2023-24 California Current Ecosystem Status Report

NOAA California Current IEA Team

Presented to PFMC
March 9, 2024

John Pohl, NOAA

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Core Team: Andrew Leising, Mary Hunsicker, Greg Williams, Nick Tolimieri, Lynn Dewitt, Abigail Harley, Chris Harvey

Contributions from >90 individuals
23 different agencies/institutions

John Pohl, NOAA

2023-24 CCIEA Ecosystem Status Report Highlights

KEY TAKEAWAYS FROM 2023

- Mixed basin-scale climate indicators: Negative Pacific Decadal Oscillation (**Neg PDO = cool, productive coastal waters**) then a transition to **El Niño**
- **Atmospheric rivers** added record mountain snowpack in early 2023, **reducing prolonged drought** conditions in California
- Diverse and productive **prey communities** provide **positive preconditioning** ahead of emerging El Niño

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Unfavorable conditions and Risk Factors

Ocean warming: 4th-largest marine heatwave

Extreme weather/flooding in early 2023

HAB events: closures/delays in fisheries, and deaths of marine mammals

Poor habitat conditions for CA salmon 3 last years

Declining catches and revenue for most sectors; Closure of CA salmon fishery

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Mixed to Positive Ecological Signals

Total upwelling below-average; periods of intense local upwelling

Lipid-rich northern copepods relatively stable off Oregon

Abundant forage: anchovies and pelagic juvenile groundfish

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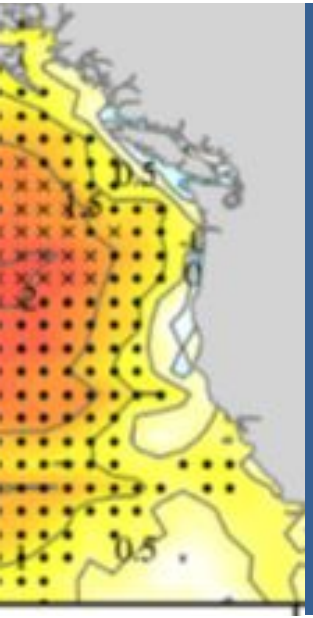
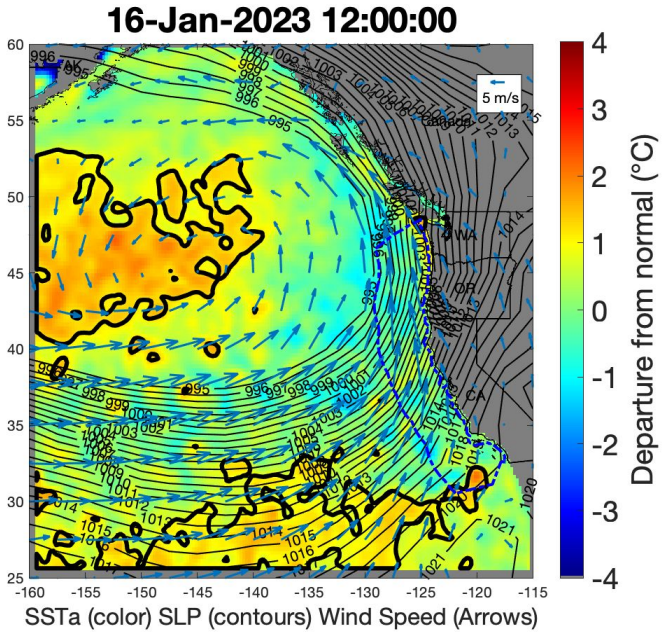
Clickable Infographic



Month-by-month “year in review”

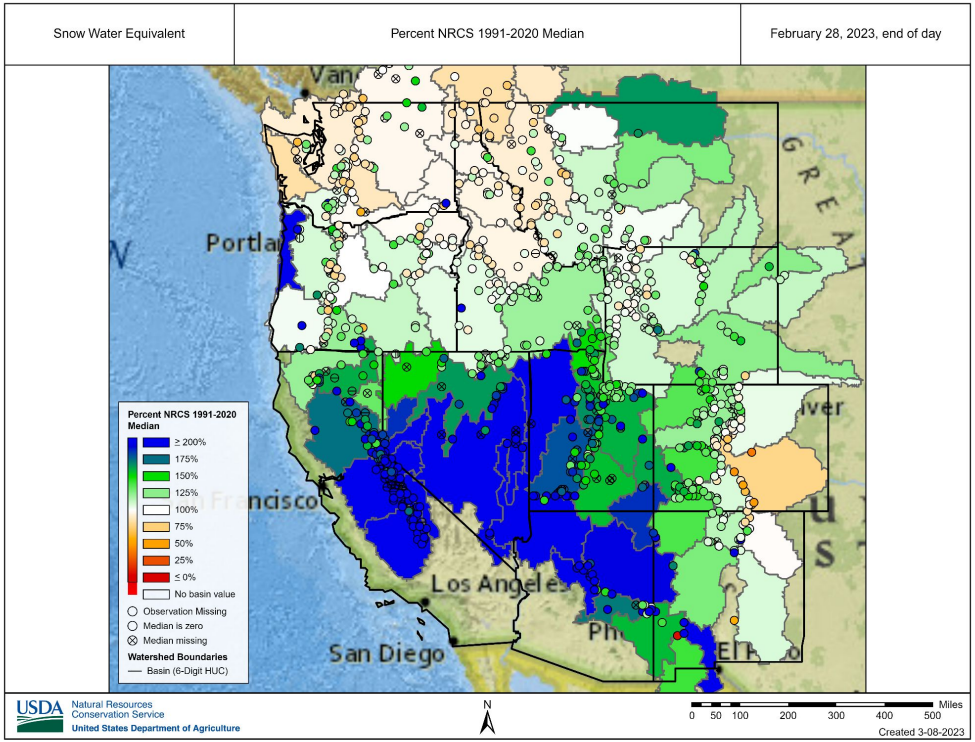
January 2023: Heatwaves and HABs



Razor clams closed in N. CA
from late 2022 until mid 2023

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

February 2023: Super Snowpack, > 200% SWE in some places!!!!



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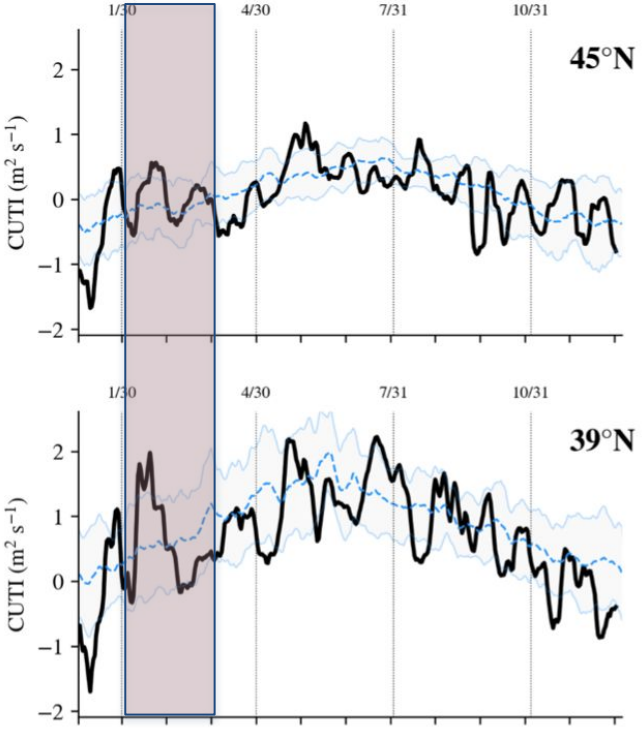
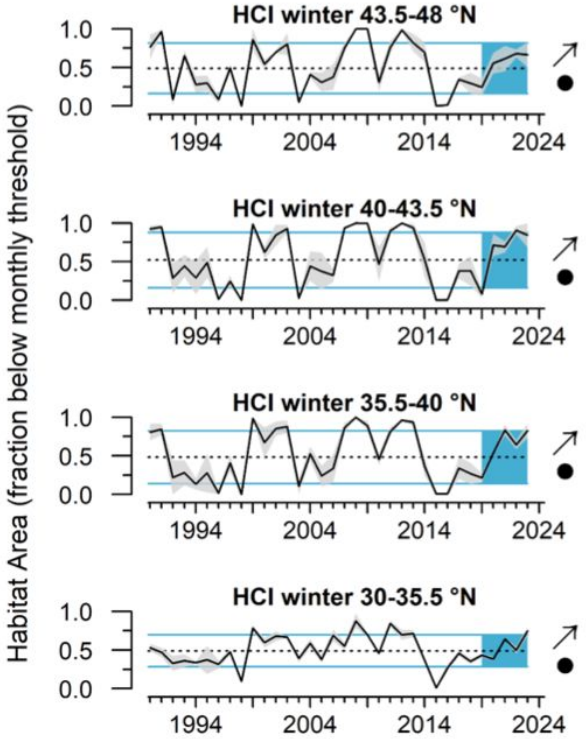
March 2023: Upwelling mixed, lack of habitat compression





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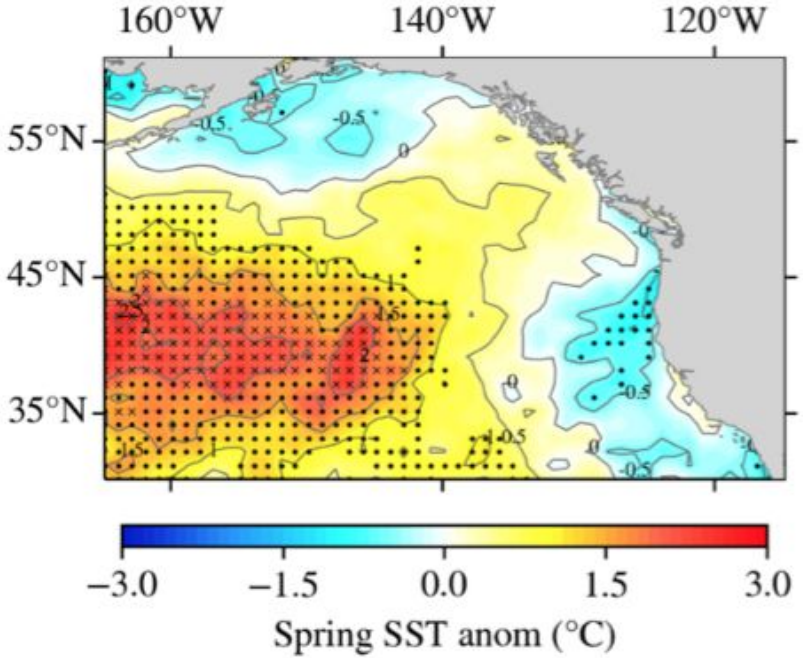
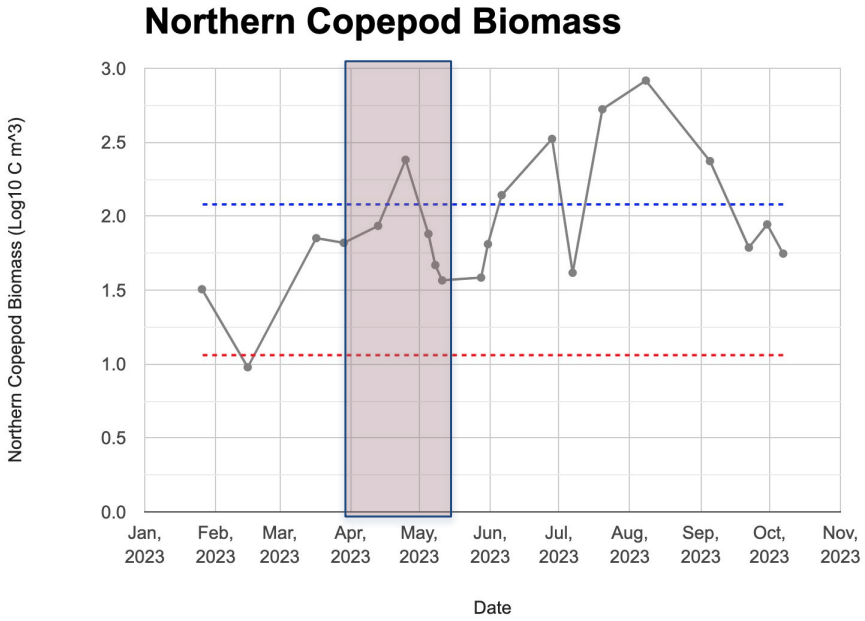
April/May 2023: Very warm ocean conditions across NEP (offshore)





Lipid-rich copepods already abundant!

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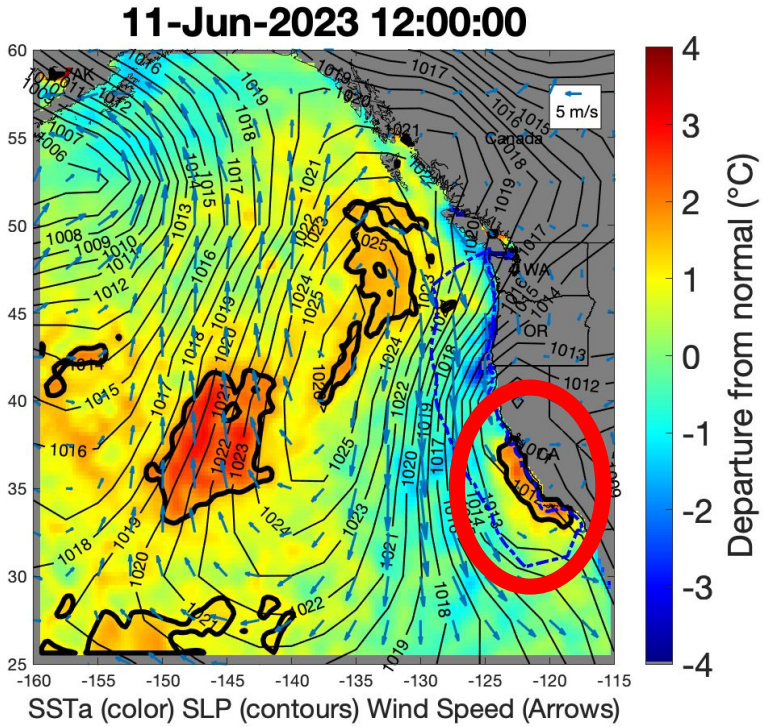
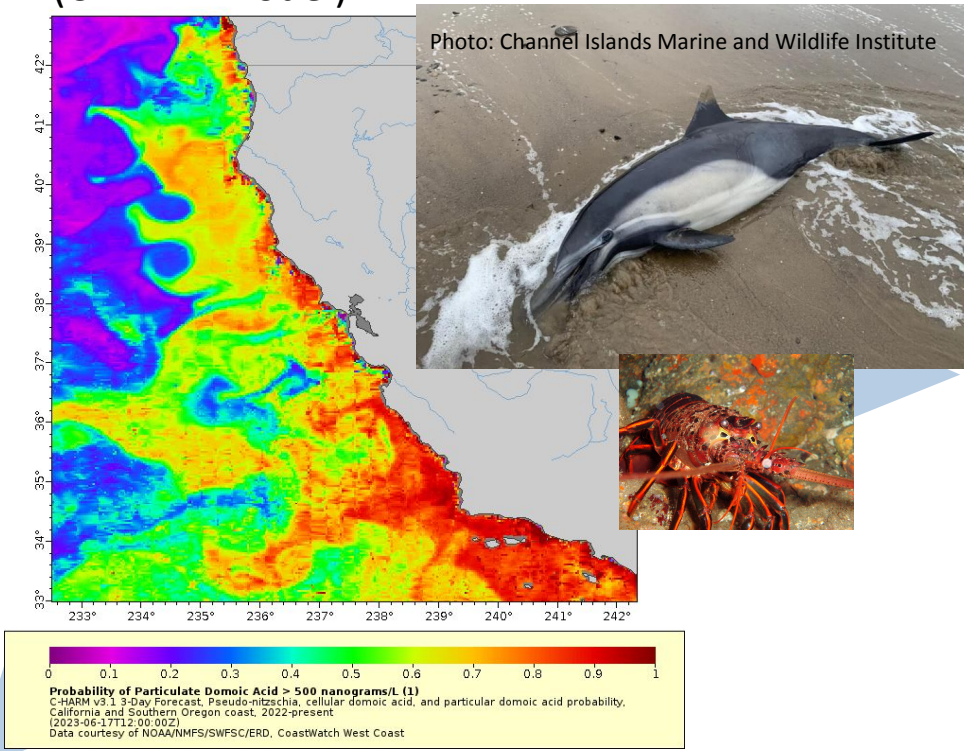
June 2023: Marine mammal UME



Domoic Acid Probability
(CHARM model)



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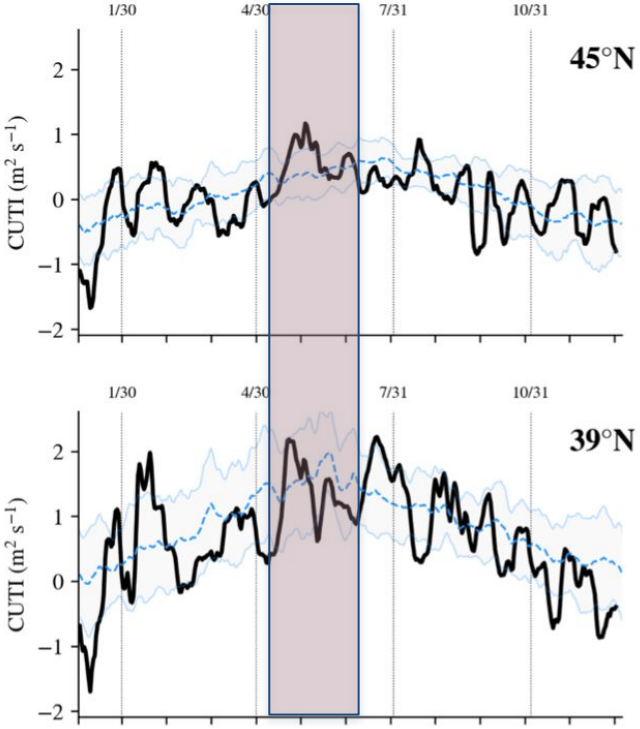
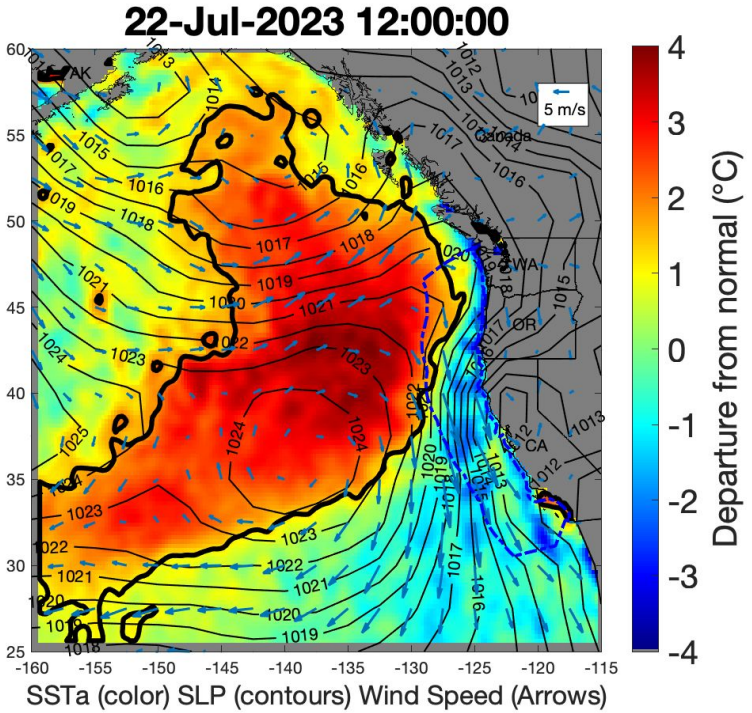
July 2023: Return to STRONG upwelling, but heatwave looming…





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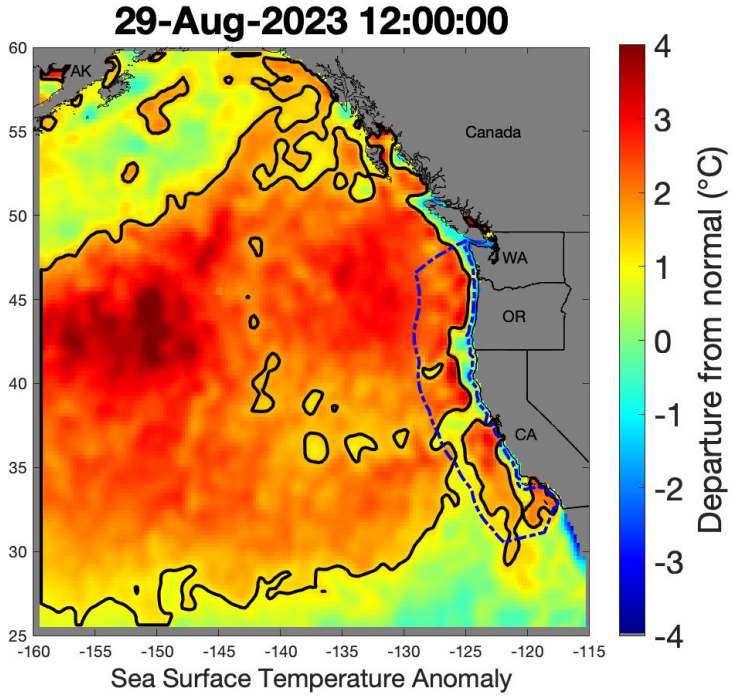
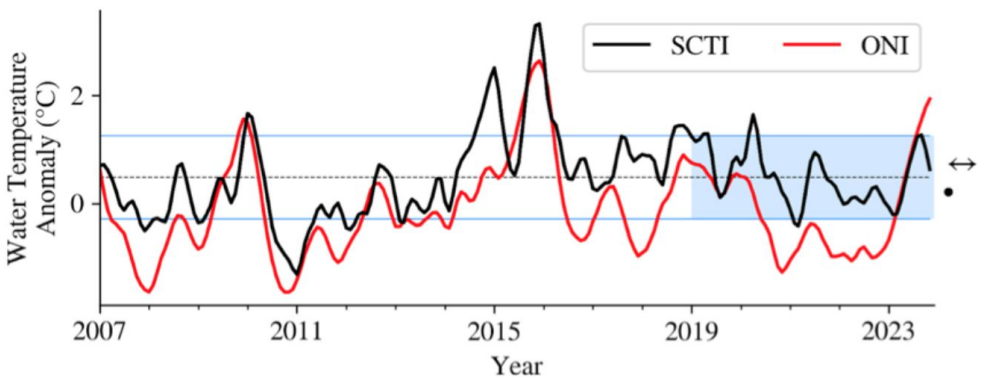
August 2023: Max heatwave and El Niño on the horizon





El Niño index (ONI) suggests high likelihood of 23/24 El Niño, Southern CA Temperature Index (SCTI; subsurface glider data) already showing possible influence

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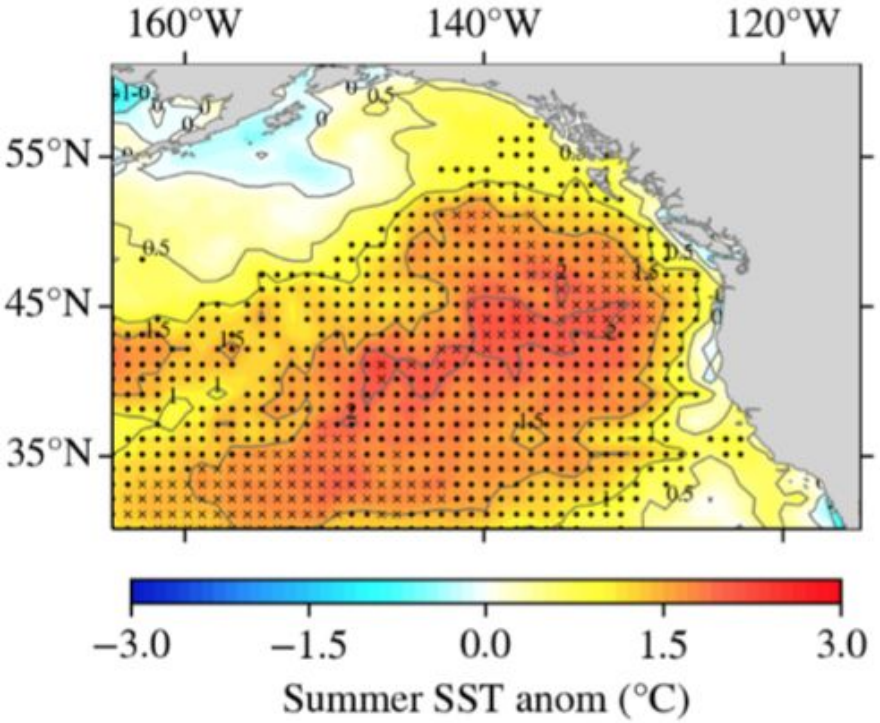
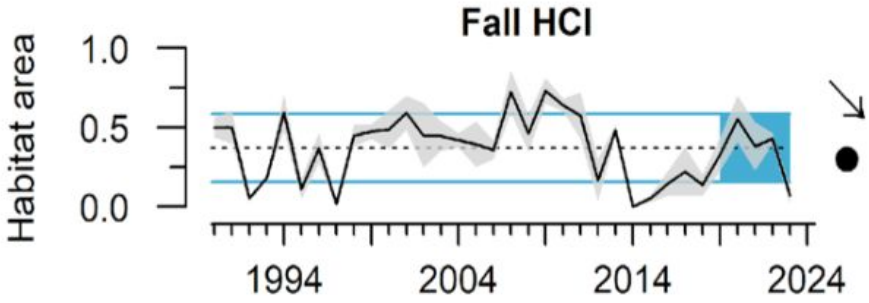
September 2023: Continued heat and habitat compression





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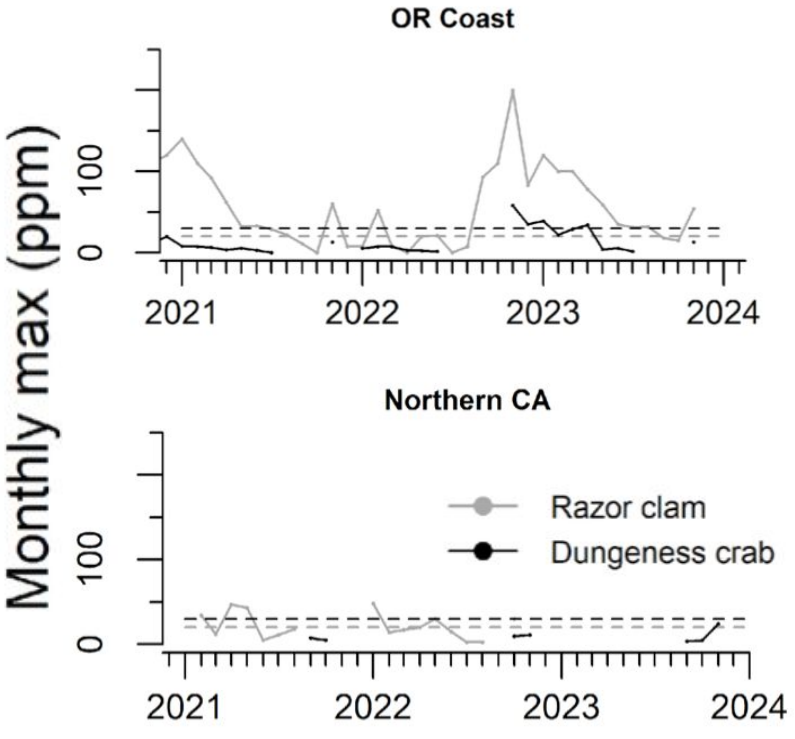
Oct/Nov 2023: DA events and shellfish closures



Meat Quality + Elevated Entanglement Risk

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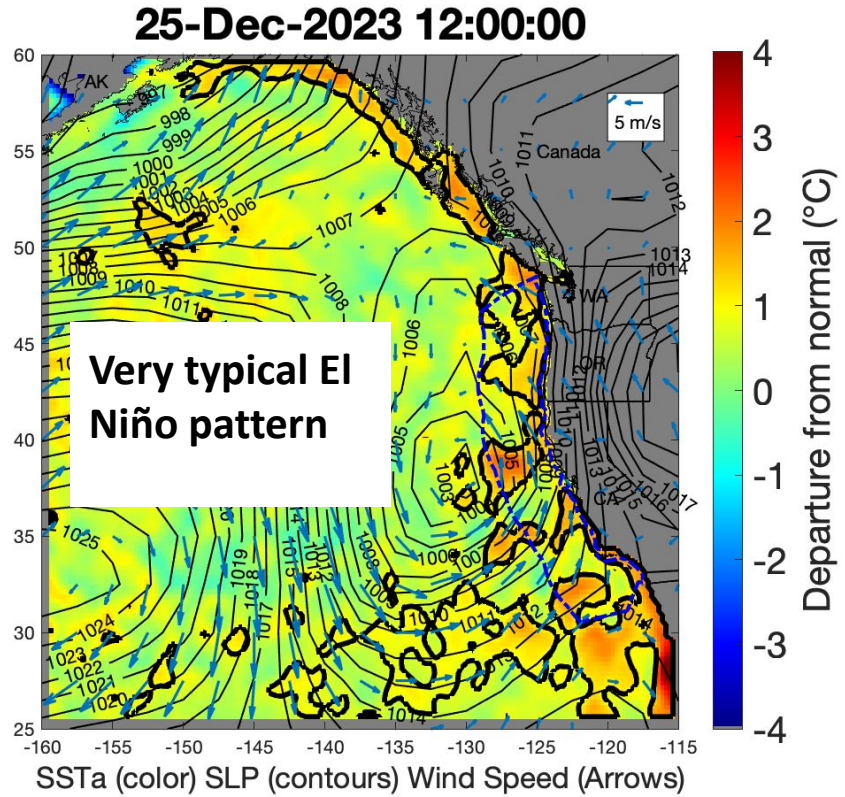
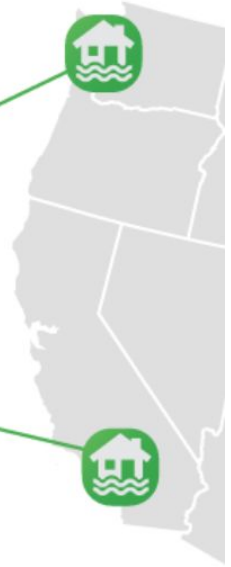
December 2023: El Niño arrives



An atmospheric river brought record-breaking precipitation and warm temperatures to parts of the Pacific Northwest on Dec 5, causing severe flooding and landslides that left residents trapped in their homes.

On Dec 21, an atmospheric river brought heavy rainfall and flooding to portions of southern CA. The city of Oxnard recorded 3.18 in. of rain—more than one month's total rainfall—in less than an hour.



https://www.ncei.noaa.gov/access/monitoring/monthly-report/national/202312

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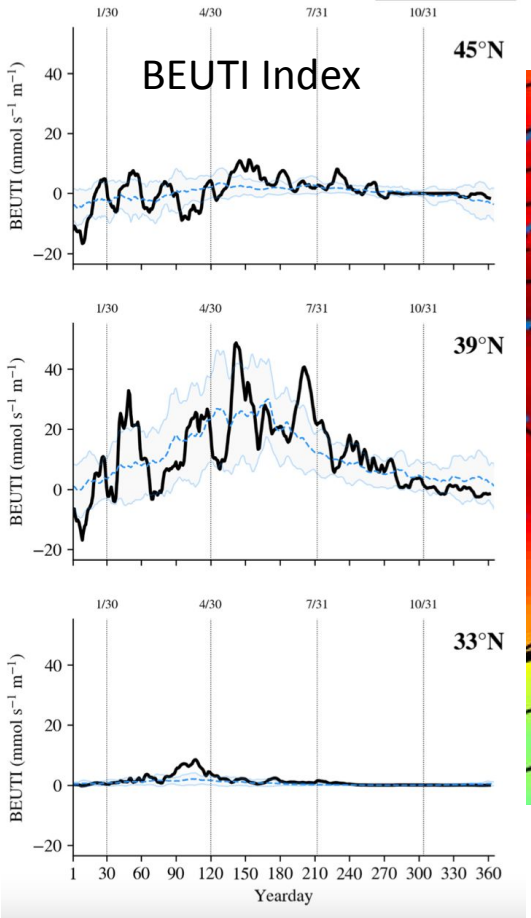
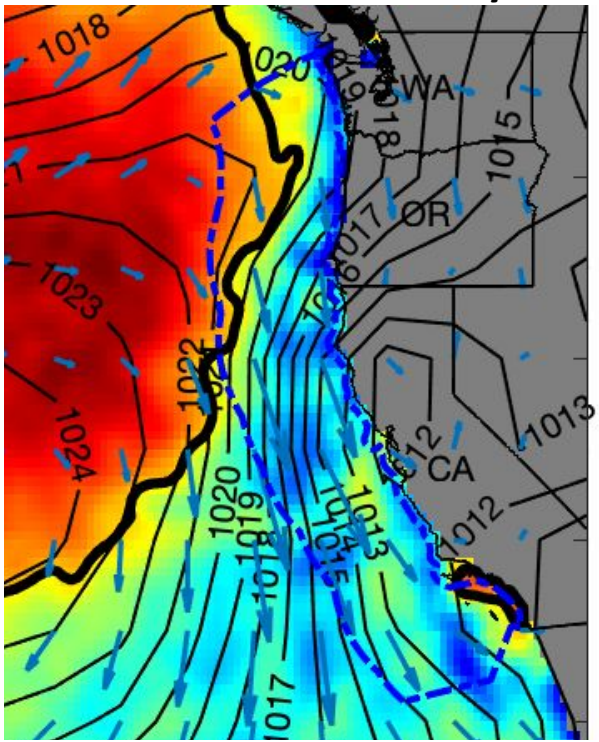
2023, Physical Summary: Upwelling may provide resilience



JULY 2023 SST Anomaly



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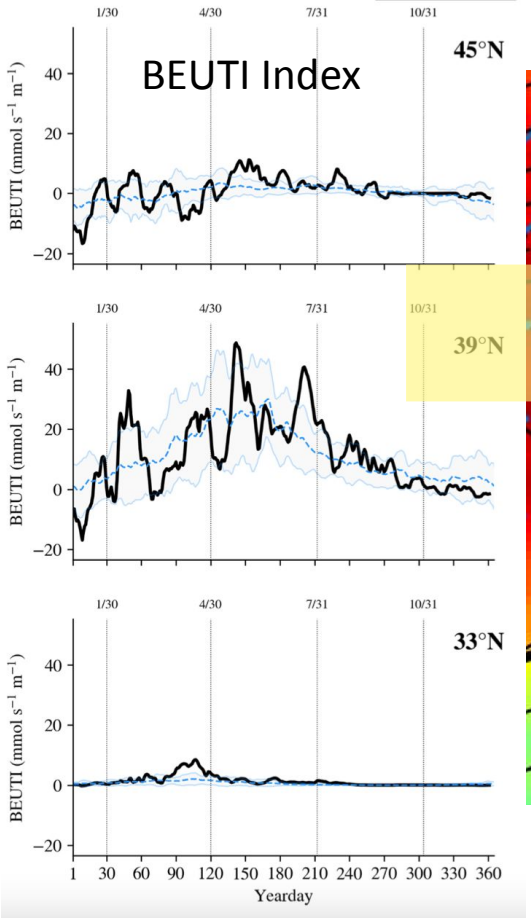

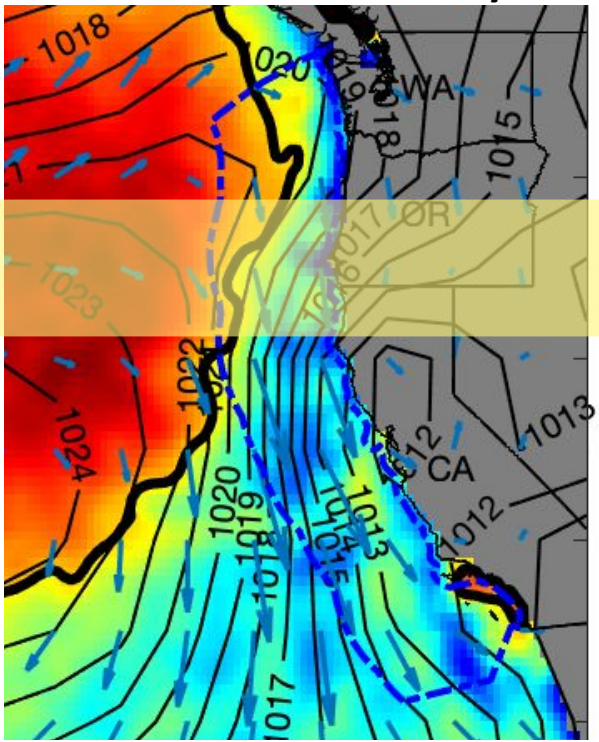

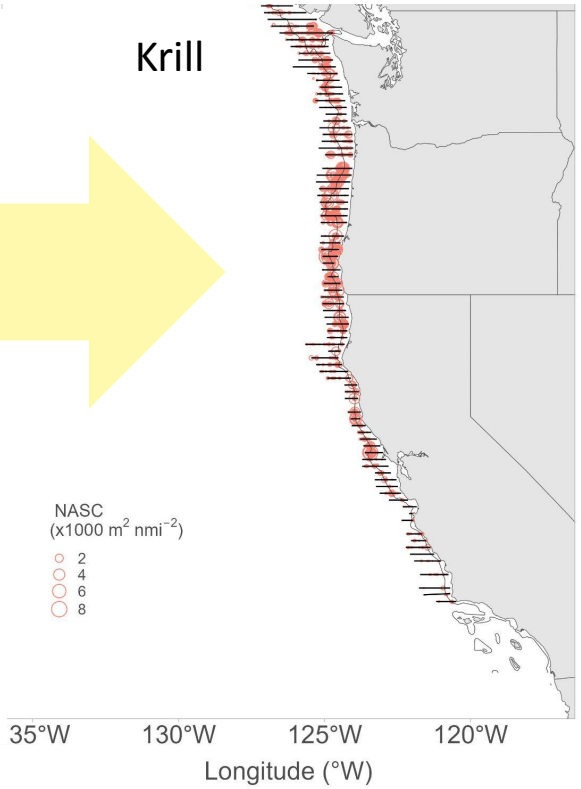

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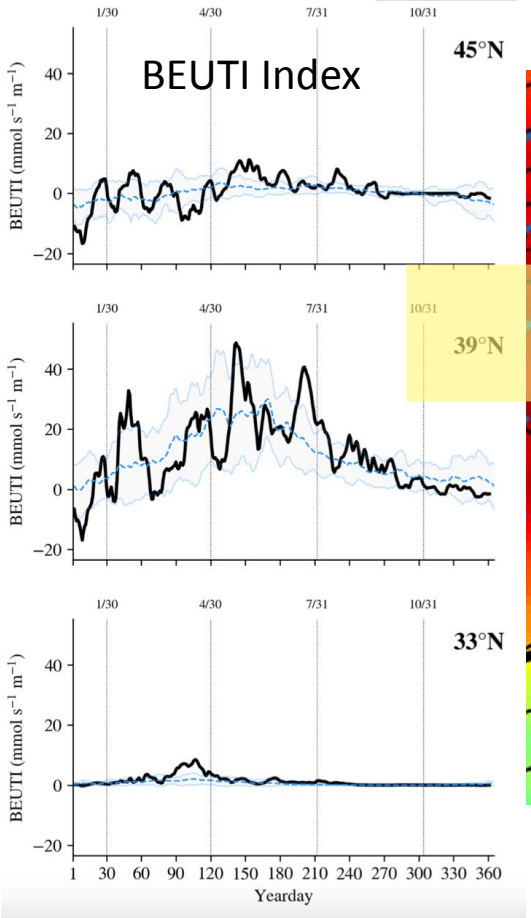
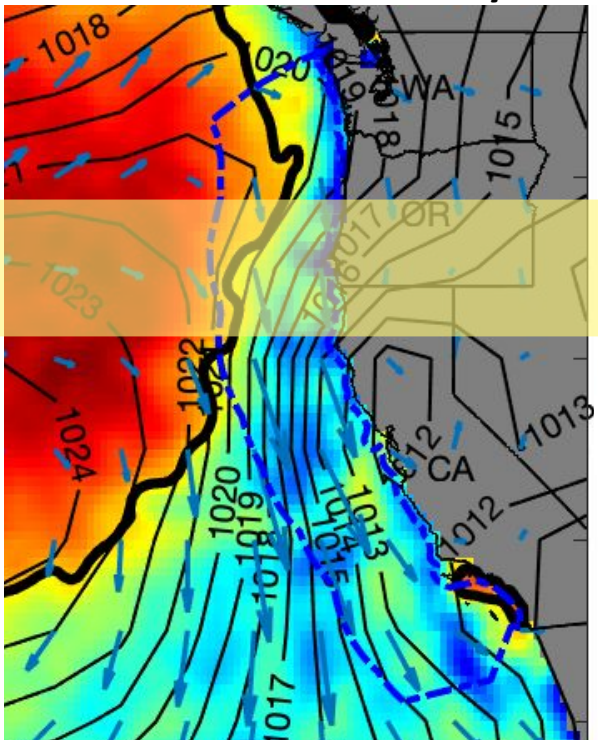
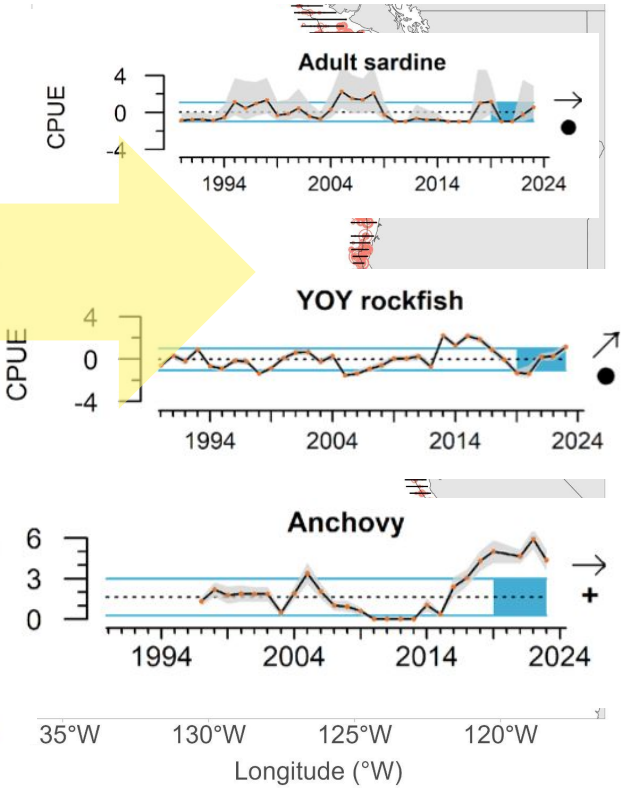




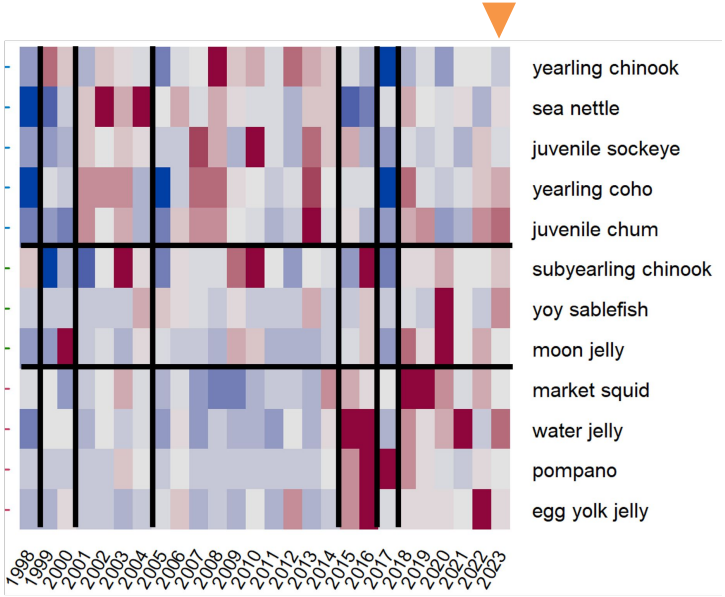


Connecting some dots in the food web

Mixed but favorable ecological signals of the forage community

High abundance of juvenile sablefish & juvenile salmon

Low abundance of yearling chinook & juvenile sockeye salmon



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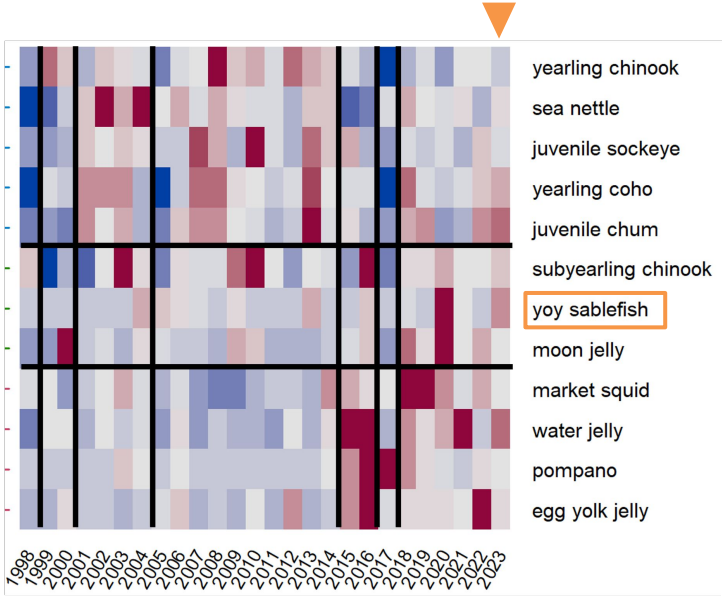
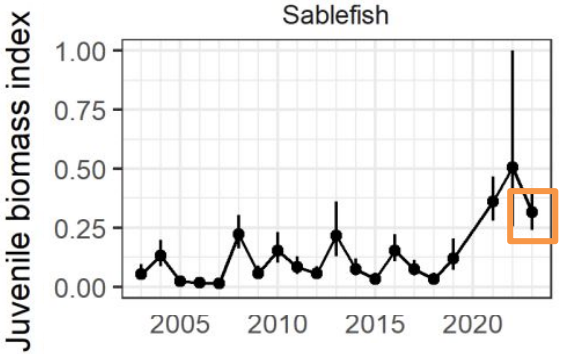


C. Morgan



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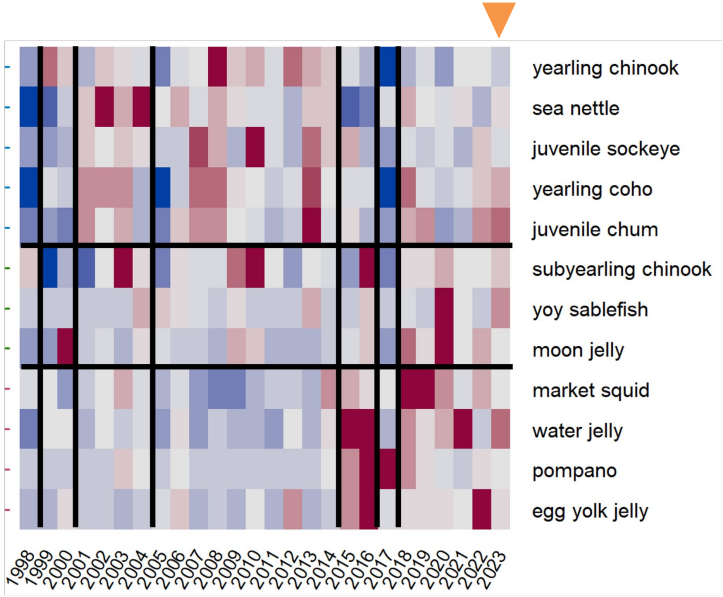
Evidence of high prevalence of juvenile rockfish



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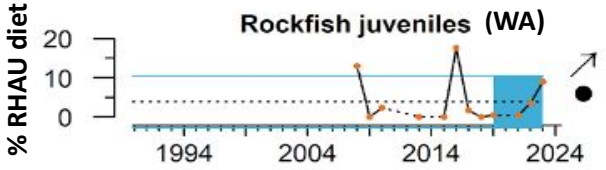

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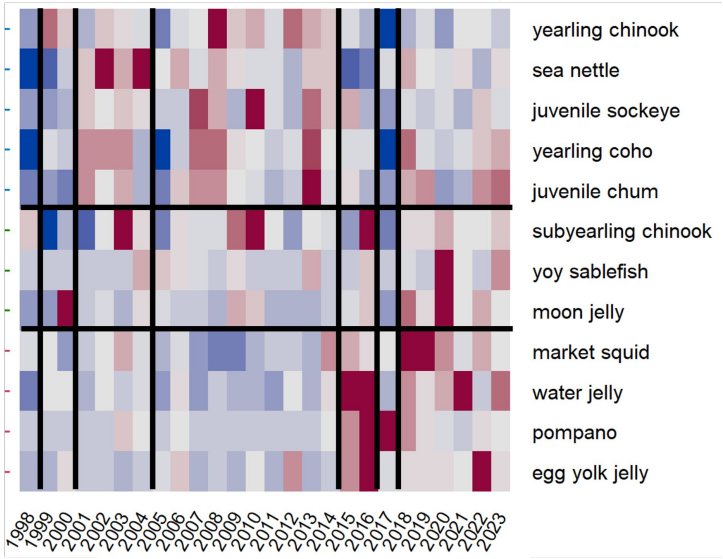
Northern copepod biomass stable and near average



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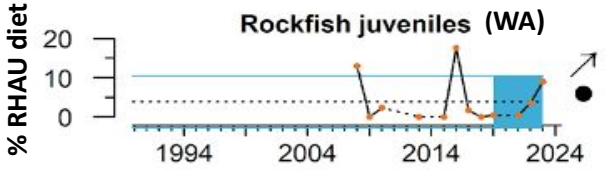

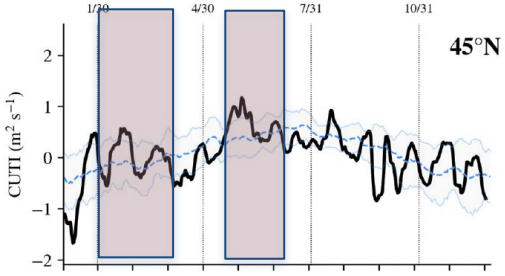

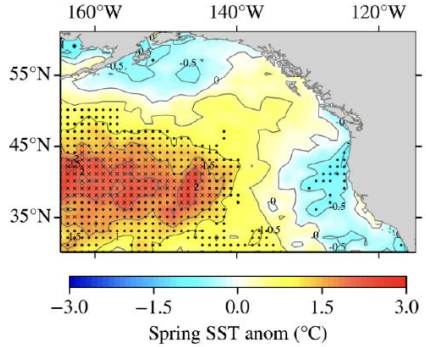

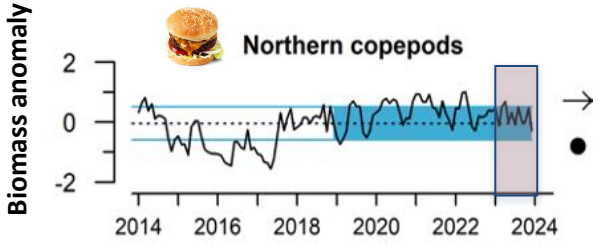

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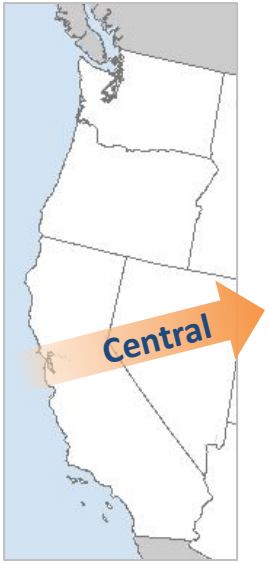
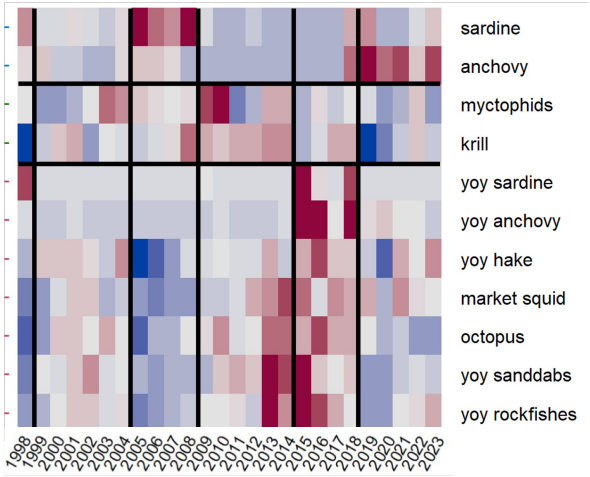


High abundance of adult anchovy

Increase in adult sardine, yoy hake, yoy rockfishes

Low yoy anchovy, yoy sardine and krill



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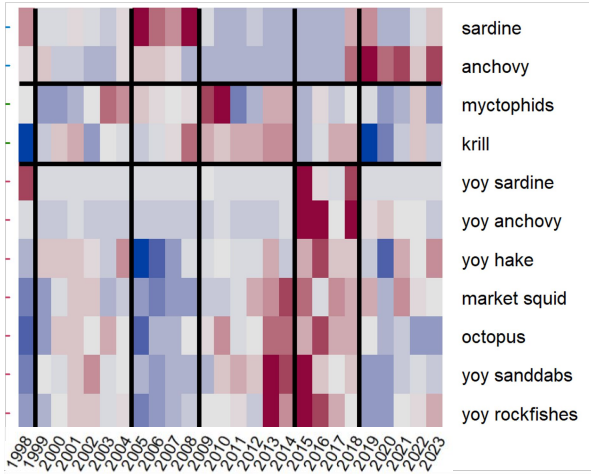
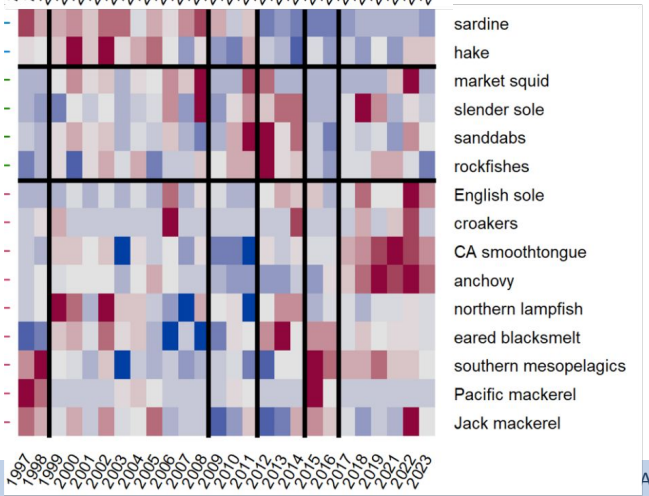


High abundances of larval anchovy, CA smoothtongue

Larval hake increased, low sardine and rockfishes



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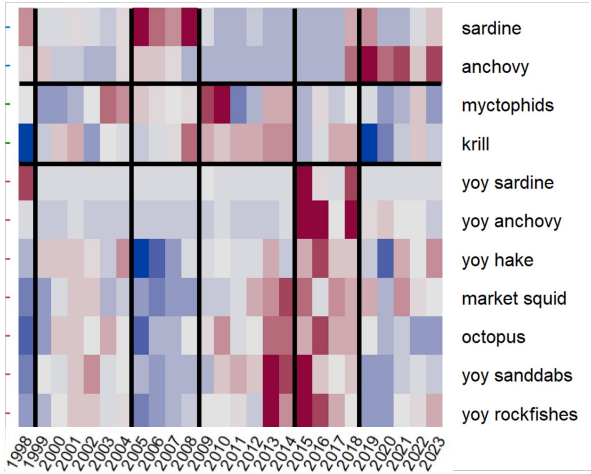
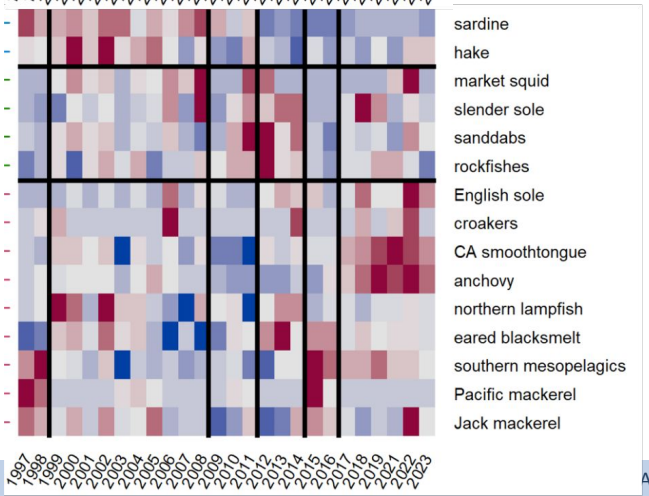
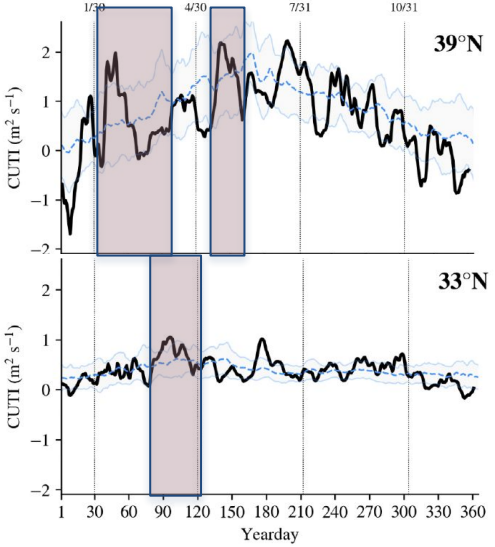
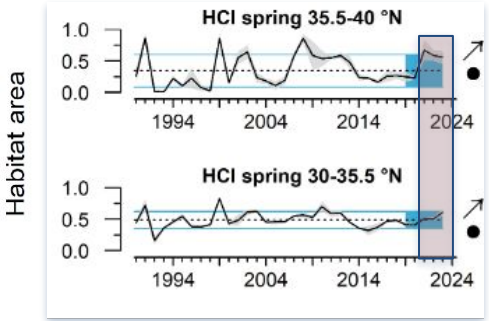


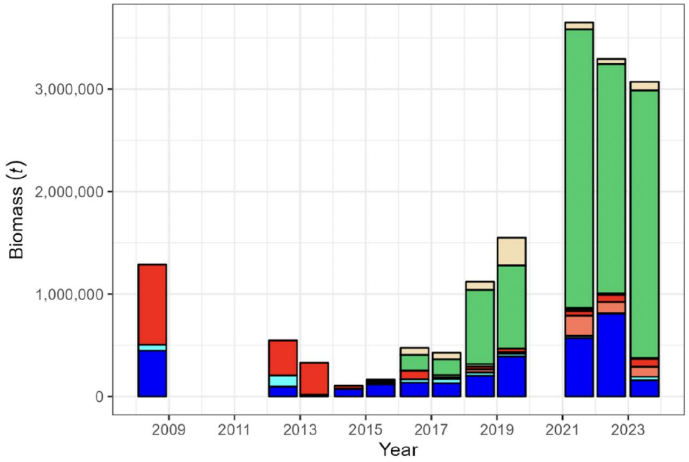






High production of anchovy reflected in coastwide CPS survey

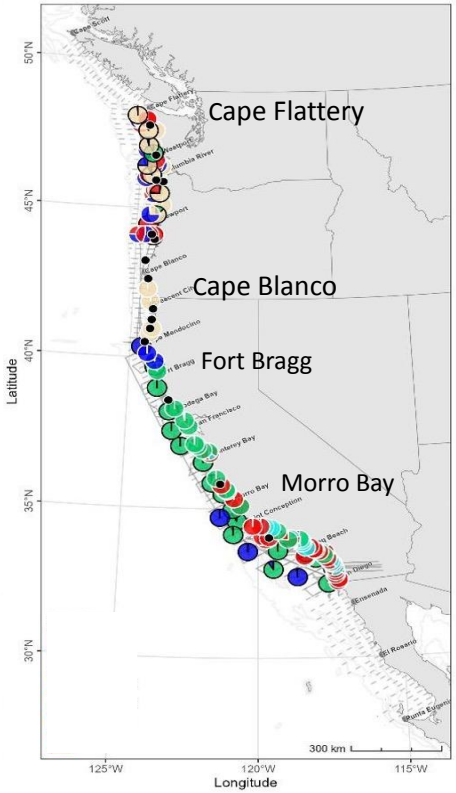
CPS Biomass



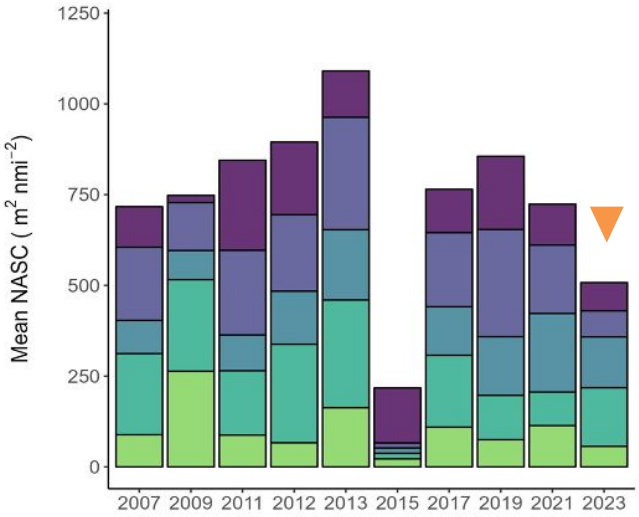
CPS

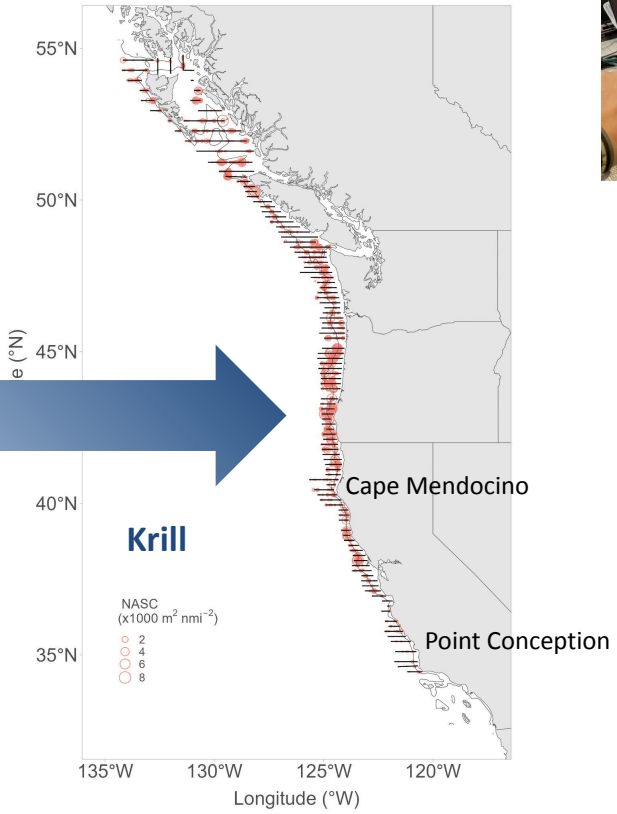
- P. herring
- Anchovy (c)
- Anchovy (n)
- R. herring
- Sardine (n)
- Sardine (s)
- P. mackerel
- J. mackerel

CPS Distribution



Lower abundance of krill observed in coastwide survey





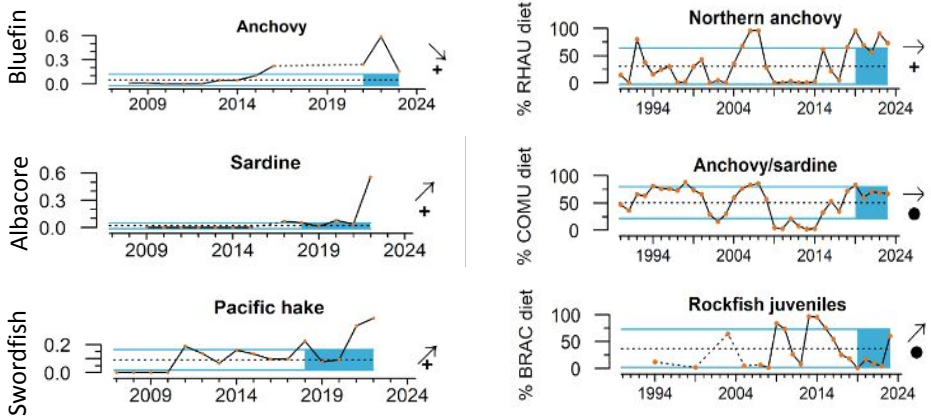
Predators capitalize on diverse and abundant forage

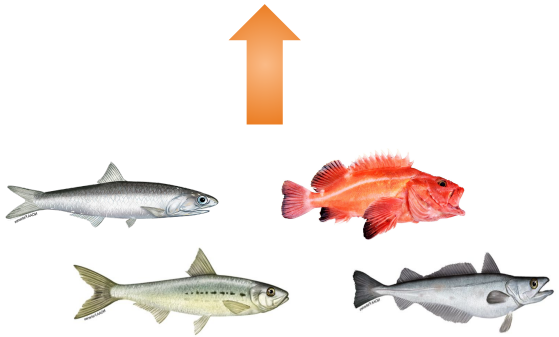
R. Levalley

Highly Migratory Species

Central CA seabirds

Proportion of diets

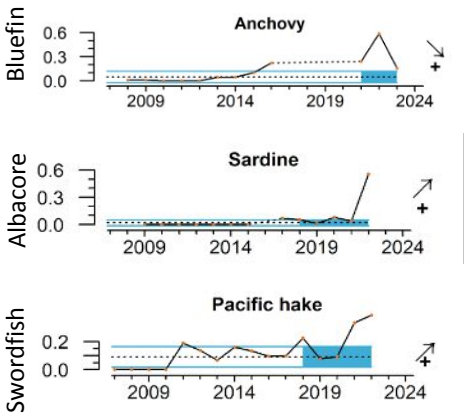




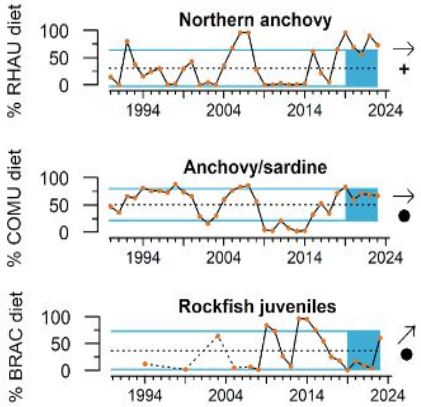
Predators capitalize on diverse and abundant forage

Proportion of diets

Highly Migratory Species

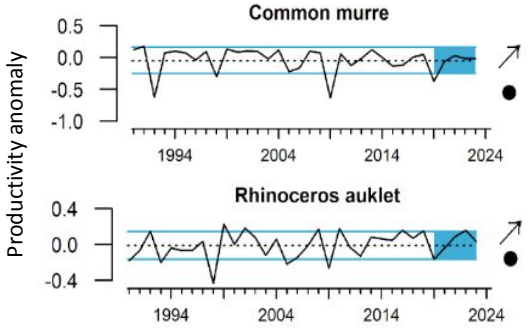


Central CA seabirds

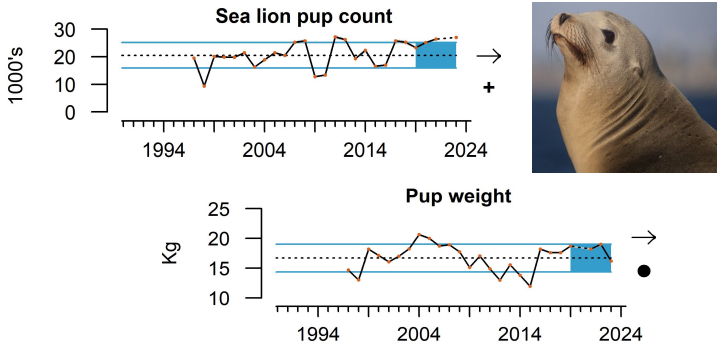


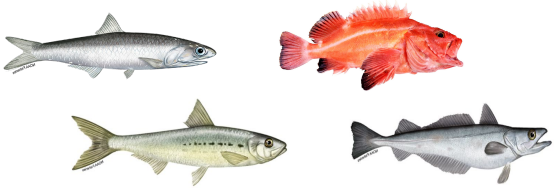
R. Levalley

Central CA seabirds

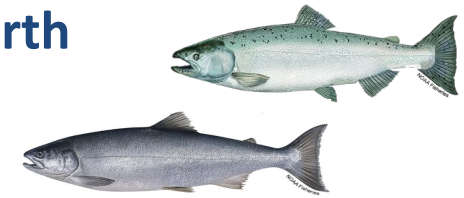


Sea lions



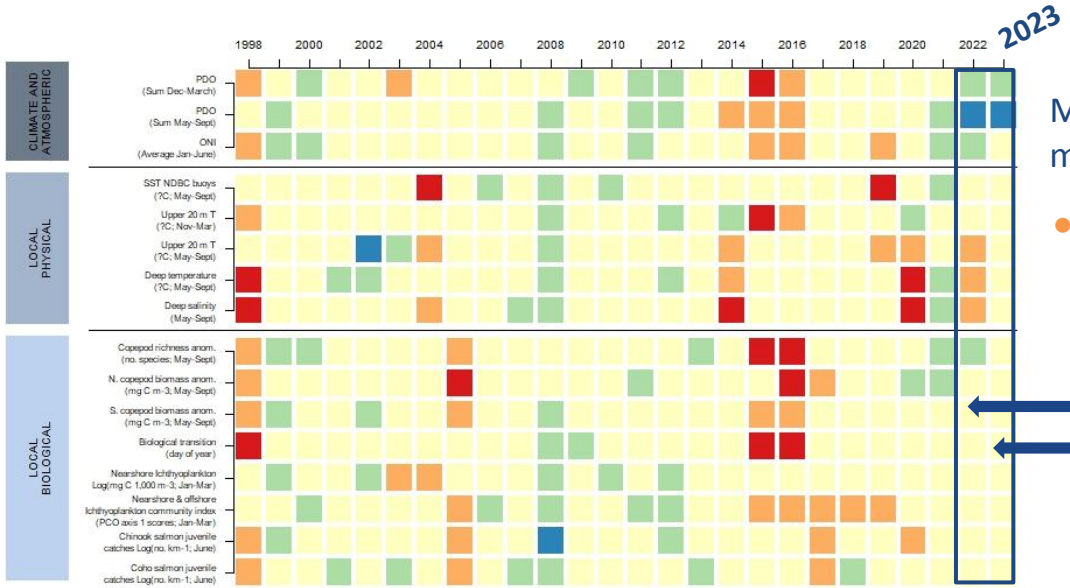


Near average conditions for Chinook and Coho in the north



Northern California Current stoplight table

(Columbia Basin Chinook, Oregon coho)



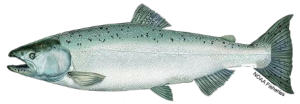
Most indicators near-average in 2023, suggesting moderate ocean conditions for juvenile salmon

- Conditions -> average survival for returning coho and near average returns for Chinook in 2024

Chinook salmon from smolt year 2022 and coho salmon from smolt year 2023 represent dominant adult age classes in 2024

Blue: >2 s.d. above the mean; green: >1 s.d. above the mean; yellow: ±1 s.d. of the mean; orange: >1 s.d. below the mean; red: >2 s.d. below the mean.

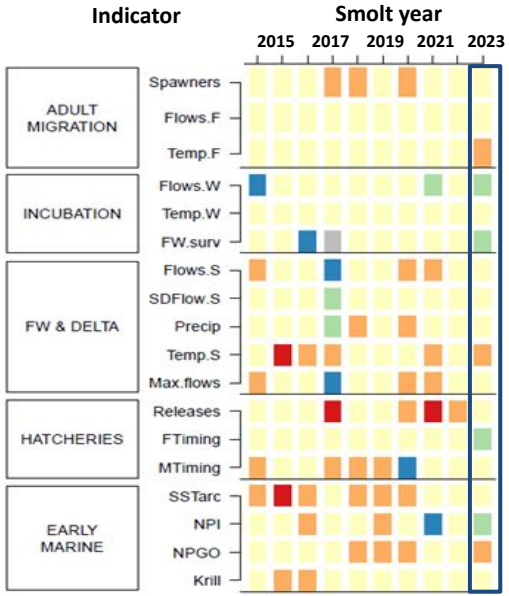
CA salmon smolt signals are of ‘substantially increased concerns’



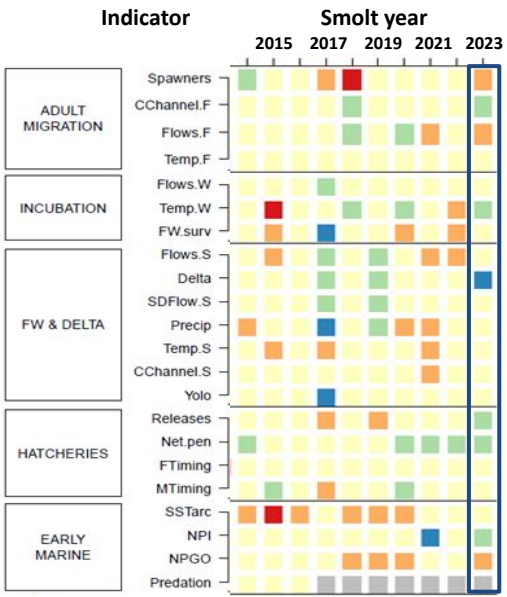
Smolt year 2023, returns begin 2025:

- Mixed but overall conditions improved from 2022
- Adult spawning and spawning temperatures were relatively poor
- Near or above average FW conditions (outmigration improved<-better snowpack)
- Near or below average marine conditions (NPGO, SSTarc)

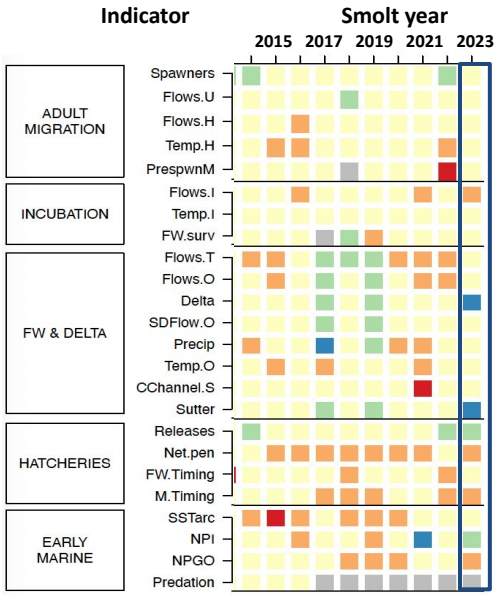
Klamath River Fall Chinook



Sacramento River Fall Chinook



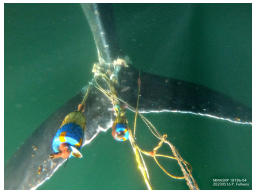
Central Valley Spring Chinook

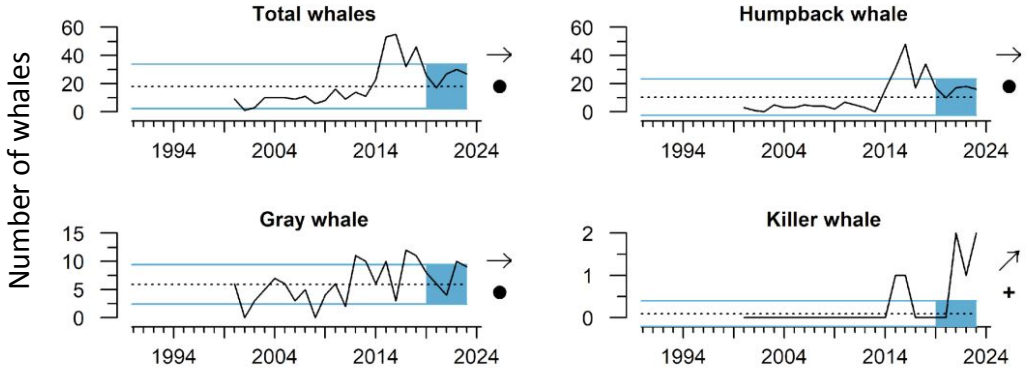


Whale entanglements slightly lower in 2023

Confirmed whale entanglement reports:

- Remained above pre-2014 levels, but lower than peak years and slightly lower than 2022
- 2023 data still preliminary

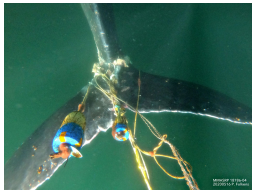


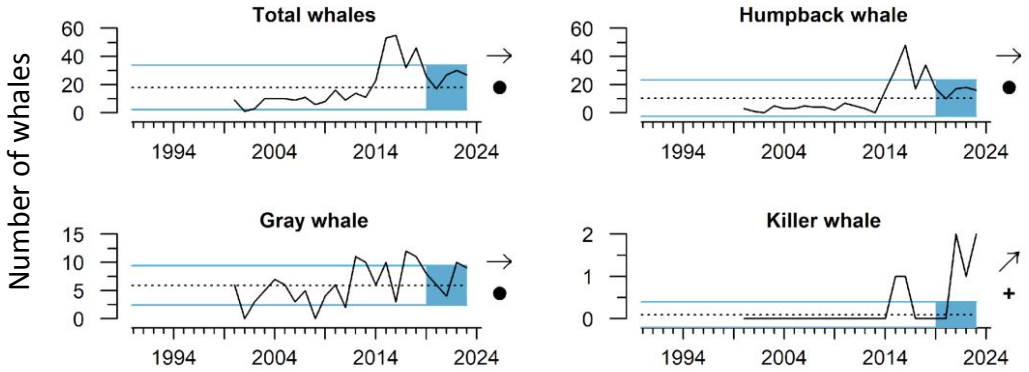


Whale entanglement risk impacts Dungeness crab fishery in California

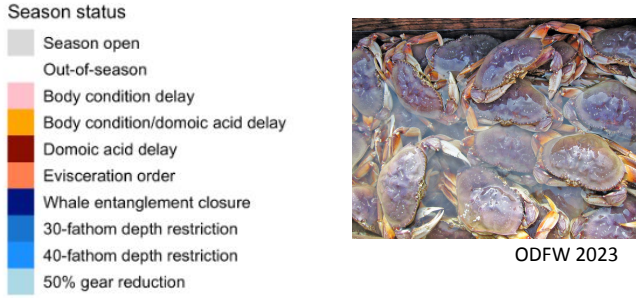
Confirmed whale entanglement reports:

- Remained above pre-2014 levels, but lower than peak years and slightly lower than 2022
- 2023 data still preliminary

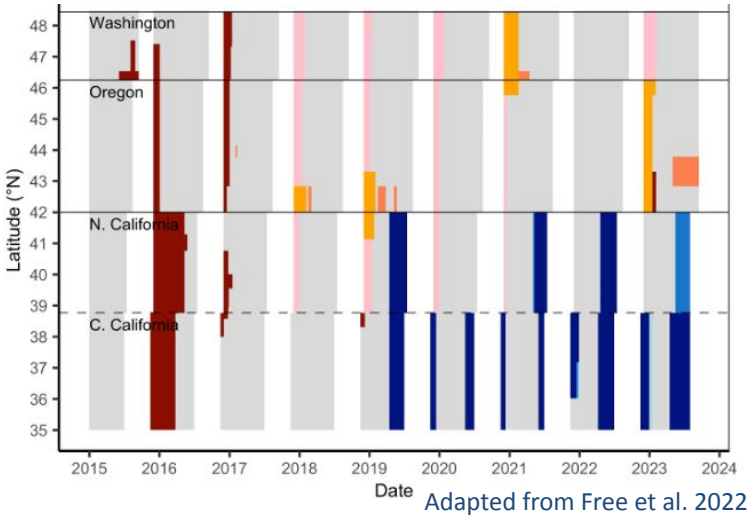




West Coast Dungeness crab fishery closures:



ODFW 2023

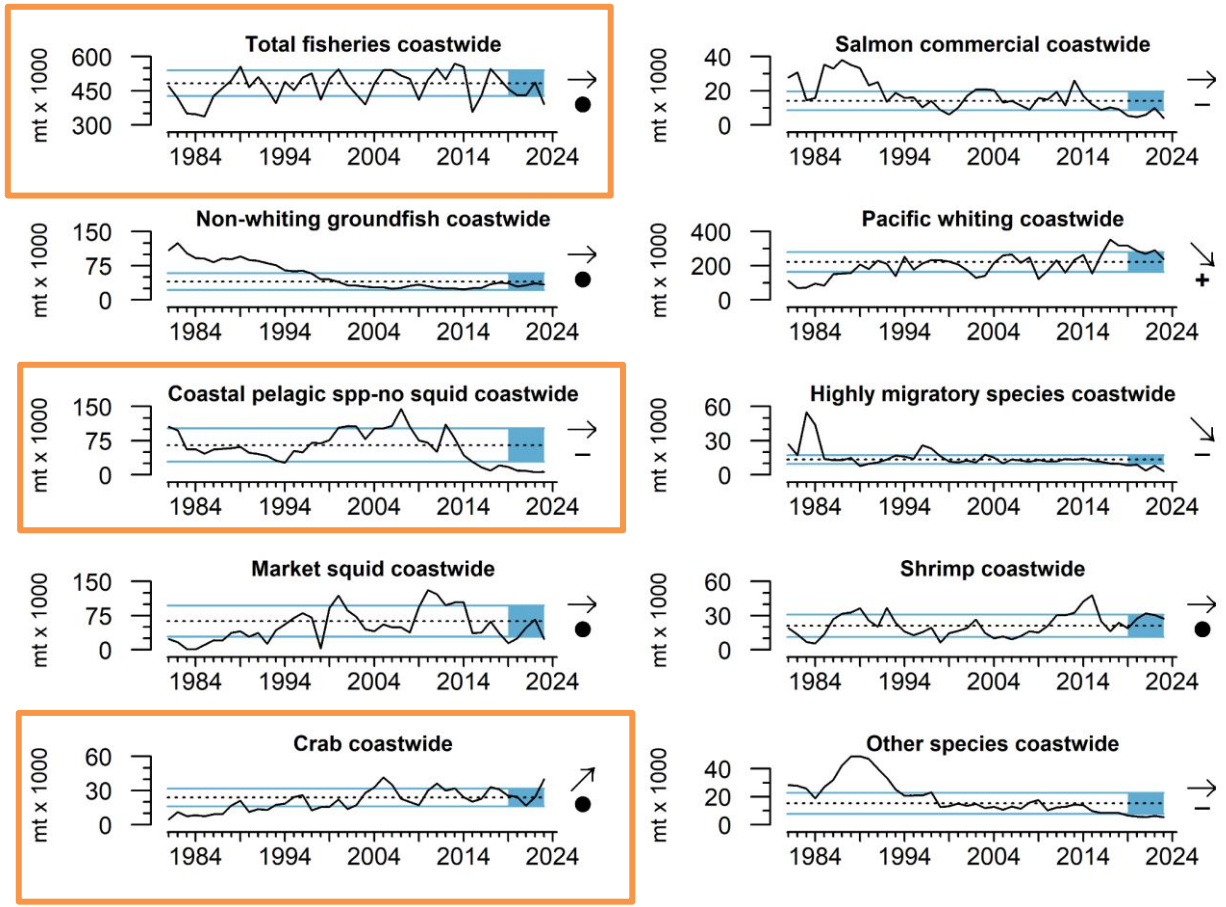


Adapted from Free et al. 2022

Human activities and wellbeing

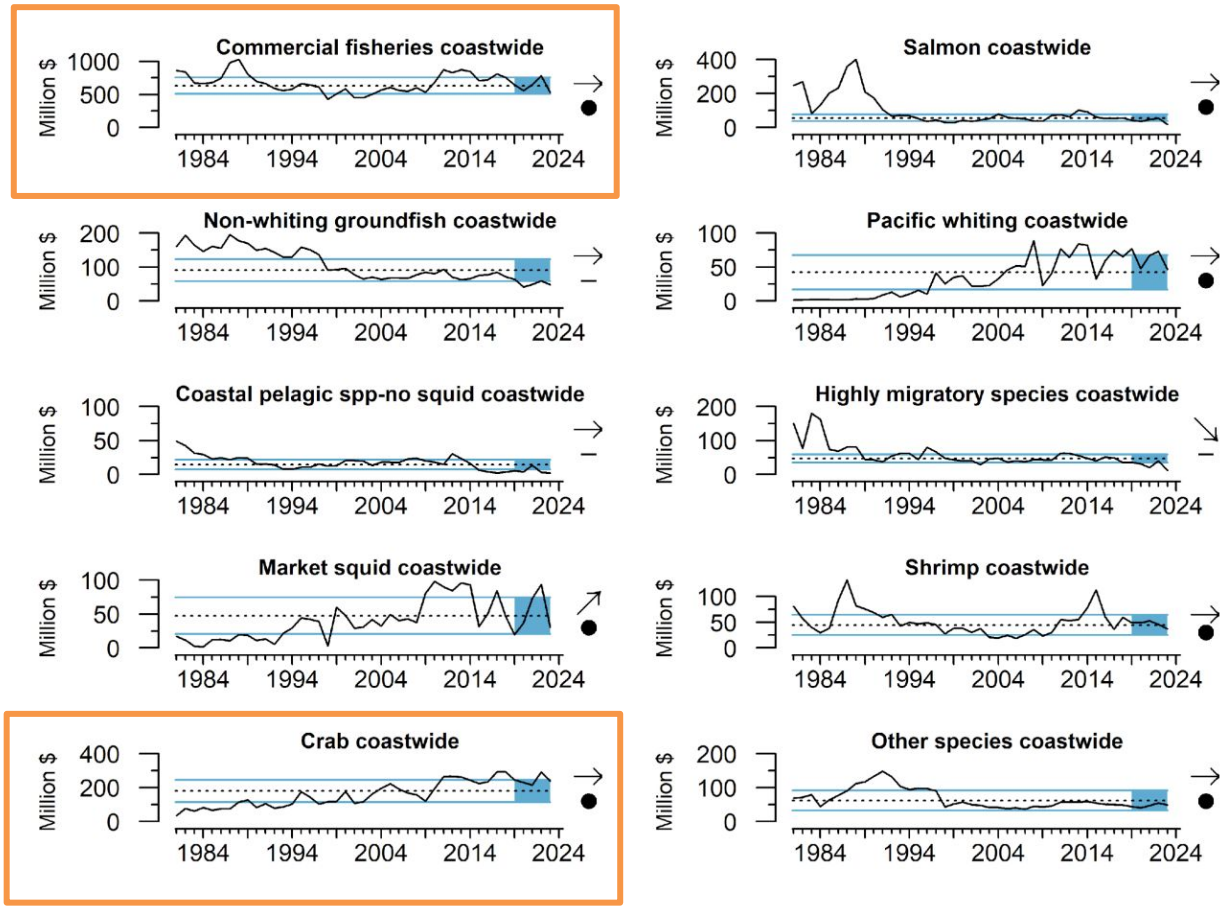
John Pohl, NOAA

Fishery landings decreased in 2023, in total and in most harvest groups



- Coastwide total landings decreased 20% from 2022
- Landings increased for crab (65%) and CPS finfish (12%) fisheries
- Whiting landings are high, CPS and HMS are low
- Salmon fishery was closed in CA
- Recreational landings increased for third year in a row to long-term average

Fishery revenue decreased in 2023 for all harvest groups



- Total revenue decreased by 32% from 2022 (based on available data)
- Crab revenue still high but down from 2022
- Non-whiting groundfish, CPS, and HMS revenue is low

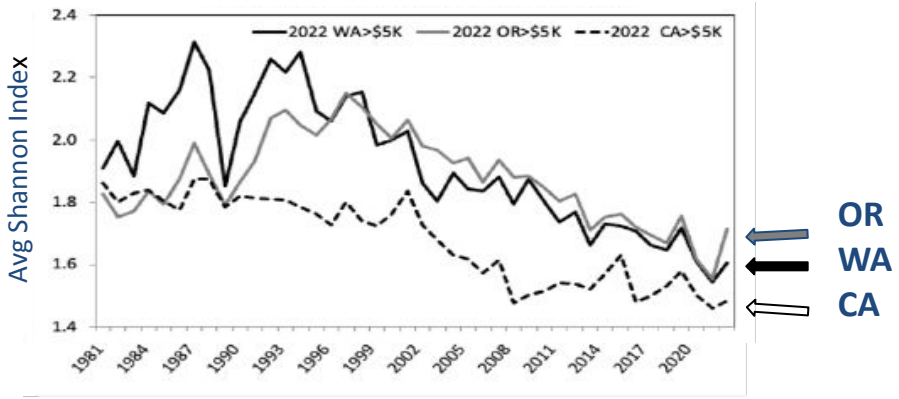
Fishery diversification has declined, posing more risk for vessel owners

Greater diversification of fishing portfolios may increase average revenue and reduce yearly revenue variability; possibly greater resilience to shocks

- Diversification <- measure of how revenue is spread across species groups
- Decline in diversification since mid-1990s
- CA, OR, WA fleets saw increases in diversification in 2022

➔ Port-level and temporal diversification (Appendix S)

Fishery revenue diversification



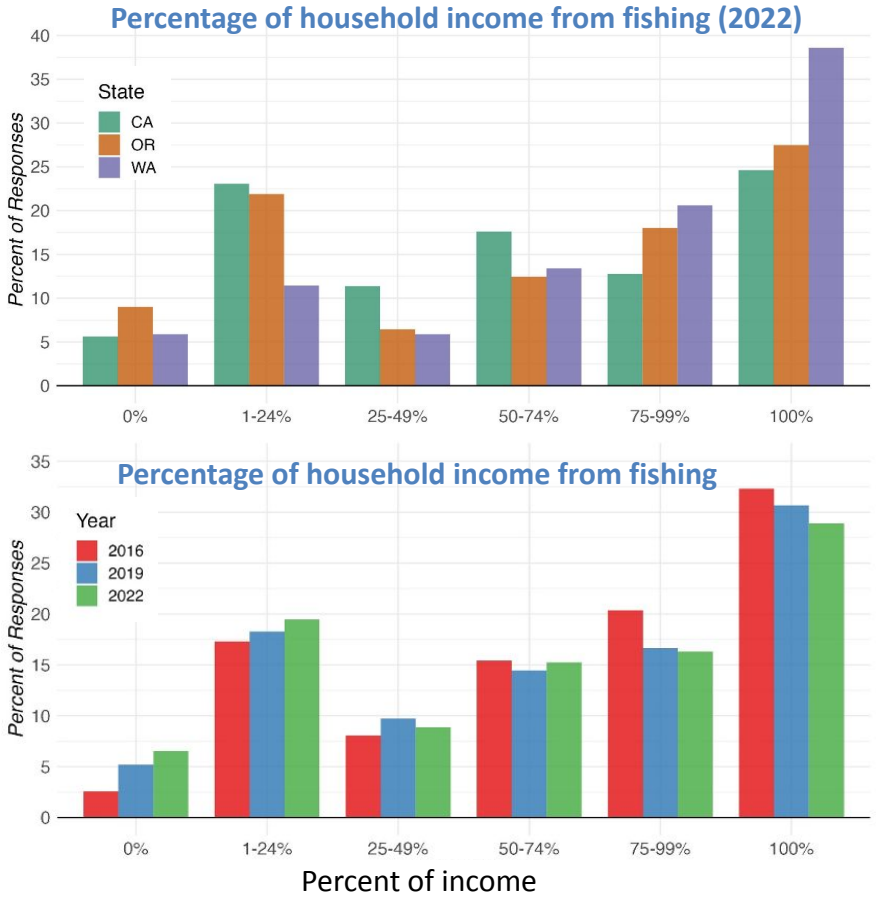
Regional differences in livelihood diversification, shifts over time

Livelihood diversification can reduce risk if:

- ➢ Non-fishing income (NFI) unaffected by fishery
- ➢ Can increase NFI when fishing income is low.

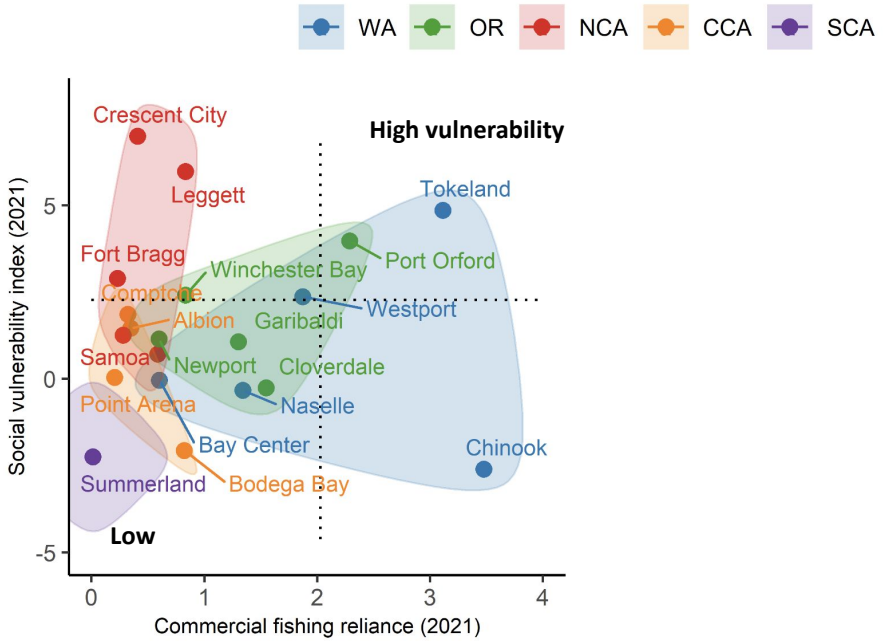
- WA vessel owners derive a higher % of household income from fishing than OR and CA
- Decrease in vessel owner households 100% dependent on fishing income since 2016
- Increase in households deriving <50% of income from fishing

See Appendix S.2 for more information



Higher fishing community vulnerability in Washington and Oregon

- Port Orford, OR, Tokeland, WA, and Westport, WA had high *commercial reliance* and high social vulnerability

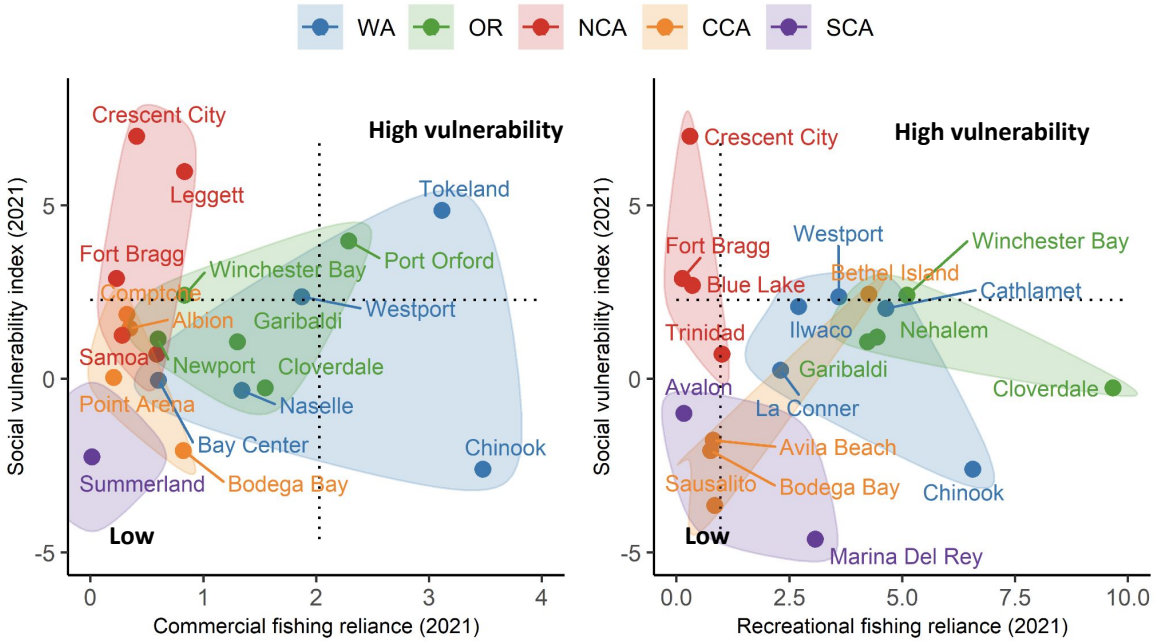


Colored polygons group the five highest-scoring communities for both forms of fishing reliance by region

Dotted lines indicate 1 s.d. above the means for all communities

Higher fishing community vulnerability in Washington and Oregon

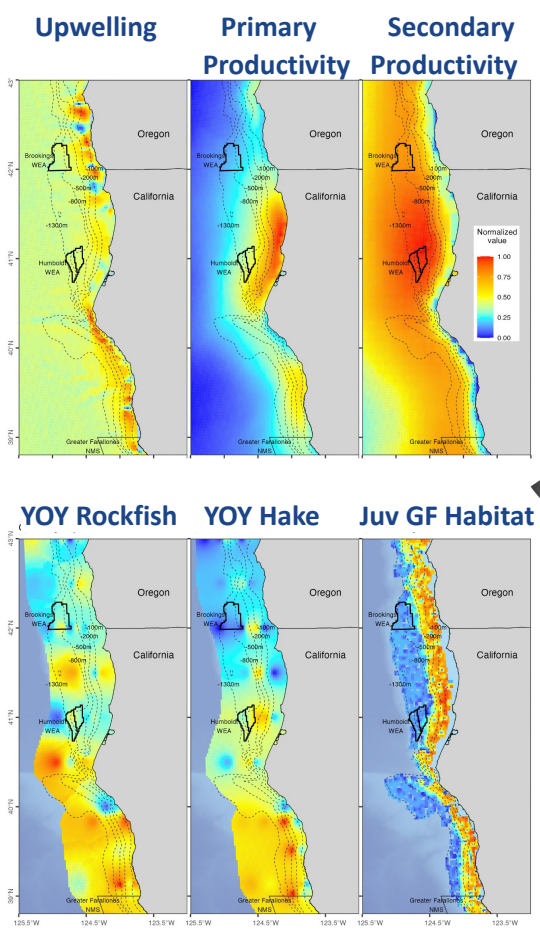
- Port Orford, OR, Tokeland, WA, and Westport, WA had high *commercial reliance* and high social vulnerability
- Bethel Island, CA, Winchester Bay, OR and Westport, WA had high *recreational* reliance with the highest social vulnerability
- Appendix E: Risk due to climate change is predicted to be greater for more northern groundfish fishing fleets

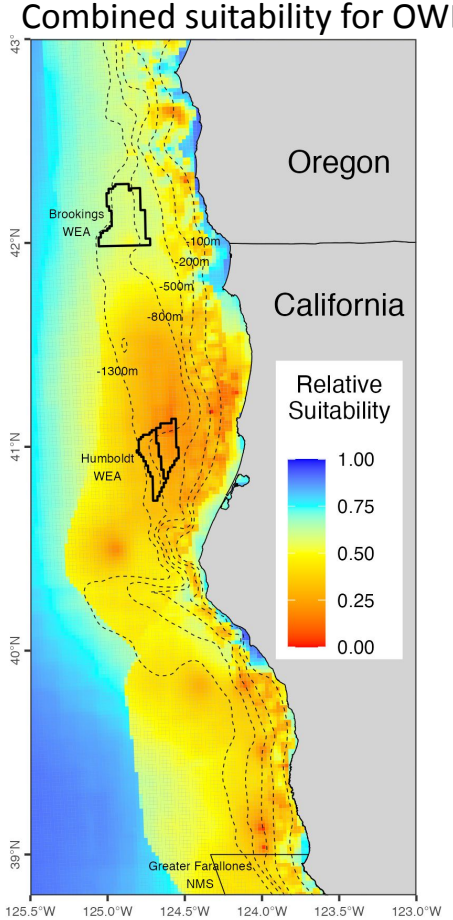


Colored polygons group the five highest-scoring communities for both forms of fishing reliance by region

Dotted lines indicate 1 s.d. above the means for all communities

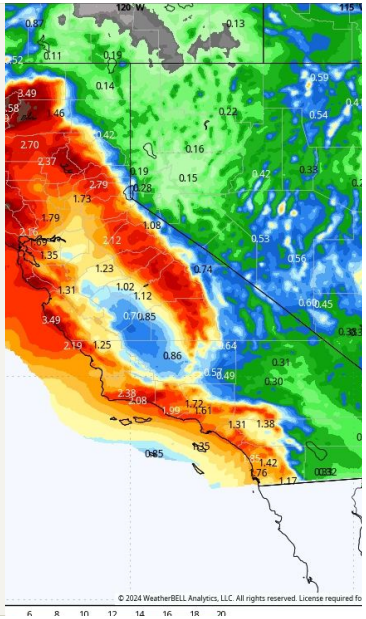
Ecosystem indicators may help inform marine planning efforts





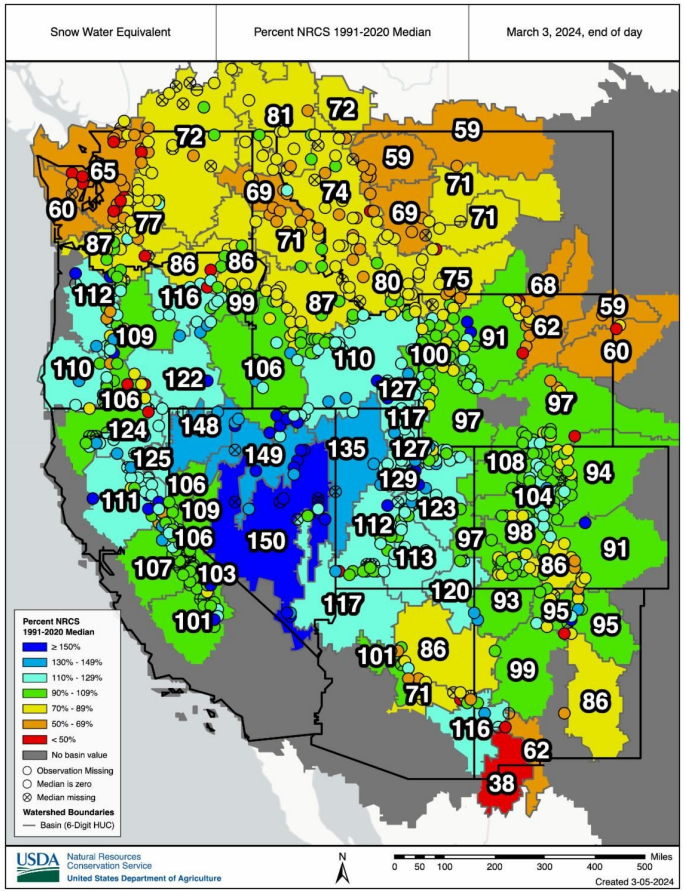
- Last year -> fisheries indicators
- This year -> 6 ecosystem indicators
- Spatial suitability scores: high score (blue) = more "suitable" for OWE development
- Near-term needs: potential to identify hotspots and inform siting
- Long-term needs: baseline conditions to detect possible OWE impacts

Draft OR WEA shown

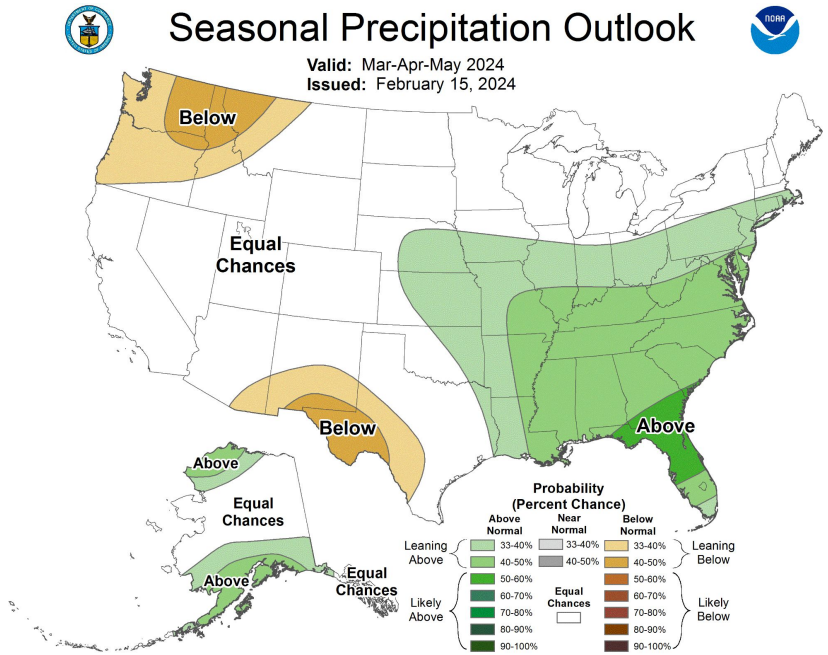


What can we expect in 2024?

2024 Physical forecasts: average in CA, below average in NW



El Niño precipitation: ave in some areas, but not as much snow…..
”wet but warm” conditions



2024 Physical forecasts: likely moving toward La Niña

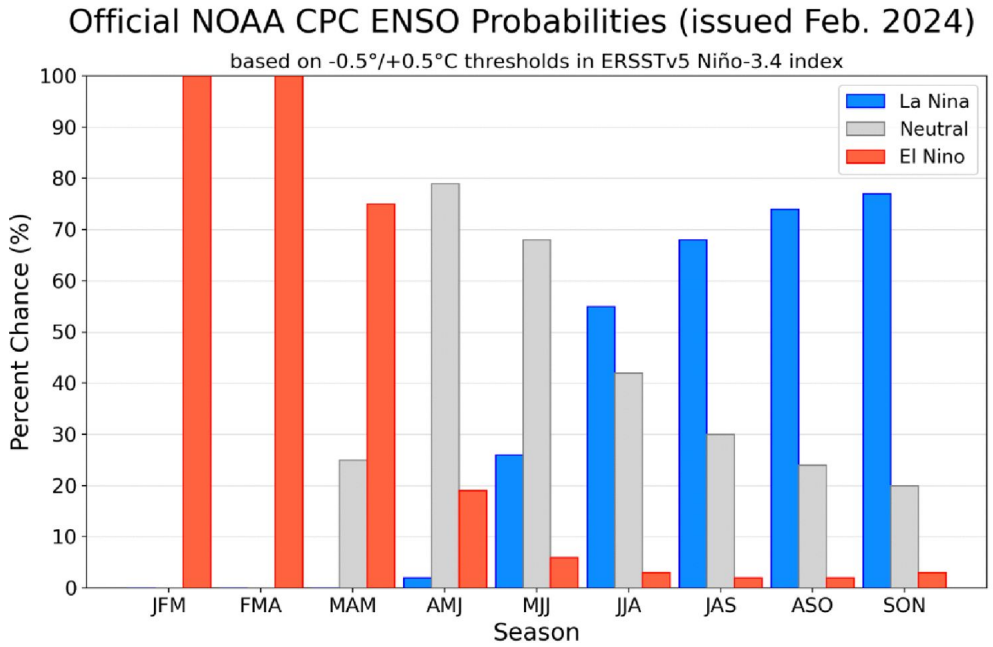
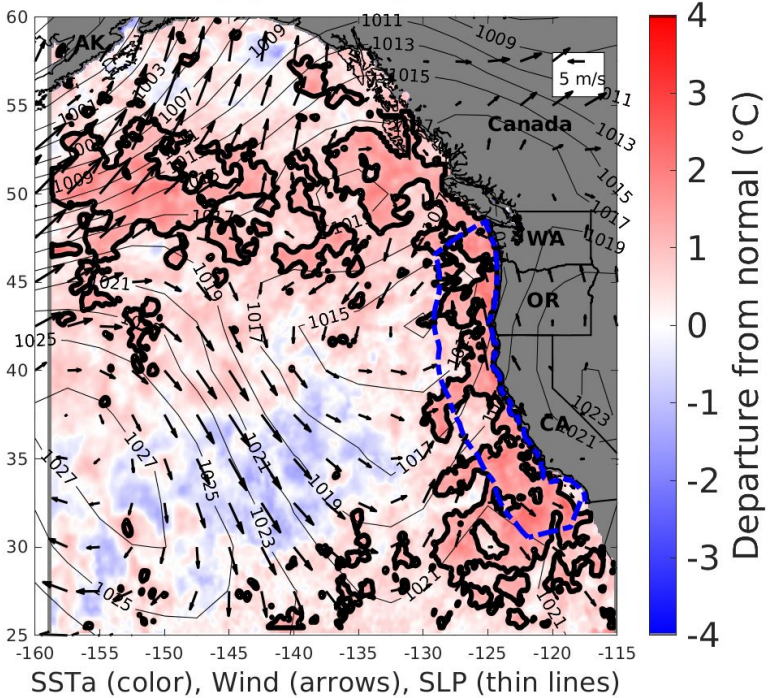


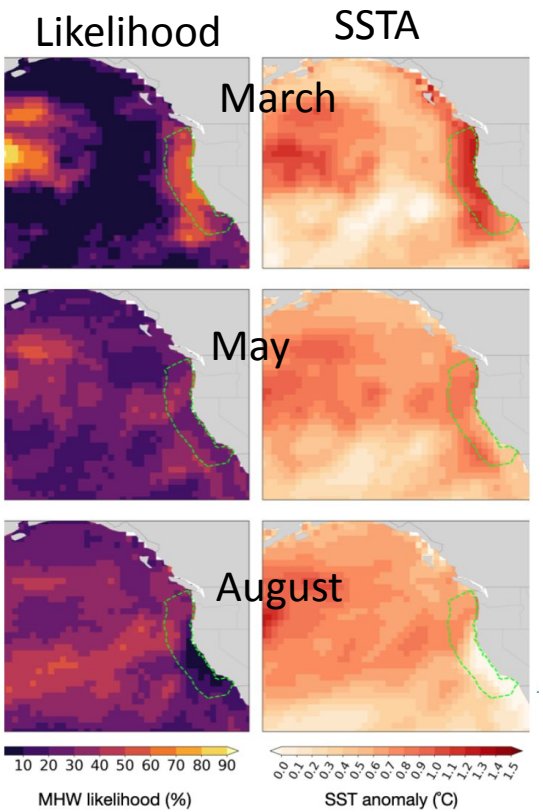
Figure 7. Official ENSO probabilities for the Niño 3.4 sea surface temperature index (5°N-5°S, 120°W-170°W). Figure updated 8 February 2024.

*NOTE: these forecast models become much more accurate around mar/april, so stay tuned!

2024 Physical forecasts:

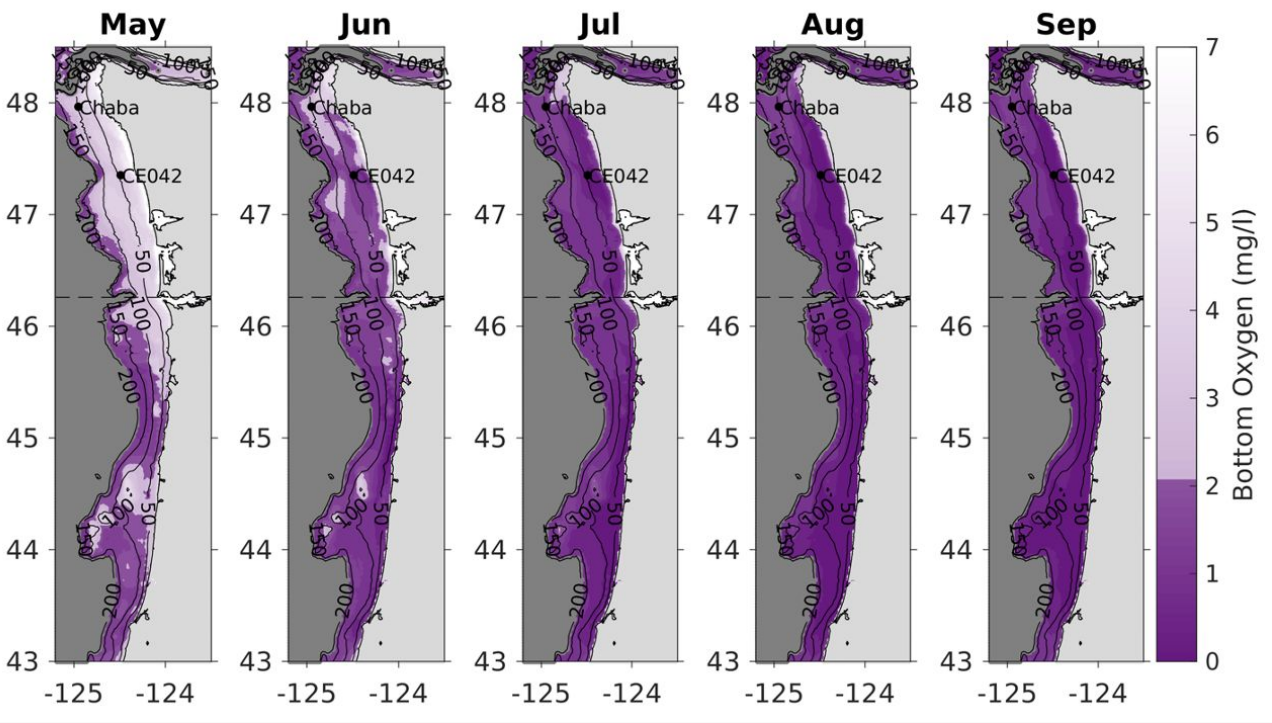
Still some offshore heatwave activity in the NW, but mostly warm coastal due to El Niño





Offshore heatwave and nearshore heat likely to continue through May, then return to previous pattern in August

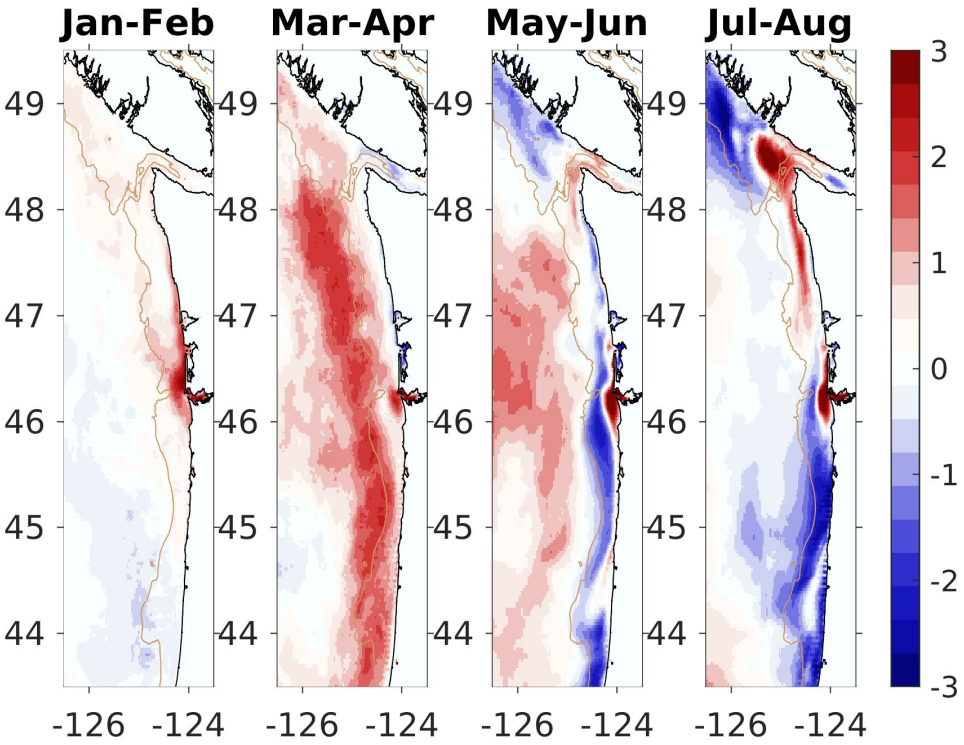
JSCOPE January forecast: Bottom Oxygen Low in Northern CCE



- Dissolved oxygen *lower than the previous years, but* high uncertainty in late summer
- Hypoxia (<2 mg/L) forecast to be prominent over nearly half of the Oregon shelves in May and spreads to all of Washington's shelves by July, *earlier* than average for recent years.

http://www.nanoos.org/products/j-scope/forecasts.php

JSCOPE January forecast: strong Spring bloom



- Higher Chlorophyll in spring than past years
- High Chl extending into summer in offshore and then WA coast in late summer
- Below ave in summer off OR
- Similar uncertainty as O2

http://www.nanoos.org/products/j-scope/forecasts.php

El Niño prognosis: El Niños have a lot of variability, BUT….

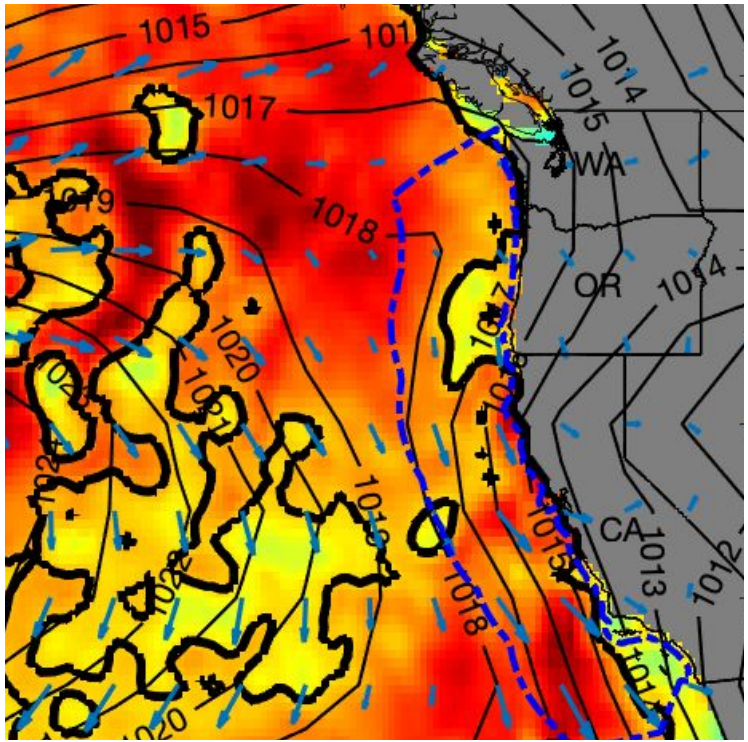
….see appendix E: Indicators of climate change and variability for more details

Species/index	Potential Impact
Snow water equivalent	More initial snowpack forecast, but likely warmer weather transitions to rain instead of snow
Habitat compression	Habitat compression through spring
Copepods	Increase in southern (lipid poor) species and increase in species richness
Krill	Lowered abundance, lower adult sizes
Anchovy	Continued relatively high numbers but likely lower than past few years
Market squid	Lower abundance and northward shift
Rockfish	Dominated by larvae due to poor survival of later stages
Sablefish	Larger and closer to shore
Salmon	Poorer conditions for all stages
Sea lions	Reduced pup weights/productivity
Harmful algal blooms	Increased HAB activity and subsequent closures

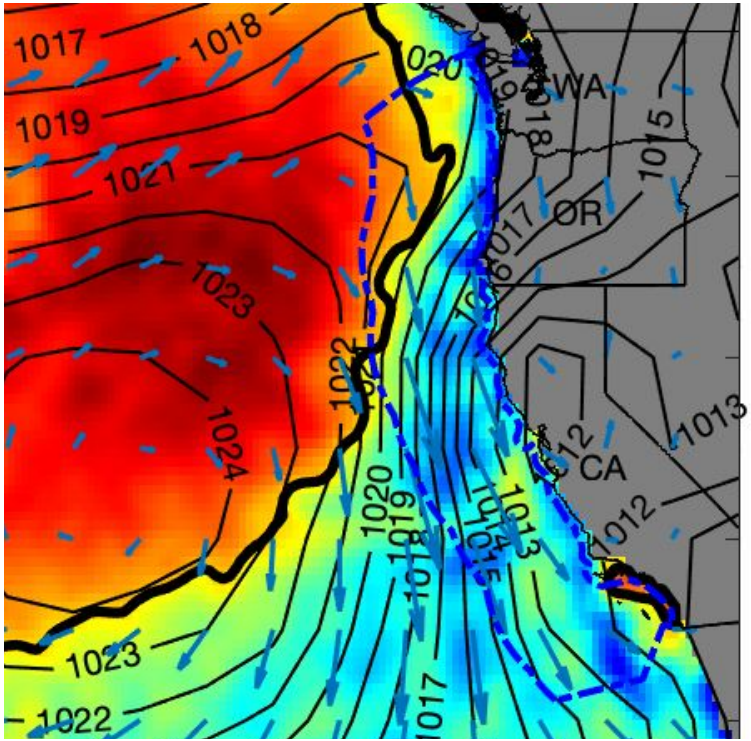
Table E.1. Potential CCE impacts during 2024, assembled by the CCIEA team

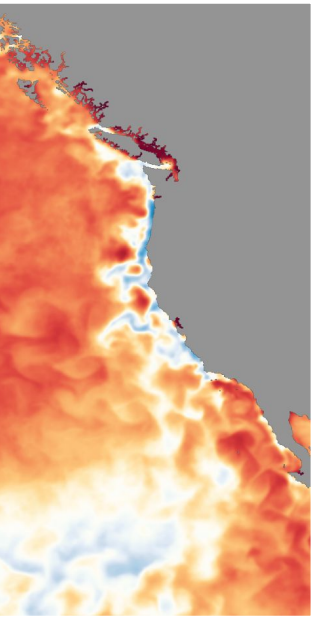
Preconditioning 2016 vs 2024: Sea surface Temperature tells the story…

JULY 2015 SSTa



JULY 2023 SSTa





Conclusions

2023: Ecosystem conditions mixed, with favorable signs

Ecosystem conditions

- Periods of strong upwelling provided cool and productive coastal waters
- Diverse and abundant forage for predators
- Positive preconditioning may buffer the system against El Niño conditions
- Multiple HAB events -> marine mammal strandings and fisheries disruptions

2023: Mixed trends in human activities

Ecosystem conditions

- Periods of strong upwelling provided cool and productive coastal waters
- Diverse and abundant forage for predators
- Positive preconditioning may buffer the system against El Niño conditions
- Multiple HAB events -> marine mammal strandings and fisheries disruptions

Human activities

- Commercial fishery landings and revenue declined
- Salmon fisheries closures and 2024 outlook is poor for some regions
- Crab fisheries landings increased and revenue was high, recreational rebounds

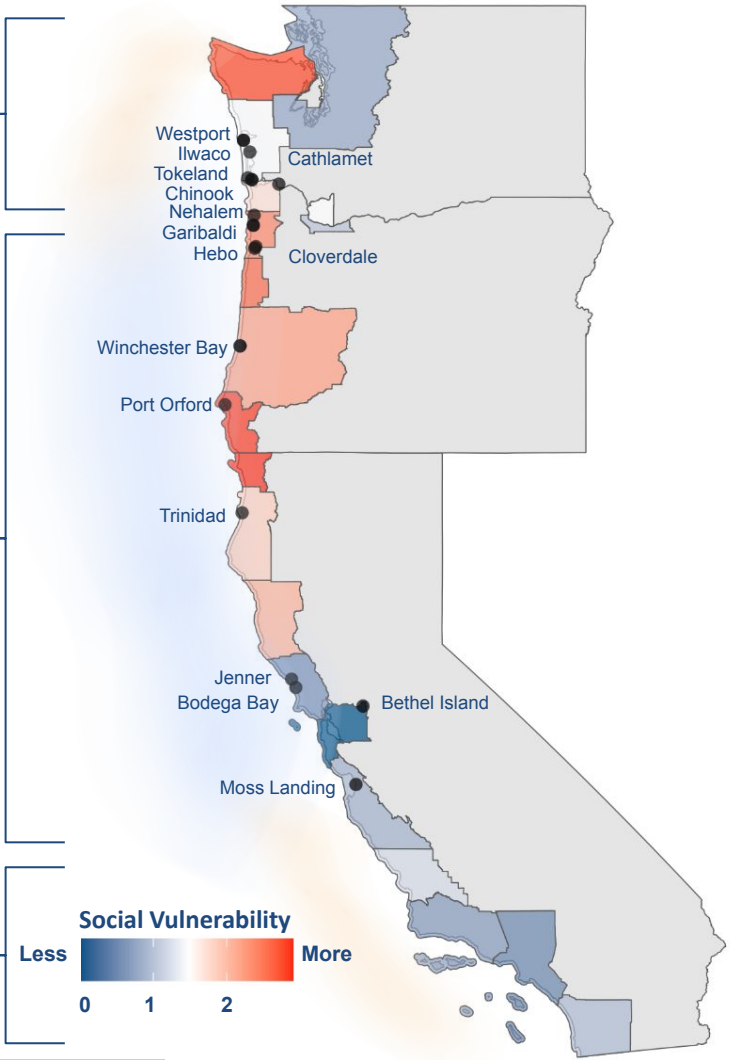
Linking ecological and social vulnerability

- Expansion of information on human well being in the ESR
- This knowledge combined with ecosystem conditions can provide insights about communities most impacted by climate variability

Less favorable
warm, low O2

Most favorable
ocean conditions in 2023

Less favorable
warm, lower productivity

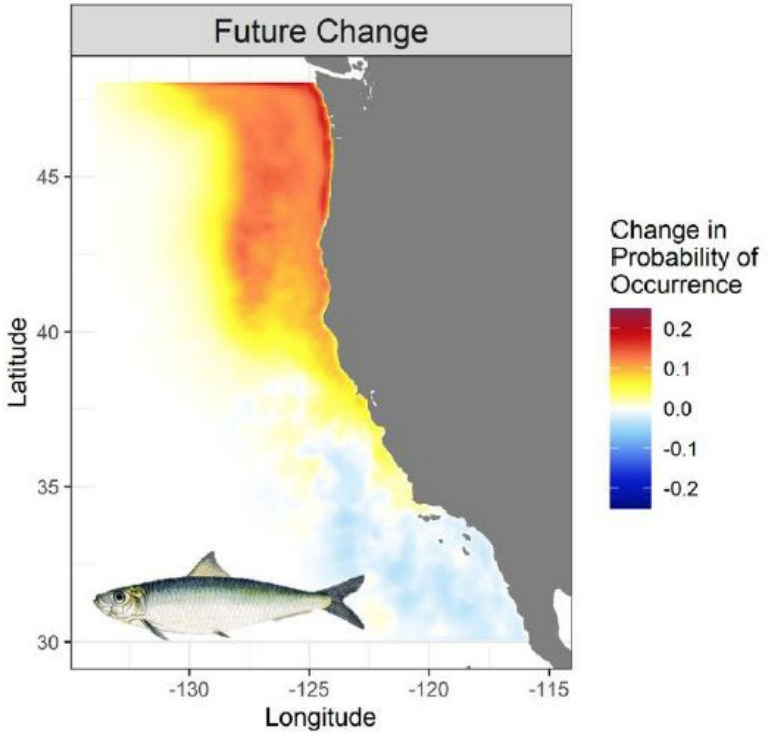


Supporting climate-ready fisheries

The resilience of the CCE is not likely to be sustained indefinitely, especially with climate change

The “Climate Change Appendix” includes new research to support climate-informed decision-making:

- Seasonal forecasts of marine heatwaves
- Projections of long-term shifts in the distribution and abundance
- Social-ecological vulnerability and climate risk for fishing fleets



H.1.a Supplemental CCIEA Team Report 2: Appendix E. Developing Indicators of climate change and variability

Thank you!

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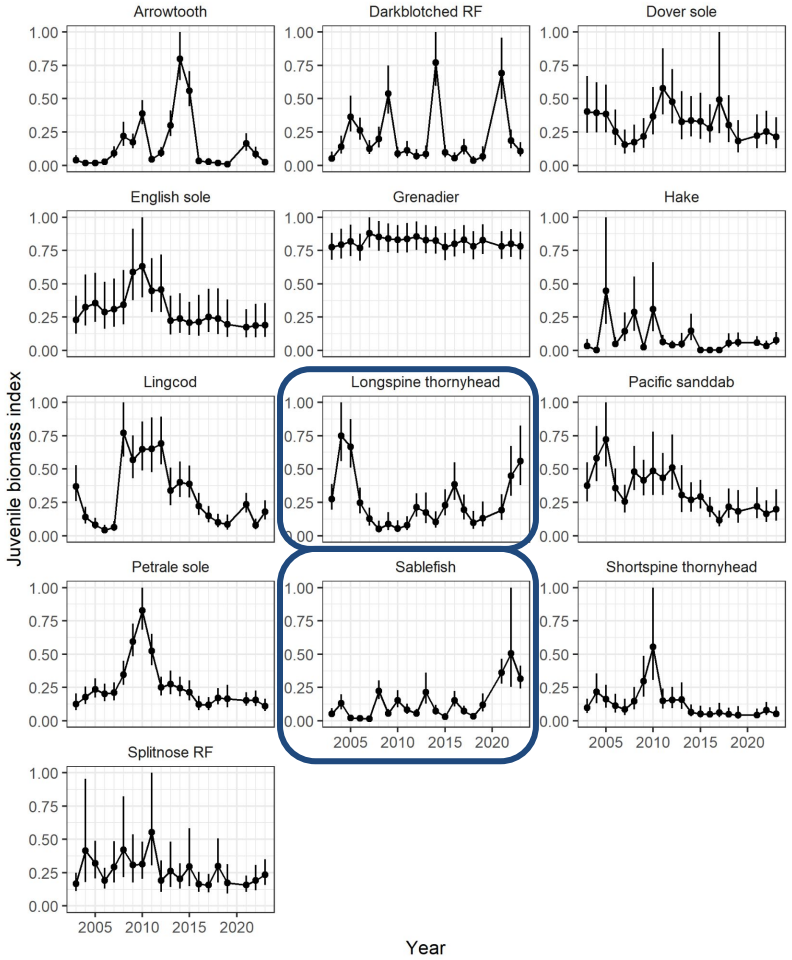
Mary.Hunsicker@noaa.gov

Extra slides

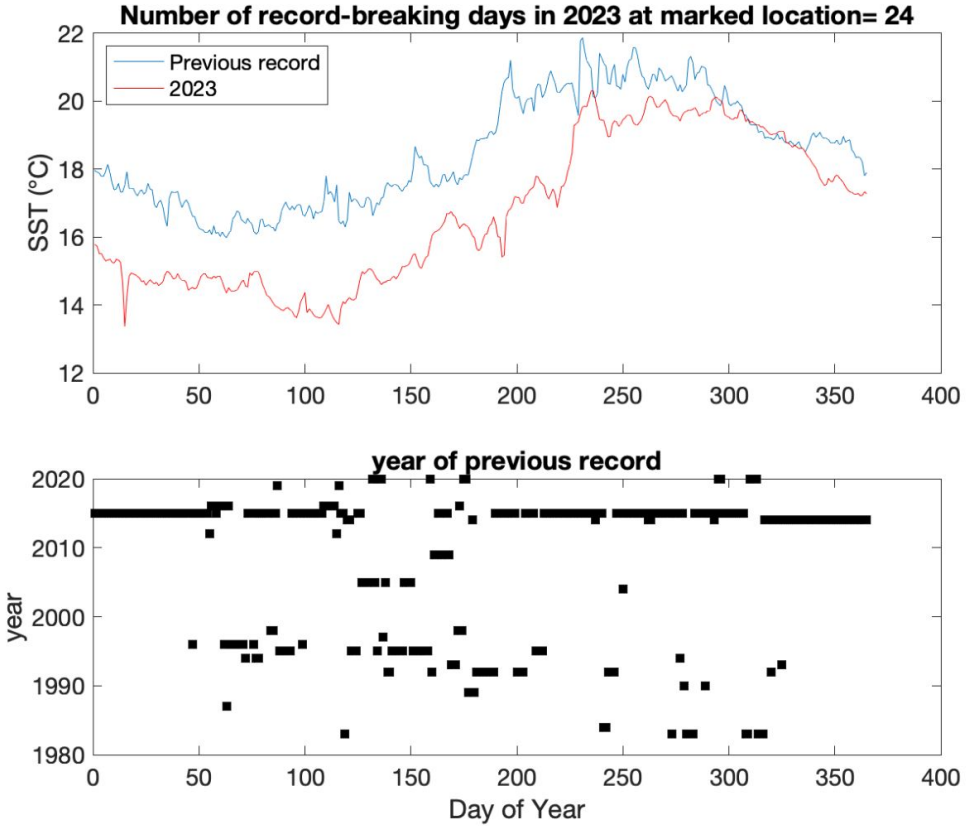
Central Valley Fall Chinook

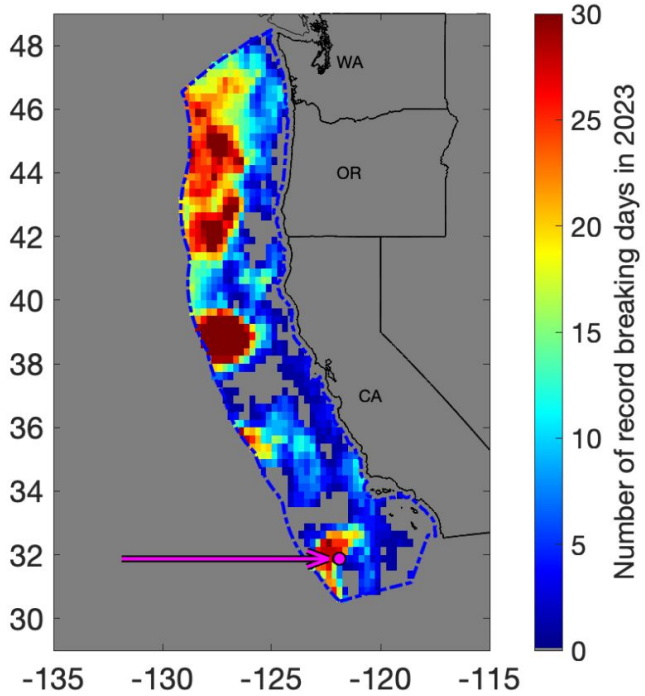
Spawning Escapement (t=0)	Incubation Temperature (Oct-Dec t=0)	Egg thiamine concentration (nmol/g)	February Median Flow (t+1)	Chinook Age in Fall 2024
2019: 121,600 (met goal)	11.3°C (suboptimal)	No data	6,030 cfs **(very low)**	5
2020: 100,100 (low)	11.5°C (poor)	11.0 **(good)**	6,015 cfs **(very low)**	4
2021: 73,230 (low)	13.0°C **(very poor)**	6.6 (low)	4,925 cfs **(very low)**	3
2022: 35,782 **(very low)**	11.7°C (poor)	8.1 (low)	9,005 cfs **(low[1])**	2

Groundfish:

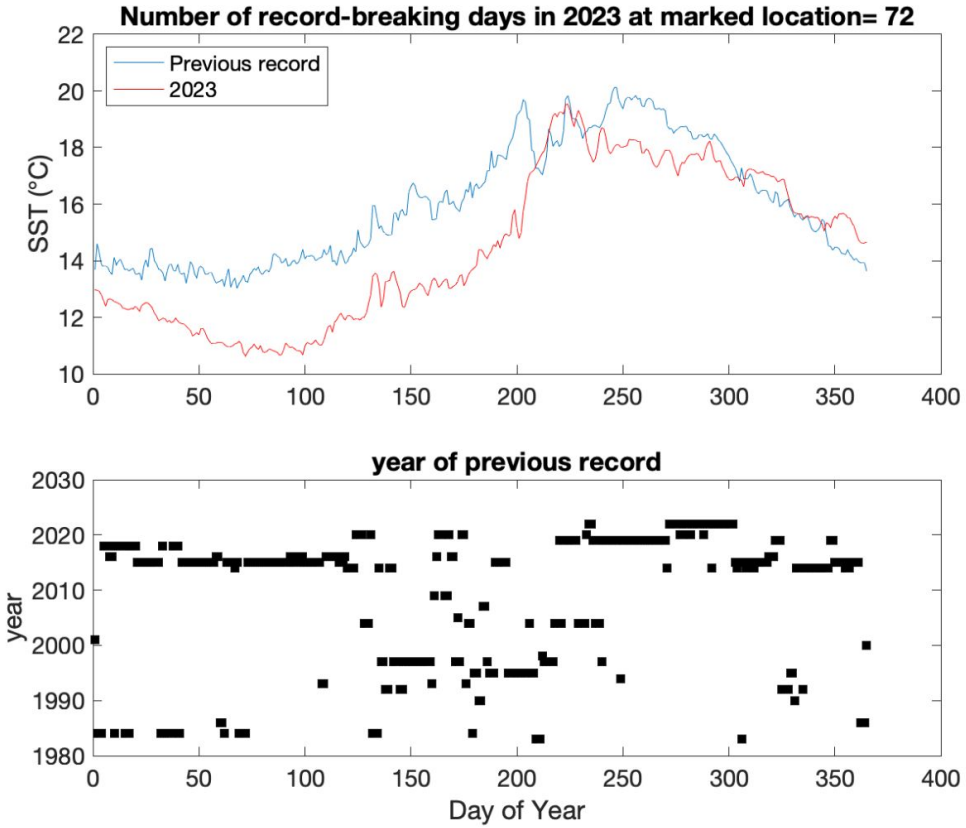

Arrowtooth
Darkblotched RF
Dover sole
English sole
Grenadier
Hake
Lingcod
Longspine thornyhead
Pacific sanddab
Petrale sole
Sablefish
Shortspine thornyhead
Splitnose RF
Juvenile biomass index
Year
1.00
0.75
0.50
0.25
0.00
2005
2010
2015
2020

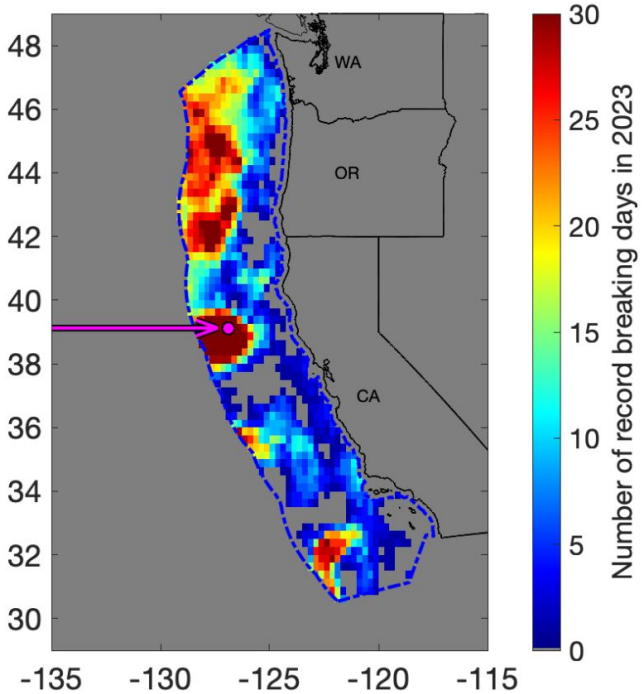
“Hot” Topic: SST record breakers 2023





“Hot” Topic: SST record breakers 2023





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