Identification of Restoration Alternatives in North Fork of Lewis River


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Objectives and Tasks

1. Assimilate and evaluate current data and utility for identifying restoration opportunities in NF and Lower Lewis

2. Limiting life-stage and habitat x species

3. Identify potential restoration opportunities

4. Info/data needed to refine 2 and 3

Compliment/Parallel EDT Analysis
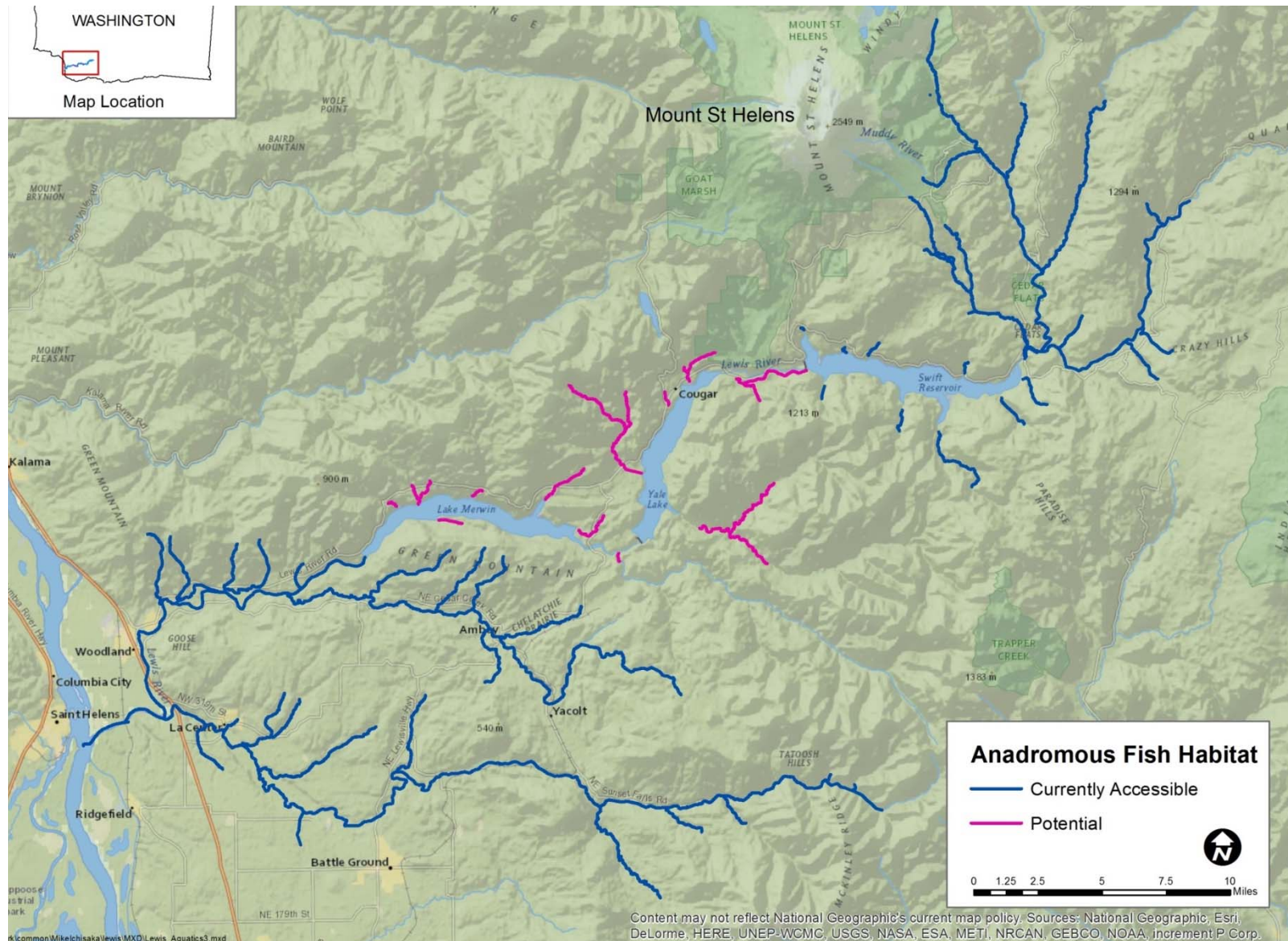
1. Review and Assess Existing Data and Utility Assessing Restoration Opportunities

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Kalama, Washougal and Lewis River
Habitat Assessments

Chapter 1: I

How Certain Are Salmon Recovery Forecasts?
A Watershed-scale Sensitivity Analysis

A. H. Fullerton · D. Jensen · E. A. Steel · D. Miller ·
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Keywords Uncert
Conservation · La

Lower

Abstract Complex relationships between landscape and aquatic habitat conditions and salmon (Oncorhynchus spp.) populations make science-based management decisions both difficult and essential. Due to a paucity of empirical data, models characterizing these relationships are often used to forecast future conditions. We evaluated uncertainties in a suite of models that predict possible future habitat conditions and fish responses in the Lewis River Basin, Washington, USA. We evaluated sensitivities of predictions to uncertainty in model parameters. Results were sensitive to 60% of model parameters but substantially so (partial regression coefficients| >0.5) in <10%. We also estimated accuracy of several predictions using field surveys. Observations mostly fell within predicted ranges for riparian shade and fine-sediment deposition, but large woody debris estimates matched only half the time. We provide suggestions to modelers for improving model accuracy, describe how managers can incorporate predictions uncertainty into decision-making, thereby improving successful salmon habitat recovery.

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Lewis River
Large Woody Debris Assessment

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Development of New Information to Inform Fish Passage Decisions at the
Yale and Merwin Hydro Projects on the Lewis River
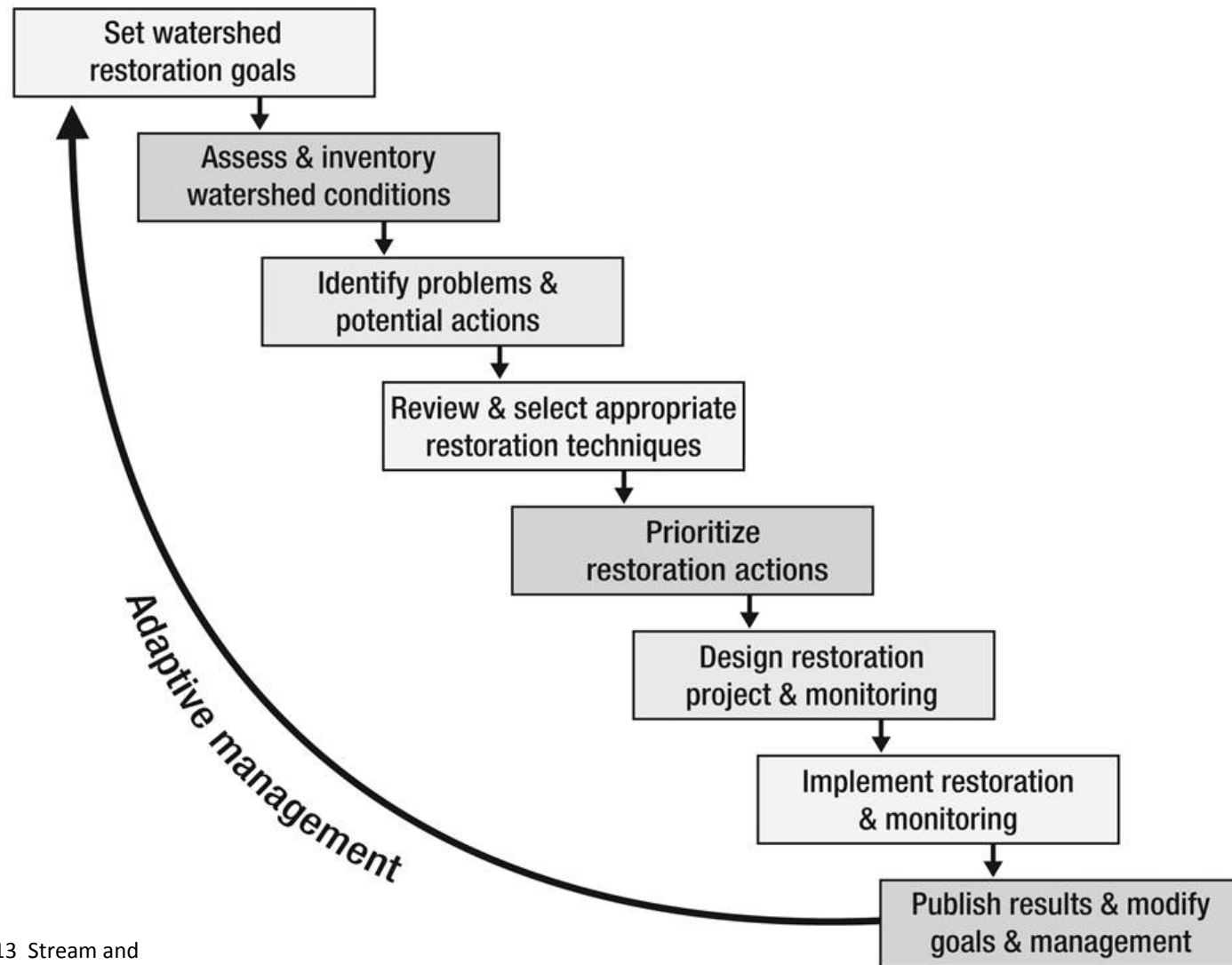
Annual Progress Report

August 2015

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Steps in Restoration Process

Set watershed restoration goals

Assess & inventory watershed conditions

Identify problems & potential actions

Review & select appropriate restoration techniques

Prioritize restoration actions

Design restoration project & monitoring

Implement restoration & monitoring

Publish results & modify goals & management

Adaptive management

From: Roni and Beechie. 2013 Stream and Watershed Restoration: A guide to restoring riverine processes and habitats. Wiley-Blackwell.

Data Sources vs Restoration Steps

Description of Data/Info	Data type			Provides data to assist with				
	Report	GIS, Excel, etc.	Geographic Coverage	Assess condition	Limiting life-stage or habitat	Rest. I.D.	Prioritiz-ation	Back-ground Info
Fish or Habitat Models								
EDT outputs and source data		X	Basin	X	X		X	X
Salmon PopCycle Model	X	X	Basin					X
Assessments								
Integrated Watershed Assessment	X	X	Basin	X				X
Shoreline Master Plan, B.A.s, etc.	X		NF. Lewis					X
Recovery Planning reports/data	X		Lower			X	X	X
Watershed Assessment Models	X	X	Basin	X		X		
LWD assessment	X		Lower					
Channel types		X	Basin					
Monitoring Data								
Habitat and LWD surveys (USGS)		X	Upper Basin	X		X		X
Parr, smolt, spawner etc. surveys	X	X	Various					X
Other habitat survey data	X		Various					X

Summary of review of Data

- \> 50 pubs relevant to tasks

- Data available to do limiting habitat/life stage
  - Use EDT summaries provided by ICF
  - Assimilate fish-habitat data from other sources

- Assessment data
  - Channel types etc. (NOAA)
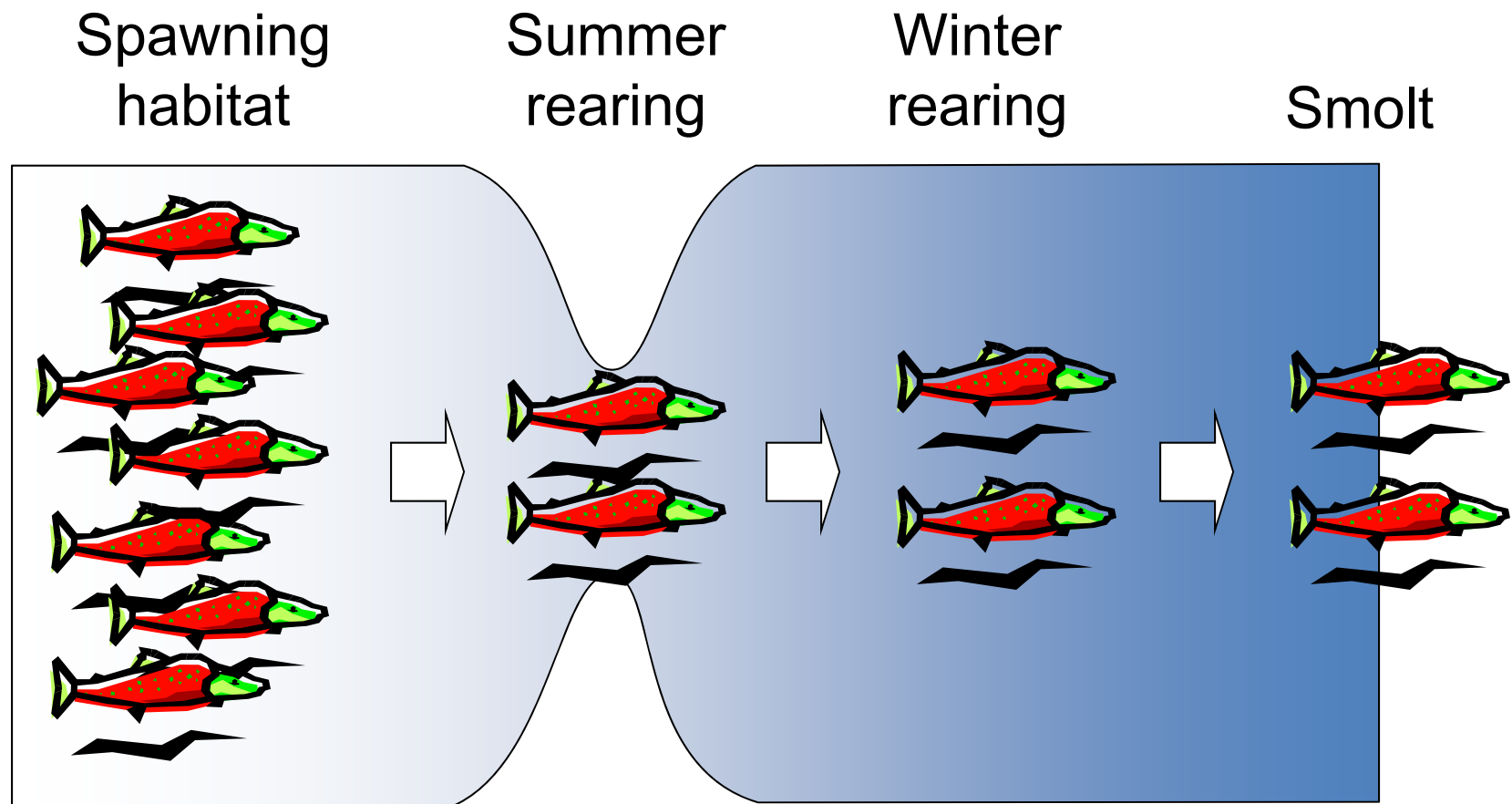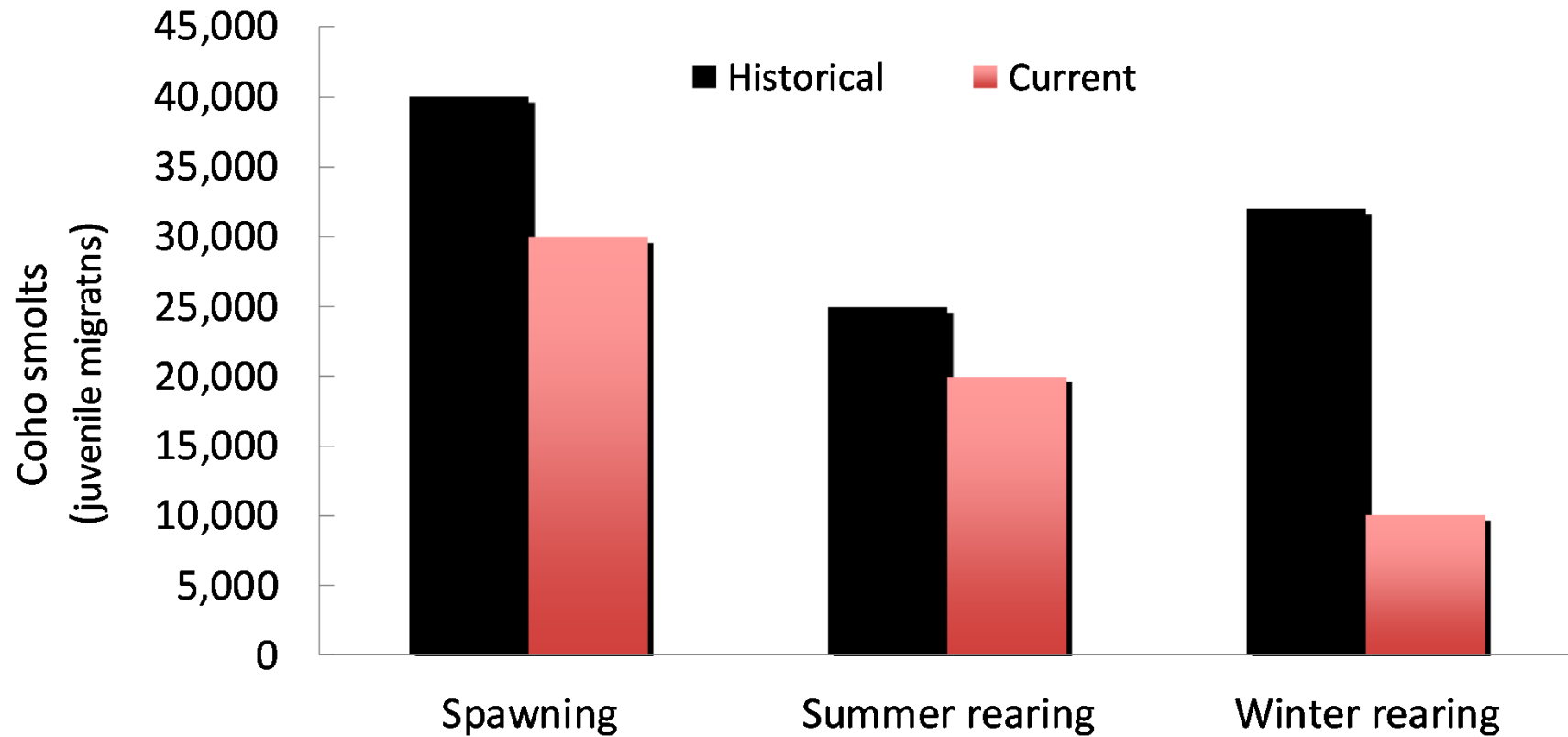 - Watershed processes (NOAA)

2. Limiting Life Stage and Habitat

Spawning habitat → Summer rearing → Winter rearing → Smolt

Image Courtesy of G. Pess

What Habitat and Life Stage is Limiting?

Data and Figure G. Pess NOAA

Limiting Factors Analysis

Based on Reeves et al. 1989, Beechie et al. 1994, and others

**Habitat Data by
Season & Life Stage**

X

Seasonal Fish Density

X

Smolt Survival Factor

=

Smolt Production Potential

R. Peters photo

Basic Assumptions of Limiting Factors Analysis

- Full seeding

- No density dependence

- Standardized survival at subsequent life stages

R. Peters photo

Coho Limiting Factors Multipliers

(Reeves et al. 1989; Beechie et al. 1994, Pollock et al. 2004)

Habitat Type	Parr or Pre-smolt/m²	Survival to smolt stage	Smolt Factor (m²)
Side channel			
Summer	1.7	0.25	**0.319**
Winter	5	0.31	**0.775**
Tributaries			
Summer pool	1.7	0.25	**0.425**
Summer riffle	1.7	0.25	**0.213**
Winter pool	5	0.31	**1.085**
Winter riffle			**0**
Pond/Lake			
Summer pond	1.5	0.25	**0.375**
Winter pond	5	0.31	**0.775**
Reservoir			**0.0025**

Same type of info was applied to steelhead, and Chinook

Smolt Production Potential (SPP)

Habitat Type	(fish/m²)		
	Coho	Steelhead	Spring Chinook
Side channel			
Summer	0.32	0.05	0.11
Winter	0.78	0.19	NA
Tributaries			
Summer pool	0.43	0.06	0.13
Summer glide		0.06	0.03
Summer riffle	0.21	0.05	0.02
Winter pool	1.09	0.02	N.A.
Winter glide		0.01	N.A.
Winter riffle	0.00	0.00	N.A.
Mainstem			
Summer		0.01	0.02
Winter		0.01	
Pond/Lake			
Summer pond	0.38	0.00	0.01
Winter pond	0.78	0.00	NA
Summer reservoir	0.003	0.00	0.02
Winter reservoir	0.003		NA

Used ICF/EDT Habitat Data

Species	Life stage	Month	Gradient	Wetted Width
Coho	Juvenile	Aug. & Jan.	<3%	All
Coho	Spawning	Nov.	<3%	<25 m
Steelhead	Juvenile	Aug. & Jan.	<5%	All
Steelhead	Spawning	April	<5%	
Spring Chinook	Juvenile	Aug. & Jan.	<5%	All
	Spawning	Oct.	<3%	>10 m

Total Spawning Habitat
Proportion of Different Habitats (based on EDT/ICF)

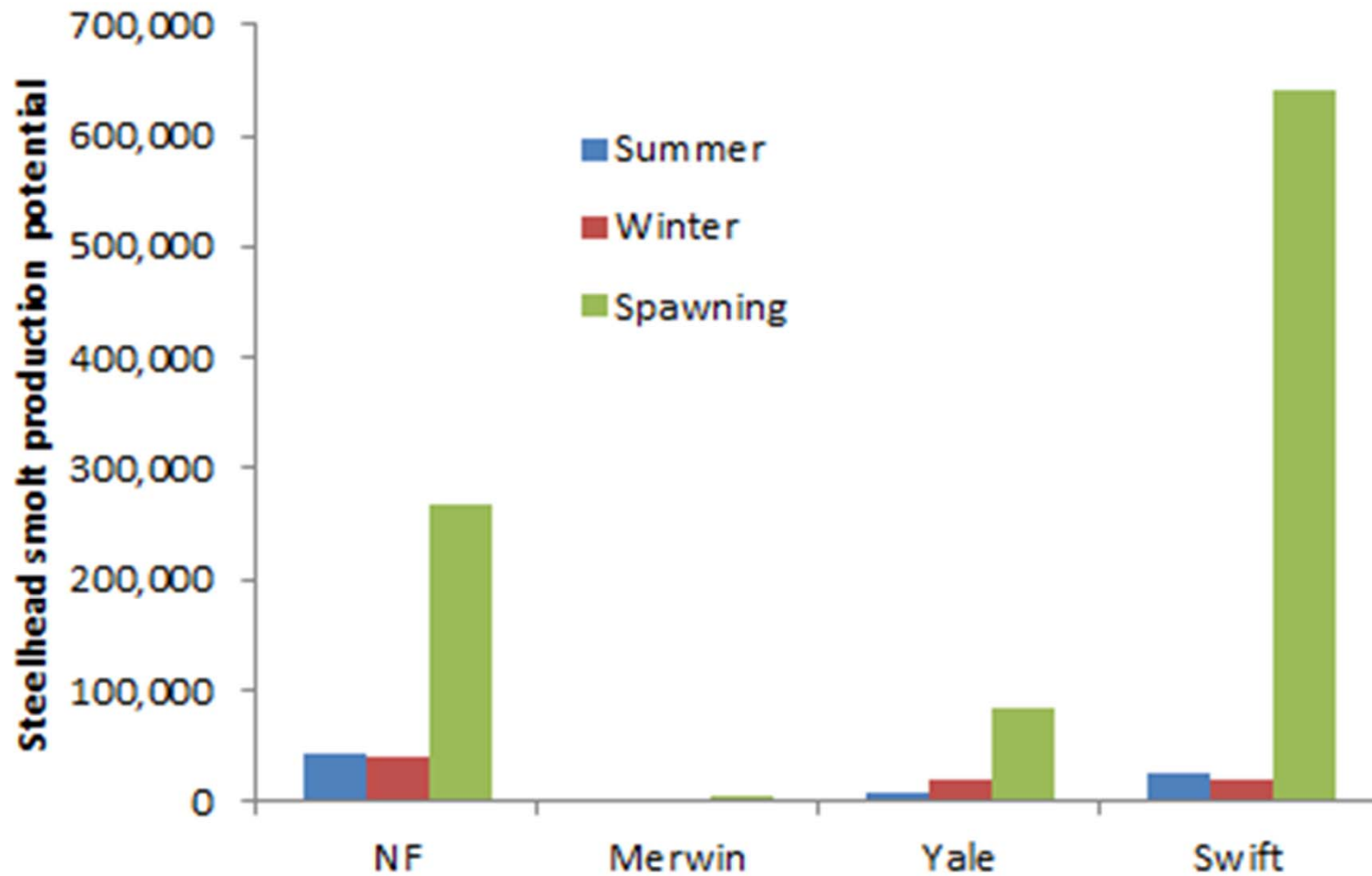|	Habitat	Coho	Steelhead	Chinook
Low flow < 3 cfs	Glides	0.4	0.3	0.4
	Pool Tails	0.8	0.6	0.8
	Small Cobble Riffles	0.6	0.45	0.6
Headwater	Glides	0.4	0.275	0.4
	Pool Tails	0.8	0.55	0.8
	Small Cobble Riffles	0.6	0.4125	0.6
Low Stream Order	Glides	0.15	0.25	0.4
	Pool Tails	0.25	0.5	0.8
	Small Cobble Riffles	0.25	0.375	0.6
Mid Stream Order	Glides	0.05	0.15	0.4
	Pool Tails	0.1	0.3	0.8
	Small Cobble Riffles	0.1	0.225	0.6
High Stream Order	Glides	0.03	0.05	0.4
	Small Cobble Riffles	0.05	0.075	0.6

Assumptions

- EDT estimates of total amount of habitat for each month are accurate

- Rearing & spawning habitat criteria appropriate

- Area of reservoir < 3 m deep accurately represent amount of rearing habitat

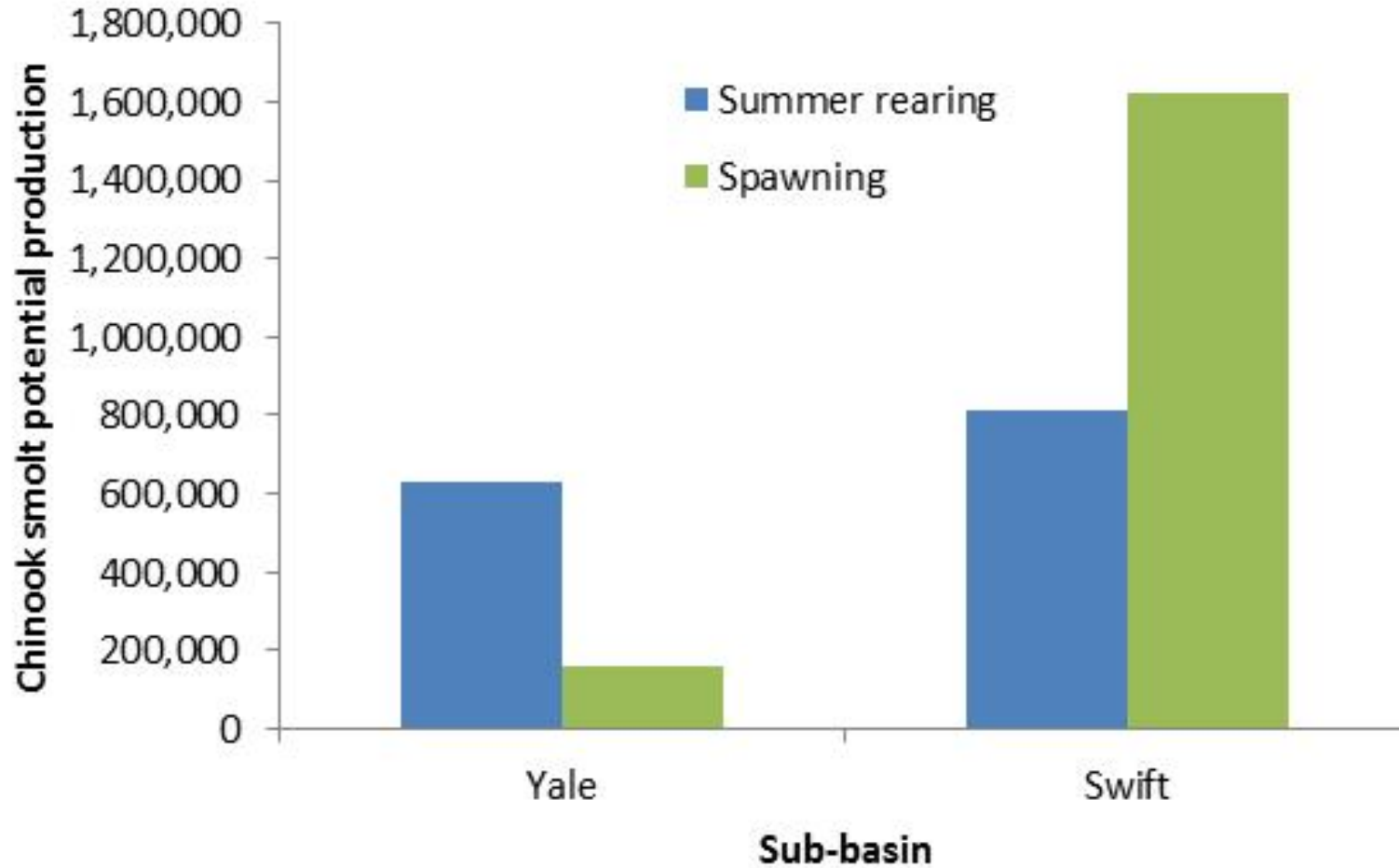- Habitat specific densities from other studies appropriate
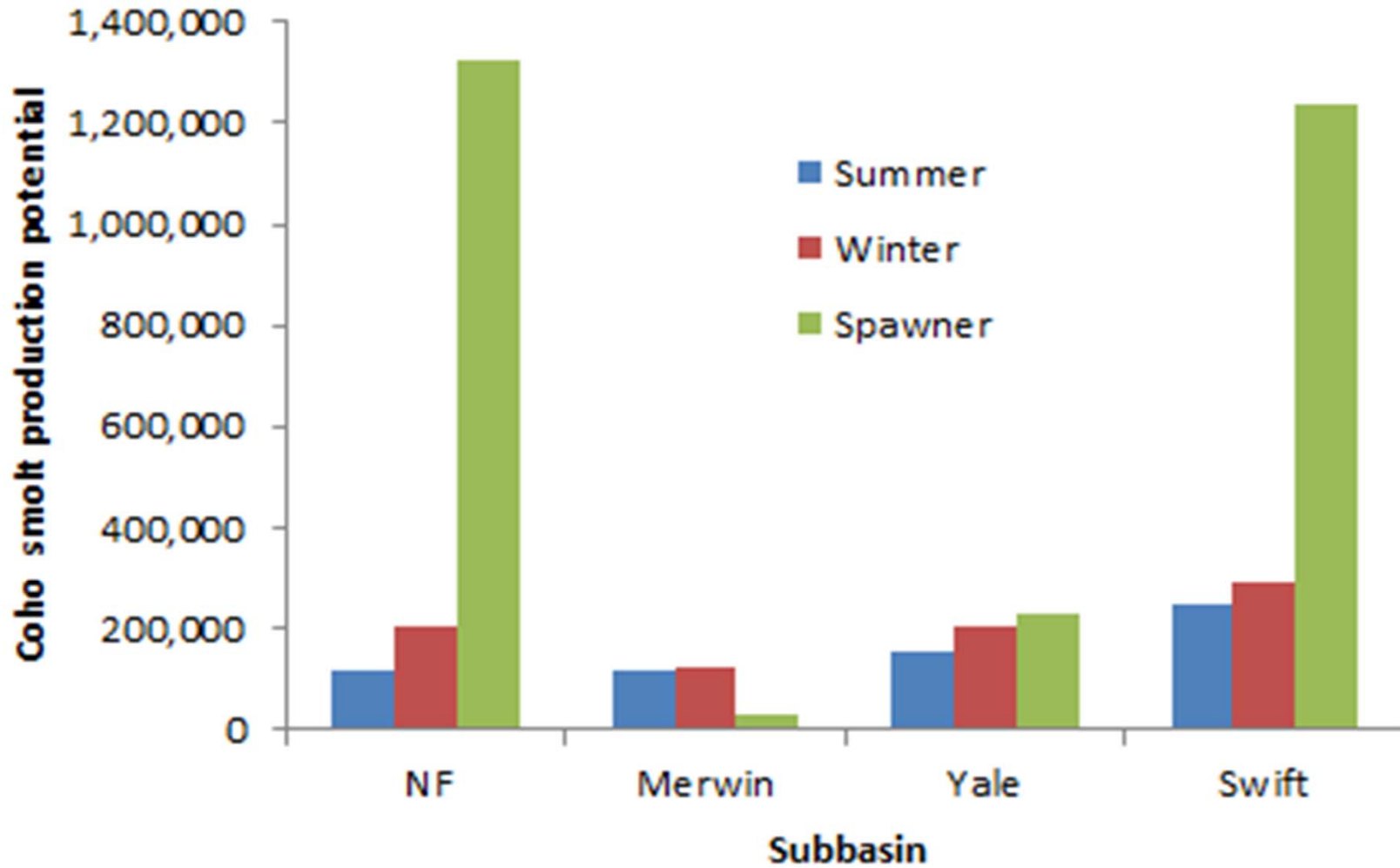
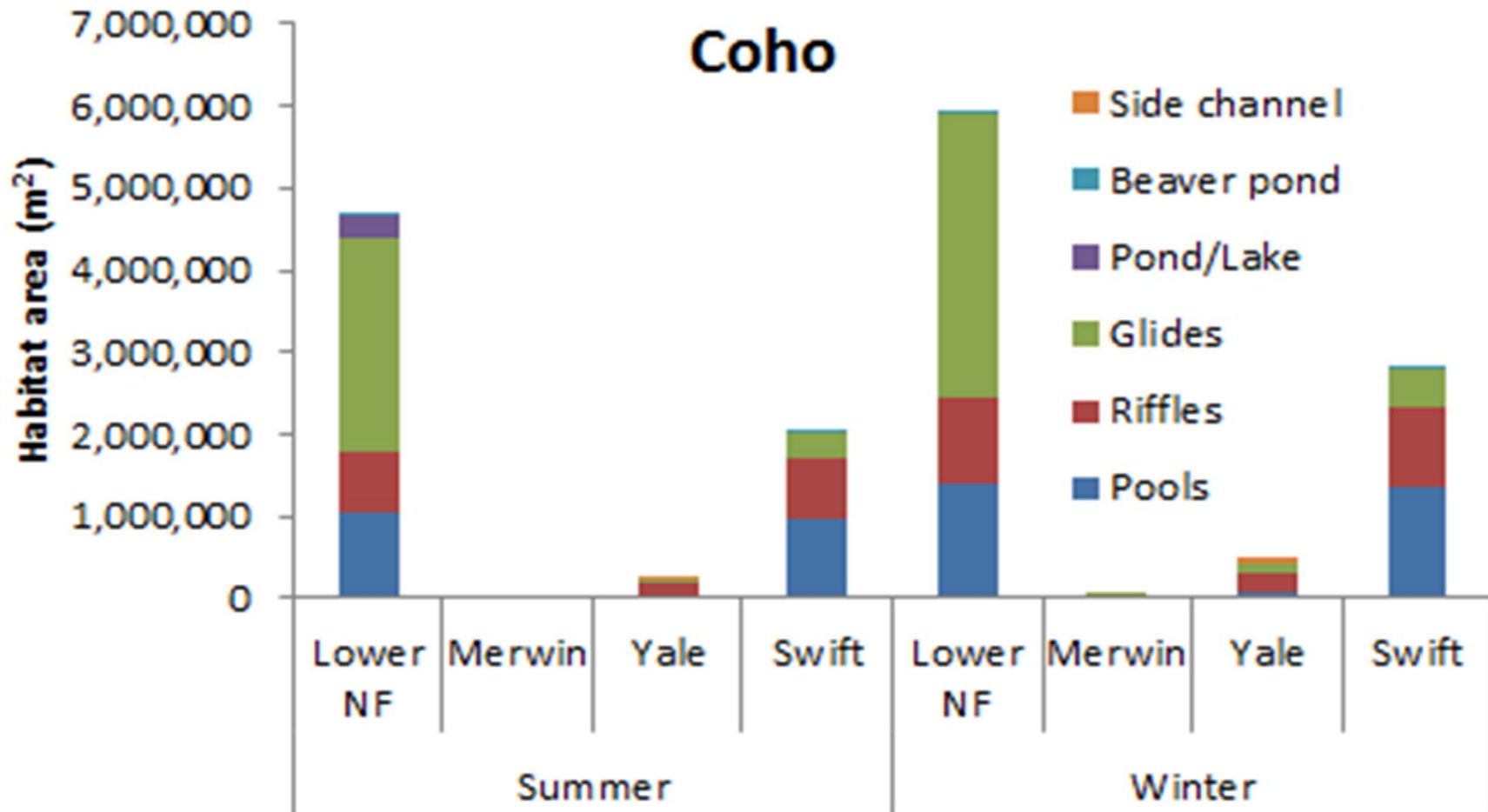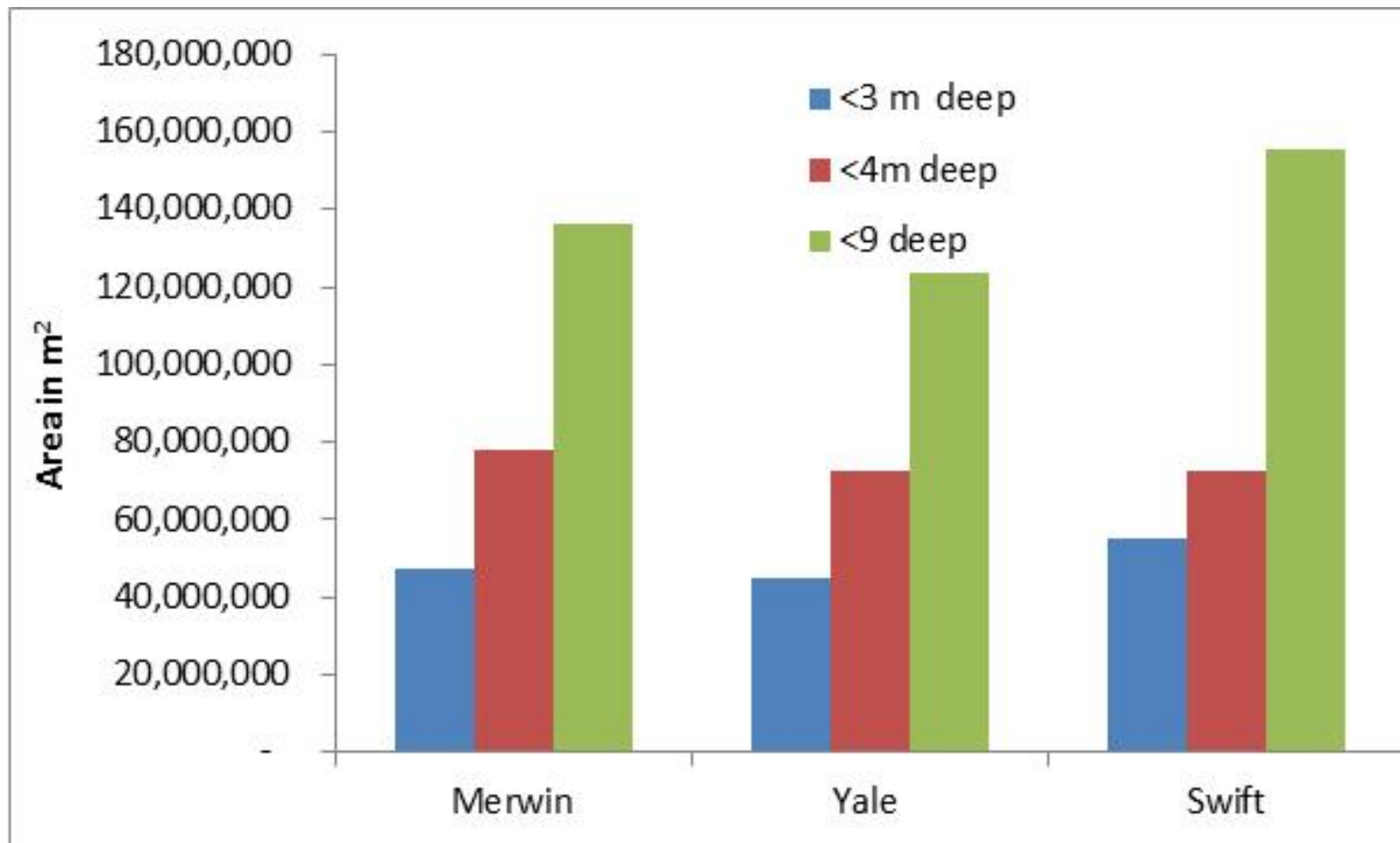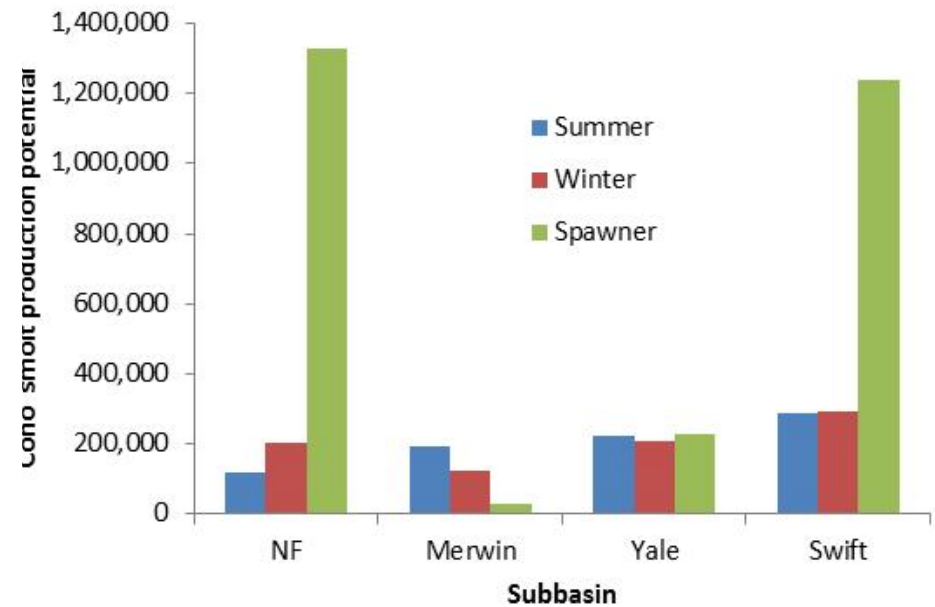# SPP Winter Steelhead

SPP Spring Chinook

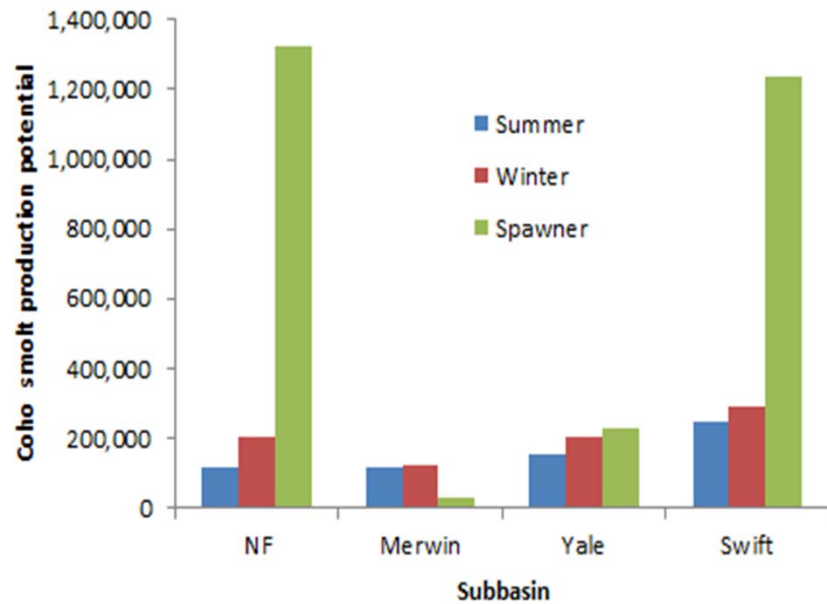# Habitat Area

But 99% of Total Rearing Habitat Area is in Reservoirs

Sensitive to Definition of Littoral Habitat
< 3 m vs < 4m

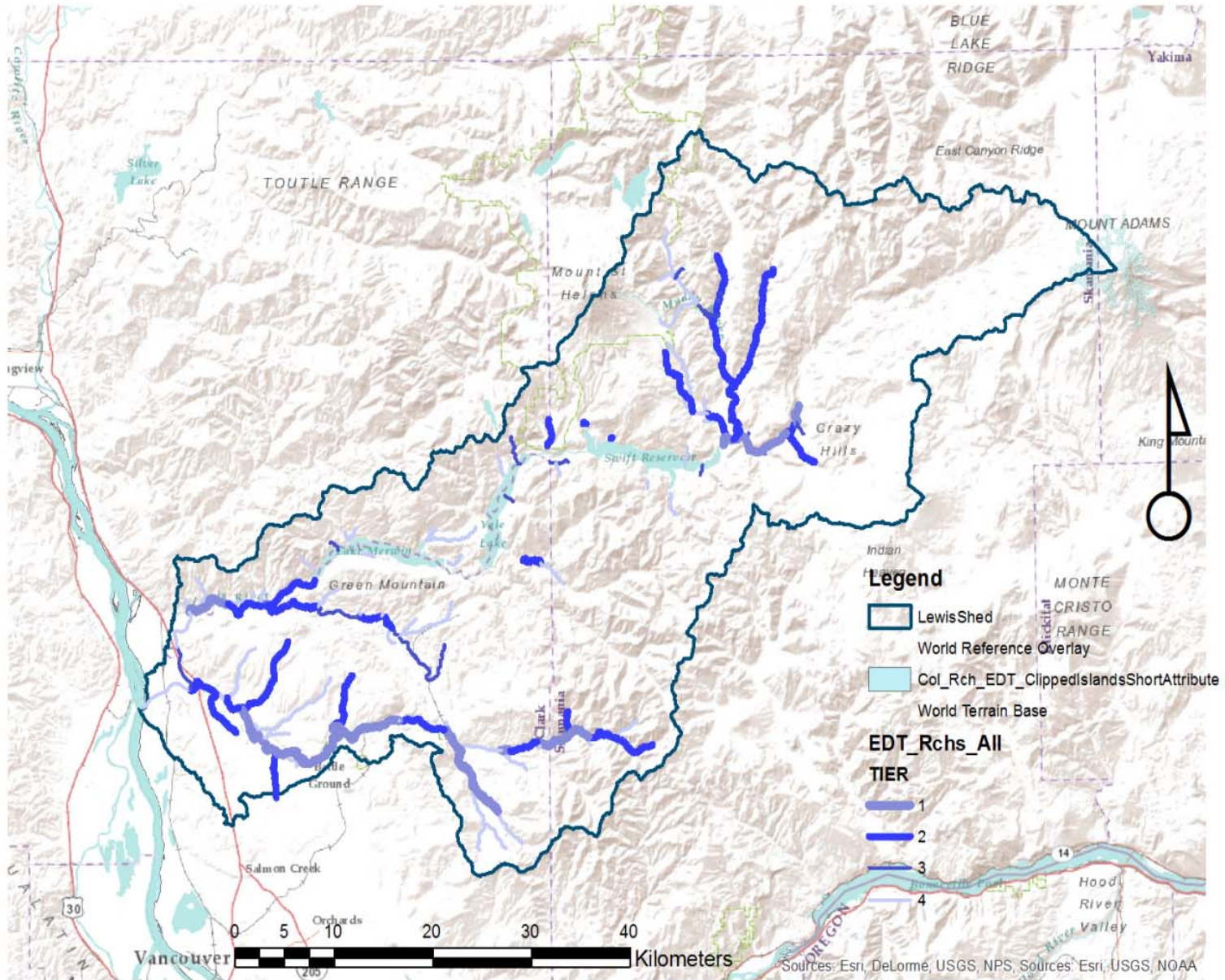*Issue for Coho and spring Chinook....not for steelhead

3. Identify potential restoration opportunities

J McMillan photo

J McMillan photo

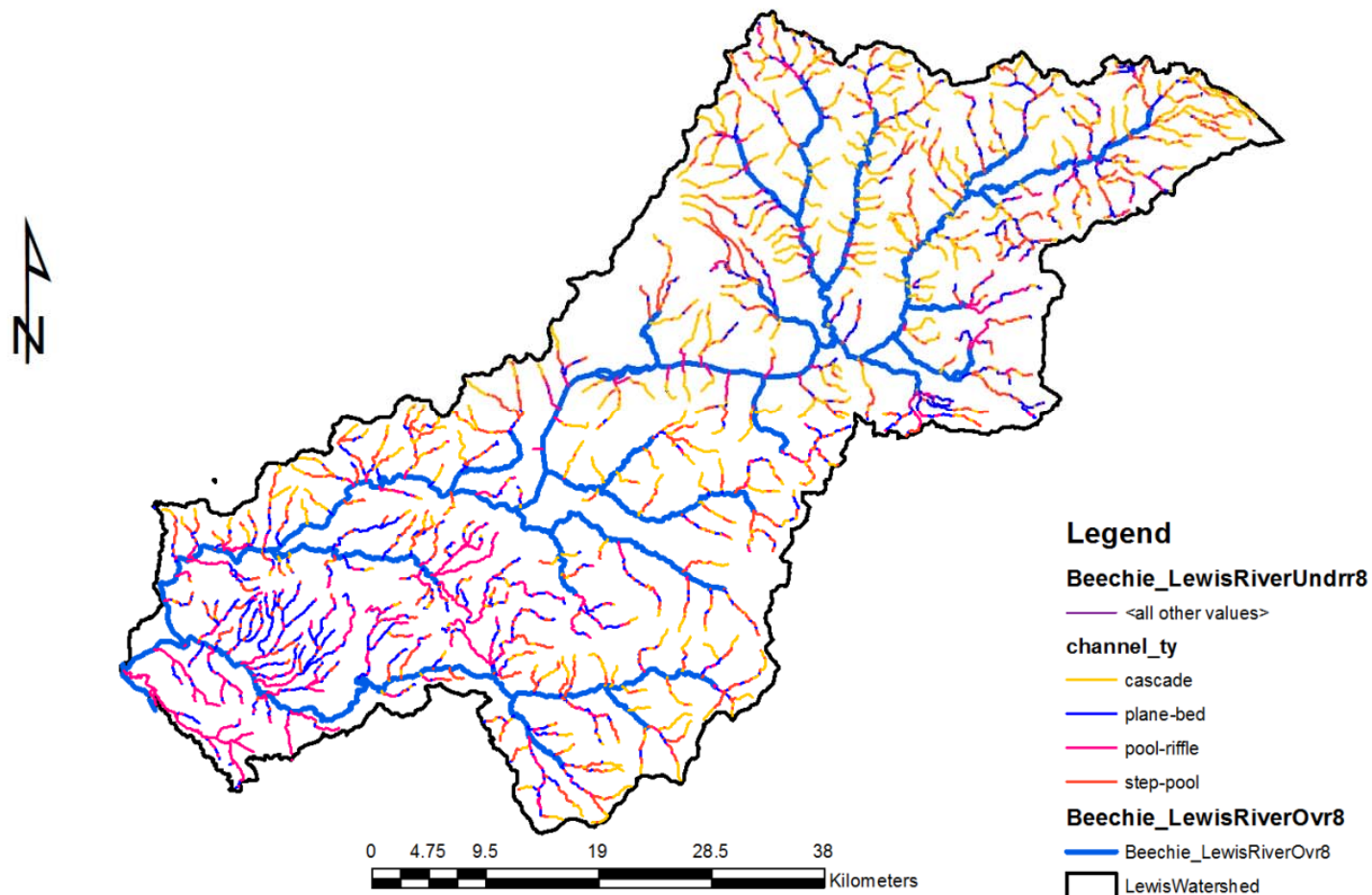# 3. Identify potential restoration opportunities

- EDT highest priority reaches & outputs (ICF)

- Limiting habitat and life stage (Limiting factors analysis)

- Watershed assessment data from previous analysis on riparian, sediment, and hydrologic condition (Fullerton et al. 2010)

- Geomorphic channel characteristics (Beechie and Imaki 2014)

- Watershed processes and habitats improved by restoration strategies (Roni et al. 2013)

- Information on specific reaches from previous recovery planning efforts (Keefe et al. 2004; LCFRB 2010).

EDT Reach Outputs Tier 1 and 2

Channel Types for Lewis River Basin

Lewis River Tributary Channel Types

Legend

Beechie_LewisRiverUndrr8
— <all other values>
channel_ty
— cascade
— plane-bed
— pool-riffle
— step-pool
Beechie_LewisRiverOvr8
— Beechie_LewisRiverOvr8
☐ LewisWatershed

0   4.75   9.5   19   28.5   38
Kilometers
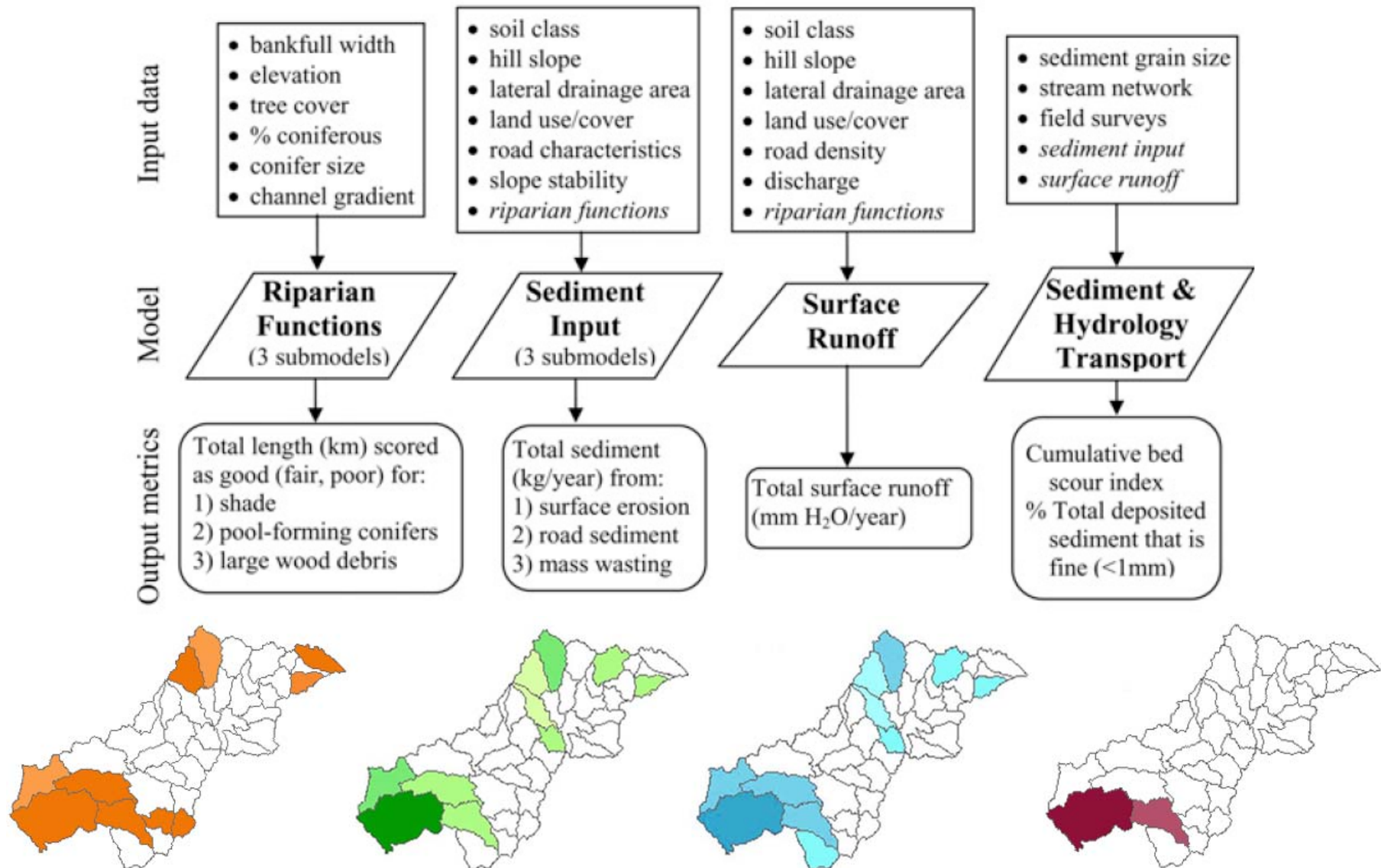
Data from Beechie and Imaki 2014

NOAA Assessment

Fullerton et al. 2010

Restoration Measures that Improve Habitat for Limiting Life Stage

Limiting life stage and habitat	Examples of Major restoration categories
Summer rearing	instream habitat, remove barriers, reconnect side channels, riparian restoration (reduce temp), LWD
Winter rearing	instream habitat, impassible barriers, reconnect side channels/floodplain, levee setback or removal, increase beaver ponds, construct off-channel habitat, riparian, LWD
Spawning Habitat	Remove barriers, reduce fine sediment, reduce scour, restored floodplain habitat and side channels, gravel addition, LWD addition

Example of Assessment Data

Reach	Seral Stage	Shade Factor	Pool-Forming Conifers	LWD Score	Riparian Function Score	Fine Surface Sediment	Fine Mass Wasting Sediment	Fine Road Sediment
Lewis 18	O	2	0	2	M	55,276	320	1,684
Lewis 18	O	2	0	2	M	55,276	320	1,684
Lewis 19	O	2	0	2	M	55,276	320	1,684
Lewis 21	O	2	0	2	M	182,849	597	5,274
Campgrnd Cr.	MIX	3	1	3	G	16,149	792	1,619
Muddy R 1	O	2	0	2	M	117,161	1,477	3,135
Muddy R 1	O	2	0	2	M	117,161	1,477	3,135
Muddy R 1	O	2	0	2	M	117,161	1,477	3,135
Clearwater Tribs	L	3	0	3	G	19,447	972	1,658
Rush Creek	L	3	0	3	G	8,649	289	88
Little Creek	O	2	0	2	M	60,153	878	1,602
Spencer Creek	O	2	0	2	M	87,635	1,243	2,641

Example of Restoration Measures

Reach	Restoration Measure Recommended	Rational for selecting restoration measure
Lewis 18	LWD	low LWD and percent pool
Lewis 19	LWD, side channels	Low LWD, percent pool and channel type
Lewis 21	LWD, roads restoration	Low percent pool, LWD, high sediment yield
Swift Campground Creek	Roads	High percent fines, camp ground area
Muddy R 1	Side channels, LWD	Low LWD scores, and island braided channel type
Clearwater Tribs	NA (high levels of fines appears to be due to headwaters in blast zone of Mt. St. Helens.	Mt. St. Helens blast zone appears to be source of sediment
Rush Creek	Protection (steep channel)	Steep channel
Little Creek	LWD	Poor LWD and pool area
Spencer Creek	LWD	Poor LWD and pool area

But, site visits required to..

- Confirm

- Feasibility

- Design

4. Data Needed to Refine Estimates

- Historical habitat/channel/floodplain conditions

- Consistent/detailed habitat data
  - Lower NF and Mainstem Lewis
  - Winter habitat

- Fish use by habitat specific to Lewis Basin

- Detailed site visits field surveys to
  - Confirm restoration type
  - Identify specific locations within reach
 - Constraints etc.

Summary

1. Considerable existing data
    – Adequate for Tasks 2 and 3
2. Limiting habitat & life stage
    – Rearing limiting above Swift
3. Restoration opportunities
    – Vary by subbasin and reach
4. Data needs to refine estimate
    – Historical habitat loss/conditio
    – Habitat and fish use
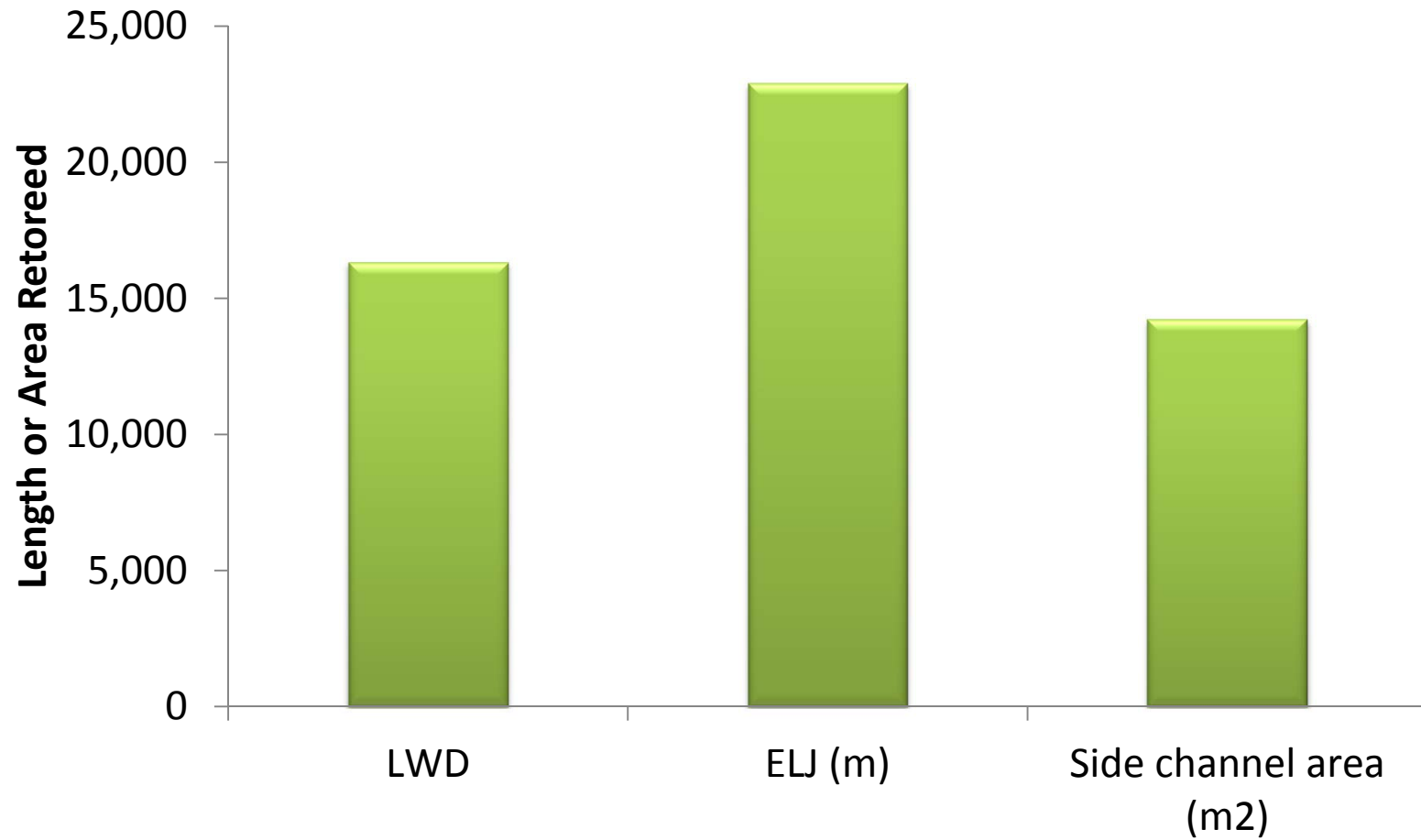   – Site visits to confirm restoration
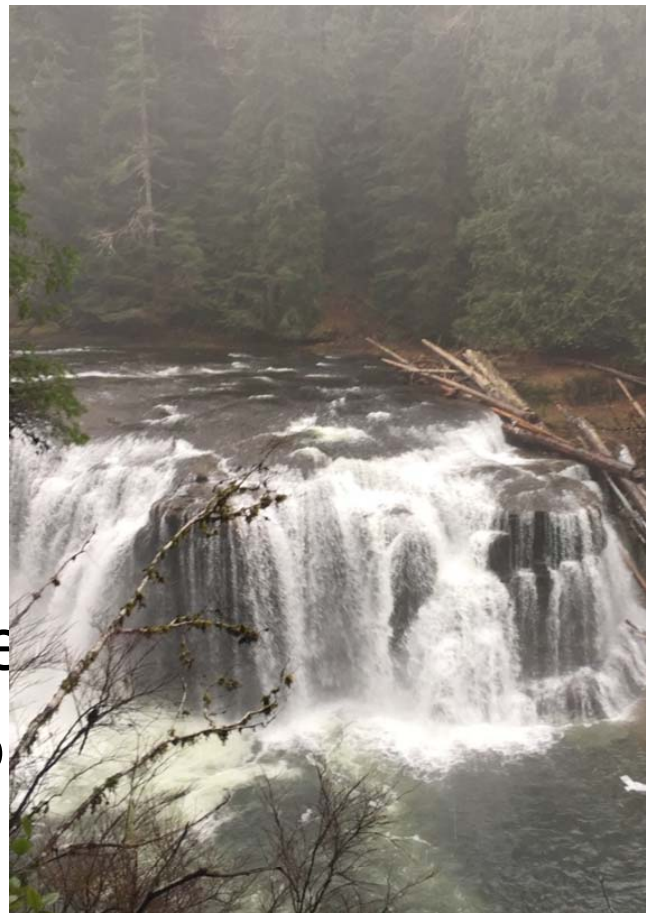
Additional Analysis Underway

Estimating Response to Restoration
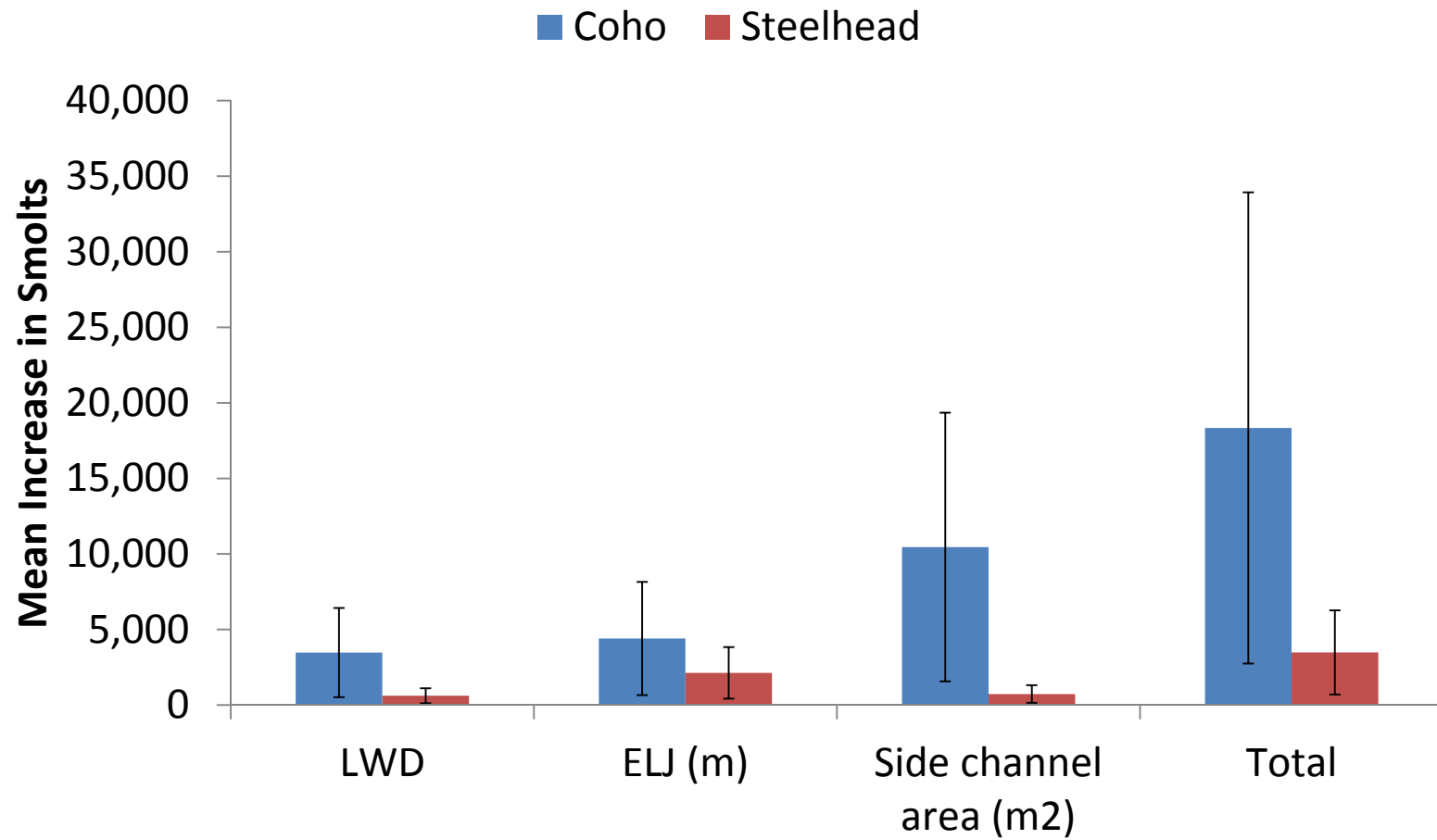

Roni et al. 2010. NAJFM
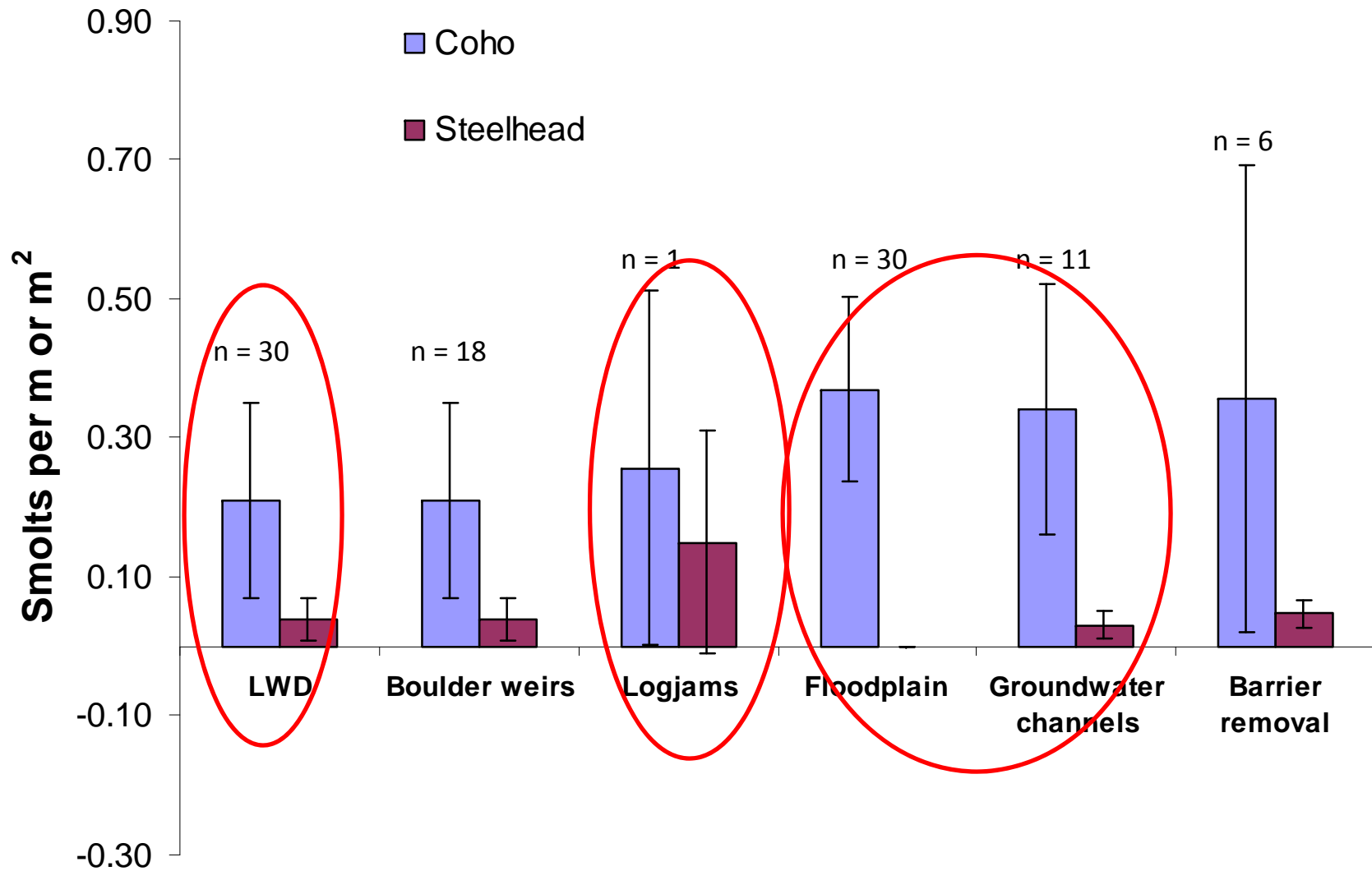
Total Length/Area Restored
Tier 1 and 2 Reaches Only

Predicted Increase in Smolts
Tier 1 and 2 Reaches Only

Preliminary

- Very preliminary

- Need to do monte carlo simulation to get
  - 95% C.I.

- Only for LWD, ELJs and side channels
  - Side channels assumed increased by 20% of length