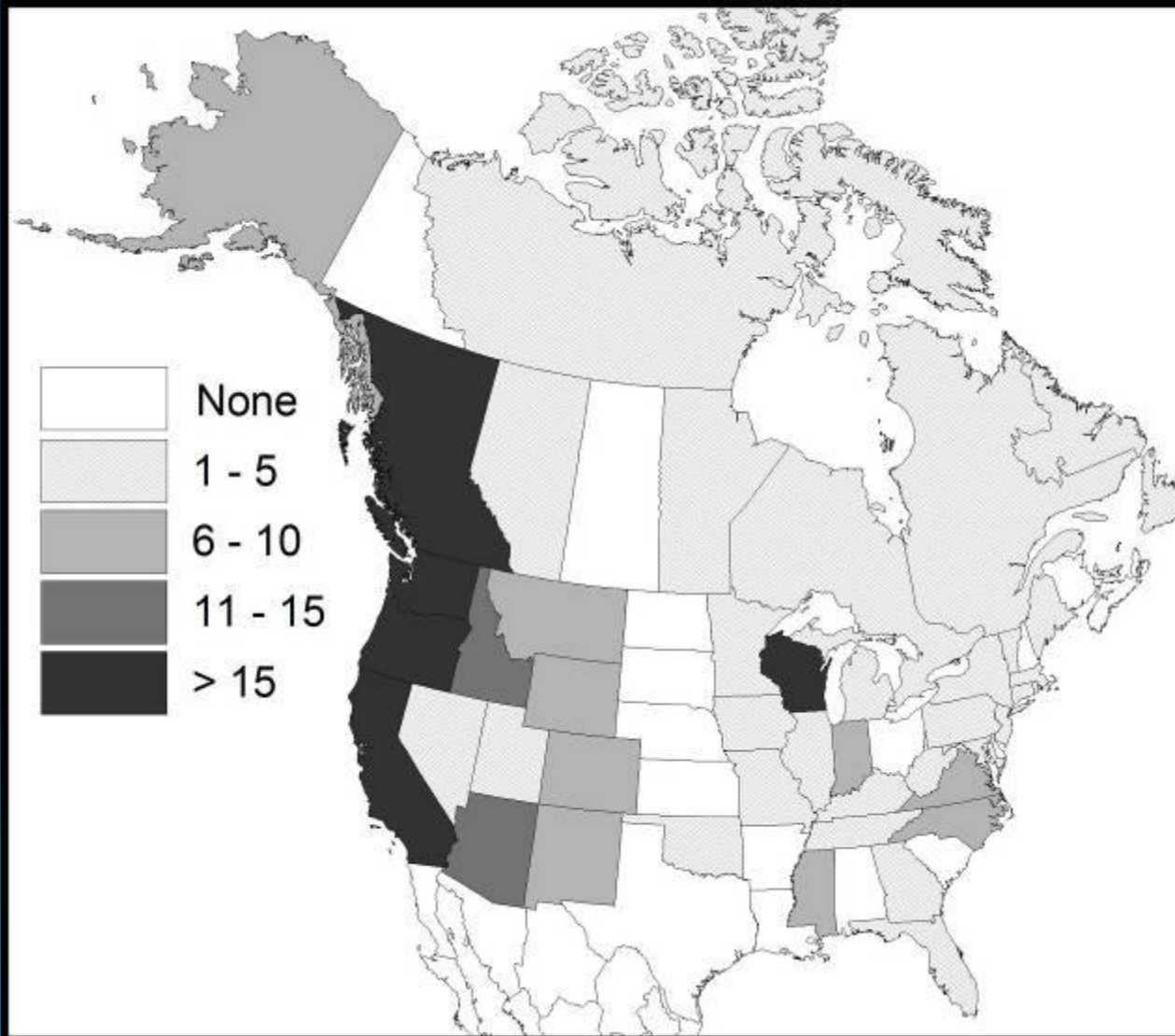
\* Corresponding author: phil.roni@noaa.gov  
 Present address: Weyerhaeuser Company WTC 1A5,  
 Port Office Box 9777, Federal Way, Washington 98063-9777, USA.  
 Present address: Snohomish County Public Works,  
 Surface Water Management Division, 2731 Westmore  
 Avenue, Suite 300, Everett, Washington 98201-3581,  
 USA.  
 Received September 14, 2000; accepted April 8, 2001

North American Journal of Fisheries Management 21:1-20, 2002  
 American Fisheries Society 2002

# Total Published Evaluations of Stream and Watershed Restoration

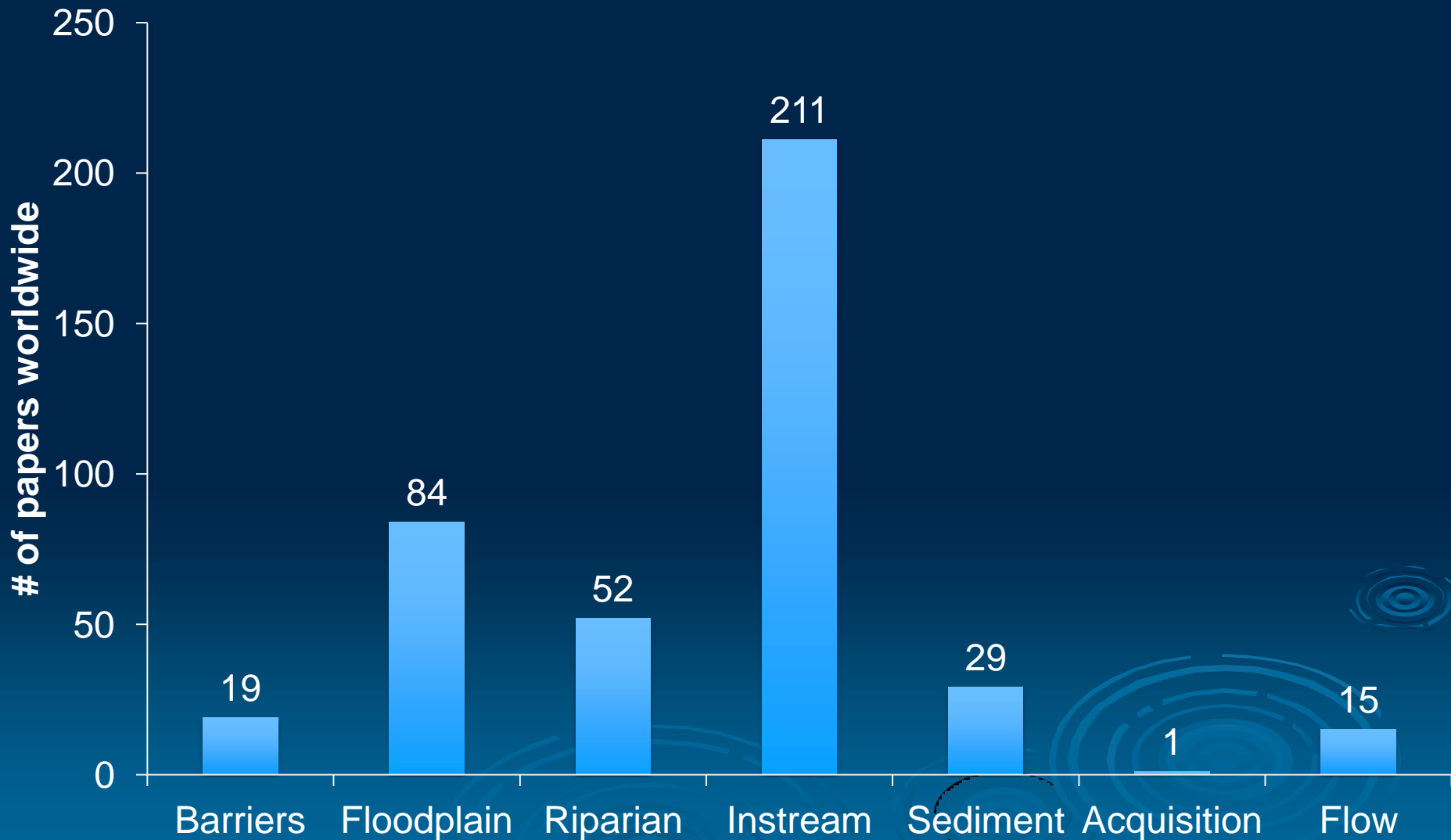


# Published Studies Evaluating Restoration





# Major Categories of Actions



# Goals for Today

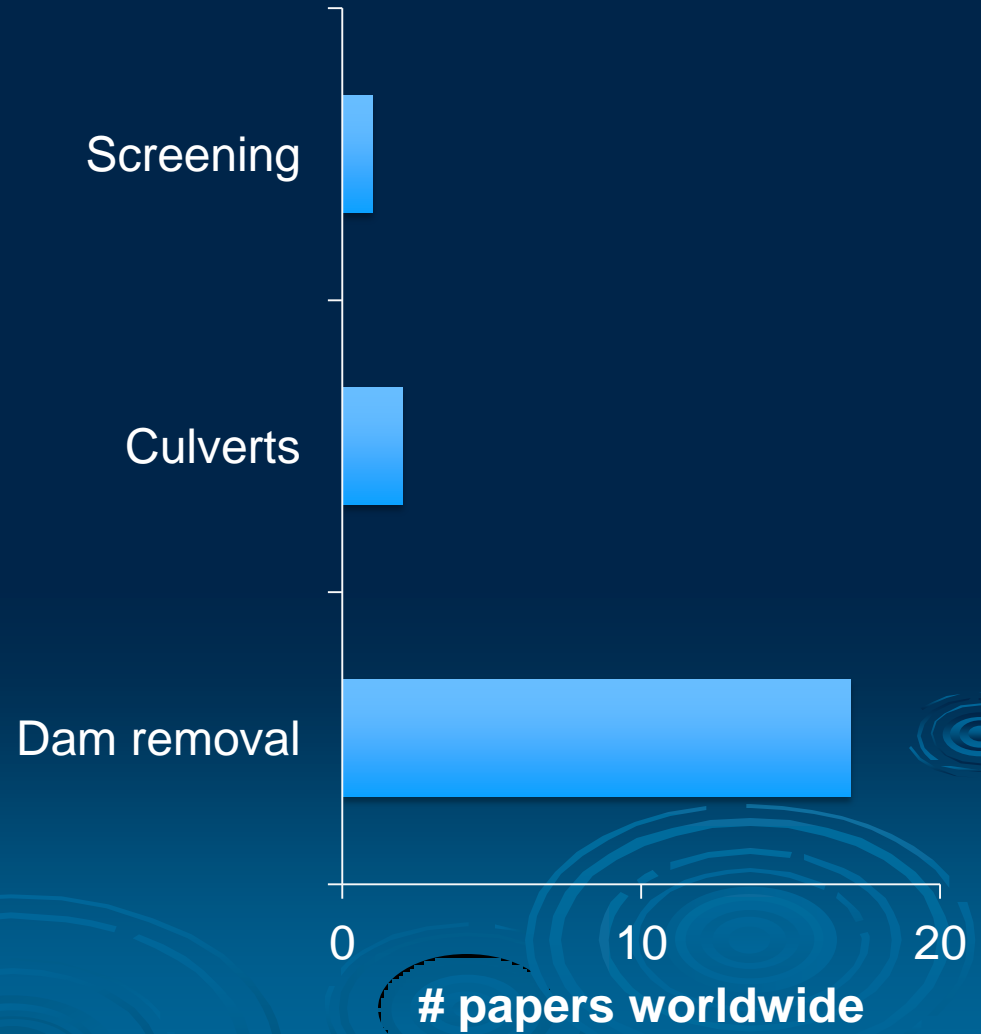
## ➤ Summary of

- What we know
- What we still need to know
- What affects success

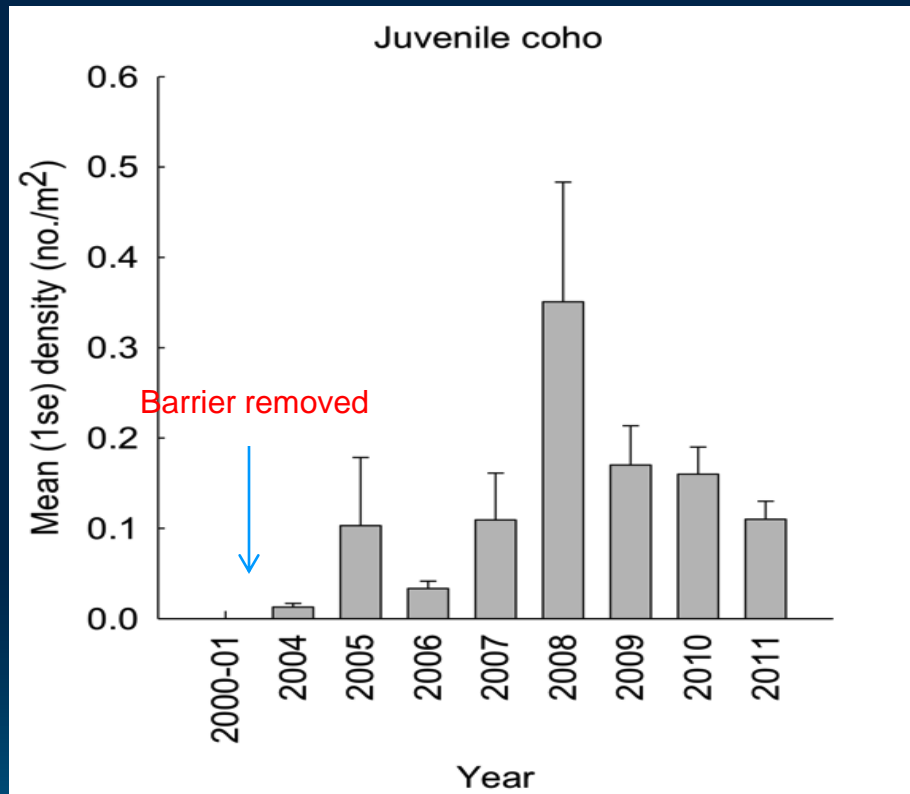
## ➤ Recommendations for Council's F&W Prgm.

## ➤ BPAs Programmatic Approach

# Barriers to Fish Passage



# Summary Barrier Removal



Barrier removed on Cedar River  
Kiffney et al. 2008; Kiffney et al. in prep

## What we know

- Rapid recolonization
- Some don't meet passage success criteria
- Surprisingly few studies on fish response to culverts

## ➤ Success depends upon

- Nearby fish populations size
- Design and maintenance

## ➤ What we need to know

- Fish response

# Floodplain Restoration



# Summary of Floodplain Effectiveness

## ➤ What we know

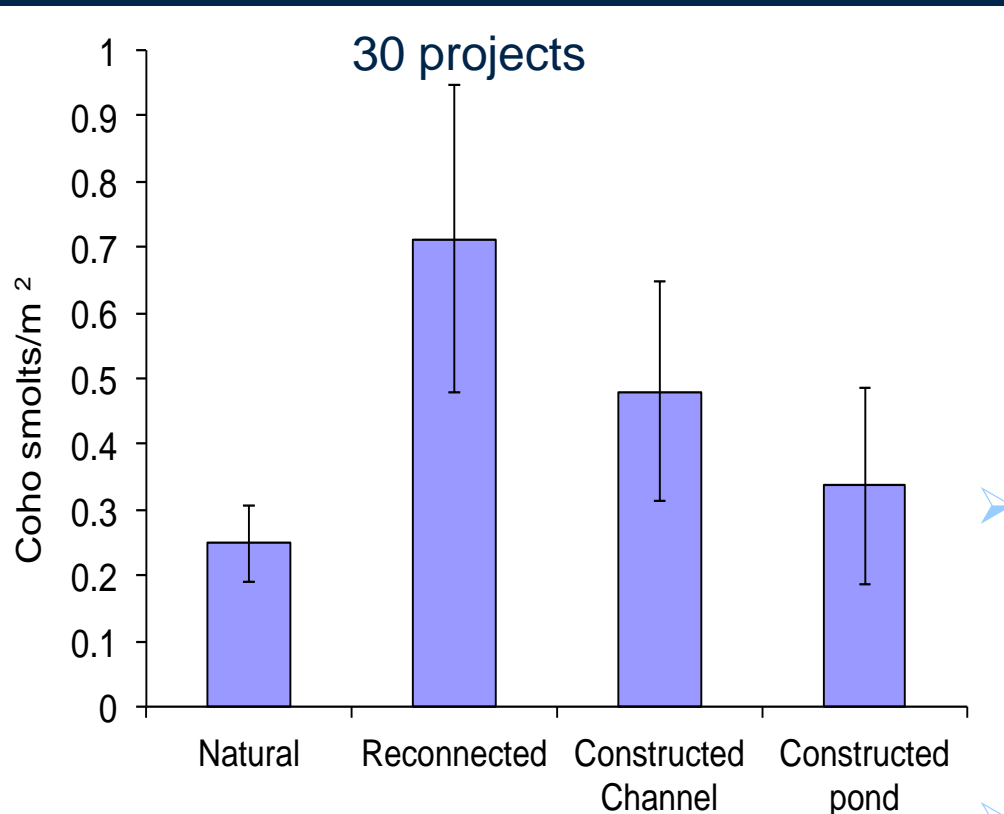
- Reconnecting existing habitats highly successful
- Other techniques show variable success rates
- Little long-term monitoring
- Good data for coho

## ➤ Success depends on

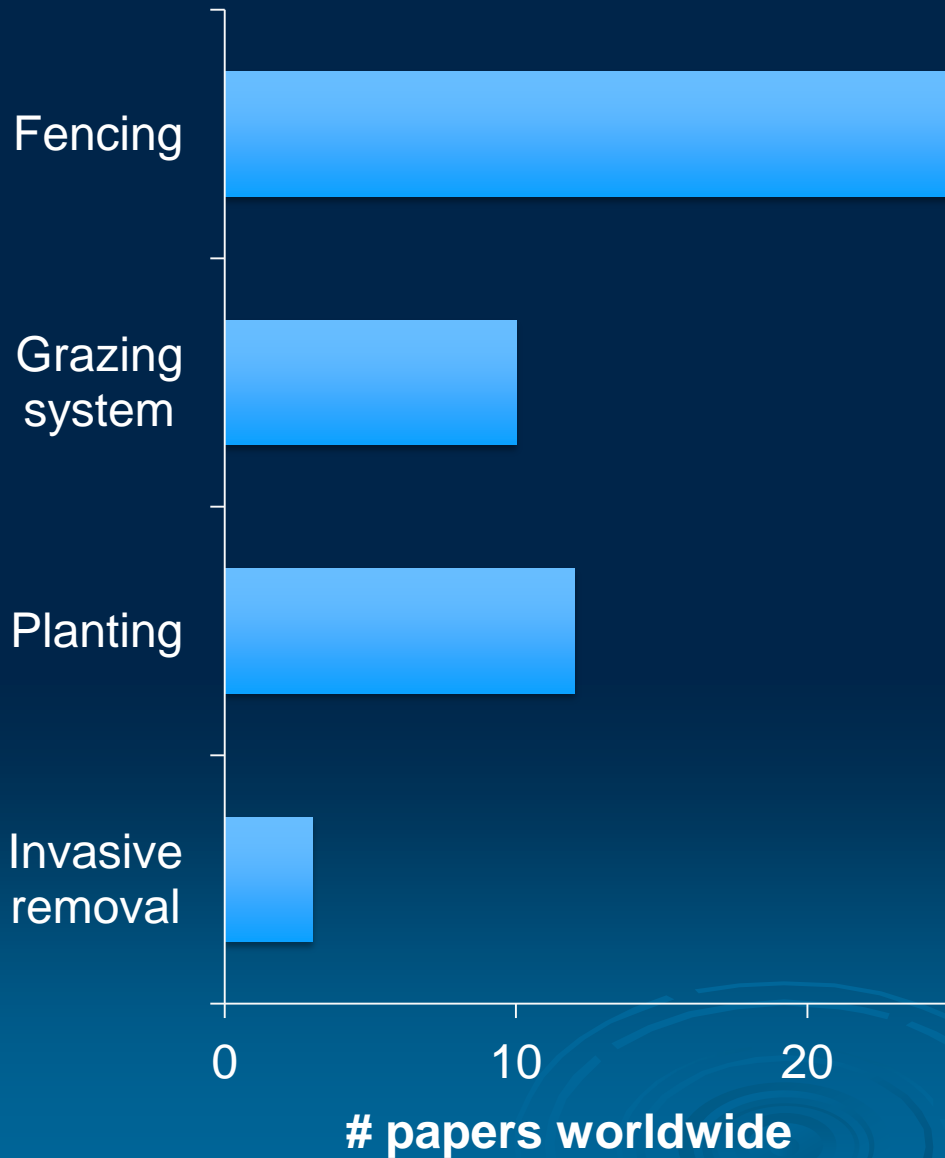
- Access, WQ, sediment
- Design issues

## ➤ What we need to know

- Response of Chinook & steelhead

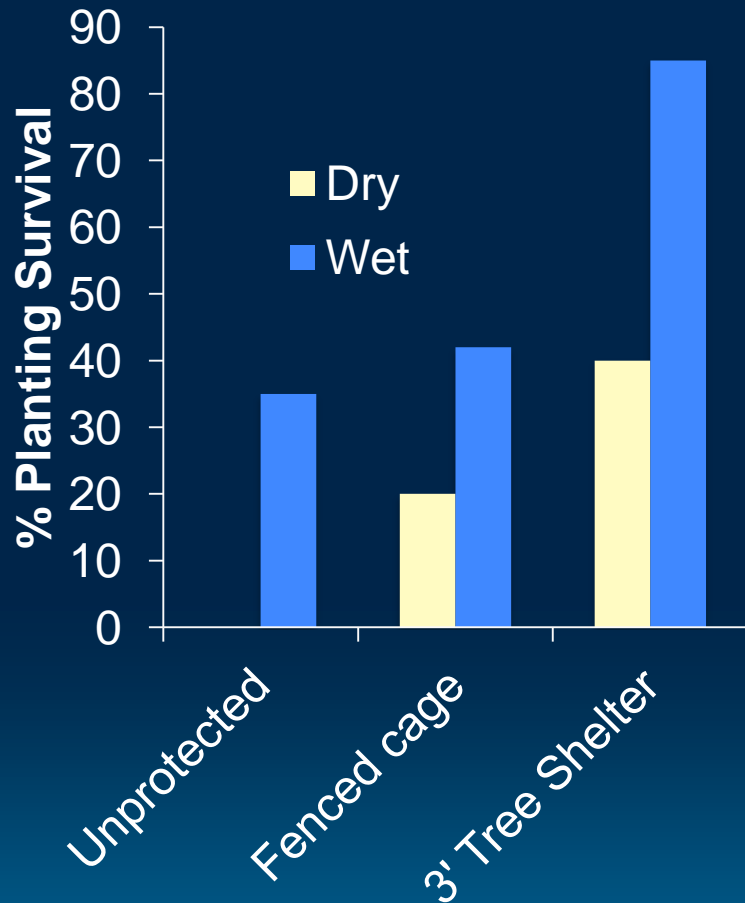


# Riparian - Planting



J. Hall NOAA photos

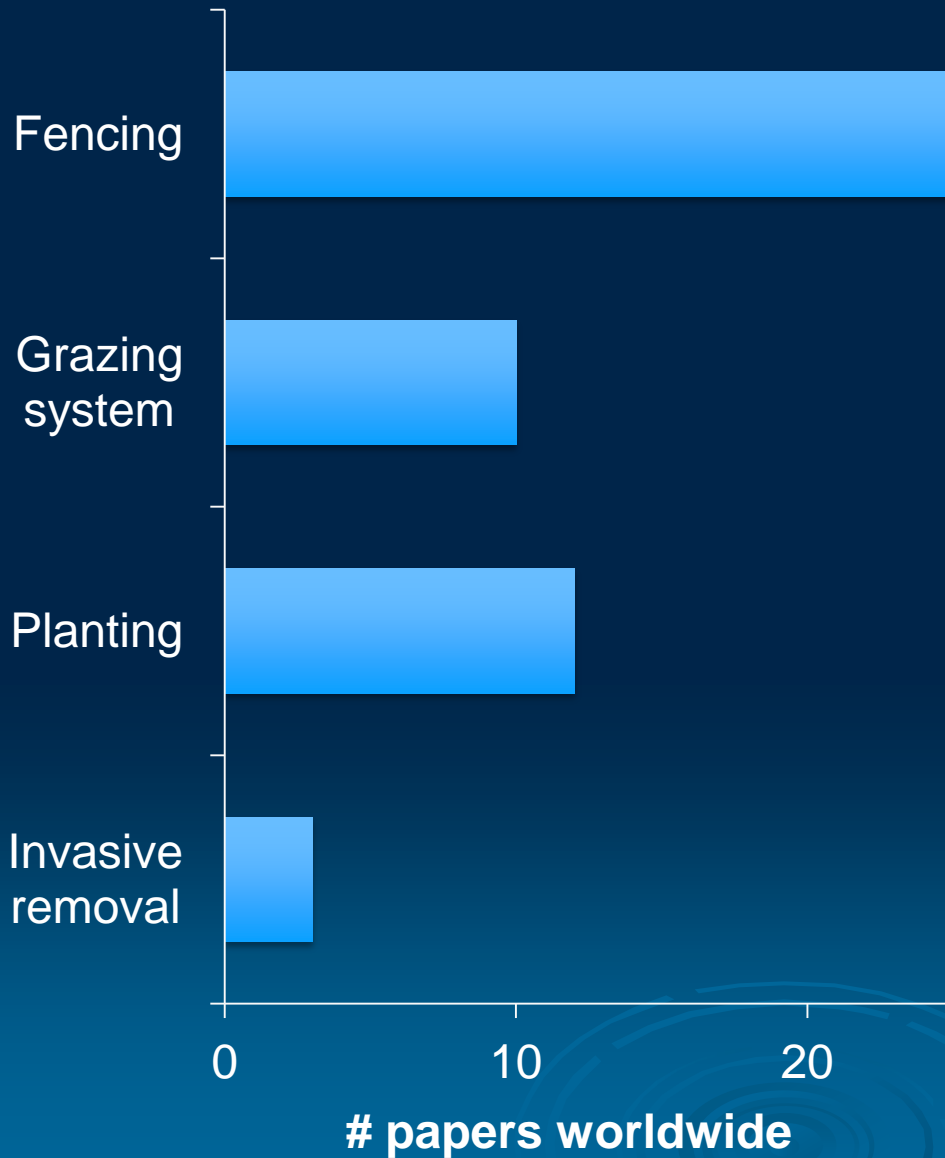
# Riparian - Planting



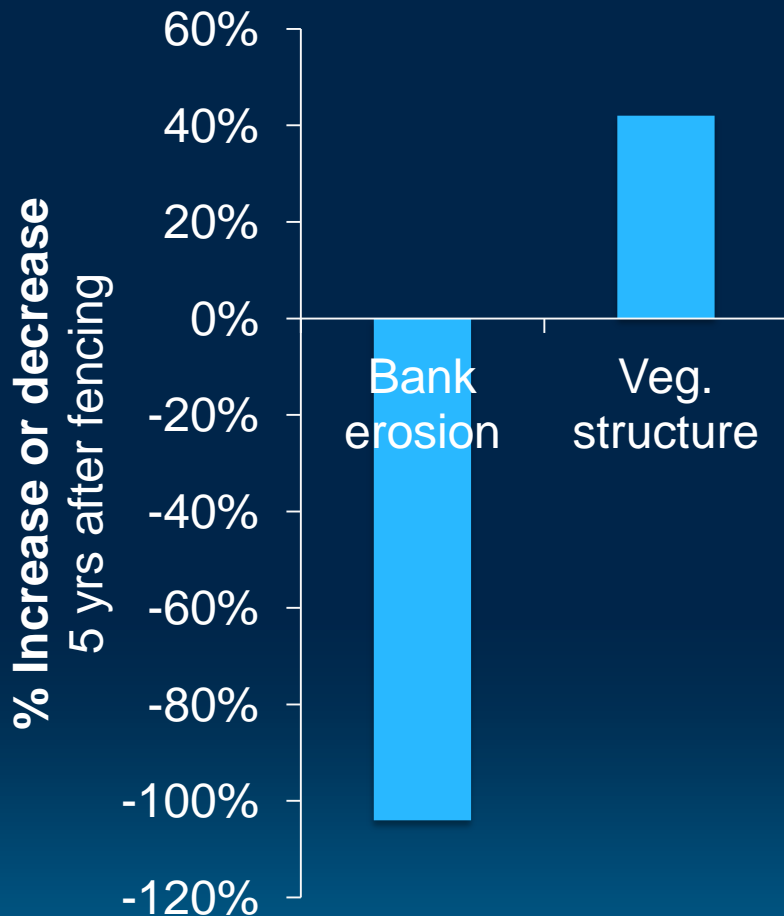
- What we know
  - shade and bank stability increase relatively rapidly
- Success depends on
  - technique
  - site prep & conditions
  - protection from herbivores
  - competition with other plants
  - planting depth
- What we need to know
  - time needed to restore LWD.
  - effects on stream habitat/biota
  - long-term response (10+ yrs)



# Riparian - Grazing



# Summary – Grazing Reduction



Tetra Tech (2012)

## ➤ What we know

- Livestock removal consistently effective
- Quick recovery of veg., sediment, channel width, shade

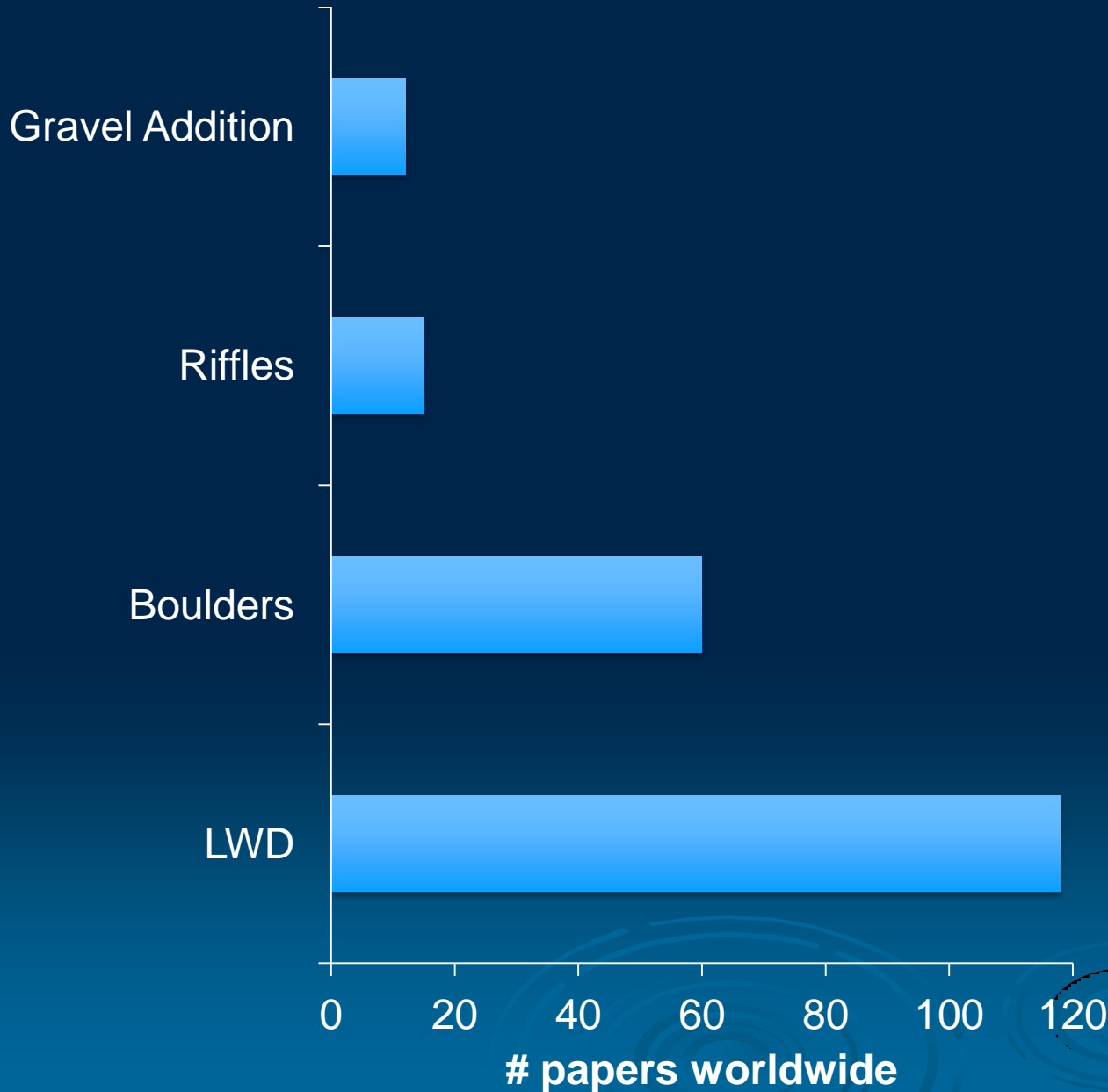
## ➤ Success depends on

- Upstream conditions
- Grazing duration
- Invasive species
- Rest. of flooding & processes
- Scale of project

## ➤ What we need to know

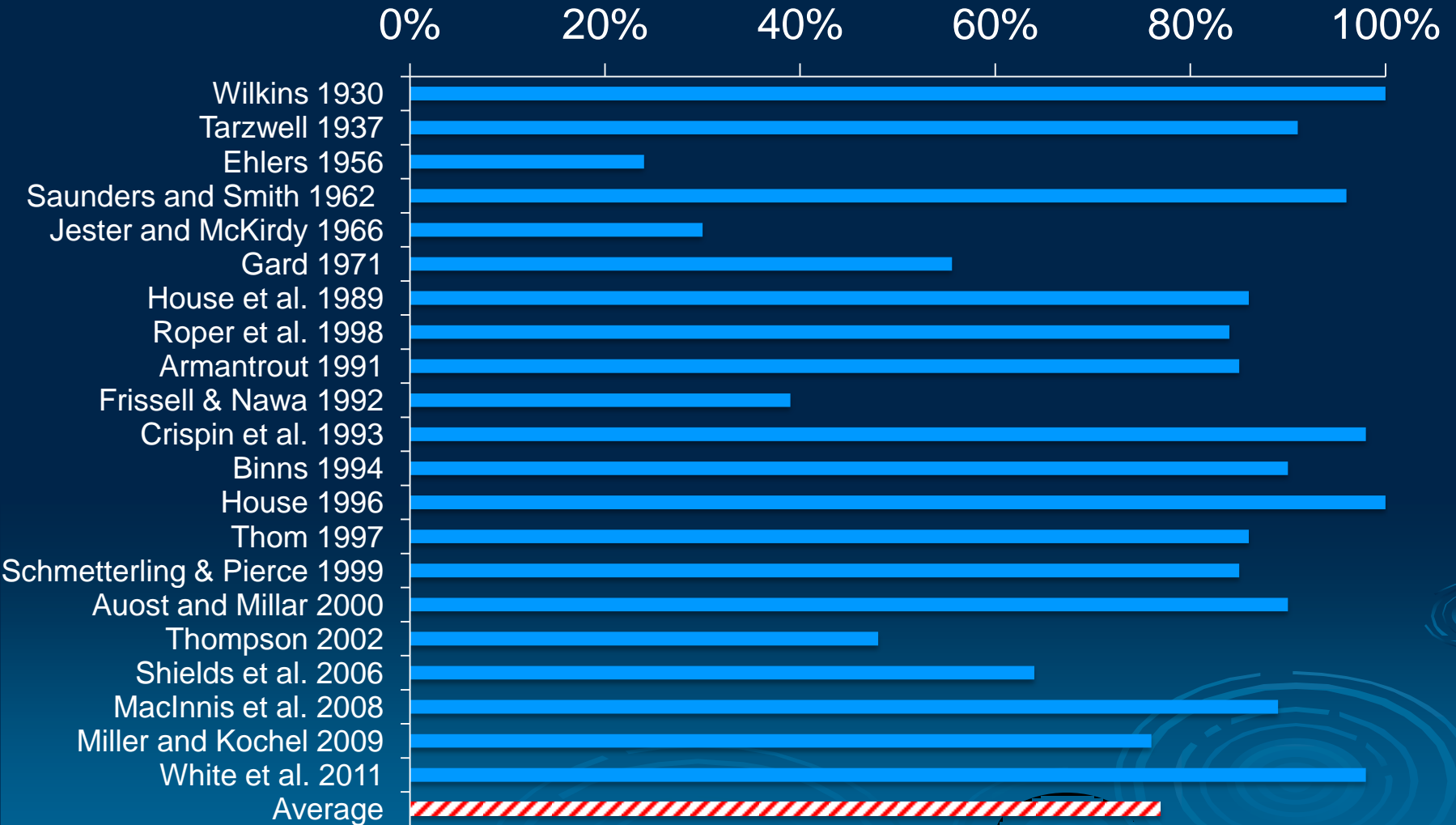
- Fish & instream response?

# Instream Habitat Improvement



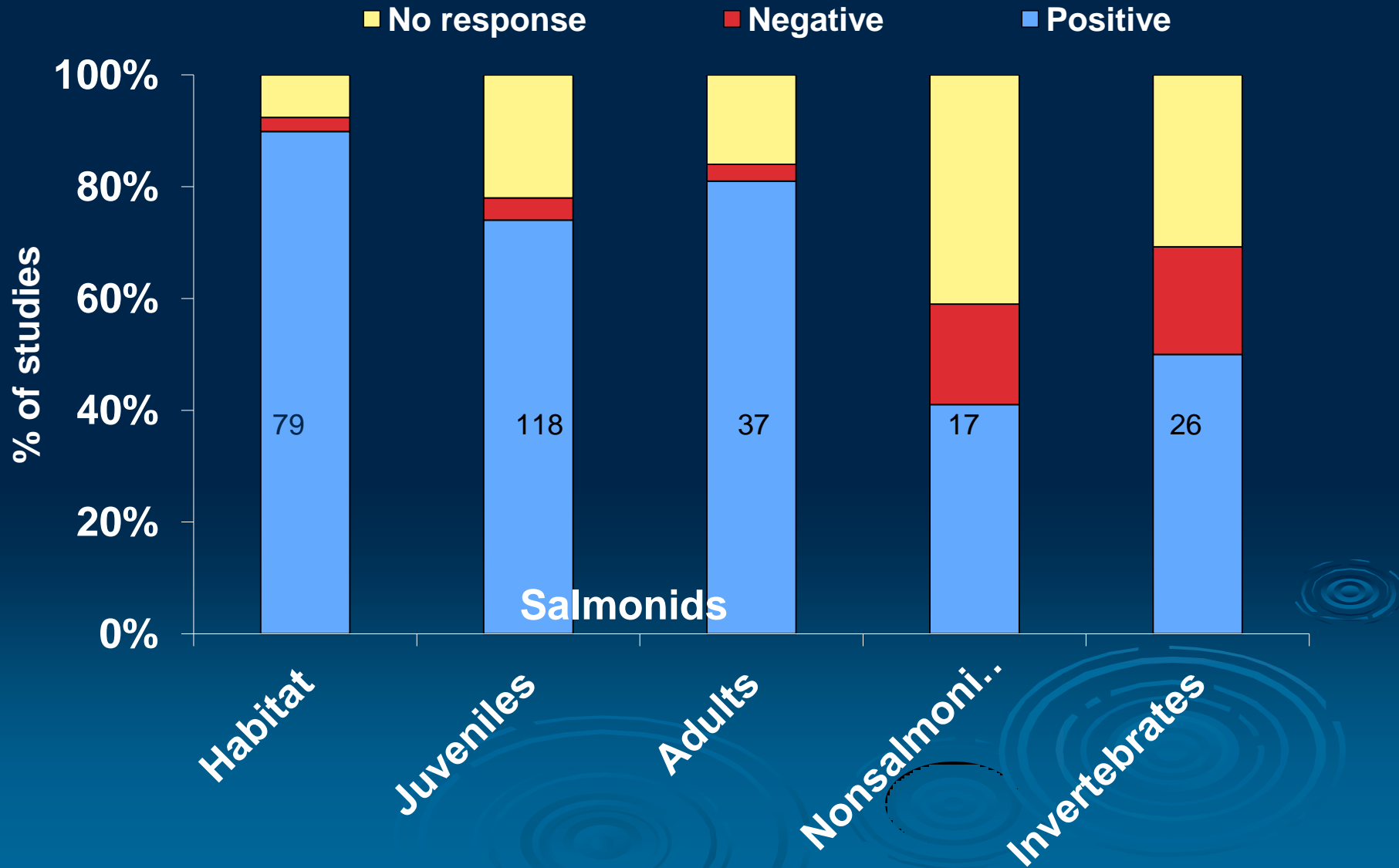
# Instream Structure Durability

Averages 77% across 21 studies



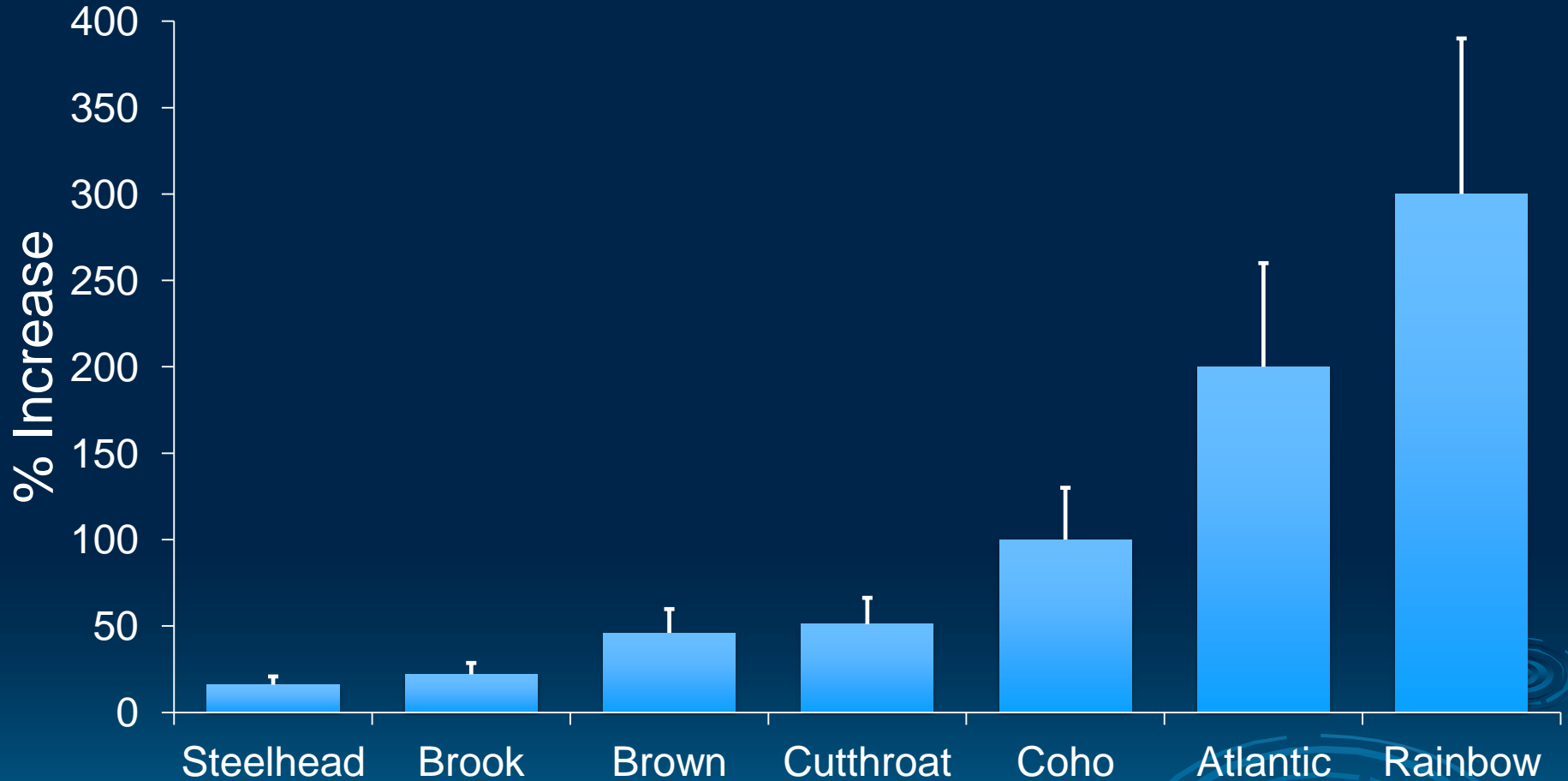
# Instream Habitat Improvement

## Physical and Biological Response



# Meta-Analysis – Whiteway et al. 2010

Examined 211 Projects



# Summary of Instream

## ➤ What we know

- Physical response and durability well documented
- Response well documented for coho, Atlantic salmon, resident trout
- Fish response varies among species, regions, watersheds

## ➤ Success depends upon

- Addressing WQ, sediment, riparian and other processes
- Intensity and amount of restoration\*\*\*
- Design

## ➤ What we still need to know

- Little to no data on Chinook or interior steelhead
- Response in larger rivers (>20 meters wide)
- Watershed-scale response



# Overall Summary

North American Journal of Fisheries Management 21:1-26, 2001  
American Fisheries Society 2002

## A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds

PHILIP RONI,\* TIMOTHY J. BEECHIE, ROBERT E. BILEY,<sup>1</sup>  
FRANK E. LEONETTI,<sup>2</sup> MICHAEL M. POLLOCK, AND GEORGE R. PESS  
Northwest Fisheries Science Center, National Marine Fisheries Service,  
Northwest Fisheries Boulevard East, Seattle, Washington 98112, USA,  
2725 Montlake Boulevard East, Seattle, Washington 98112, USA

**Abstract.**—Millions of dollars are spent annually on watershed restoration and stream habitat improvement in the U.S. Pacific Northwest in an effort to increase natural fish populations. It is generally accepted that watershed restoration should focus on restoring natural processes that create and maintain habitat rather than manipulating instream habitats. However, most project-based restoration is site-specific, that is, conducted on a short stream reach. To synthesize site-specific techniques into a process-based watershed restoration strategy, we reviewed the effectiveness of various restoration techniques at improving fish habitat and developed a hierarchical strategy for prioritizing riparian and instream techniques. Initially, efforts should focus on protecting areas with instream processes and high-quality isolated high-quality fish habitats, such as instream or off-channel habitat refuges, and high-quality riparian areas. Following a watershed assessment, we recommend that restoration focus on reconnecting isolated high-quality fish habitats, such as instream or off-channel habitat refuges, and high-quality riparian areas. Instream habitat enhancement (e.g., decommissioning and maintenance of weirs, culverts, or other artificial obstructions), instream habitat enhancement (e.g., delivery and routing), and riparian processes through road decommissioning and maintenance (e.g., exclusion of livestock, or removal) should be employed after restoring natural processes where short-term improvement in habitat are needed (e.g., habitat for endangered species), where comprehensive physical and biological evaluations of most watershed restoration methods

lack adequate guidance on which techniques are most successful for restoration or enhancement to complete. It is often unclear how individual techniques might fit into a larger restoration and recovery of riparian and instream processes. In part, the lack of guidance information on the effectiveness of various restoration and enhancement techniques (Reeves et al. 1997, Moore et al. 1997). Most physical restoration techniques, such as instream habitat enhancement (e.g., delivery and routing), and riparian processes through road decommissioning and maintenance (e.g., exclusion of livestock, or removal) should be employed after restoring natural processes where short-term improvement in habitat are needed (e.g., habitat for endangered species), where comprehensive physical and biological evaluations of most watershed restoration methods

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## Habitat rehabilitation for inland fisheries

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North American Journal of Fisheries Management 21:1-26, 2001  
American Fisheries Society 2002  
DOI: 10.1577/1043-8192(2001)021<0001;1-0

## Global Review of the Physical and Biological Effectiveness of Stream Habitat Rehabilitation Techniques

PHIL RONI,\* KAREN H. WELSH, AND TIM BUCHAN  
National Oceanic and Atmospheric Administration Fisheries, Northwest Fisheries Science Center,  
Northwest Fisheries Boulevard East, Seattle, Washington 98112, USA

**Abstract.**—The degradation of inland aquatic habitats caused by decades of human activities has led to widespread efforts to stabilize instream habitats for fish and aquatic resources. We reviewed published evidence of stream rehabilitation techniques from throughout the world, including studies on habitat improvement, riparian stabilization, floodplain connectivity and restoration, instream habitat enhancement, stream channelization, and other low-impact techniques. We examined current knowledge about the effectiveness of these techniques for improving physical habitat and increasing biological habitat. We may specify design goals for stream rehabilitation projects, such as increasing habitat quality and increasing stream flow. However, there are still many uncertainties about the effectiveness of these techniques. Stream restoration projects should be designed to increase habitat quality and increase stream flow, but the effectiveness of these techniques is still uncertain. We recommend that stream rehabilitation projects should focus on increasing habitat quality and increasing stream flow, but the effectiveness of these techniques is still uncertain. We recommend that stream rehabilitation projects should focus on increasing habitat quality and increasing stream flow, but the effectiveness of these techniques is still uncertain.

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# What we know

- Many techniques show promising results
  - particularly for physical response
- Effectiveness often depends upon
  - Addressing underlying problems & processes
  - Intensity and amount of restoration\*\*
  - Varies by region and restoration program

# What we still need to know

- Biological monitoring lacking for many
  - Techniques
    - Culverts, riparian, floodplain, instream
  - Species
    - Chinook and steelhead
  - Regions
    - Interior Columbia



# But.....

- Data for many of these techniques can be collected rather quickly
  - Because of large number of projects (e.g., culverts, LWD, riparian planting)
  - By leveraging other monitoring programs
- Several long-term intensively monitored watershed studies underway to determine population level responses



# Action Effectiveness Monitoring of Tributary Habitat Improvement: a programmatic approach for the Columbia Basin Fish & Wildlife Program


Phil Roni

Northwest Fisheries Science Center  
NOAA Fisheries

**Russell Scranton & Jason Sweet**  
**Bonneville Power Administration**  
**Fish and Wildlife Program**

Jennifer O'Neal  
Tetra Tech  
Mount Vernon, WA

# Three Components

- Improve/refine current action effectiveness monitoring
  - Sample a subset of previously completed projects
  - Sample a subset of proposed projects
- 

# Current Development of AEM Program

## Preliminary Projects Associated with Each Category

Sample number	1	2	3	4	5	6-30
<b>Extensive Post Treatment (EPT) Projects:</b>						
Full Barrier	1992-026-01	1993-066-00	1994-015-00	1996-077-02	1996-077-05	...
Large Woody Debris	13+ SRFB	1992-026-01	1992-061-02	1994-018-06	1995-004-00	...
Engineered Log Jams	1 SRFB	1984-025-00	1992-026-01	1994-018-06	1995-004-00	...
Riparian Planting	1984-021-00	1990-018-00	1990-018-00	1990-044-00	1991-019-03	...
Invasive removals	1984-021-00	1987-100-01	1987-100-02	1988-120-25	1991-019-01	...
<b>Multiple Before-After Control Impact (MBACI) Projects</b>						
Partial Barrier	1993-040-00	1994-042-00	1994-042-00	2007-396-00	2007-397-00	...
Bank Stabilization	1984-021-00	1992-026-01	1994-018-05	2000-015-00	1984-025-00	...
Levee set-back removal	10-1765	11-1565	12-1307	1987-100-01	1992-026-01	...
Channel Reconnection	14 SRFB	2008-301-00	1994-042-00	1998-028-00	1998-028-00	...
Acquisition, Lease, Easement	00-1669	01-1353	02-1650	2007-224-00	2007-397-00	...
Fencing	02-1498	05-1547	205-060	205-060	206-357	...
<b>Case Studies</b>						
Road Decommissioning	TBD					
TBD						
TBD						

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Fencing	02-1498	05-1547	205-060	205-060	206-357	...
<b>Case Studies</b>						
Road Decommissioning	TBD					
TBD						
TBD						

# EPT – Full Barrier Removal

- 115 Projects have been identified that were completed between 2004-2013
- 30 Projects will be sampled in this category
- Reconnaissance is occurring now
  - Geographic Diversity
  - Logistic Feasibility
- Field Surveys will occur in 2014 and 2015
- No monitoring for new full barrier projects will be planned



# Preliminary Schedule for EPT Monitoring

2013	2014	2015	2016	2017	2018
Full Barriers		Large Wood/Log Jams		Riparian Planting	

# Current Development of AEM Program

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# MBACI- Channel Reconnection

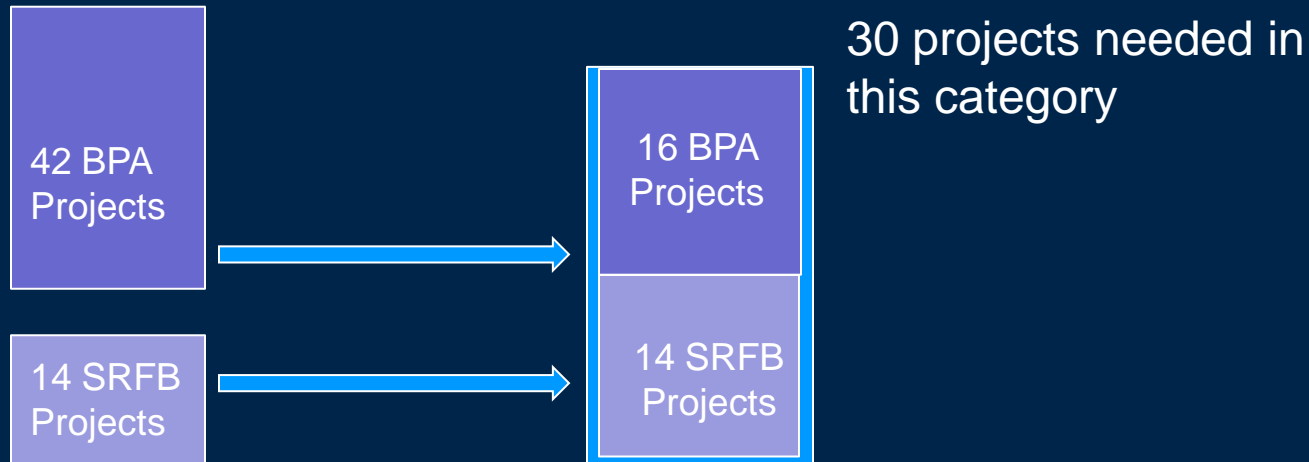
42 BPA  
Projects

14 SRFB  
Projects

30 projects needed in  
this category

- Currently, 42 projects were proposed in the Geographic Review
- 30 Projects will be sampled in this category
- 14 projects are currently being monitored in the Columbia Basin under the WA SRFB Program

# MBACI- Channel Reconnection



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# MBACI- Channel Reconnection

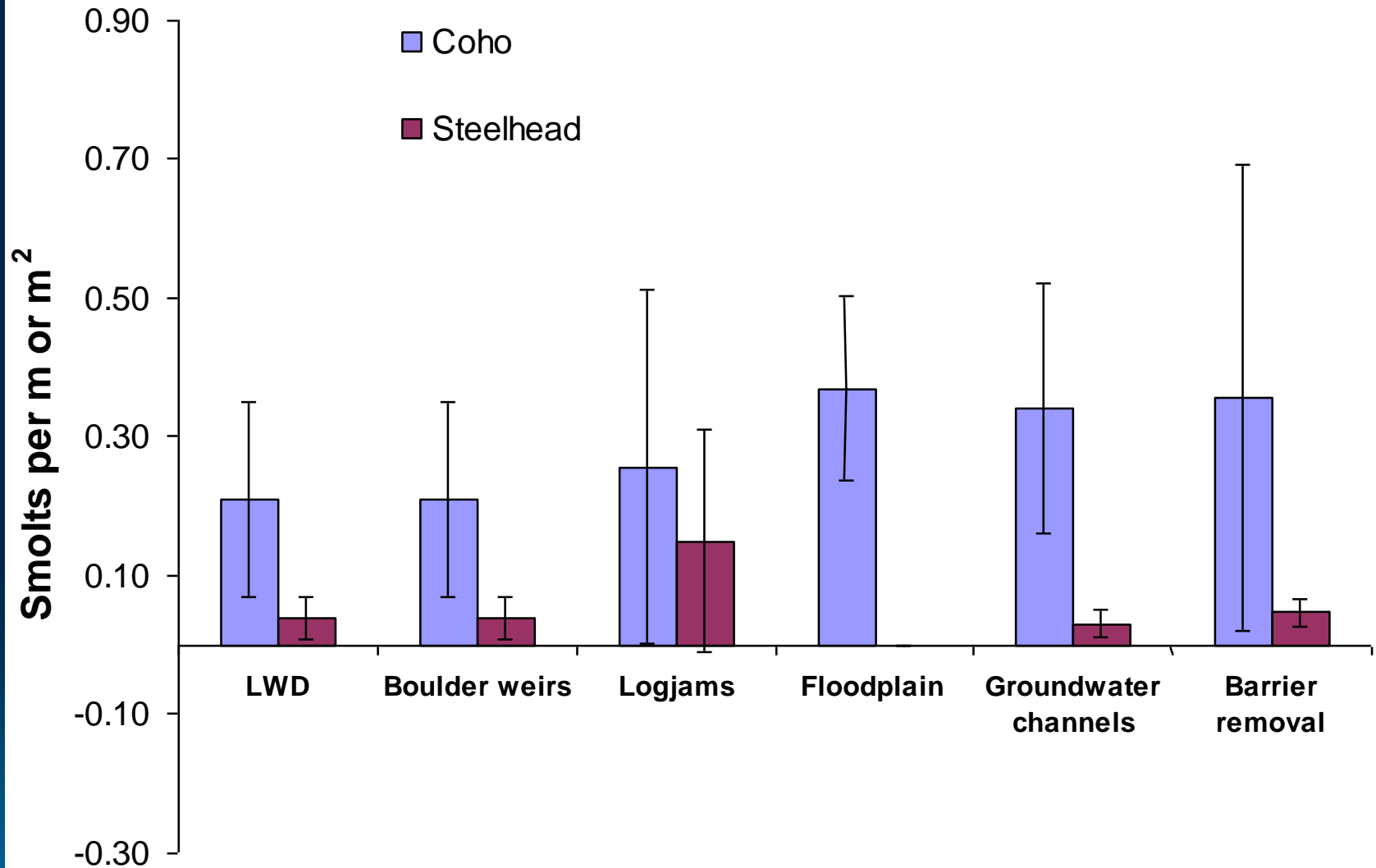
- Mill Creek Channel Reconnection Update
- Work is Scheduled to occur next summer
  - Existing fish surveys were leveraged at no additional cost
  - Habitat surveys will occur in two weeks
- Monitoring Schedule for Mill Creek

project	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22
Mill Creek	pre-1	implement	post-1	post-2			post-5			

# AEM – Next Steps

- For both EPT and MBACI Projects:
  - BPA is contacting project sponsors to gather additional information on proposed projects:
    - Scheduled year of implementation
    - Identification of control site location
    - Confirm whether sponsor or 3<sup>rd</sup> party will perform initial monitoring
  - Multi-year Work plan to be developed and reviewed by Council by December 2013

## Mean Increase in Smolts



# Additional RM&E Information

## ➤ 2013 - Benefits of Tributary Habitat Improvement Paper

- Discussion based on results from F&W Program in addition to peer reviewed sources
- Covers multiple aspects of Tributary Habitat RM&E
  - Action Effectiveness Monitoring
  - Status and Trend Monitoring (CHaMP and PIBO)
  - Watershed level effectiveness monitoring (ISEMP and IMWs)
- Available on [www.salmonrecovery.gov](http://www.salmonrecovery.gov)



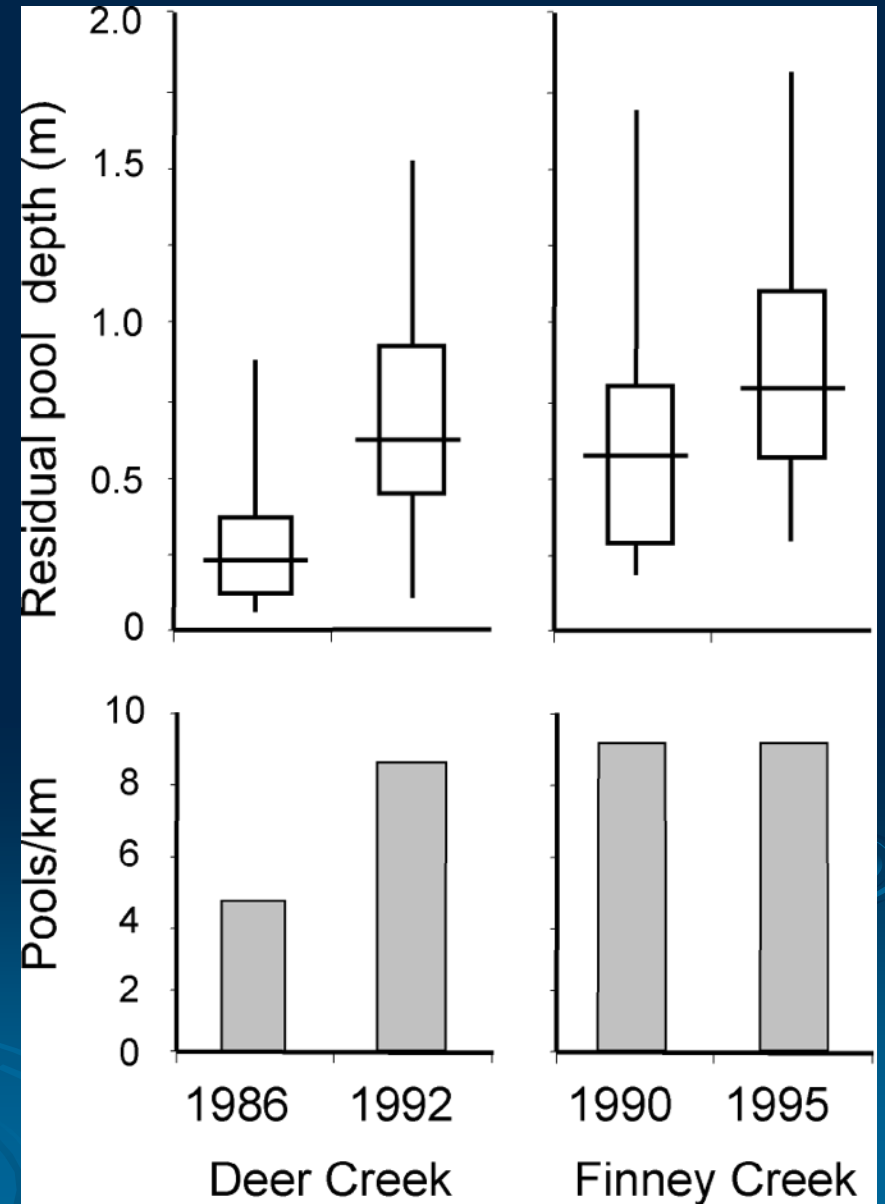
Questions?



# Extra slides



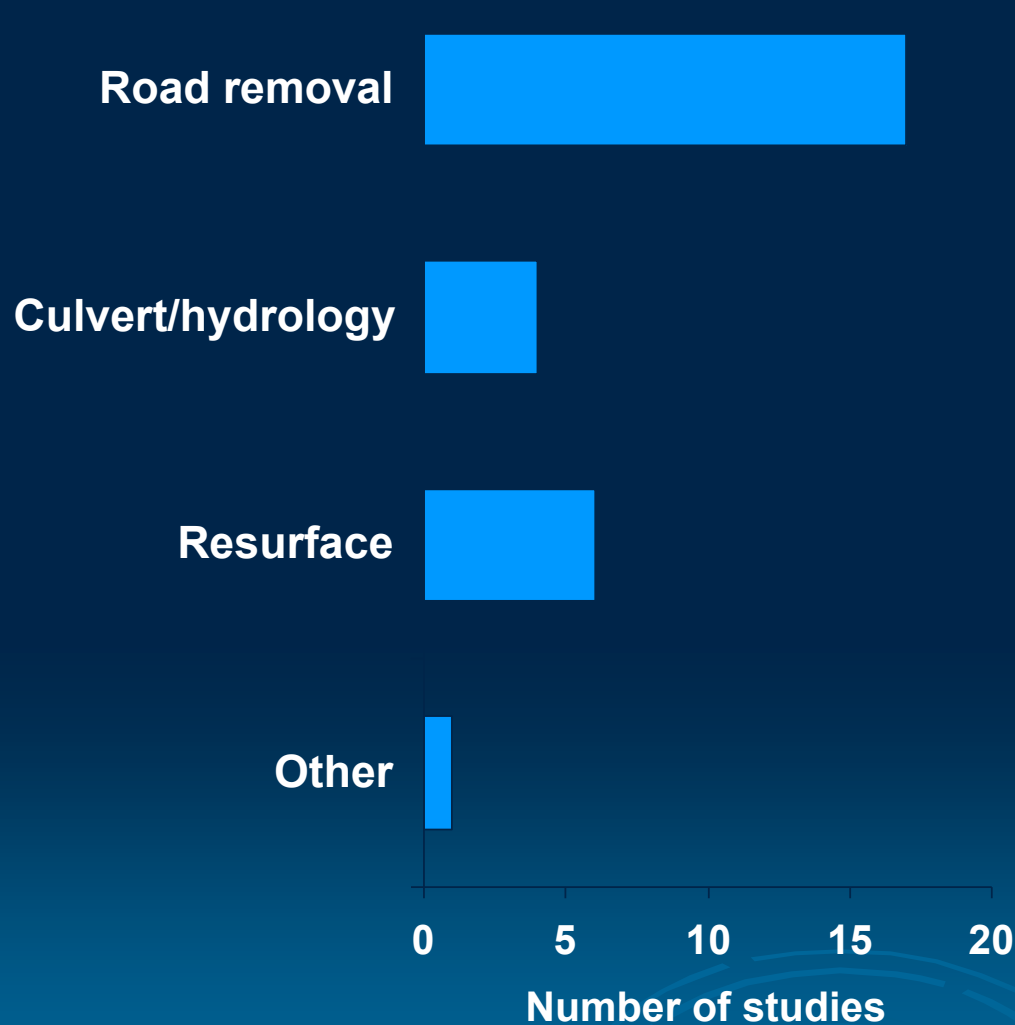
# Sediment Reduction – Road Treatments



Beechie et al. 2005

# Summary of Road Improvements

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- **What we know**
  - **Many techniques reduce sediment but**
  - **little or no in channel or biological**

- **Success depends on**
  - Technique used
  - Number of stream crossings
  - Replanting/site prep
  - Area treated, WQ

- **What we need to know**
  - Watershed-scale response
  - Fish or biological response
  - Improved spawning success