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

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**Ginny Burdick**  
Oregon

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Oregon

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.

More Info: [NPCC19-1993-029-00 - Survival Estimates for the Passage of Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs](#)

[Survival Estimates for the Passage of Spring-migrating Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs, 2020](#)



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Science Center**

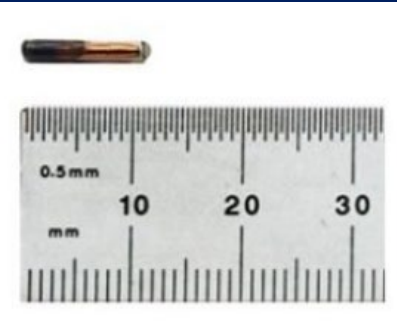
# Study of migrant juvenile salmonid survival and travel time, 1993-present

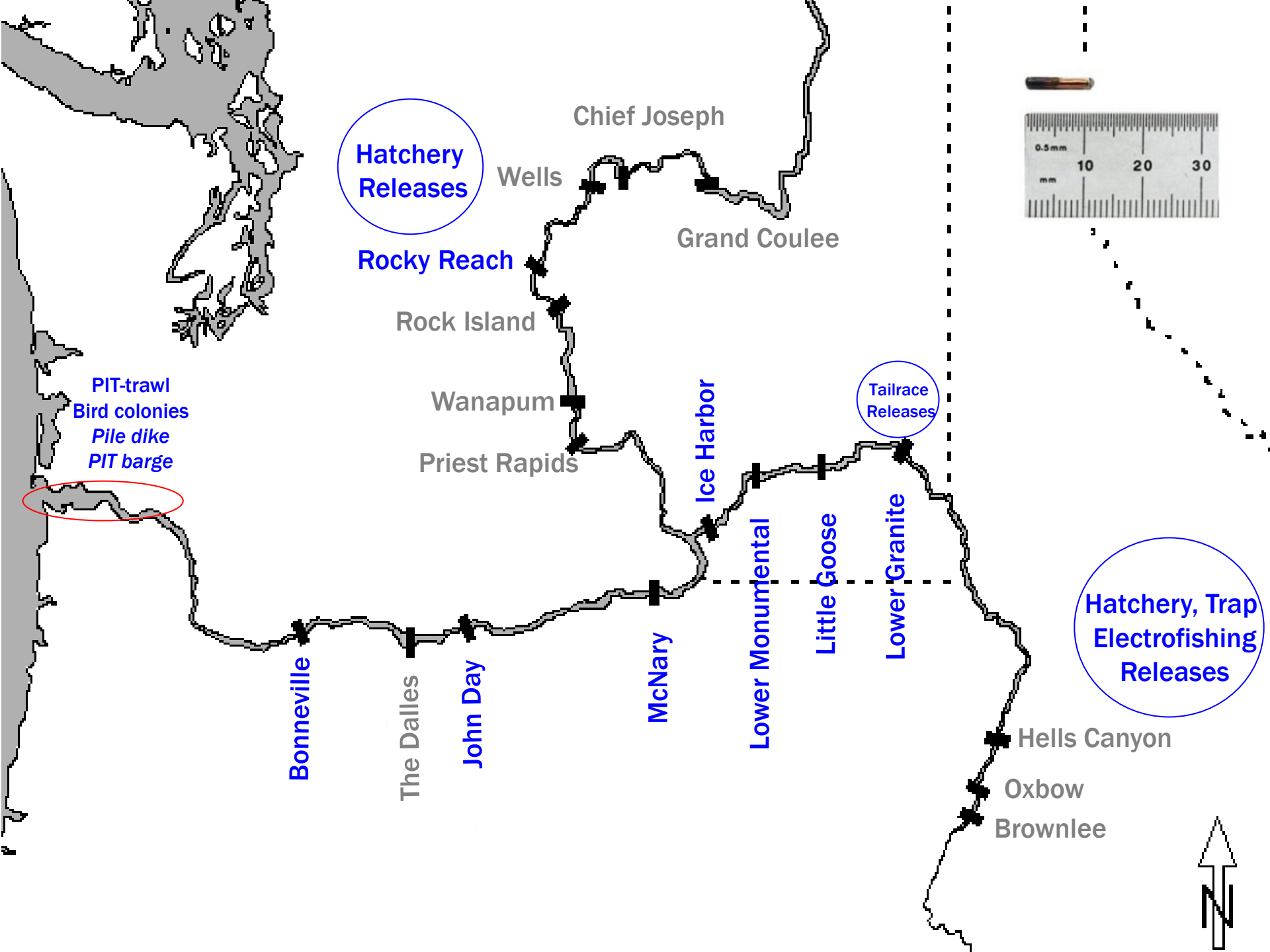
Briefing for NW Power and Conservation Council  
Fish and Wildlife Committee

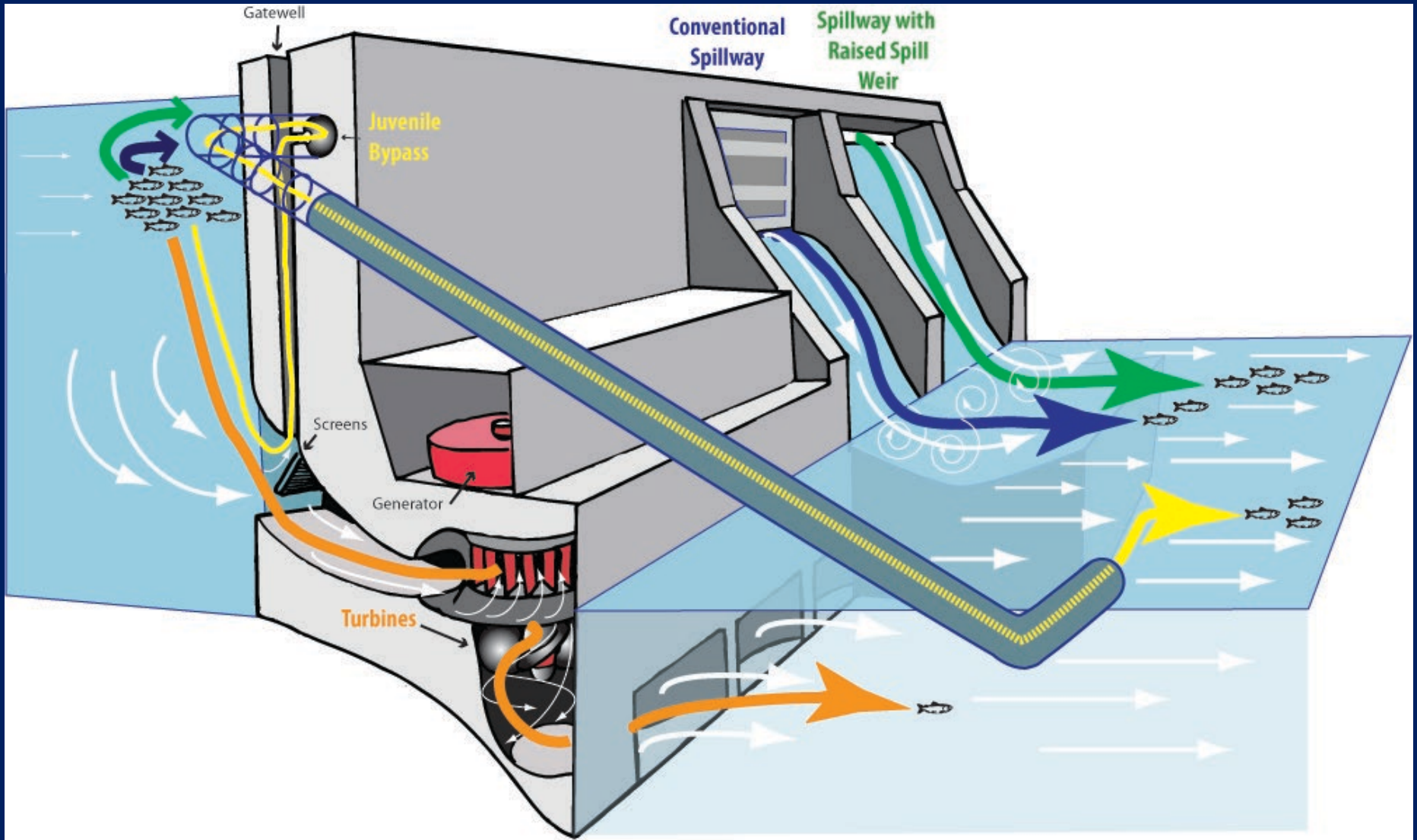
April 12, 2022

Steven G. Smith  
[steven.g.smith@noaa.gov](mailto:steven.g.smith@noaa.gov)

# Council Project 1993-029-00: "Survival Estimates for Juvenile Salmonids"





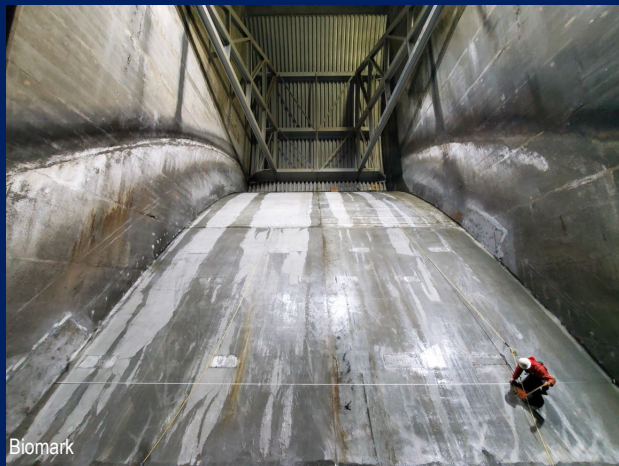
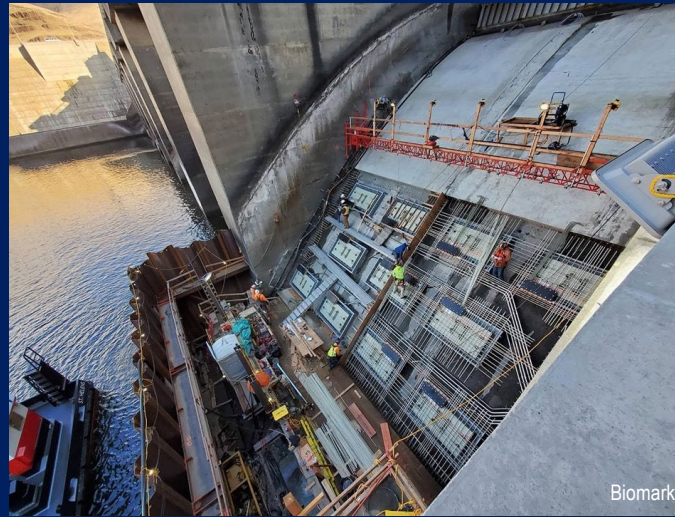
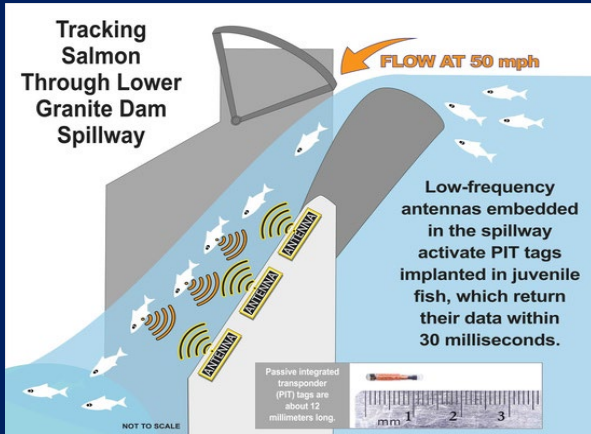




**NOAA FISHERIES**

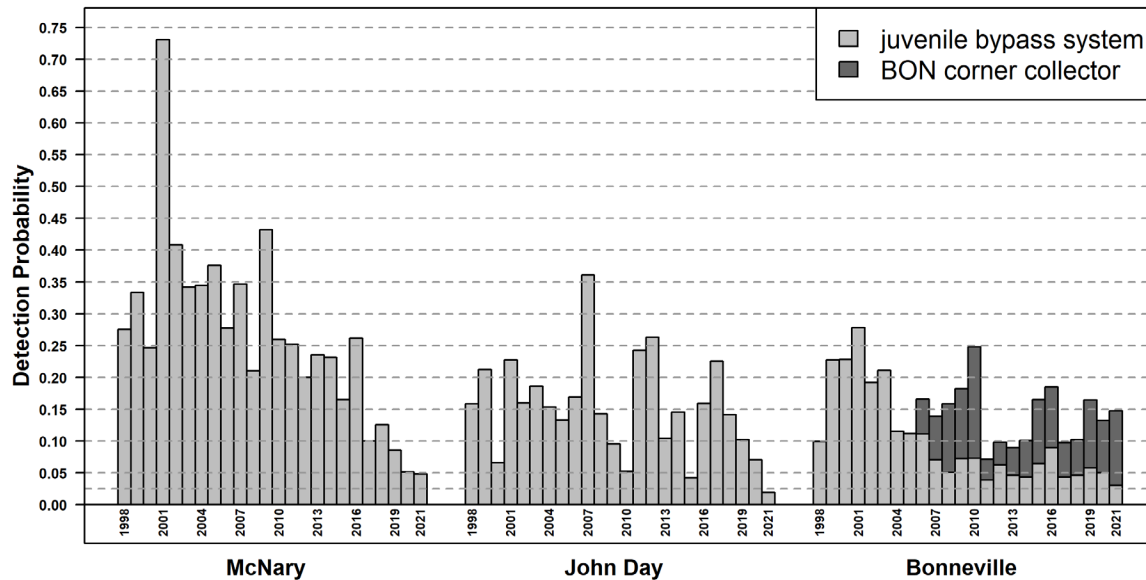
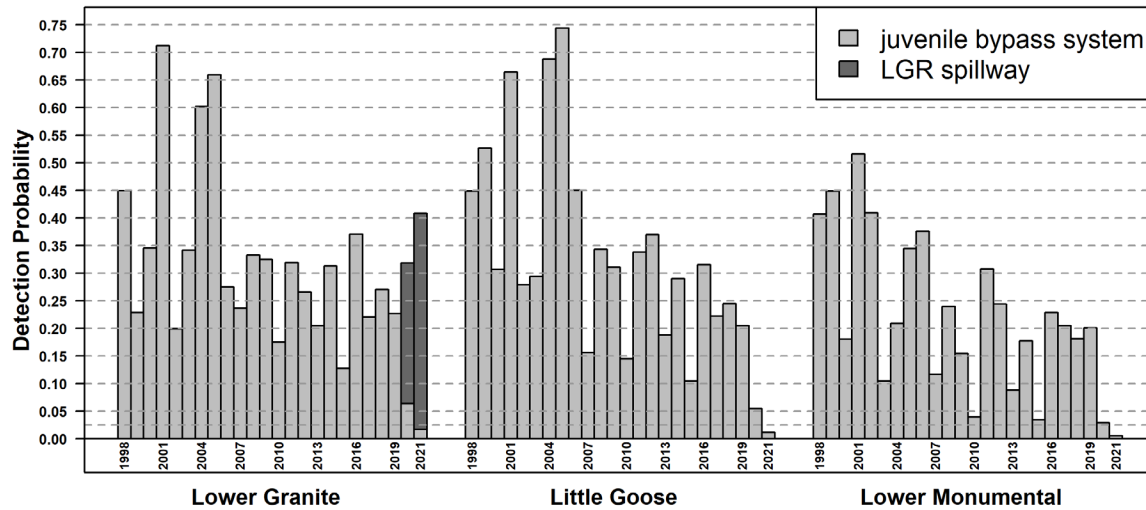
U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Northwest Fisheries Science Center

# Spillway PIT Detection at Lower Granite Dam





# 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

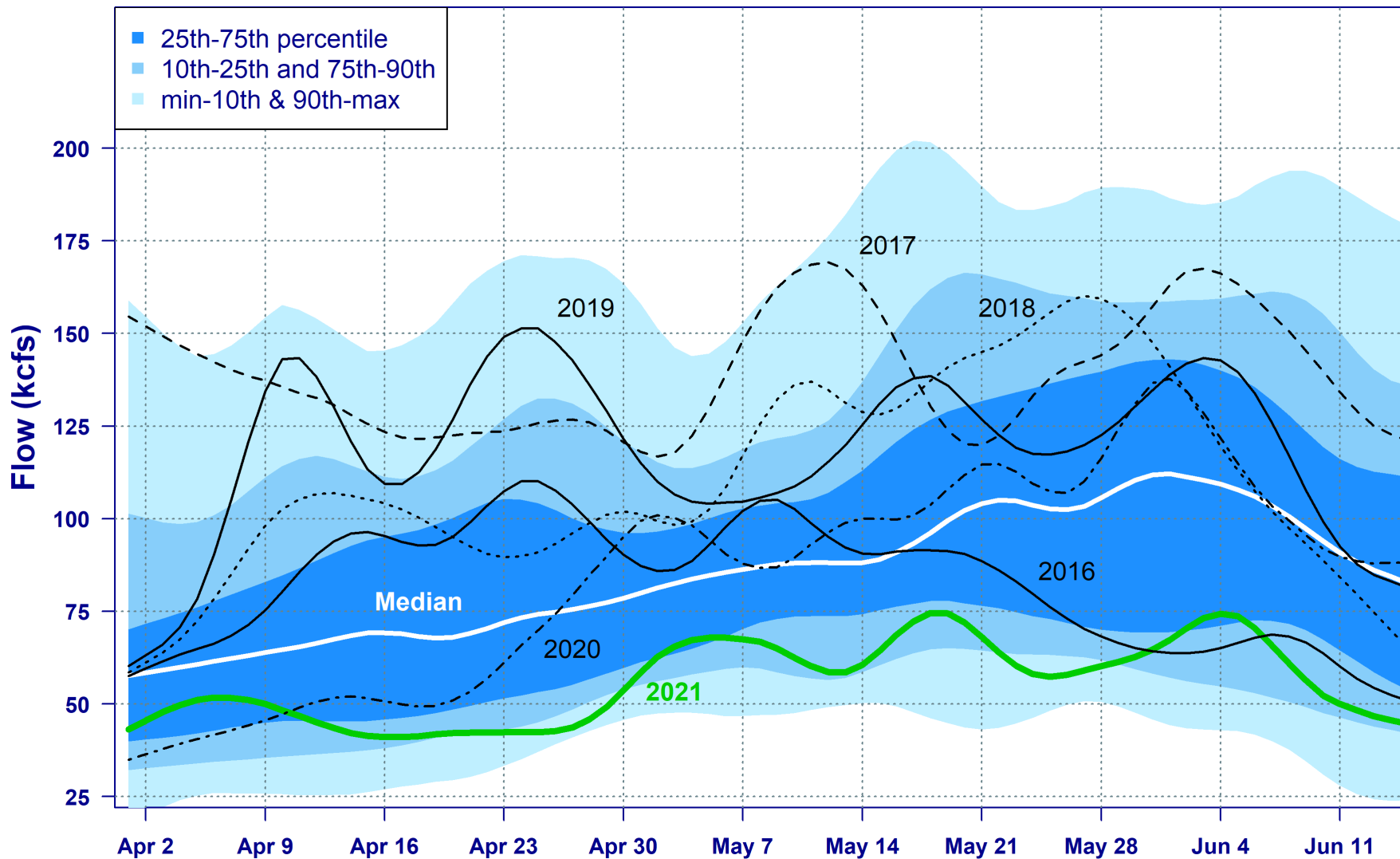
# 2021 Spring Migration

- 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

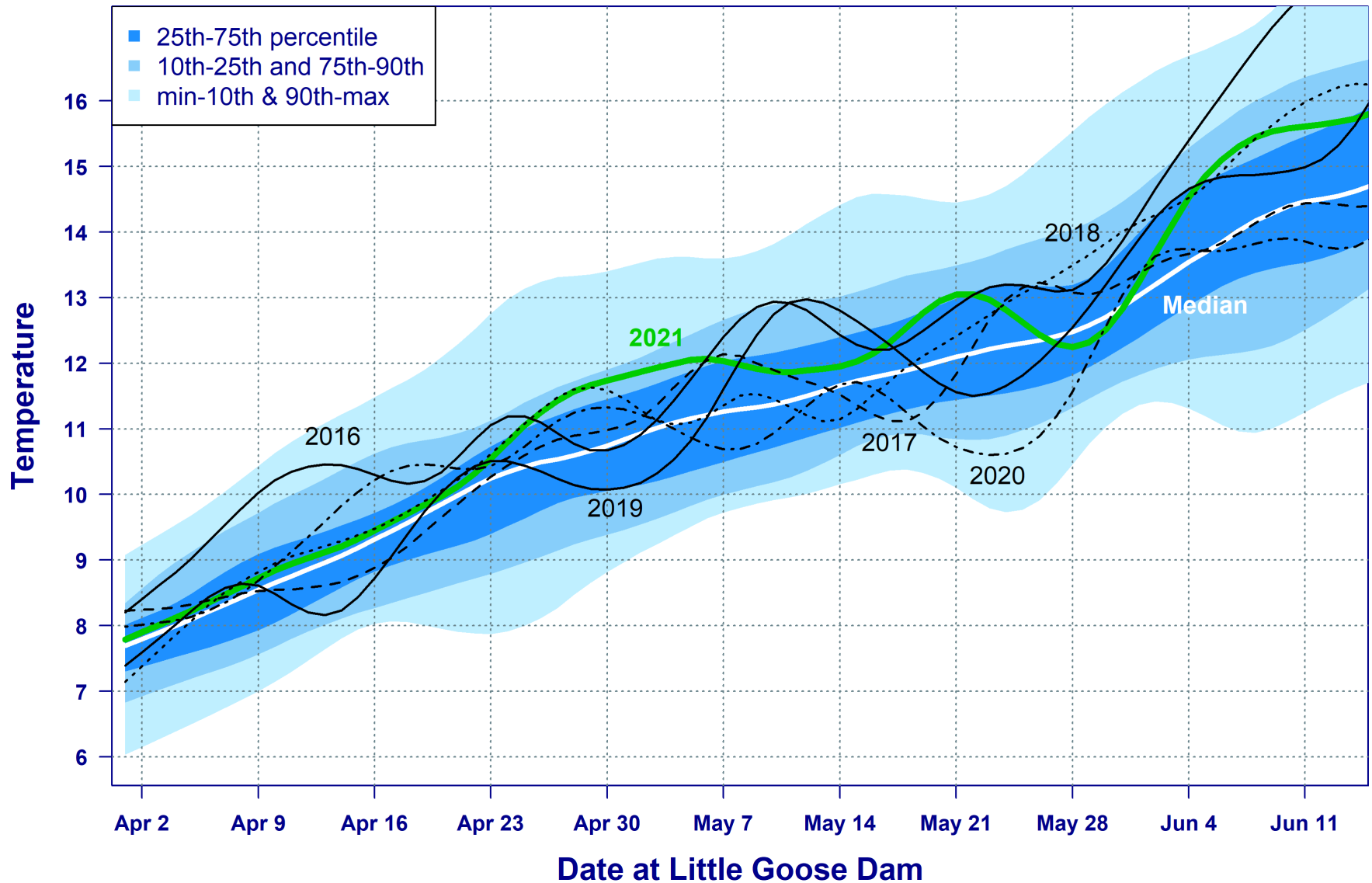
# 2021 Spring Survival Estimates

- 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

# Daily Flow (kcfs) 1989-2021 Little Goose Dam



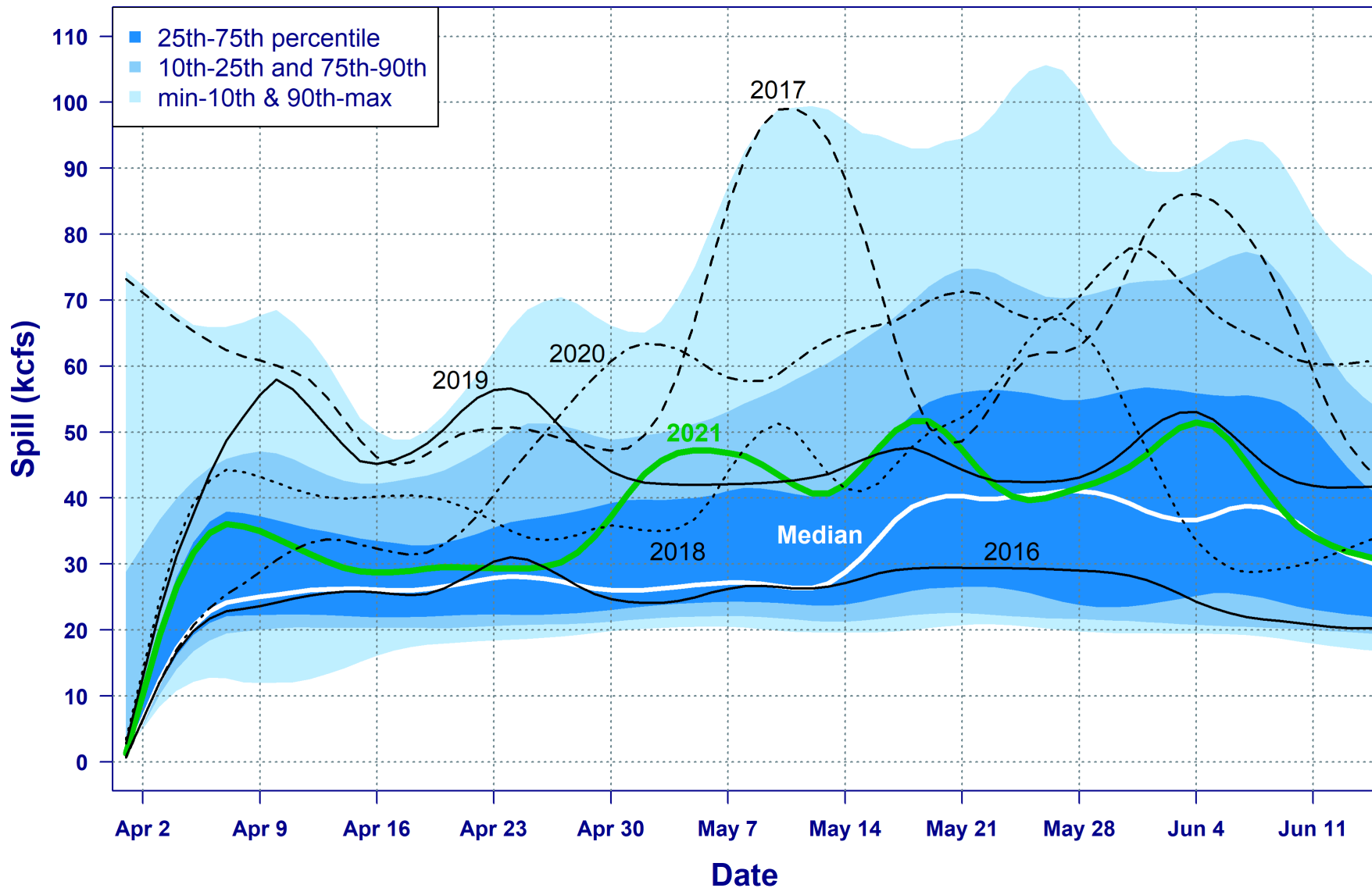
# Daily Temperature 1990-2021 Little Goose Dam



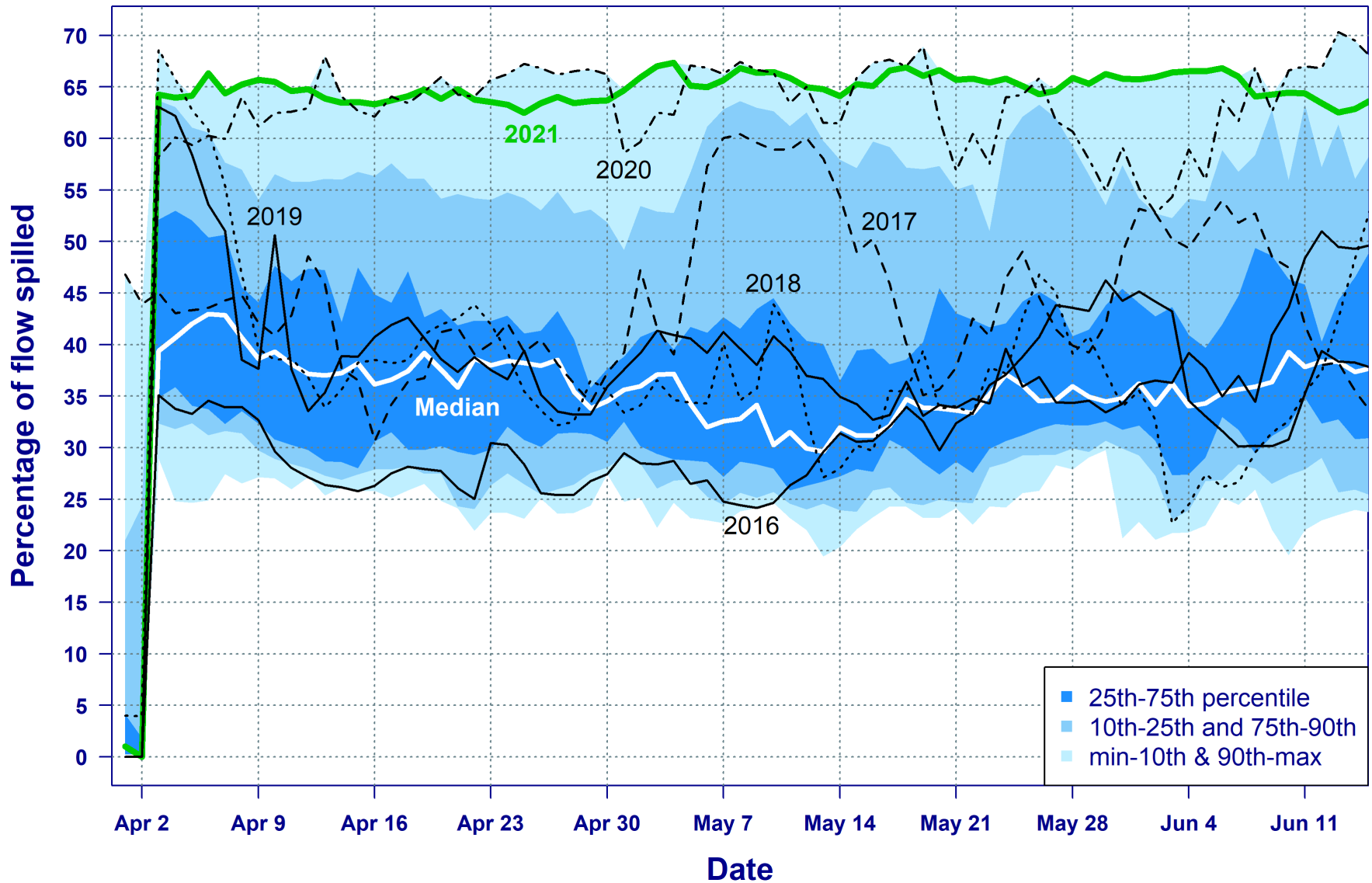


# Daily Spill (kcfs) 2006-2021

## Mean LGR, LGS, LMN

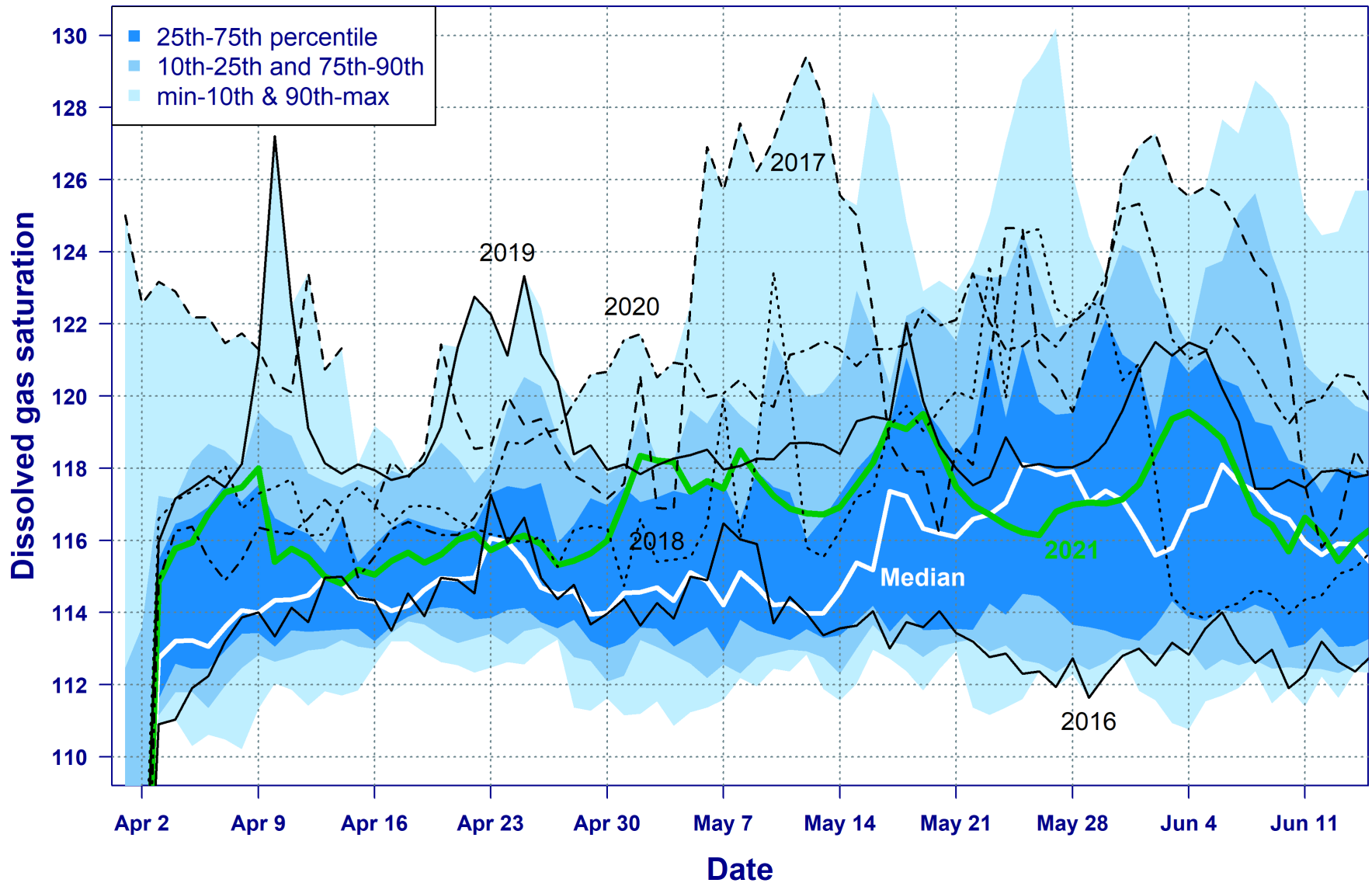


# Daily %Spill 2006-2021 Mean LGR, LGS, LMN

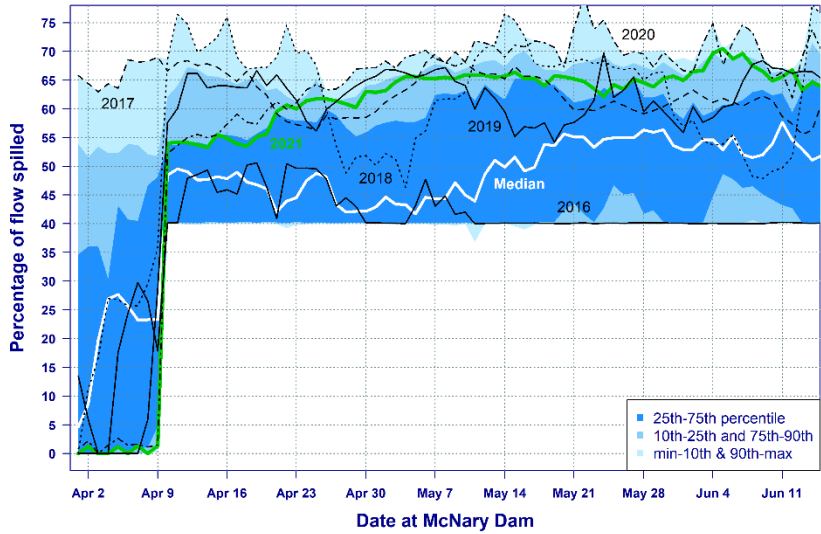


# Daily Dissolved Gas Saturation 2006-2021

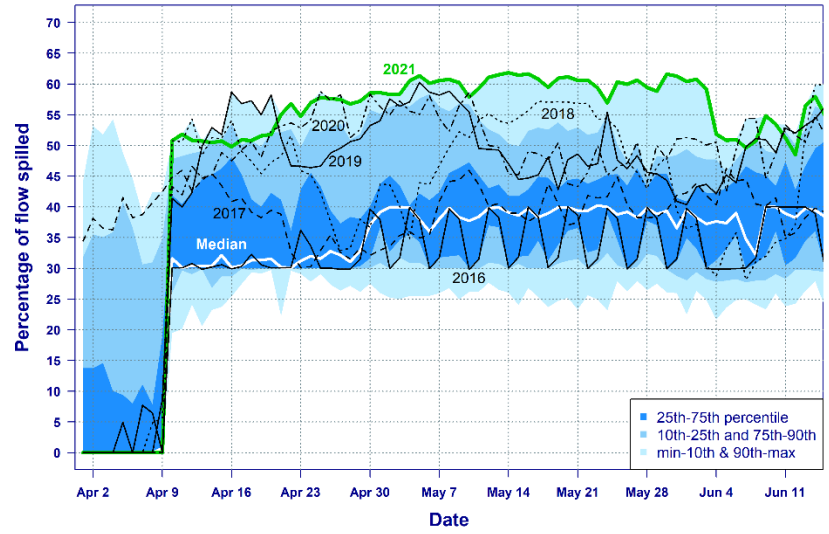
## Mean LGR, LGS, LMN



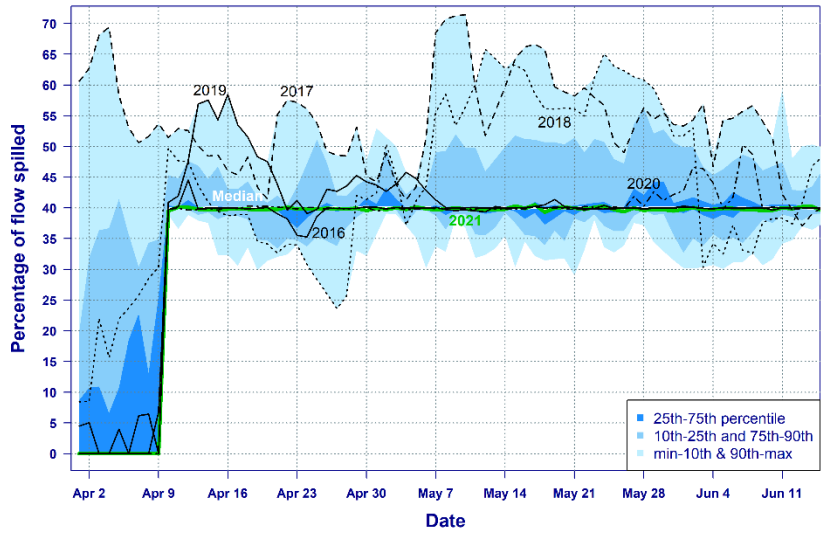
Daily %Spill 2006-2021  
McNary Dam



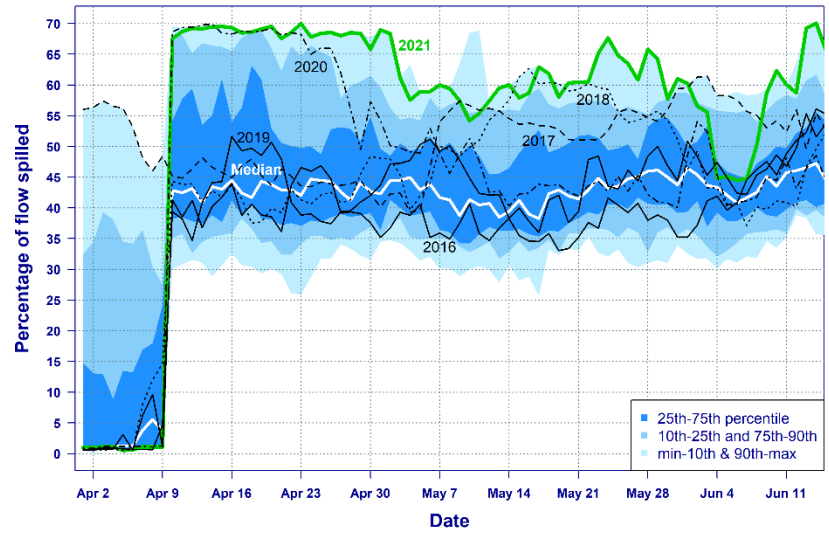
Daily %Spill 2006-2021  
John Day Dam



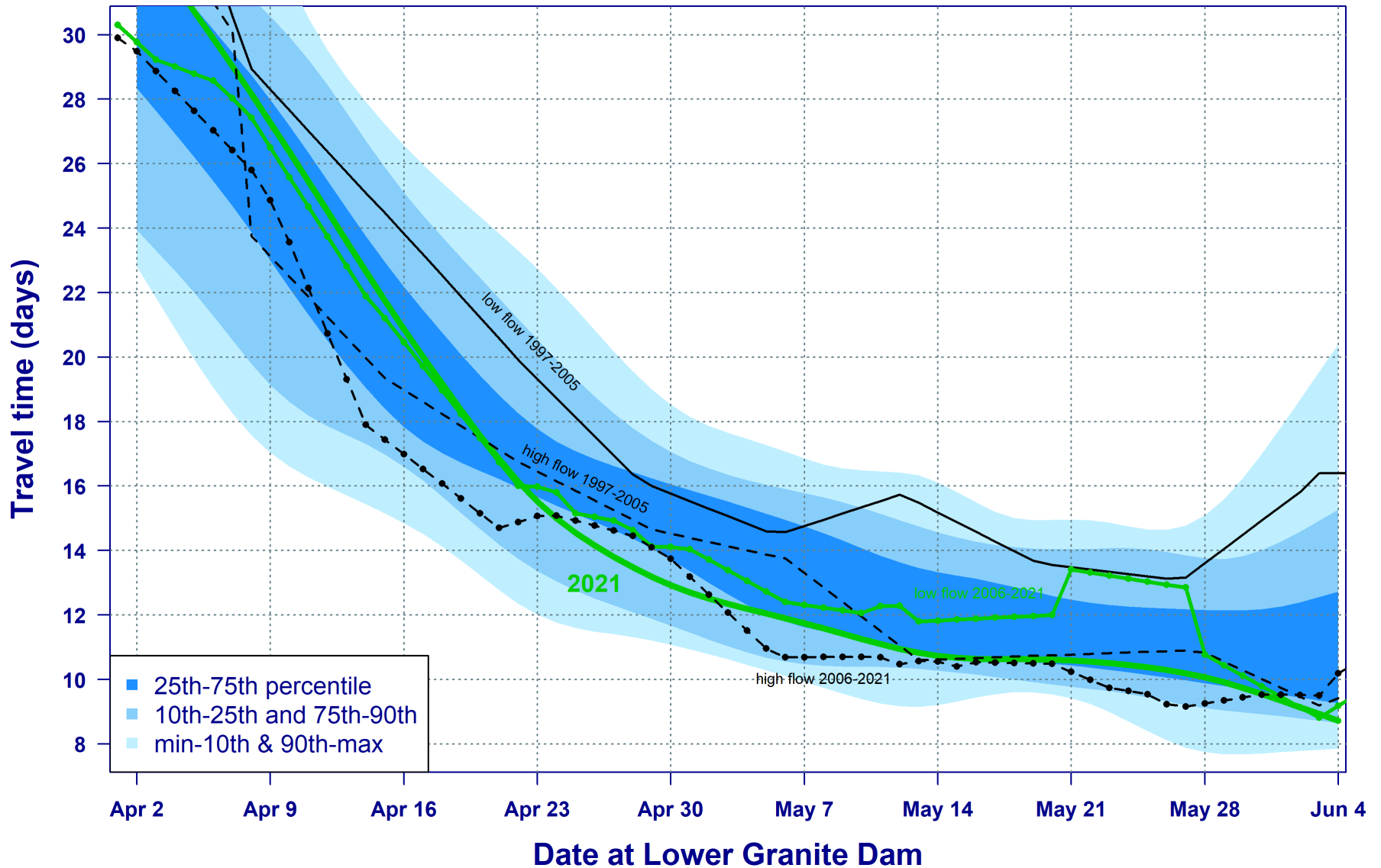
Daily %Spill 2006-2021  
The Dalles Dam



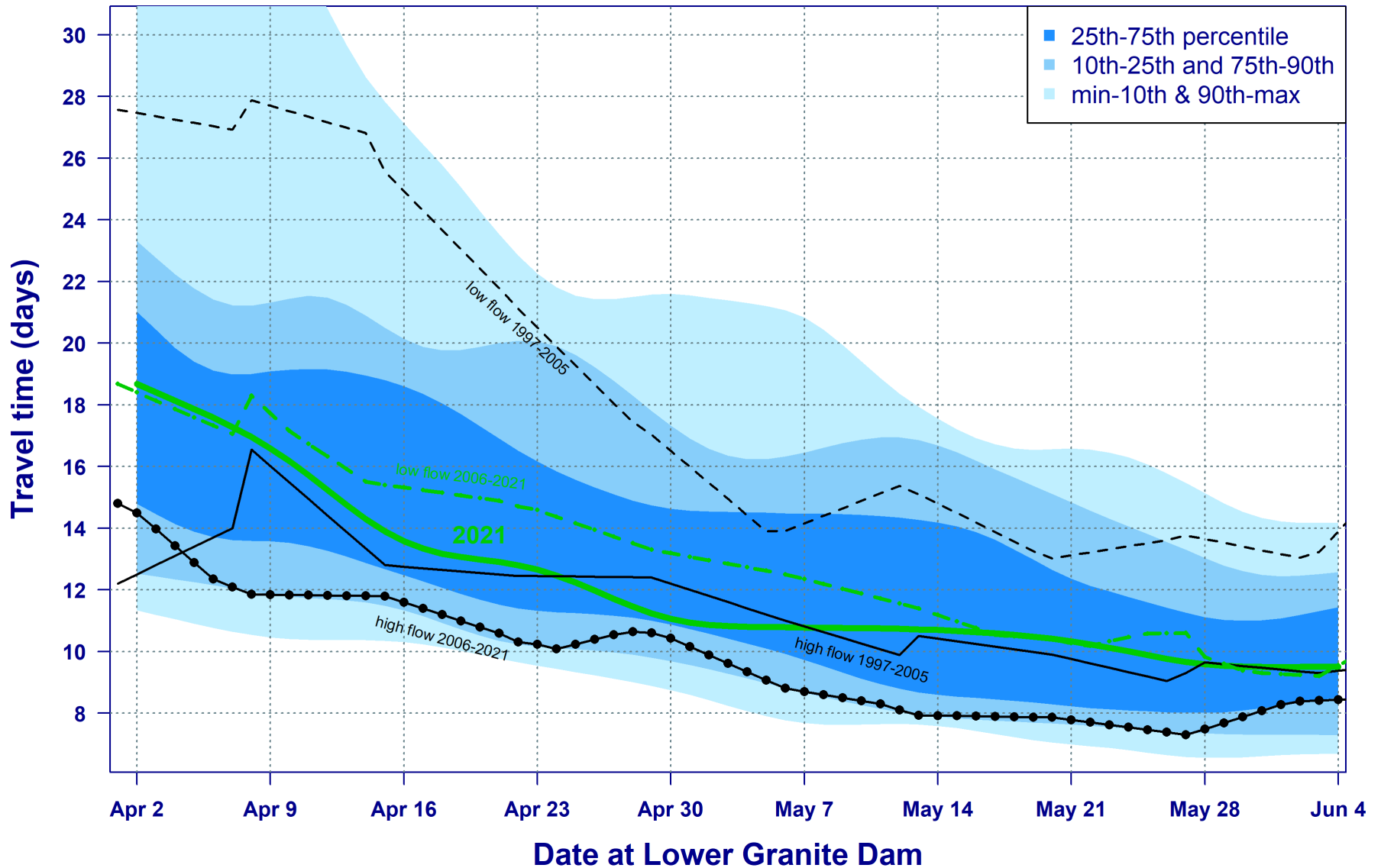
Daily %Spill 2006-2021  
Bonneville Dam



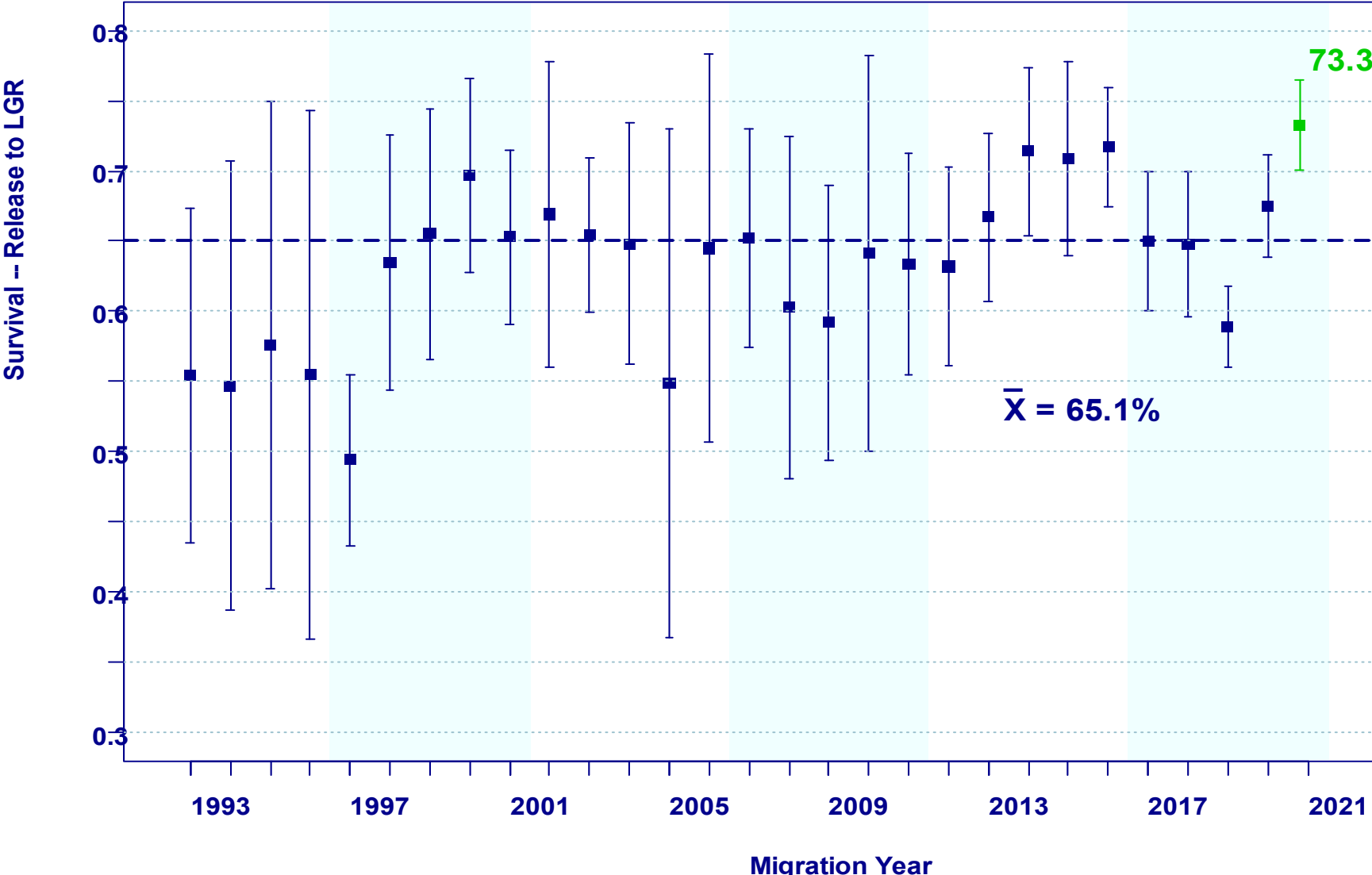
# Chinook Travel Time 1997-2021 (exc. 2001) Lower Granite to Bonneville (461 km)



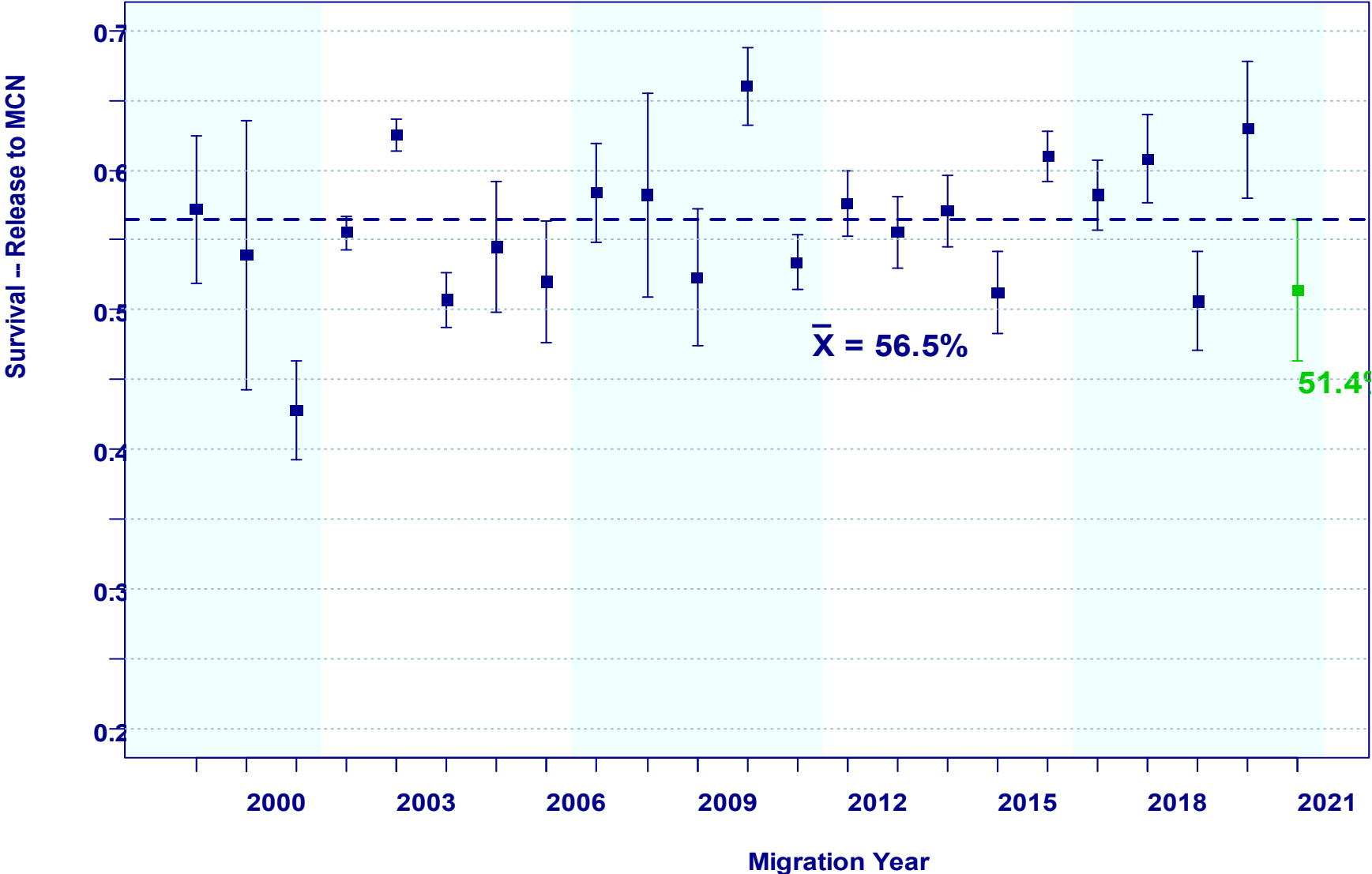
# Steelhead Travel Time 1997-2021 (exc. 2001) Lower Granite to Bonneville (461 km)



# Yearling Chinook Snake River Basin Hatcheries Mean of Index Groups

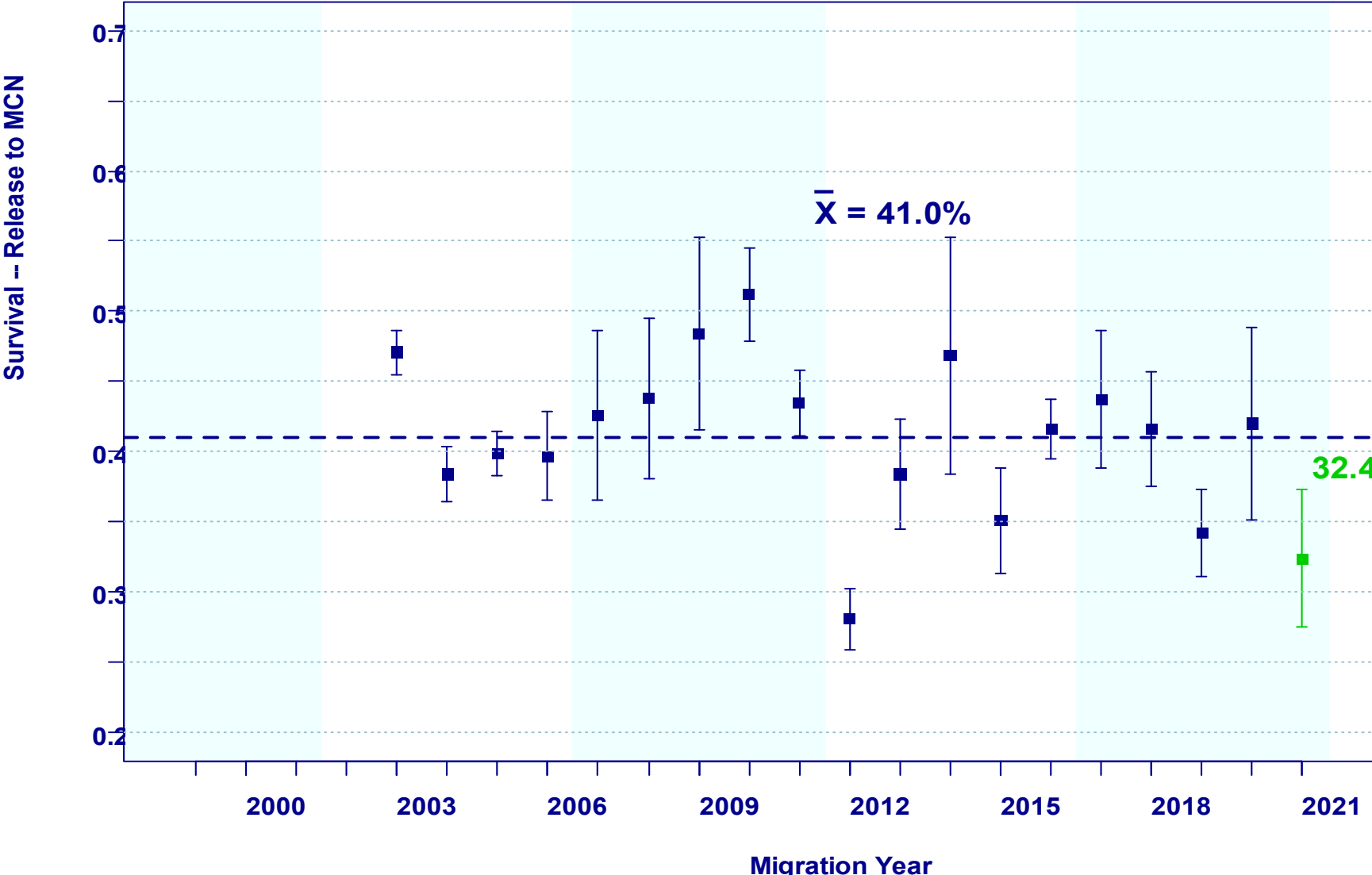


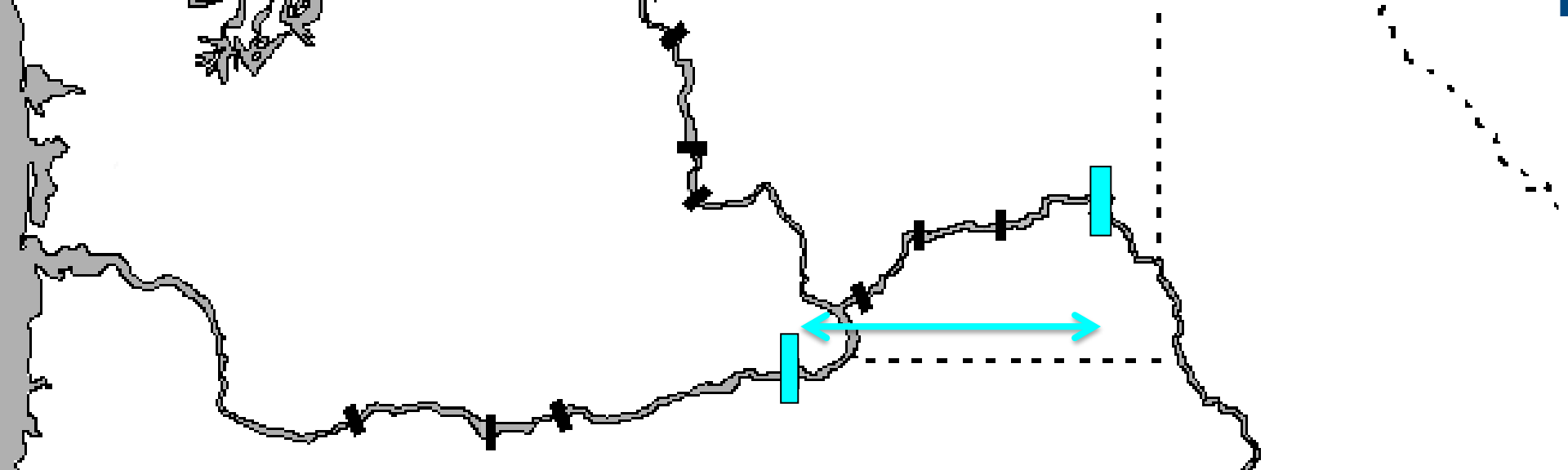
# Yearling Chinook Upper Columbia River Hatcheries Mean of Index Groups





# Steelhead Upper Columbia River Hatcheries Mean of Index Groups



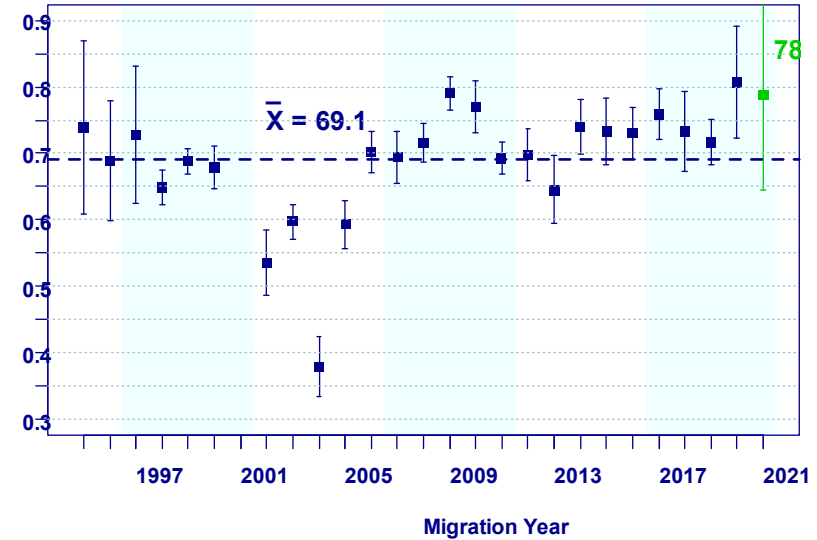
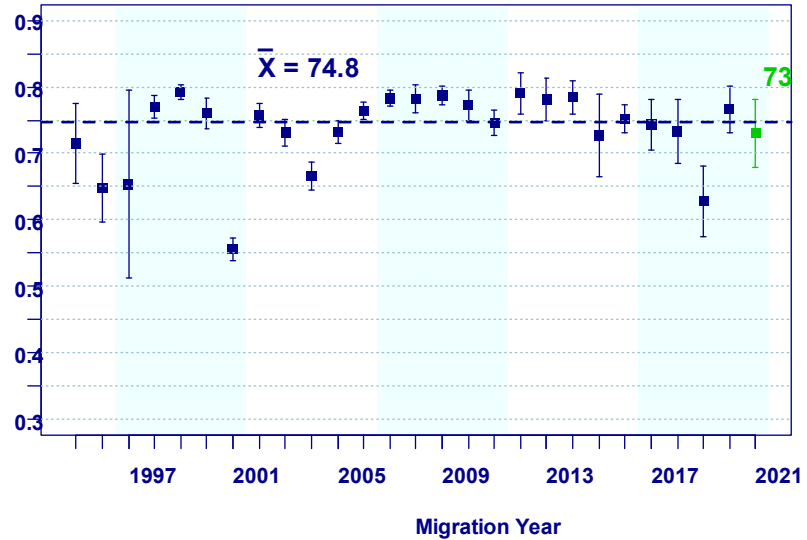


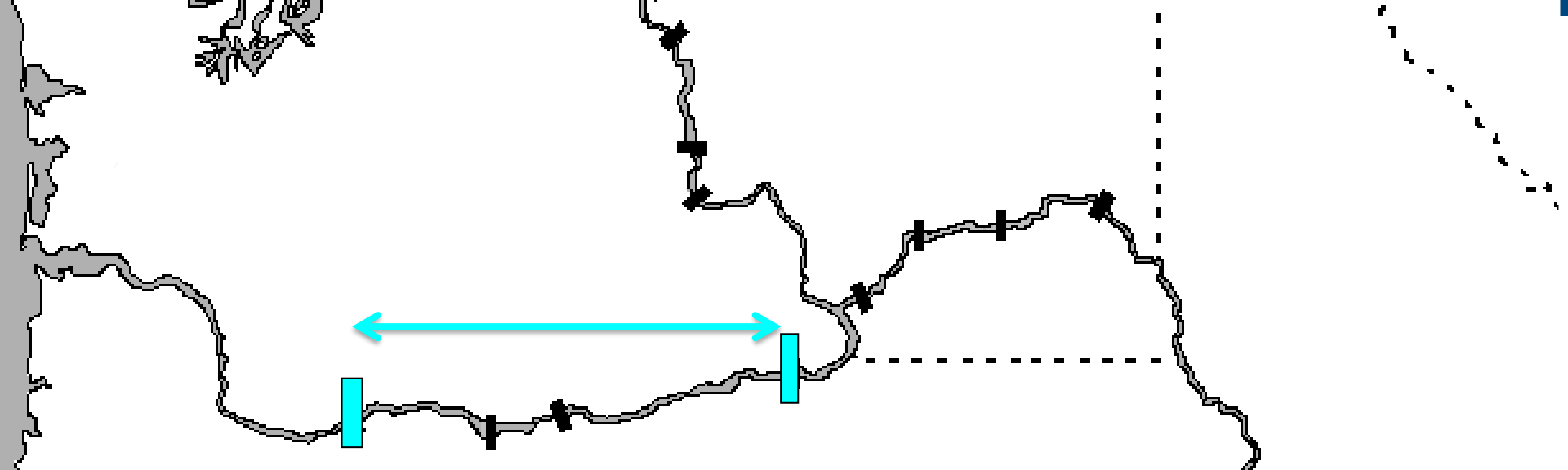
Estimated Survival -- LGR to MC

Yearling Chinook

Lower Granite to McNary

Steelhead



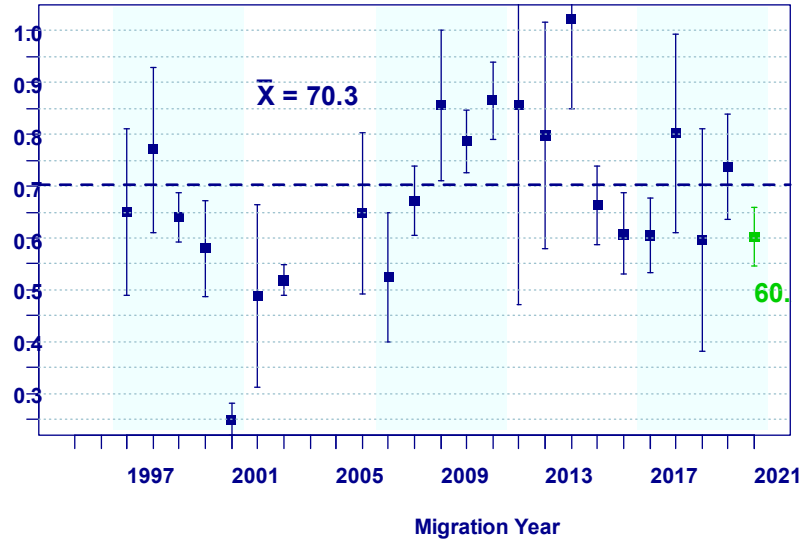
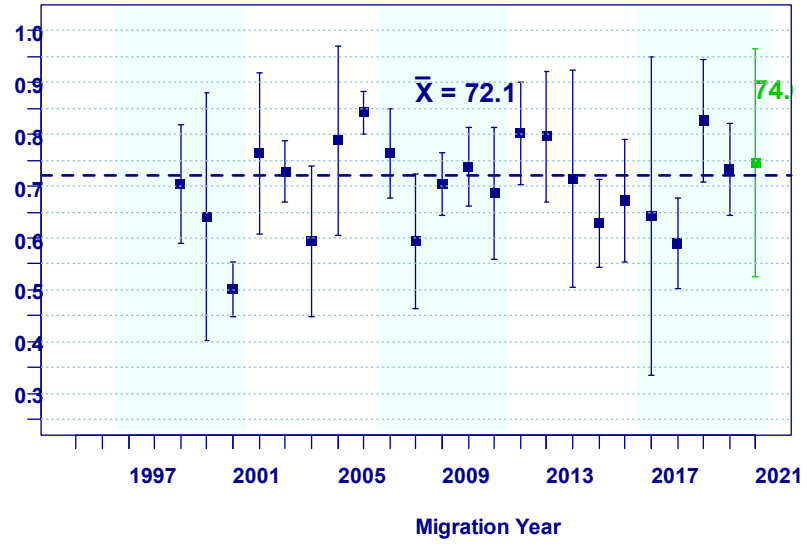


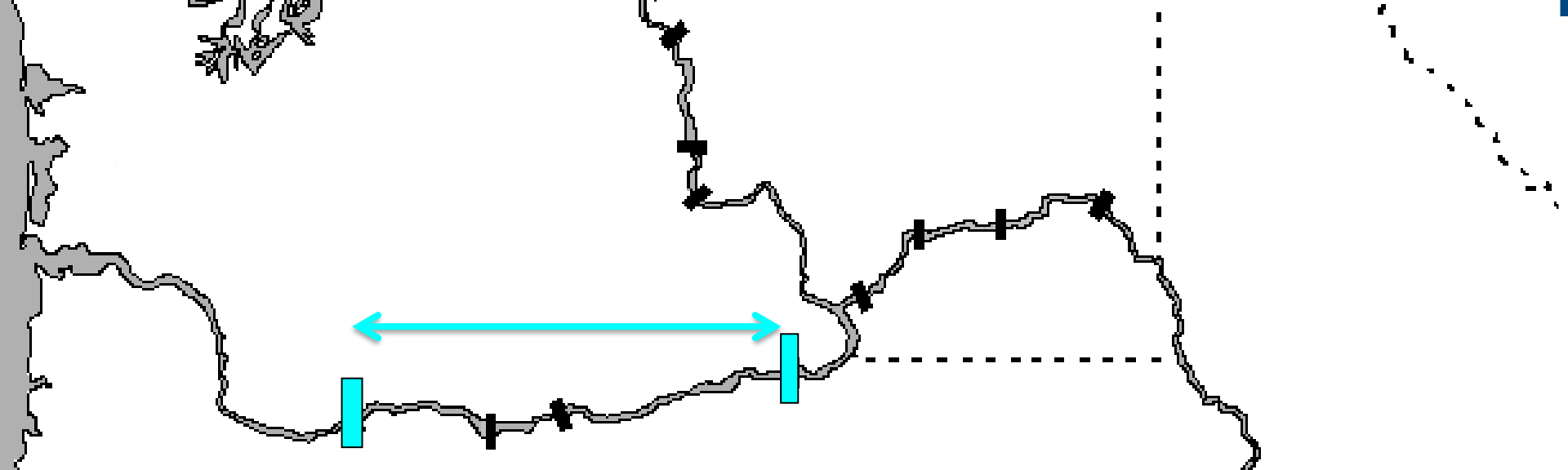
Estimated Survival -- MCN to BC

### Yearling Chinook

### McNary to Bonneville Fish from Snake River

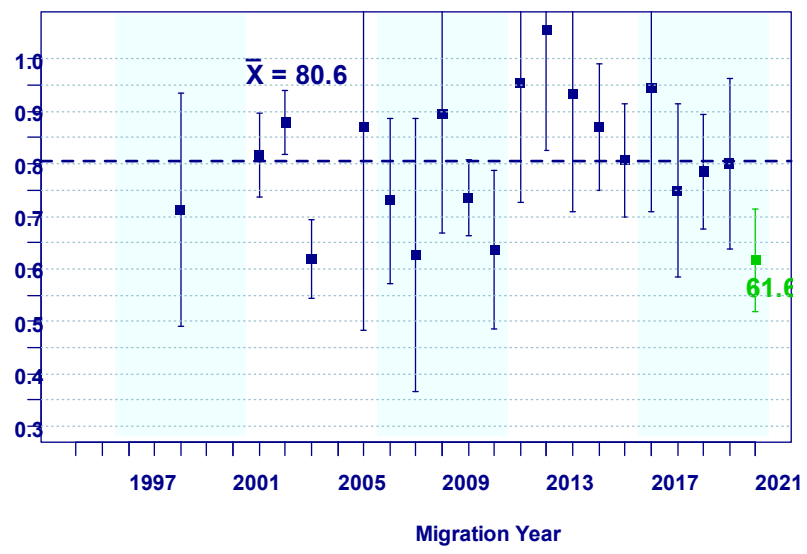
### Steelhead





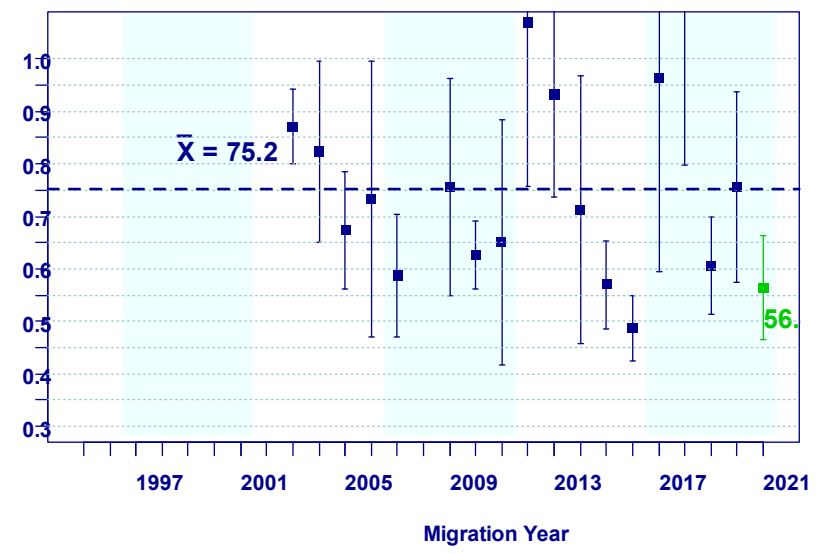
Estimated Survival -- MCN to BC

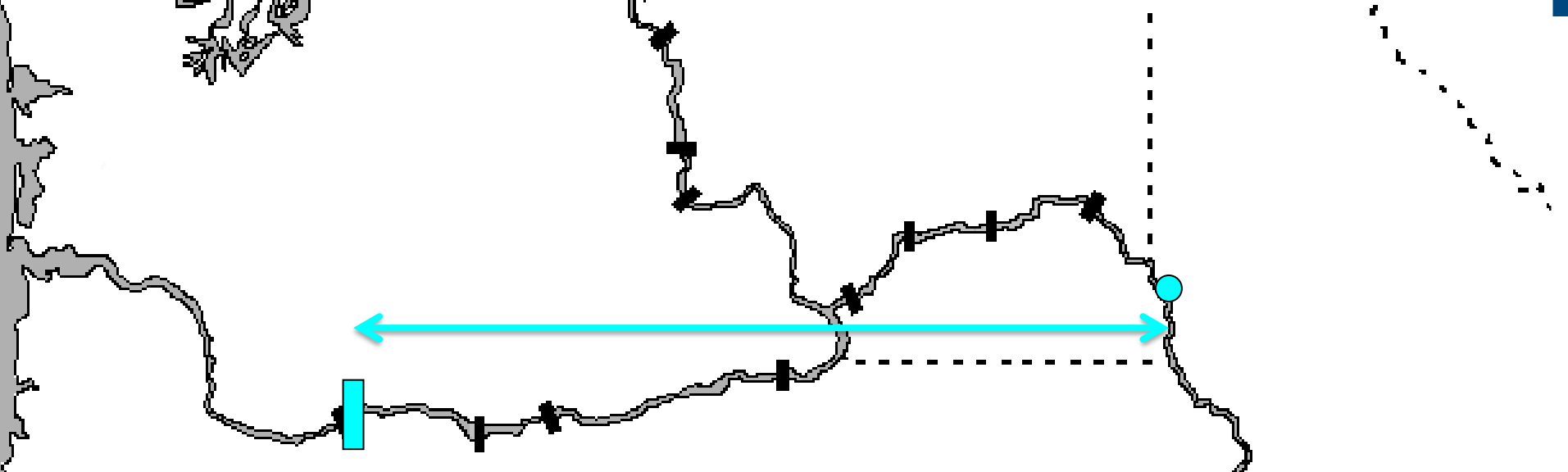
Yearling Chinook



McNary to Bonneville  
Fish from Upper Columbia

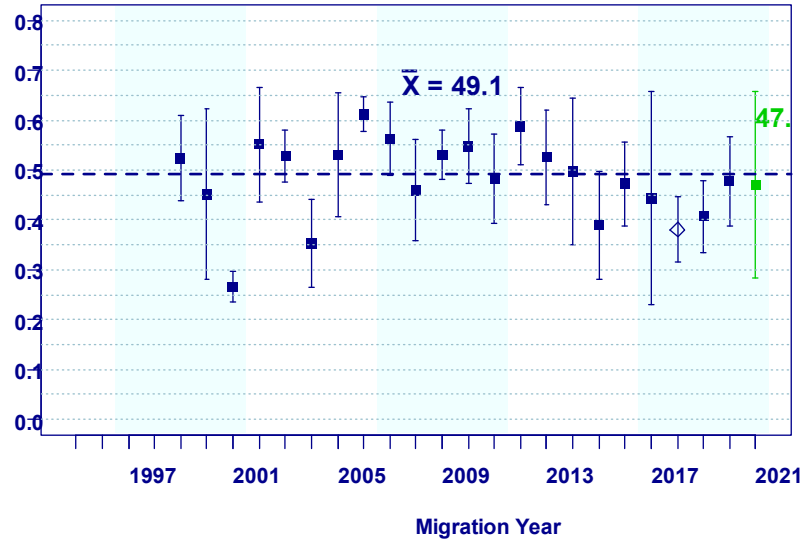
Steelhead



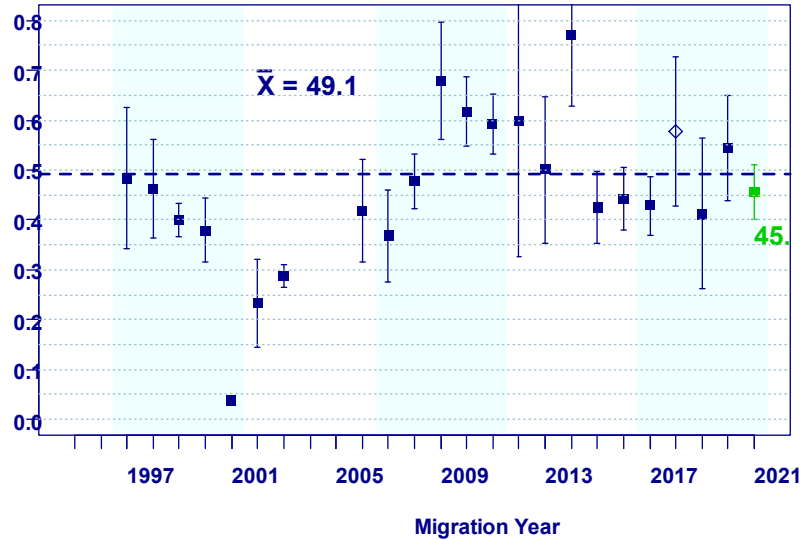


Estimated Survival -- Snk Trp to

Yearling Chinook

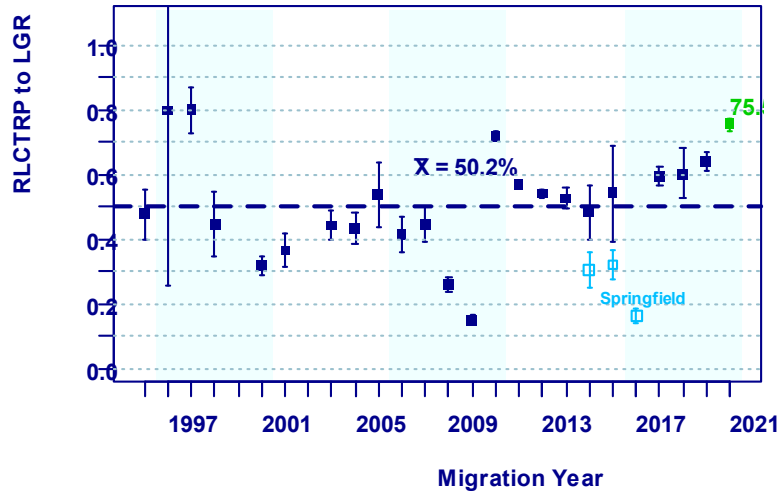


Snake River Trap to Bonneville Steelhead

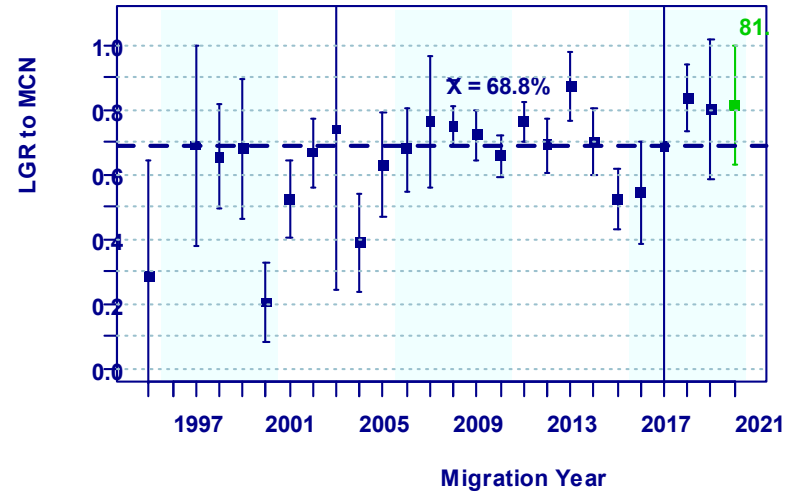


# Snake River Sockeye: Estimated Sur

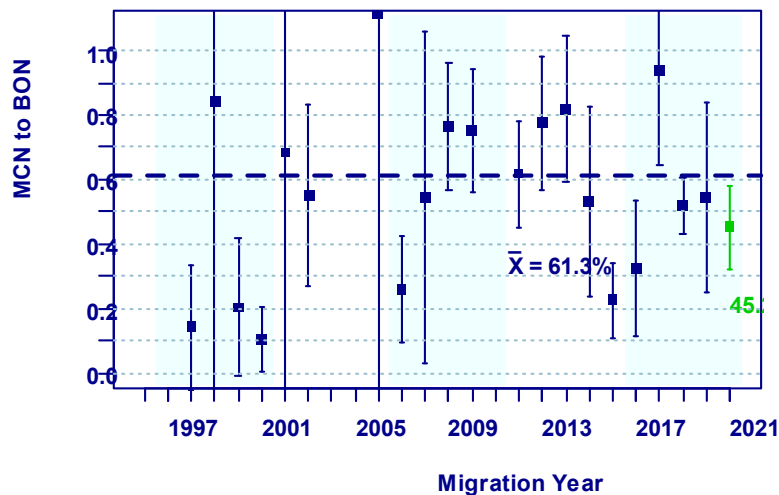
Redfish Lake Trap to Lower (



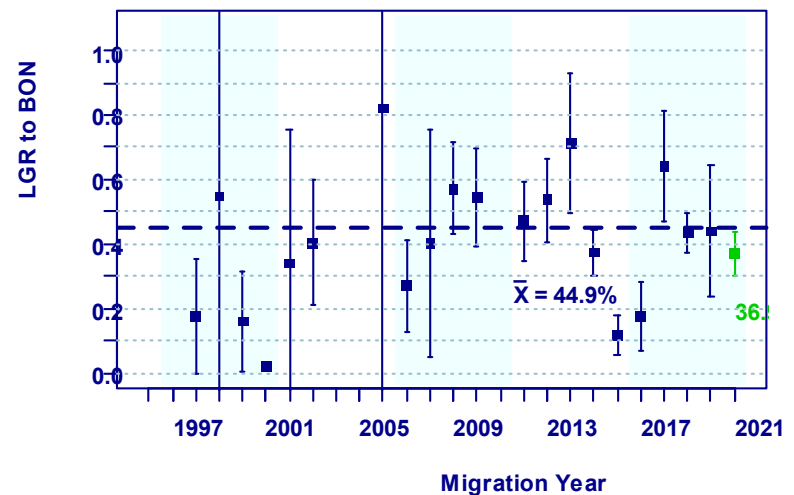
Lower Granite to McNary



McNary to Bonneville

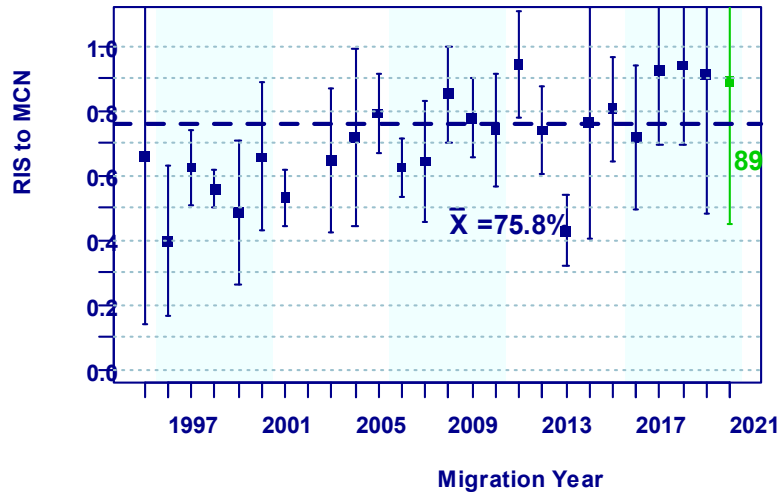


Lower Granite to Bonneville

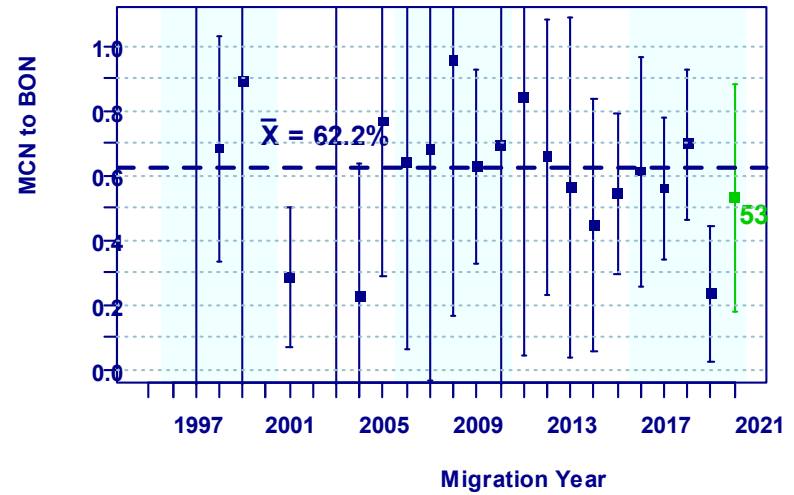


# Columbia River Sockeye: Estimated

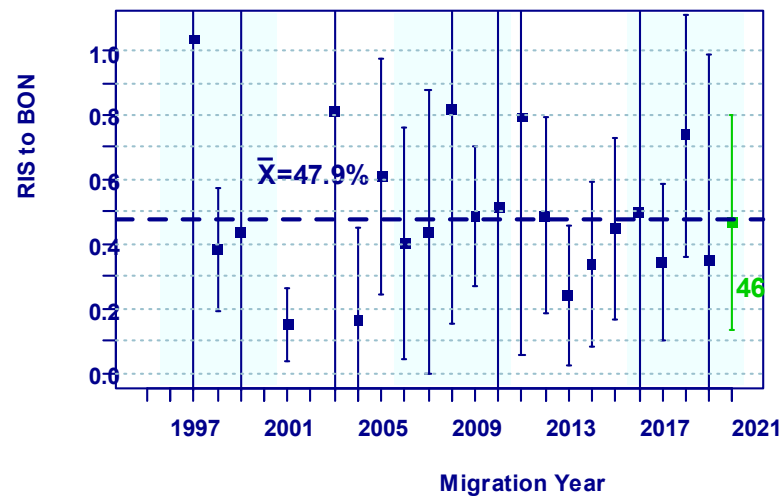
## Rock Island to McNary

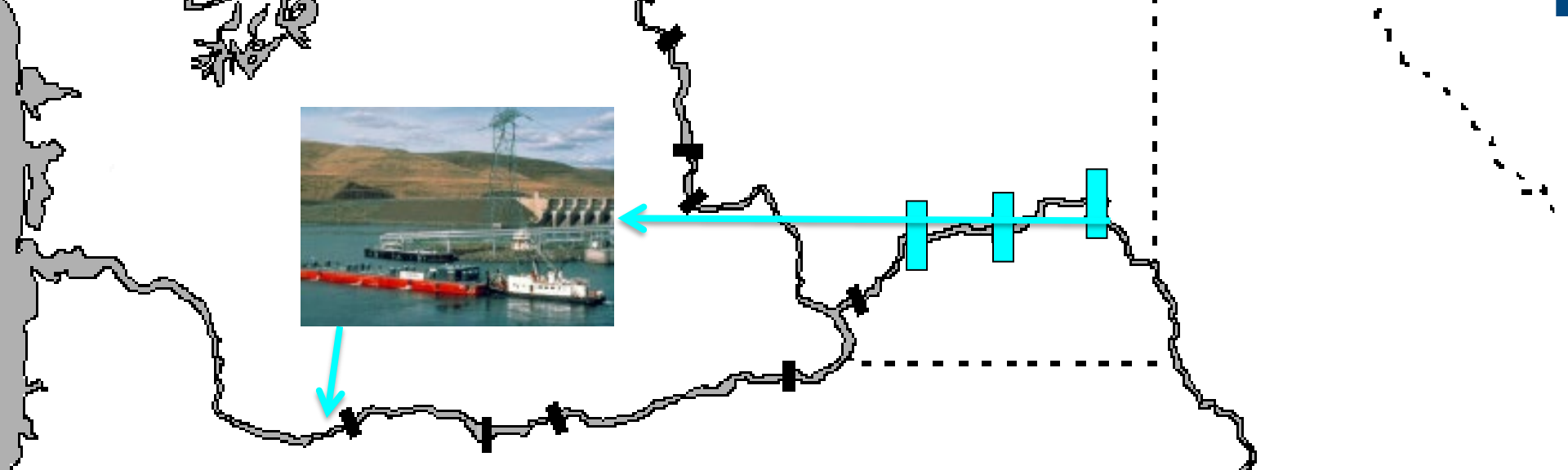


## McNary to Bonneville



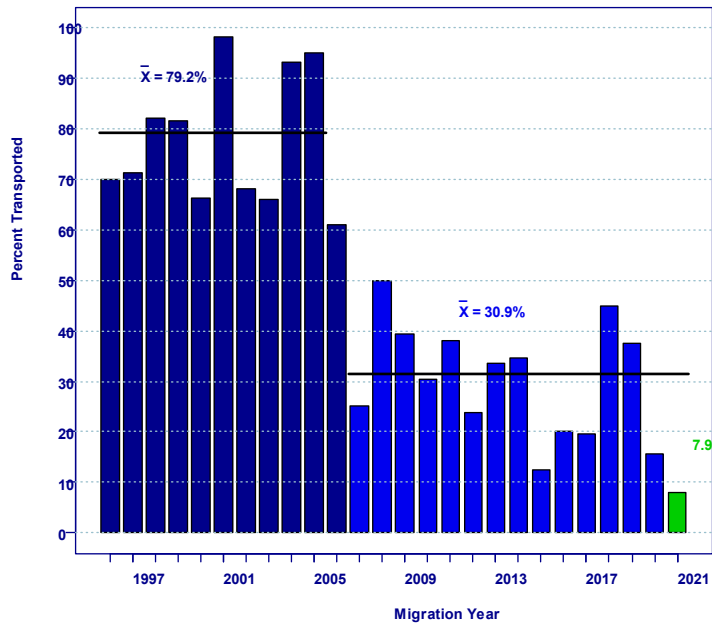
## Rock Island to Bonneville



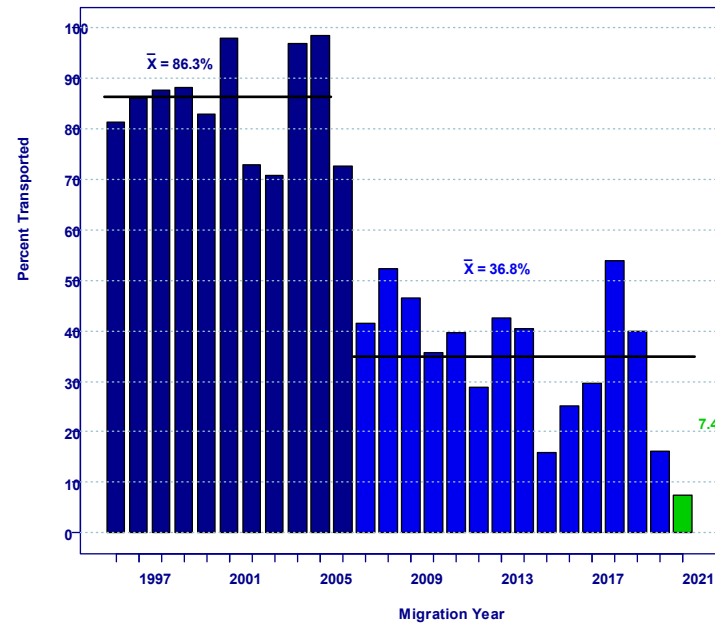


## Estimated Percent Transported

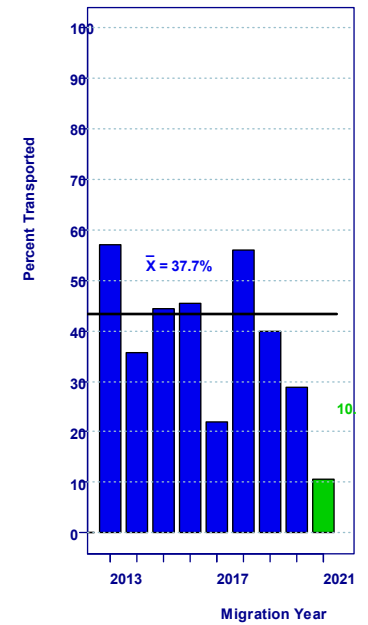
Yearling Chinook



Steelhead



Sockeye

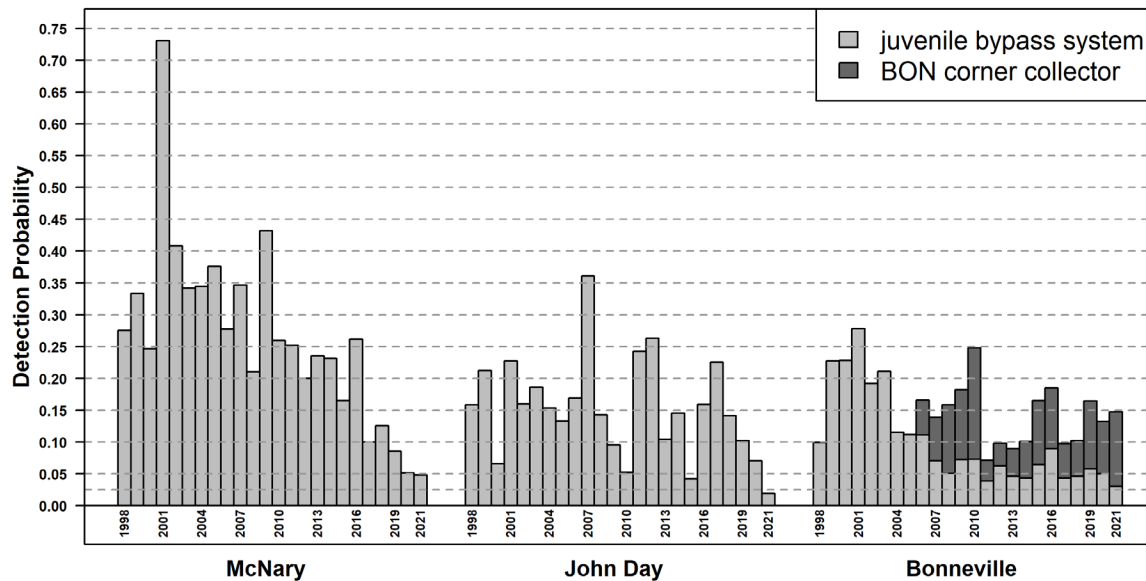
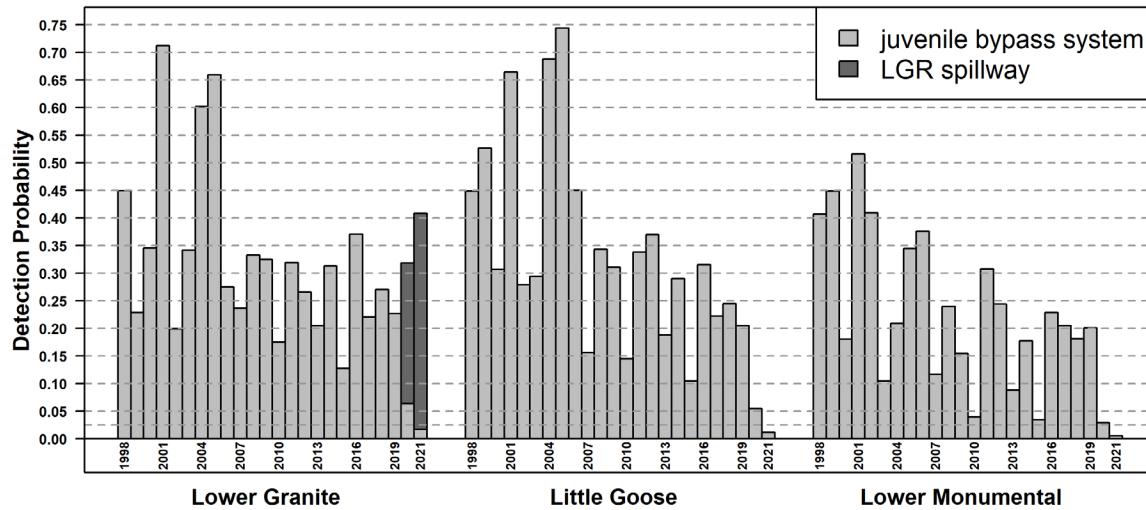




# Almost 30 Years of Survival Study

- 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



# 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



**NOAA FISHERIES**

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Northwest Fisheries Science Center