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# Northwest **Power** and Conservation Council

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Oregon

April 7, 2026

## MEMORANDUM

**TO:** Council Members

**FROM:** Kris Homel

**SUBJECT:** Briefing on Salmon Ocean Ecology and the Benefits of Long-Term Data Collection

## BACKGROUND:

**Presenter:** Brian Burke, Ph.D. (Supervisory Research Fishery Biologist, National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center)

**Summary:** Brian will present research findings and outlooks associated with Chinook and Steelhead returns to the Columbia River based on indicators of ocean conditions.

**Relevance:** The monitoring efforts associated with Brian's presentation have been consistently supported by the Council and were also highlighted as critical in both the 2014 Fish and Wildlife Program and the 2020 addendum. These efforts are implemented through Project #1998-014-00, *Ocean Survival of Salmonids*. This information is relevant to our Program goals, objectives, and performance indicators by providing a preview of what is expected for adult returns in the current year and an overview of the ocean ecological indicators. This work addresses several measures in the Fish and Wildlife Program.

**Workplan:** Fish and Wildlife Division work plan 2026; Program planning & Coordination.

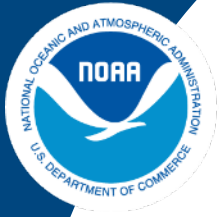
**Background:** The Council's research and monitoring efforts related to the marine environment for anadromous fish began in 1998 in response to the 1996 amendment to the

Northwest Power Act, which calls on the Council to consider ocean conditions when making project funding recommendations.

The Council's Fish and Wildlife Program recognizes the ocean environment as an integral component of the Columbia River ecosystem. Measures in the Program support monitoring the ocean conditions and in-river restoration actions to determine those actions of greatest benefit, to separate the effects of ocean-related mortality from that caused in the freshwater part of the life cycle, and to assess salmonid survival and evaluate restoration potential given variable ocean conditions.

To date, full support for this baseline information has not been provided by Bonneville Power Administration as recommended by the Council as part of the Mainstem and Program Support Project review on August 14, 2019 (please see *Project-Specific Recommendations (page 13)*).

More info: <https://www.fisheries.noaa.gov/west-coast/science-data/ocean-conditions-indicators-trends>



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# Salmon Ocean Ecology and the Benefits of Long-Term Data Collection

*Northwest Power and Conservation Council  
April 9<sup>th</sup>, 2026*



**Presenter:** Brian Burke  
NOAA Fisheries, NWFSC

**Team:** Toby Auth, Brian Beckman, Anna Bolm, Josh Bowman, Cindy Bucher, Lisa Crozier, Elizabeth Daly, Jennifer Fisher, Rebecca Forney, David Huff, Mary Hunsicker, Kym Jacobson, Jessica Miller, Cheryl Morgan, Cat Nickels, Krista Nichols, Kathleen O'Malley, Joe Smith, Kelcee Smith, Nick Strait, Kelsey Sweica, Don Van Doornik, Laurie Weitkamp, Amy Wallace, Brian Wells, Jen Zamon, Sam Zeman

# Outline

1. Field Operations
2. Benefits of Long-term Data Collection
  - Chinook Sibling Regression
  - Coho Growth and Maturation
  - Stoplight Chart and Forecasts
3. Budget and Upcoming Modifications



# Our Team

- Field Biologists
- Ecologists / Zoologists
- Modelers / Statisticians
- Physiologists
- Geneticists
- Database Specialists
- Students / Volunteers





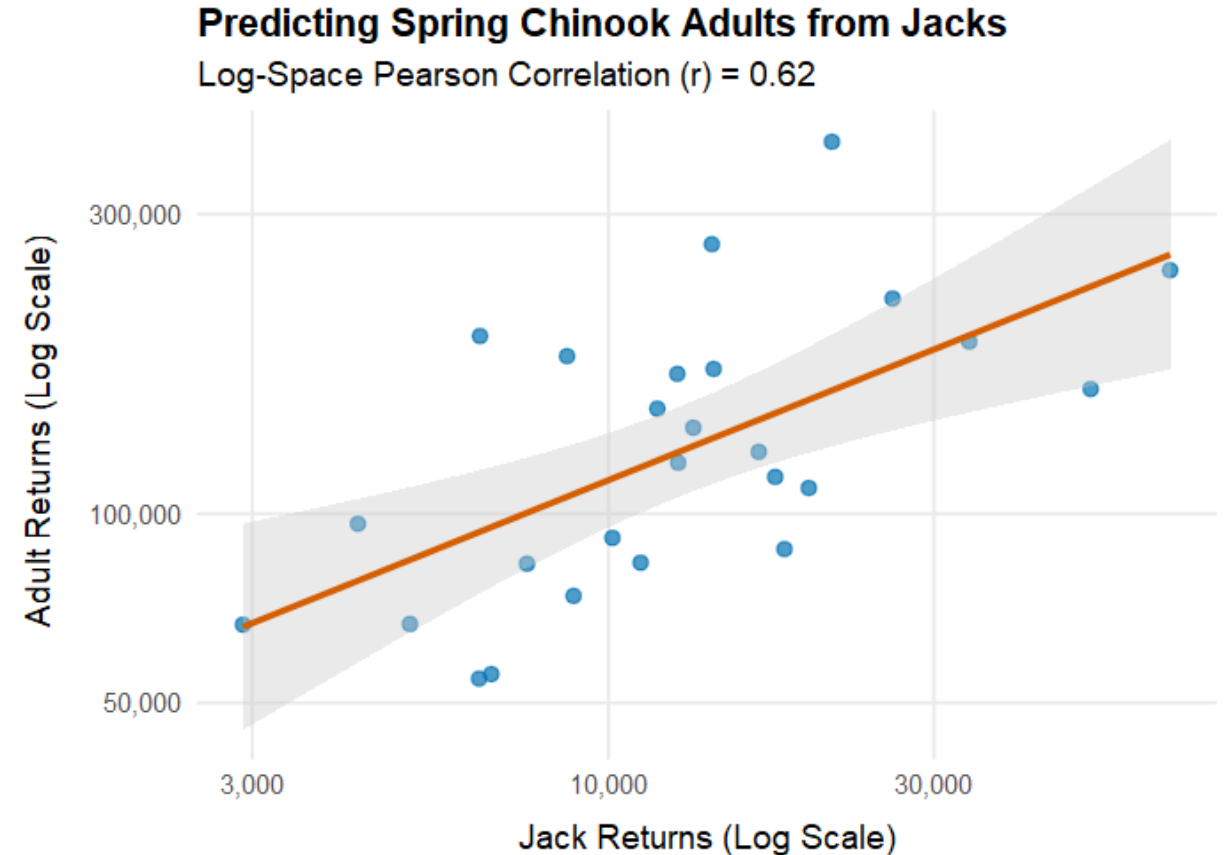
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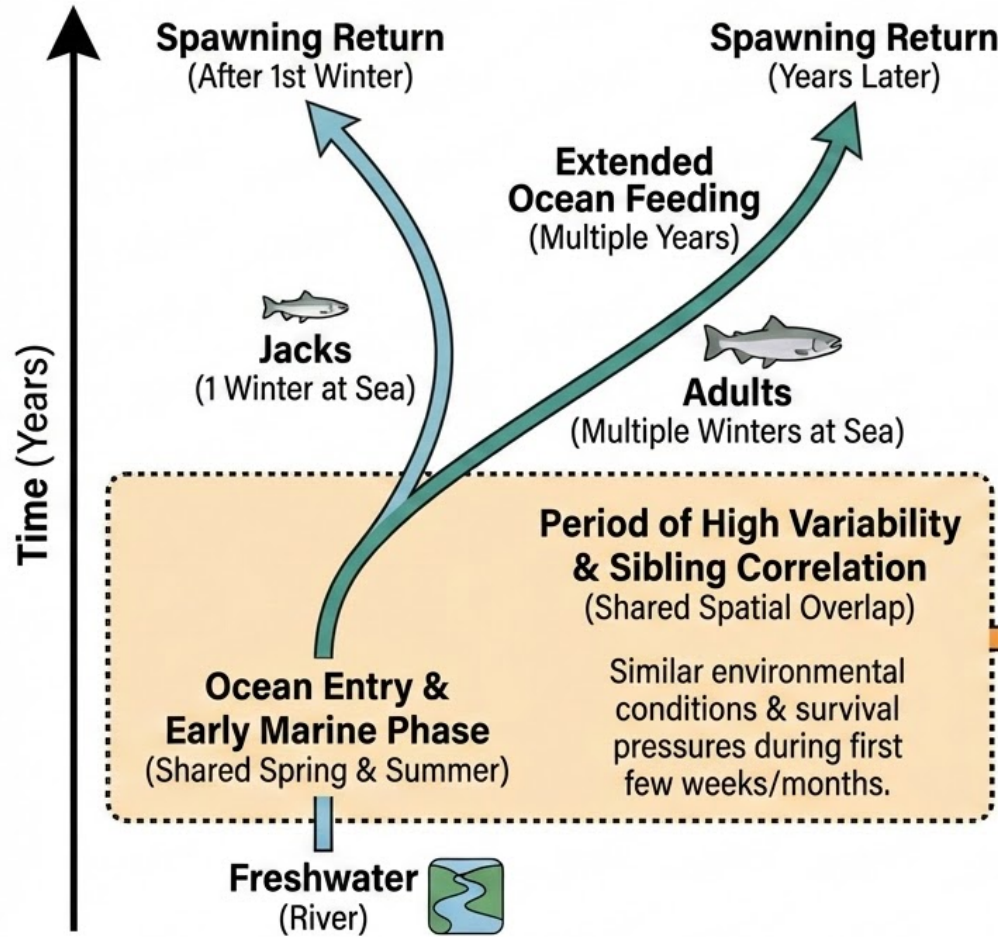


# Sibling Regression

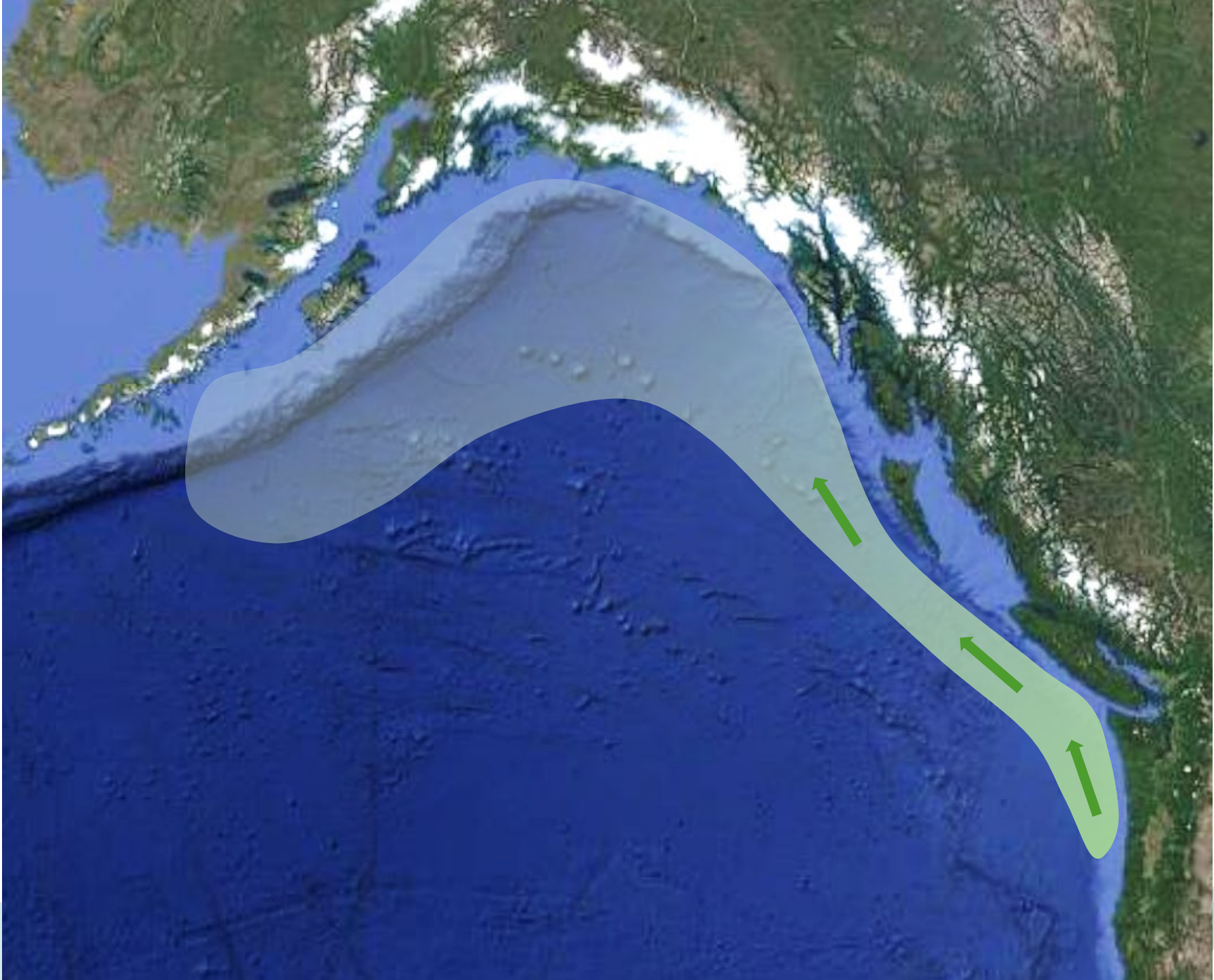
- Very common modeling approach for estimating adult salmon returns
- If you want to know how many seniors will be graduating next year, it's helpful to know how many juniors there are this year



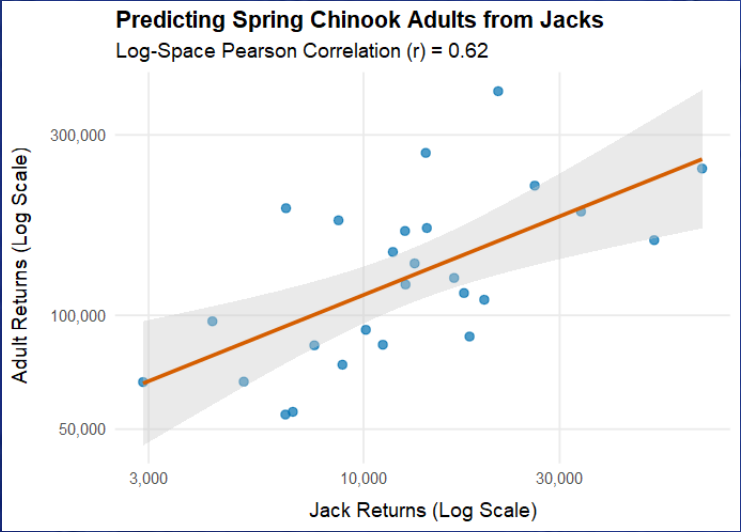
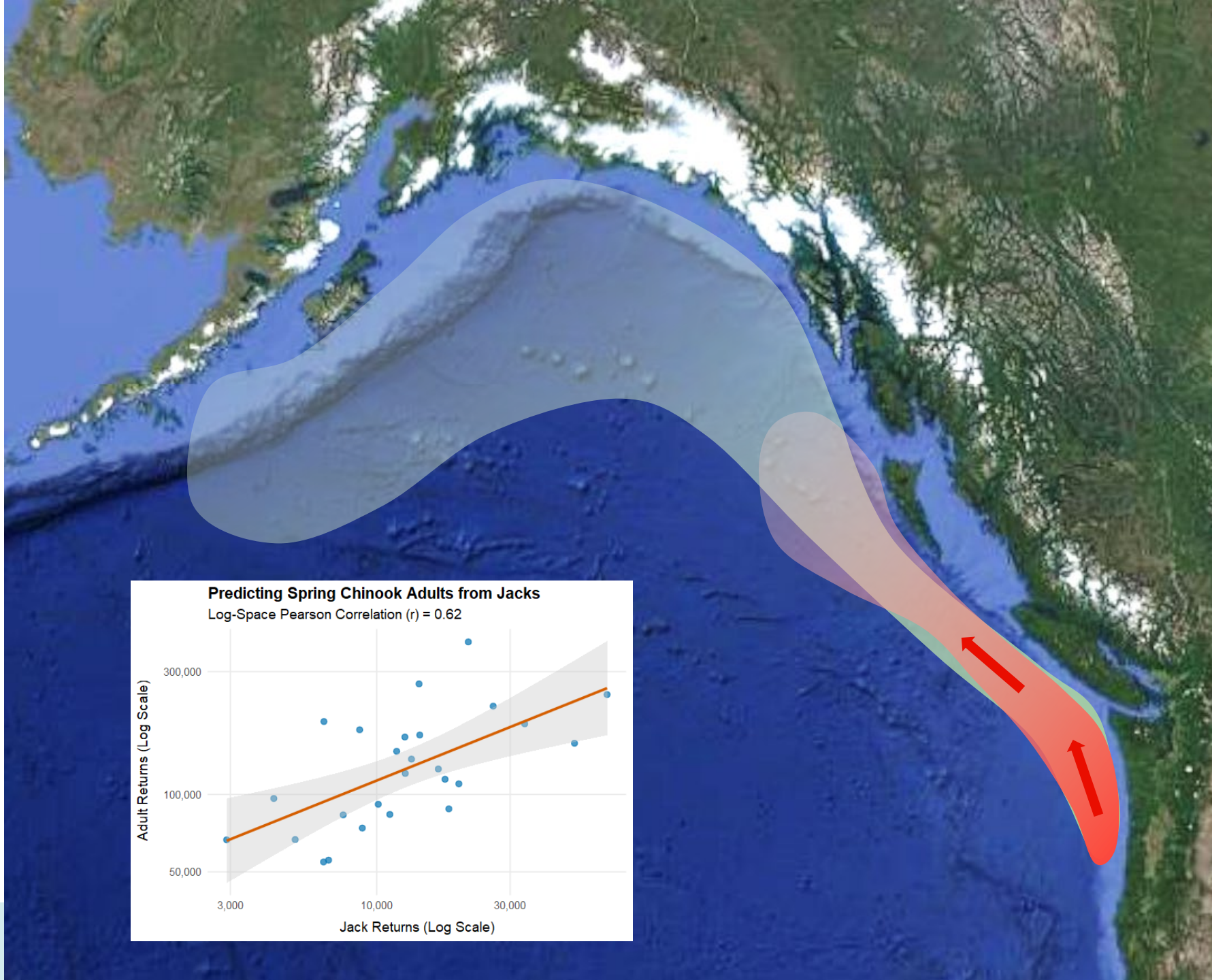
# Why are jacks correlated with adults?



- Evidence shows that most of the variability in ocean survival happens in the first weeks to months
- Cohort Strength is mostly set before they diverge
- A good year for one is likely to be a good year for the other



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# Can we refine the period of variable mortality?

- All fish are collocated upstream of Bonneville Dam
- We catch fish in May right after they enter the ocean
- Then again in June, when they've been in the ocean for several weeks
- Jacks come back a year before adults
- This provides multiple periods of overlap, allowing us to ask more precise questions about when cohort strength is set



## Interior Spring Chinook Salmon

- May residence time: 0-3 weeks
- June residence time: 2-6 weeks

Bonneville Dam

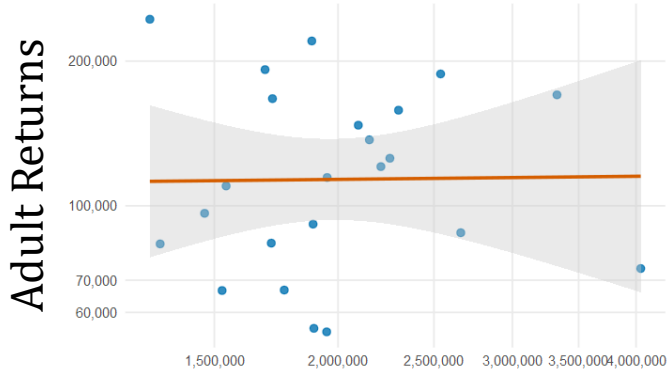


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# When is Cohort Strength set?

## In the River

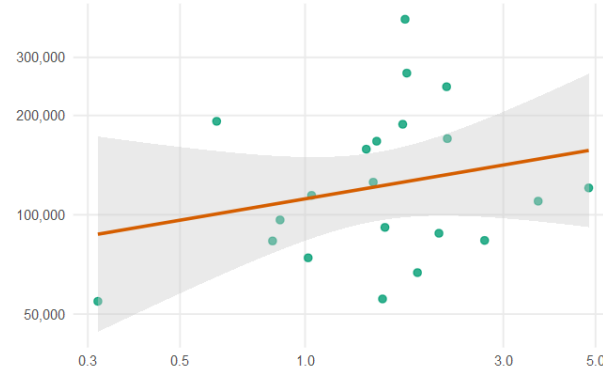
Spring Chinook Adults and Smolt Index at Bonneville  
Pearson Correlation (r) = 0.01



Smolt Index at Bonneville Dam

## Late May

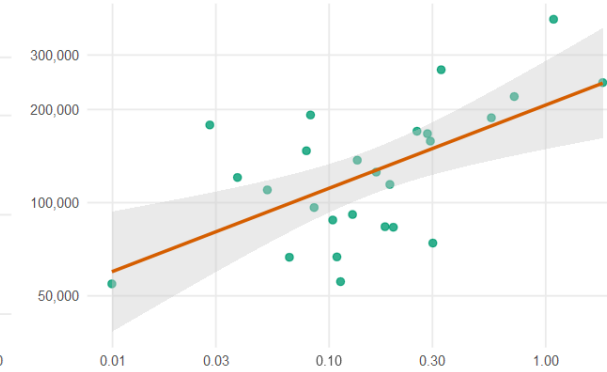
Spring Chinook Adults and May Survey CPUE  
Pearson Correlation (r) = 0.24



May JSOES CPUE

## Late June

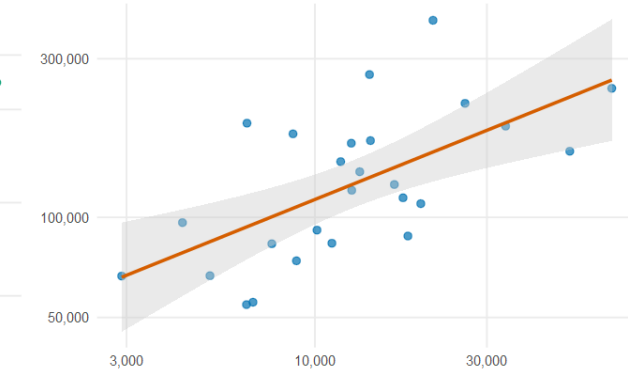
Spring Chinook Adults and June Survey CPUE  
Pearson Correlation (r) = 0.6



June JSOES CPUE

## Fall / Winter

Predicting Spring Chinook Adults from Jacks  
Log-Space Pearson Correlation (r) = 0.62



Jack Returns

# What can we learn from JSOES' long-term data?

- Cohort Strength is largely set between May and June, in the ocean
- June CPUE can be used in forecasting models, much like jack abundance, but a year earlier (2 years before adults return)
- Much of the interannual variability in survival occurs off the coast of Washington (we don't have to manage the ocean, just coastal Washington)



# Outline

## 1. Field Operations

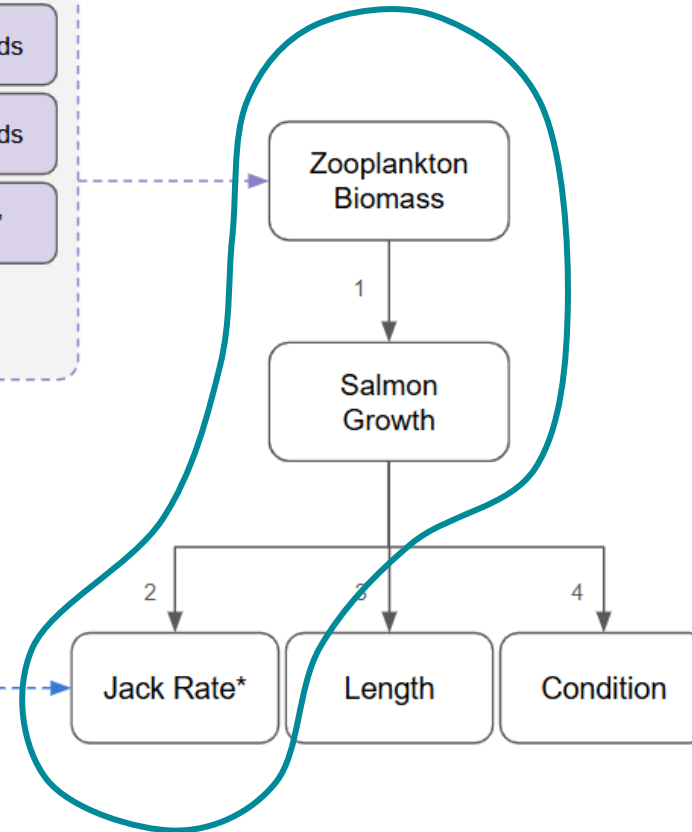
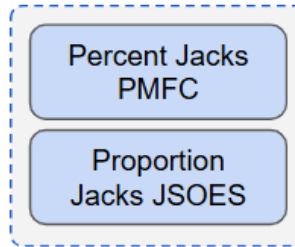
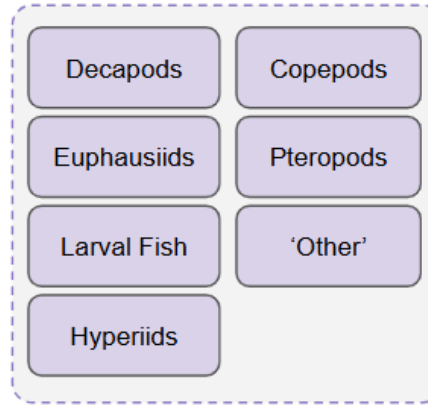
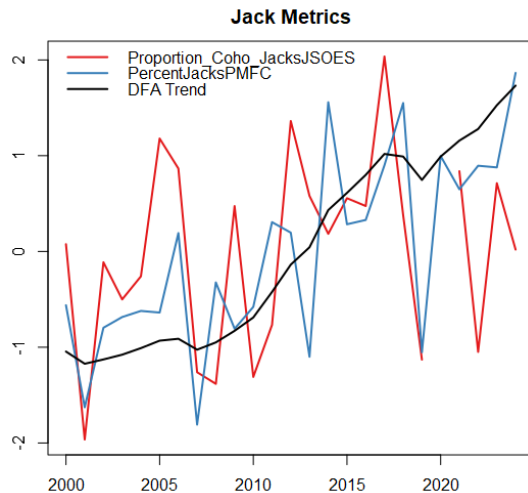
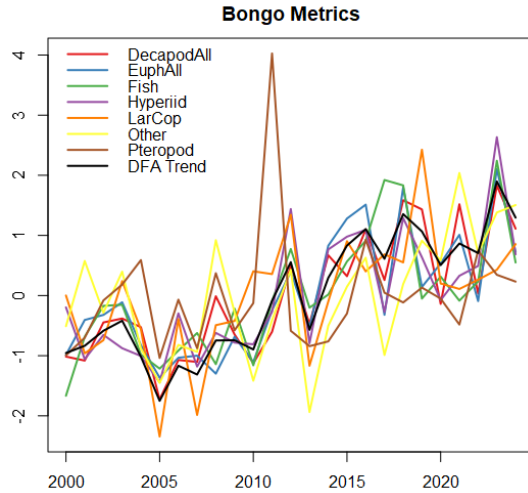
## 2. Benefits of Long-term Data Collection

- Chinook Sibling Regression
- Coho Growth and Maturation
- Stoplight Chart and Forecasts

## 3. Budget and Upcoming Modifications

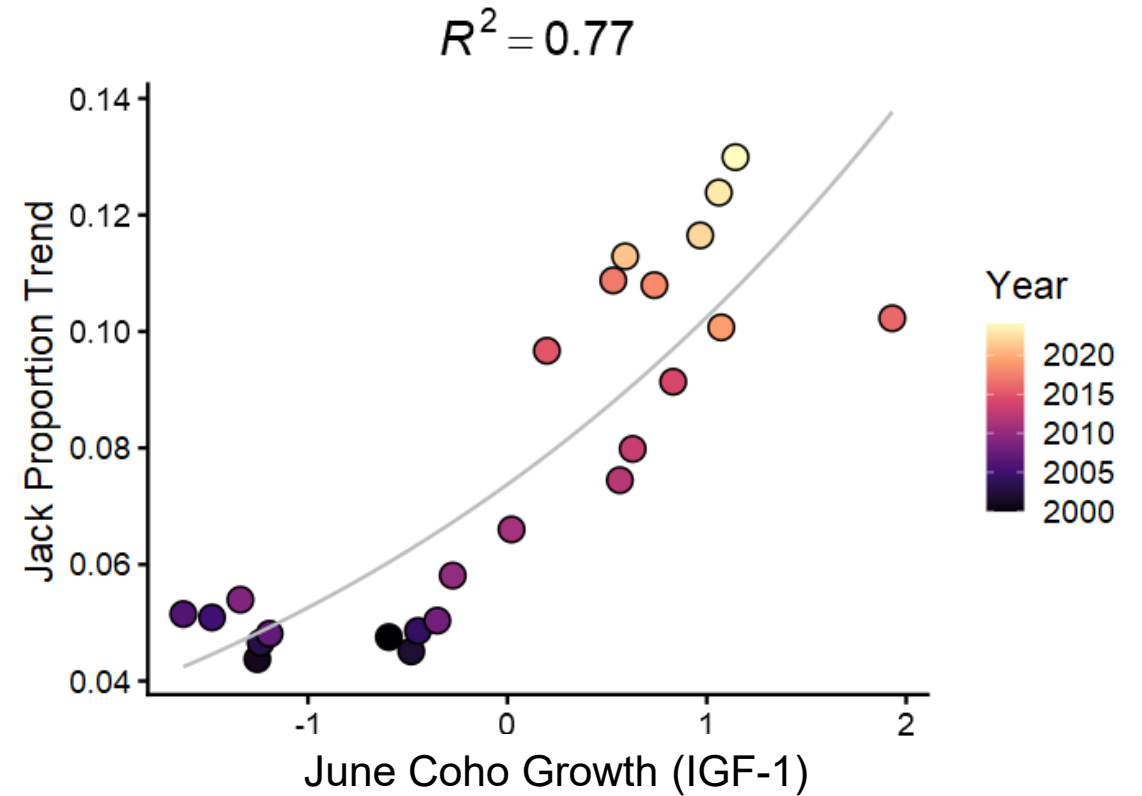
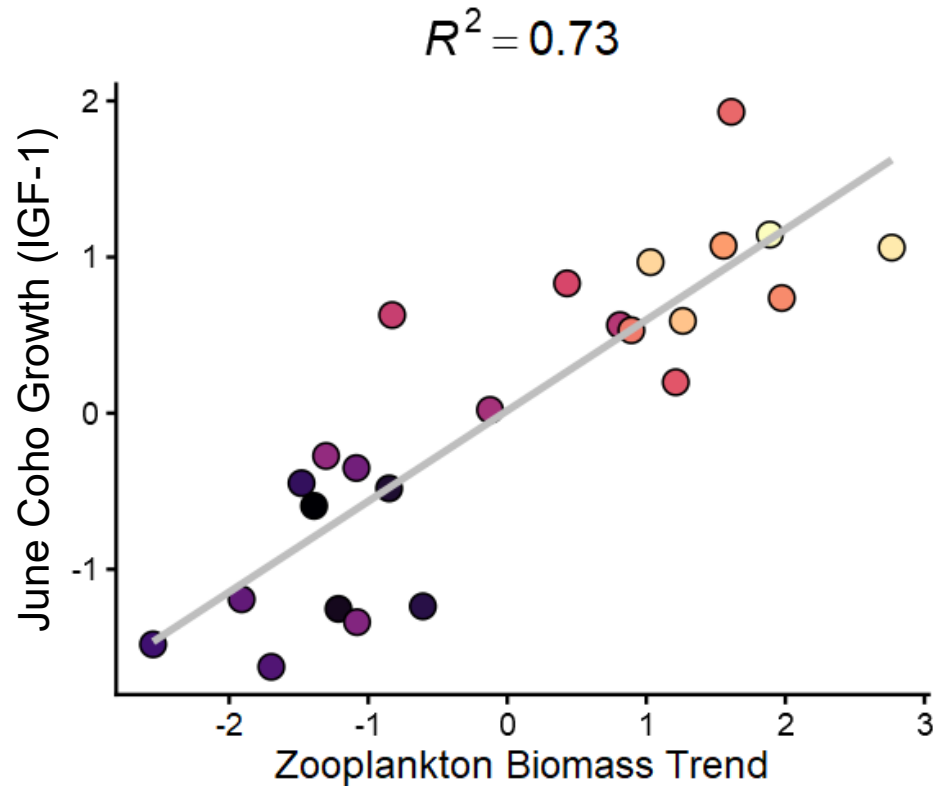


# Modeling Approach (for Coho Salmon)



Dashed boxes represent data dimension reduction via DFA.  
Asterisk denotes a beta regression rather than linear regression

# Importance of Coho Growth



# Importance of Coho Growth

- Higher biomass at lower-trophic levels results in higher growth rates (not surprising, but good to show)
- Higher growth rates increase jack rates
- Forecastable with JSOES data
- Good for improving adult returns models and essential for Life Cycle Models



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# NOAA's 'Stoplight Chart'

<https://www.fisheries.noaa.gov/west-coast/science-data/ocean-ecosystem-indicators-pacific-salmon-marine-survival-northern>

## Basin Scale

## Local Physical Conditions

## Local Biological Conditions

## Summary

## Additional Indicators

ECOSYSTEM INDICATORS		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
CLIMATE & ATMOSPHERIC	PDO (Sum Dec-March)	Red	Yellow	Green	Red	Yellow	Red	Yellow	Red	Yellow	Green	Green	Red	Green	Green	Yellow	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Green	Yellow	Green	Green
	PDO (Sum May-Sept)	Yellow	Green	Yellow	Yellow	Green	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Red	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Green	Yellow	Green	Green
	ONI (Average Jan-June)	Red	Green	Green	Green	Yellow	Red	Yellow	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Yellow	Red	Red	Red	Yellow	Red	Red	Green	Green	Yellow	Red	Yellow
LOCAL PHYSICAL	SST NDBC buoys (°C; May-Sept)	Red	Green	Yellow	Green	Green	Yellow	Red	Yellow	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Red	Yellow	Green	Green
	Upper 20 m T (°C; Nov-Mar)	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	Upper 20 m T (°C; May-Sept)	Red	Yellow	Yellow	Green	Green	Red	Red	Red	Yellow	Green	Green	Green	Green	Yellow	Green	Green	Red	Red	Red	Red	Yellow	Yellow	Red	Red	Red	Yellow	Green	Green
	Deep Temp (°C; May-Sept)	Red	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	Deep Salinity (May-Sept)	Red	Green	Yellow	Green	Green	Red	Red	Red	Yellow	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
LOCAL BIOLOGICAL	Copepod richness (May-Sept anom)	Red	Green	Green	Yellow	Yellow	Red	Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Red	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
	N copepod biomass (May-Sept anom)	Red	Red	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	S copepod biomass (May-Sept anom)	Red	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
	Biological transition	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	Coastal Ichthyoplankton Prey Biomass (Jan-Mar)	Red	Green	Yellow	Yellow	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
	Ichthyoplankton Community Composition (Jan-Mar)	Yellow	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
	Chinook salmon juvenile catch	Red	Green	Green	Red	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
	Coho salmon juvenile catch	Red	Yellow	Red	Green	Yellow	Green	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
MEANS & RANKS	Mean of ranks	24.1	8.8	10.1	10.2	8.4	17.7	21.4	22.4	14.3	12.6	4.1	11.3	16.3	9.6	7.8	10.6	16.7	23.3	23.0	21.6	15.9	19.9	15.4	7.4	12.6	12.4	16.2	11.4
	Rank of the mean rank	Red	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
NOT INCLUDED IN THE MEAN OF RANKS OR STATISTICAL ANALYSES	Physical Spring Trans (UI based)	Green	Green	Red	Red	Green	Yellow	Yellow	Red	Yellow	Green	Green	Green	Yellow	Yellow	Red	Yellow	Red	Red	Red	Red	Yellow	Yellow	Yellow	Green	Red	Yellow	Yellow	Green
	Physical Spring Trans - Hydrographic	Red	Green	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	Upwelling Anomaly (sum April-May)	Yellow	Red	Red	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
	Length of Upwelling Season (UI based)	Green	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green
Copepod Community Index (May-Sept)	Red	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Yellow	Yellow	Green	



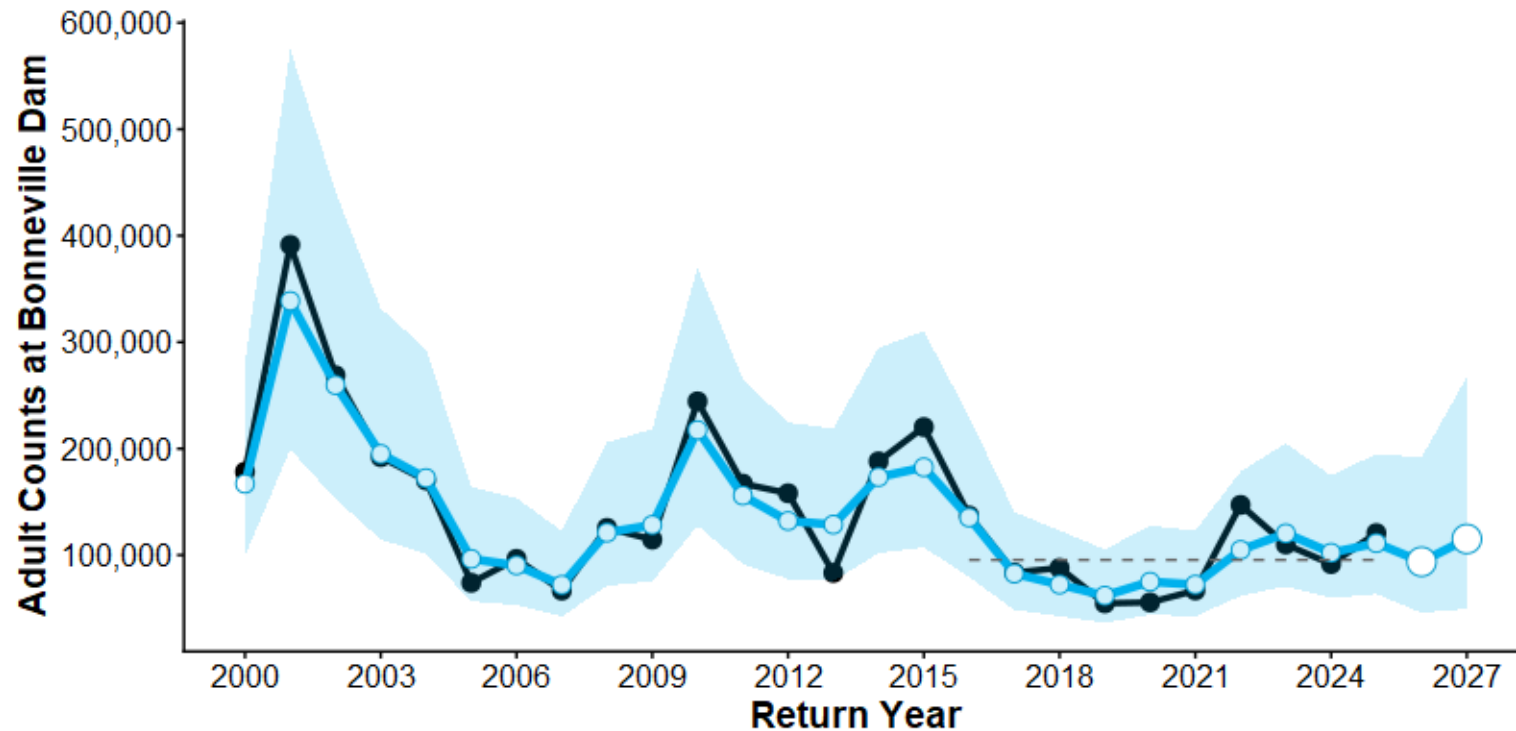
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# Spring Chinook at Bonneville Dam

Output from a Dynamic Linear Model

Forecast for 2026 = 94K

Forecast for 2027 = 115K



Count data obtained from: [https://www.cbr.washington.edu/dart/query/adult\\_annual\\_sum](https://www.cbr.washington.edu/dart/query/adult_annual_sum)

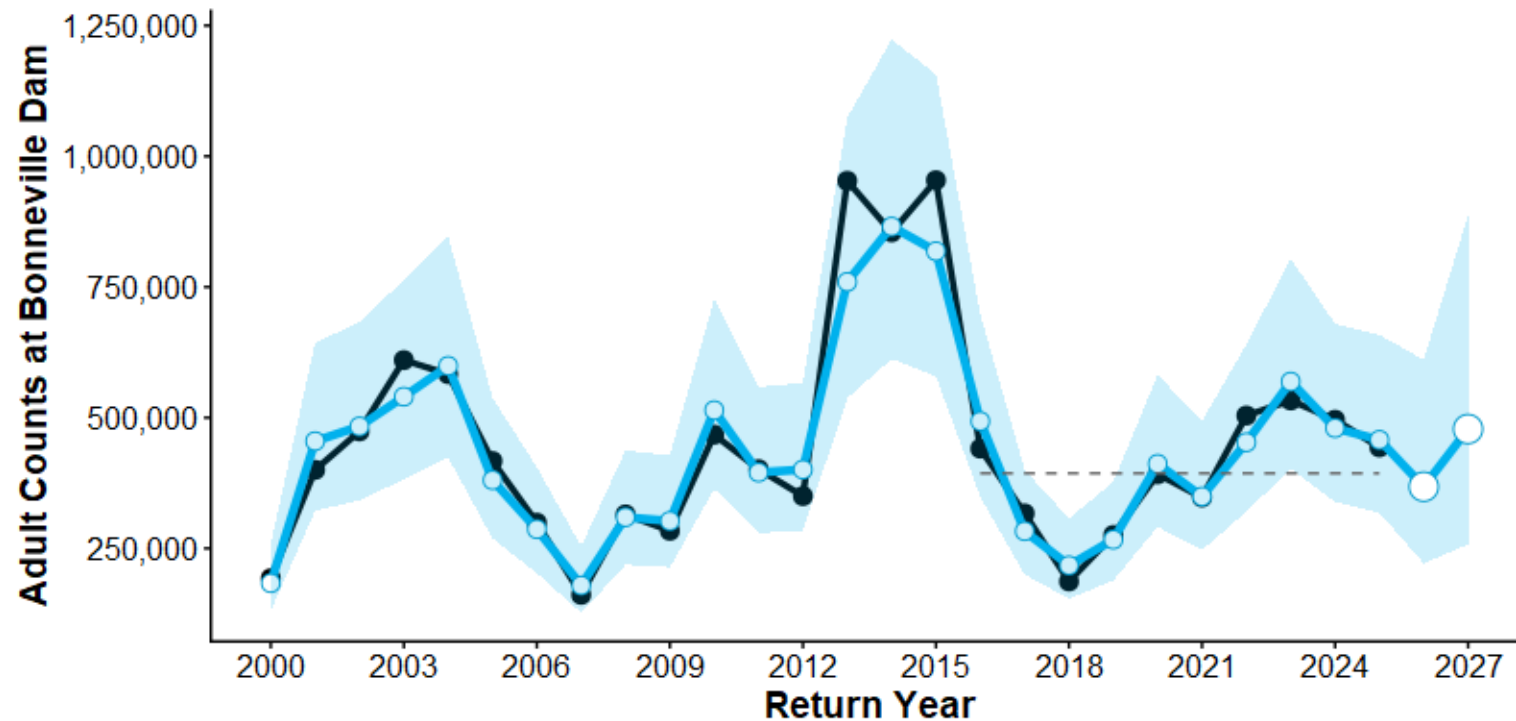


# Fall Chinook at Bonneville Dam

Output from a Dynamic Linear Model

Forecast for 2026 = 368K

Forecast for 2027 = 478K



Count data obtained from: [https://www.cbr.washington.edu/dart/query/adult\\_annual\\_sum](https://www.cbr.washington.edu/dart/query/adult_annual_sum)

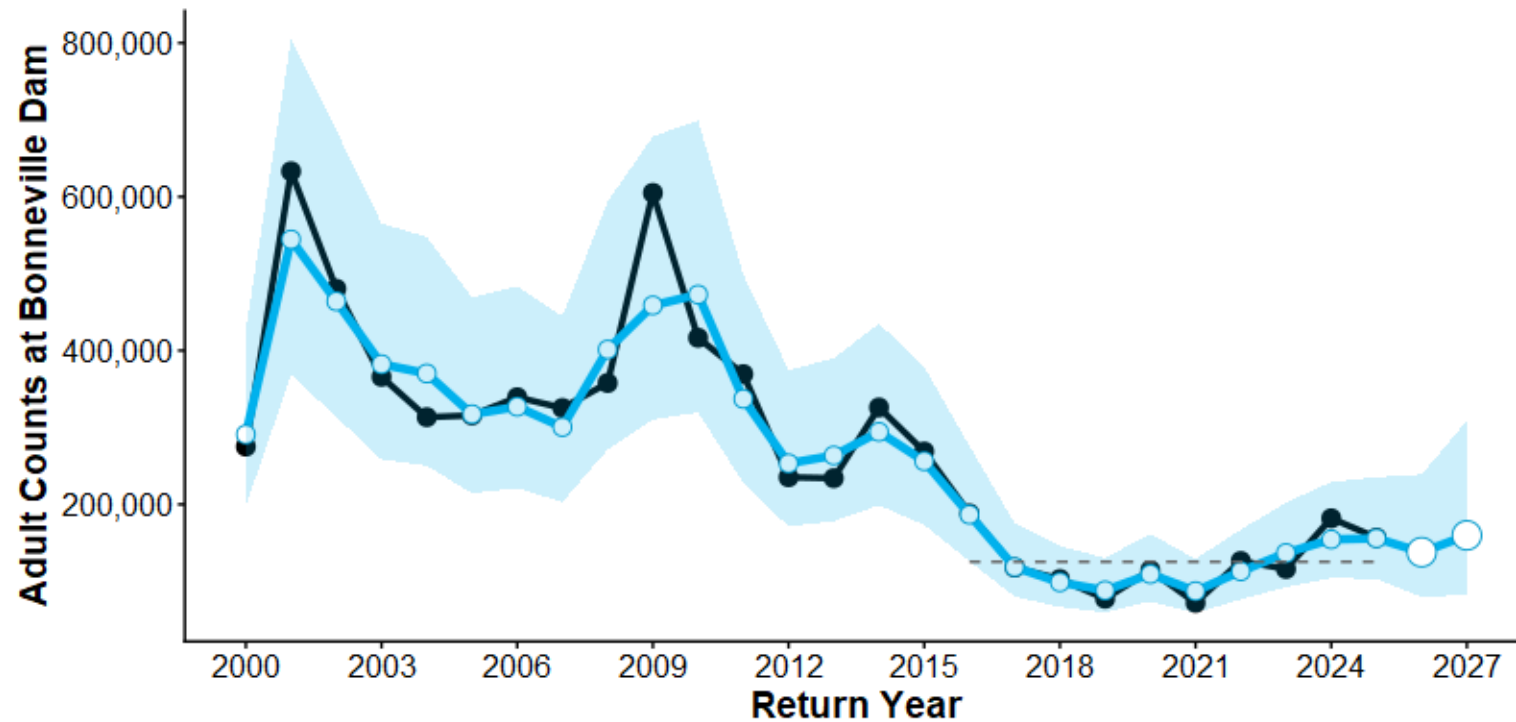


# Steelhead at Bonneville Dam

Output from a Dynamic Linear Model

Forecast for 2026 = 138K

Forecast for 2027 = 160K

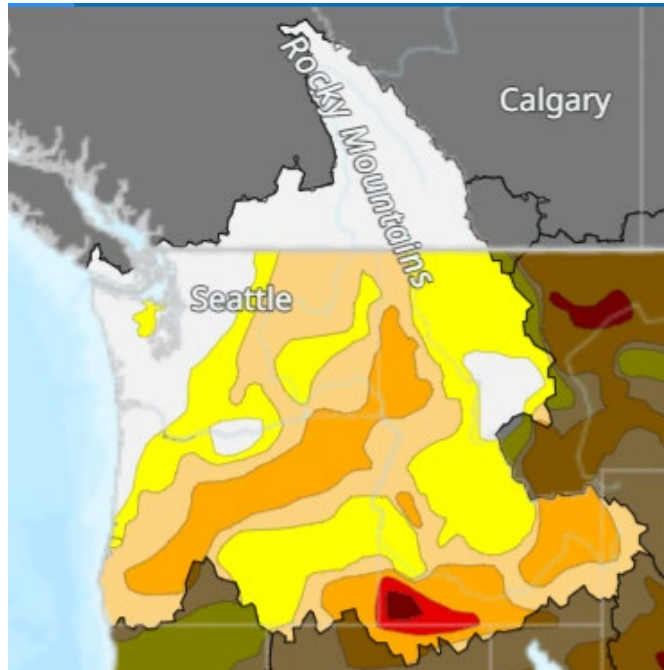








Count data obtained from: [https://www.cbr.washington.edu/dart/query/adult\\_annual\\_sum](https://www.cbr.washington.edu/dart/query/adult_annual_sum)

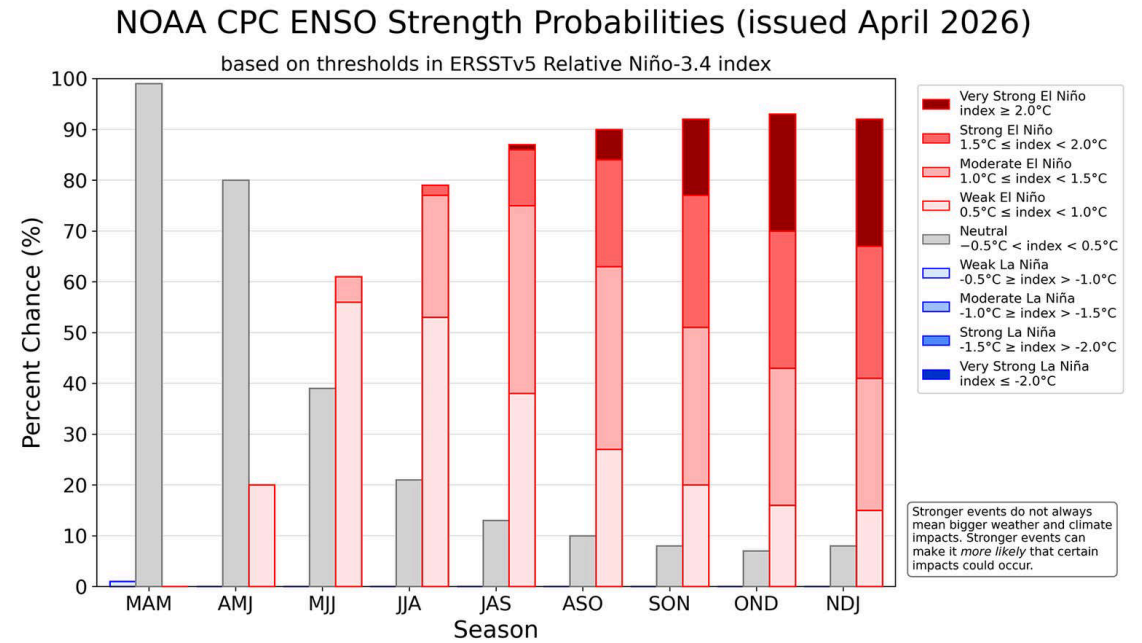


# Early warning for 2026

## Very Strong El Niño Expected



	D0 – Abnormally Dry	<b>32.64%</b>
	D1 – Moderate Drought	<b>30.52%</b>
	D2 – Severe Drought	<b>21.26%</b>
	D3 – Extreme Drought	<b>1.89%</b>
	D4 – Exceptional Drought	<b>0.53%</b>
	Total Area in Drought (D1–D4)	<b>54.20%</b>



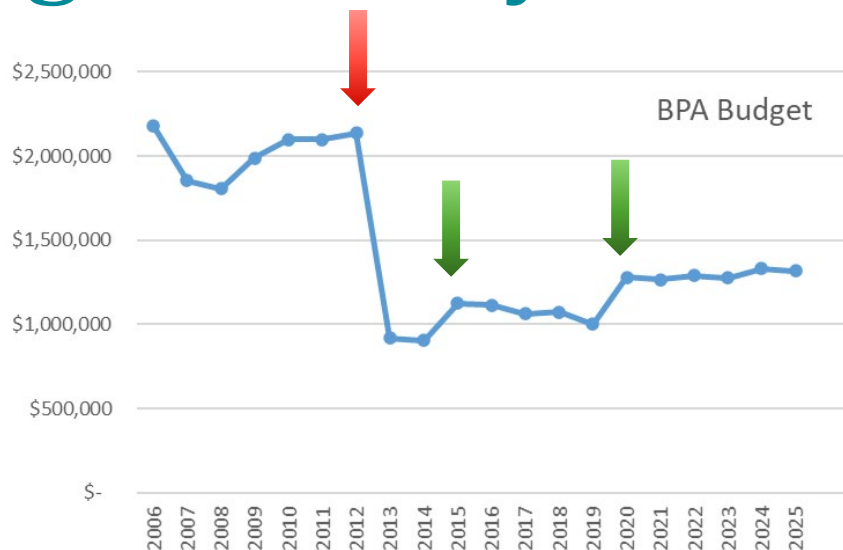
<https://www.drought.gov/watersheds/pacific-northwest>

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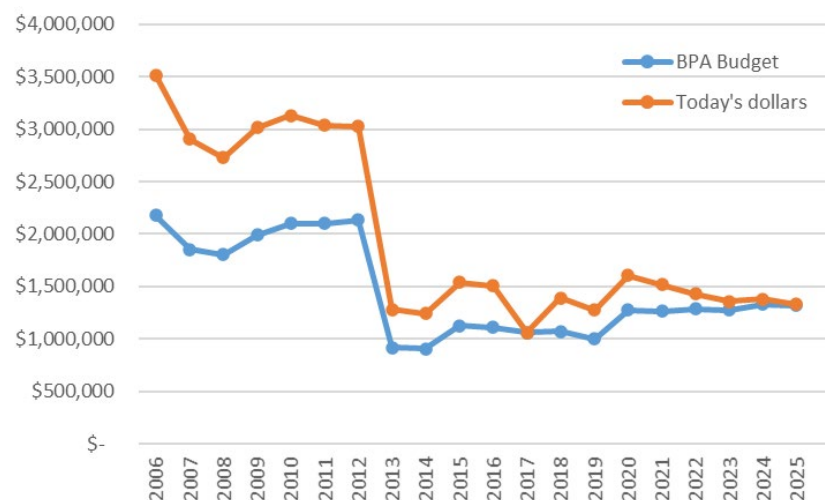
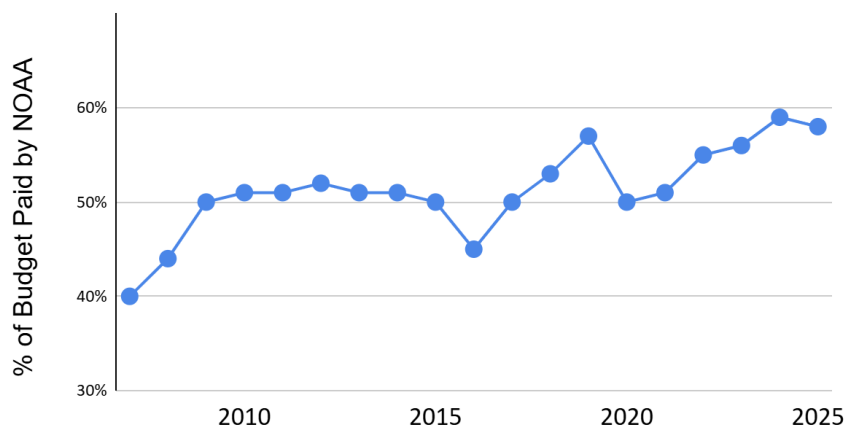


# Budget History



- ~~May~~, June, and ~~September~~ surveys
- ~~Canadian survey~~
- ~~Predator survey~~
- ~~Estuarine modeling~~
- ~~Telemetry tagging/tracking~~
- ~~Salmon parasites~~

## Cost Share



# Heads up: Survey Adjustments

- Taking advantage of Advanced Technologies to maximize efficiency
  - Digital data collection
  - Thermal Imaging cameras and AI for birds and mammal detection (NOAA funded)
  - eDNA to map predator distributions along WA coast (unfunded)
- No longer collecting IGF (growth hormone)
- Potentially cancel the May survey, starting in 2028





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# Take Home Messages

1. Year class strength is set in the coastal ocean, within 2 months of fish leaving the river
2. Ocean growth *strongly* influences jack rate, with implications for population dynamics and recovery
3. 2024 and 2025 were about average – adult returns this year and next year should be too
4. Rising costs are requiring us to modify our efforts

# Questions?



[brian.burke@noaa.gov](mailto:brian.burke@noaa.gov)



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# NWPPC F&W Draft 2026 Program

## Current



## Soon



## Research, Monitoring, and Evaluation

- **PNO 1.** Evaluate the effects of flow regulation on plume and nearshore ocean characteristics and salmon and steelhead productivity, abundance, and diversity.
- **PNO 2.** Continue long-term monitoring of the distribution, abundance, survival, and growth of juvenile salmon and steelhead in the plume and nearshore ocean along with the corresponding environmental conditions they experience while inhabiting those environments. Results from this research will improve understanding of how marine ecosystem changes affect Columbia River salmon and steelhead.
- **PNO 3.** Distinguish ocean-related mortality from that caused in the freshwater part of the life cycle in order to assess the relative benefits of different mitigation actions taken in freshwater.
- **PNO 4.** Continue to produce and report annually on a stoplight chart containing physical and biological indicators for ocean conditions experienced by juvenile Columbia River salmon and steelhead and hypothesized to correlate with growth or survival.
- **PNO 5.** Develop and report on stock-specific ocean indicators (stoplight charts) for forecasting salmon and steelhead returns using a mechanistic ecosystem approach. These stock-specific indicators may help identify the most important ecological drivers of survival under variable ocean conditions.
- **PNO 6.** Continue to produce an annual index of ocean survival from Bonneville Dam back to Bonneville Dam, and forecasts of survival.
- **PNO 7.** Investigate predator and prey relationships for salmon in the plume and nearshore ocean.
- **PNO 8.** Sustain implementation of nearshore ocean and plume monitoring and research at a level adequate to deliver useful information about salmon and steelhead survival in the nearshore ocean and plume as described above.
- **PNO 9.** Describe and analyze patterns of larval Eulachon dispersal into the Columbia River plume associated with changes in the physical characteristics of the plume.

## Freshwater Actions to Improve Ocean Survival

- **PNO 10.** Continue to investigate links between actions taken in freshwater and the response of juvenile salmon and steelhead in the nearshore ocean and plume to identify which freshwater actions (e.g., such as those that improve smolt body size or affect run timing) affect marine growth and survival.
- **PNO 11.** Identify key uncertainties and opportunities to improve in-river management to best allow fish to accommodate variable ocean conditions. Predicting future ocean conditions and anadromous fish returns allows for adjustments to inland actions and may lead to increased survival benefits.

## Forum

- **PNO 12.** The Council supports efforts by the Ocean and Plume Science and Management Forum and science/policy exchanges to encourage coordination and communication between ocean scientists and fish and wildlife agencies and tribes, meeting as often as needed.

