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

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March 7, 2023

MEMORANDUM

TO: Council Members

FROM: Mark Fritsch

SUBJECT: Briefing on Recent Ocean Observations and Outlooks for Salmon Returns in 2023

BACKGROUND:

Presenter: Brian Burke (Supervisory Research Fish Biologist, National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center)

Summary: Brian will present research findings and outlooks associated with Chinook and Coho 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. The monitoring efforts are implemented through [Project #1998-014-00, *Ocean Survival Of Salmonids*](#). This information is relevant to our high-level indicators and strategy performance indicators by providing a preview for 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. In addition to this presentation today, critical ocean research and monitoring topics will be further discussed at the next Ocean and Plume Science and Management Forum, which is anticipated for fall 2023.

Workplan: Fish and Wildlife Division work plan 2023 (Draft); Program planning & policy, and Program Implementation.

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:

- [Ocean and Plume Science and Management Forum website](#)



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What happens in the ocean *doesn't* stay in the ocean

*Northwest Power and Conservation Council
March 14th, 2023*



Presenter: Brian Burke
NOAA Fisheries, NWFSC

Team: Brian Beckman, Cindy Bucher, Brandon Chasco, Elizabeth Daly, Susan Hinton, David Huff, Mary Hunsicker, Kym Jacobson, Meredith Journey, Jessica Miller, Cheryl Morgan, Krista Nichols, Craig Norrie, Joe Smith, Don Van Doornik, Laurie Weitkamp, Brian Wells, Jen Zamon

Also supported by:

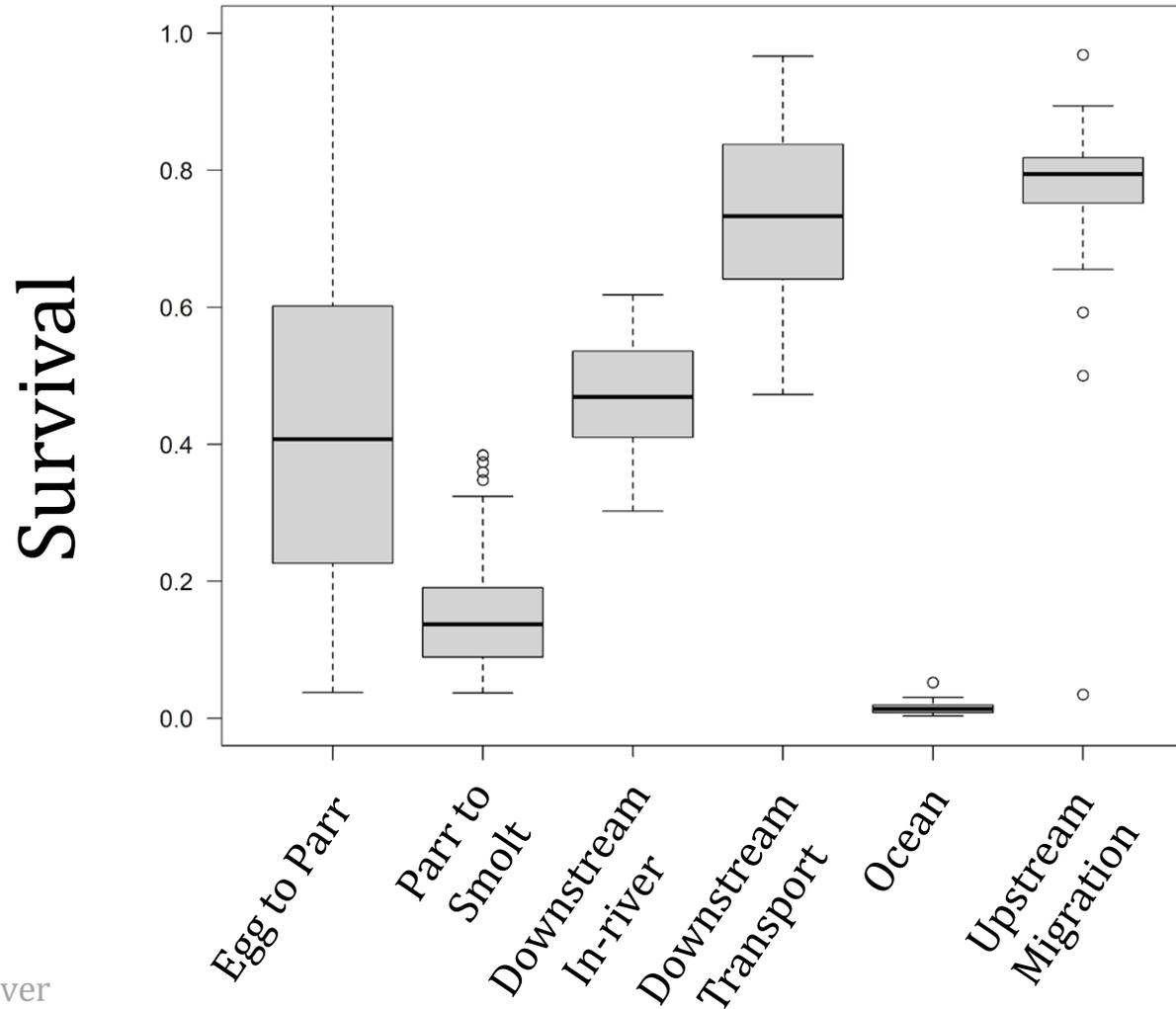


Take home message:

- Conditions when salmon first enter the ocean largely determine population trends
- Marine conditions are in decline (despite some years, like 2021, being good)
- Management actions exist in both freshwater and the marine environment that can mitigate this decline



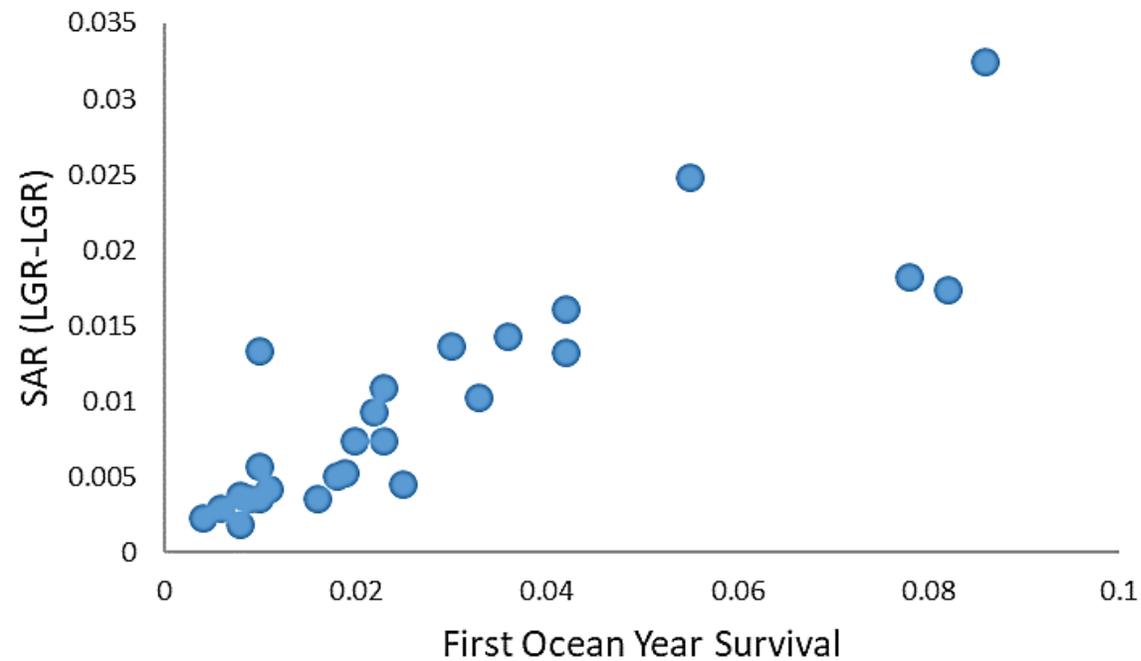
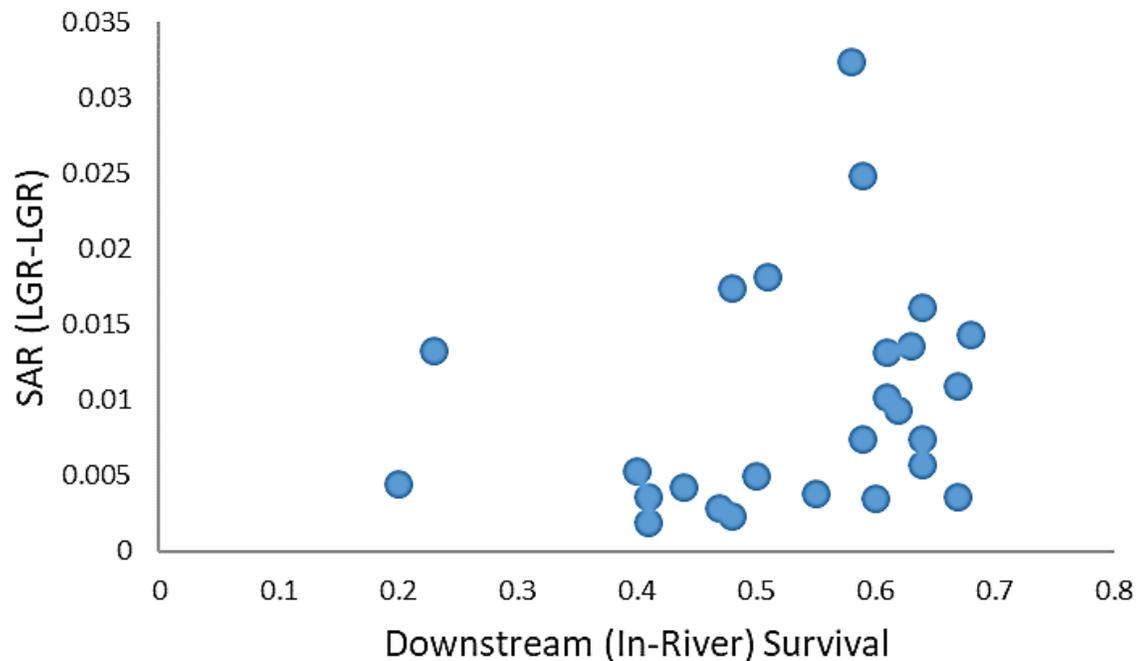
Ocean survival is the lowest of all life stages



Lisa Crozier, unpublished Life Cycle Model data for Snake River spring/summer Chinook

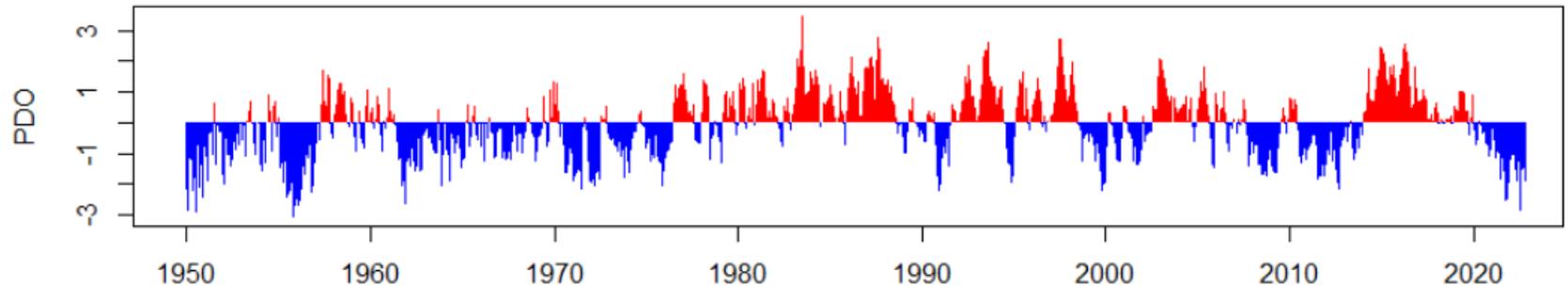
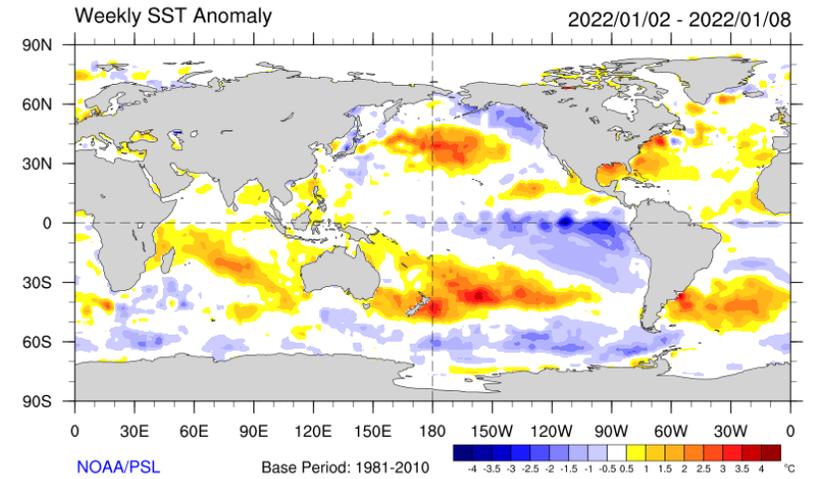
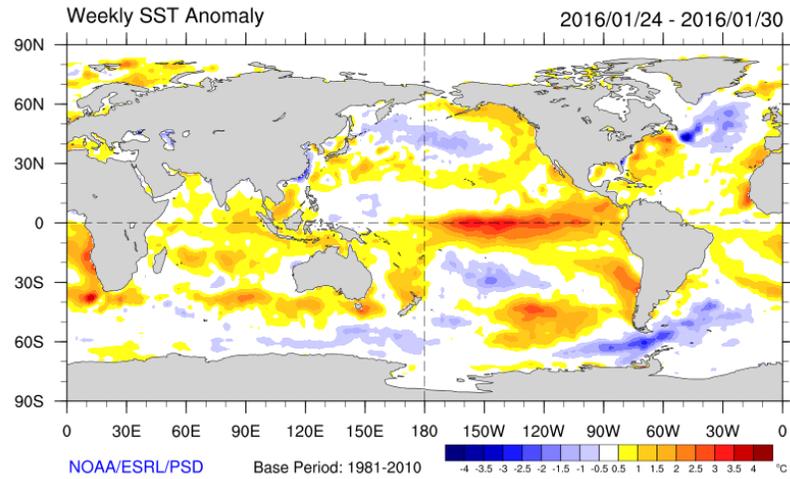
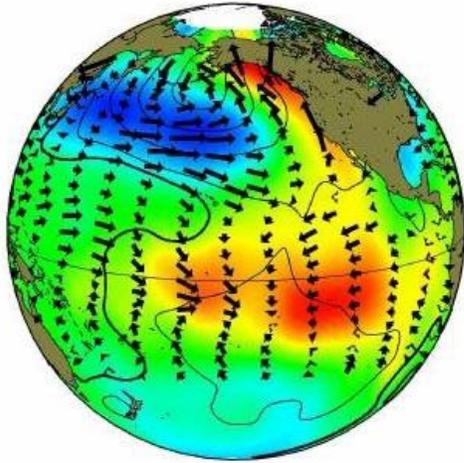
Ocean survival is Critical

Wild Snake River spring/summer Chinook, 1994-2019

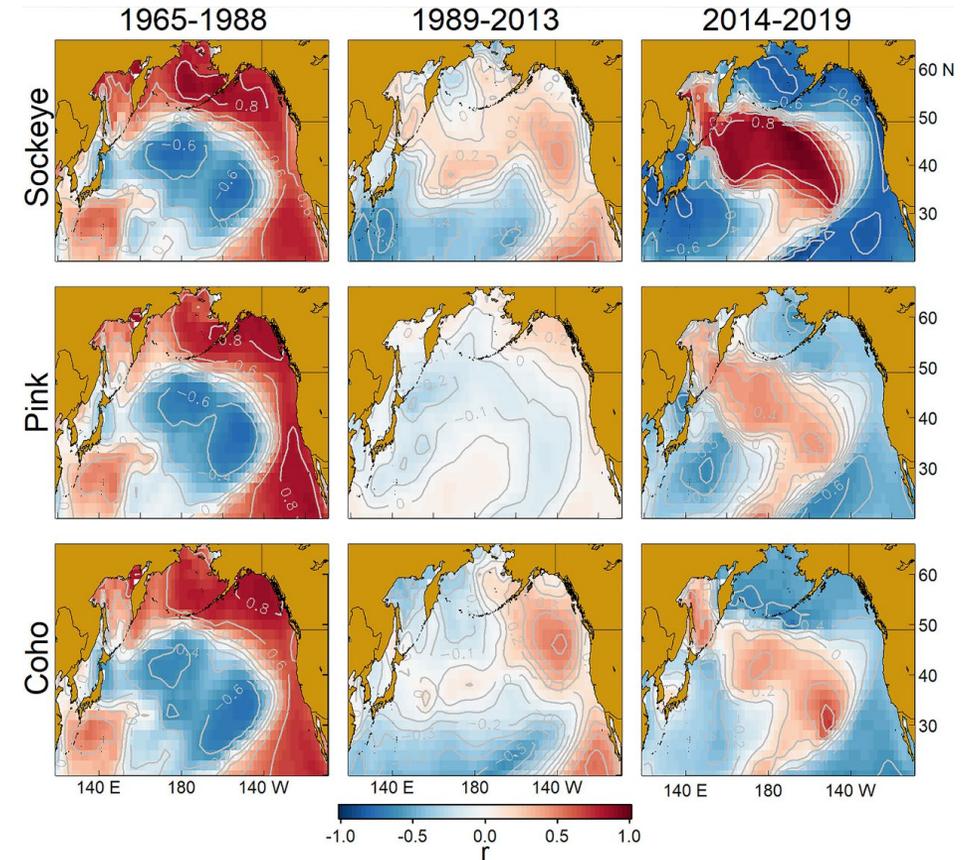
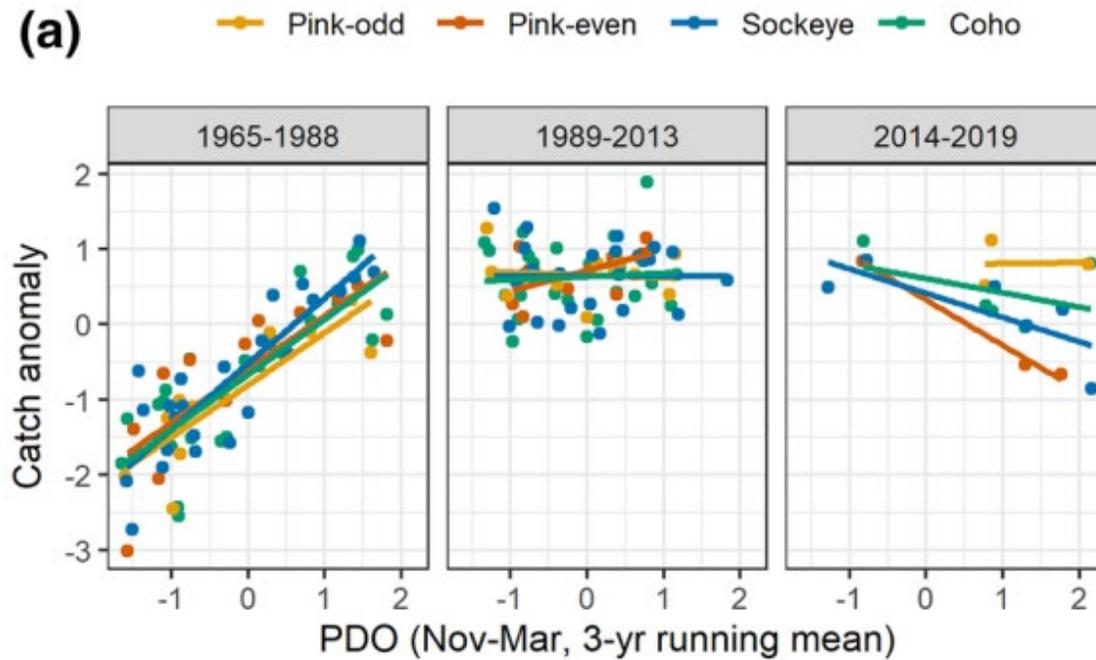


Data from Fish Passage Center:
https://www.fpc.org/documents/Q_fpc_cssreports.php

Pacific Decadal Oscillation (PDO)

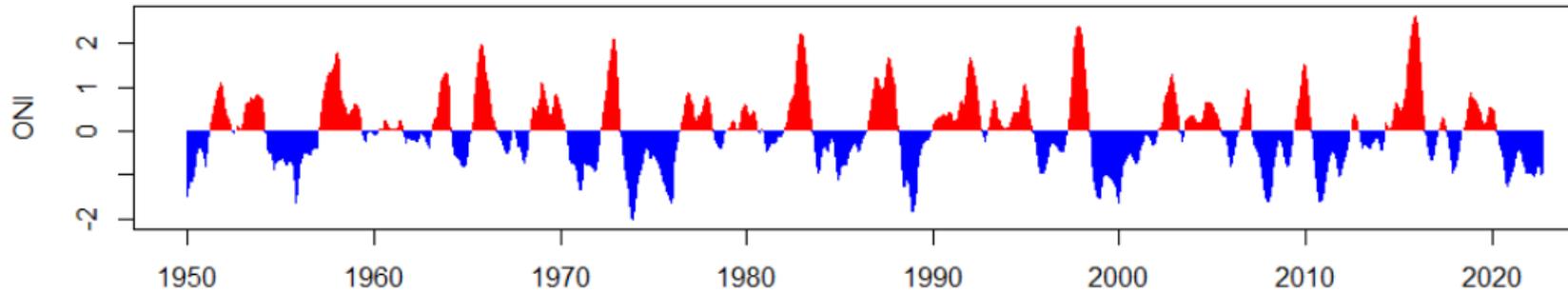
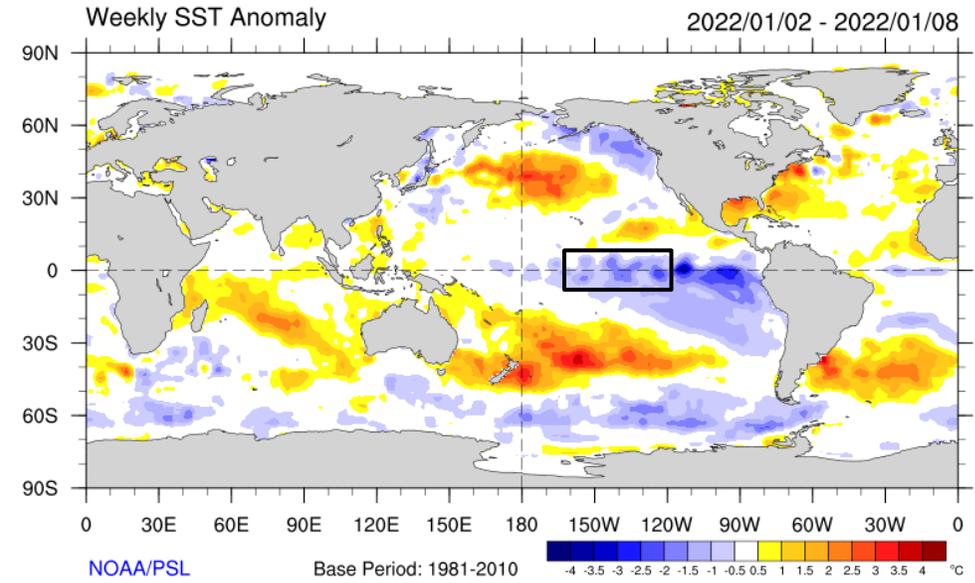
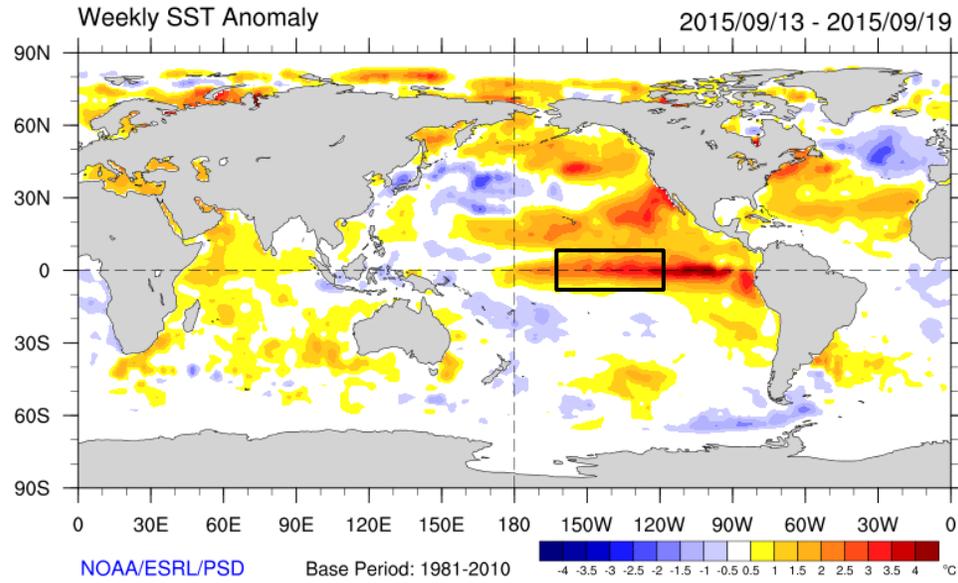


Changing PDO-Salmon Relationships

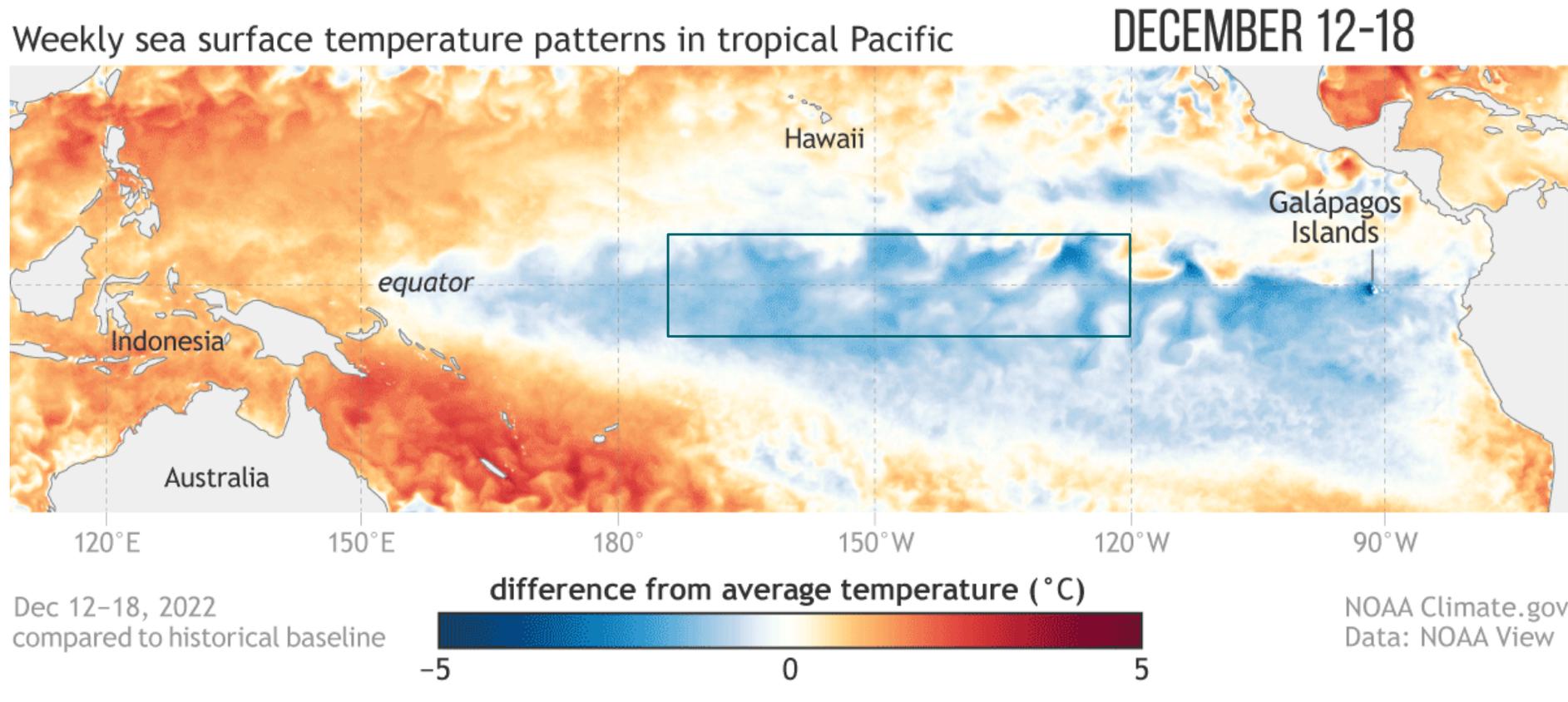


Litzow, M. A., et al. (2020). Quantifying a novel climate through changes in PDO-climate and PDO-salmon relationships. *Geophysical Research Letters*, 47, e2020GL087972. <https://doi.org/10.1029/2020GL087972>

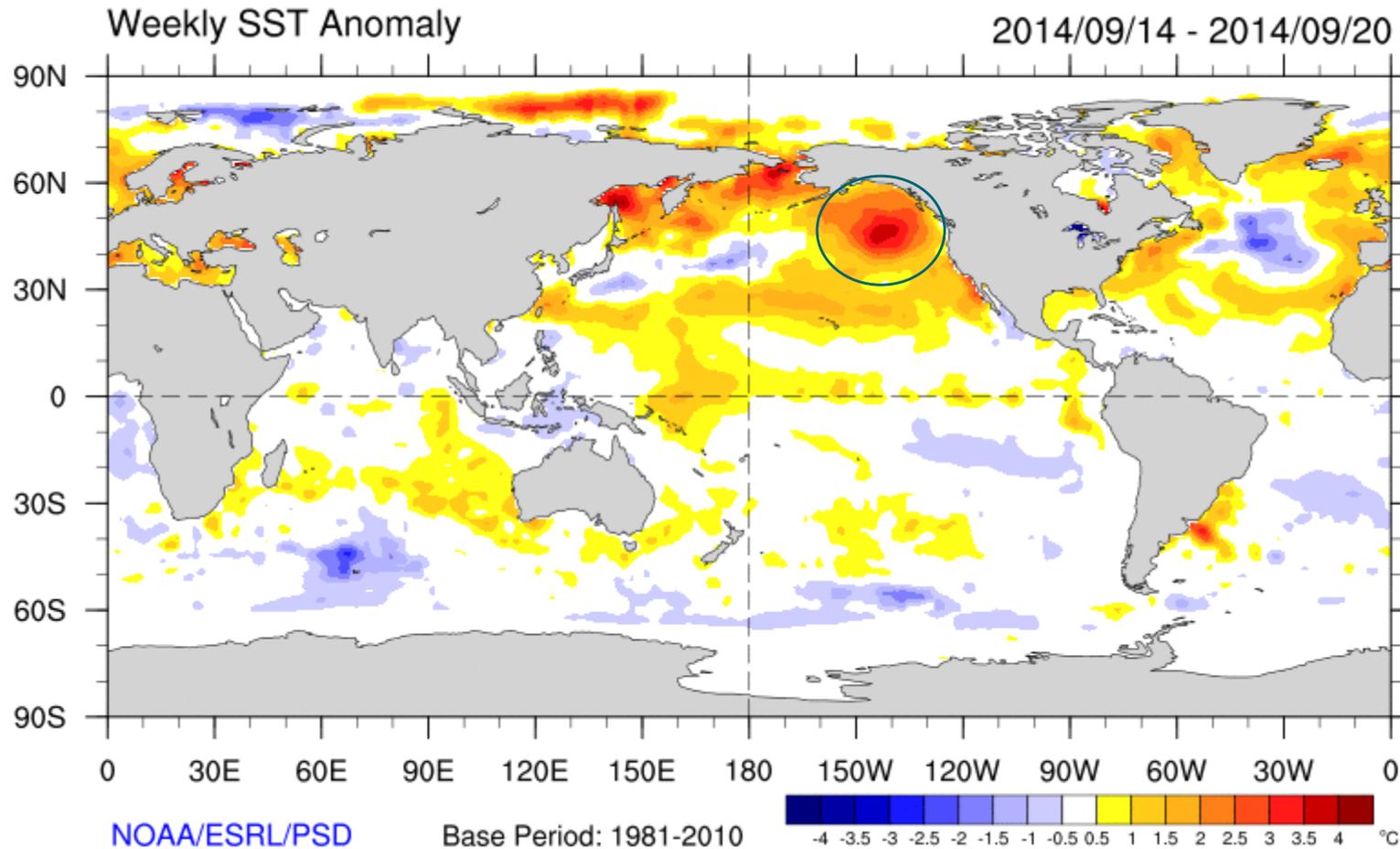
El Niño



La Niña is officially over – next up: neutral or El Niño??

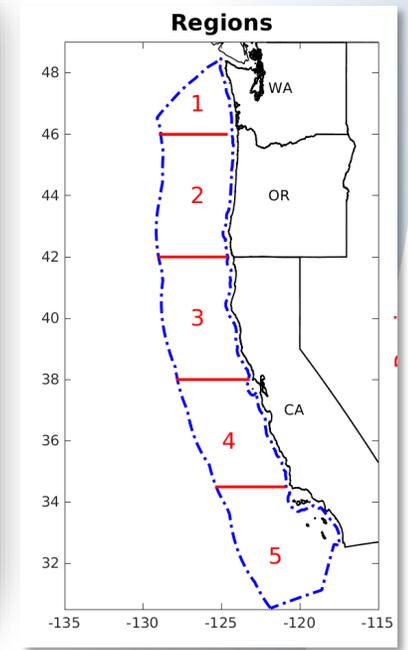
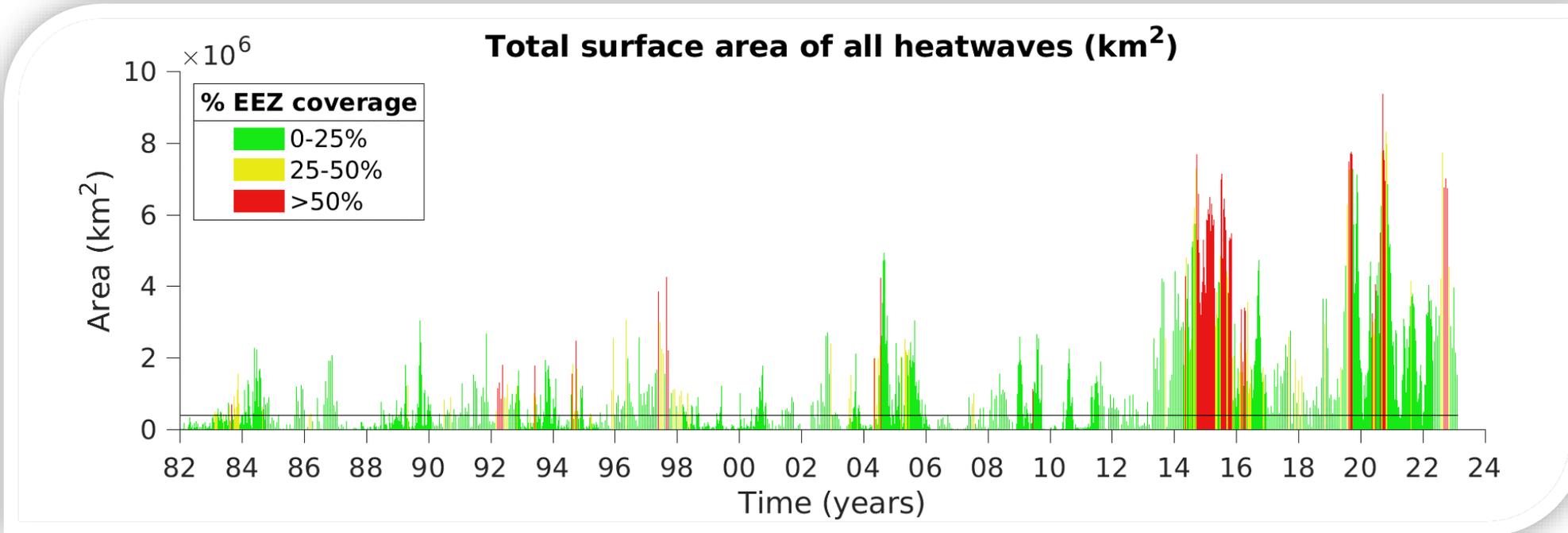


Marine Heat Wave



* High pressure reduces winter storms, resulting in less mixing with deep, cold water
<https://psl.noaa.gov/map/clim/sst.shtml>

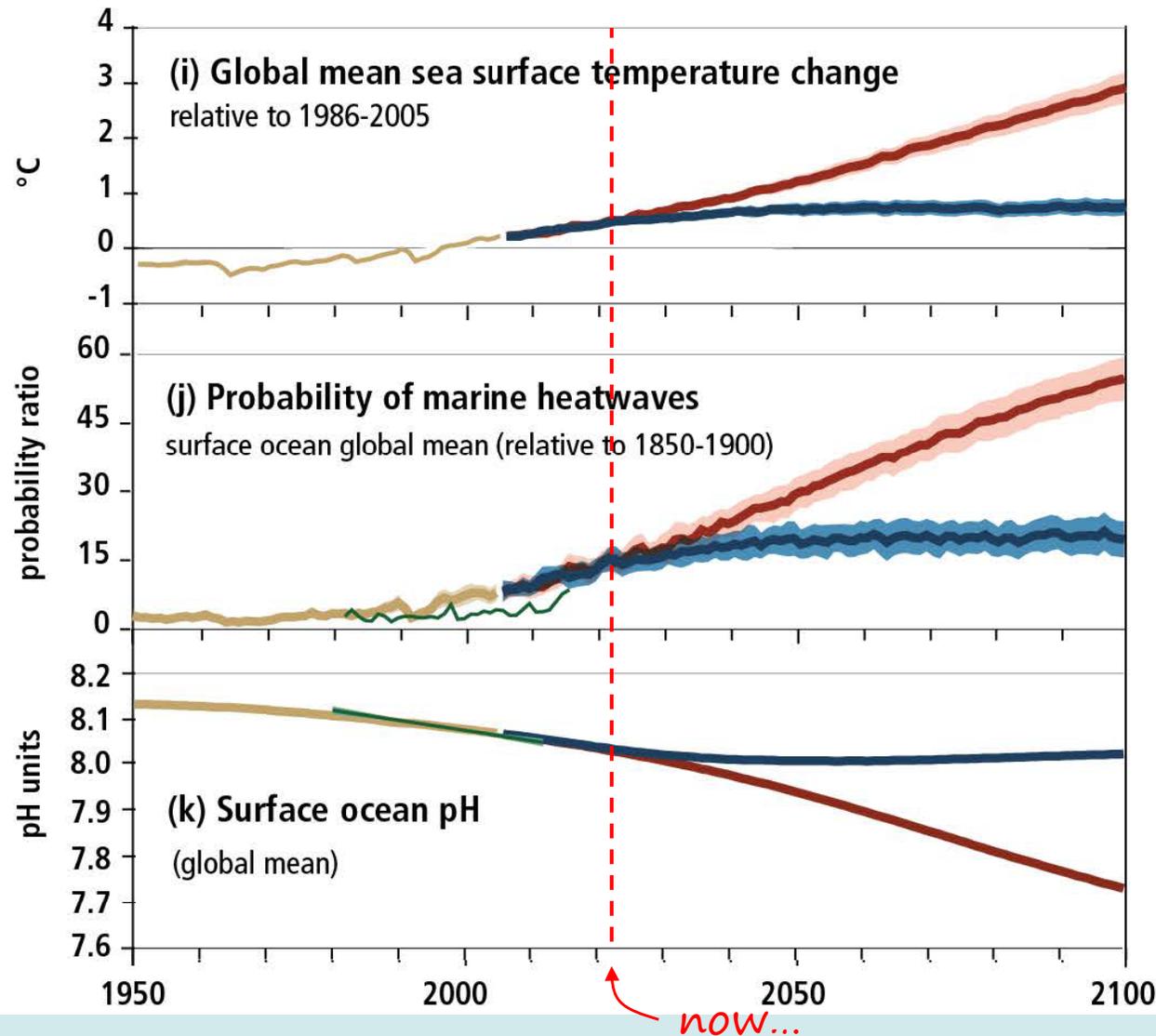
NE Pacific marine heatwaves are increasing



California Current Ecosystem Status Report NOAA

<https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker>

NE Pacific marine heatwaves are increasing



- Observed
- Modelled historical
- projected RCP8.5
- projected RCP2.6



IPCC 2019. The Ocean and Cryosphere in a Changing Climate, Fig SPM.1



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One (of many) Biological Responses: Range Expansions



What's in store for this summer?

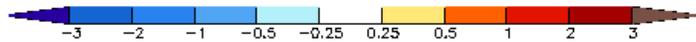
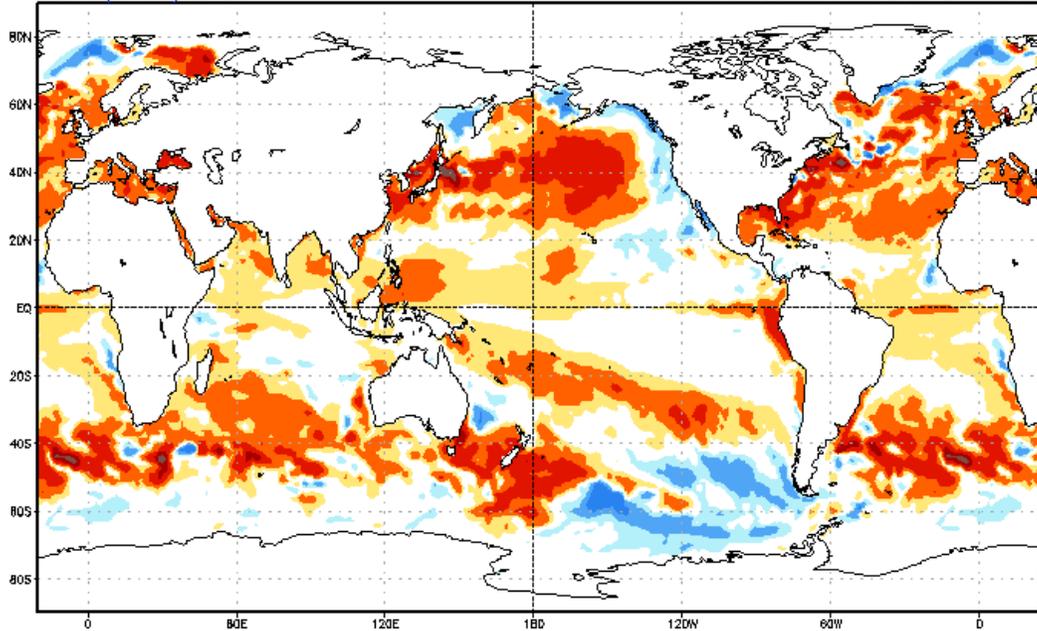


CFSv2 seasonal SST anomalies (K)

NWS/NCEP/CPC

Initial conditions: 14Feb2023-23Feb2023

Mar-Apr-May 2023

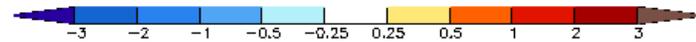
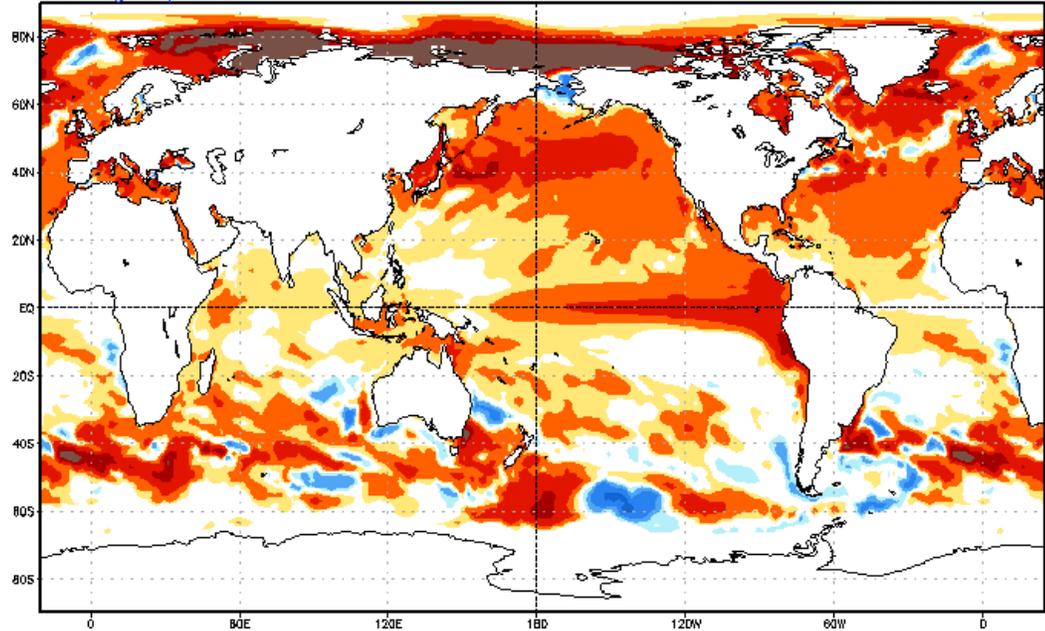


CFSv2 seasonal SST anomalies (K)

NWS/NCEP/CPC

Initial conditions: 14Feb2023-23Feb2023

Jul-Aug-Sep 2023



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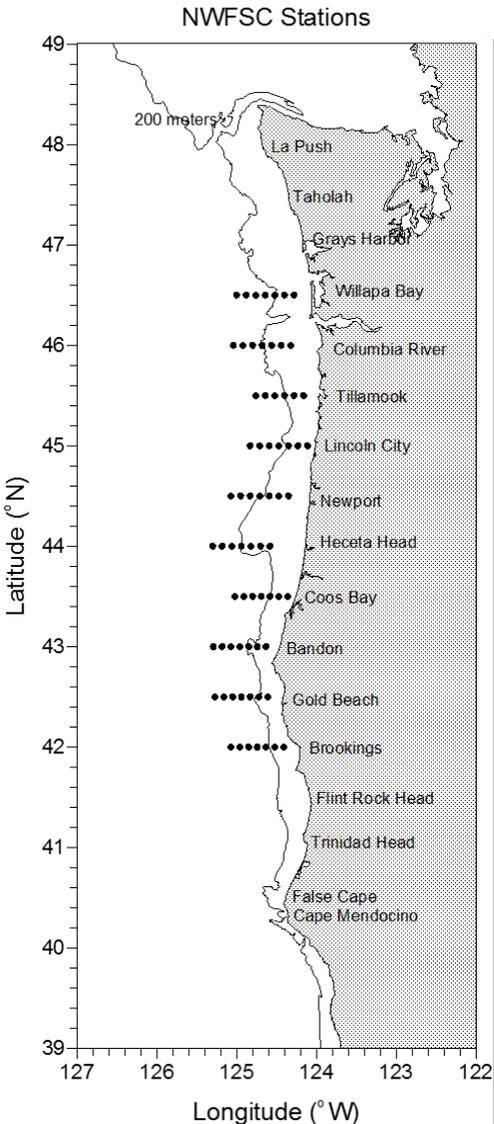
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Newport Hydrographic Line and Northern California Current Survey

Newport Line: Sampled biweekly for 27 years



Pre-recruit: May-June (2011, 2013-2019)



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





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**BONNEVILLE
POWER ADMINISTRATION**



Juvenile Salmon and Ocean Ecosystem Survey (JSOES)

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





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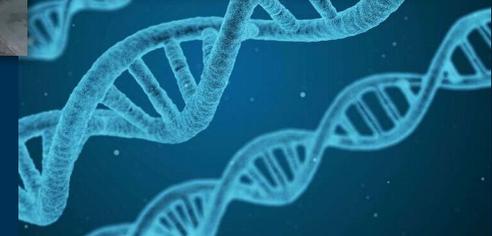
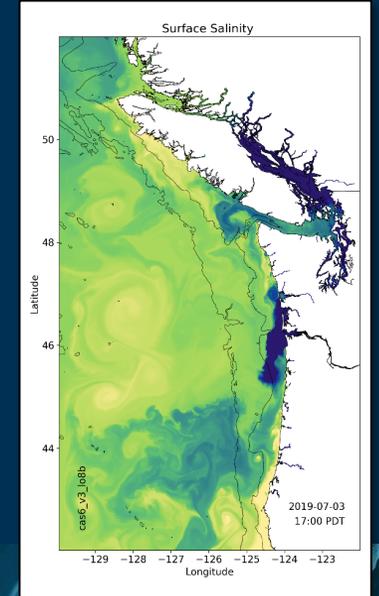
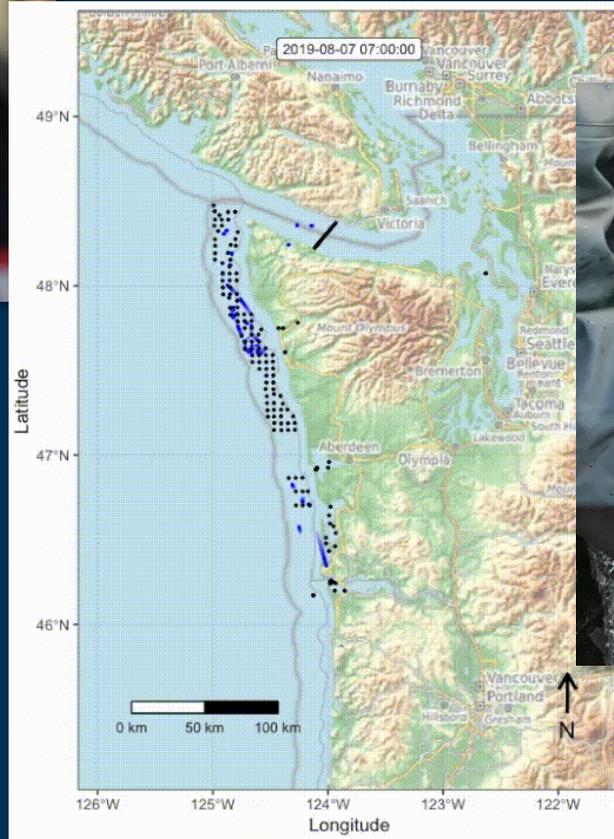


SOBaD Advanced Technologies and Emerging Tools

**REMUS
1000**

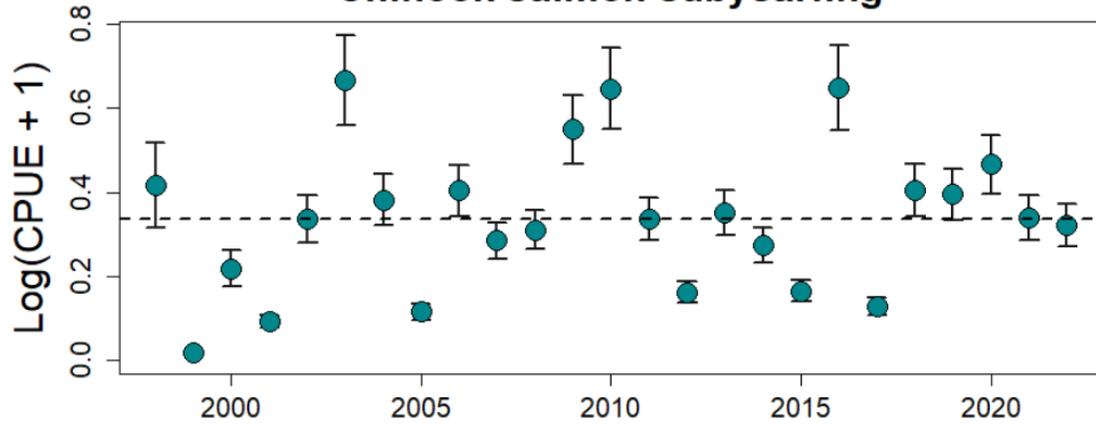


1000
Meter Rated
22.25
Feet Long
High
Endurance

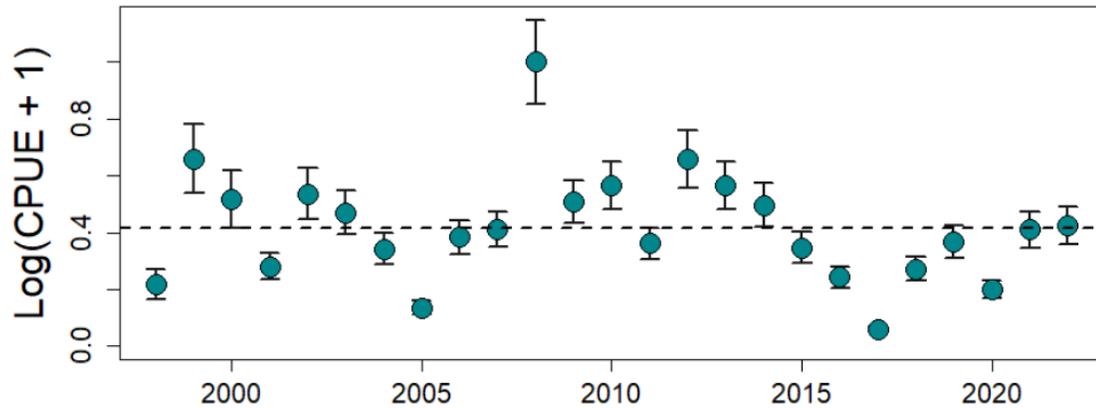


JSOES Catches - June, 1998-2022

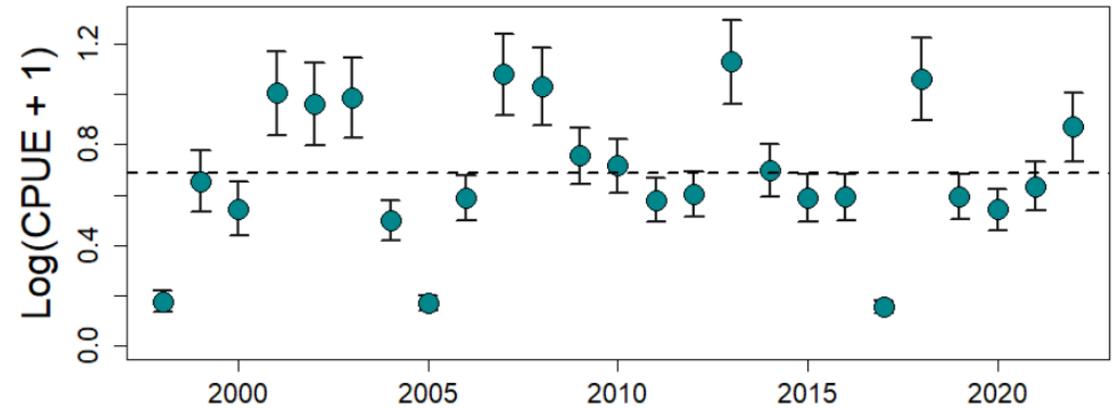
Chinook salmon subyearling



Chinook salmon yearling

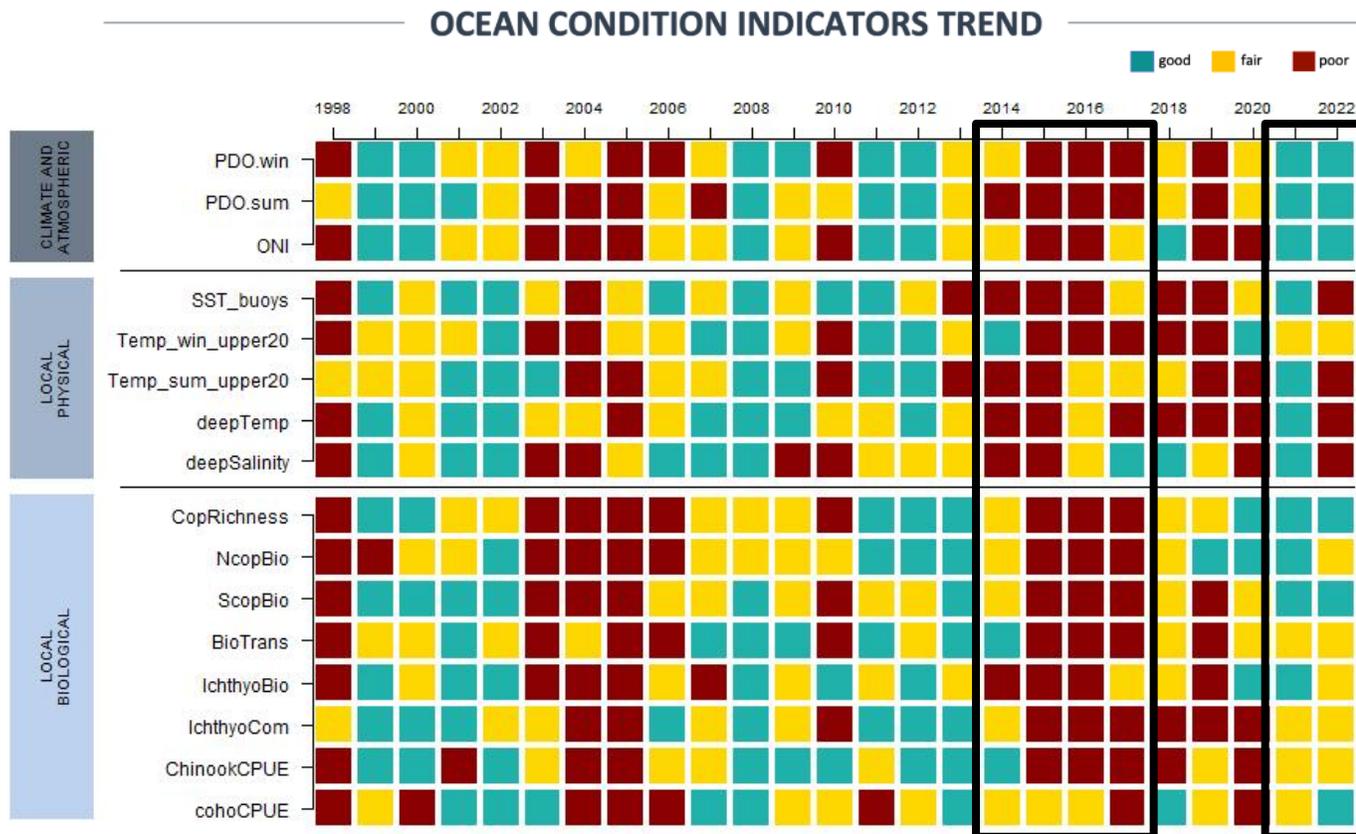


Coho salmon yearling



NOAA's 'Stoplight'

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



2022

Early spring

- Strong upwelling
- Negative PDO

Summer and Fall

- Weak upwelling
- High temperatures
- Mediocre biological conditions



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Box 1.1: 2022-23 CCIEA Ecosystem Status Report Highlights



Key takeaways from 2022:

Basin-scale climate patterns started out encouragingly, but were offset in part by local dynamics and a major marine heatwave

Food web dynamics provided resilience, including ongoing production of anchovy in the south

Unfavorable Conditions and Risk Factors

- 4th-largest marine heatwave on record, with more coastal influence than recent years
- A dry spring in 2022 contributed to low snowpack and continued drought
- Extreme weather in early 2023
- Uptick in HAB activity in late 2022 led to shellfish fishery closures or delays
- Fishing portfolios continue to be less diversified, both in target species and total weeks fished
- Potential constraints of offshore wind on fishing and research are coming into focus

Mixed Ecological Signals

- Lipid-rich copepods off Oregon abundant but declined earlier than normal
- Juvenile salmon conditions were mixed
- Chinook salmon returns: encouraging signals in north, concerns for California
- Anchovies remain abundant in surveys and predator diets in central and south
- Low bird densities offshore in the north; good production in central
- A strong new year class of sablefish?



<https://www.fisheries.noaa.gov/feature-story/unsettled-pacific-ocean-offers-surprises-climate-change-alters-ecosystem>

An extended graphical summary is provided in Appendix D

2022-2023 California Current Ecosystem Status Report



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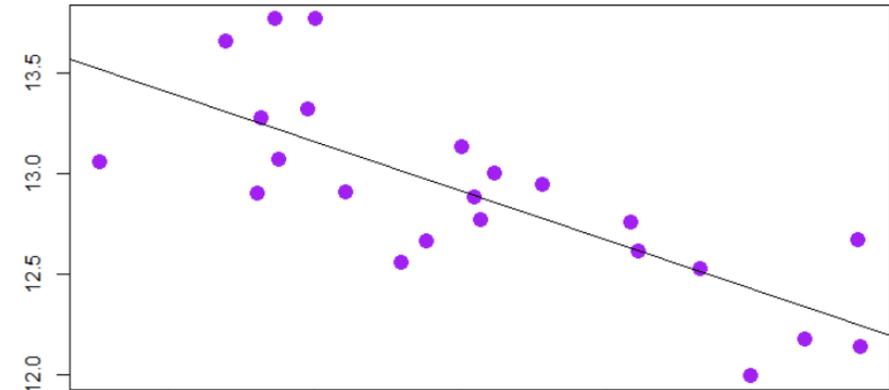
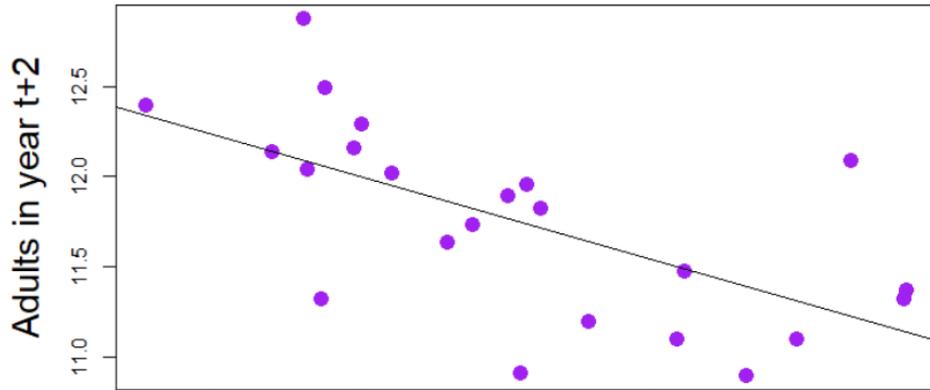
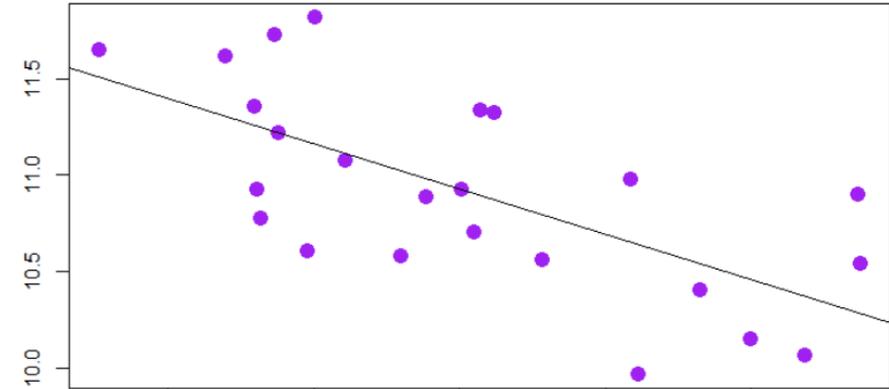
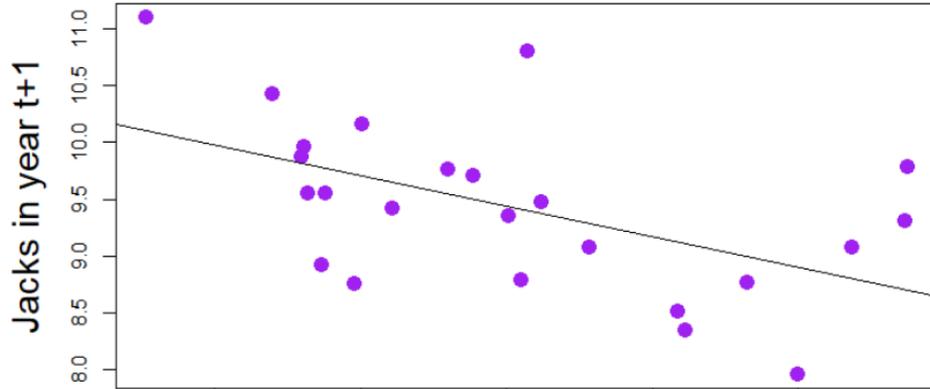
What does all this mean for salmon returns?



Ocean Conditions and Salmon Survival

Spring Chinook

Fall Chinook



Ocean conditions in year t

Ocean conditions in year t

Outlooks for adult returns to Bonneville Dam

(based on Dynamic Linear Models)

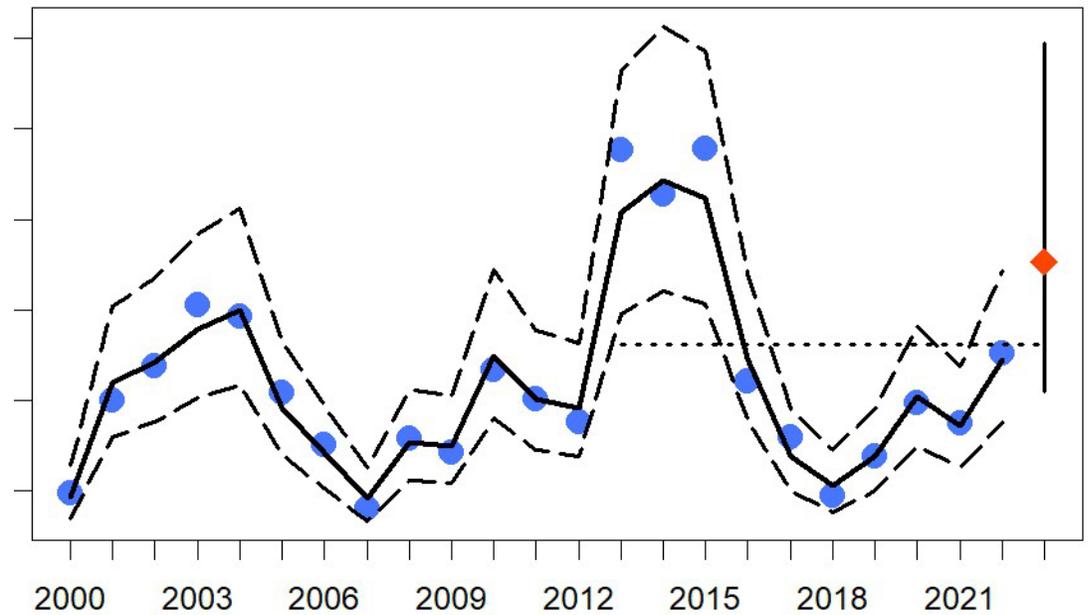
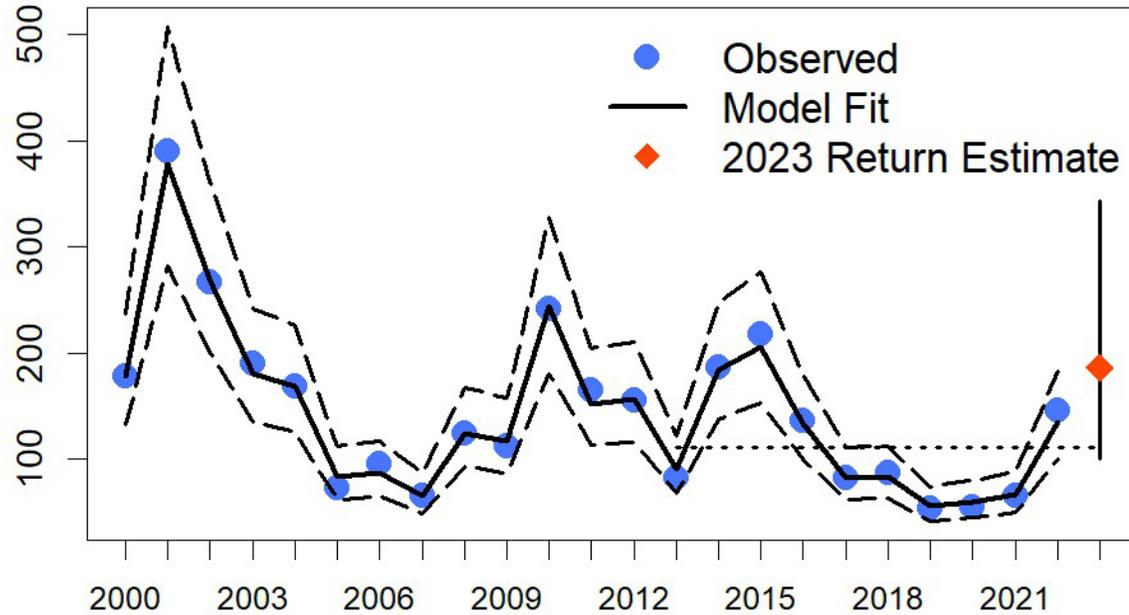
Spring Chinook

186K (100-343K)

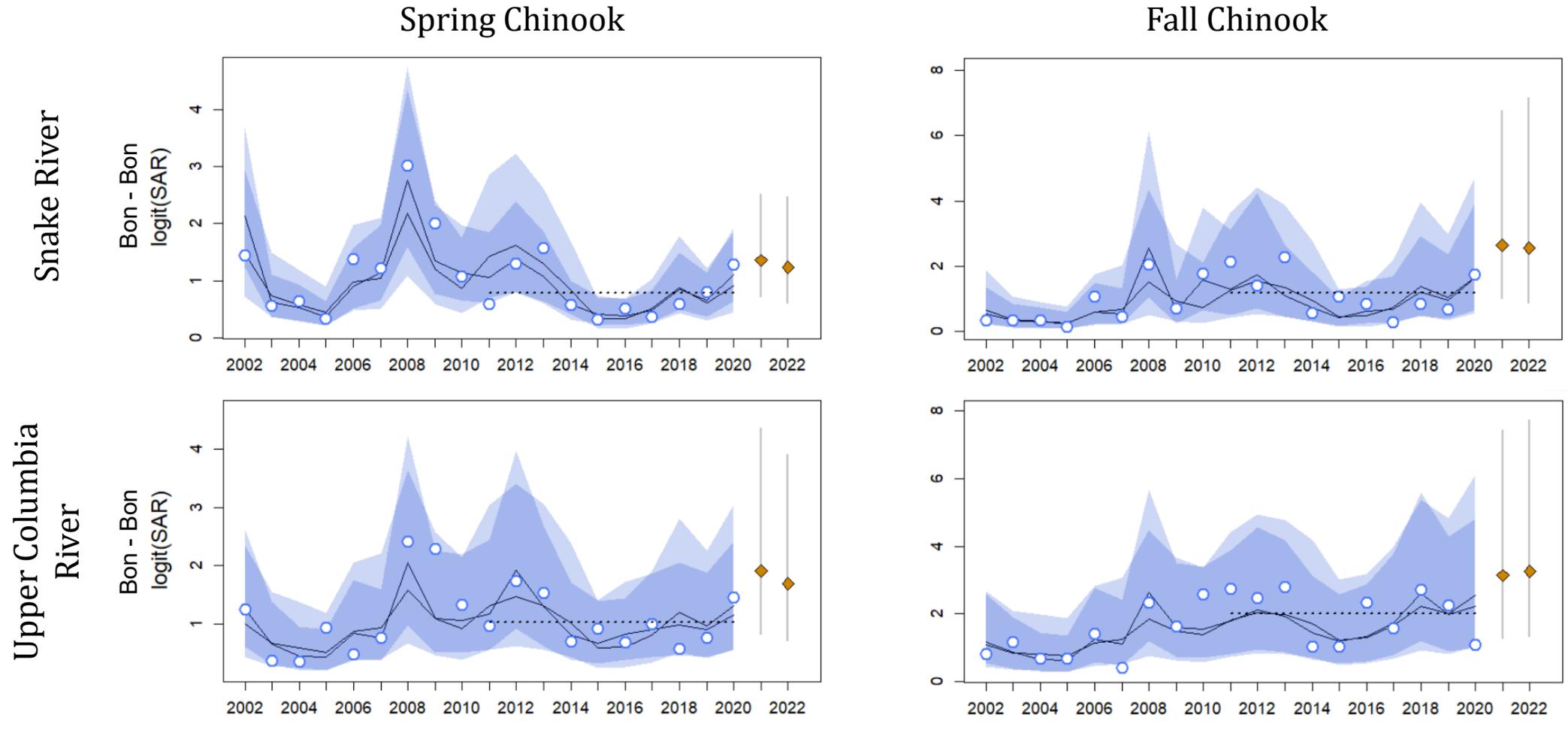
Fall Chinook

739K (418K-1.19M)

Adult Counts at Bonneville



PIT-tag based SAR models at the stock level



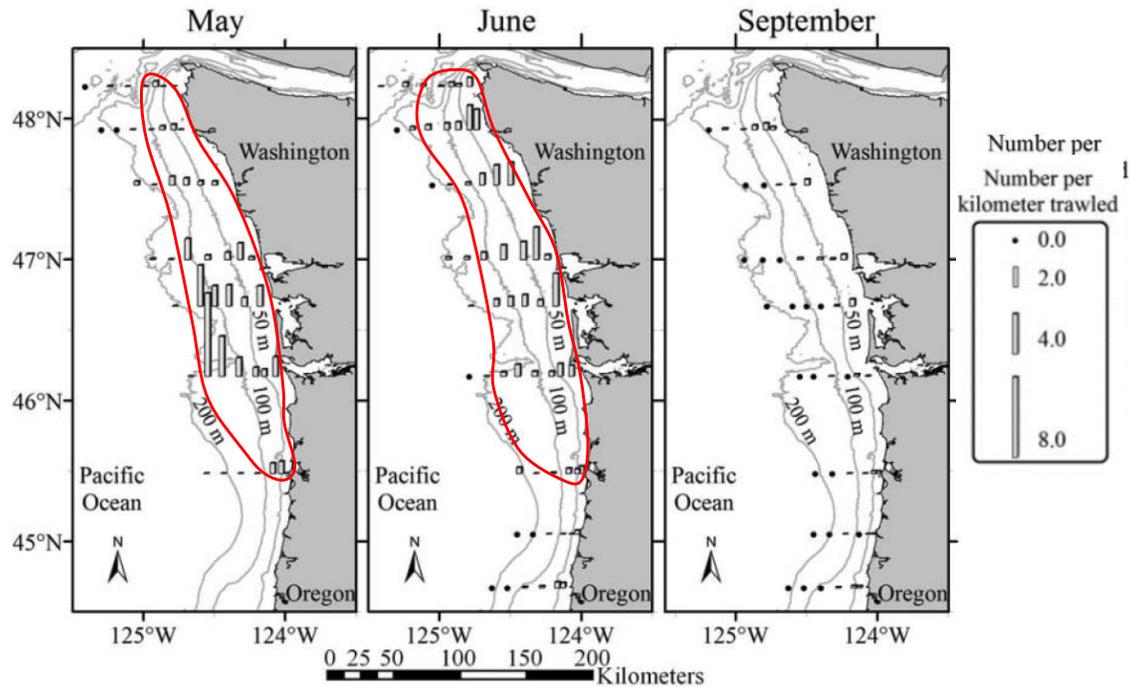
Columbia River DART
https://www.cbr.washington.edu/dart/query/pit_sar_esu



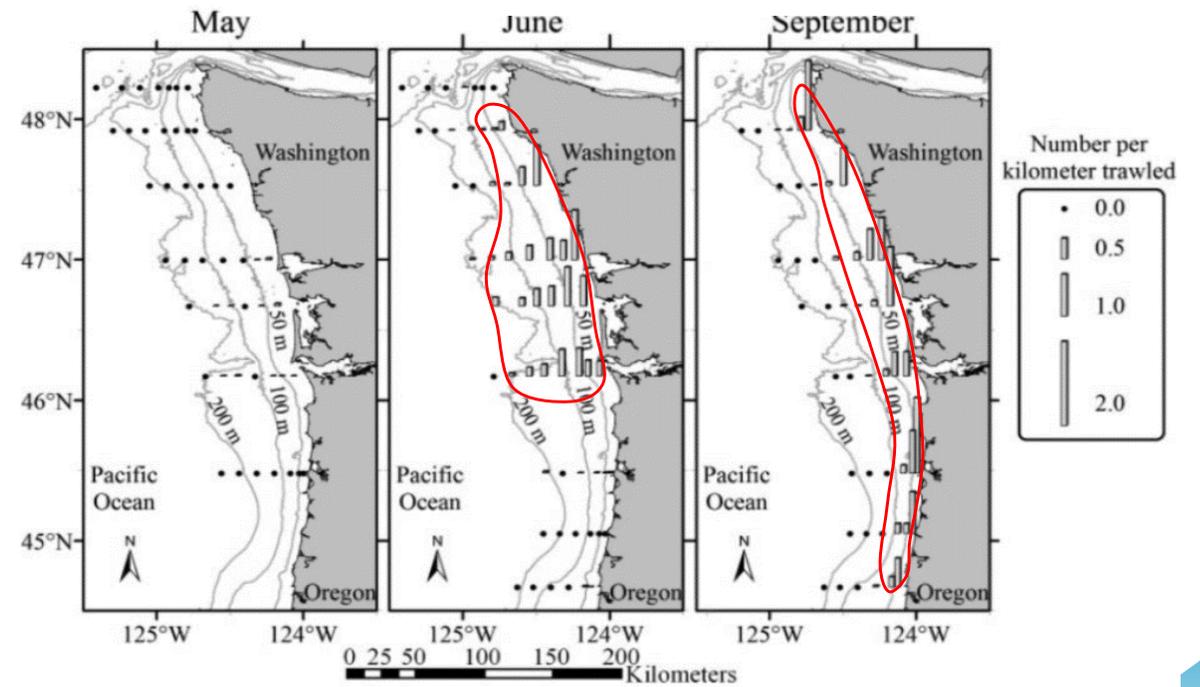
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Spatial distribution is stock-specific (models should be too)

Snake River Fall Yearling Chinook



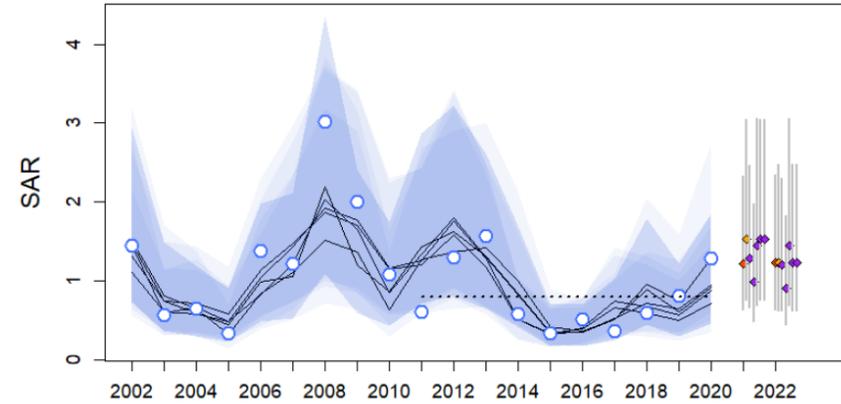
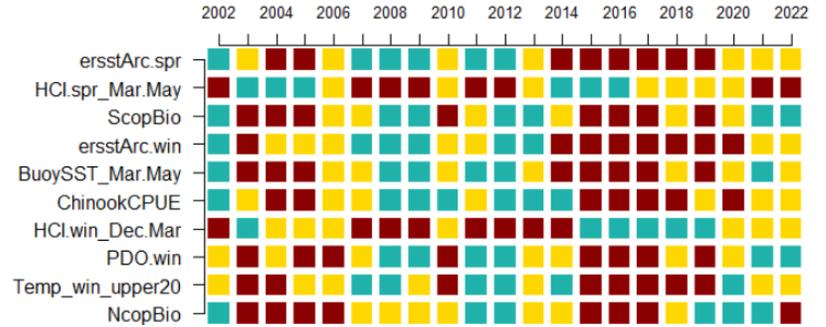
Snake River Fall Subyearling Chinook



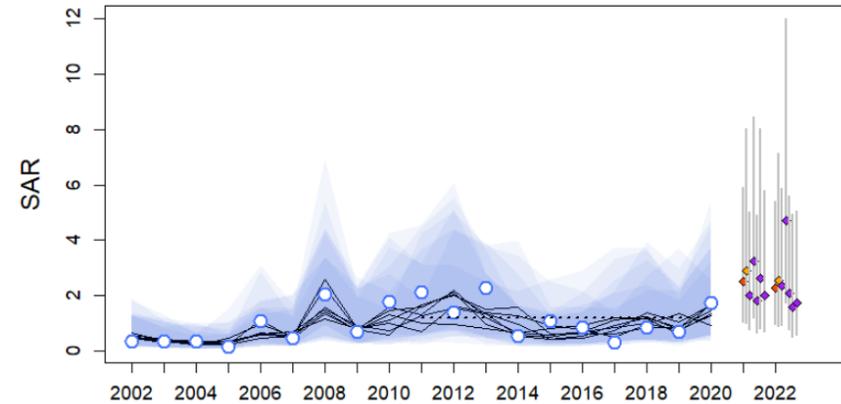
Teel, et al. 2015. Marine and Coastal Fisheries 7:274-300.

Stock-specific indicators would be better for forecasting

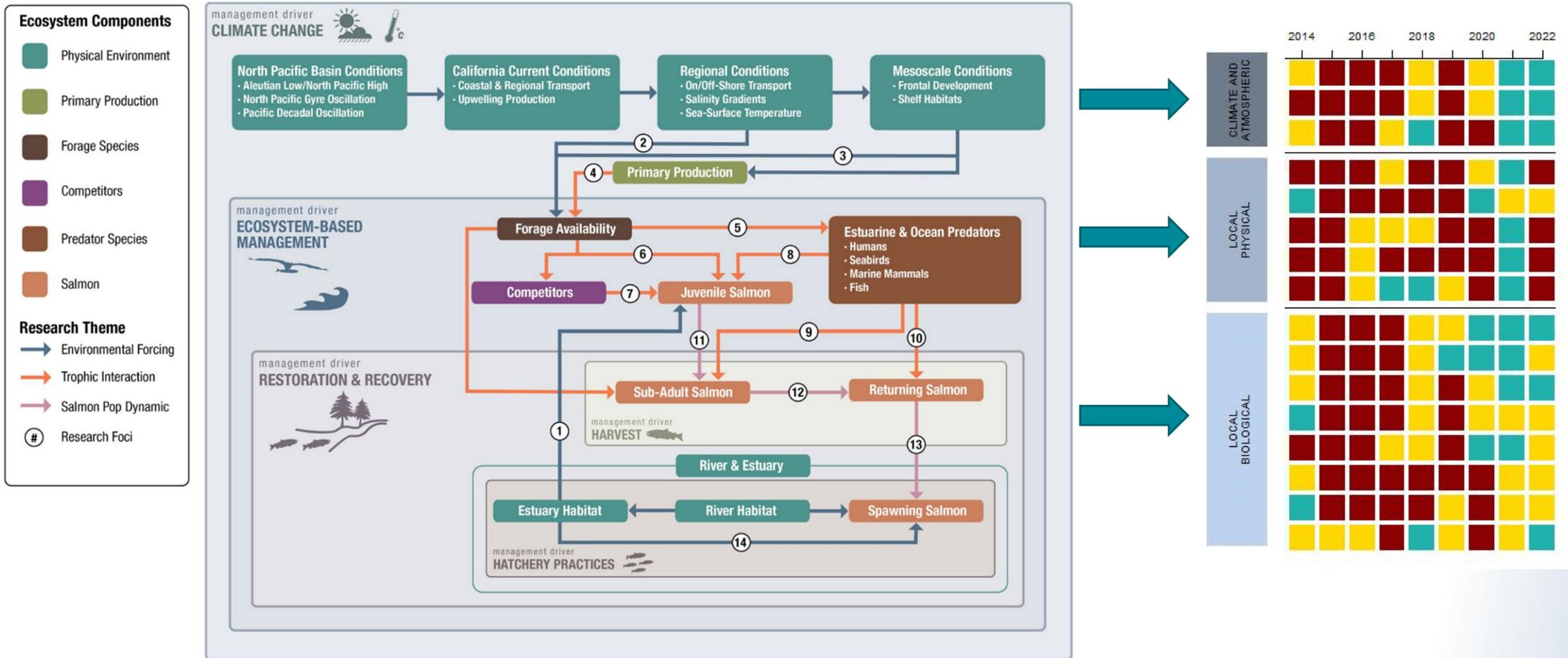
Snake River Spring Chinook



Snake River Fall Chinook

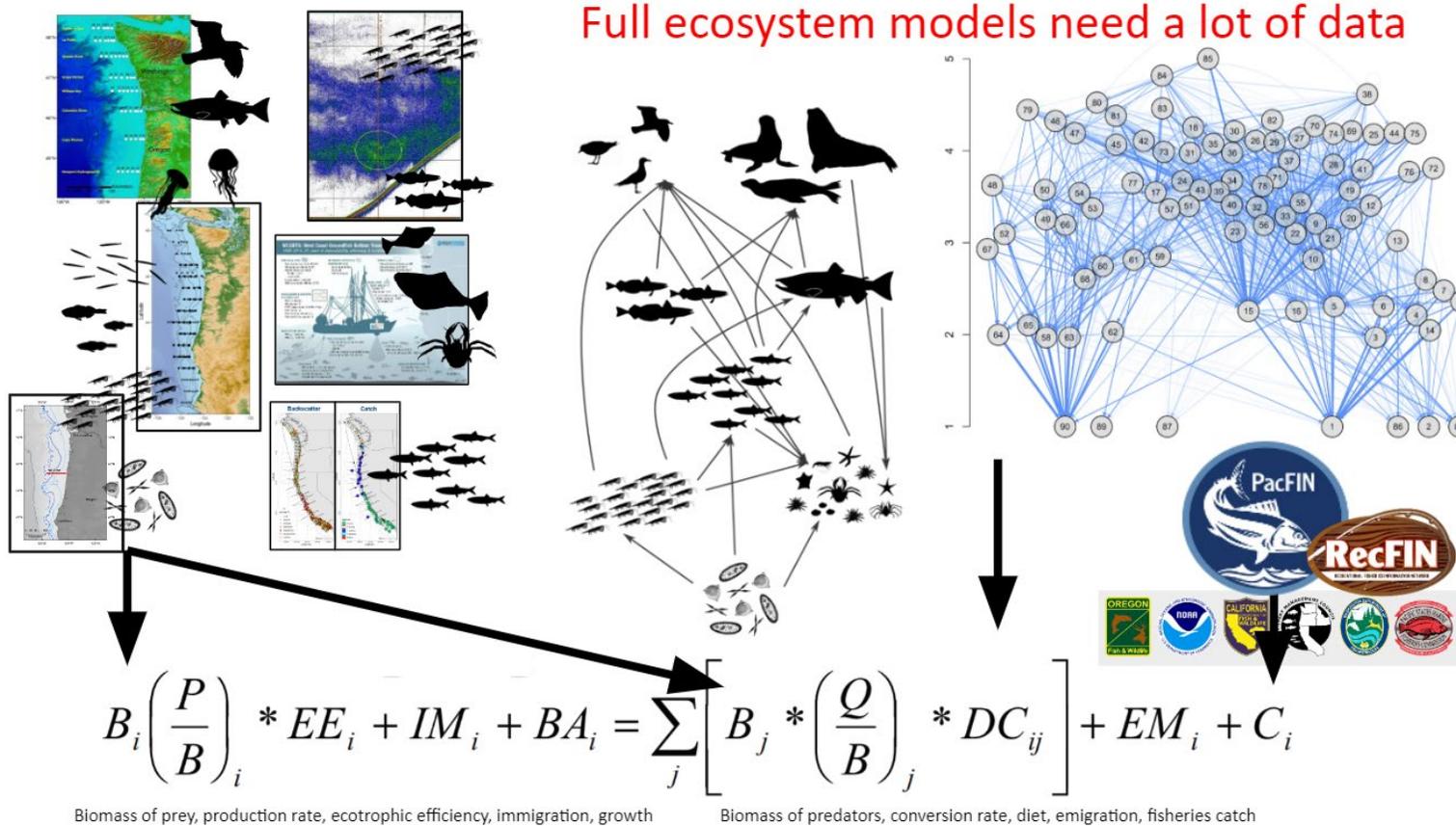


A mechanistic Ecosystem approach would be best



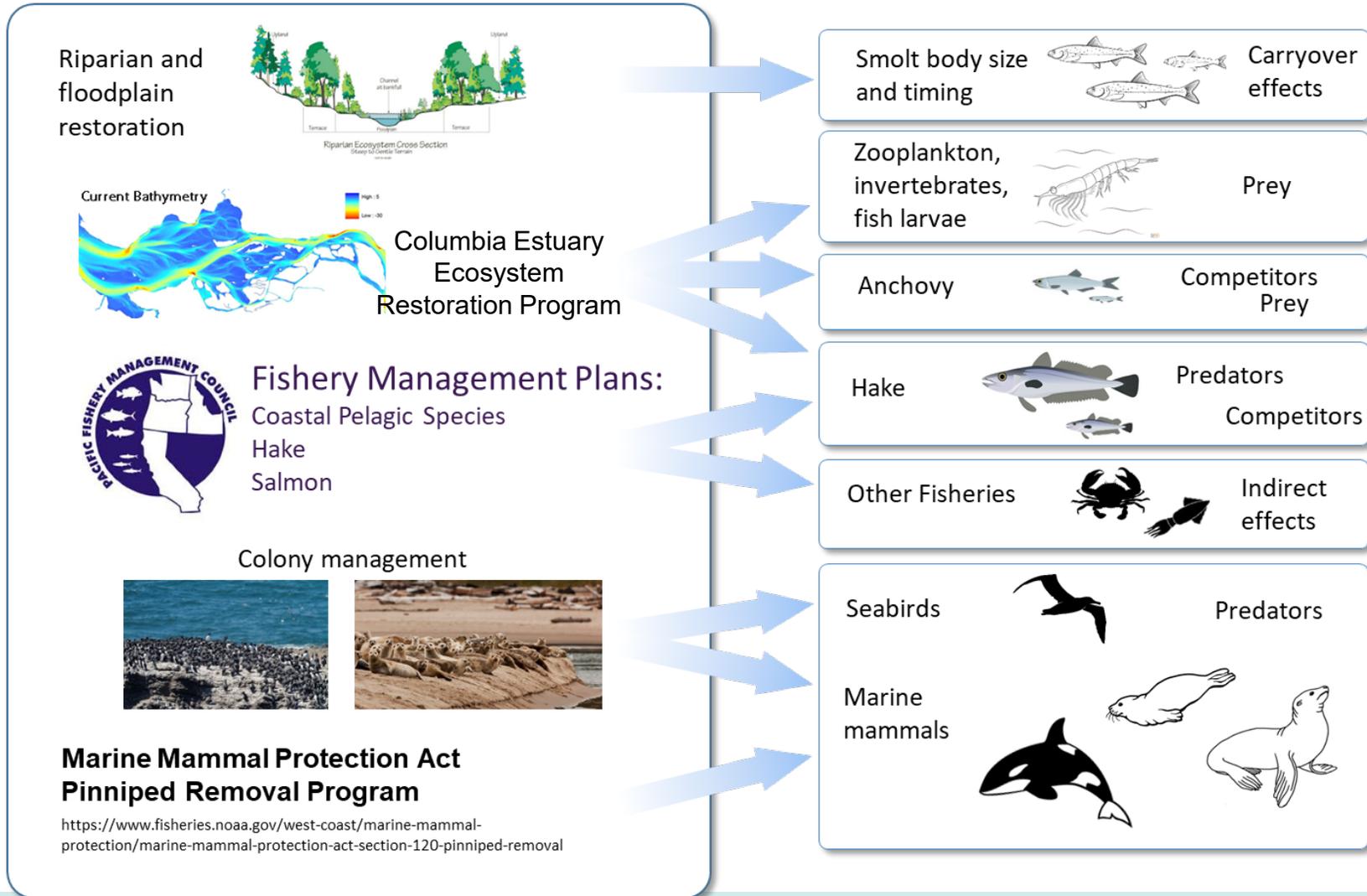
Wells et al. 2020
<https://doi.org/10.3389/fmars.2020.00342>

WRAP Salmon Marine Survival Project

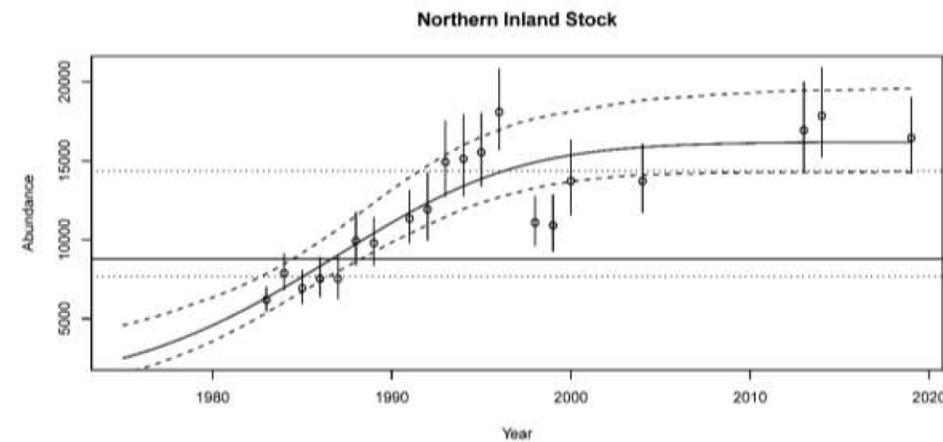
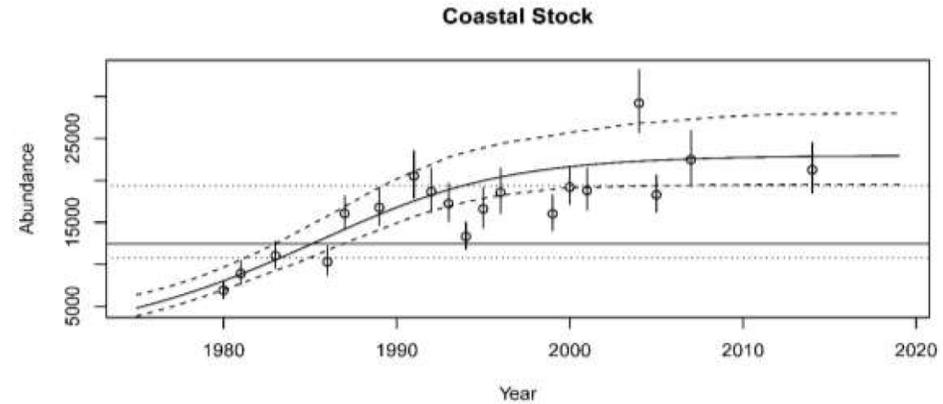
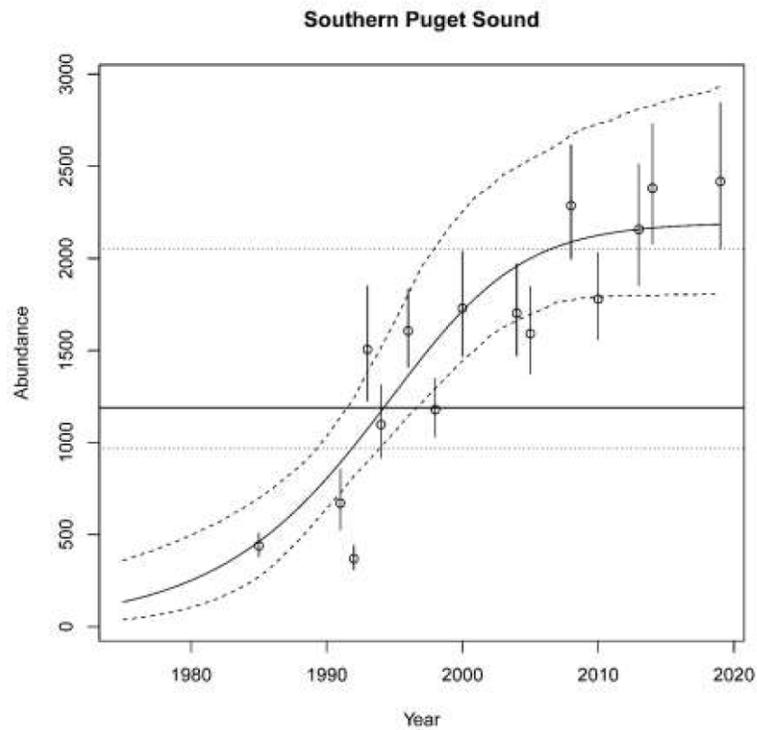


- Use multiple perspectives to identify the most important ecological drivers of salmon survival in climate change scenarios
- Inform priorities for data collection
- Inform management of the uncertainties and potential benefits of a diverse array of actions

We Have Management Options for Ocean Survival

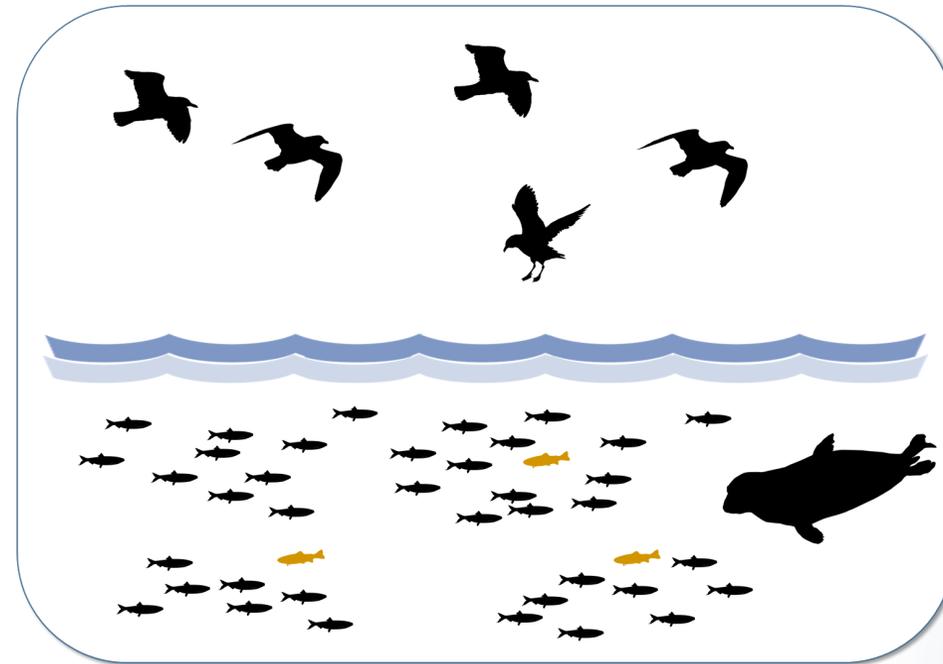
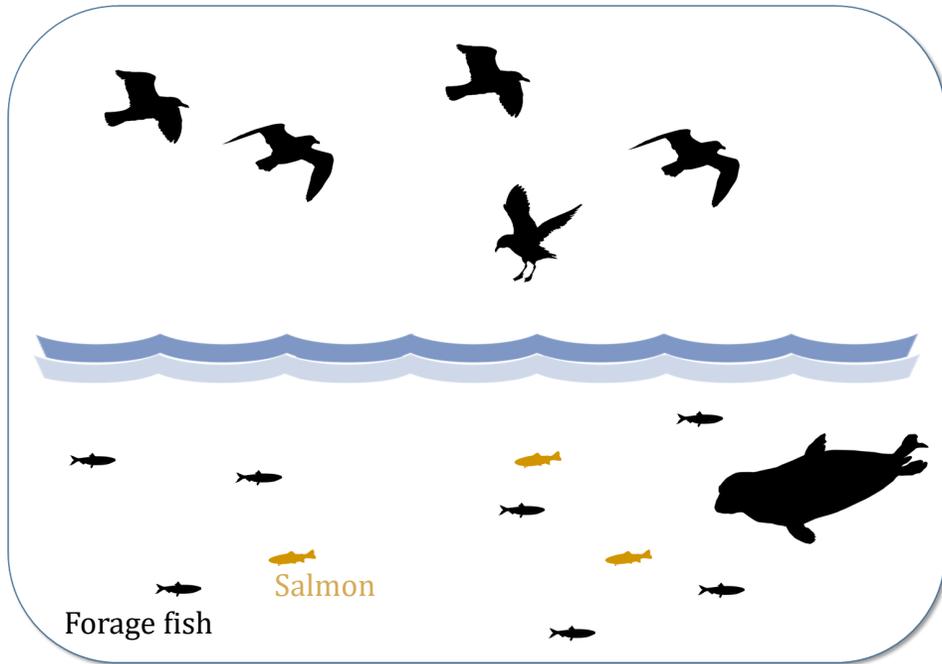


Marine Mammal Protection Act has been hugely successful



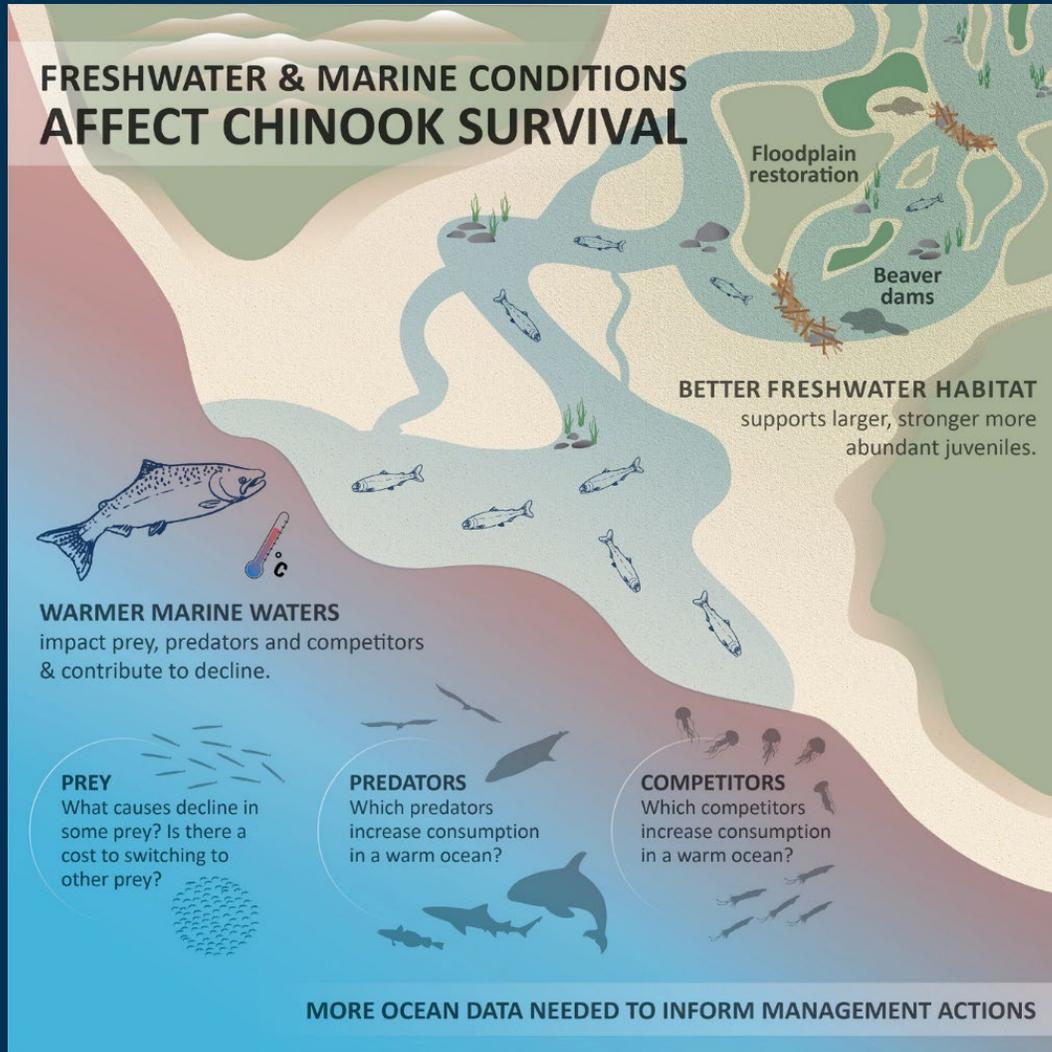
Washington State Academy of Sciences. (2022). Pinniped Predation on Salmonids in the Washington Portions of the Salish Sea and Outer Coast. Seattle, WA: WSAS, 1-81.

Alternate prey for salmon predators can increase salmon survival



We provide data from telemetered harbor seals and steelhead indicating that the resulting high abundance of age-1+ anchovy provided an alternative prey source for predators of migrating steelhead smolts.

-Moore, M. E., et al. 2021. Marine Ecology Progress Series 662:139-156.



- Ocean conditions in 2021 were good, but they didn't last long – 2022 showed mixed signals, but generally unfavorable
- Carry-over effects, predator controls, and alternative prey represent important emerging management levers
- Now is the time to ramp up marine science efforts to identify and inform additional marine management actions