April 5, 2022

MEMORANDUM

TO: Fish and Wildlife Committee Members

FROM: Leslie Bach

SUBJECT: Study of migrant juvenile salmonid survival and travel time, 1993-present

BACKGROUND:

Presenter: Dr. Steven G. Smith, NOAA-Fisheries, NW Fisheries Science Center

Summary: Dr. Smith will provide an update on the estimates of reach survival and travel time for juvenile salmonids through the Snake and Columbia River dams. He will describe the data collection and analysis, and discuss current conditions and longer-term trends.

Relevance: This work is conducted under Council Project Number 1993-029-00, “Survival Estimates for the Passage of Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs”. It 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.

Background: In 1993, the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the University of Washington (UW) began research to determine survival and travel-time characteristics of PIT-tagged wild and hatchery reared juvenile salmonids migrating through Snake River dams and reservoirs. Objectives of the research include providing estimates of smolt travel time and survival through the Snake and Columbia Rivers,
relating annual estimates of smolt travel time and survival to migration conditions, and relating annual estimates of smolt travel time and survival with adult returns. Annual information on temporal changes in juvenile survival and migration timing provides important information to help evaluate the effectiveness of structural and operational changes at Snake and Columbia River dams. The reach and project survival information gained from this study has been instrumental in focusing research and mitigation efforts throughout the hydropower system.


Survival Estimates for the Passage of Spring-migrating Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs, 2020
Study of migrant juvenile salmonid survival and travel time, 1993-present

Briefing for NW Power and Conservation Council
Fish and Wildlife Committee
April 12, 2022

Steven G. Smith
steven.g.smith@noaa.gov
Council Project 1993-029-00: “Survival Estimates for Juvenile Salmonids”
Spillway PIT Detection at Lower Granite Dam

Low-frequency antennas embedded in the spillway activate PIT tags implanted in juvenile fish, which return their data within 30 milliseconds.
Estimated proportion detected of passing PIT-tagged Snake River yearling Chinook
Downstream of Bonneville Dam
Outline – Smolt Survival

• Migration conditions, travel time and survival of PIT-tagged smolts through the hydropower system in 2021
  
  - Preliminary Results Memo: October 7, 2021 – no bird recovery data
  - Today – bird recovery data from estuary included
  - Annual Report to BPA in prep
    – potential to include mid-river bird recovery data
  
  - Only those fish left to migrate in-river
  
  - Only juvenile data, not survival to adult
2021 Spring Conditions

- Flow well below average throughout season
- Water temperature above average most of season
- Record high spill percentage
- Moderate dissolved gas, probably because of low flow
2021 Spring Migration

• **Travel times**
  - Slightly shorter than in other recent low-flow years

• **Less than 10% transported**

• **Very low numbers passed dams via juvenile bypass systems**
  - Low PIT-tag detection probabilities (data quality diminished)
  - Low numbers collected for transportation
2021 Spring Survival Estimates

- Snake River Yearling Chinook: Near average
- Snake River Steelhead: Below average
- Columbia River Yearling Chinook and Steelhead:
  - Below average, both to McNary Dam and in lower Columbia
- McNary-to-Bonneville below average for multiple stocks
- Generally imprecise because of low detection rates
  - some >100%, likely for same reason
Steelhead Travel Time 1997-2021 (exc. 2001)
Lower Granite to Bonneville (461 km)
Yearling Chinook
Snake River Basin Hatcheries
Mean of Index Groups

Survival – Release to LGR

Migration Year


\( \bar{X} = 65.1\% \)

73.3%
Yearling Chinook
Upper Columbia River Hatcheries
Mean of Index Groups

<table>
<thead>
<tr>
<th>Migration Year</th>
<th>Survival - Release to MCN</th>
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<tbody>
<tr>
<td>2000</td>
<td>0.2</td>
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<tr>
<td>2003</td>
<td>0.3</td>
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<tr>
<td>2006</td>
<td>0.4</td>
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<td>2009</td>
<td>0.5</td>
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<td>2012</td>
<td>0.6</td>
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<td>2015</td>
<td>0.7</td>
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<td>2018</td>
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<td>2021</td>
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\( \bar{X} = 56.5\% \)
Yearling Chinook

Estimate Survival: MCN to BO

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<tbody>
<tr>
<td>Survival</td>
<td>0.3</td>
<td>0.4</td>
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<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
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Mean: $\bar{X} = 72.1$

McNary to Bonneville

Fish from Snake River

Steelhead

Mean: $\bar{X} = 70.3$

Mean: $\bar{X} = 60.0$
Yearling Chinook

Snake River Trap to Bonneville

Steelhead

Estimated Survival -- SnkTrp to X = 49.1

Migration Year

Migration Year
Snake River Sockeye: Estimated Survival

Redfish Lake Trap to Lower Granite (RLCTRP to LGR)

Lower Granite to McNary (LGR to MCN)

McNary to Bonneville (MCN to BON)

Lower Granite to Bonneville (LGR to BON)

Migration Year

Survival Rates:
- RLCTRP to LGR: X = 50.2%
- LGR to MCN: X = 68.8%
- MCN to BON: X = 61.3%
- LGR to BON: X = 44.9%
Columbia River Sockeye: Estimated

Rock Island to McNary

Migration Year


X = 75.8%

McNary to Bonneville

Migration Year


X = 62.2%

Rock Island to Bonneville

Migration Year


X = 47.3%
Almost 30 Years of Survival Study

- Warming of river is evident in data
- Increase in spill percentage over years
- Smolt travel times reduced
- No unequivocal long-term trends in smolt survival
Estimated proportion detected of passing PIT-tagged Snake River yearling Chinook

![Graph showing detection probability for different locations and years.](image-url)
Consequences of (Very) Low PIT-Tag Detection Rates

- Less information means generally lower precision in all estimates

- Analytical measures taken to get broad-scale estimates
  - Adjustments for finer scales not possible

- Lost Resolution
  - Subsets of smolts (e.g. wild vs hatchery; LGR spillway-detected vs. bypass-detected)
  - Some one-project reaches extremely imprecise
  - Temporal resolution degraded; virtual release groups must be pooled over longer periods
  - More difficult to investigate effects of seasonally changing conditions
    - “2021 is basically worthless for the COMPASS model” – J. Faulkner
Consequences of (Very) Low PIT-Tag Detection Rates

- Increased spill is intended to benefit fish, but the current information environment decreases power to understand the actual effect
  - Difficult to demonstrate a benefit
  - Difficult to recognize if harm is being done inadvertently
Acknowledgments

• Bonneville Power Administration

• Northwest Power and Conservation Council

• PTAGIS – Pacific States Marine Fisheries Commission

• Avian Predation Detection Project
  - Real Time Research -- Astoria-Megler Bridge etc.
  - Corps of Engineers Fish Field Units – East Sand Island

• DART – University of Washington Columbia Basin Research

• NOAA Colleagues: Jim Faulkner, Dan Widener

• Legions of Taggers, Coordinators, Agencies, etc.
Questions