Reading the Signals: Ocean Ecosystem Indicators, Recent Trends, and Why They Matter

Upper Columbia River Salmon Recovery Board Summit
January 21st, 2026

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Also supported by:

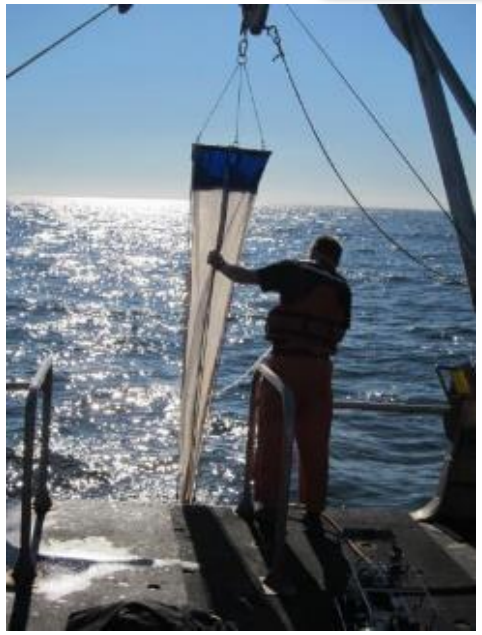
Outline

- Who we are and what we do
- The Ocean Ecosystem
- Why this matters to you

NOAA FISHERIES

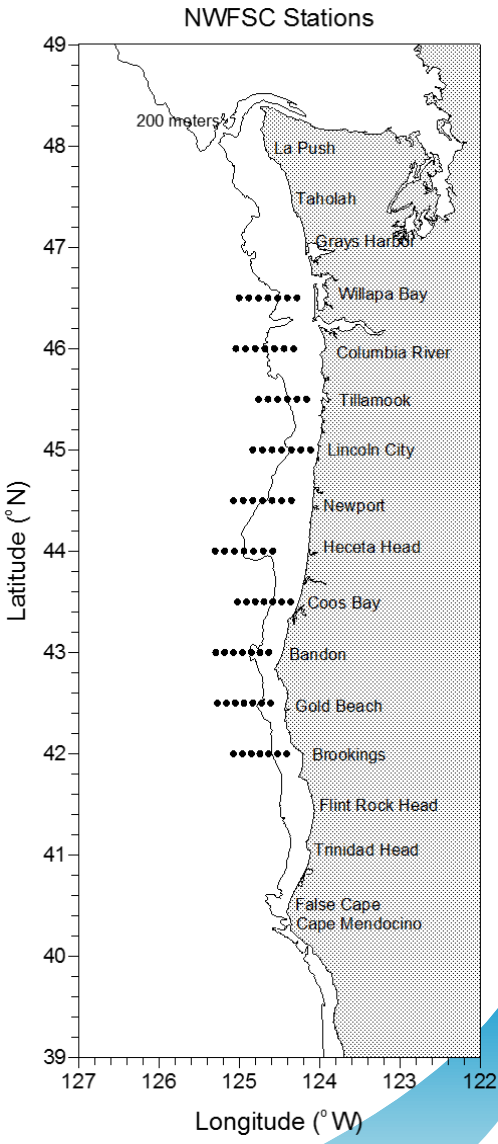
Newport Hydrographic Line and Northern California Current Survey

Newport Line: Sampled biweekly for 30 years



Pre-recruit: May-June (2011, 2013-present)

NCC Survey: Seasonal (2-4 times per year)

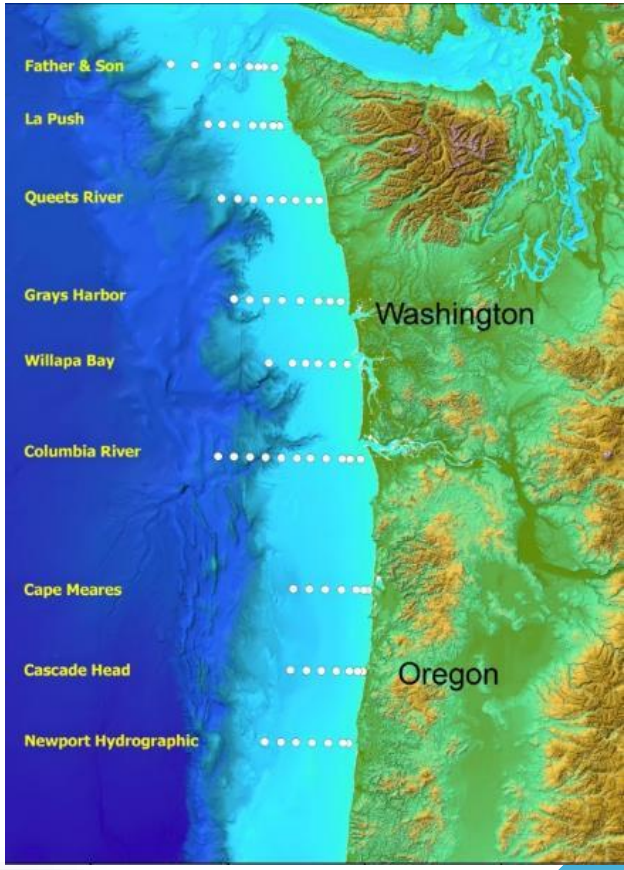


NOAA FISHERIES

Juvenile Salmon and Ocean Ecosystem Survey (JSOES)

BONNEVILLE POWER ADMINISTRATION

- May (2006 – 2012, 2015 - present)
- June (1998 – present)
- September (1998 – 2012)



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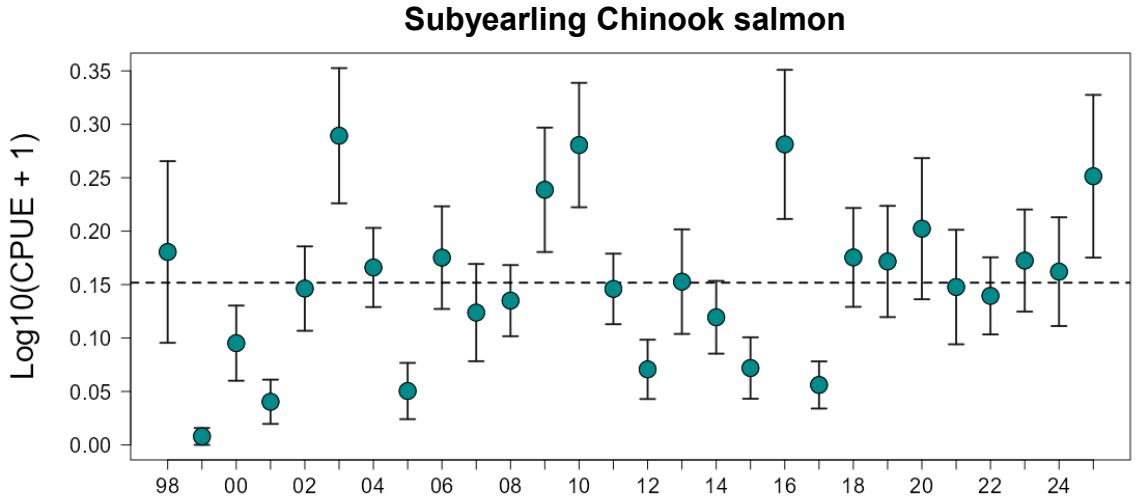
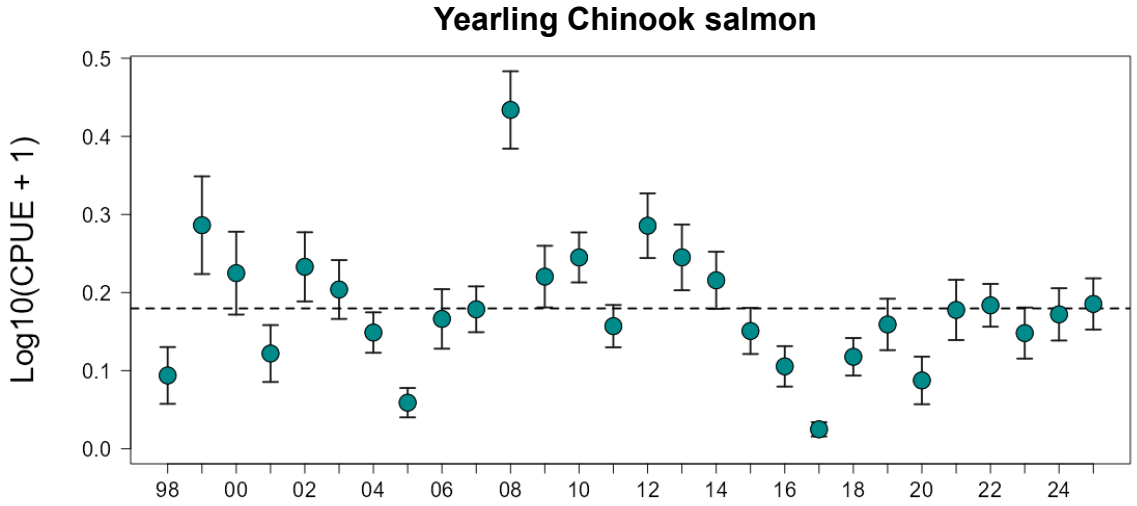
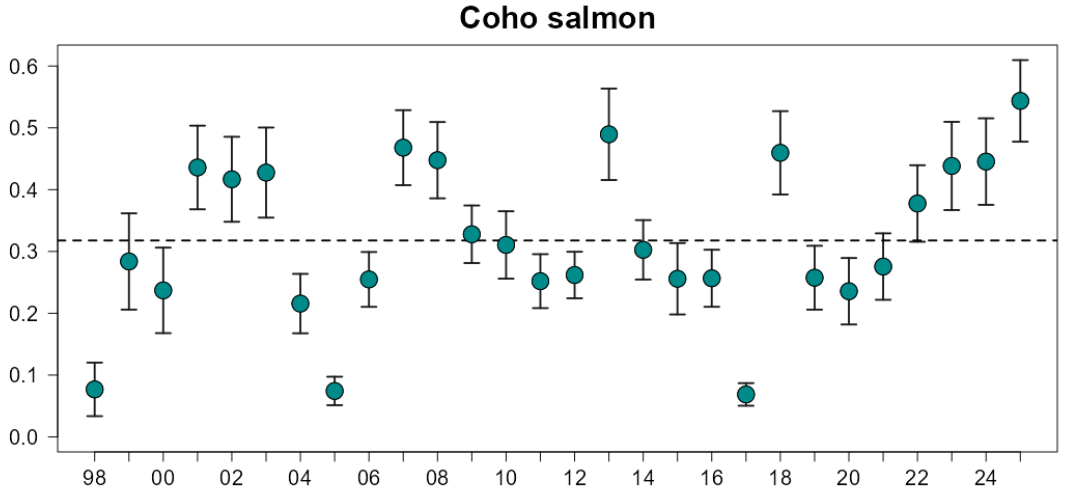
JSOES Catches - June, 1998-2025







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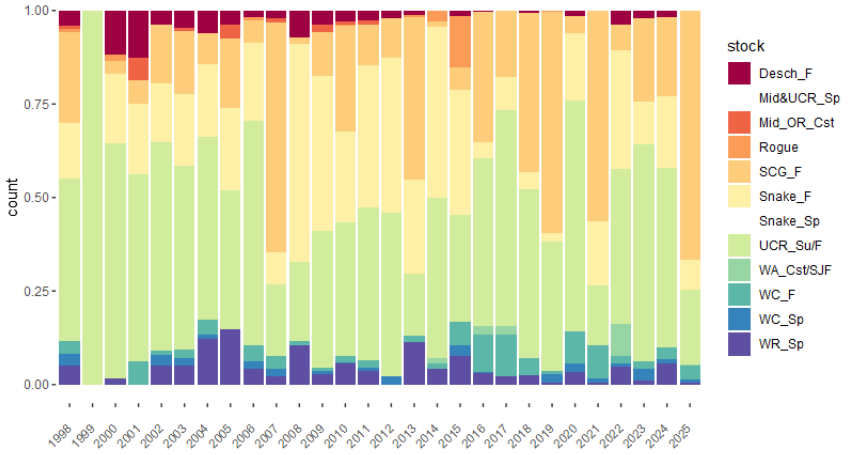
Upper Columbia River Contributions to our Catch

May

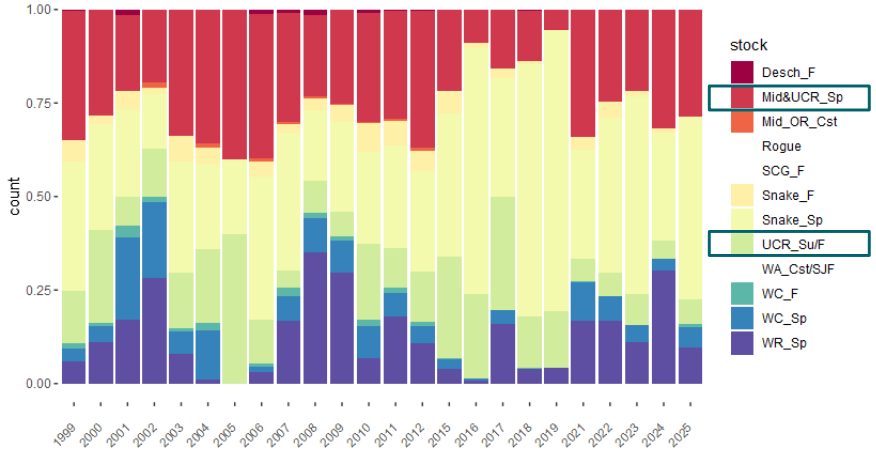
June

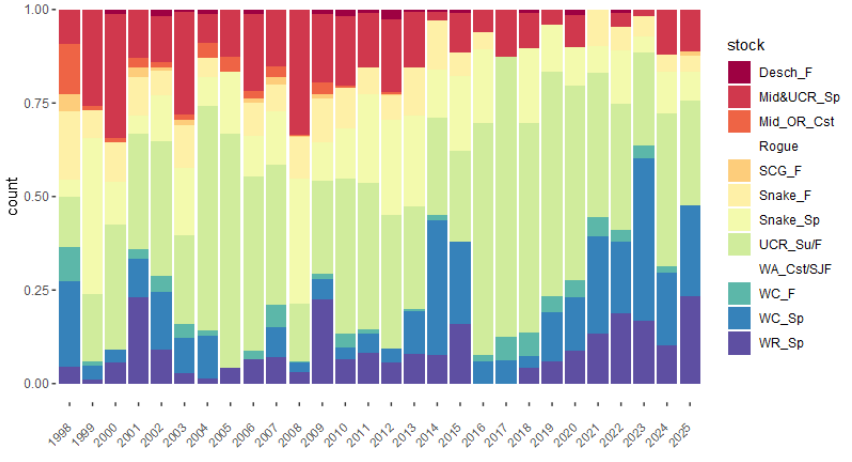
Subyearling Chinook

We catch very few
Subyearling Chinook in May



Yearling Chinook





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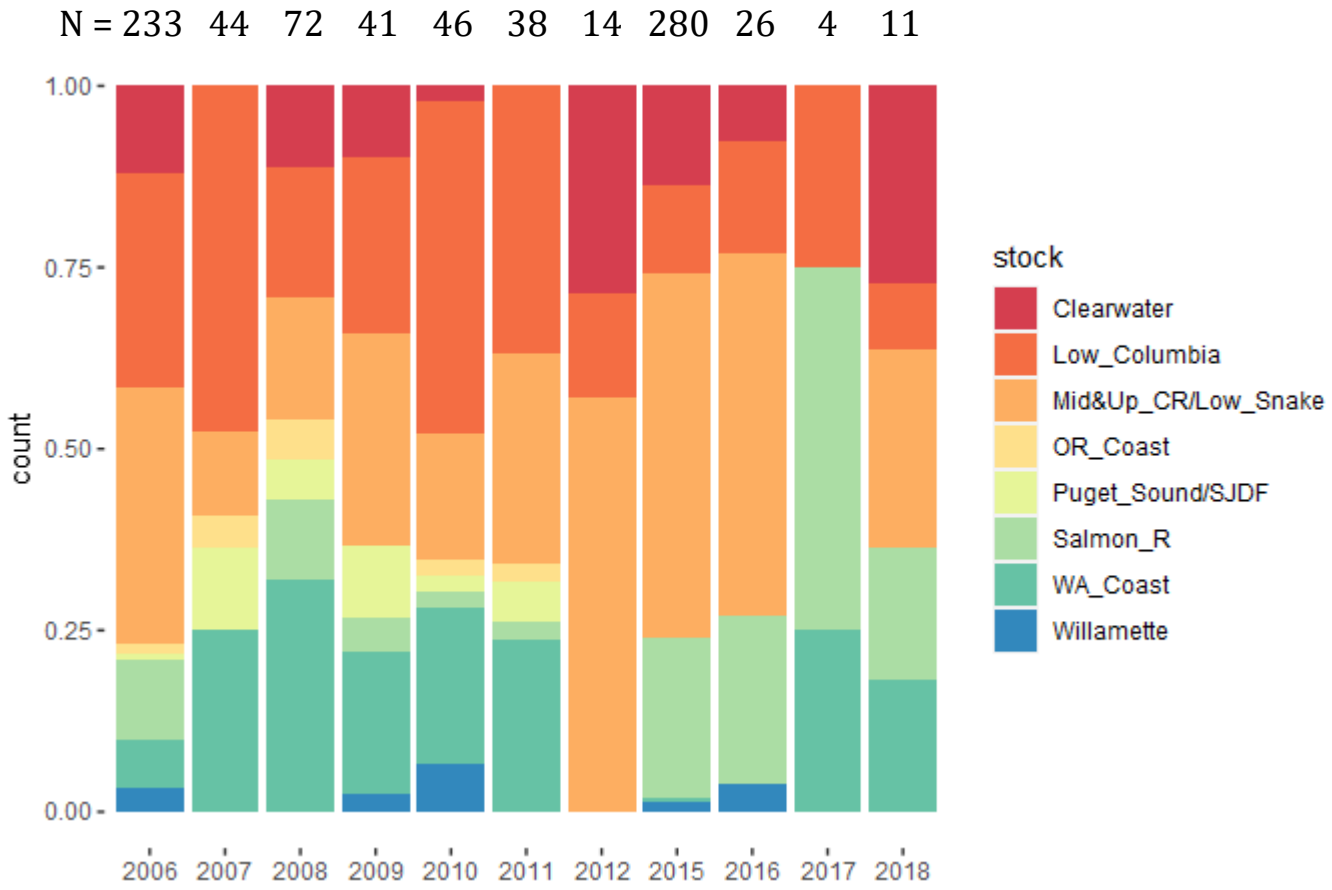
Columbia River Steelhead



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Outline

- Who we are and what we do
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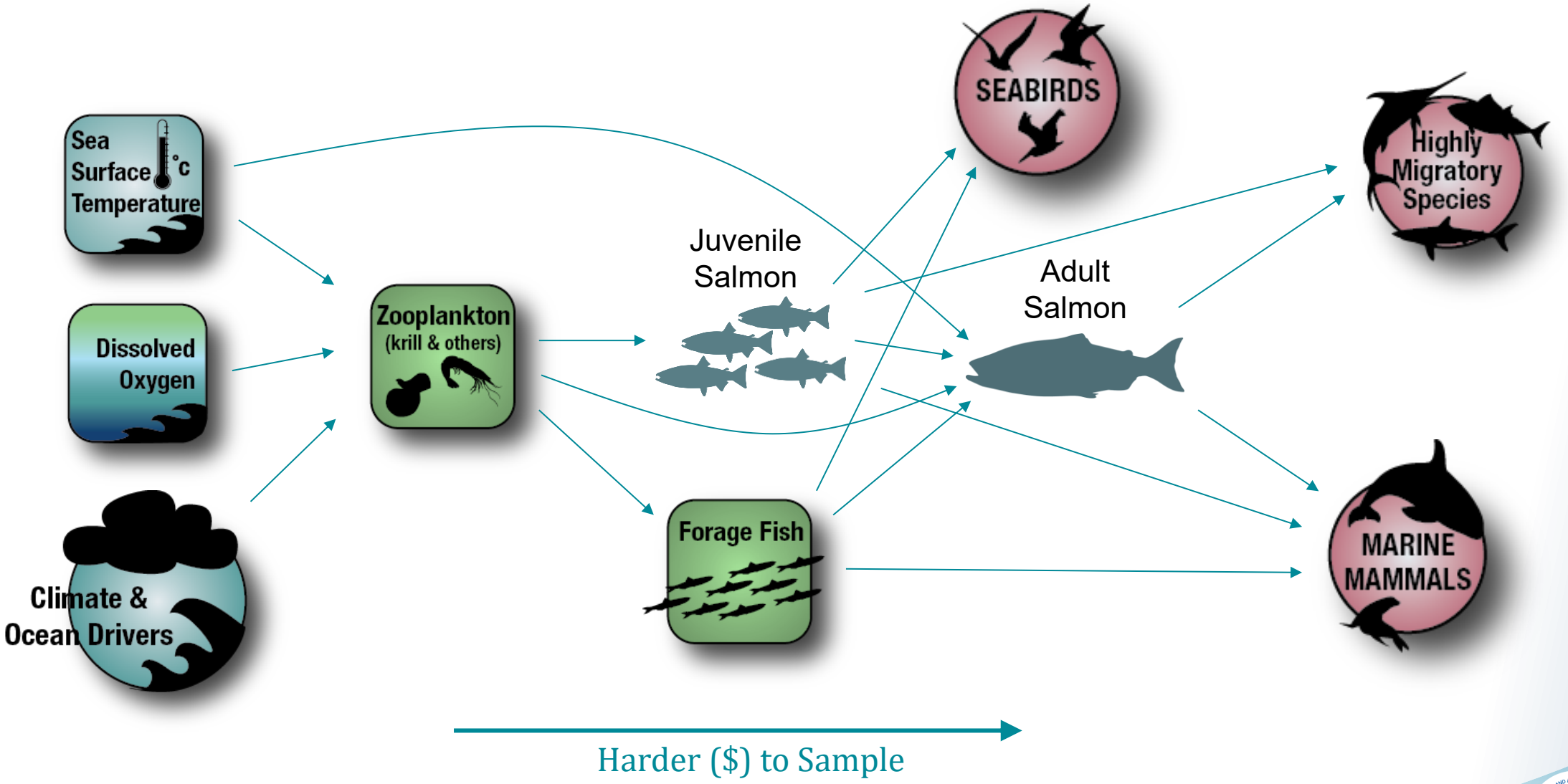
- Why this matters to you

Oversimplified Ocean Dynamics



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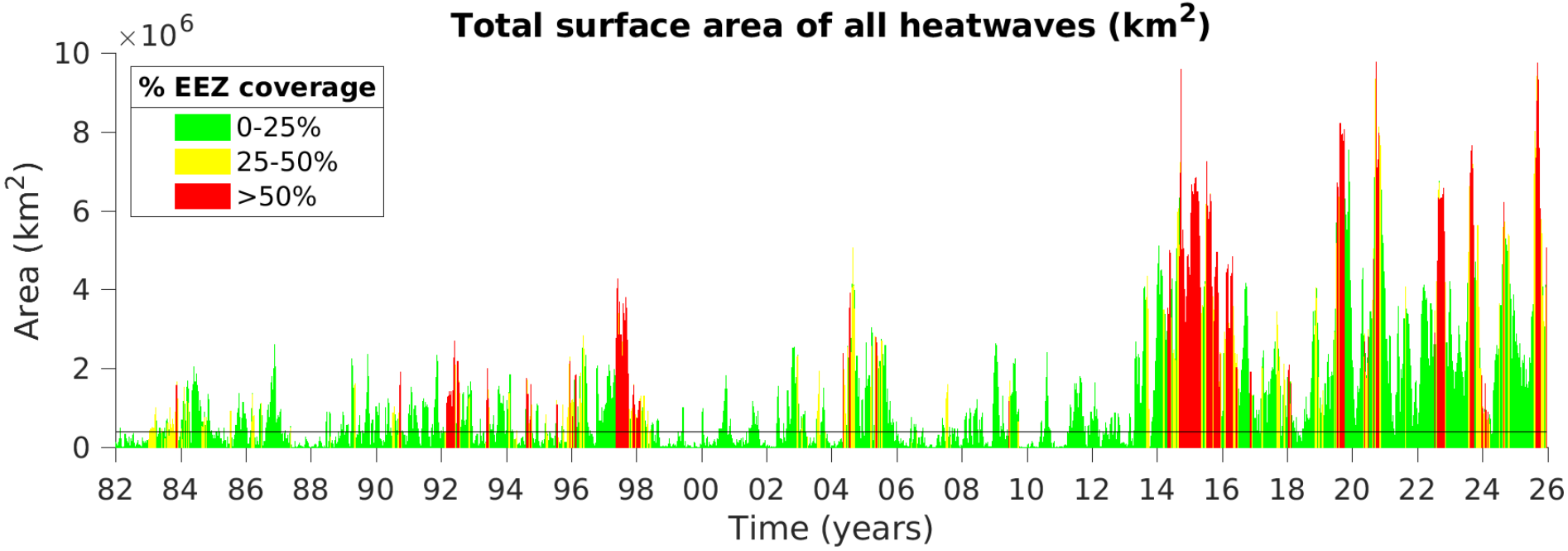
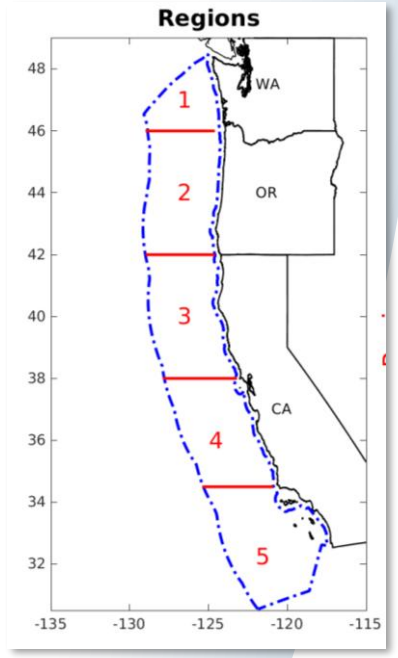
How should we think about Marine Heatwaves?





California Current Ecosystem Status Report NOAA
https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker

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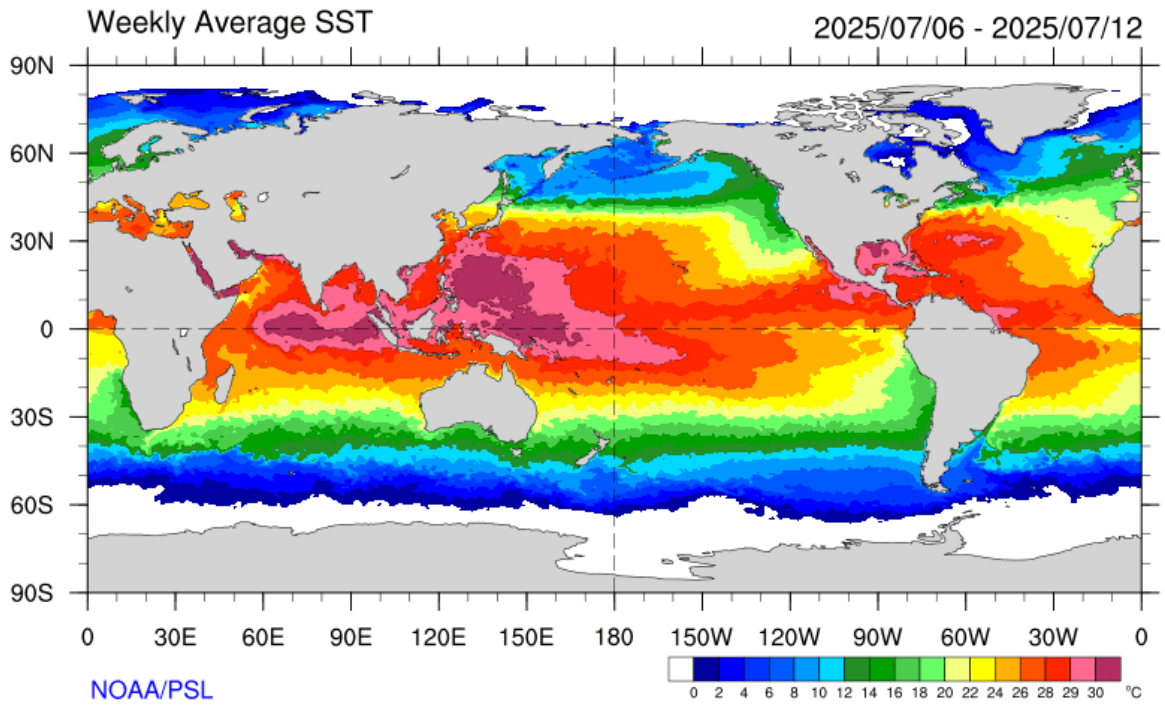
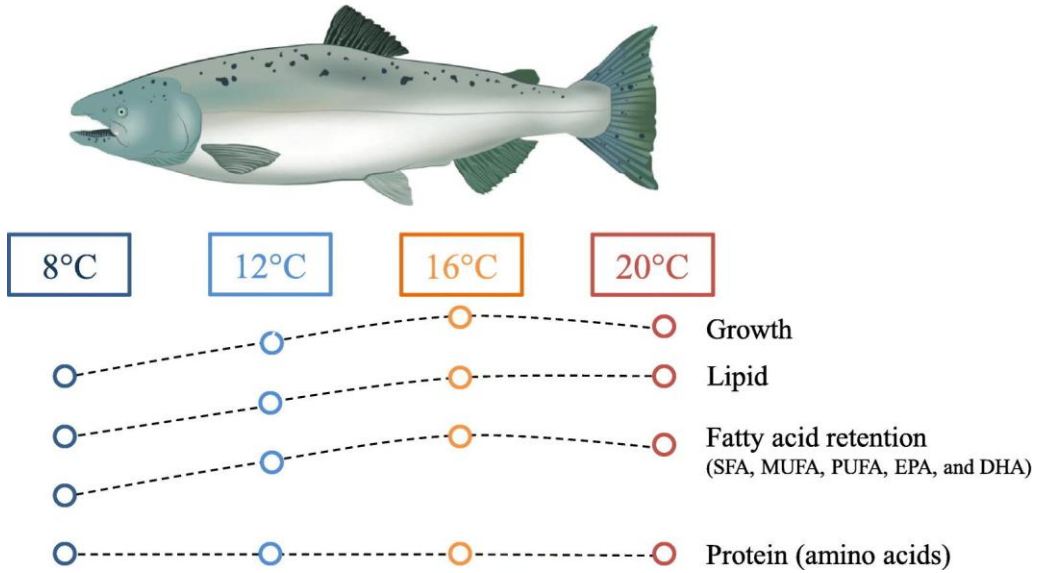
Direct impacts of temperature changes are probably minor





Bruno et al. 2023. https://doi.org/10.1016/j.cbpa.2023.111412

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Ocean Indicators: Correlations with broader Ecosystem Impacts

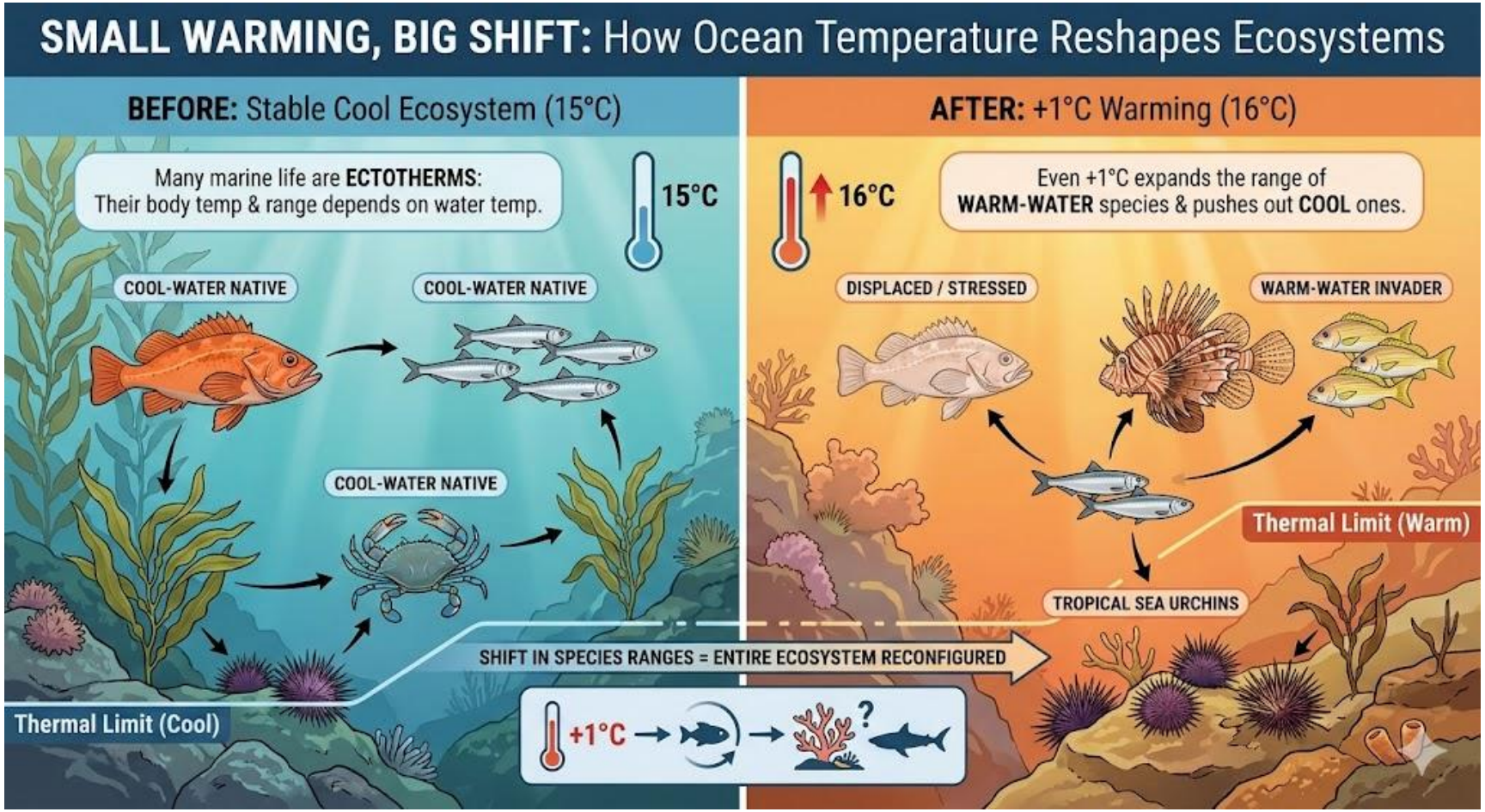
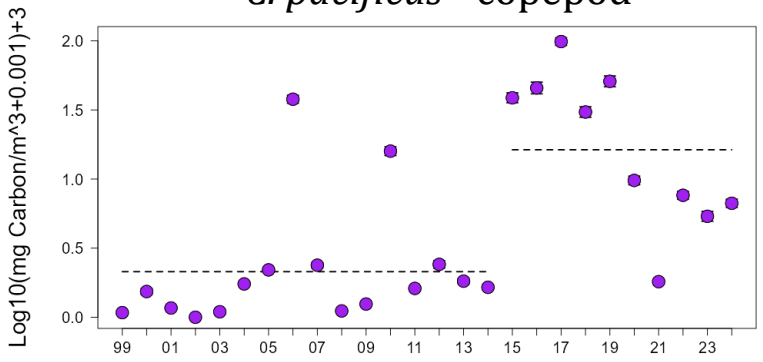


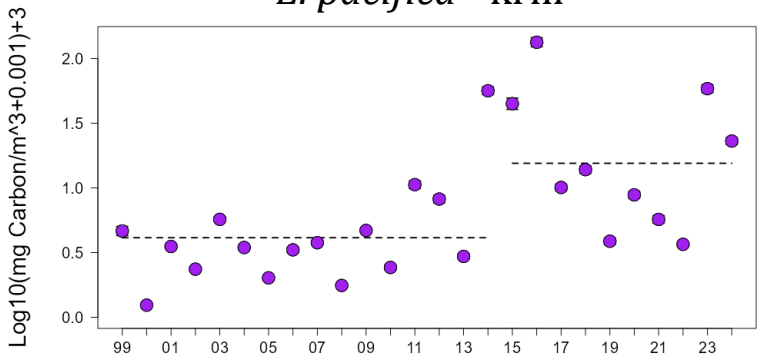
Image created by Gemini

Multiple Plankton Species Increased Since 2014 (from copepods to larval fish)

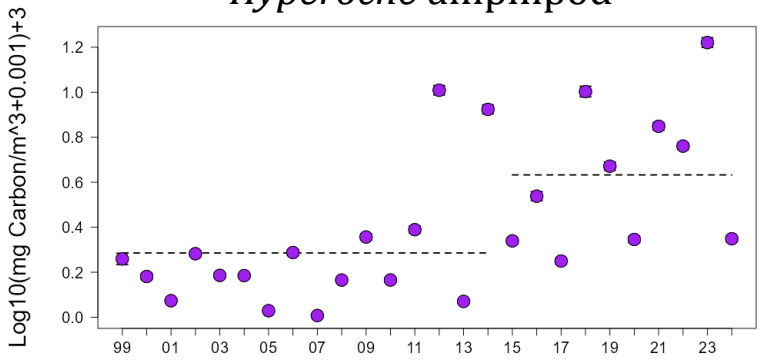
C. pacificus - copepod



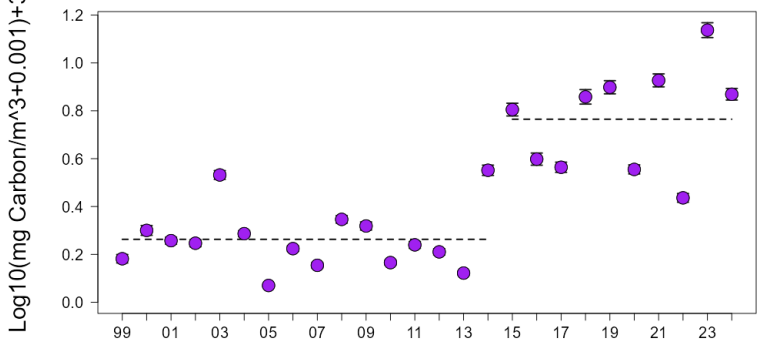
E. pacifica - krill



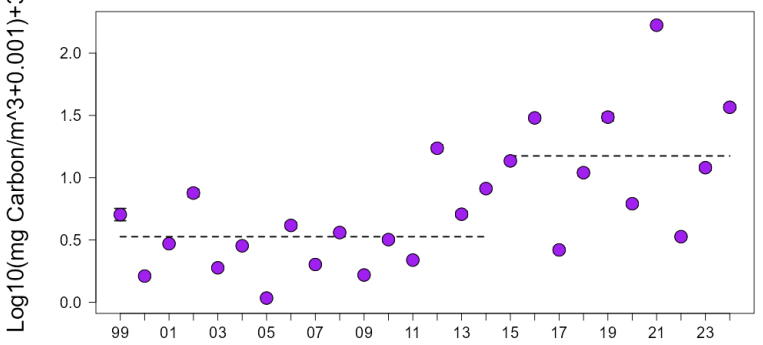
Hyperoche amphipod



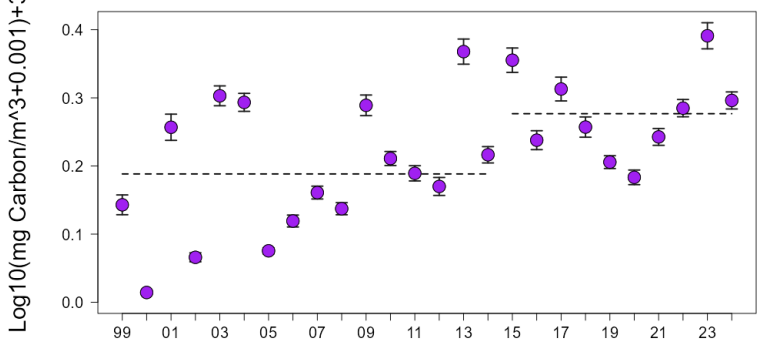
Hippolytid shrimp



Pygmy/Red rock crab



Sebastes spp. – rockfish



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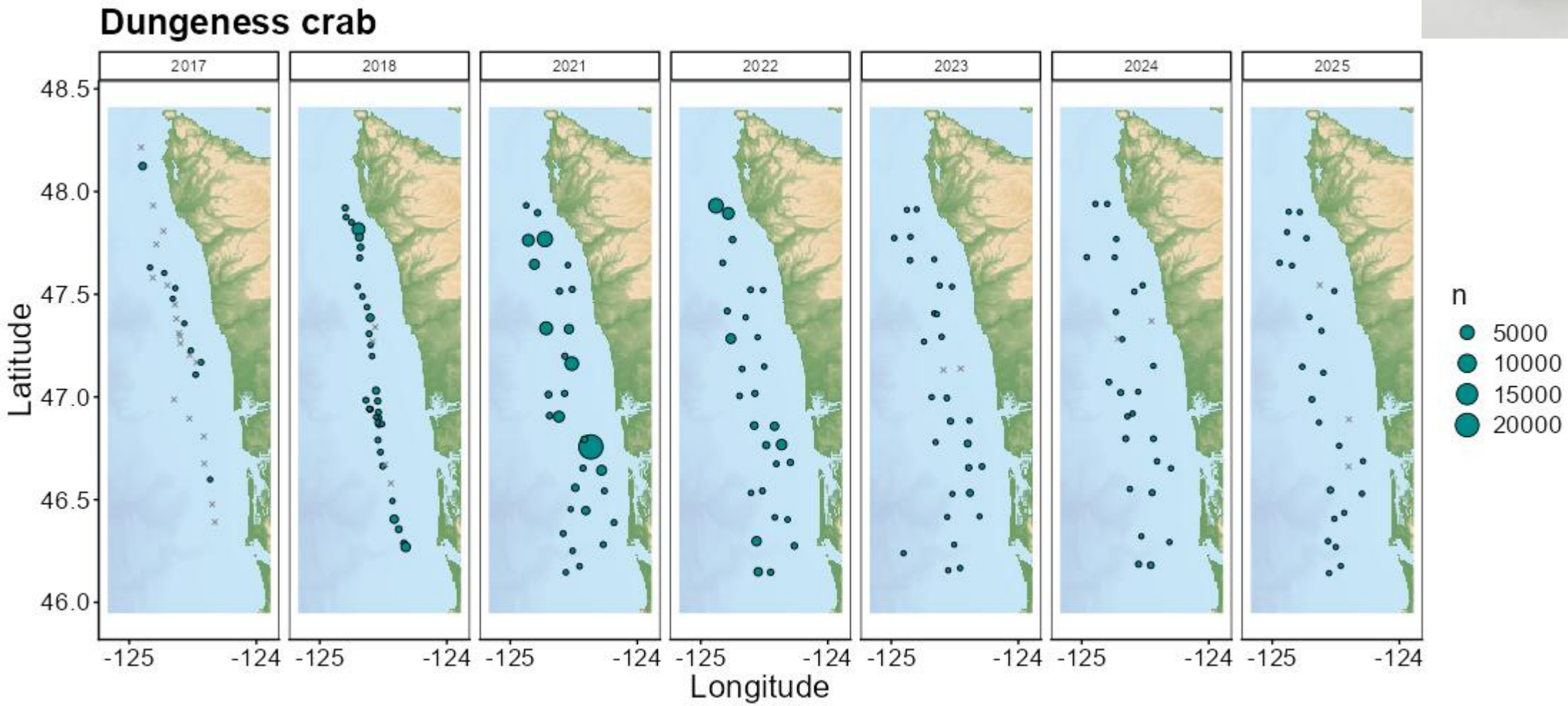
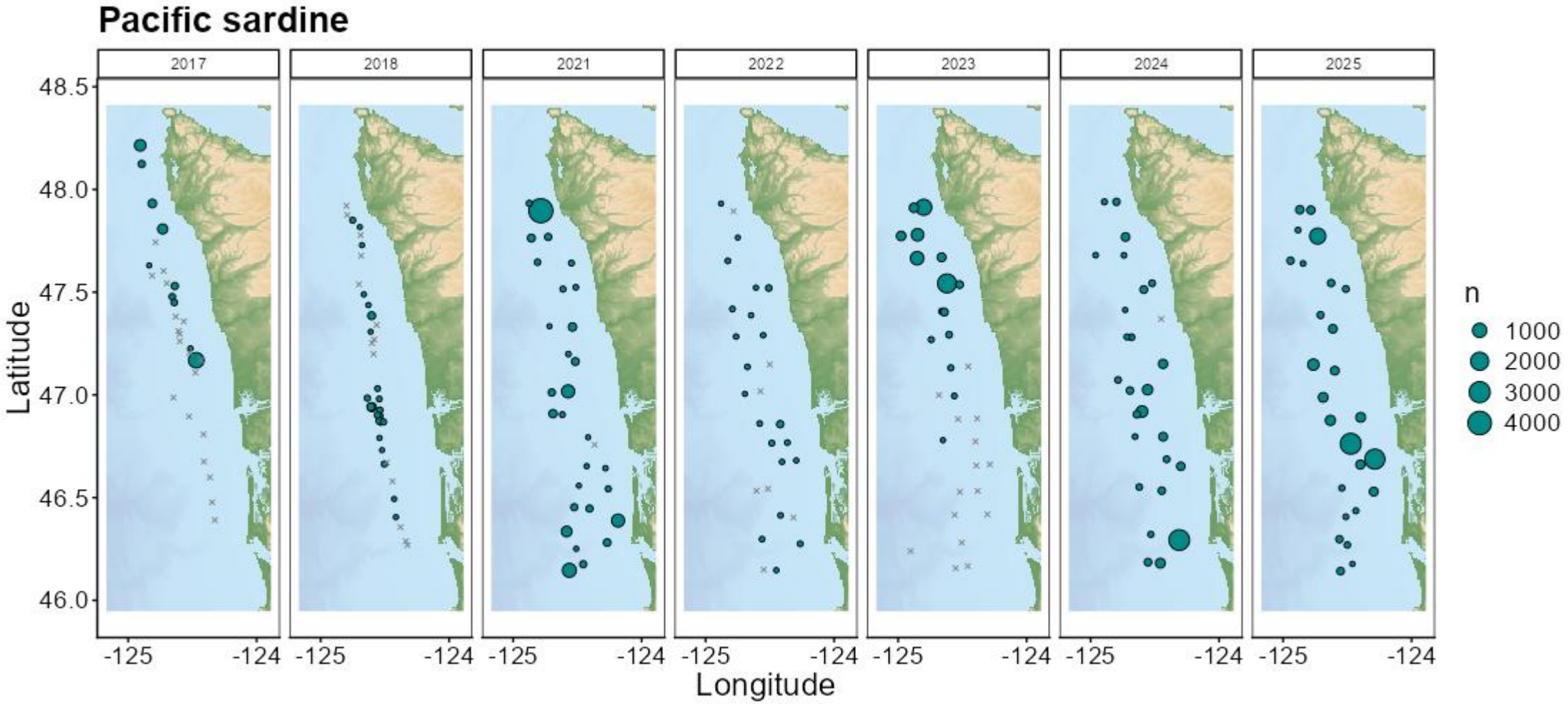
May Prey – Dungeness Crab Megalopae



May Prey – Juvenile Pacific sardine



Outline

- Who we are and what we do
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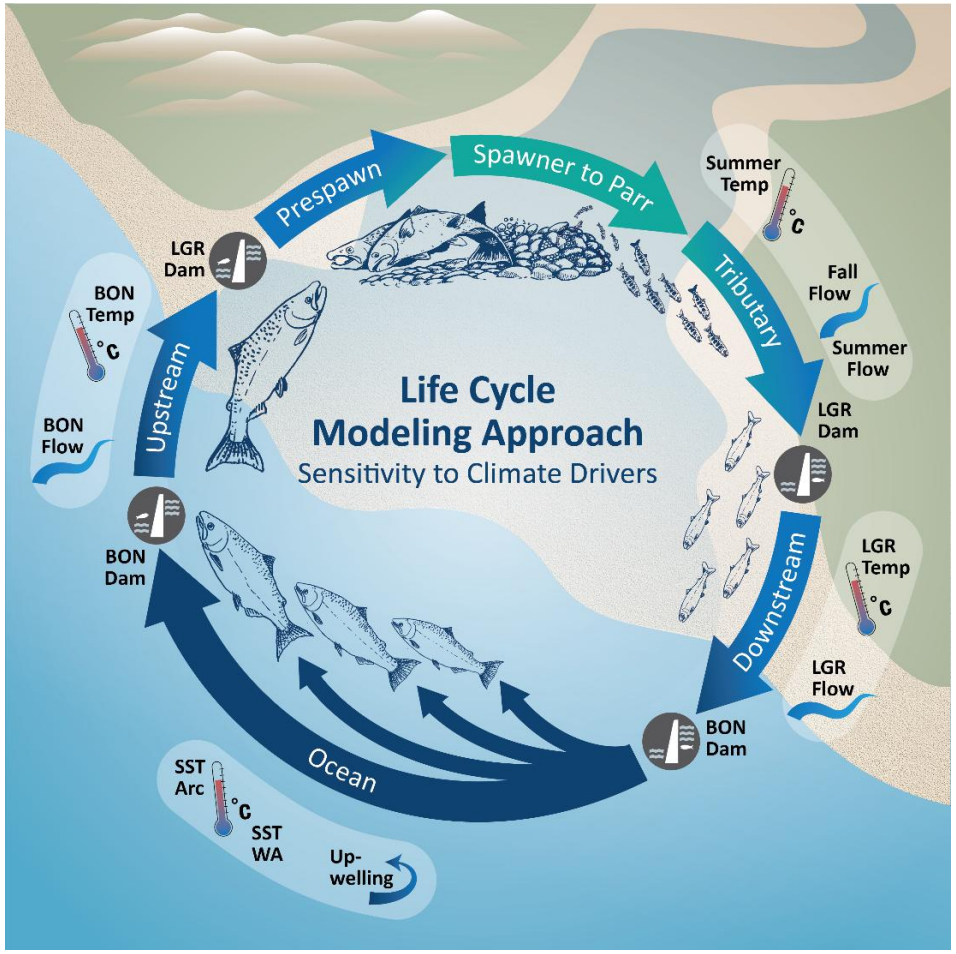
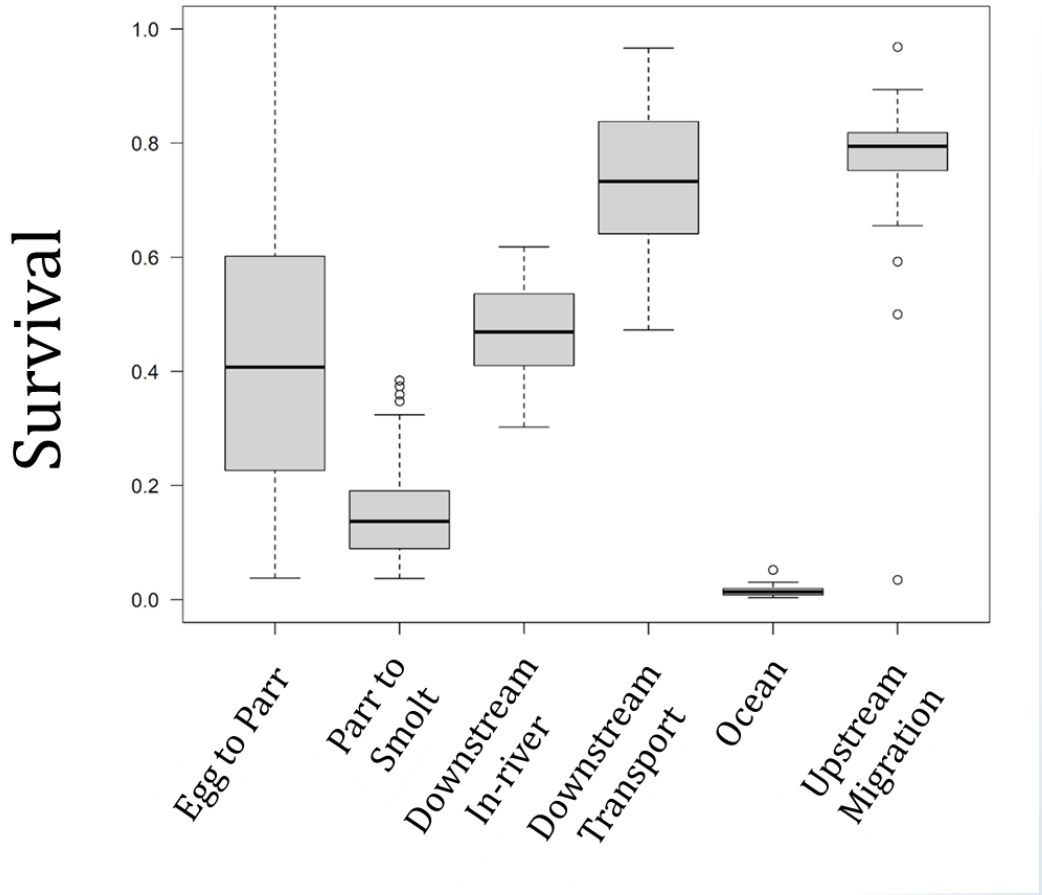
NOAA FISHERIES

Life Cycle Models, Survival, and the Ocean





Crozier et al. 2021. Communications Biology
https://doi.org/10.1038/s42003-021-01734-w

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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

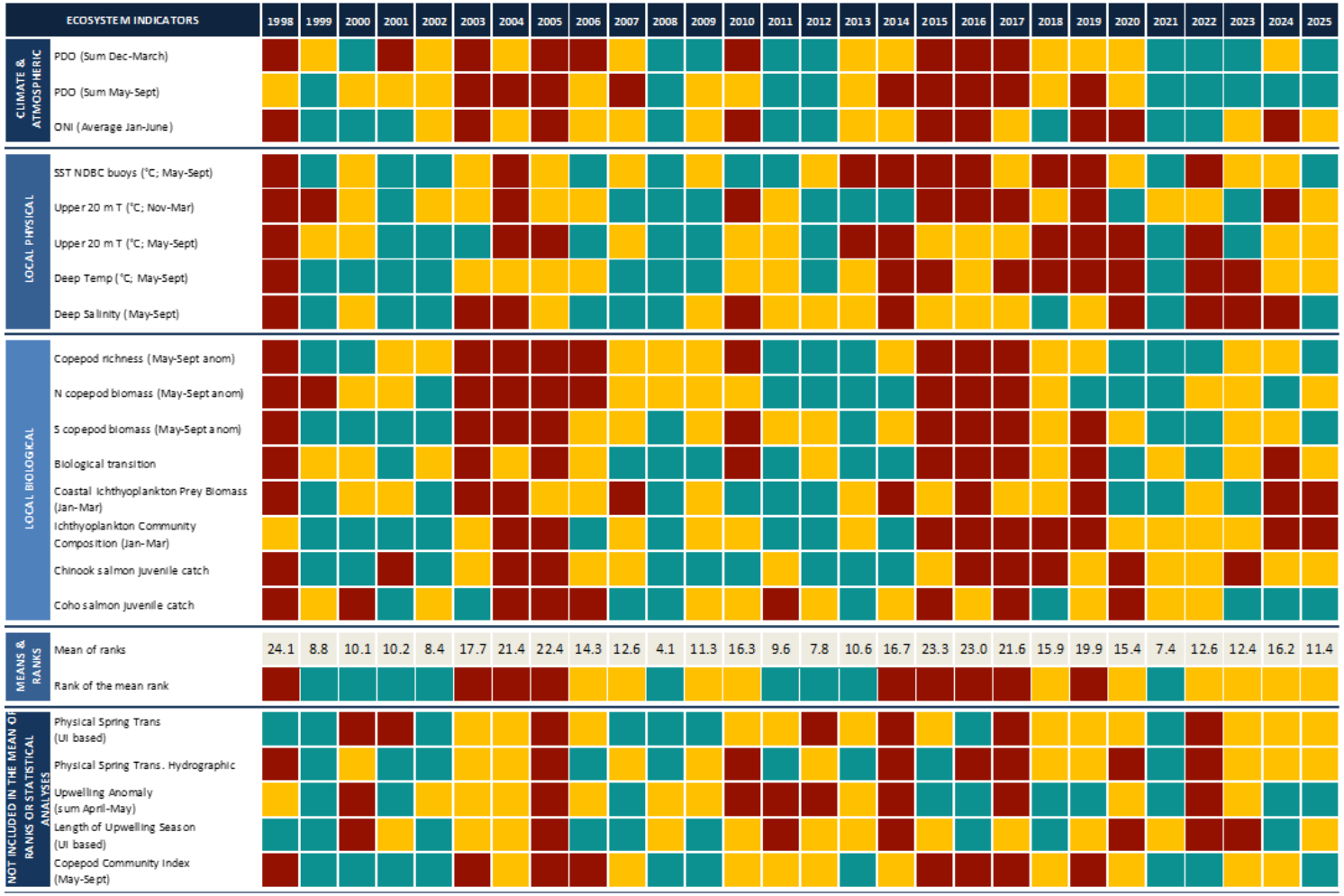
Basin Scale

Local Physical Conditions

Local Biological Conditions

Summary

Additional Indicators



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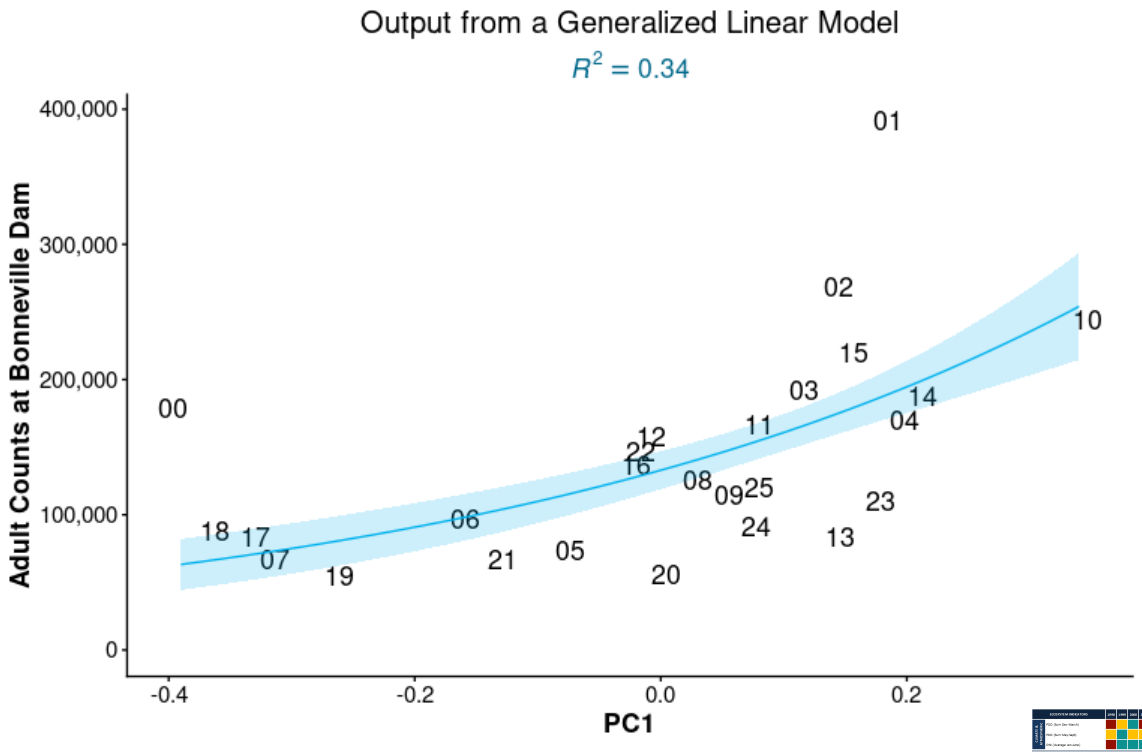
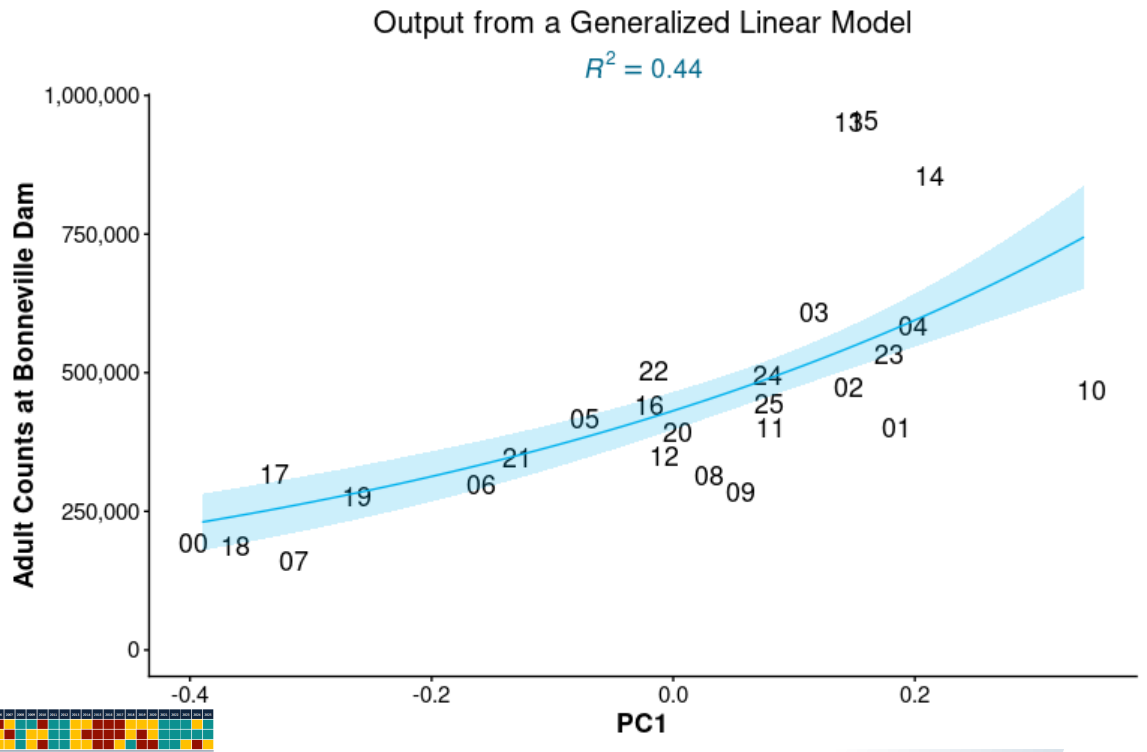
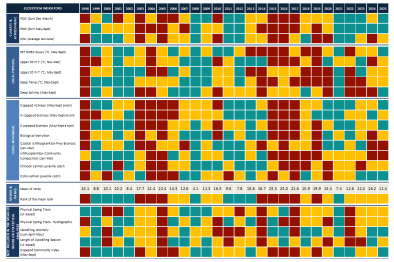
Ocean conditions are correlated with salmon returns

Spring Chinook



Fall Chinook





Count data obtained from:
https://www.cbr.washington.edu/dart/query/adult_annual_sum

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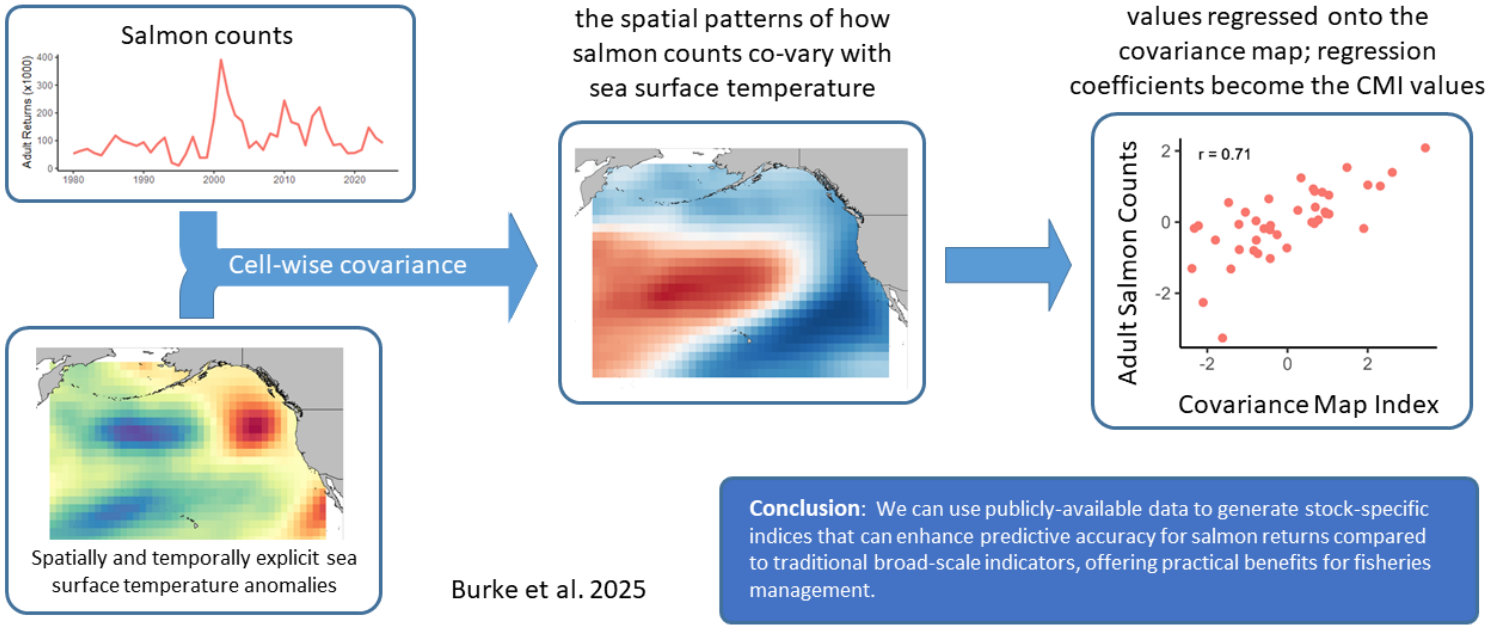
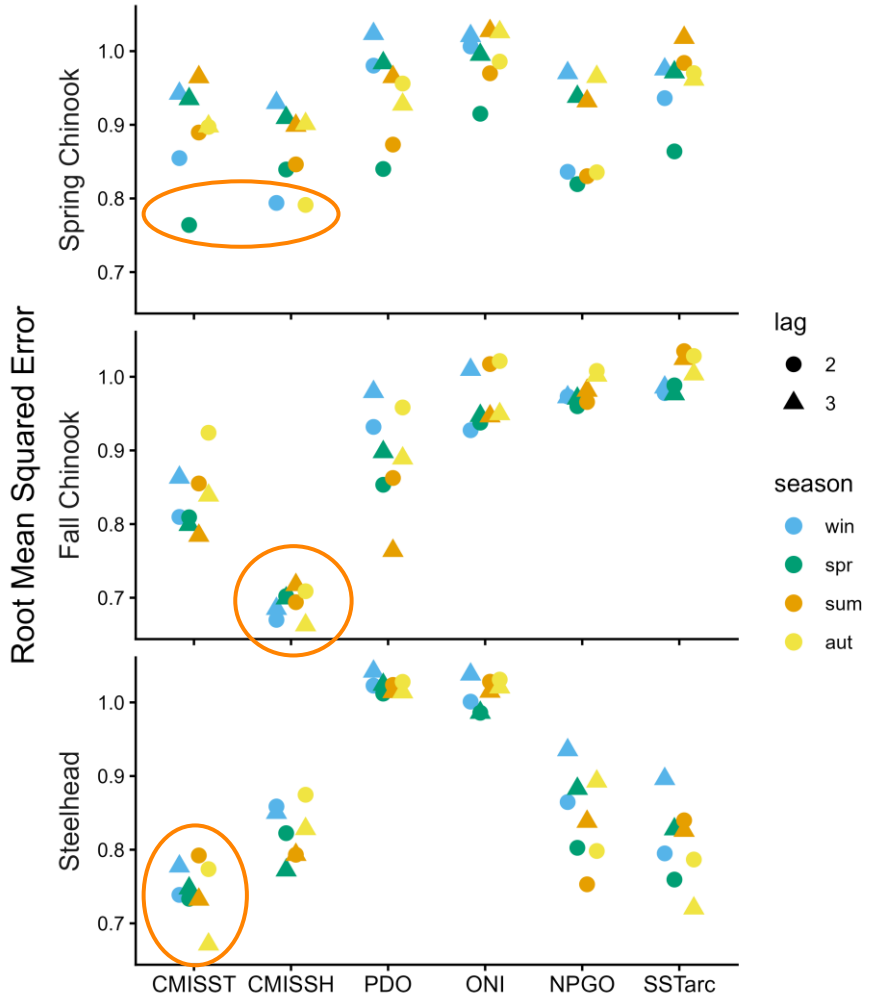
Stock-specific Index based on Sea Surface Temperature

Improving salmon marine survival models with covariance map indices (CMIs) of sea surface temperature and height



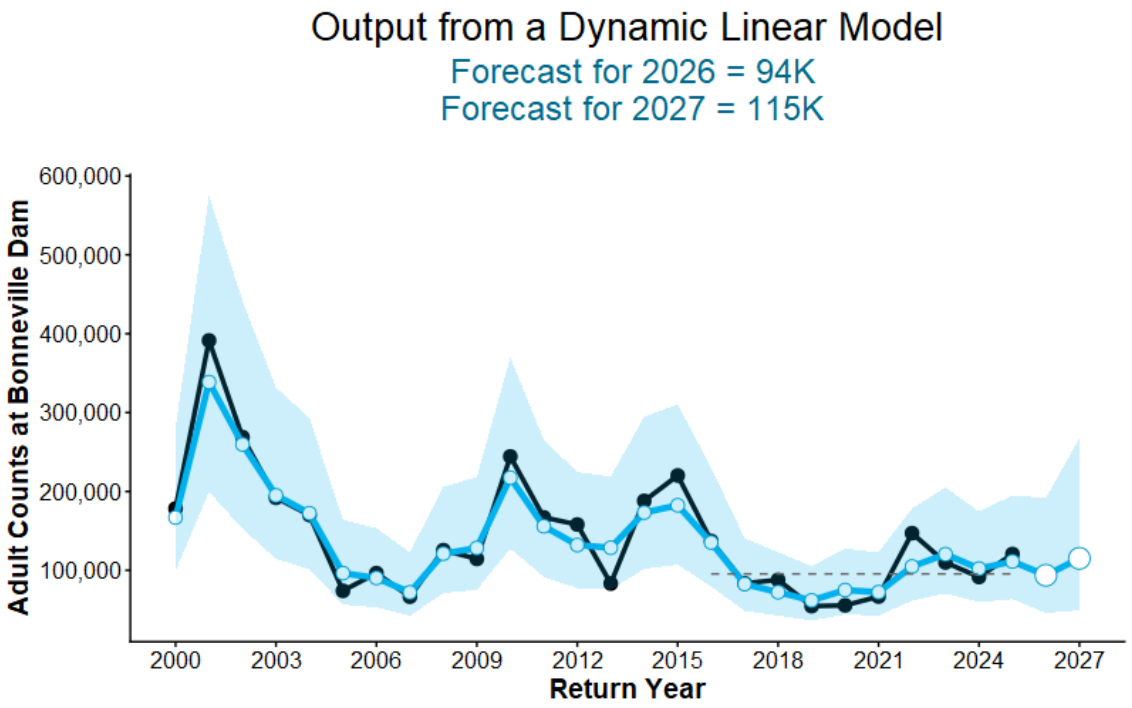
Conclusion: We can use publicly-available data to generate stock-specific indices that can enhance predictive accuracy for salmon returns compared to traditional broad-scale indicators, offering practical benefits for fisheries management.



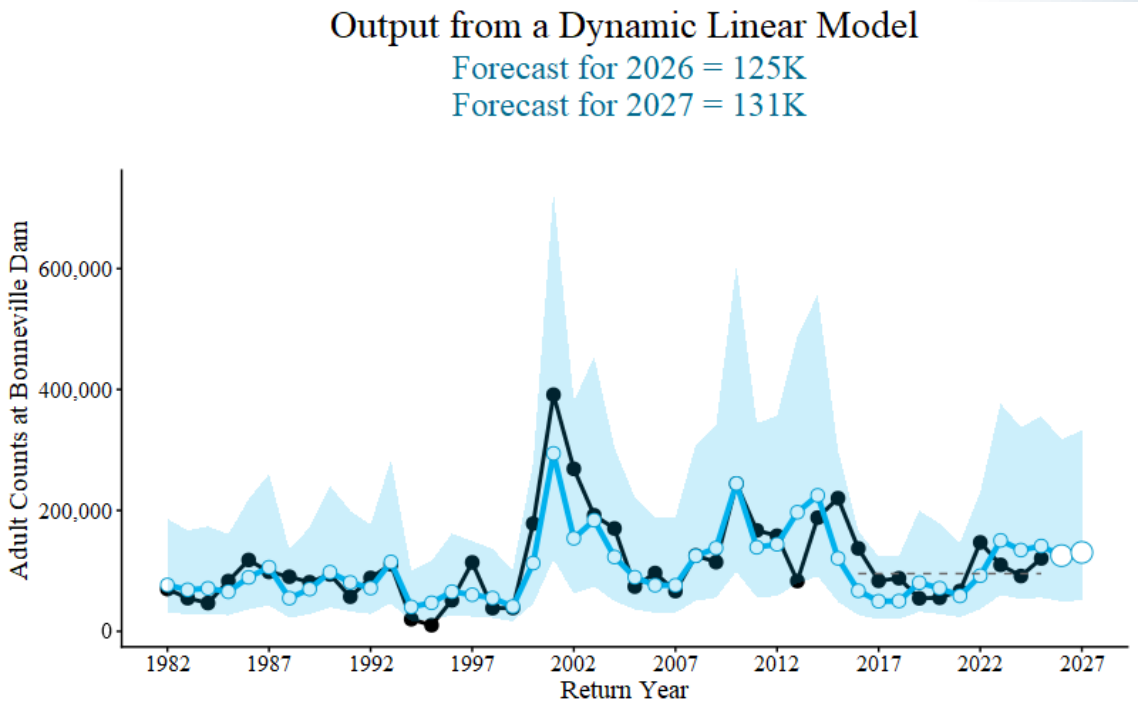
Publication: https://doi.org/10.1016/j.ecoinf.2025.103575
Shiny App: https://connect.fisheries.noaa.gov/CMISST/

Spring Chinook at Bonneville Dam

Stoplight - based



CMISST



Count data obtained from: https://www.cbr.washington.edu/dart/query/adult_annual_sum

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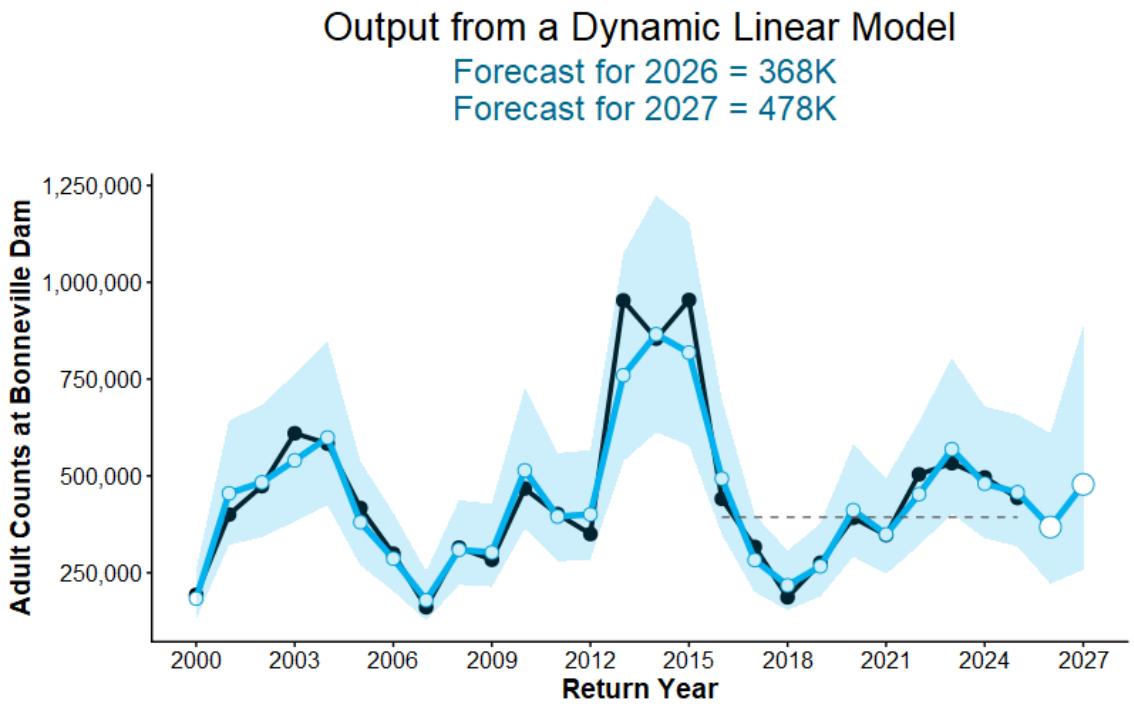
Fall Chinook at Bonneville Dam

Stoplight - based



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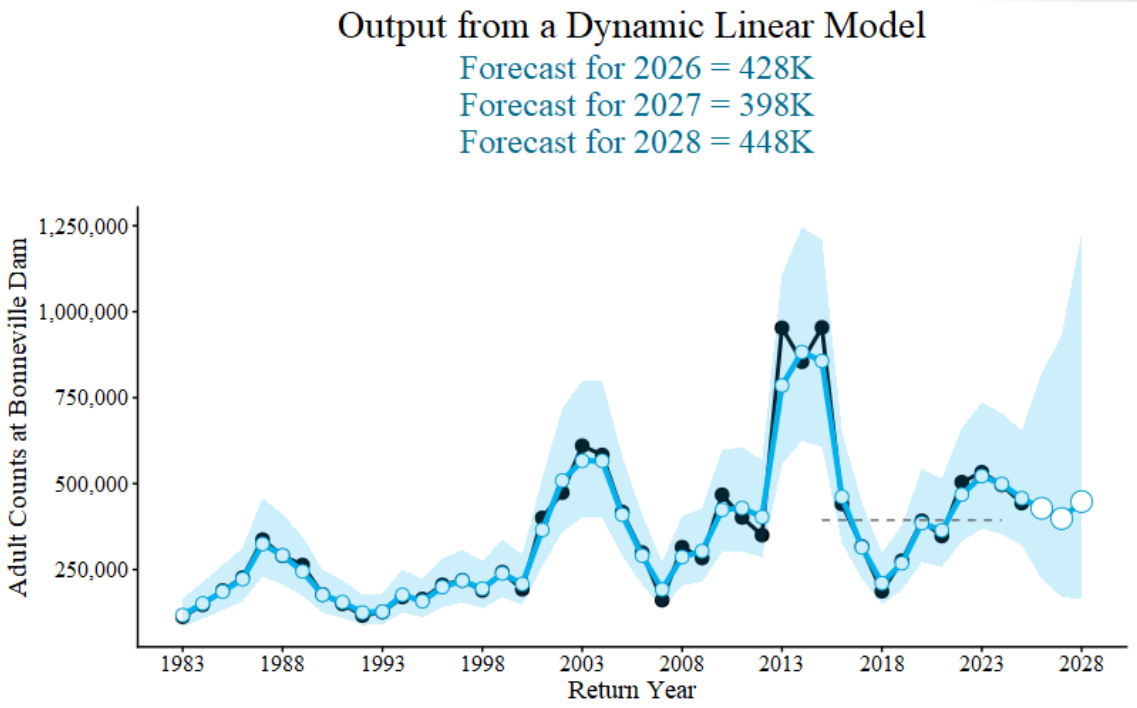

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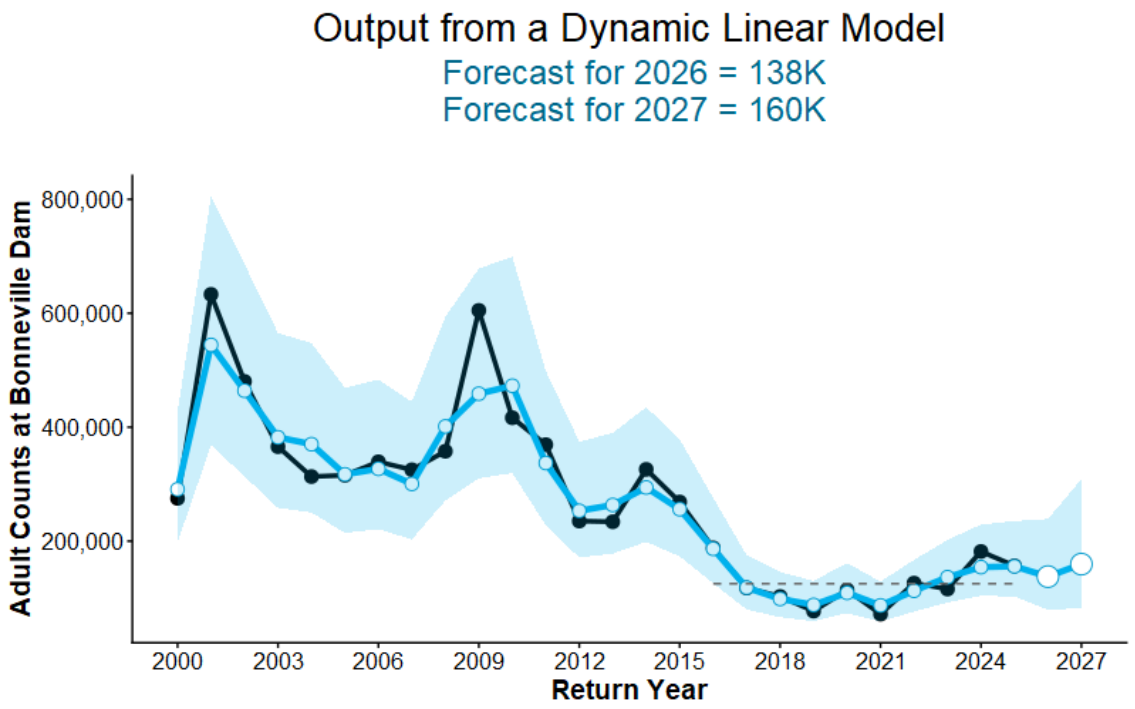
Steelhead at Bonneville Dam

Stoplight - based



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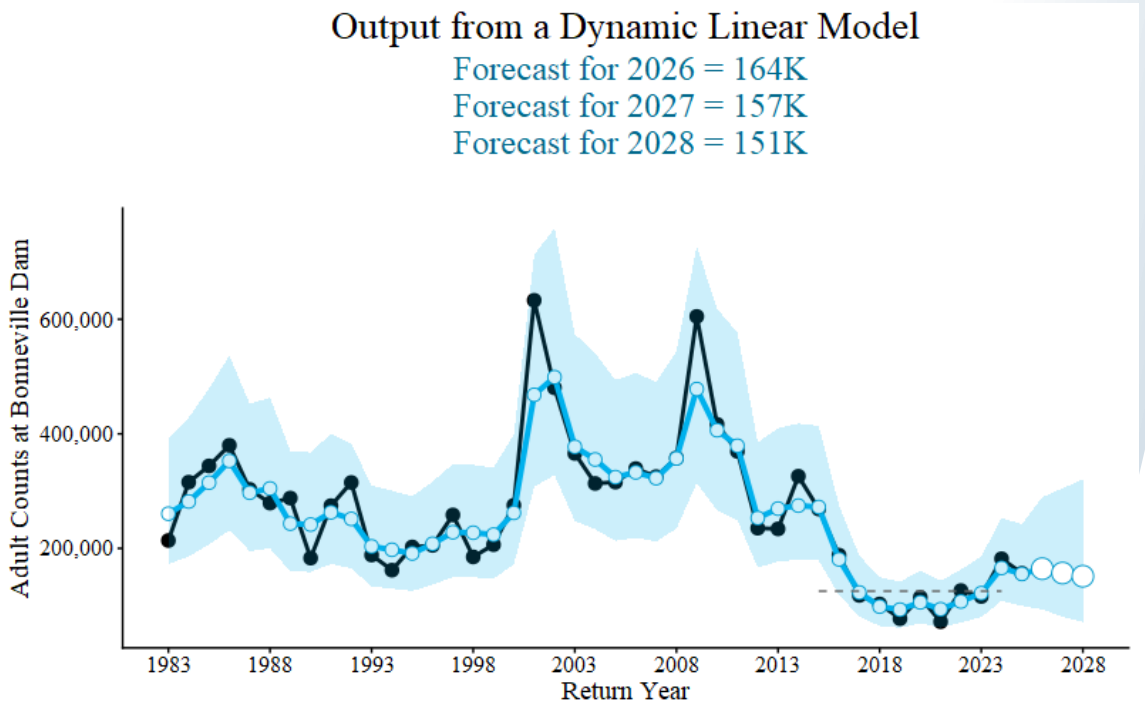

Count data obtained from: https://www.cbr.washington.edu/dart/query/adult_annual_sum

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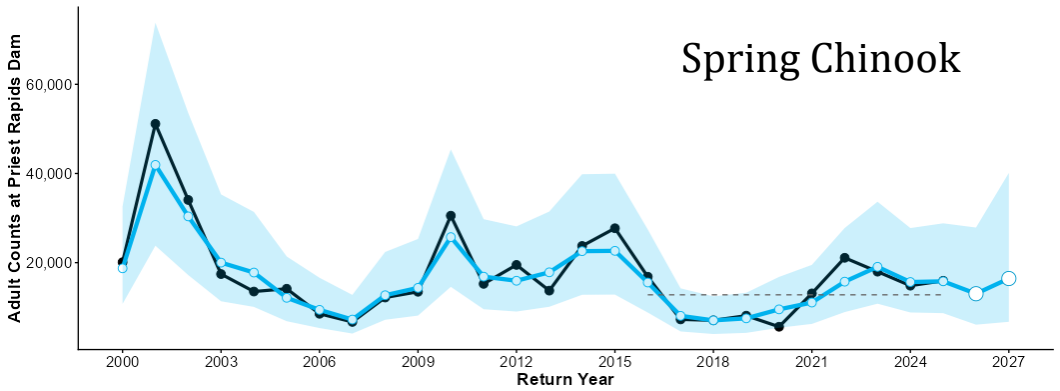
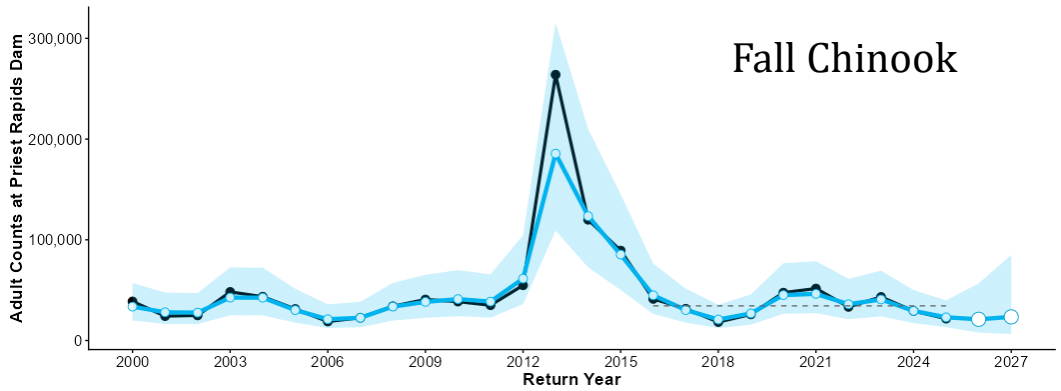
Expectations for Priest Rapids Dam Counts

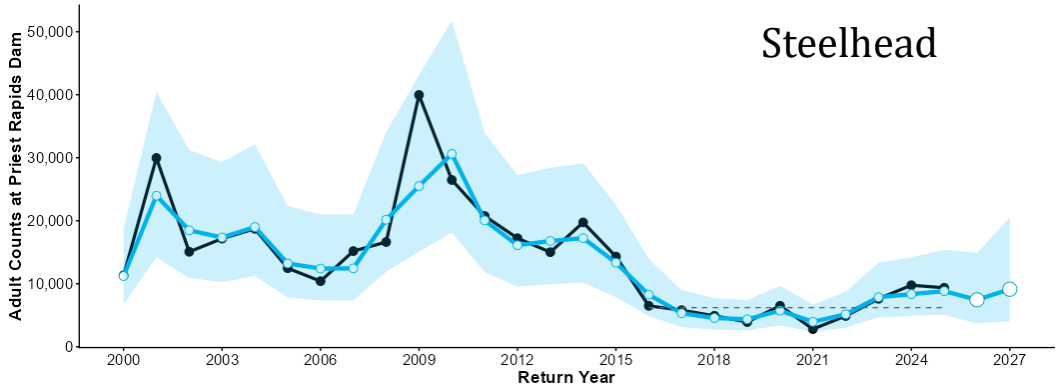
Output from a Dynamic Linear Model
Forecast for 2026 = 13K
Forecast for 2027 = 16K



Output from a Dynamic Linear Model
Forecast for 2026 = 21K
Forecast for 2027 = 23K



Output from a Dynamic Linear Model
Forecast for 2026 = 7K
Forecast for 2027 = 9K



Count data obtained from: https://www.cbr.washington.edu/dart/query/adult_annual_sum

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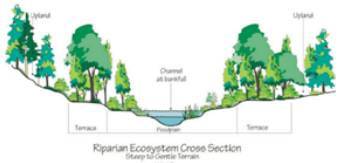
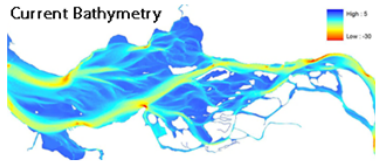
We Have Management Options for Ocean Survival

Riparian and floodplain restoration





Estuary Restoration Act

Fishery Management Plans:
- Coastal Pelagic Species
- Hake
- Salmon

Colony management

Marine Mammal Protection Act
Pinniped Removal Program

https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/marine-mammal-protection-act-section-120-pinniped-removal

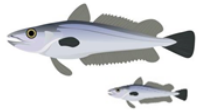
Smolt body size and timing — Carryover effects

1

Zooplankton, invertebrates, fish larvae — Prey

Anchovy — Competitors, Prey

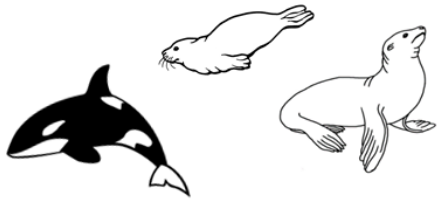
Hake — Predators, Competitors



Other Fisheries — Indirect effects

Seabirds — Predators

Marine mammals



2

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1. Where does Size Variability come from?

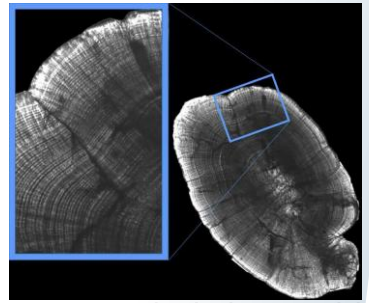
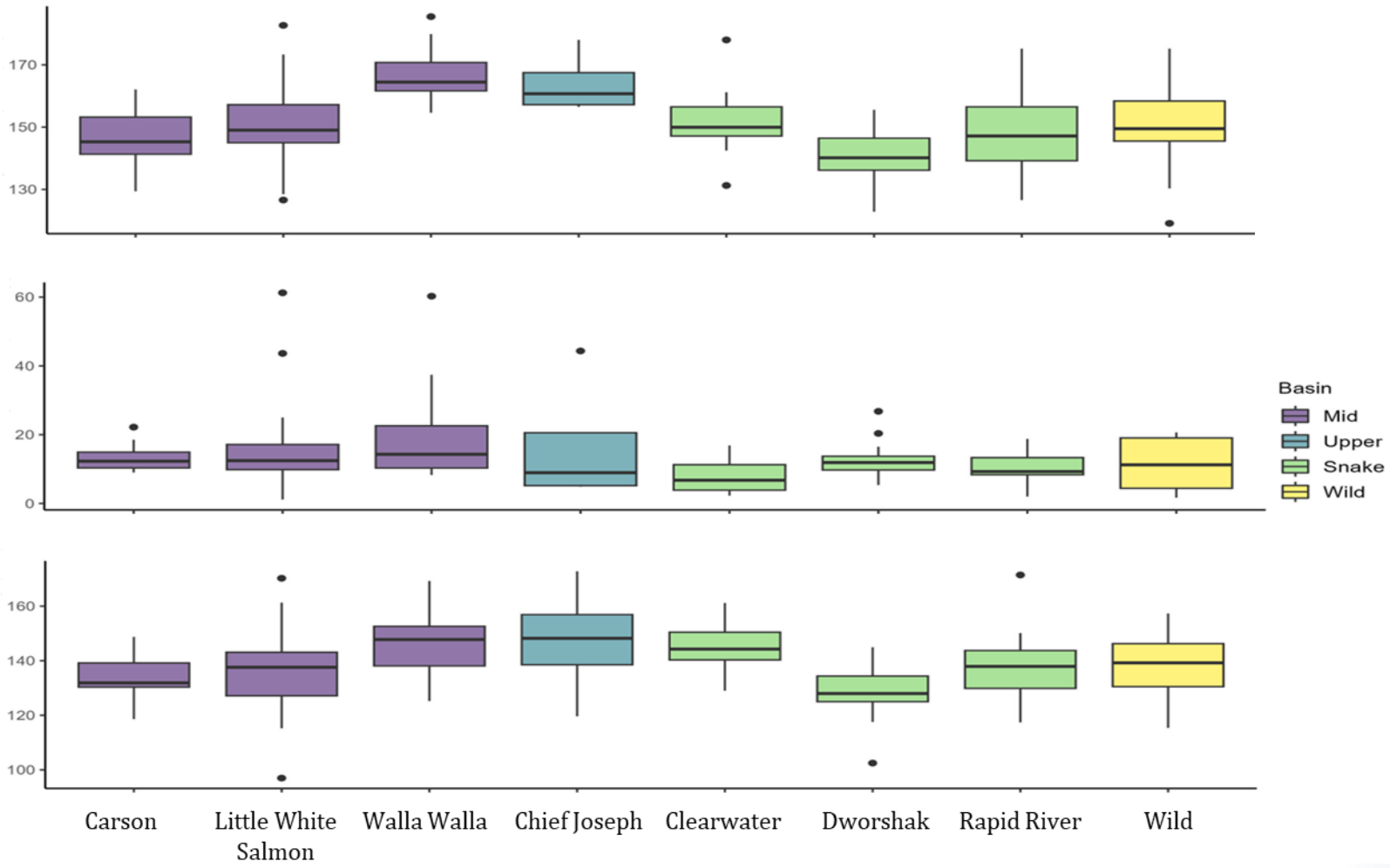


Photo by Elianna Rosenthal

Size in the Ocean

Ocean Growth

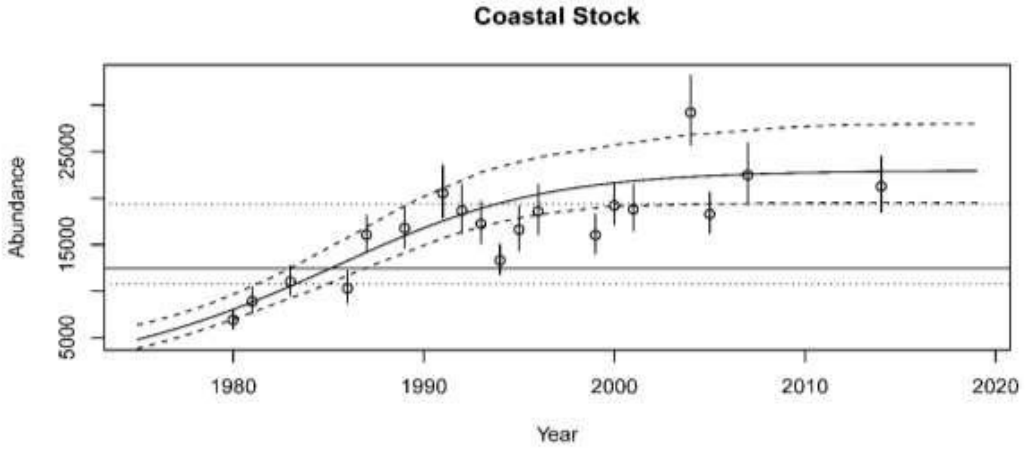
Size at Ocean Entry

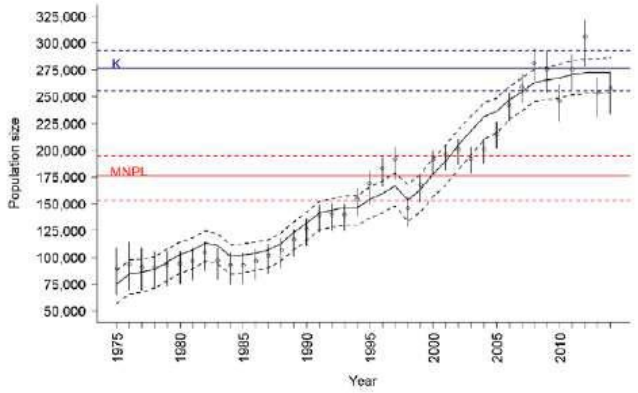


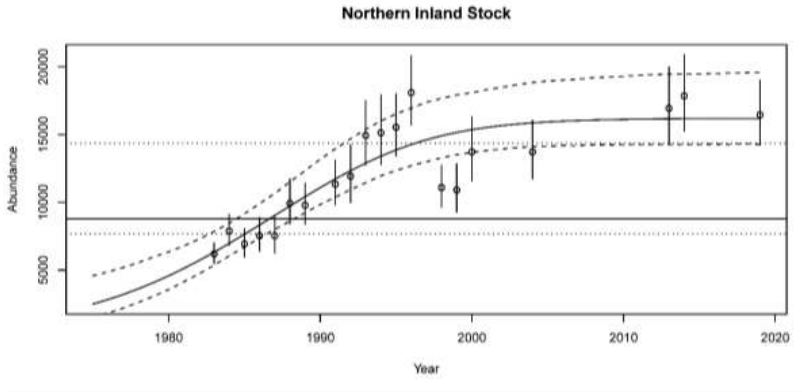
Forney et al. In Review

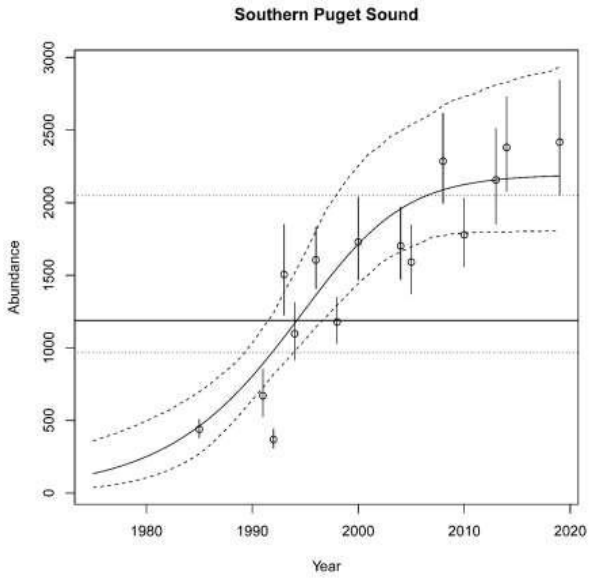
NOAA FISHERIES

2. Washington pinnipeds are more abundant than they ever were









https://wdfw.wa.gov/sites/default/files/publications/02579/wdfw02579.pdf

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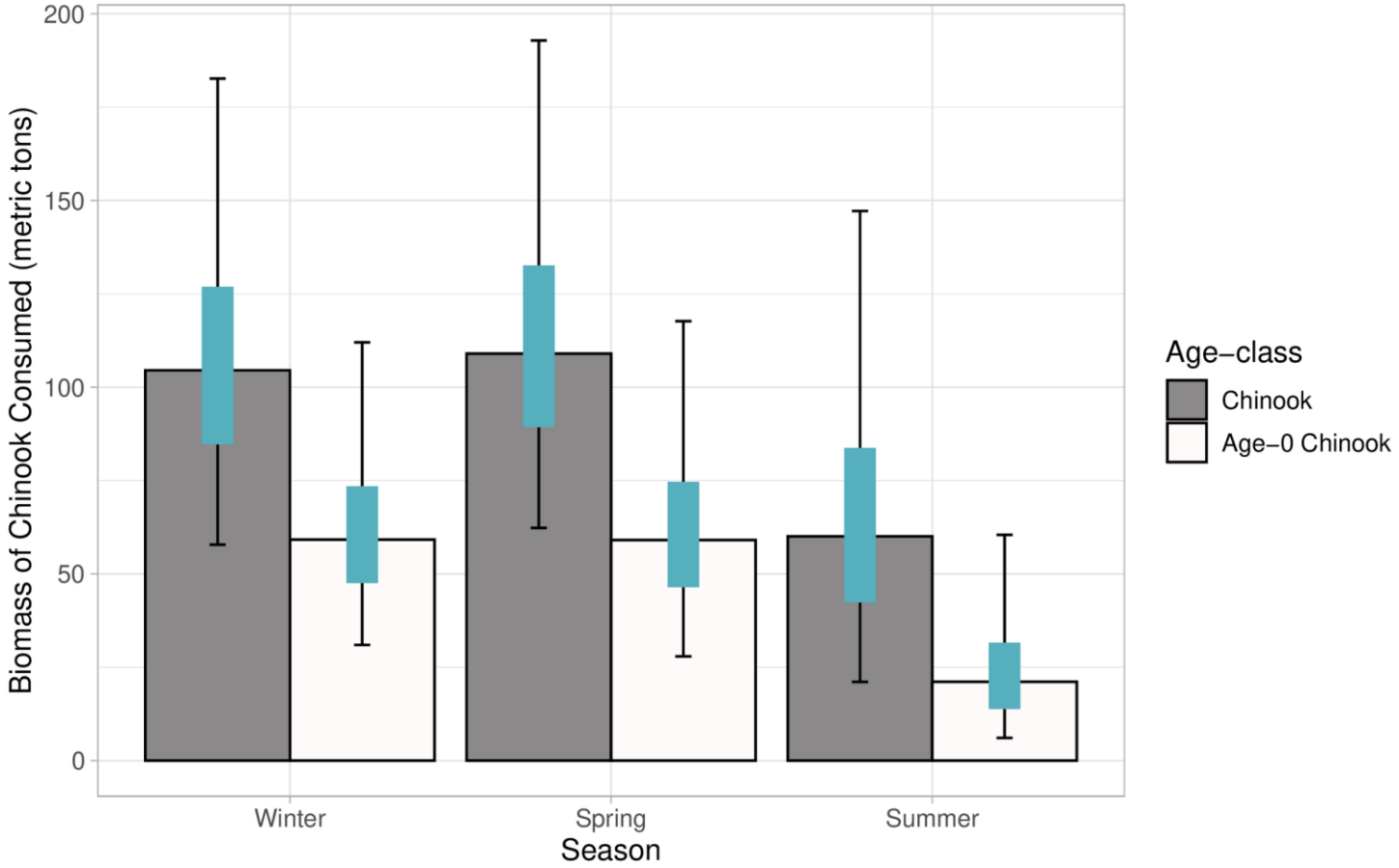
Stellar Sea Lions eat more juveniles than we thought



Lewis et al. 2025. https://doi.org/10.1371/journal.pone.0334612

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Take Home Messages

1. The ocean is not homogenous – where and when salmon migrate will determine their ocean experience, growth, and survival
2. 2022 through 2025 were about average – adult returns this year and next year should be too (generally speaking)
3. We *can* influence marine survival; even freshwater management can affect marine survival

Thanks for your interest

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