

# A habitat assessment approach for restoration planning



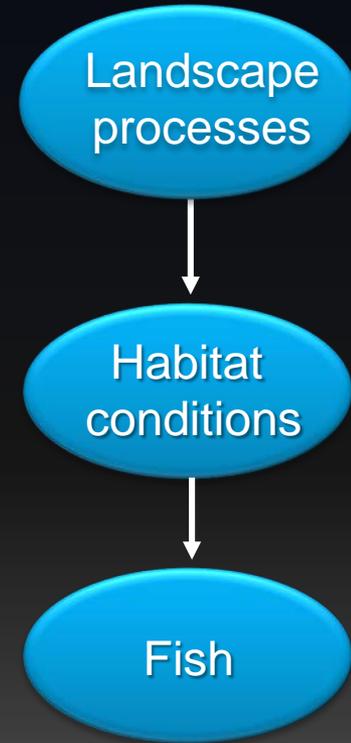
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NOAA Fisheries

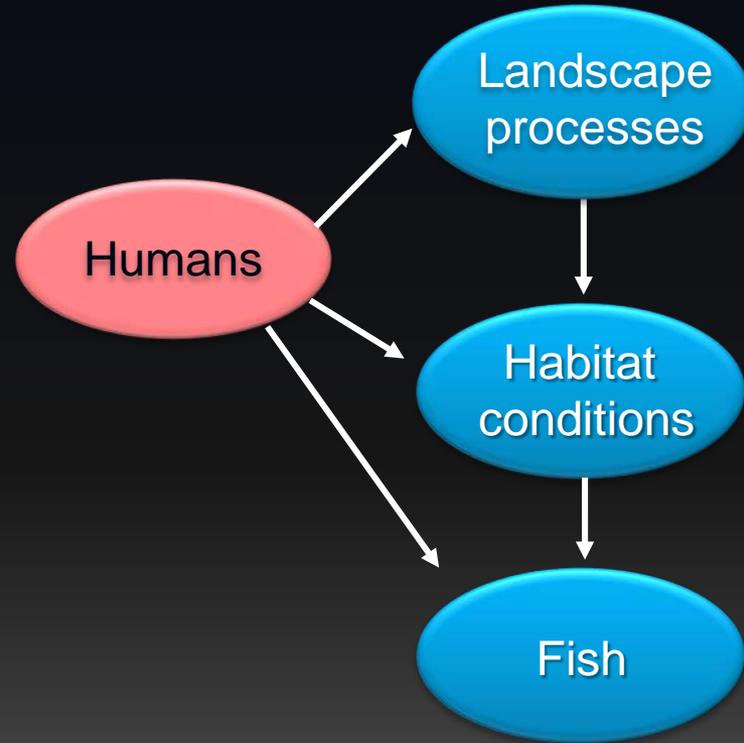
# Main Objectives of a Restoration Approach

- Identify freshwater life stages that limit salmon population recovery
- Identify restoration scenarios that provide the largest benefit to salmon populations
- Develop monitoring designs to inform the above objectives and to help determine effectiveness of actions

# Influences on Habitat Productivity: From “Riverscapes” to Fish

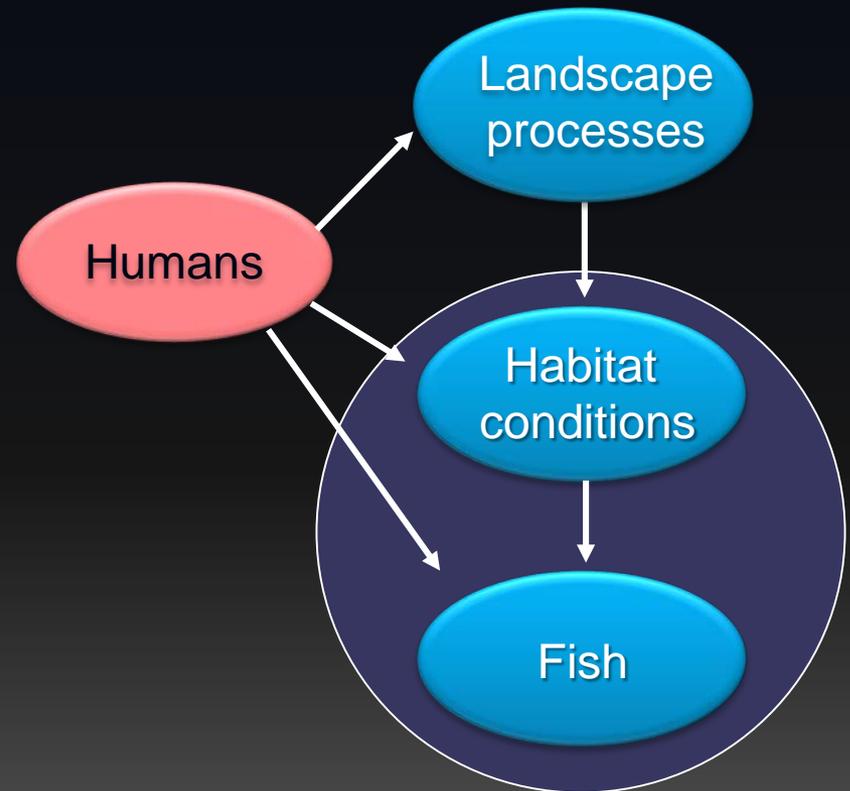


# Influences on Habitat Productivity: From “Riverscapes” to Fish



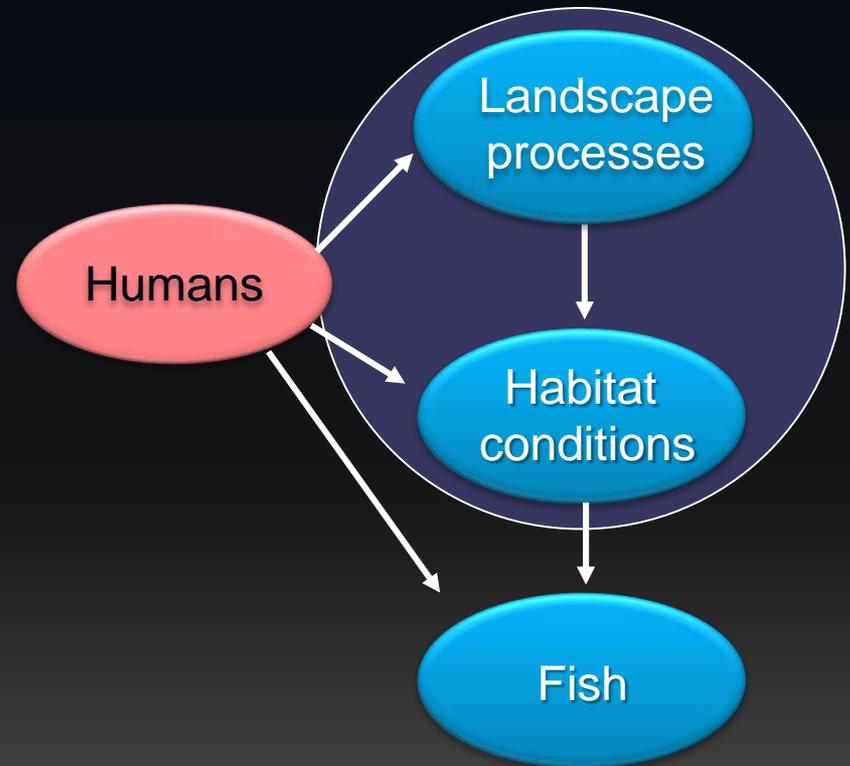
# Developing a Restoration Approach

- Q1: How have habitats changed and altered Fish Populations?



# Developing a Restoration Approach

- Q2: What are the root causes of habitat and biological change?



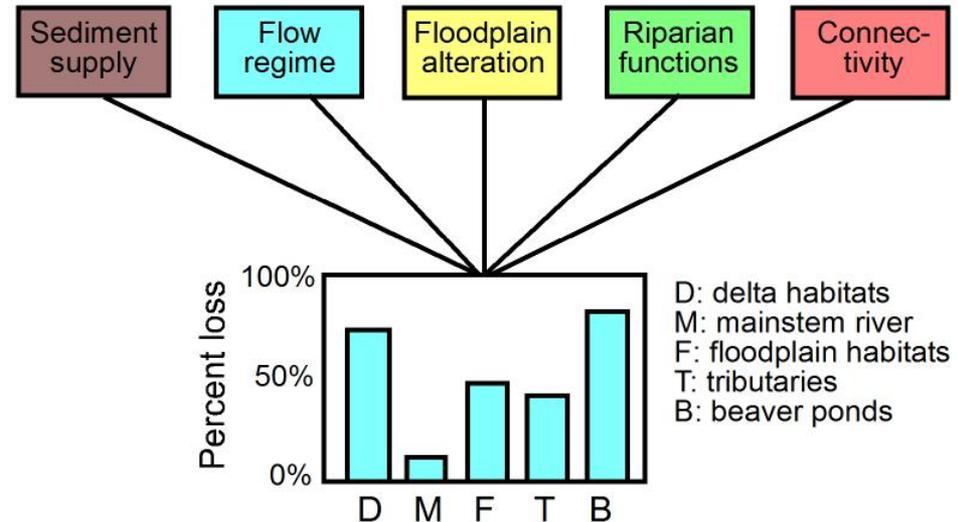
- Q1: How have habitats changed and altered biota?

Q1: How have habitats changed and altered fish populations?

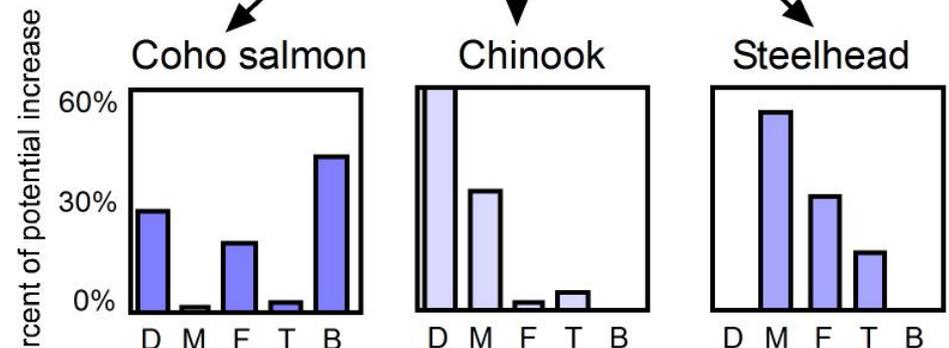
- How has habitat changed from historical conditions (e.g., how much habitat of various types has been lost)?
- How important is each habitat type to each species?

## a. Analysis and selection of actions

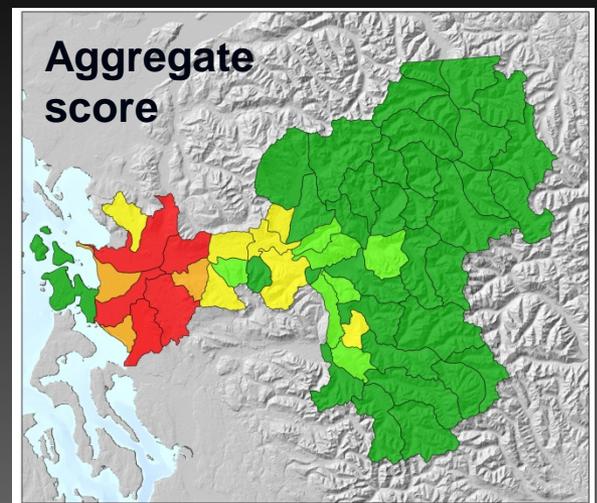
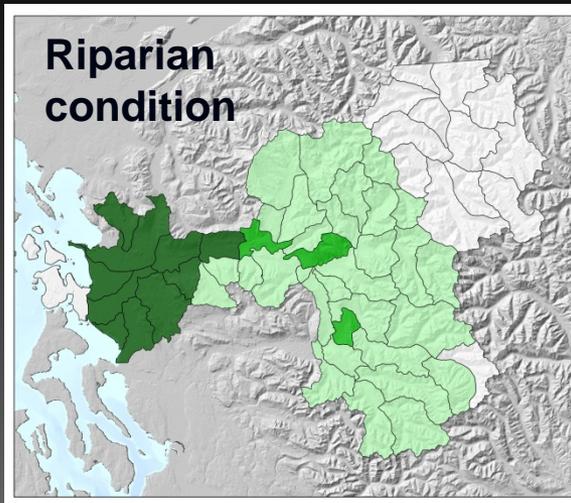
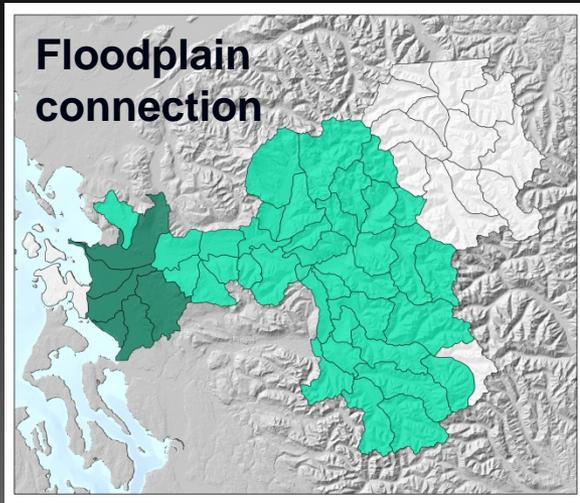
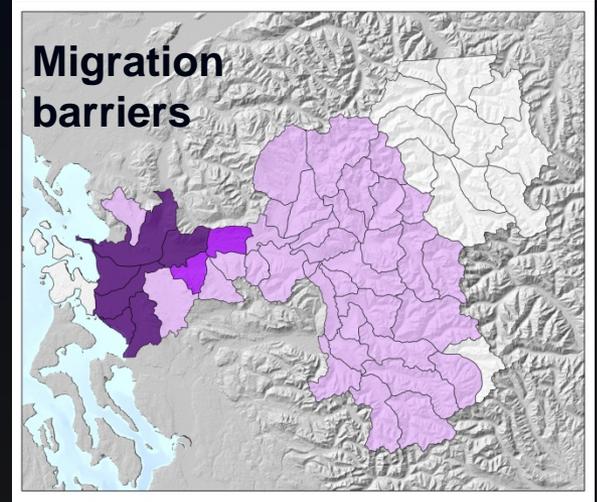
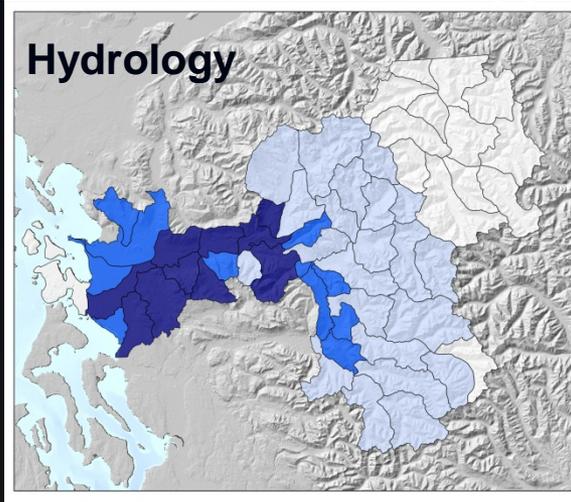
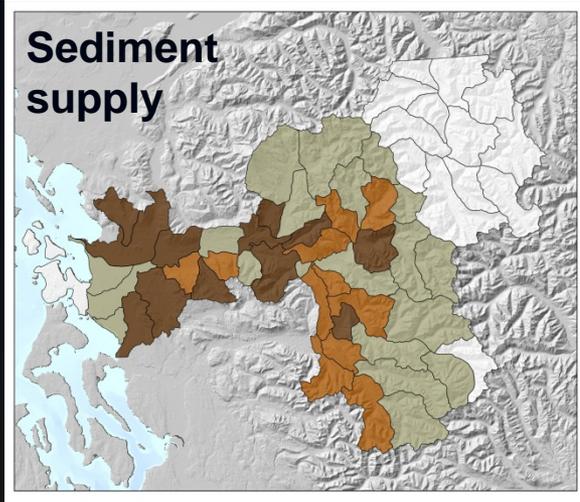
Analysis of habitat change and causes relative to reference



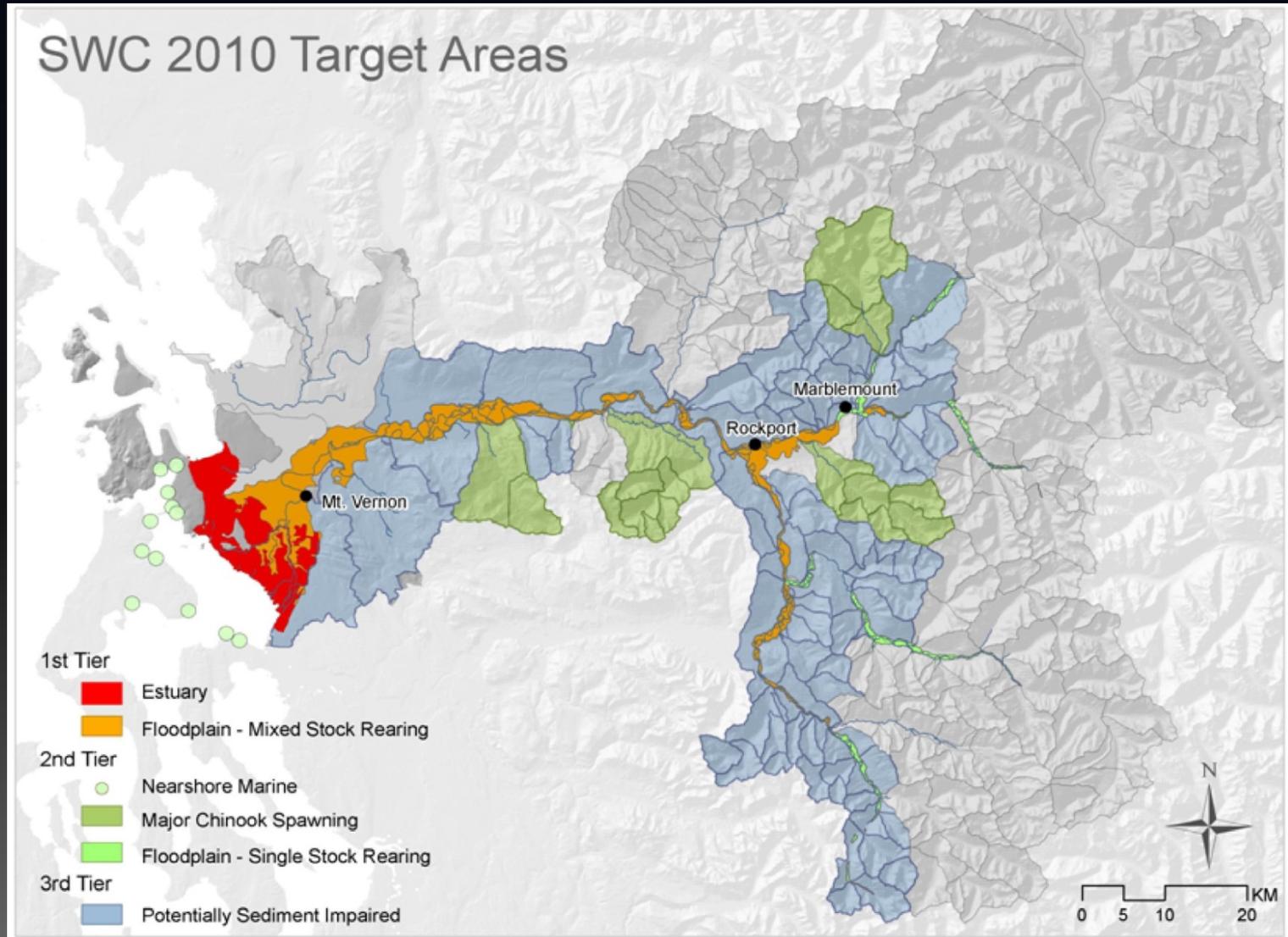
Biological effects and selection of actions relative to restoration goals



# Q2: What are the Root Causes of Habitat Change?



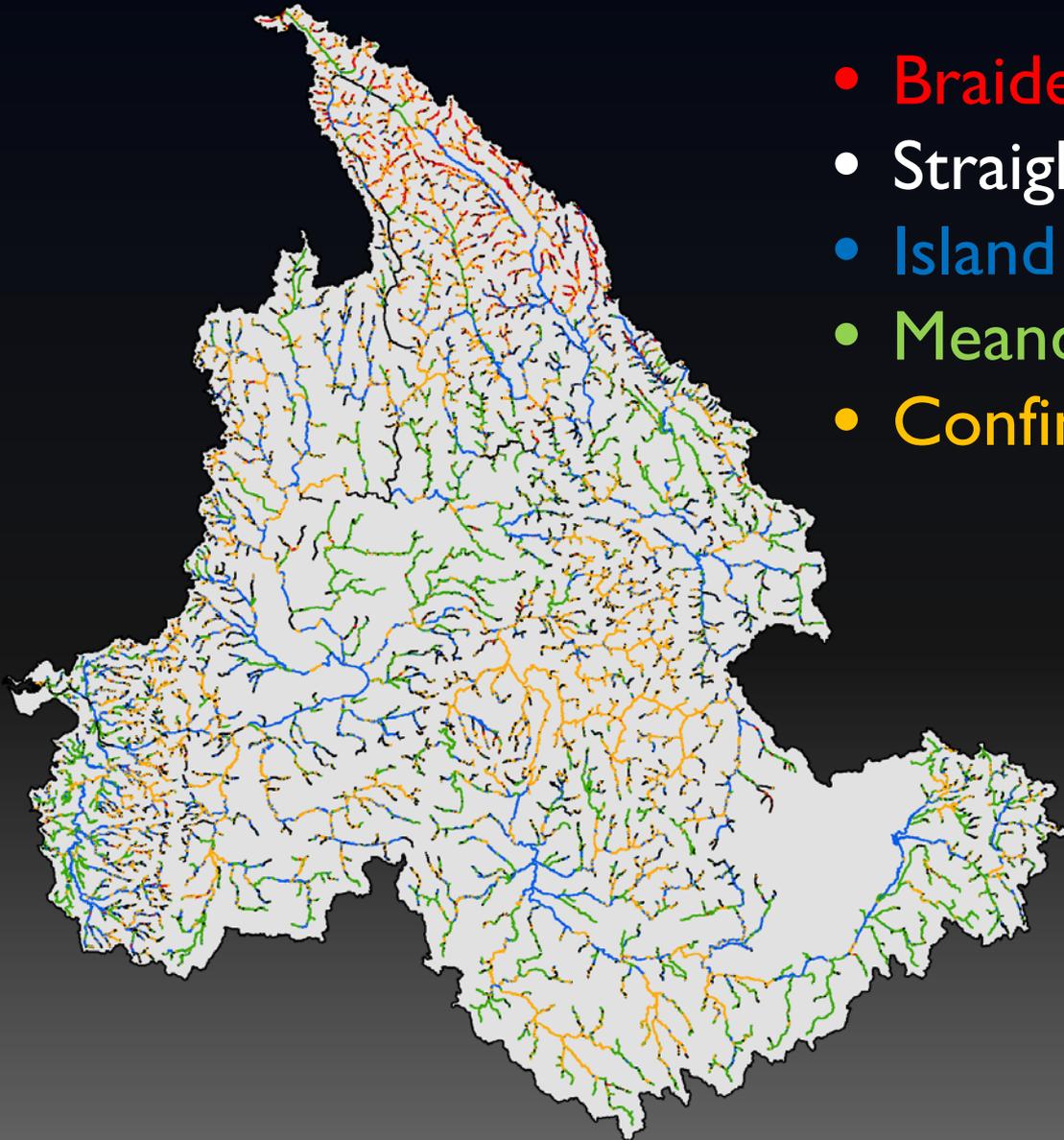
# Example from Skagitit Basin: Restoration Priorities



# Understanding Historical and Current Habitat Capacity Can Inform Restoration Planning

- An approach to evaluating historical and current habitat capacity in the Columbia Basin is in process at the NWFSC
  - Empirically estimate capacity by fitting stock-recruit models to available data.
  - Estimate existing habitat availability (via stream reach mapping) and historical availability (by combining existing stream reaches with geomorphic channel types)
  - Assign fish densities (derived from stream surveys) to each channel type
  - Can then also estimate capacity under different scenarios of habitat amount and access on broad spatial scales.

# Sum channel type lengths



- **Braided:** 2210 km
- **Straight:** 10165 km
- **Island Braided:** 12385 km
- **Meandering:** 15006 km
- **Confined:** 16046 km



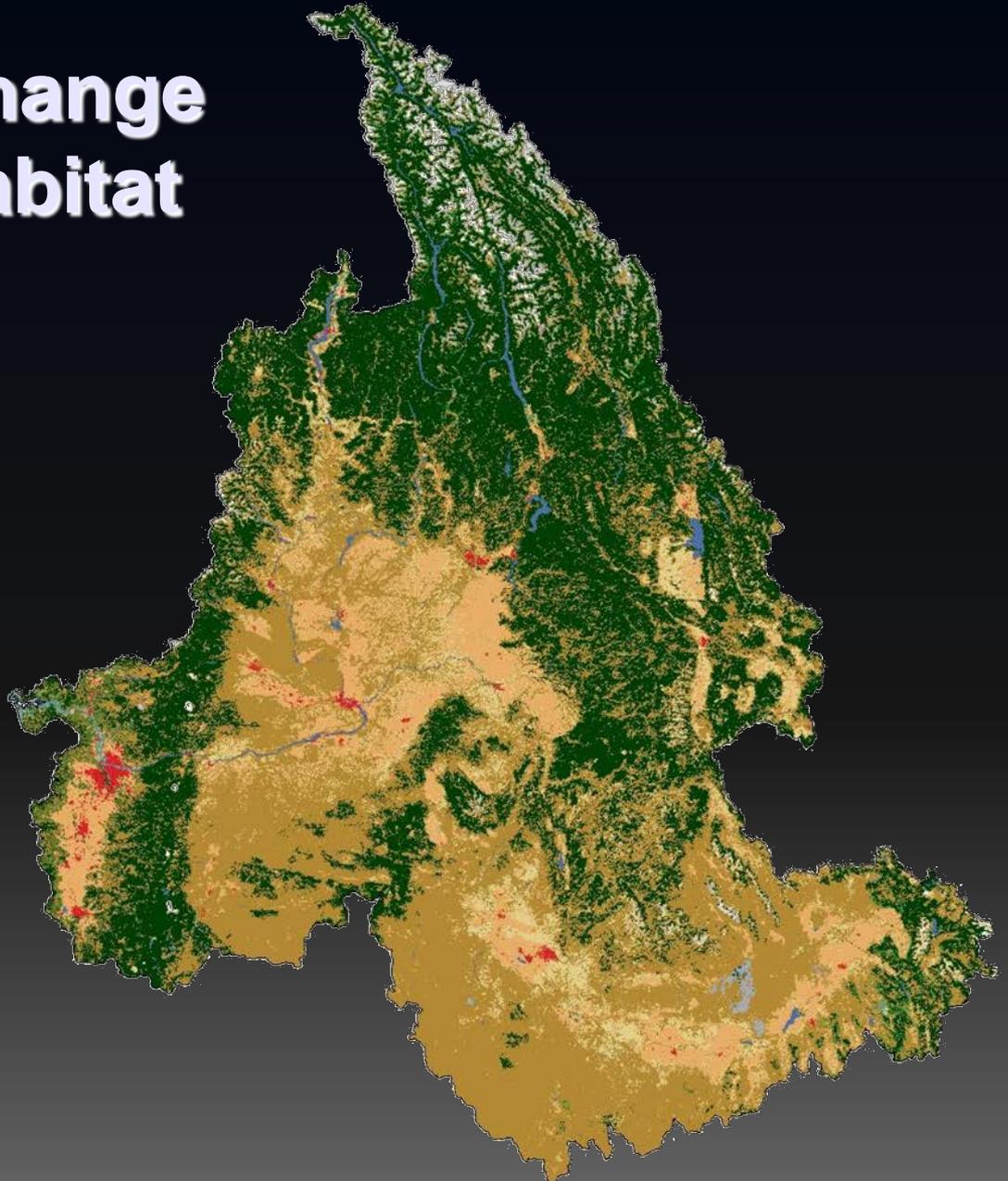
# Land use may change available fish habitat

Five land cover classes (250 m):

- Shrub
- Grass
- Forest
- Urban
- Crop

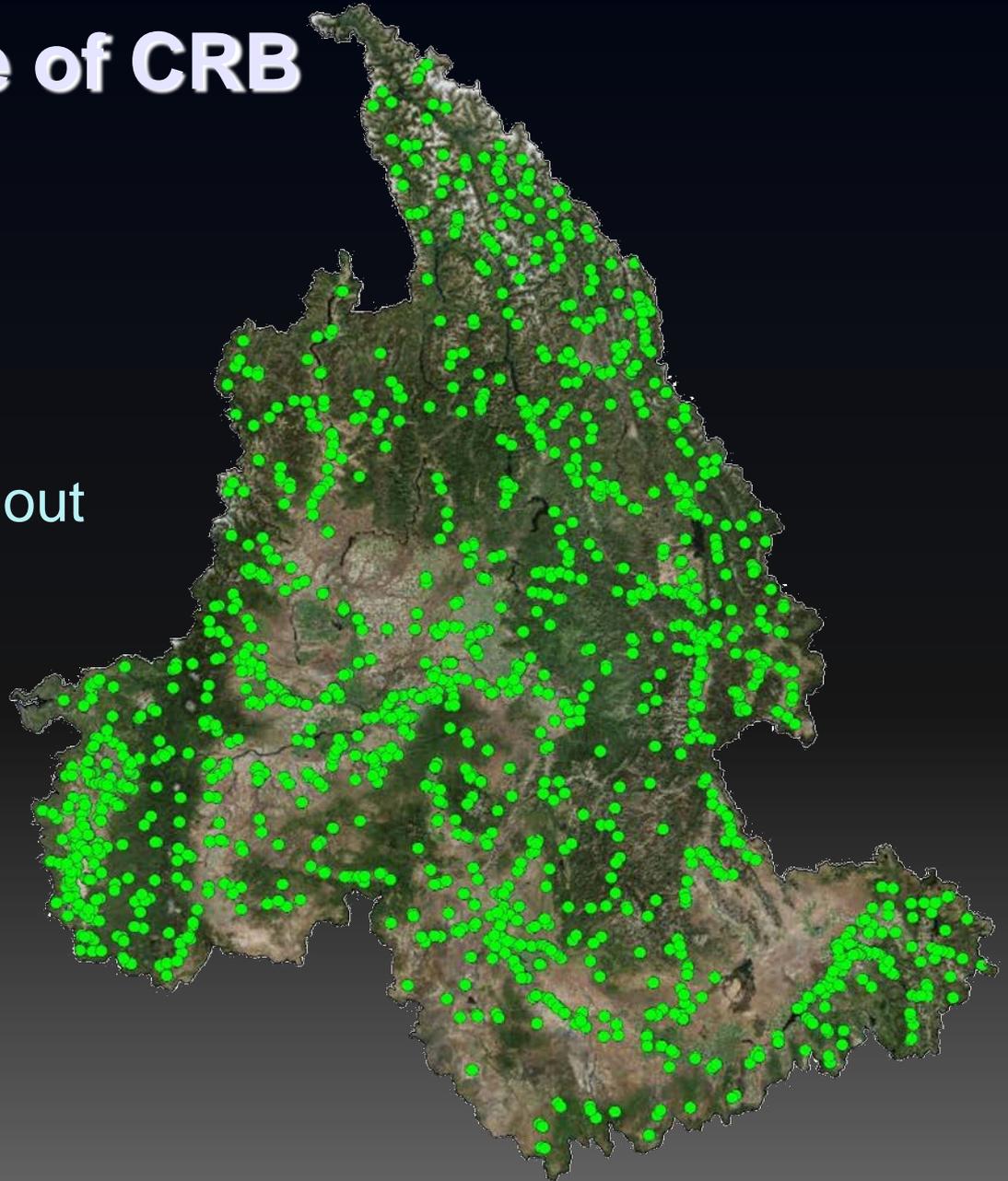
Five channel types:

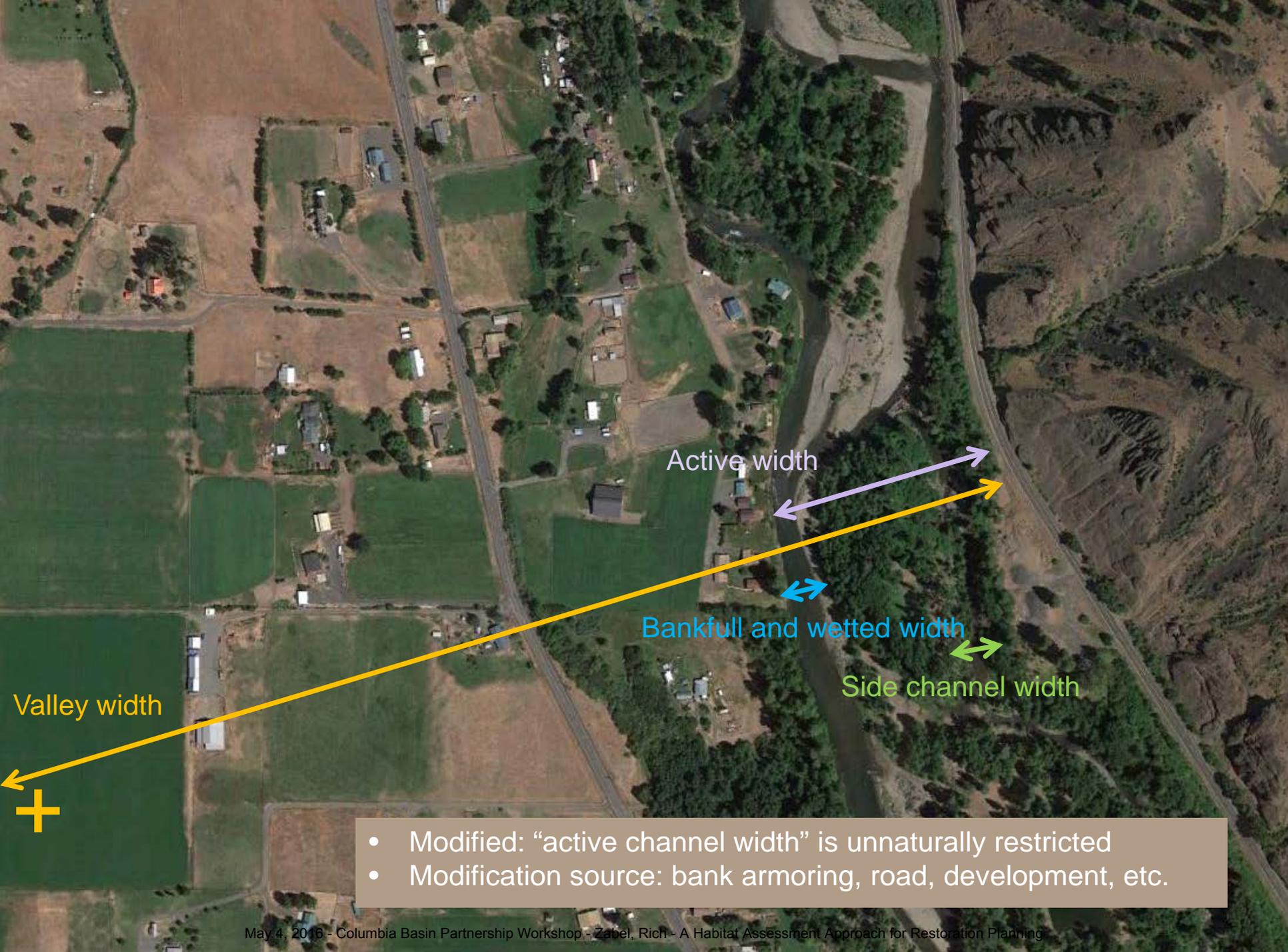
- Island-Braided
- Braided
- Meandering
- Straight
- Confined



# Stratified sample of CRB

- 150 sites for each:
  - Land cover (5)
  - Channel type (5)
  - Distributed throughout CRB
- Current n = 1673





Active width

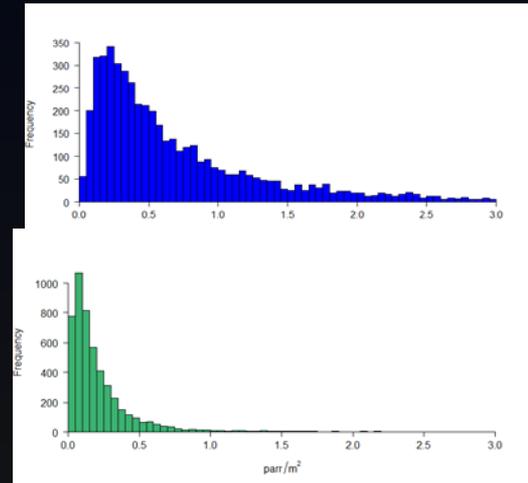
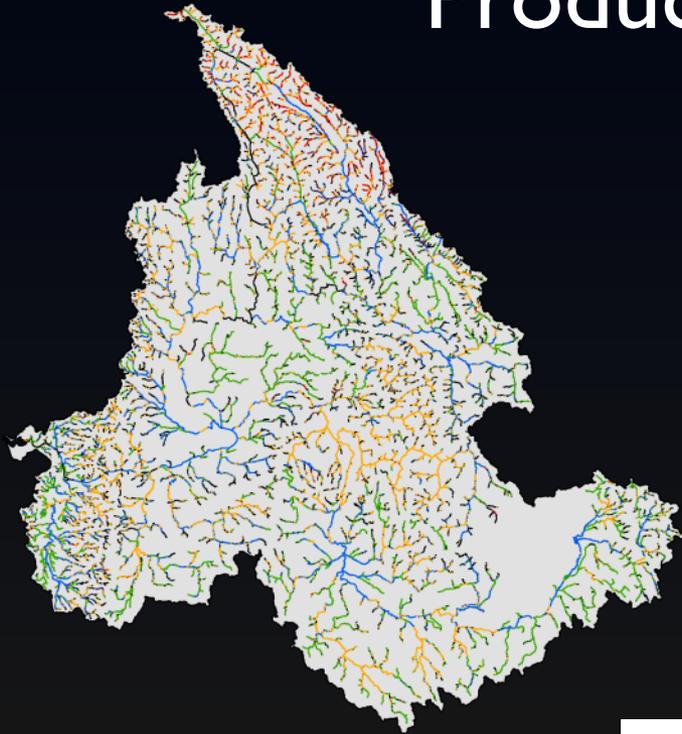
Bankfull and wetted width

Side channel width

Valley width

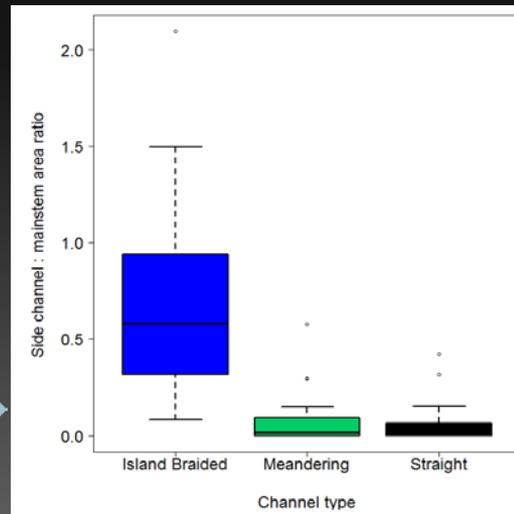
- Modified: “active channel width” is unnaturally restricted
- Modification source: bank armoring, road, development, etc.

# Production capacity

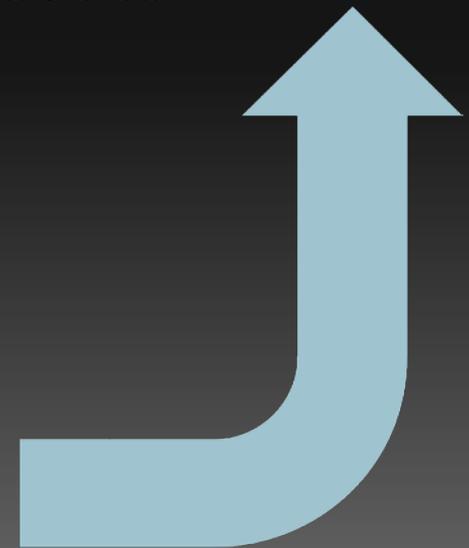


Apply fish densities to habitat area

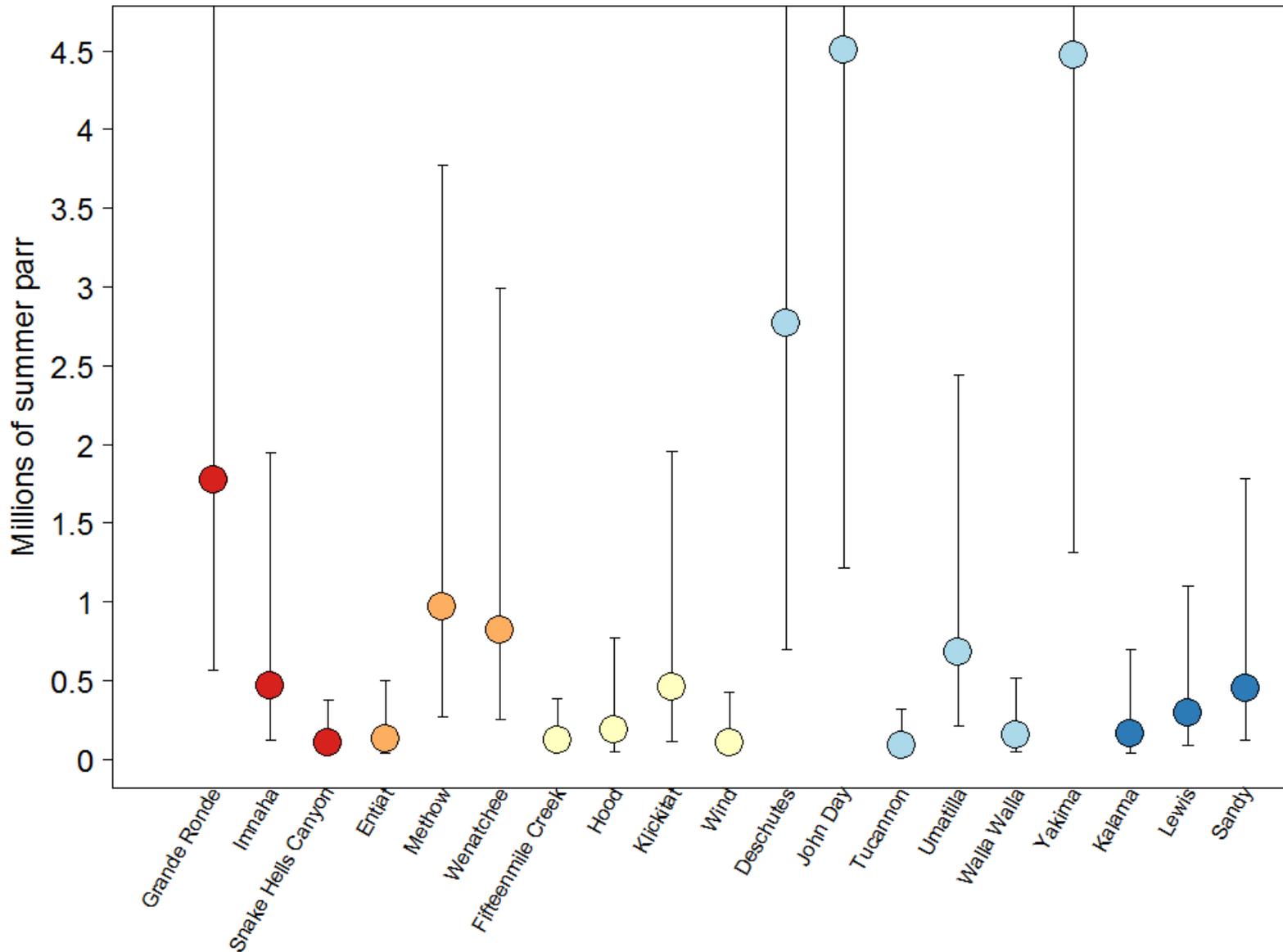
Sum channel type areas



Estimate total habitat area

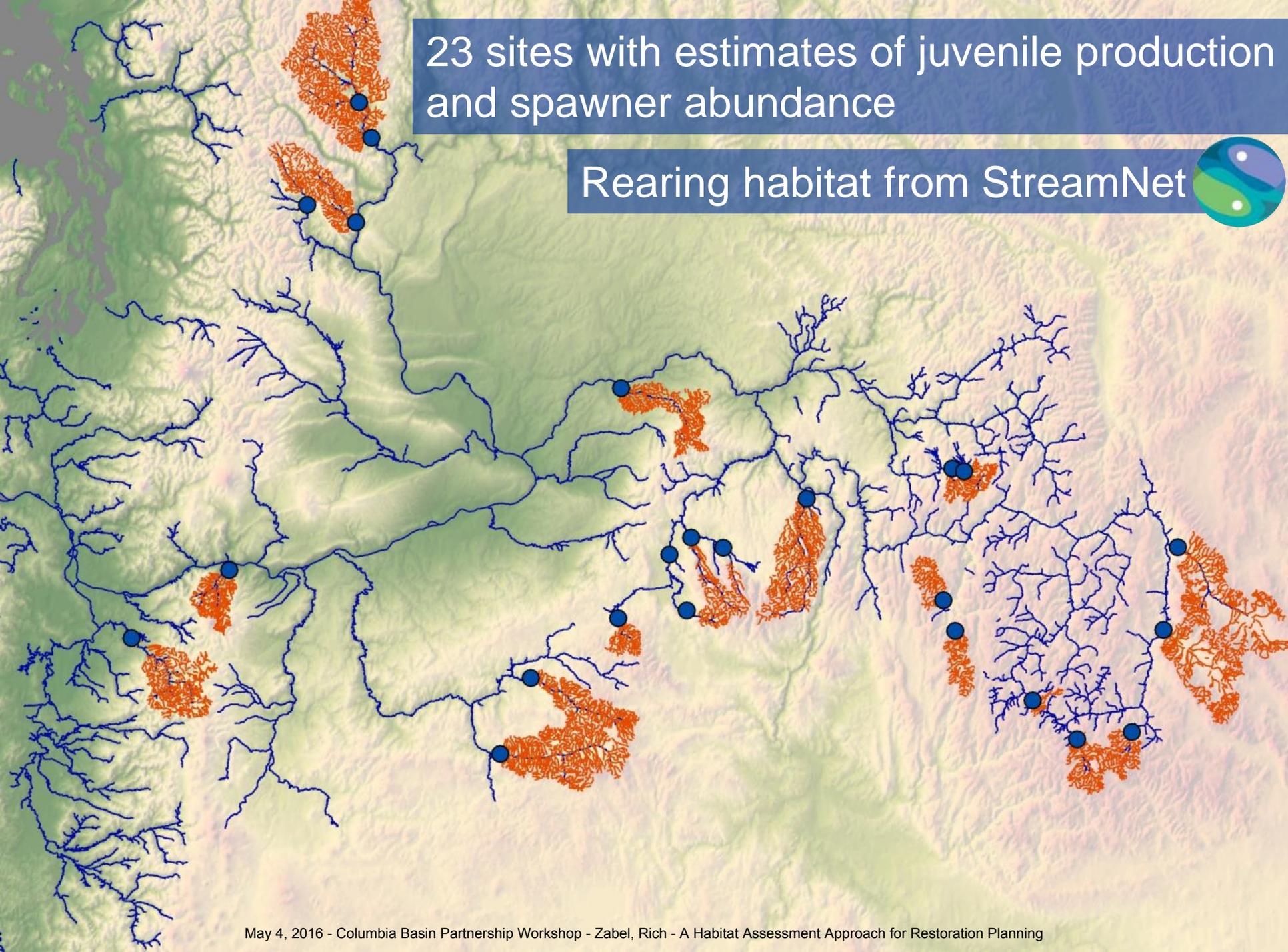


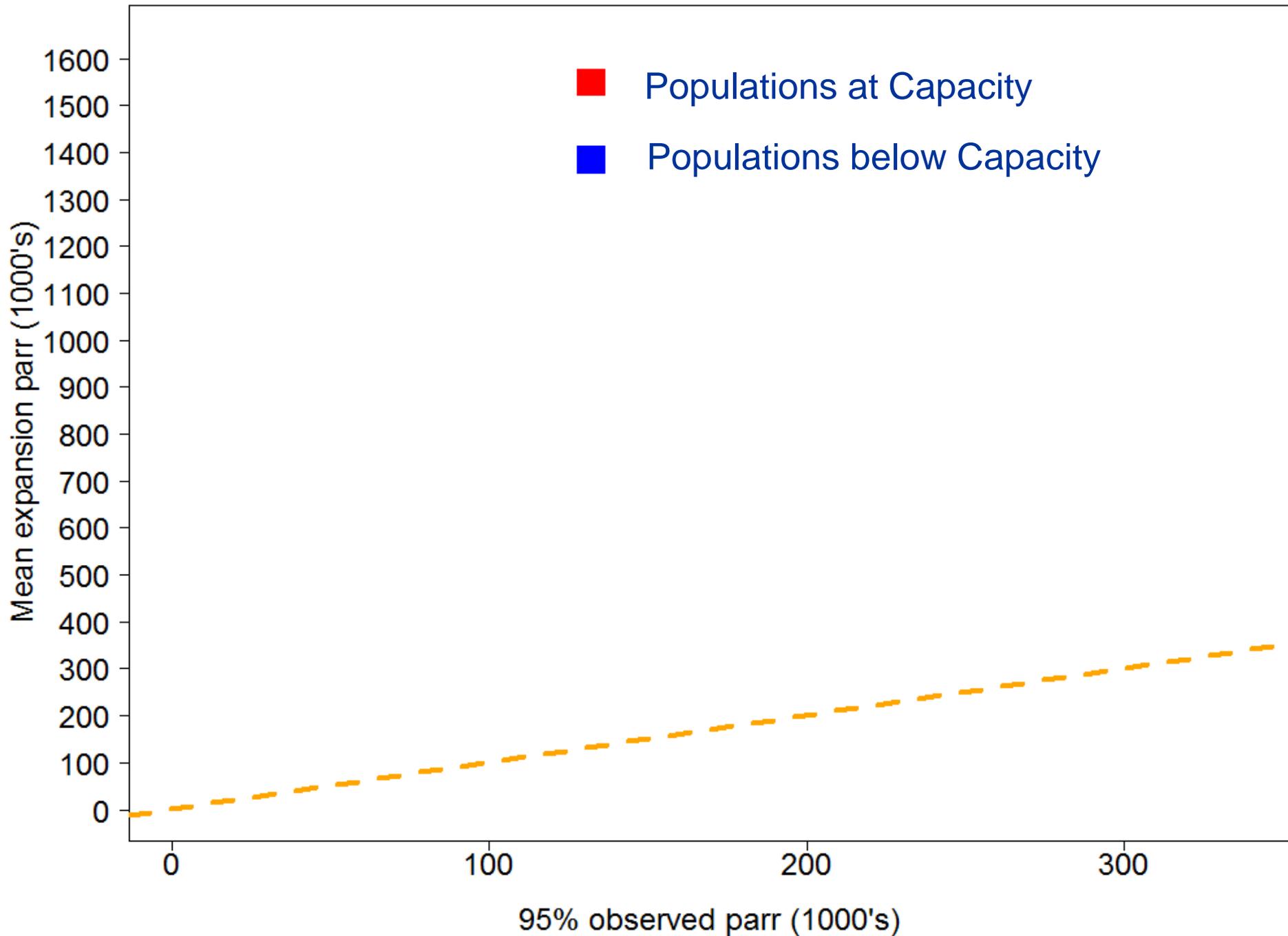
# Summer parr capacity

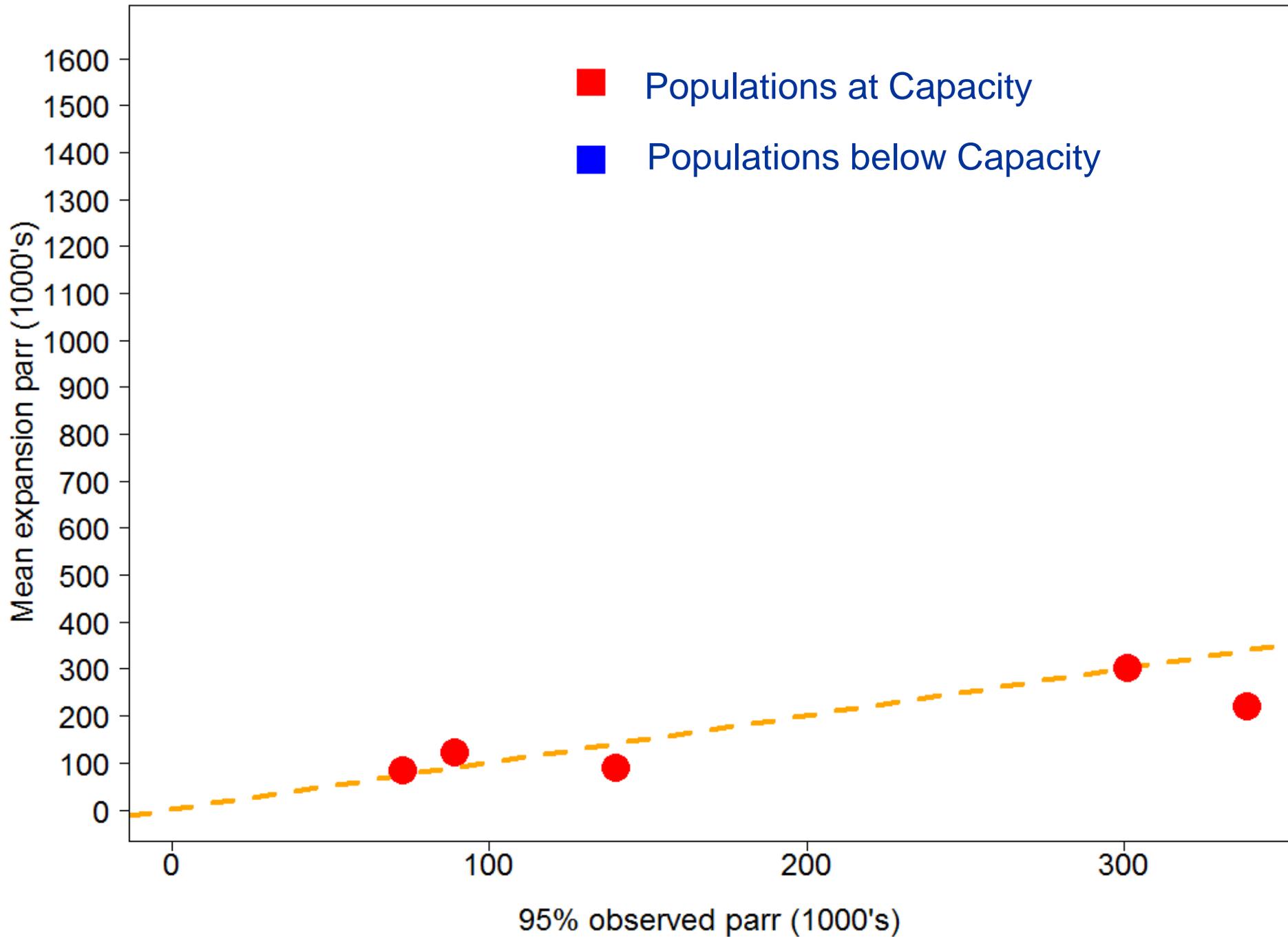


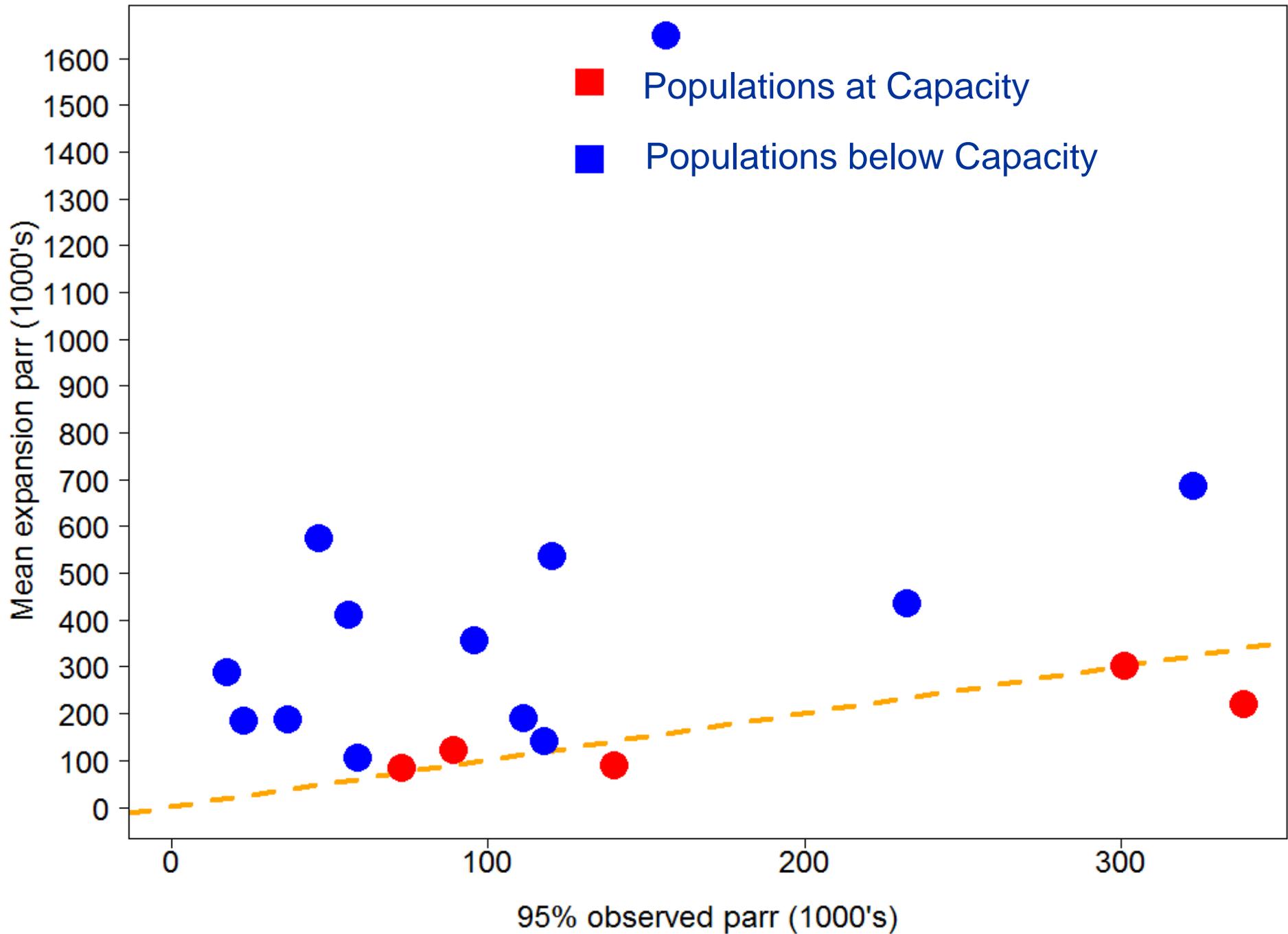
23 sites with estimates of juvenile production and spawner abundance

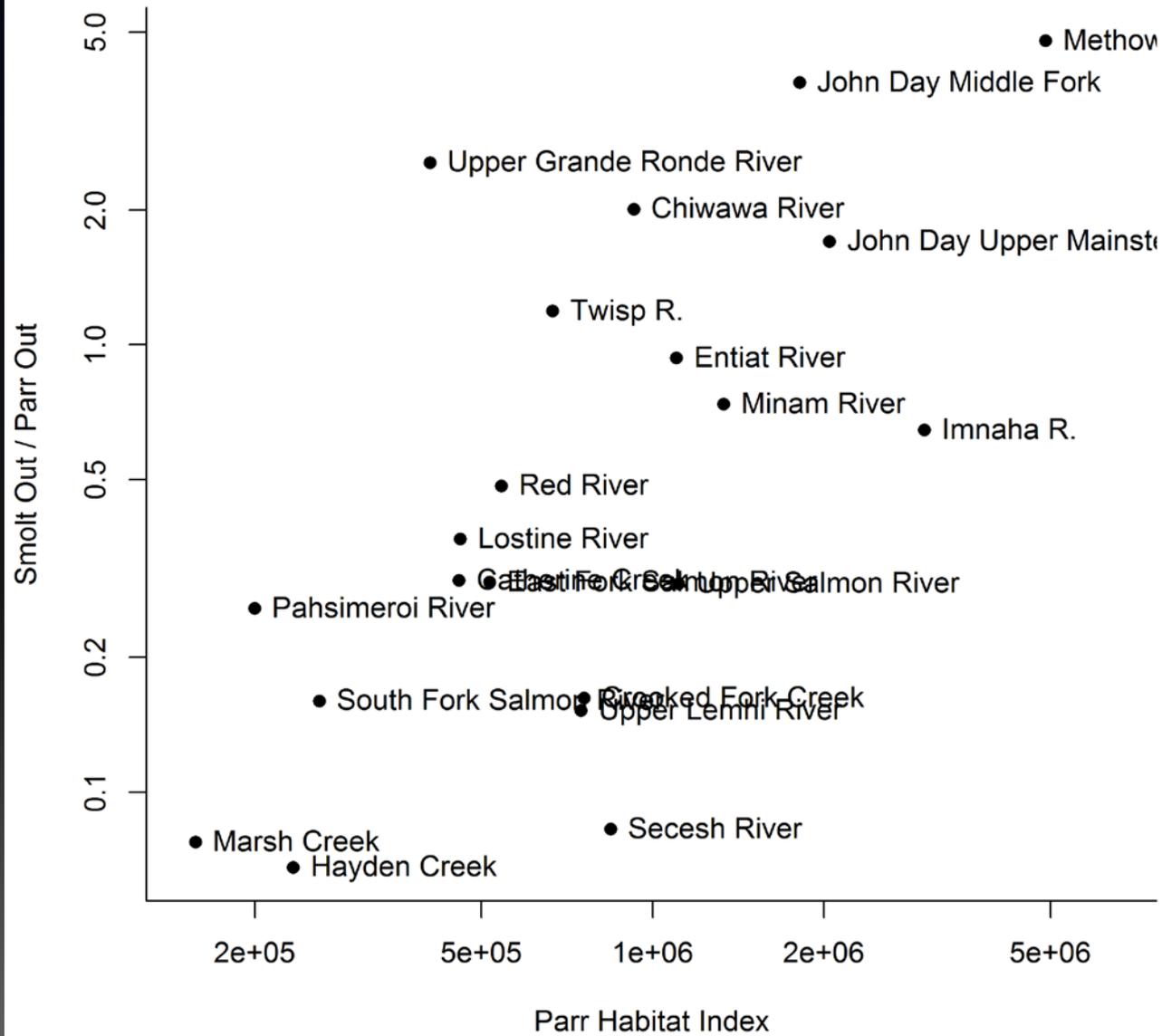
Rearing habitat from StreamNet 









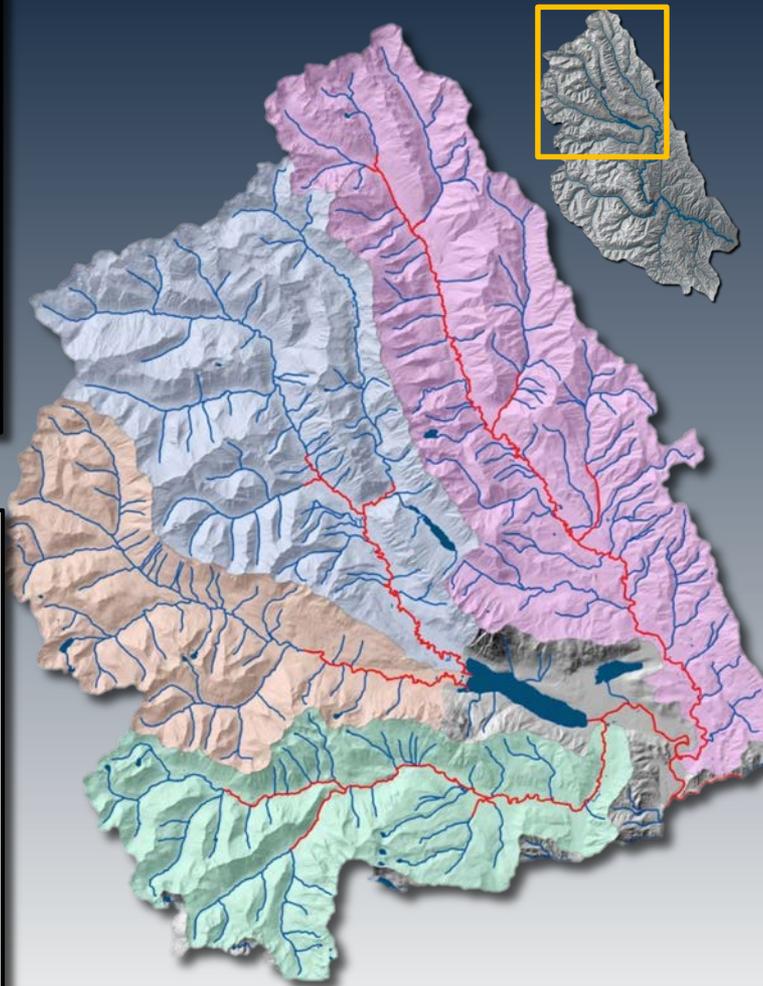
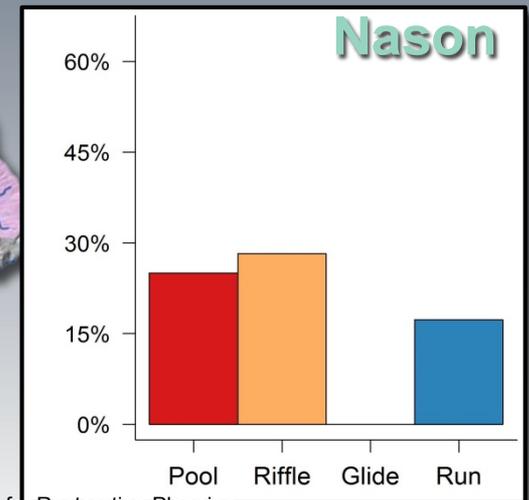
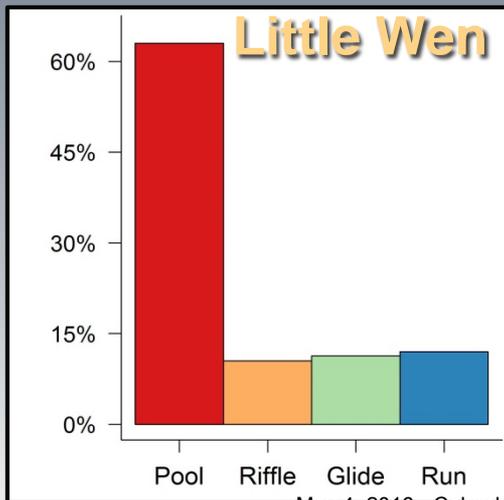
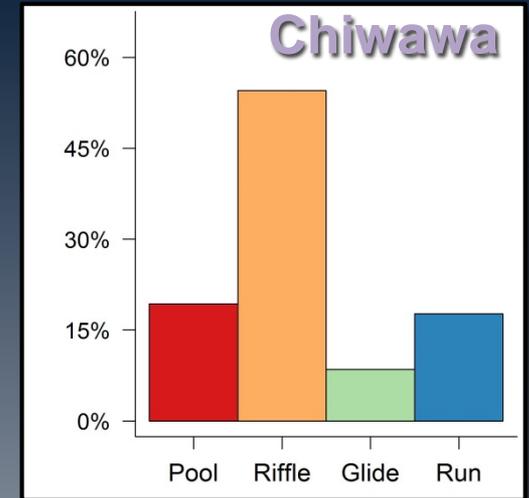
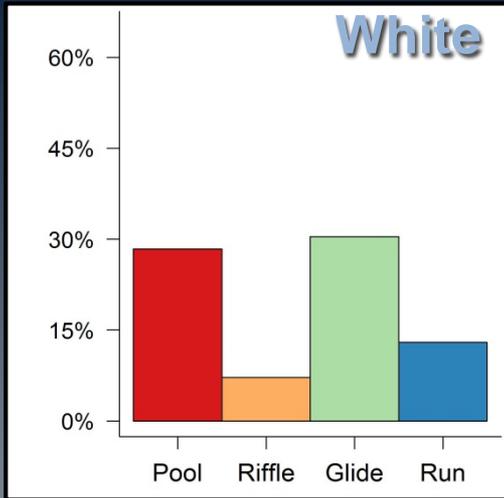


# Estimating Habitat Availability In The Wenatchee River

- How much habitat could the Wenatchee potentially provide?
- How much habitat is available to salmonids?
- Where does habitat availability differ from its potential and why?



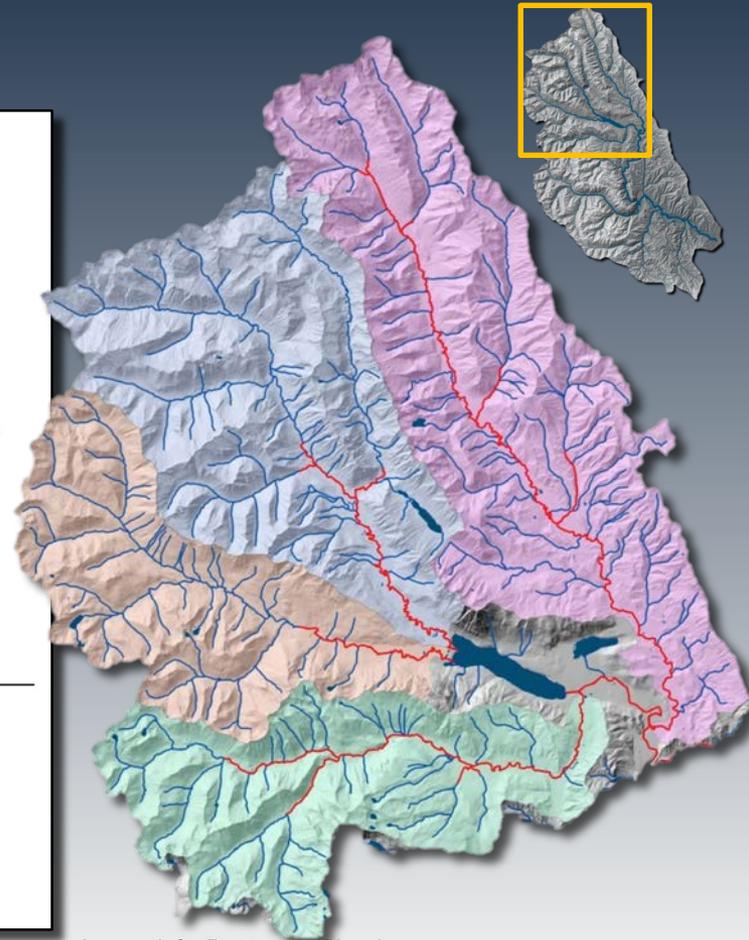
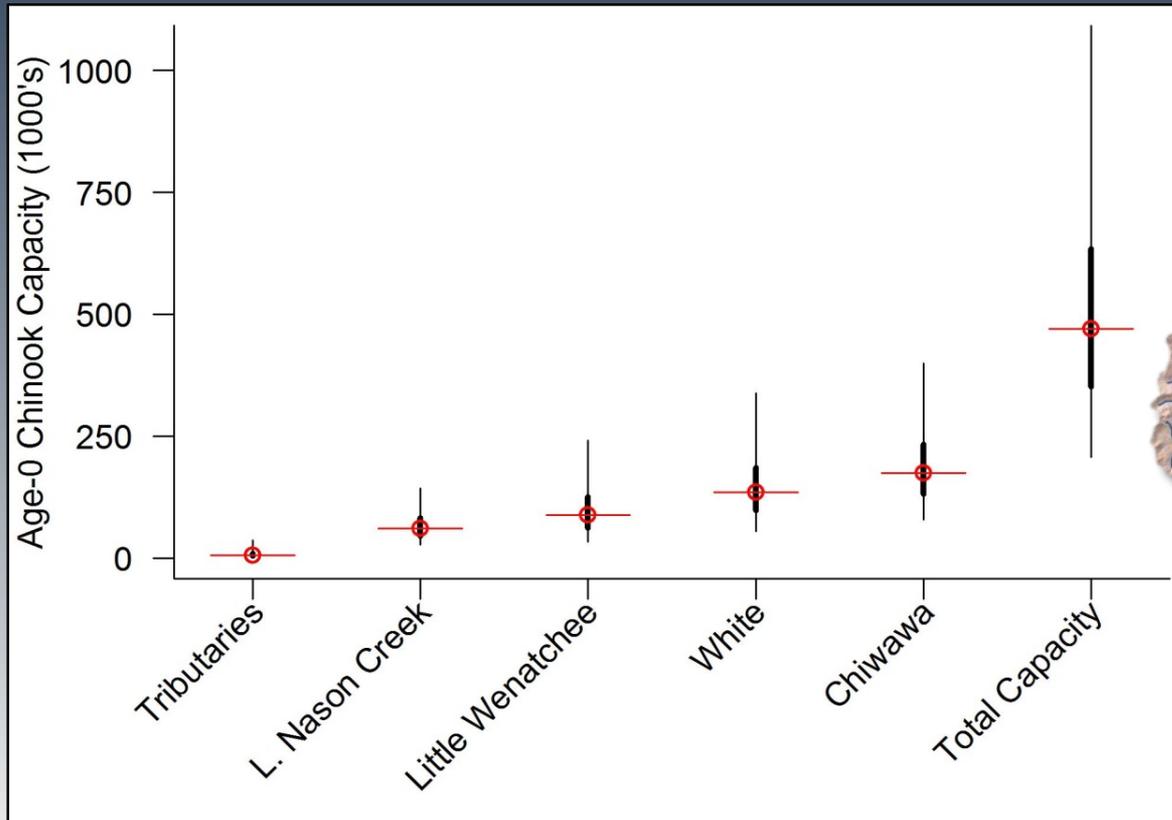
# Wenatchee Habitat Availability Varies by Basin



# Age-0 Chinook Summer Capacity

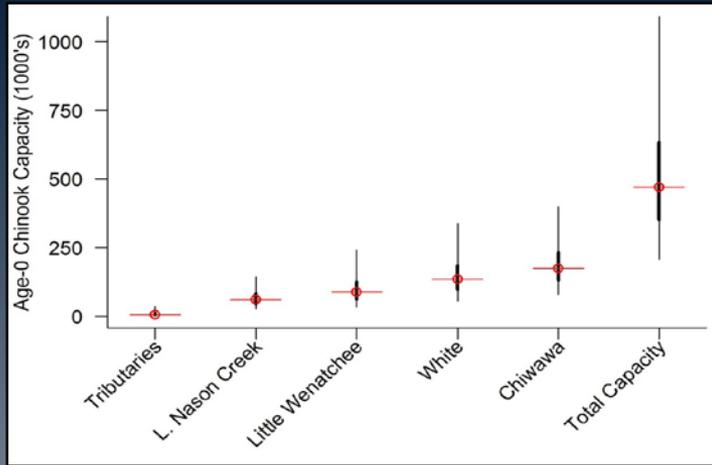
Total habitat and habitat composition drive capacity estimate.

Uncertainty is driven by fish/habitat association rather than measurement error.

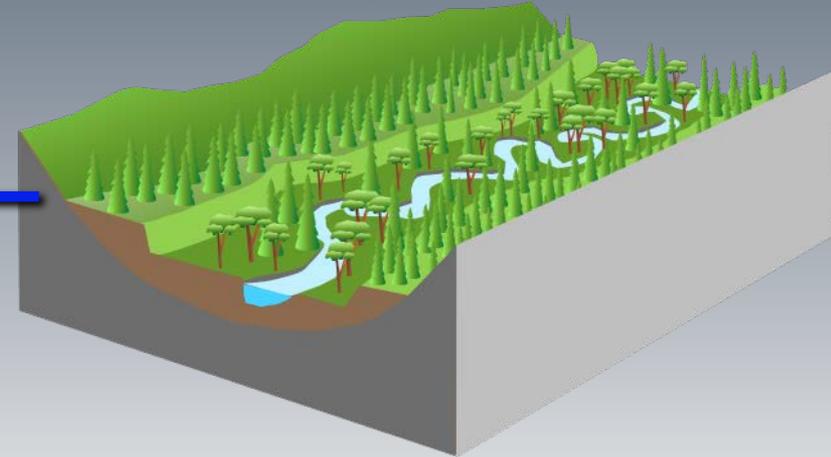
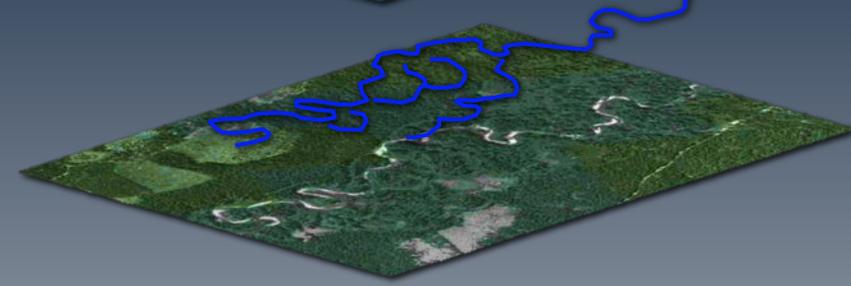
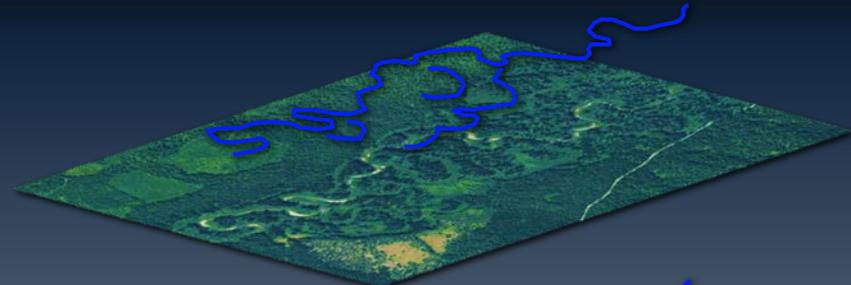
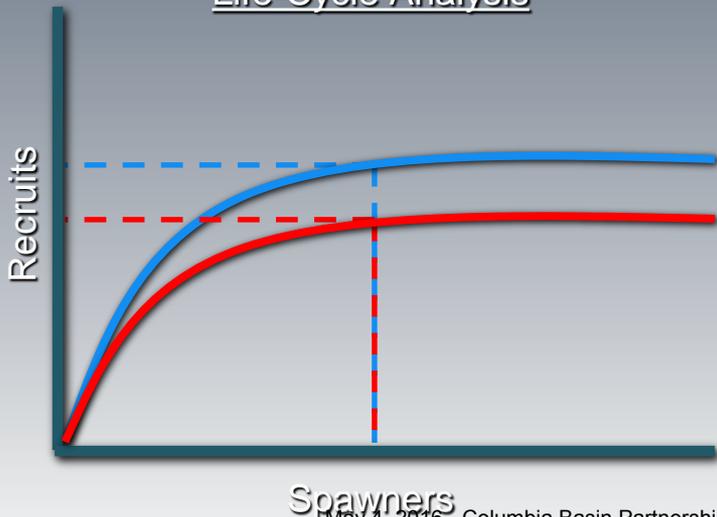


# Informing life-cycle models

## Habitat Analysis

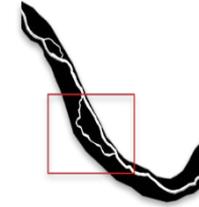


## Life-Cycle Analysis

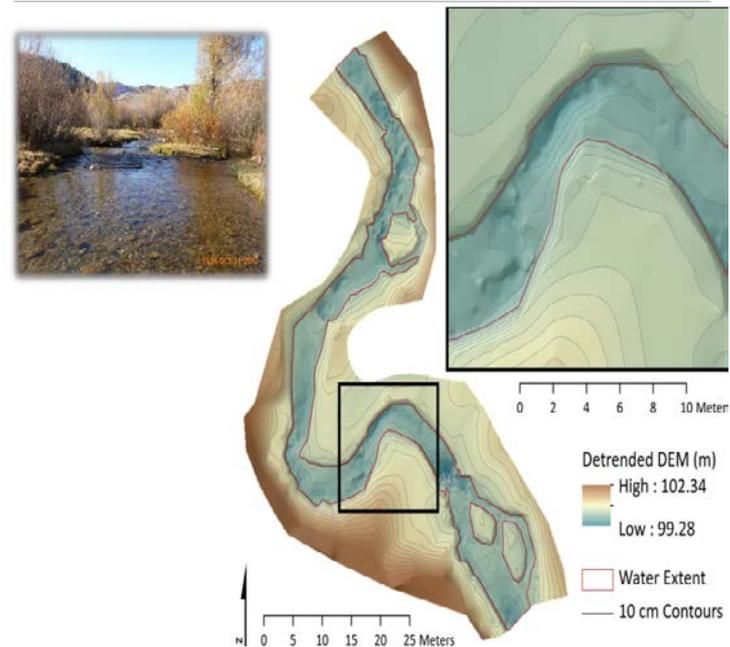


Spawners

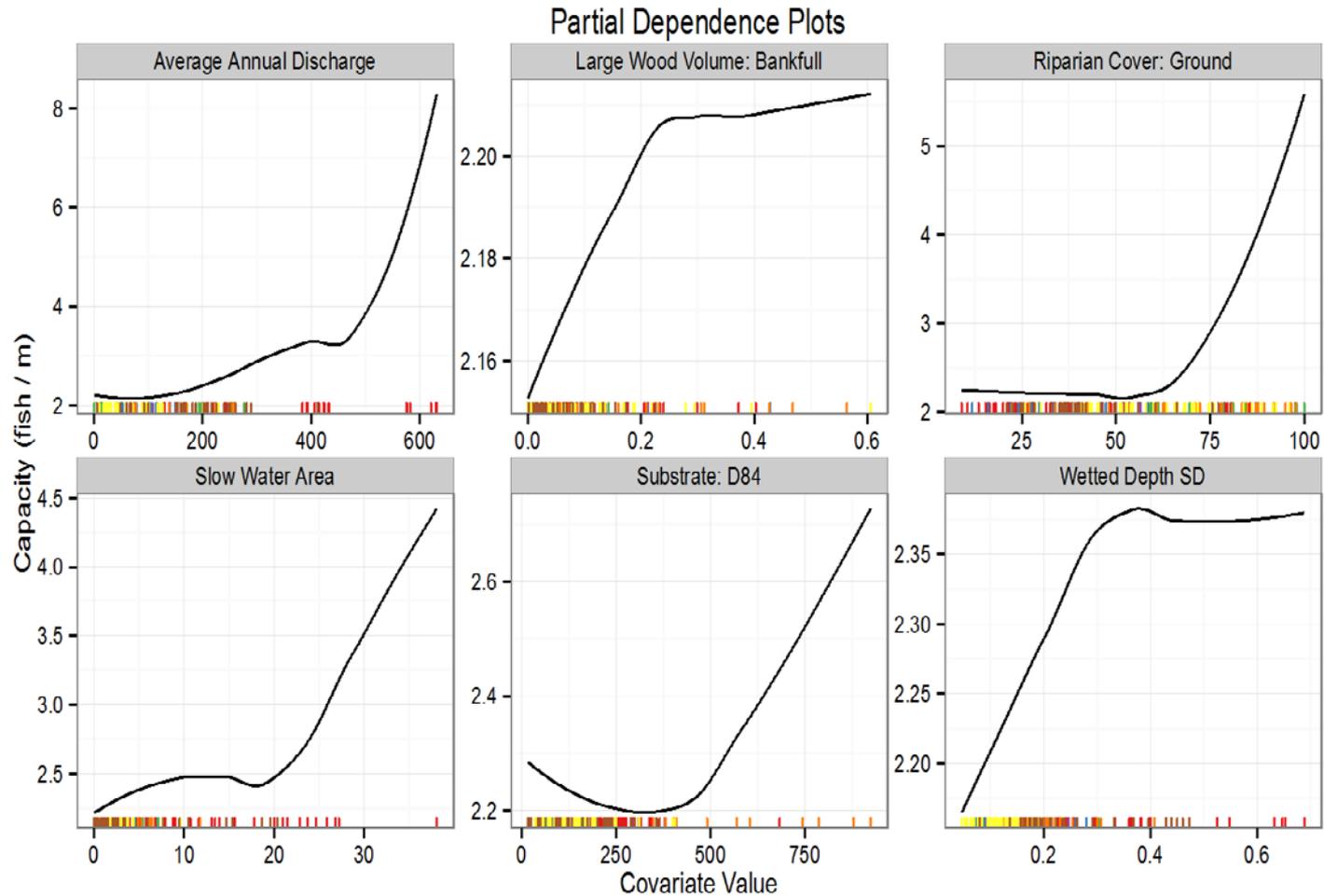
# Site-scale Data



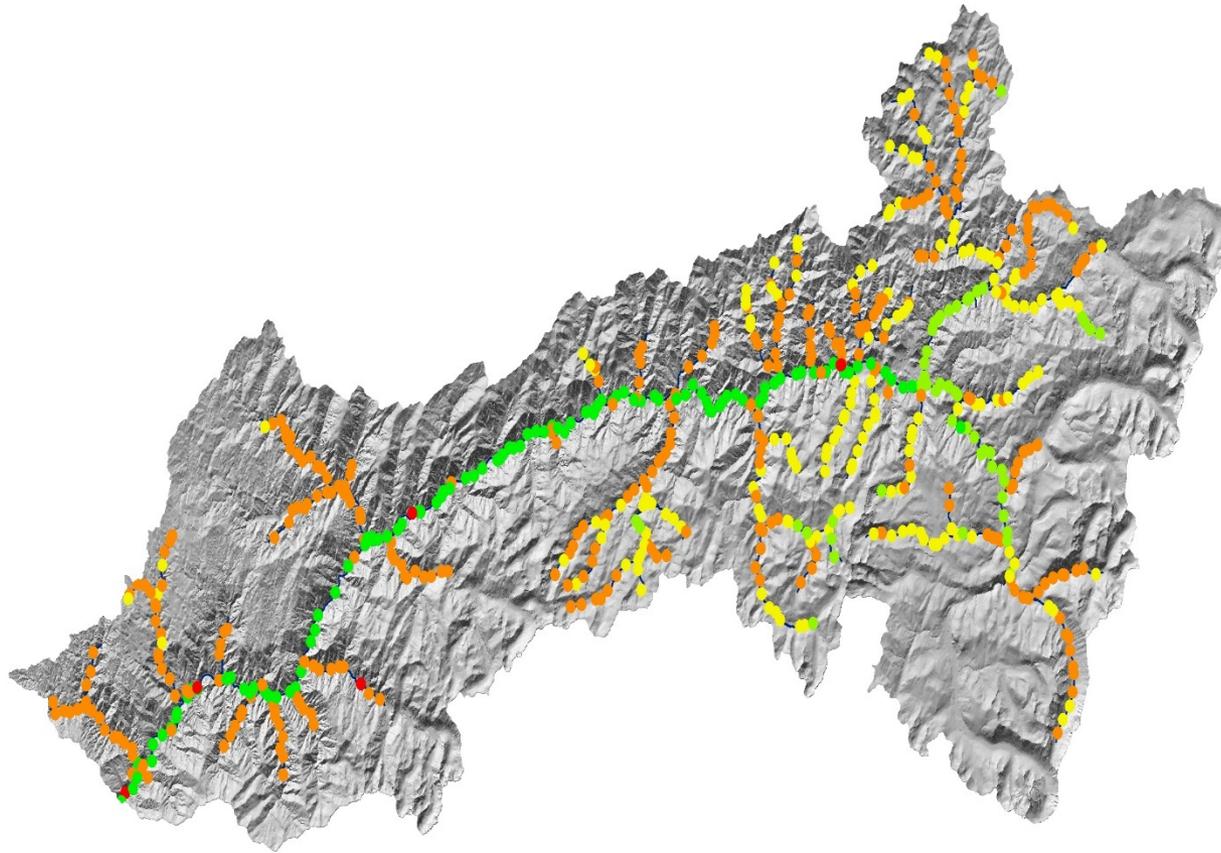
## Habitat (CHaMP)



# Partial Dependence Plots



Watershed — Entiat — John Day — Lemhi — Minam — South Fork Salmon — Upper Grande Ronde — Wenatchee



**QRF Capacity Estimates  
Juvenile Chinook**

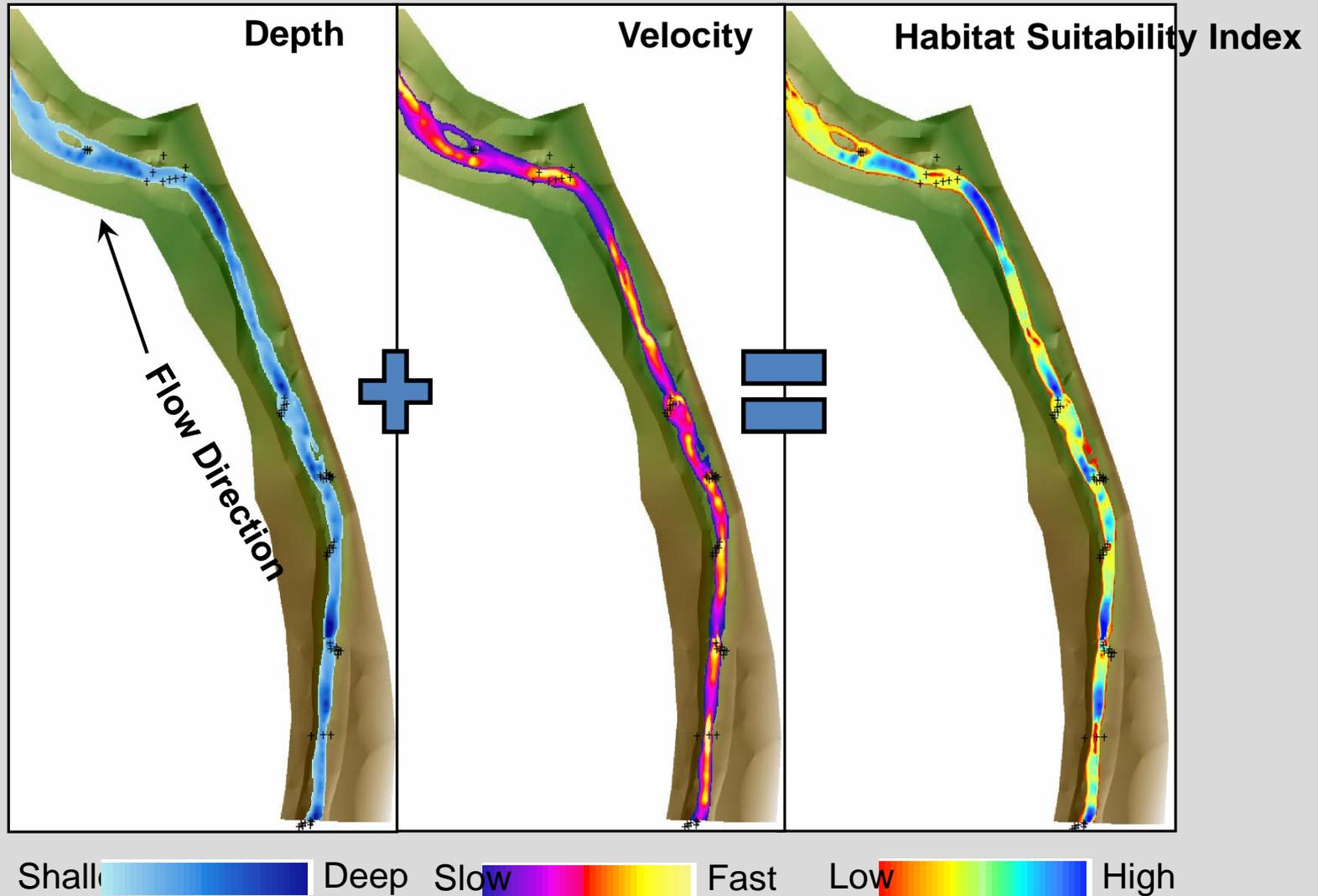
**Fish per meter**

- < 1.5
- 1.5 to 3.0
- 3.0 to 4.5
- 4.5 to 6.0
- > 6.0



0 12.5 25 Km

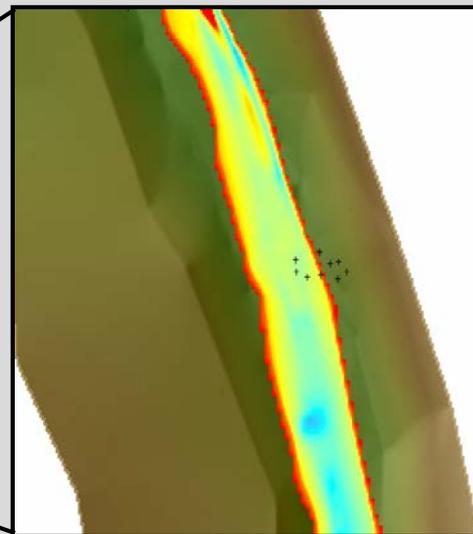
# Suitability Curves Application To Inputs



# Habitat Suitability Index

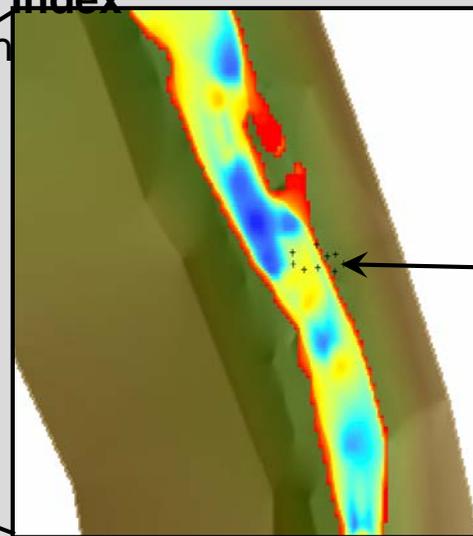
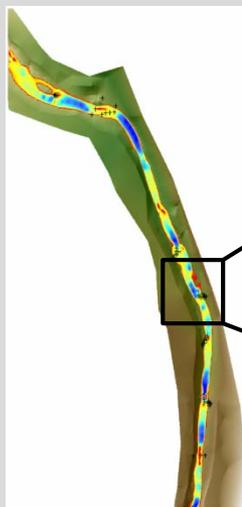
## S.F. Asotin – Pre and Post Treatment Results

Pre-Treatment (2012)



Post Treatment (2015) Habitat Suitability Index

Low  High

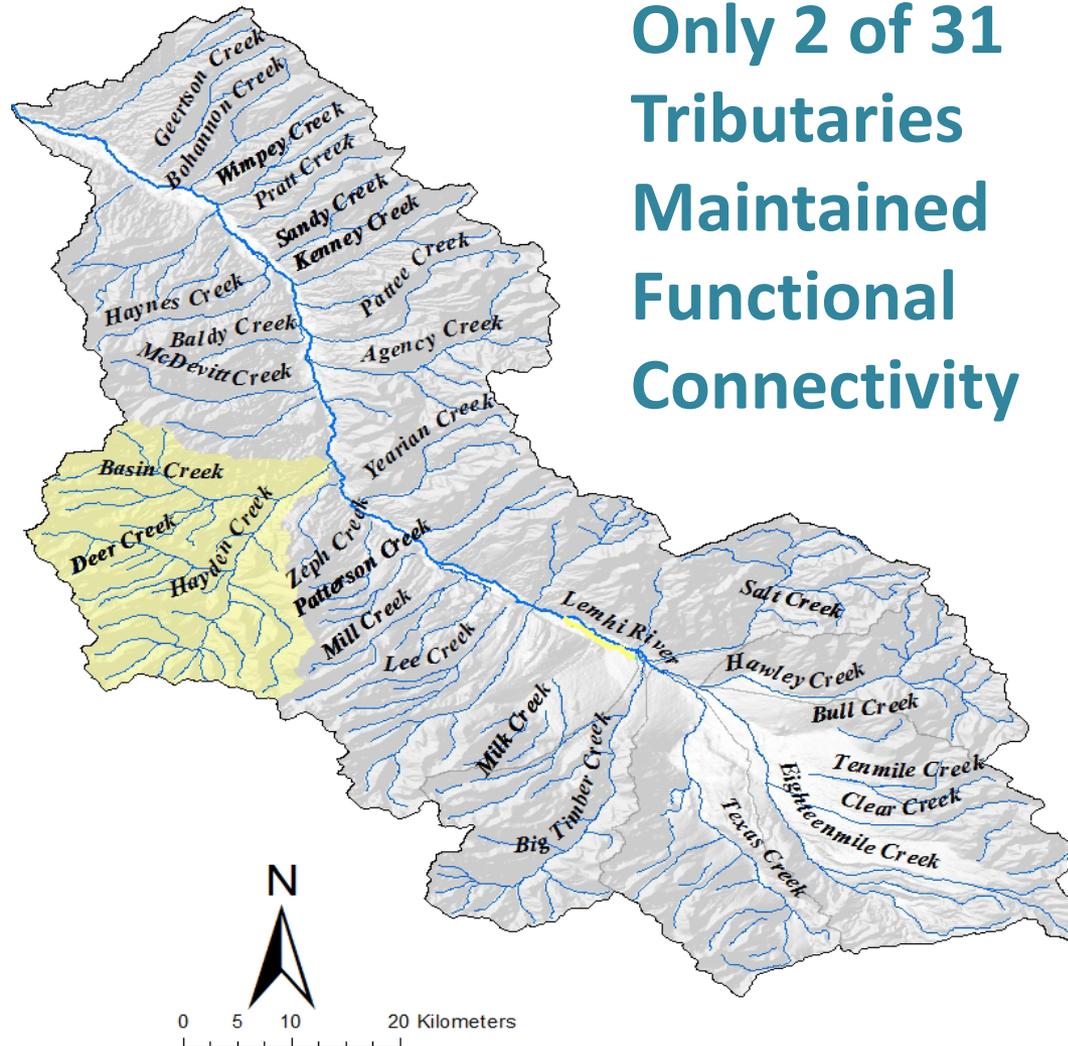


PALS

# Historical Perspective

## Lemhi Basin Water Development

### Loss of Historically Available Complex Spawning and Rearing Habitat



Only 2 of 31  
Tributaries  
Maintained  
Functional  
Connectivity

# Lemhi Restoration Actions

## Restoration Action

## Objective

Tributary Reconnects

Fish Passage

Removal of Irrigation Structures and road culverts that Inhibit Fish Passage

Fish Passage

Fish Screening to Reduce Entrainment in Irrigation Canals

Fish Passage

Eliminate Ditch Return Threats

Fish Passage

Riparian Grazing Management

Riparian Protection

Enhance Side Channels and Secondary Rearing Habitat

Habitat Improvement

Lemhi River Stream Channel Rehabilitation

Habitat Improvement

Mainstem Pool Development

Fish Passage and Habitat

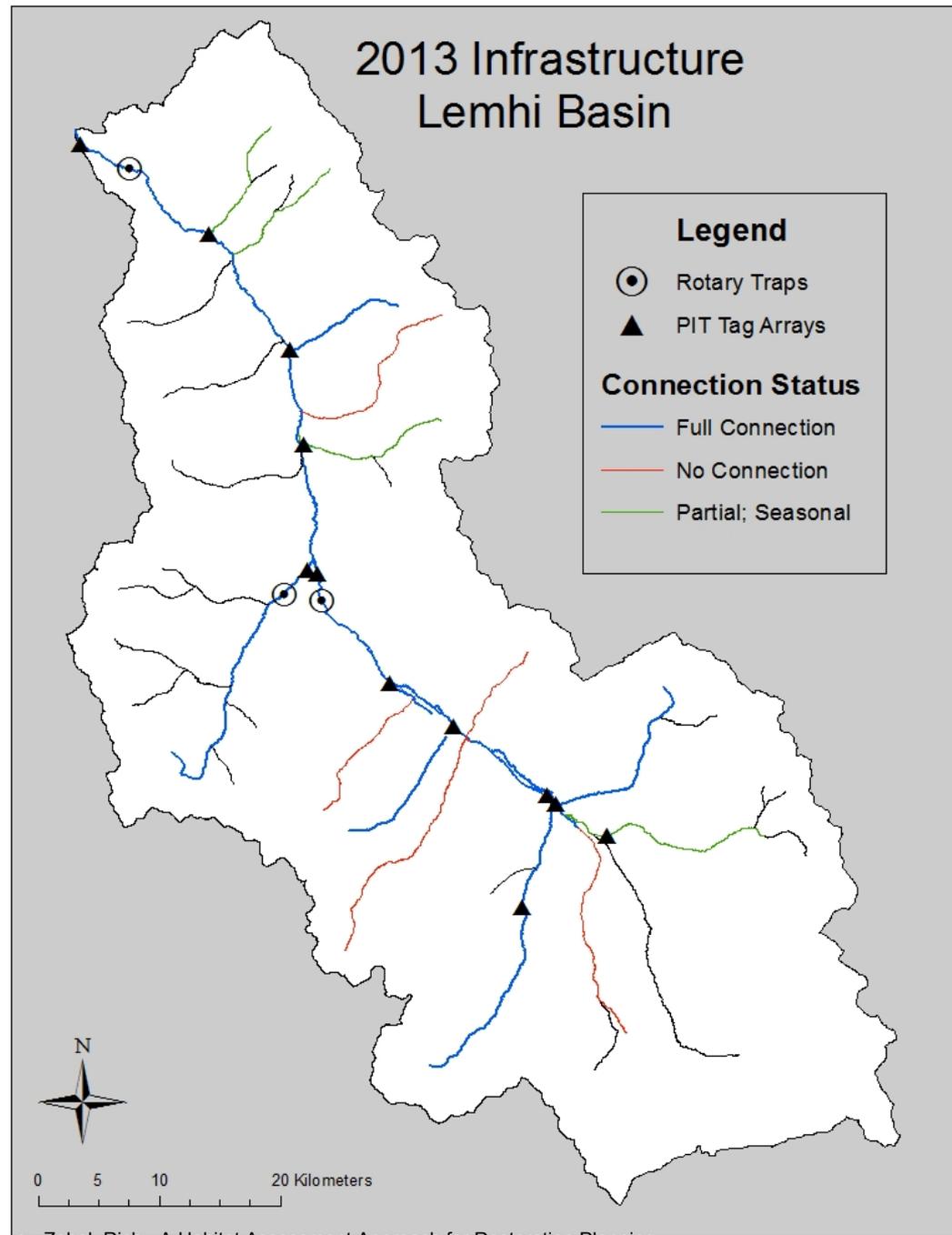
Improvement

Maintain Fish Passage in the Lemhi

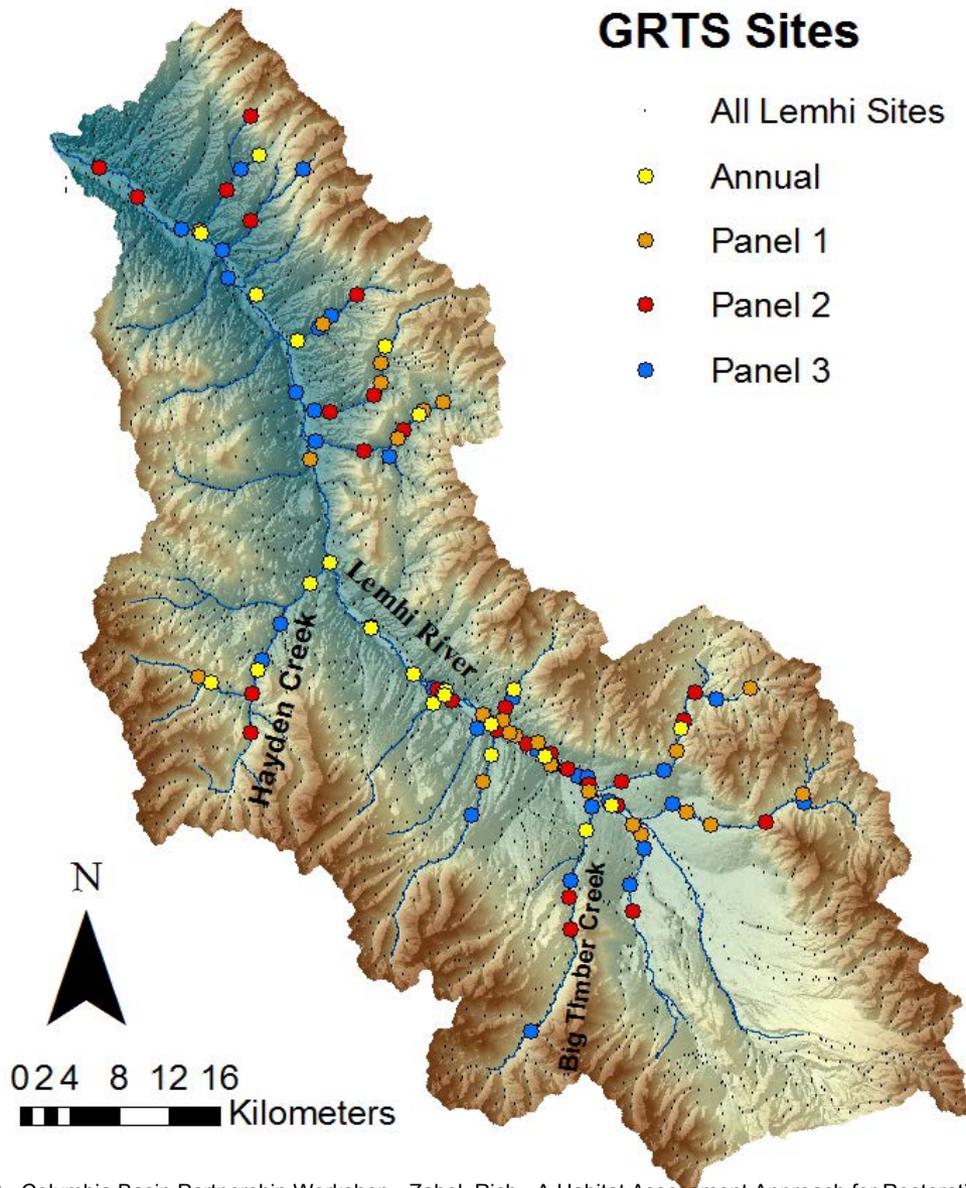
Fish Passage

# Fish Sampling Infrastructure

- Screw Traps
  - Juvenile Production
- PIT Arrays
  - Adult
    - Numbers
    - Distribution
  - Juvenile
    - Survival
    - Movement
    - Distribution

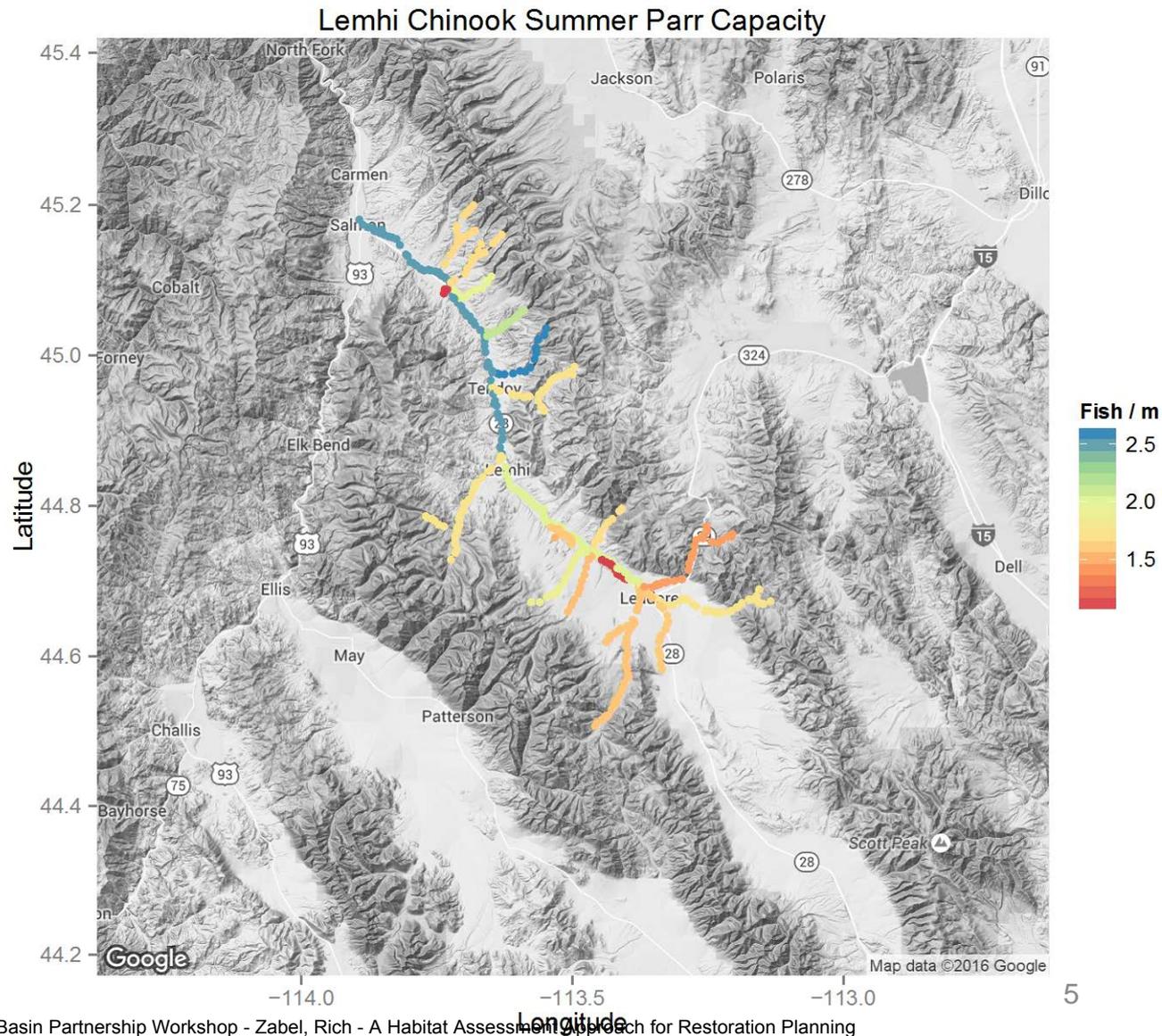


# Habitat Sampling Sites



# Summer Parr Capacity

- Based on QRF estimates
- Empirical Fish-habitat relationships
- Capacity is habitat-based



# Productivity and Abundance

Modeled using FUTURE Texas Creek Reconnection and Lower River Survival Improvements (increase by 50%)

## Baseline

Wetted area: 1.27 km<sup>2</sup>

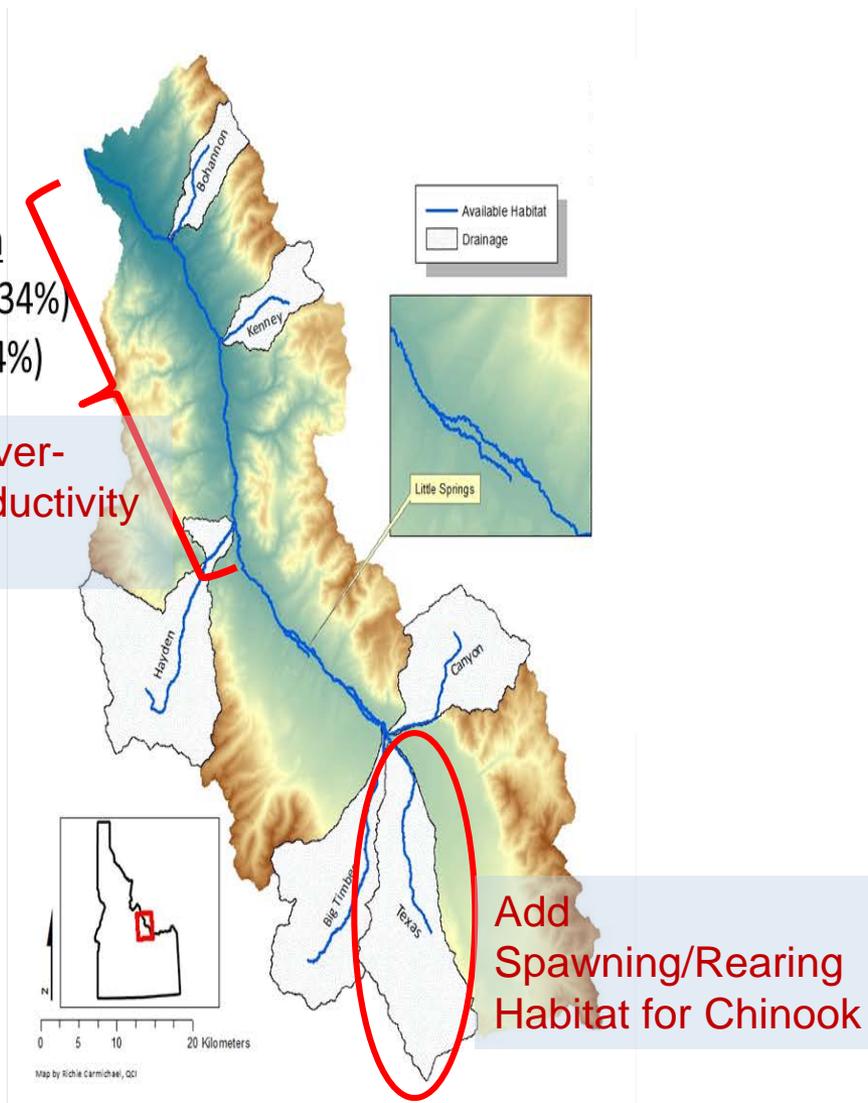
Pool area: 0.37 km<sup>2</sup>

## Tributary reconnection

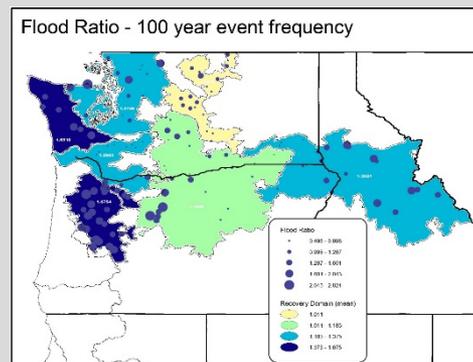
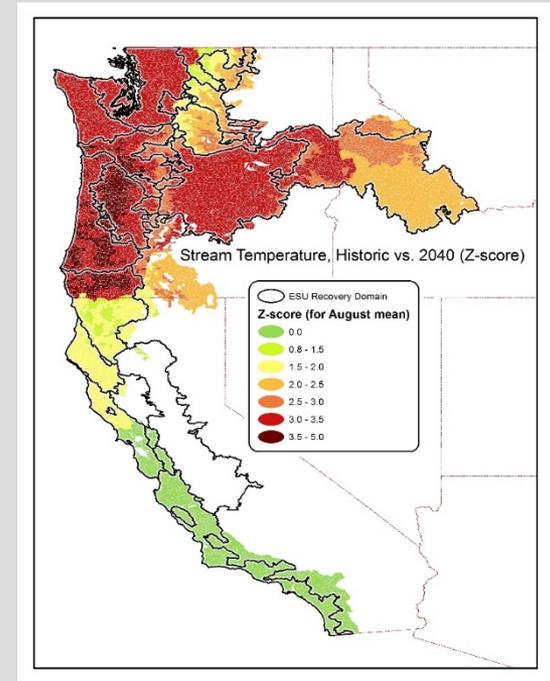
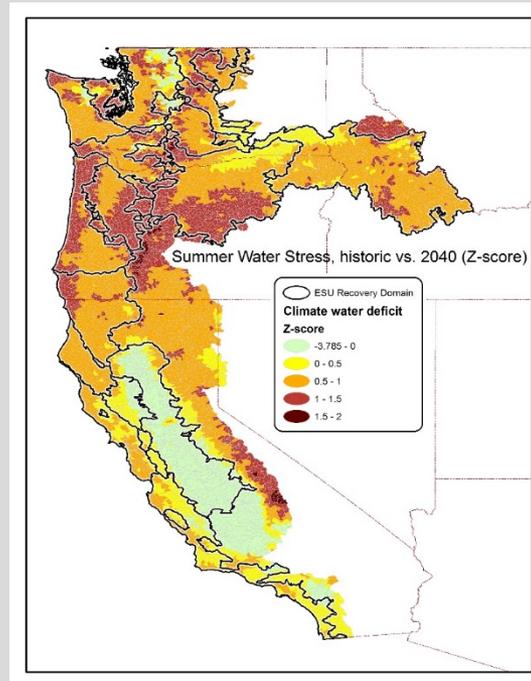
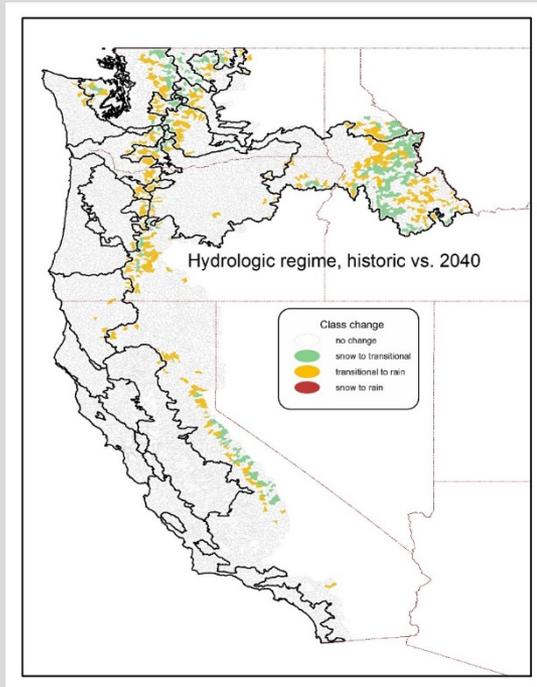
Wetted area: 1.7 km<sup>2</sup> (34%)

Pool area: 0.46 km<sup>2</sup> (24%)

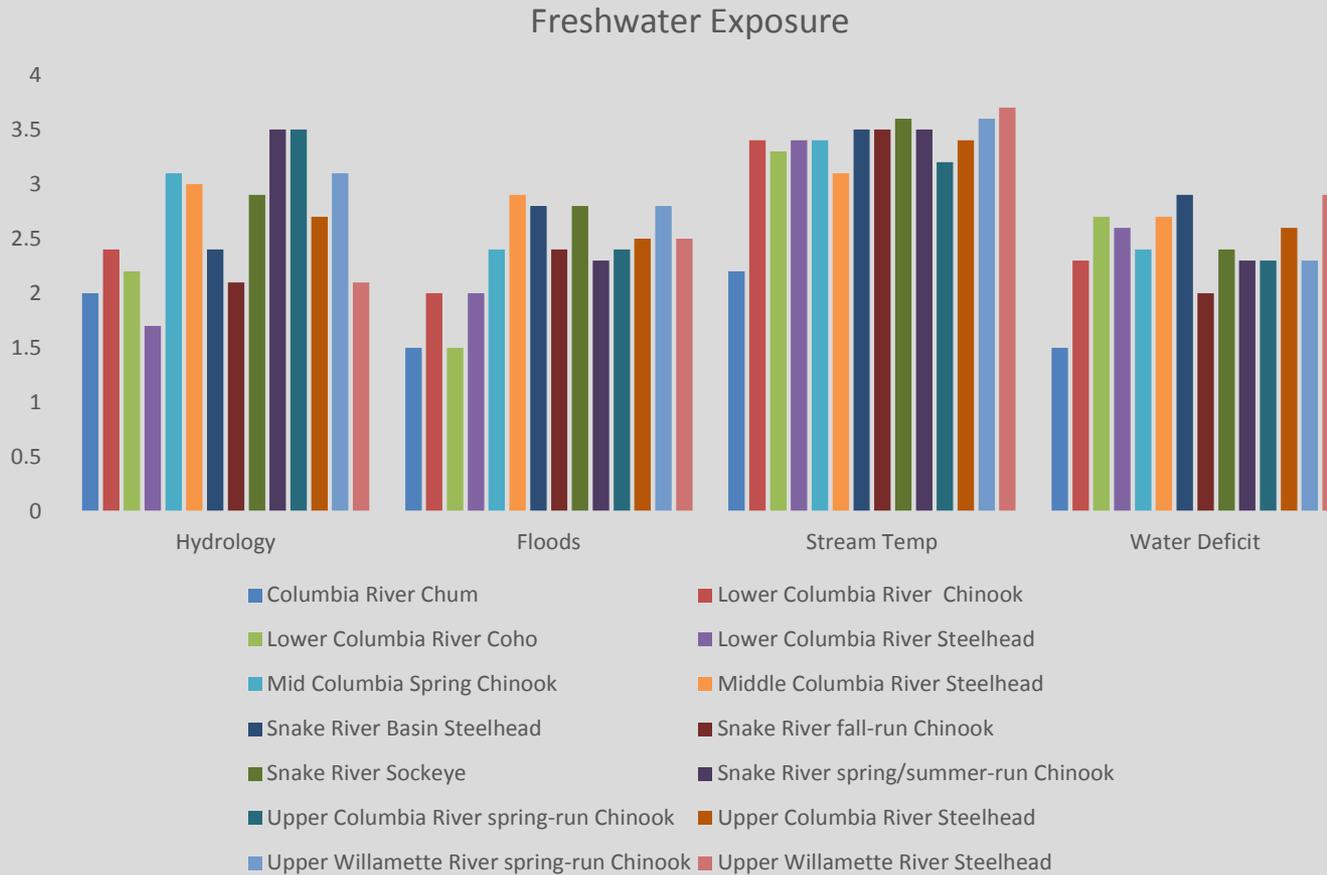
**Increase Over-  
Winter Productivity  
by 50%**



# Freshwater exposure factors



# Freshwater Exposure



# Relative risk by life stage by ESU

Columbia River ESUs

