Northwest **Power** and **Conservation** Council

July 7, 2020

MEMORANDUM

TO: **Fish and Wildlife Committee Members**

FROM: **Leslie Bach**

SUBJECT: **Life Cycle Modeling to Support the CRSO EIS and the FCRPS Biological Opinion**

BACKGROUND:

Presenter: Rich Zabel, NOAA-Fisheries

Summary: Rich Zabel from the Northwest Fisheries Science Center will provide an overview of the NOAA Fisheries life-cycle models for the Columbia River Basin. He will present a summary of model development and general applications as well as specific information on the results of modeling for the 2020 Columbia River System Operations Draft EIS and Federal Columbia River Power System Biological Opinion.

Relevance: Life-cycle modeling provides data and analyses that support measures in the Mainstem Hydrosystem Flow and Passage Operations sub-strategy of the 2014 Columbia River Fish and Wildlife Program to improve fish passage and survival through the hydrosystem. It also supports the Habitat sub-strategy by providing a method for evaluating the benefits of different habitat restoration actions on salmon and steelhead. Life-cycle modeling is a critical tool for implementing the adaptive management approach outlined in the 2014 Program.

Background: NOAA Fisheries developed and refined life-cycle models for the Columbia River hydropower system as part of several past FCRPS Biological Opinions. The life-cycle models were reviewed by the Independent Science Advisory Board (ISAB) in 2013 and again in 2017.

The models are intended to inform FCRPS analyses and decision makers about the influence of management actions on the recovery and viability of ESA-listed salmonids in the Columbia Basin. The models represent a combined effort from modeling teams consisting of scientists from NOAA's Northwest Fisheries Science Center, other federal, state, and tribal fish and wildlife agencies, and consulting firms.

More Info: Interior Columbia Basin Life-Cycle Modeling

ISAB Review of NOAA Fisheries Interior Columbia Basin Life-cycle Modeling

Life-cycle Models of Interior Columbia River Basin Spring/Summer-Run Chinook Salmon Populations

Characterizing Watershed-Scale Effects of Habitat Restoration Actions to Inform Life Cycle Models: Case Studies Using Data-Rich vs. Data-Poor Approaches

Life Cycle Modeling to support the CRSO EIS and the FCRPS Biological Opinion

NOAA FISHERIES

Northwest Fisheries Science Center

Rich Zabel

Fish Ecology Division Director

Northwest Fisheries Science Center

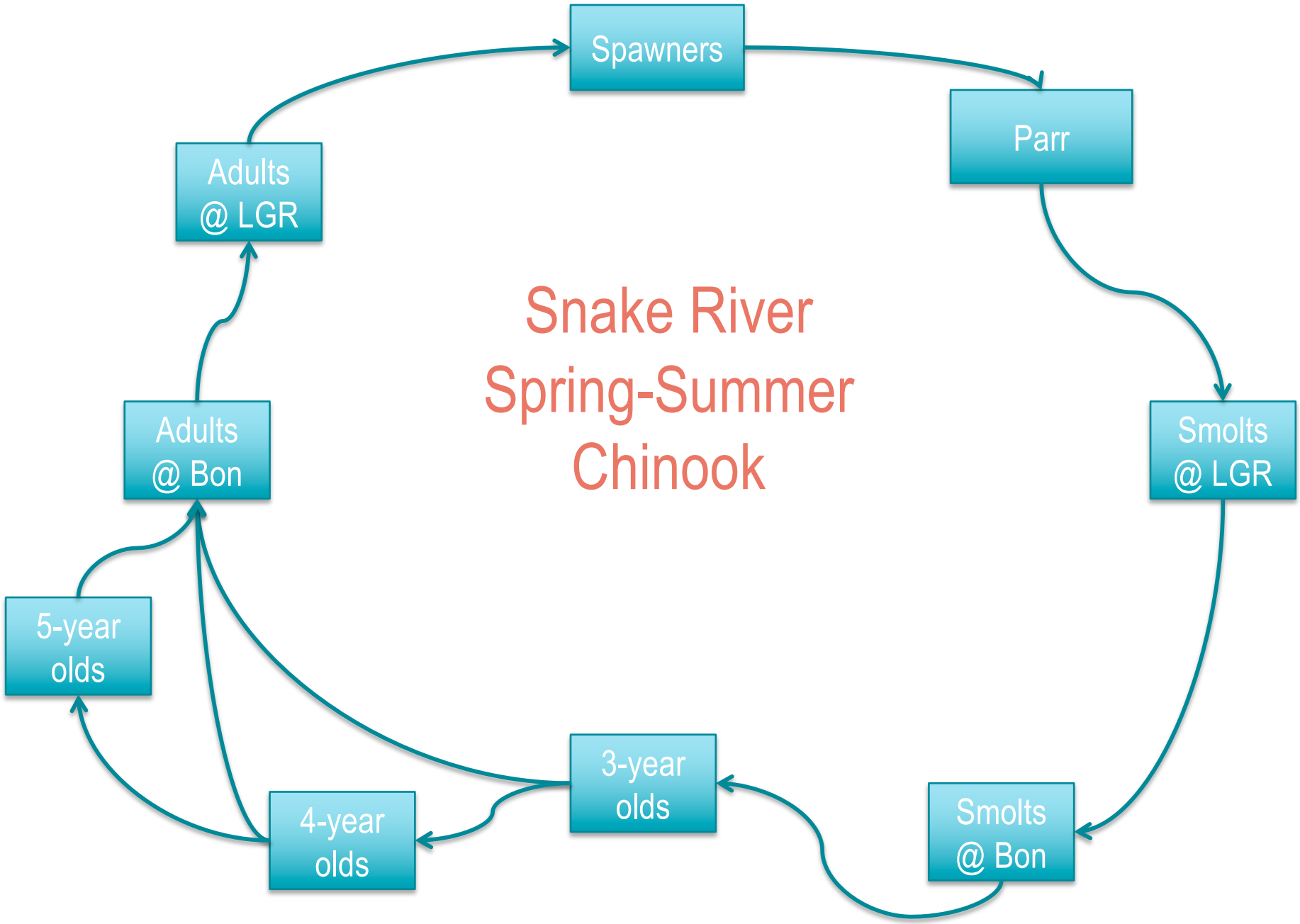
Northwest Power and Conservation Council

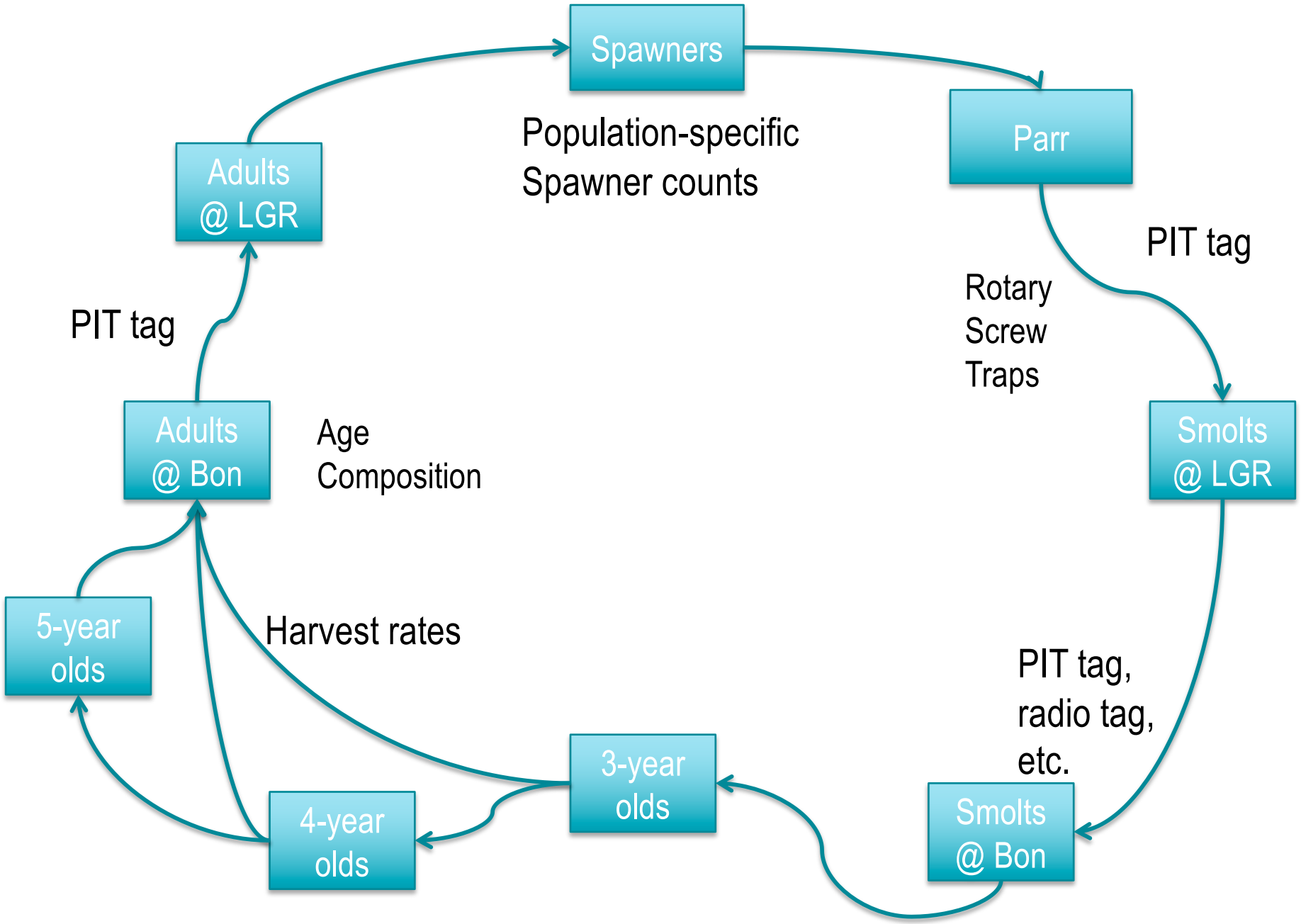
July 14, 2020

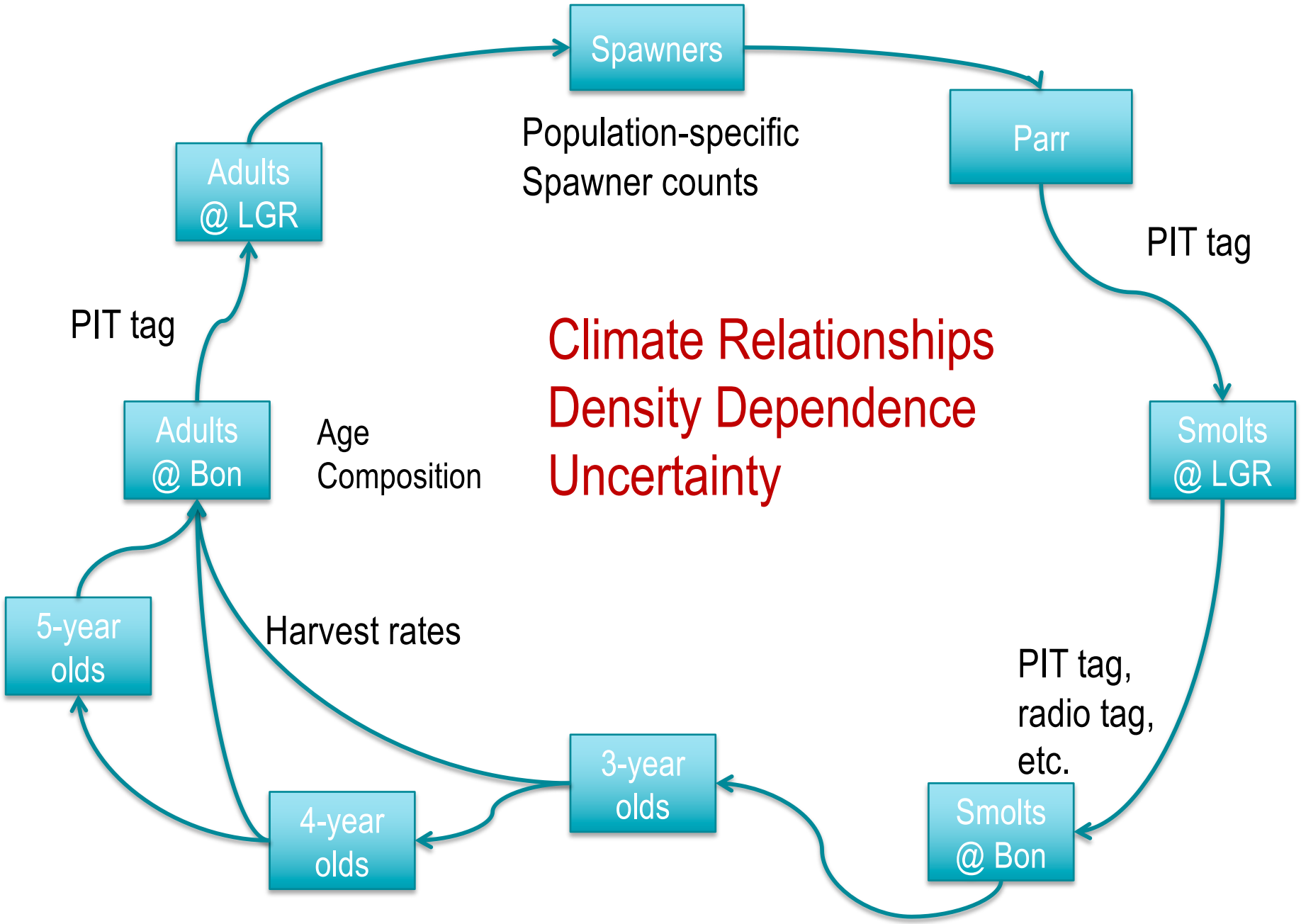
Outline

- Life Cycle Model Basics
- Hydro Modeling and the EIS
- Habitat Modeling and the 2019 BIOP
- Ocean Modeling and the 2020 BIOP
- Conclusions

Life Cycle Model Basics


Spawners
Parr
Smolts
@ LGR
Smolts
@ Bon
3-year
olds
4-year
olds
5-year
olds
Adults
@ Bon
Adults
@ LGR
Snake River
Spring-Summer
Chinook


Spawners
Population-specific
Spawner counts
Parr
PIT tag
Rotary
Screw
Traps
Smolts
@ LGR
PIT tag,
radio tag,
etc.
Smolts
@ Bon
3-year
olds
4-year
olds
5-year
olds
Harvest rates
Adults
@ Bon
Age
Composition
PIT tag
Adults
@ LGR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Adults
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Composition
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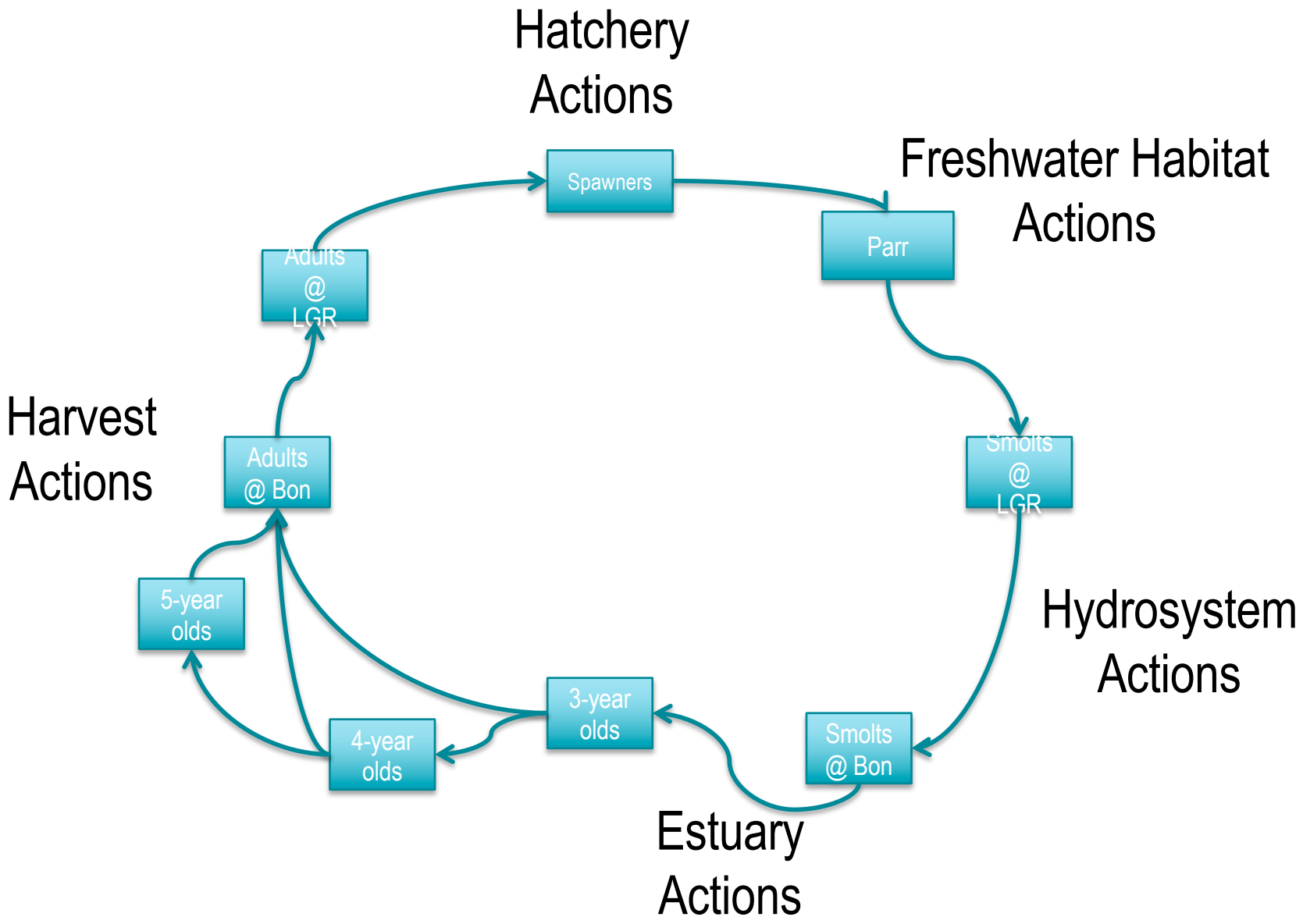
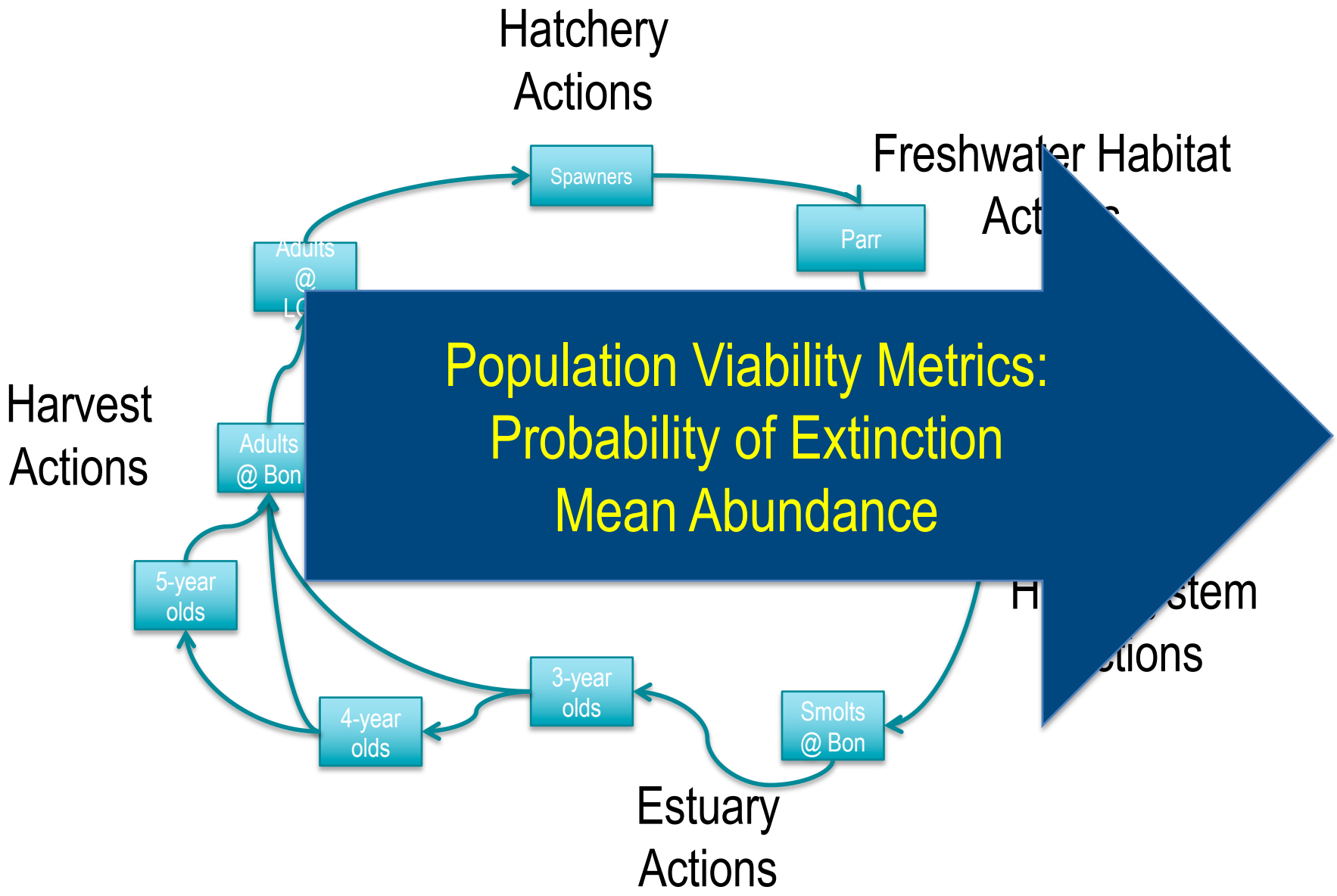
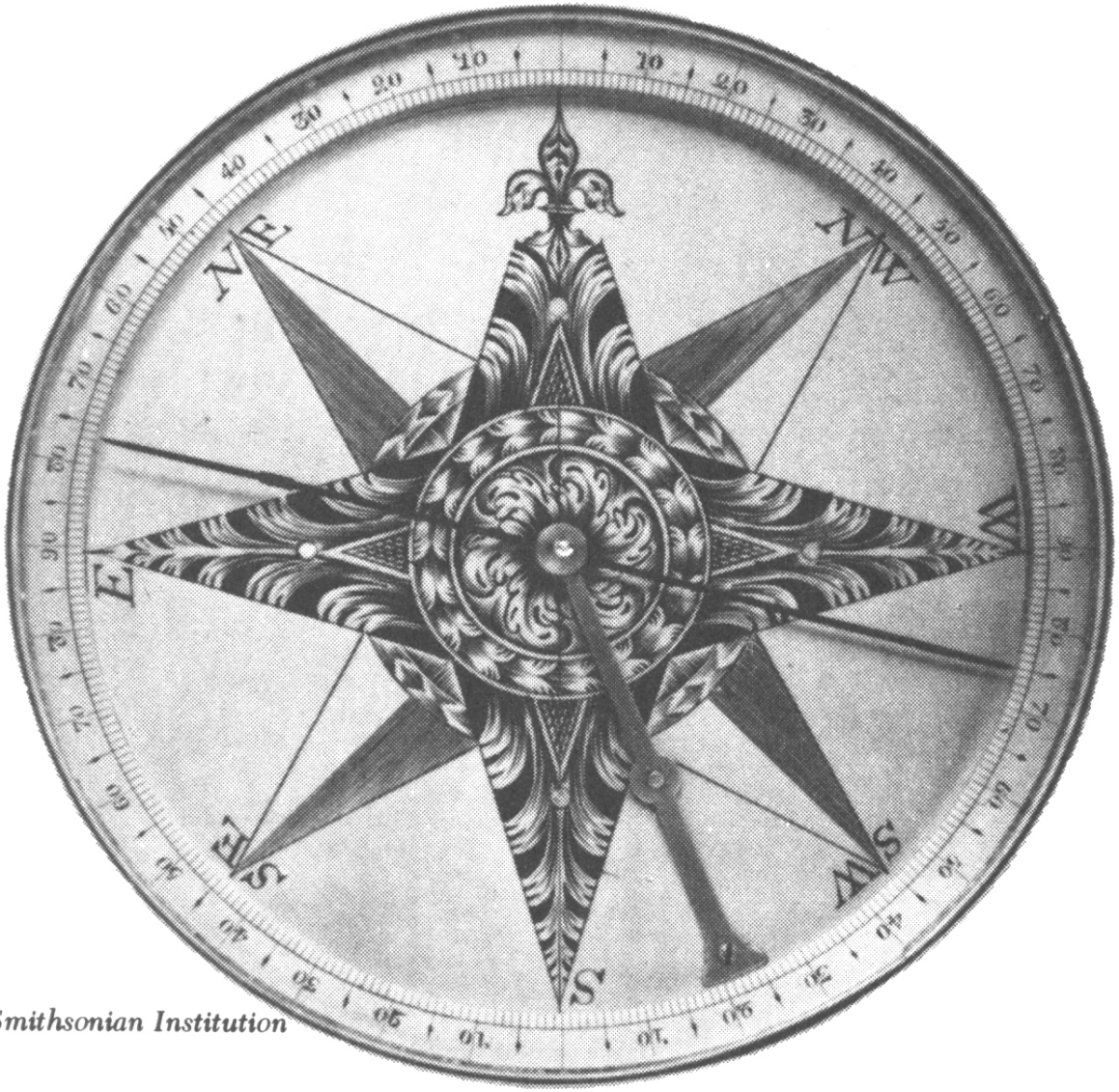
Adults
@ LGR
Climate Relationships
Density Dependence
Uncertainty


Hatchery Actions
Freshwater Habitat Actions
Harvest Actions
Hydrosystem Actions
Estuary Actions
Spawners
Parr
Smolts @ LGR
Smolts @ Bon
3-year olds
4-year olds
5-year olds
Adults @ Bon
Adults @ LGR


Hatchery Actions
Freshwater Habitat Act
Harvest Actions
Spawners
Parr
Adults @ LC
Adults @ Bon
Population Viability Metrics:
Probability of Extinction
Mean Abundance
5-year olds
3-year olds
4-year olds
Smolts @ Bon
Estuary Actions

Hydro Modeling and the CRSO EIS

Comprehensive Passage (COMPASS) Model



Zabel et al. 2008. Hydrobiologia

COMPASS Model Inputs (Daily to Hourly time steps)

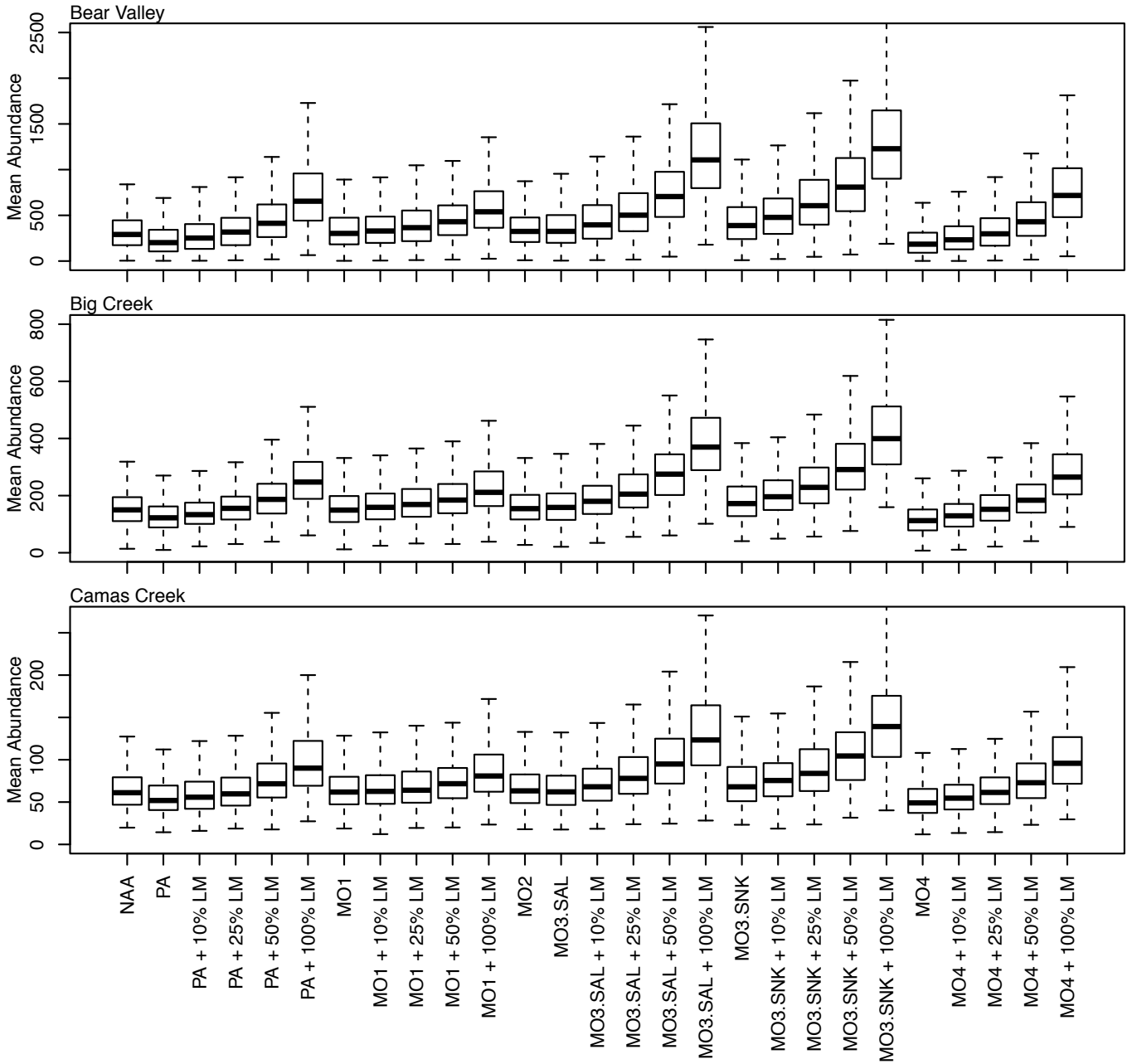
- Migration Timing and Distribution
- Reservoir Elevations, River Flows, and Spill Levels
- River Temperatures
- Route-Specific Passage and Survival Rates
- Spill Efficiency
  - Proportion of smolts passing via the spillway for a given percentage of spill
- Fish Guidance Efficiency
  - Proportion of smolts entering a turbine intake screened into the juvenile bypass system
- Calibrated using PIT tag, Acoustic Tag, and Radio Tag data

COMPASS Model Outputs for LCMs

- Smolt Survival
  - Inriver smolts
  - Transported smolts
- Smolt Arrival Time at Bonneville
- Per Cent Transported

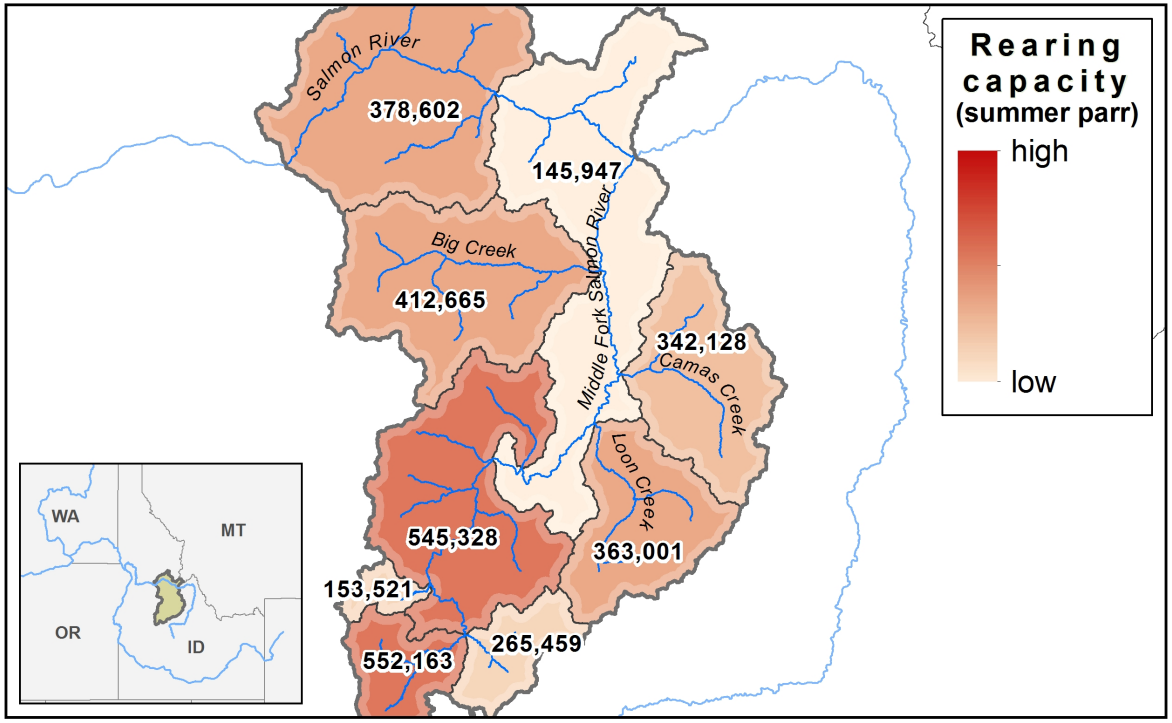
- Latent Mortality Assumptions

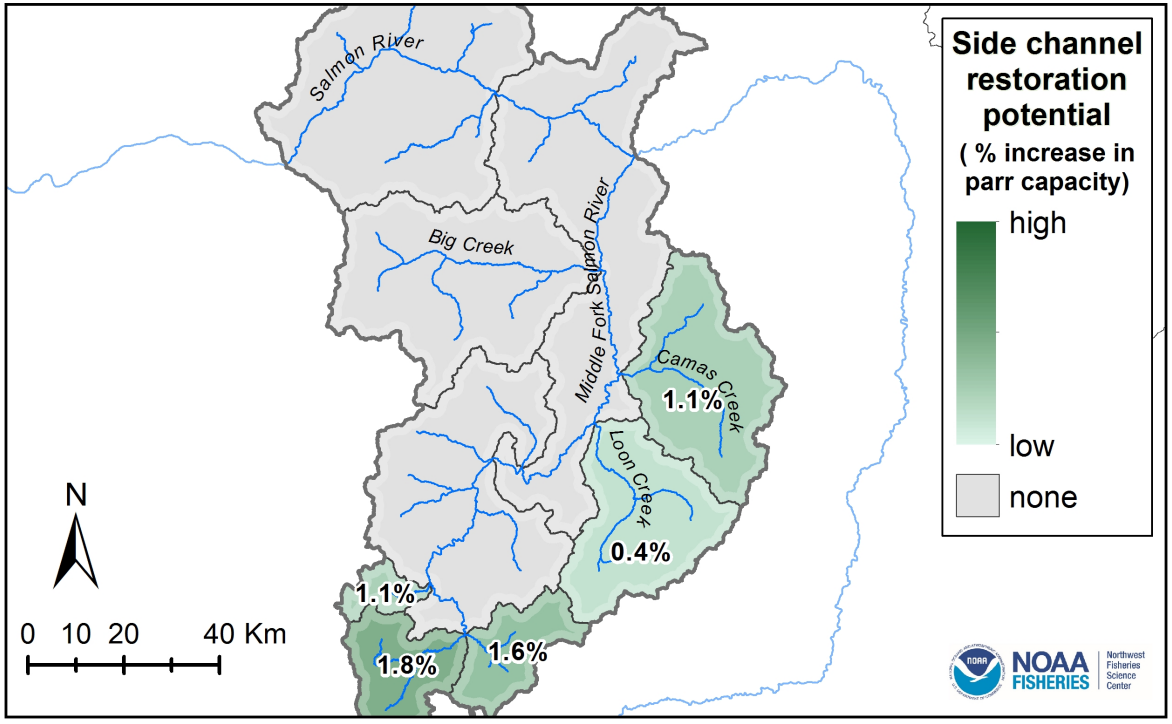
Hydro CRSO EIS Scenarios: Middle Fork MPG; 1/21/2020; Years = 24



Habitat Modeling and the 2019 BIOP

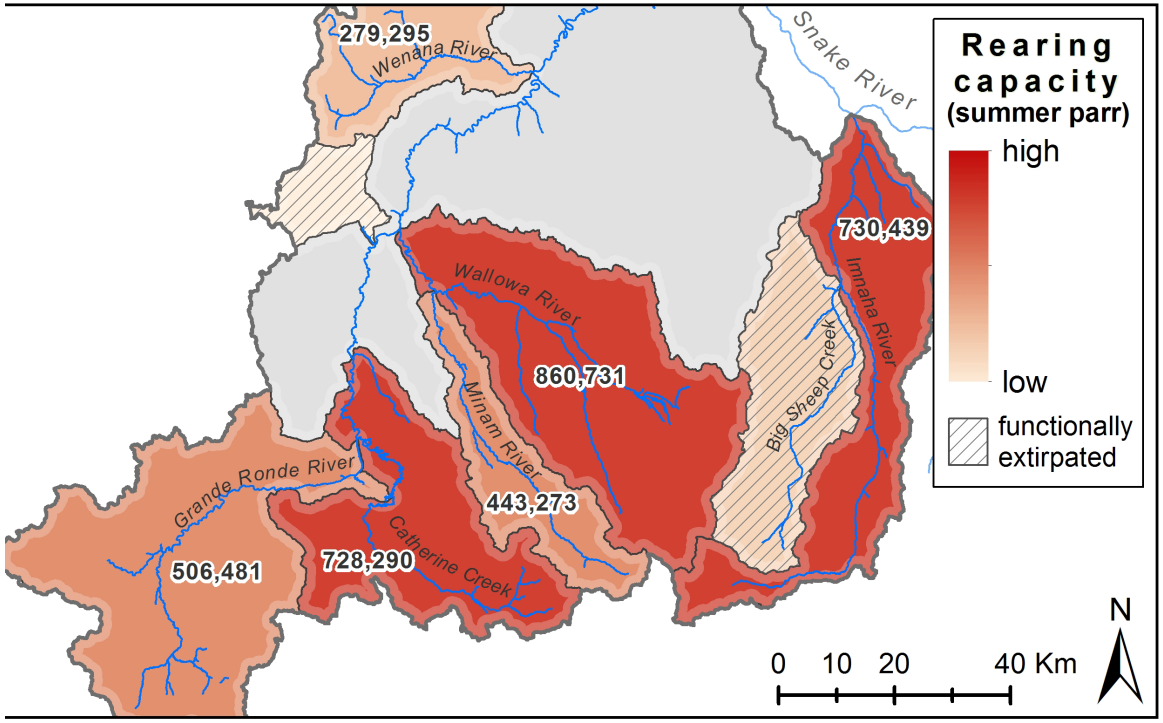
Middle Fork Salmon Spring Chinook MPG

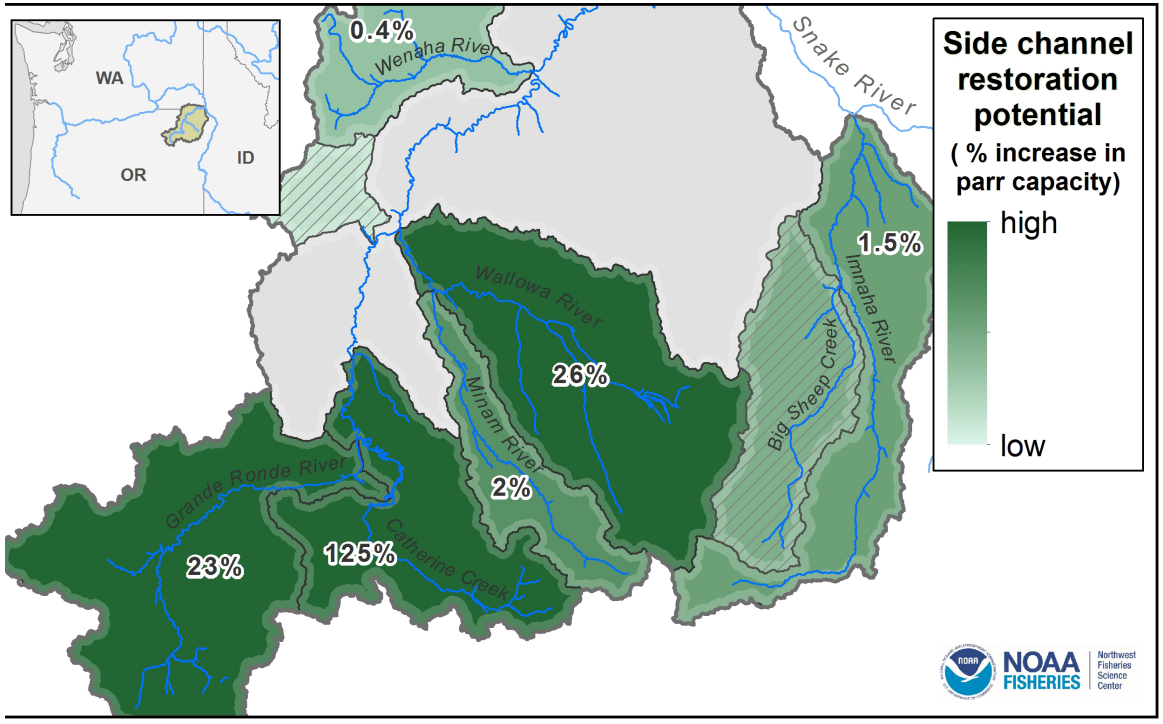




Bond et al. 2019. Can. J. Fish Aquatic Sci

Grande Ronde/Imnaha Spring Chinook MPG

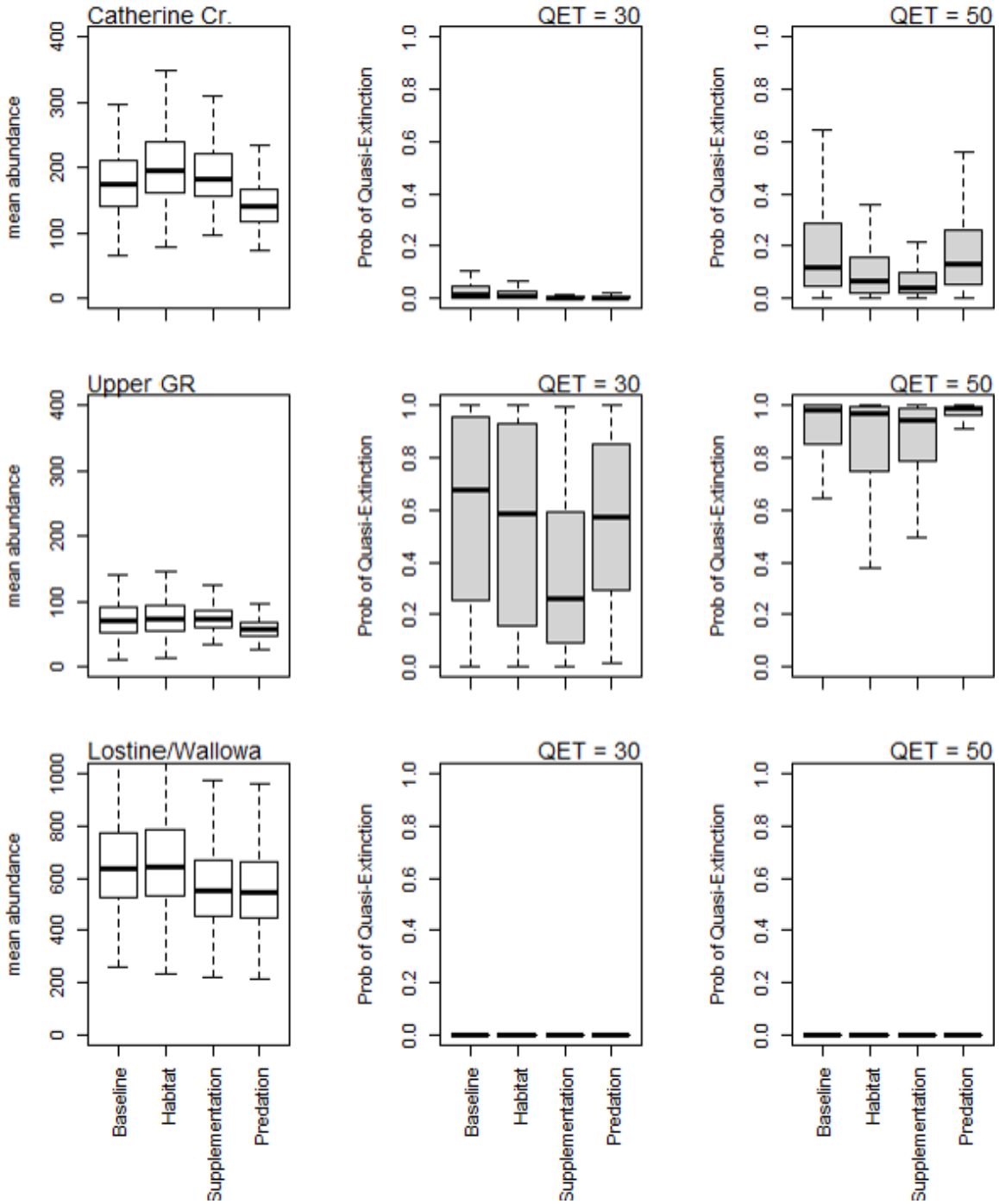




Bond et al. 2019. Can. J. Fish Aquatic Sci

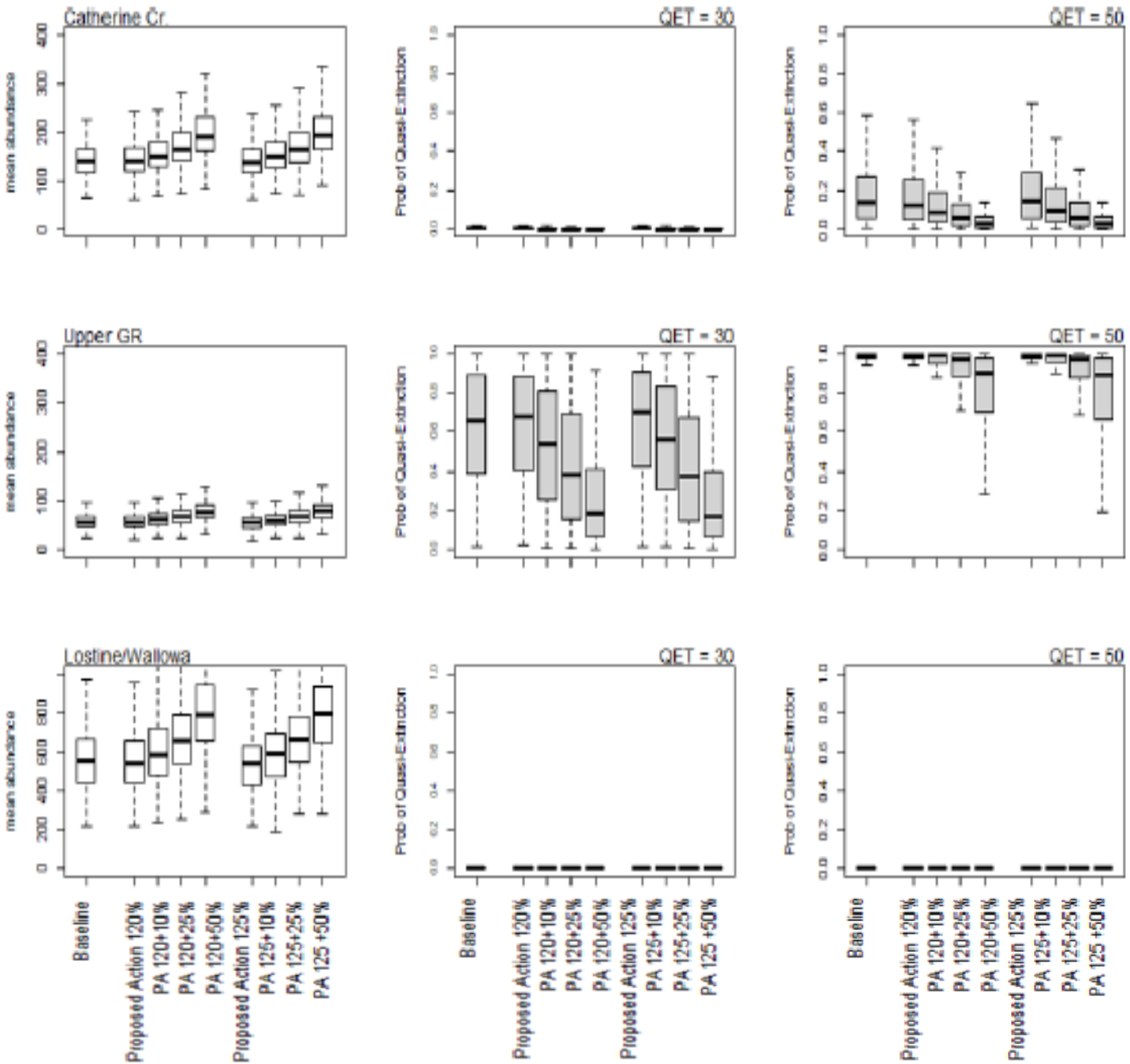
Life Cycle Modeling: 2019 Columbia River System BiOp

- Snake River spring/summer Chinook salmon
  - 4 MPGs; 20 populations
  - Mean Abundance (24 years)
  - Quasi-Extinction Risk (<30 and 50 adults for 4 consecutive years)
- Environmental Baseline (pg. 785-791)
  - Past Tributary Habitat Actions
  - Hatchery Supplementation (where applicable)
  - Pinniped Predation
- Proposed Action (pg. 816-837)
  - Hydro Action (120% Flex Spill and 125% Flex Spill)
  - Tributary Enhancement Actions
  - Latent Mortality (10%, 25%, 50% improvements in productivity)



Example:

Past Tributary Habitat Actions, Hatchery Supplementation (where applicable), and Pinniped Predation



Example:

Proposed Hydro Action and assessment of potential productivity increases (from reduced latent mortality)

Climate Change and the 2020 BIOP

We modeled Climate Change at 4 life stages

Parr to Smolt
Hydrosystem (Downstream)
Ocean
Hydrosystem (Upstream)

Crozier et al. In Review. *Communications Biology*
Chasco et al. In Review. Plos One.

Overall Conclusions

- Latent Mortality is a critical uncertainty
- Habitat Actions can be effective
- Climate Change in the Ocean Important

Thanks!

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