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

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
Snake River Spring-Summer Chinook

Spawners

Parr

Smolts @ LGR

Adults @ LGR

Adults @ Bon

5-year olds

4-year olds

3-year olds

Smolts @ Bon
Spawners

Population-specific Spawner counts

Spawners

Parr

PIT tag

Rotary Screw Traps

Smolts

PIT tag, radio tag, etc.

Smolts

Adults @ LGR

PIT tag

Adults @ Bon

Age Composition

Harvest rates

5-year olds

4-year olds

3-year olds

Smolts @ Bon
Climate Relationships
Density Dependence
Uncertainty

Population-specific Spawner counts

Spawners

Parr

Smolts @ Bon

Smolts @ LGR

Adults @ Bon

Adults @ LGR

5-year olds

4-year olds

3-year olds

Harvest rates

Age Composition

PIT tag

PIT tag, radio tag, etc.

NOAA FISHERIES
Spawners

Parr

Smolts

LGR

Smolts

Bon

Adults

3-year olds

199

Adults

4-year olds

5-year olds

Freshwater Habitat Actions

Hydrosystem Actions

Estuary Actions

Harvest Actions

Hatchery Actions

Adults @ LGR

Adults @ Bon

3-year olds

4-year olds

5-year olds

Smolts @ LGR

Smolts @ Bon

NOAA FISHERIES
Spawners
Parr
Smolts

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

Population Viability Metrics:
Probability of Extinction
Mean Abundance

Climate Variability
Climate Change
Density Dependence

Population Viability Metrics:
Probability of Extinction
Mean Abundance
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
Grande Ronde/Imnaha Spring Chinook MPG

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*
Overall Conclusions

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