

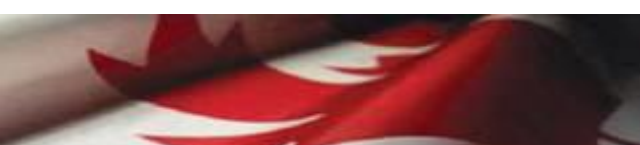


# State of the Physical, Biological and Selected Fishery Resources of Pacific Canadian Marine Ecosystems



Editors: Jennifer Boldt, Elizabeth Joyce, Strahan Tucker, Stéphane Gauthier

This presentation was assembled from SOPO presentations and reports



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# Outline

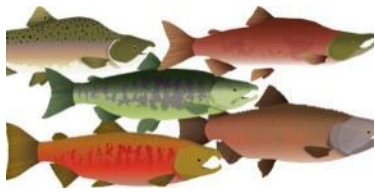
## Salmon

- Freshwater habitat
- Marine habitat
  - Physical environment
  - Prey
  - Predators
- Salmon indices

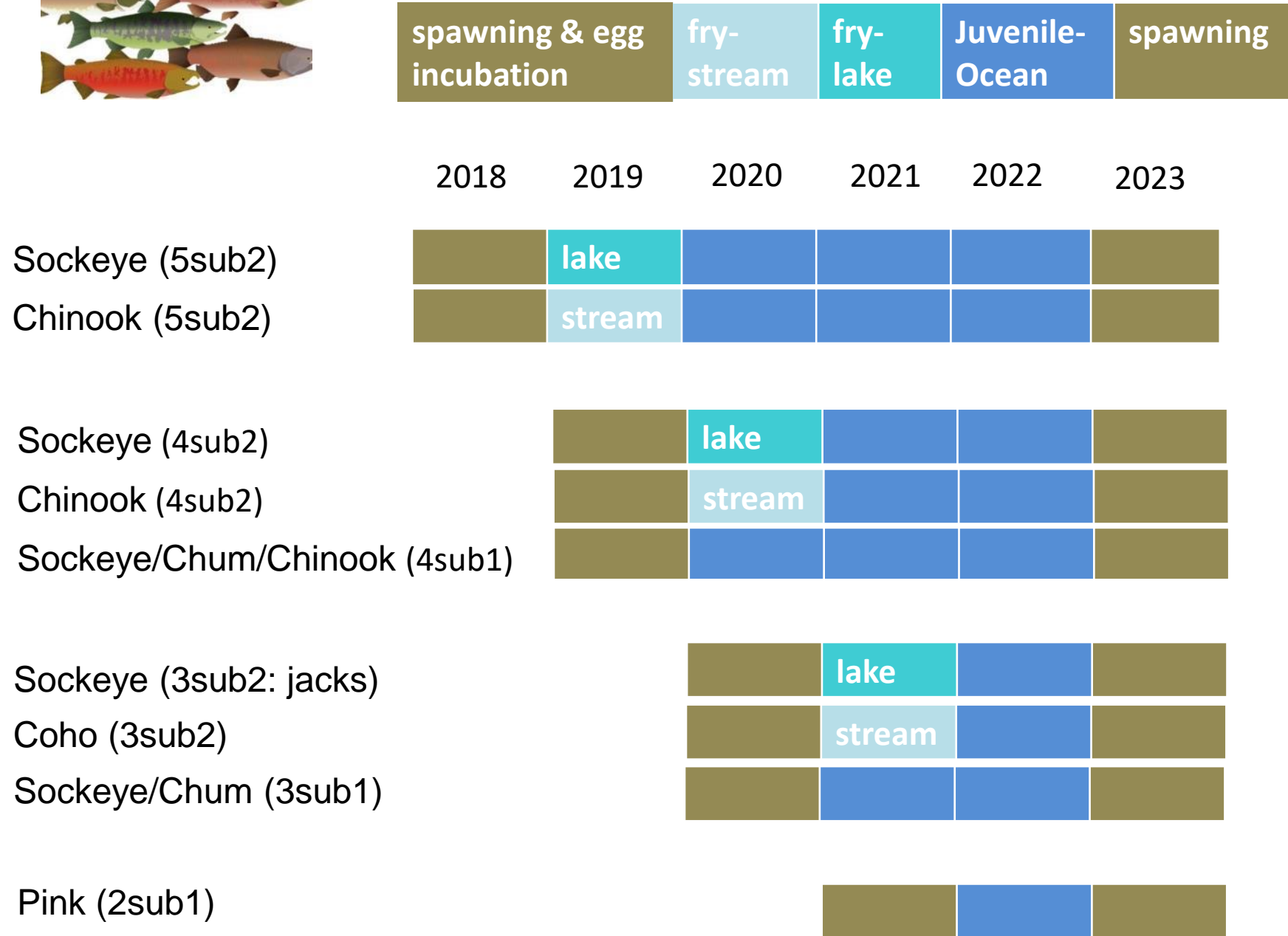


Information from DFO's State of the Pacific Ocean report





## 2023 Returns





2018, 2019, 2020, 2021



# Spring maximum air temperature anomalies

2018  
warm

2019  
warm

2020  
avg

2021  
avg; heat dome year

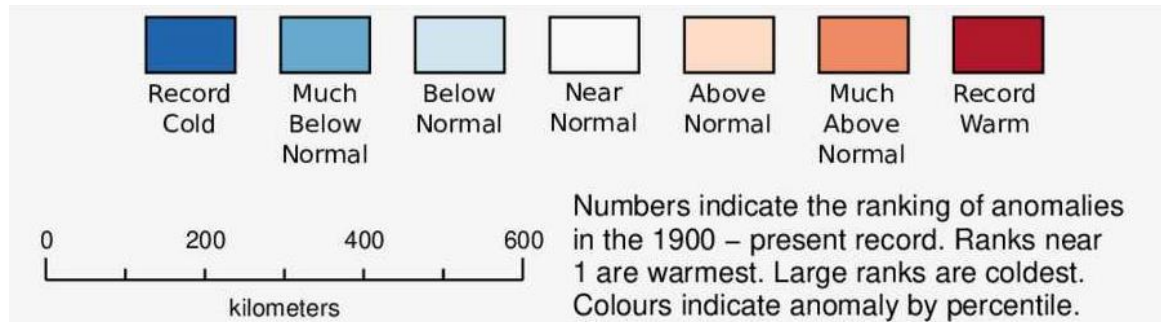
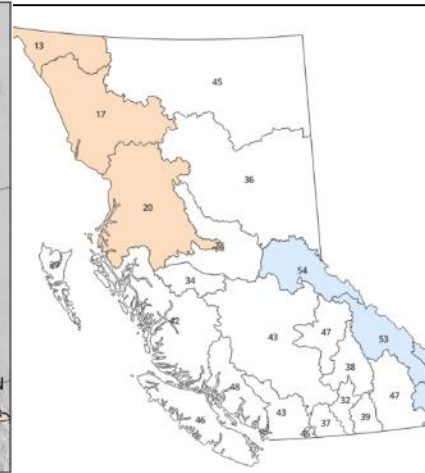
2022  
avg

spring, 2018 snow basins Tmax rankings and anomalies

spring, 2019 snow basins Tmax rankings and anomalies

spring, 2020 snow basins Tmax rankings and anomalies

spring, 2021 snow basins Tmax rankings and anomalies



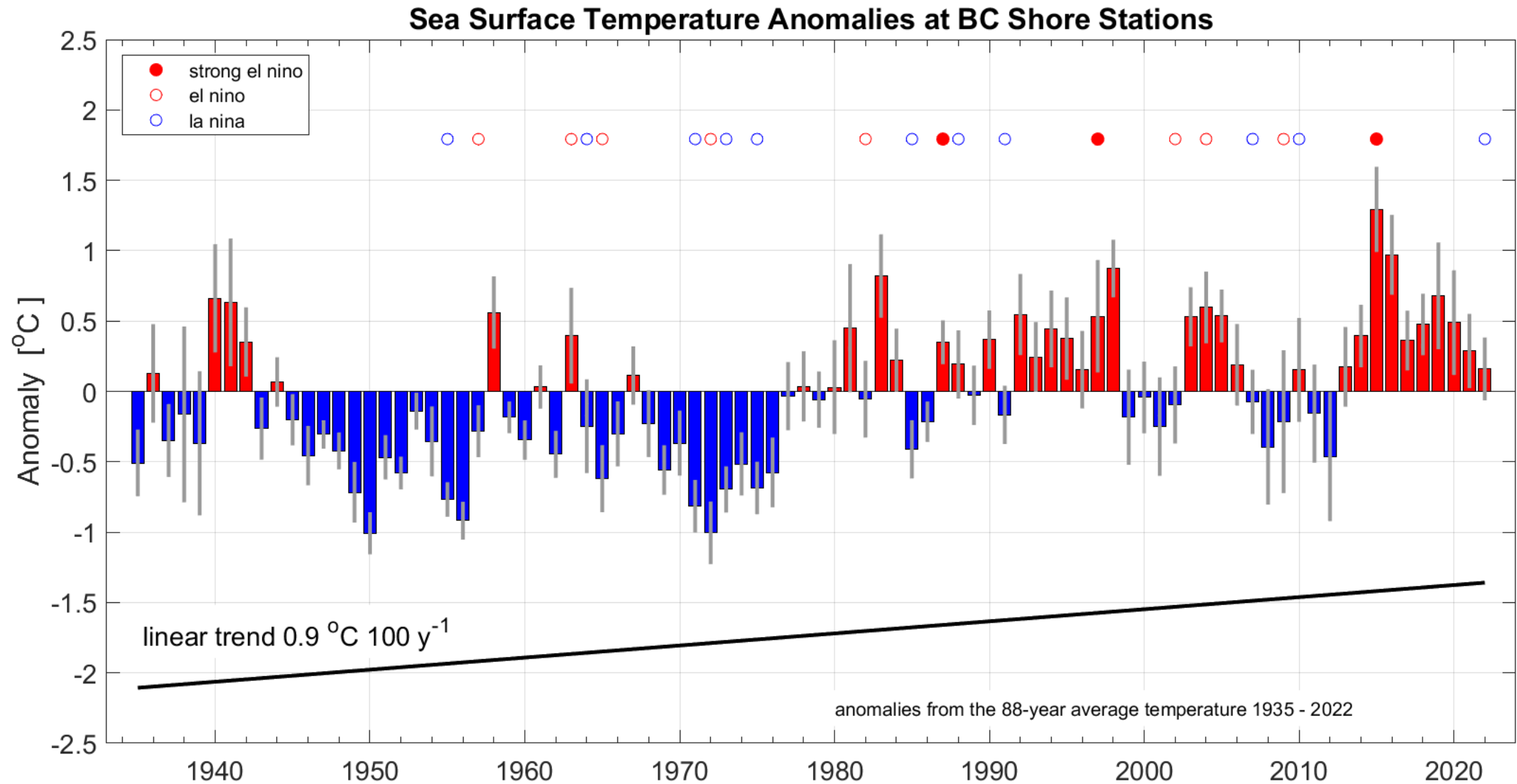


A satellite-style map of the Pacific Northwest coast of North America, including parts of British Columbia, Canada, and the United States. A large, irregular area of the ocean and coastal waters is highlighted with a semi-transparent cyan overlay, outlined by a bright cyan border. The text "2020, 2021, 2022, 2023" is centered in white over the cyan area.

2020, 2021, 2022, 2023

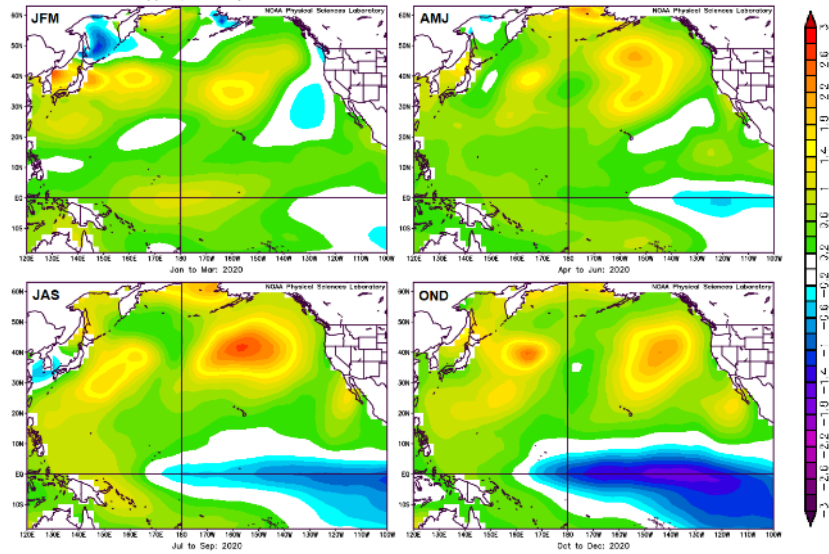


# Long-term increasing SST at shore stations in B.C.

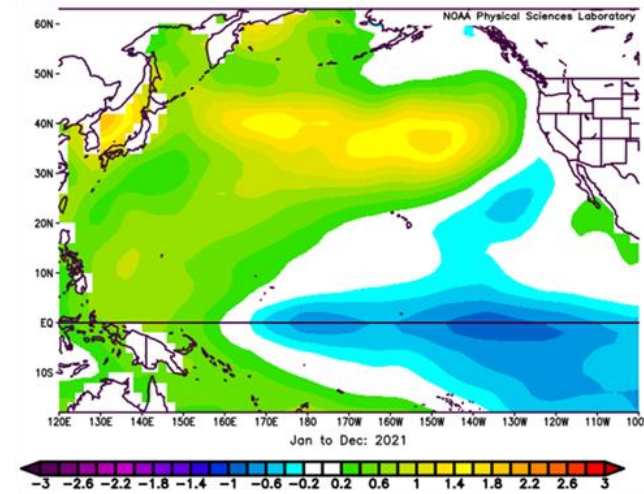


# Recent marine heatwaves

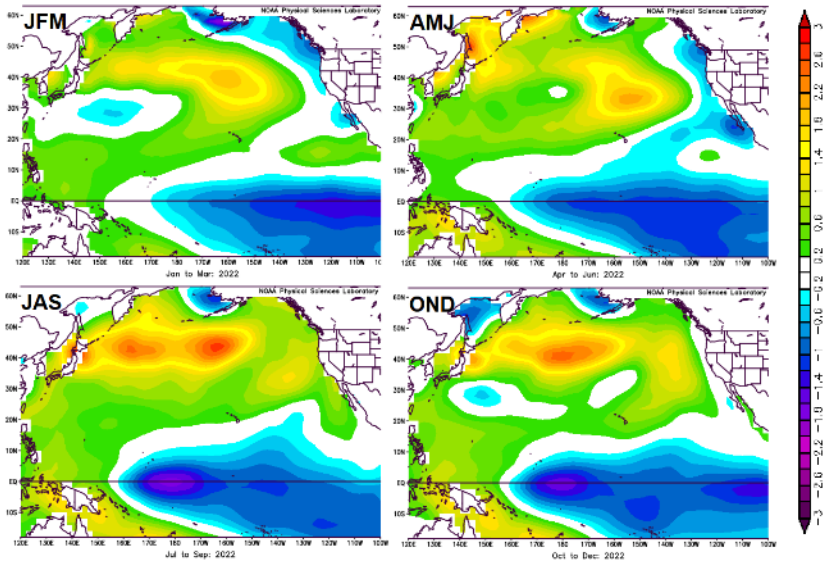
## 2020 Marine heatwave



## 2021 near normal, despite La Niña

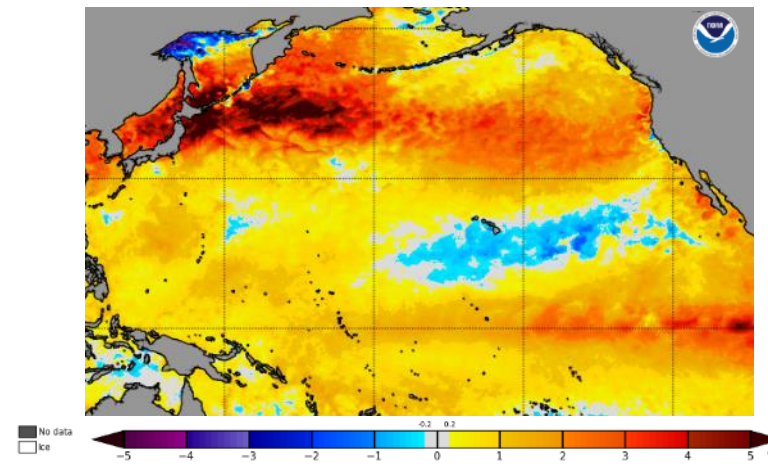


## 2022 near normal, brief marine heatwave



## 2023 Marine heatwave

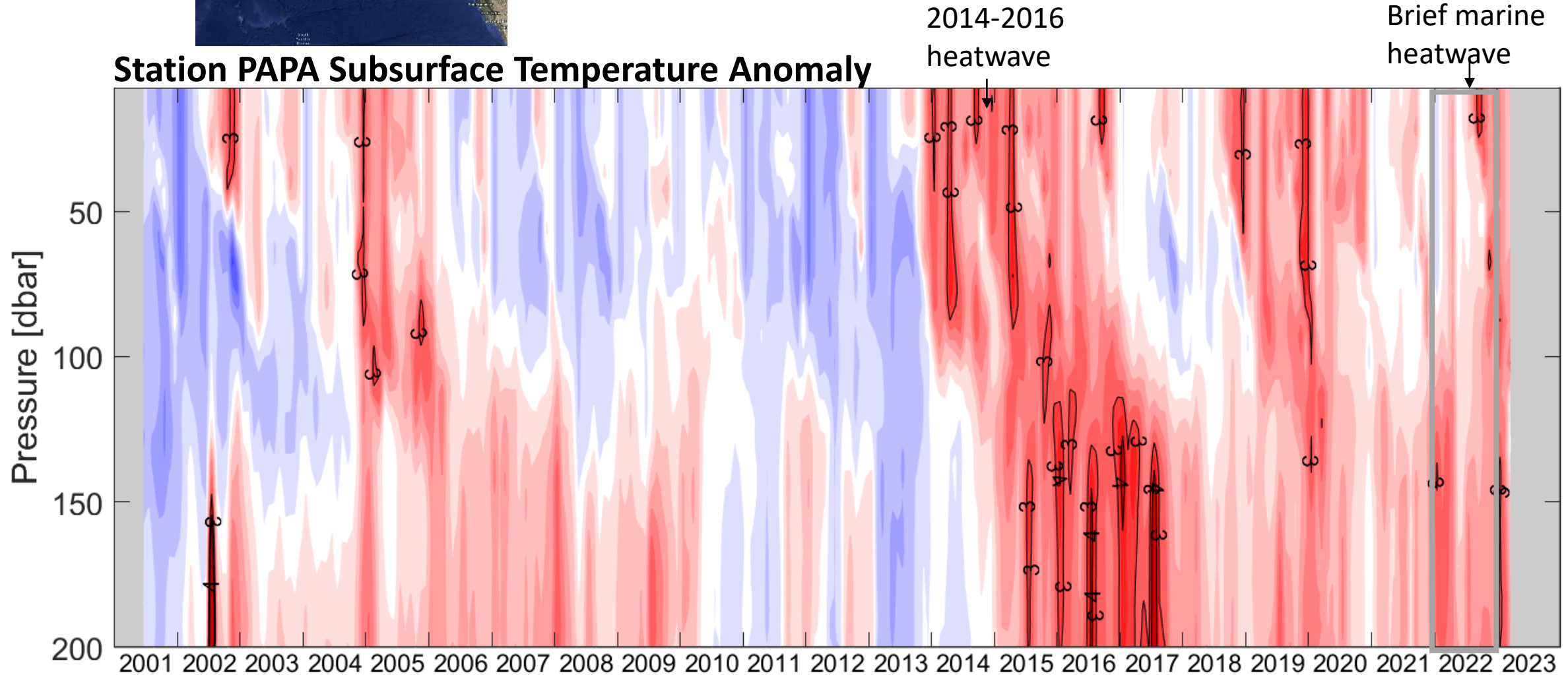
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



# Heatwaves can affect the entire water column



## Station PAPA Subsurface Temperature Anomaly

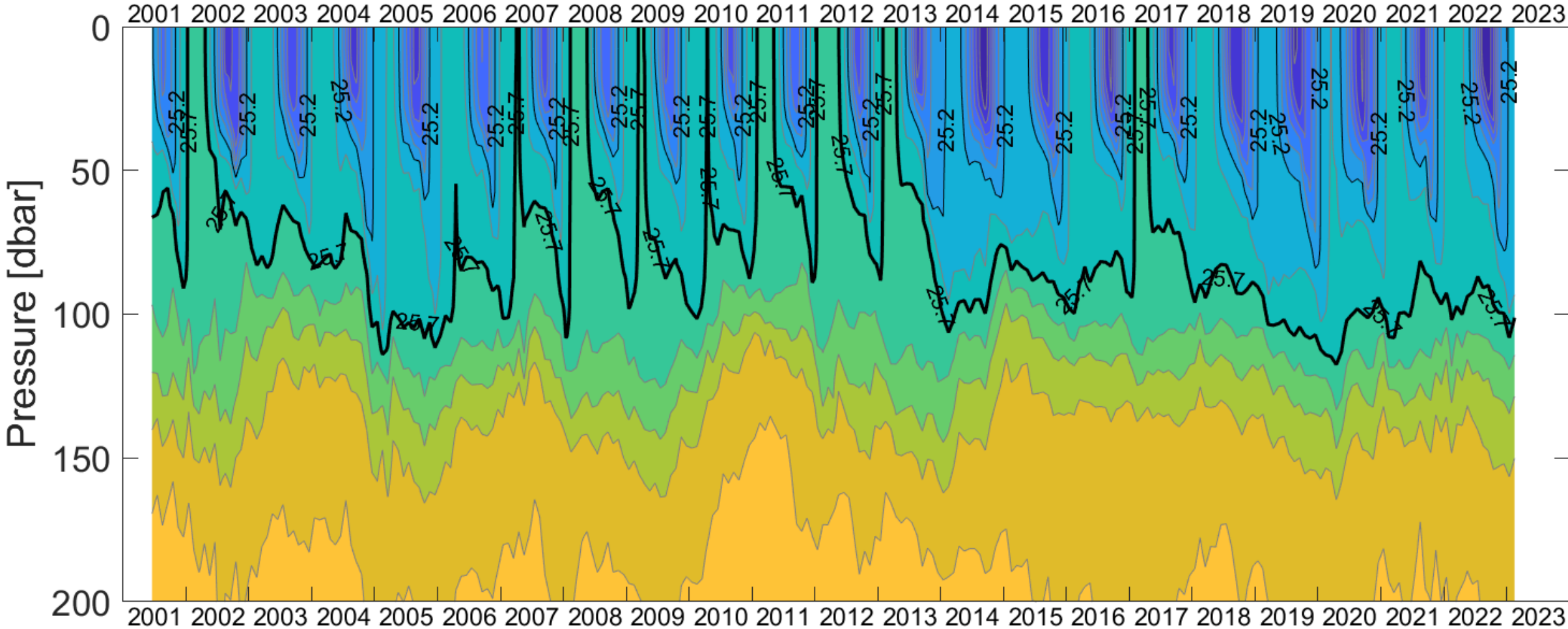


Argo data



# Reduced vertical mixing of nutrients to surface waters in heatwave years can lead to reduced productivity

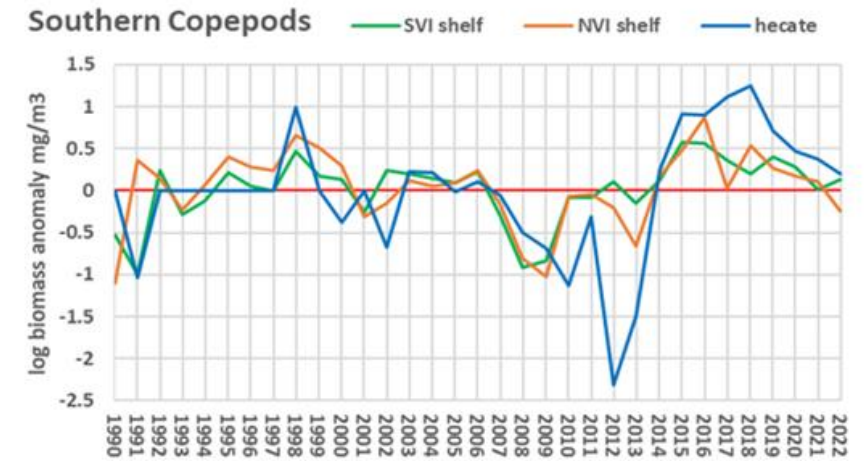
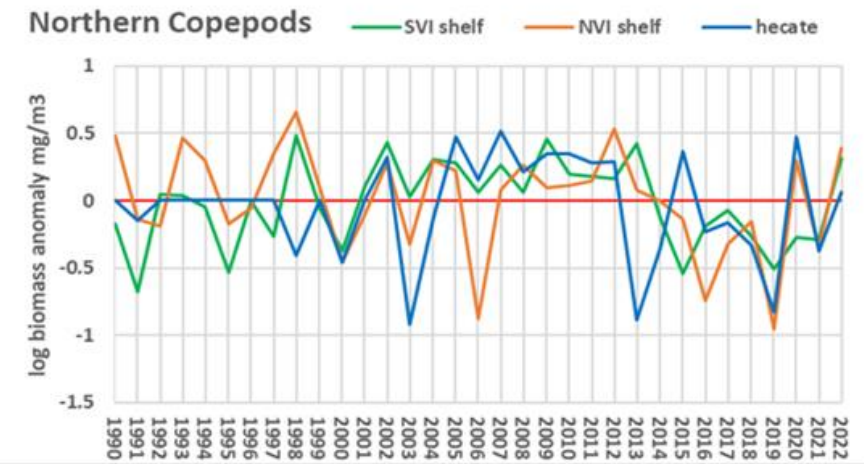
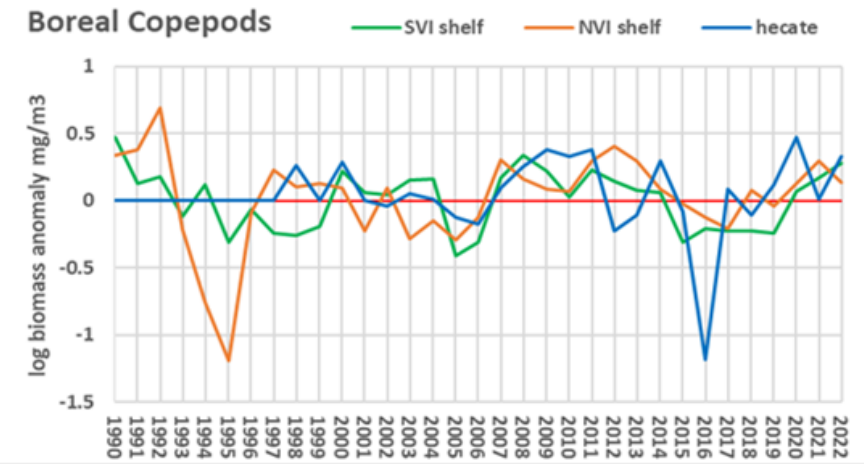
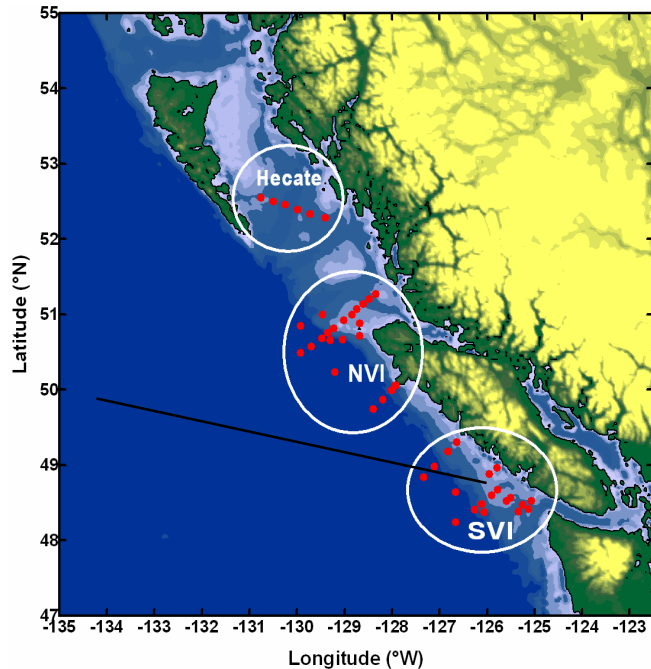
Reduced mixing due to the blob      Normal mixing      Similar to blob      Normal mixing



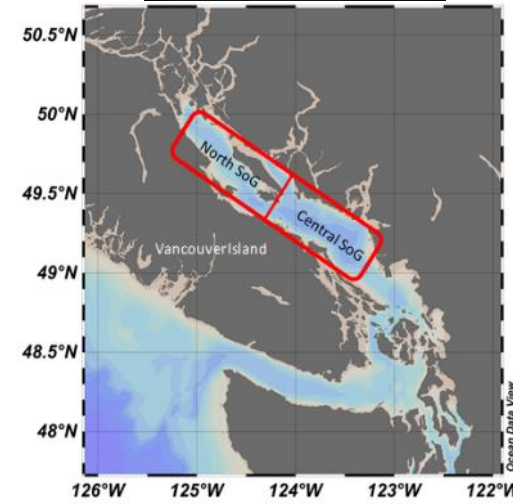
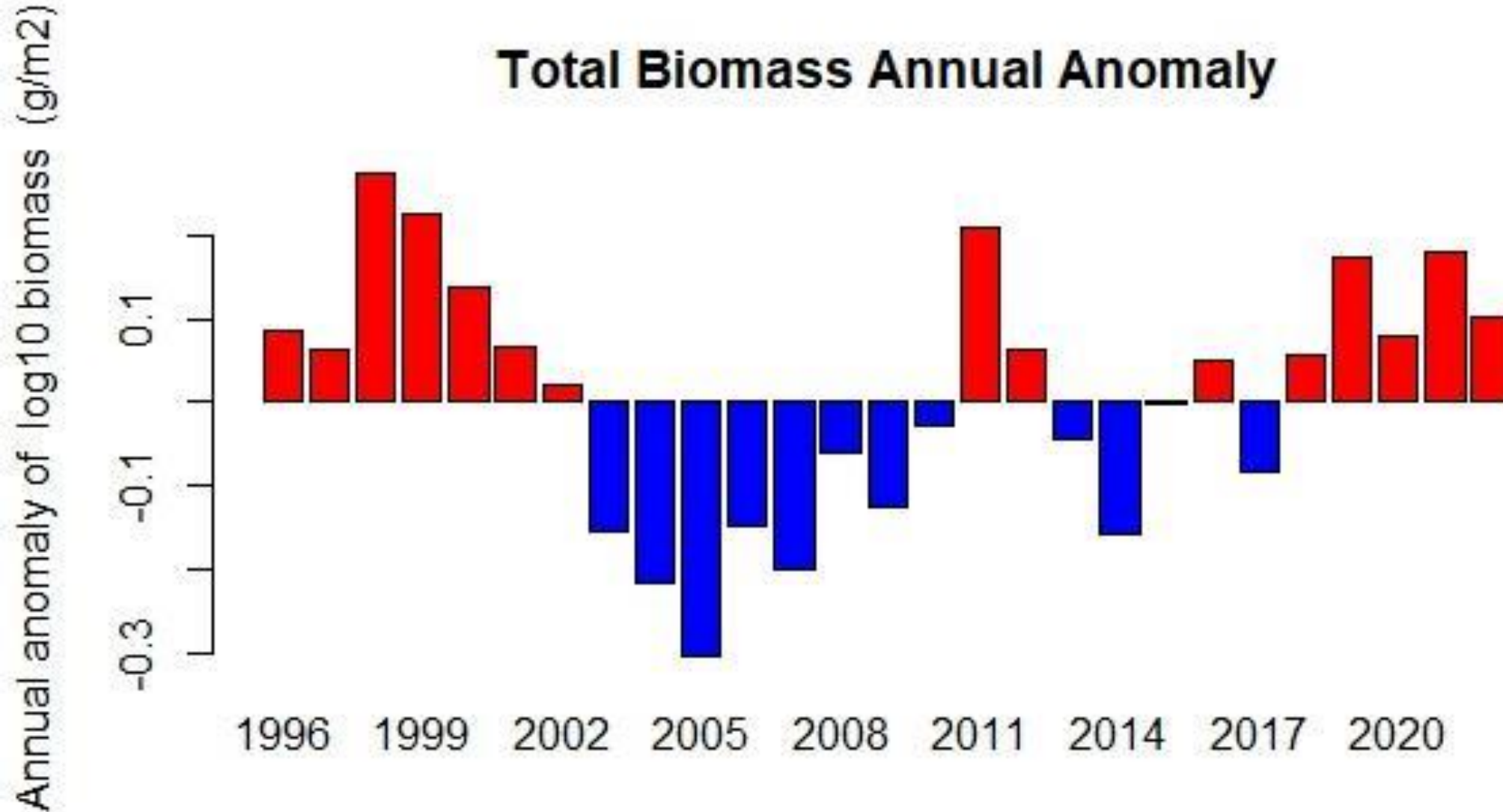
# Zooplankton communities returning to average after the 2014-2016 heatwave

2022

- Boreal shelf & northern copepod biomass increased or average
- Southern copepod species biomass declined

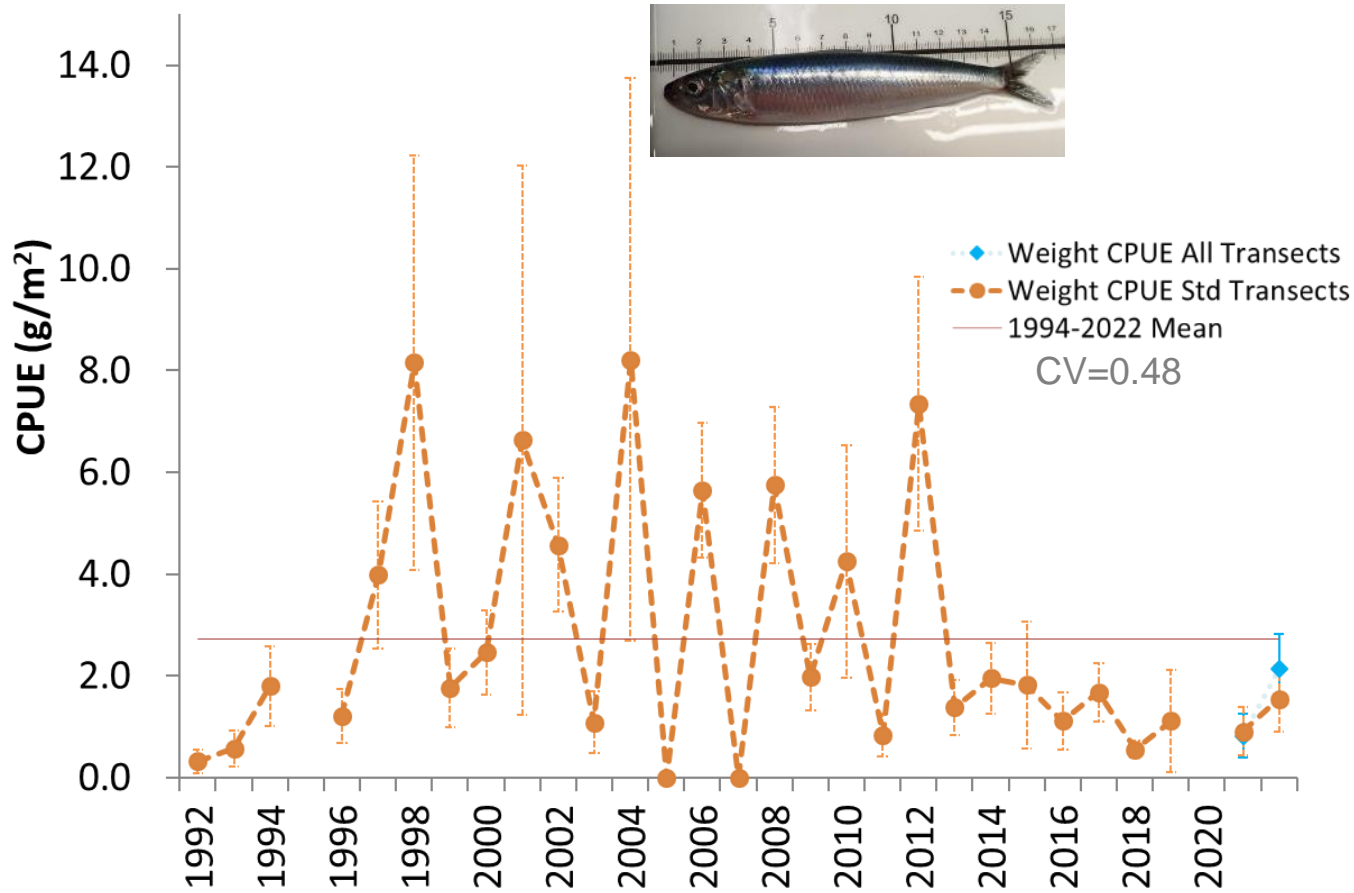


# Strait of Georgia zooplankton biomass above average in recent years

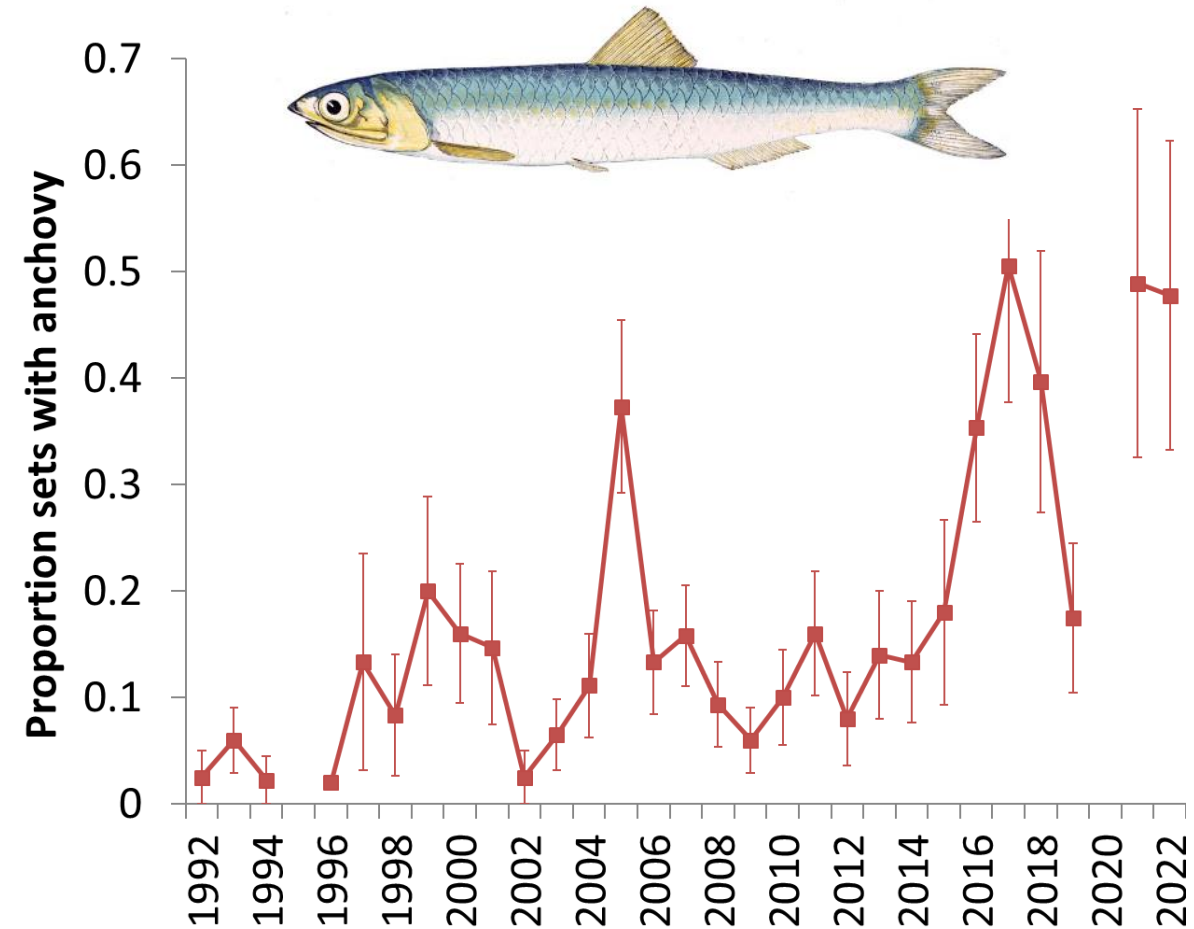


# Strait of Georgia *Prey for juvenile Chinook and Coho Salmon*

## Age-0 Pacific Herring abundance below average

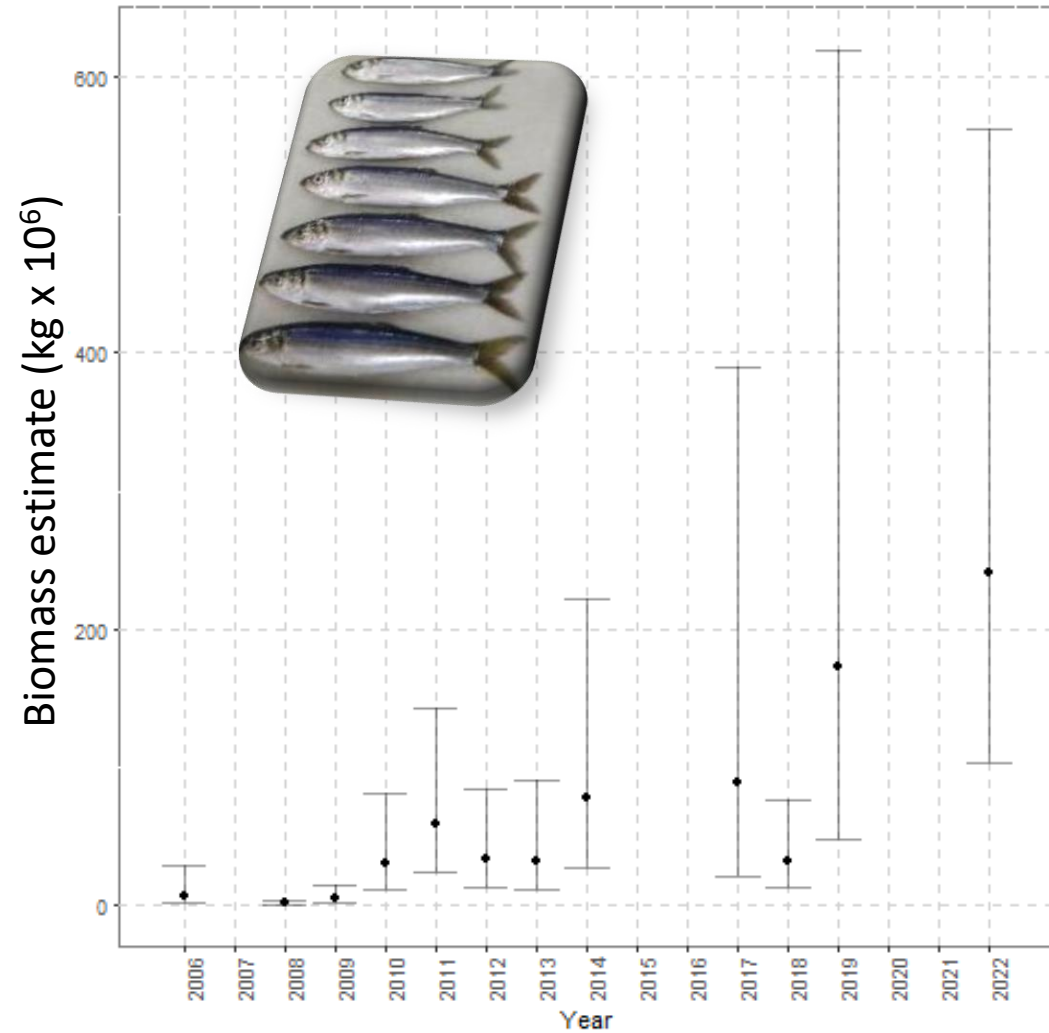


## Increased occurrence of Northern Anchovy

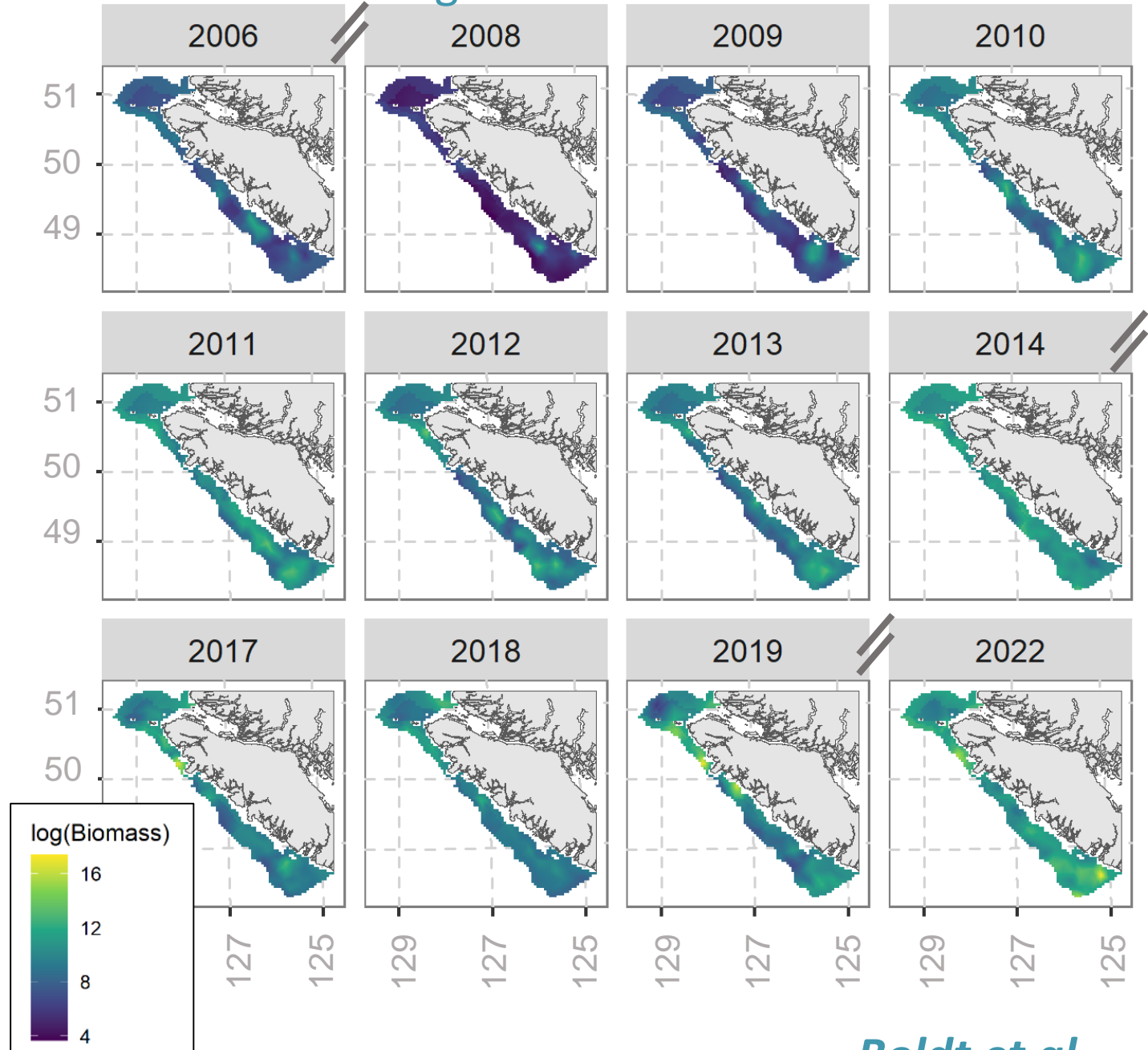


# Pacific Herring biomass increased

*Prey for adult Chinook and Coho Salmon*

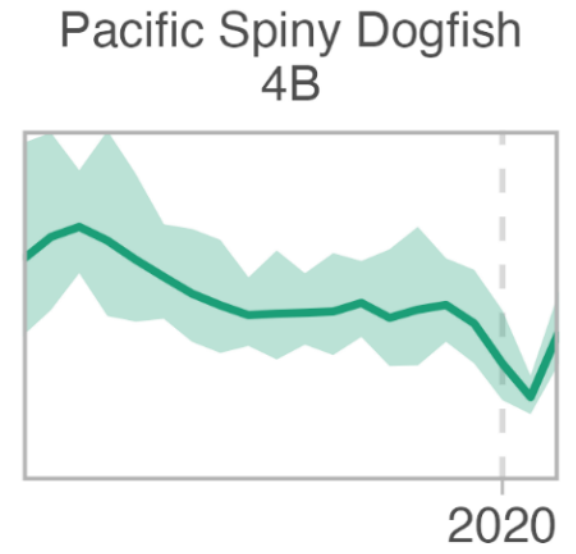
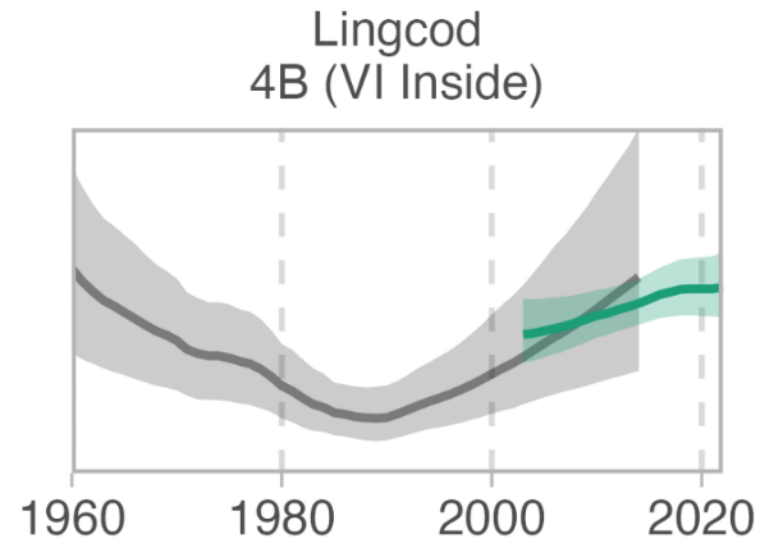
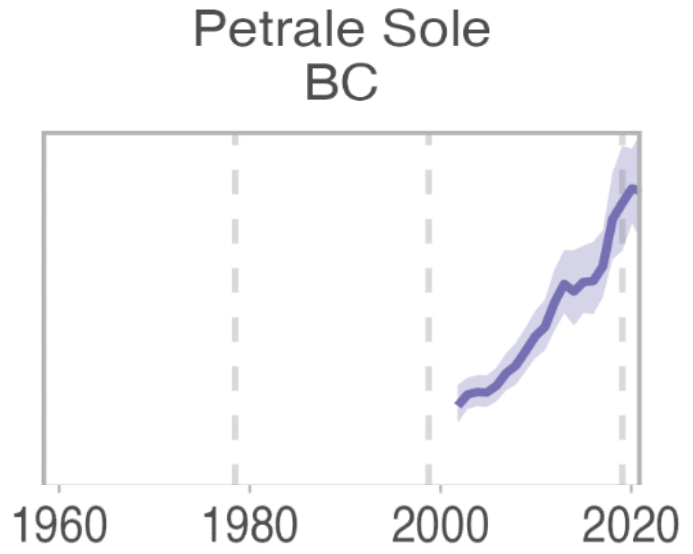


## Pacific Herring biomass summer distribution

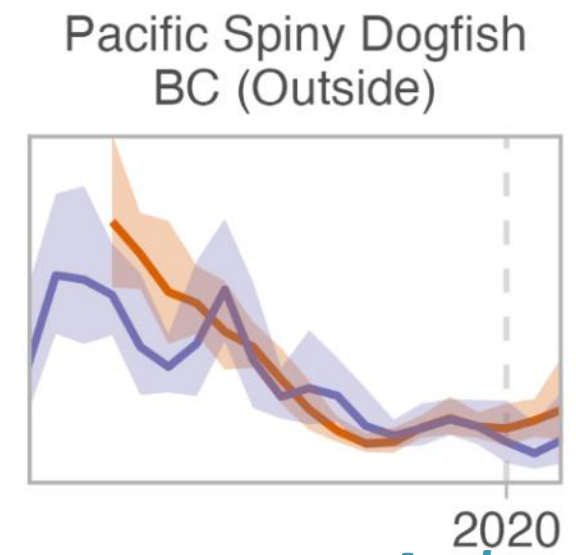
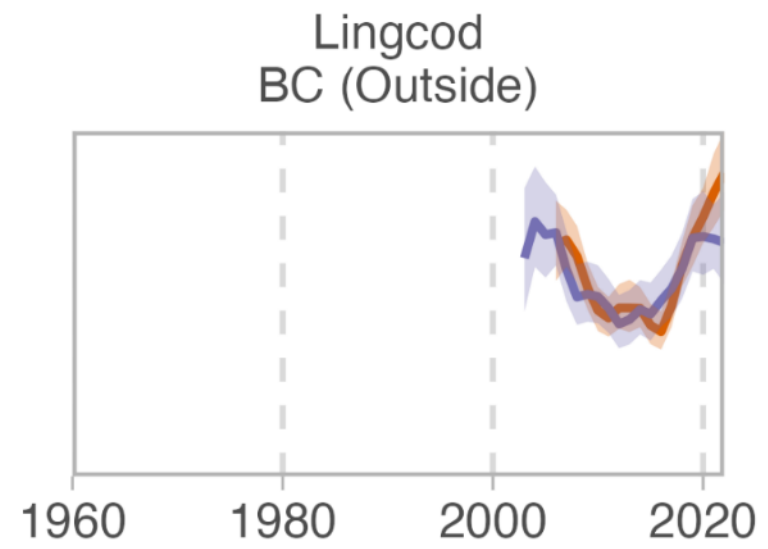


# Groundfish: salmon predators some increased, others decreased

Relative biomass or abundance estimate



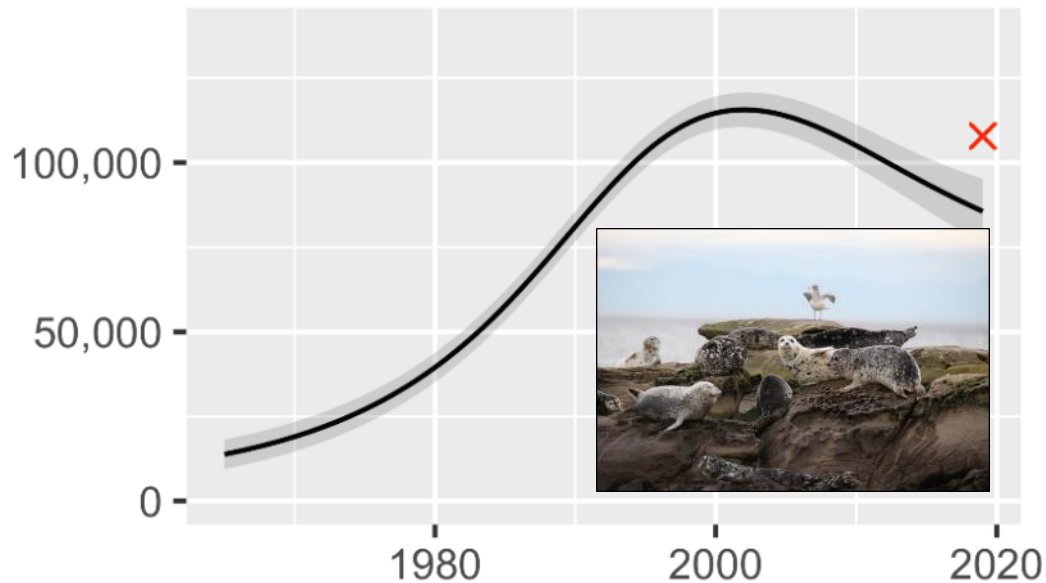
- Type
- Assessment
  - HBLL (inside)
  - HBLL (outside)
  - Synoptic trawl



# Harbour Seals abundance is stable/decreasing California Sea Lion abundance has stabilized

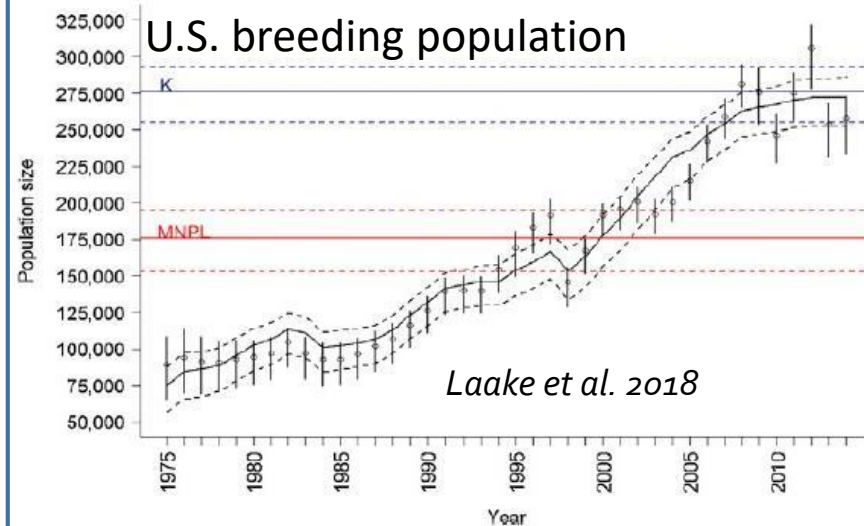
## Harbour Seals

BC coastwide



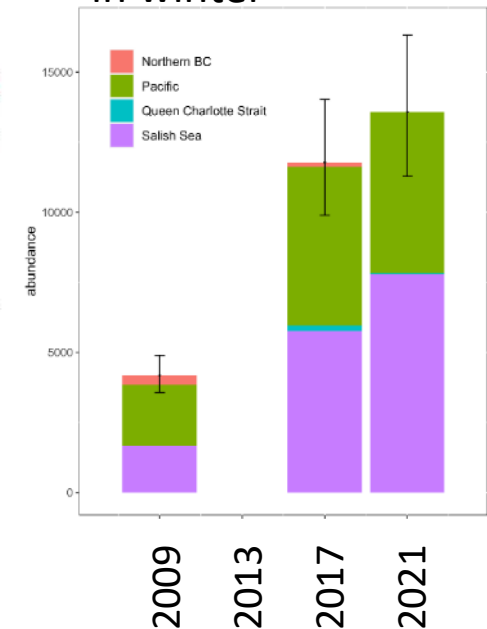
Estimated ~90,000 in B.C. as of 2019  
Trend: stable/decreasing

## California Sea Lions



The 2014 US breeding season population was estimated at 257,606 (stabilized)

B.C. number of animals hauled out in winter



# Some whale populations have shown recovery while others have not

- Southern Resident Killer Whales- 74 (2023); Endangered
- Northern Resident Killer Whales- 310 (2019); mean annual population growth rate 2.2% since 1973; Threatened
- Bigg's Killer Whales
  - Sightings have increased in the Salish Sea coincidentally with an increase in their main prey, Harbour Seals.
  - A subset of ~349 individuals most often found in coastal waters has grown at an average annual rate of 4.1% since 2012 (Towers et al. 2019).
- Humpback Whales
  - continued to recover from past exploitation, have reoccupied former habitat in B.C., summer abundance estimated at 12,500 (95% CI 8,500 – 18,600) in 2018.



Photo: John Ford, DFO



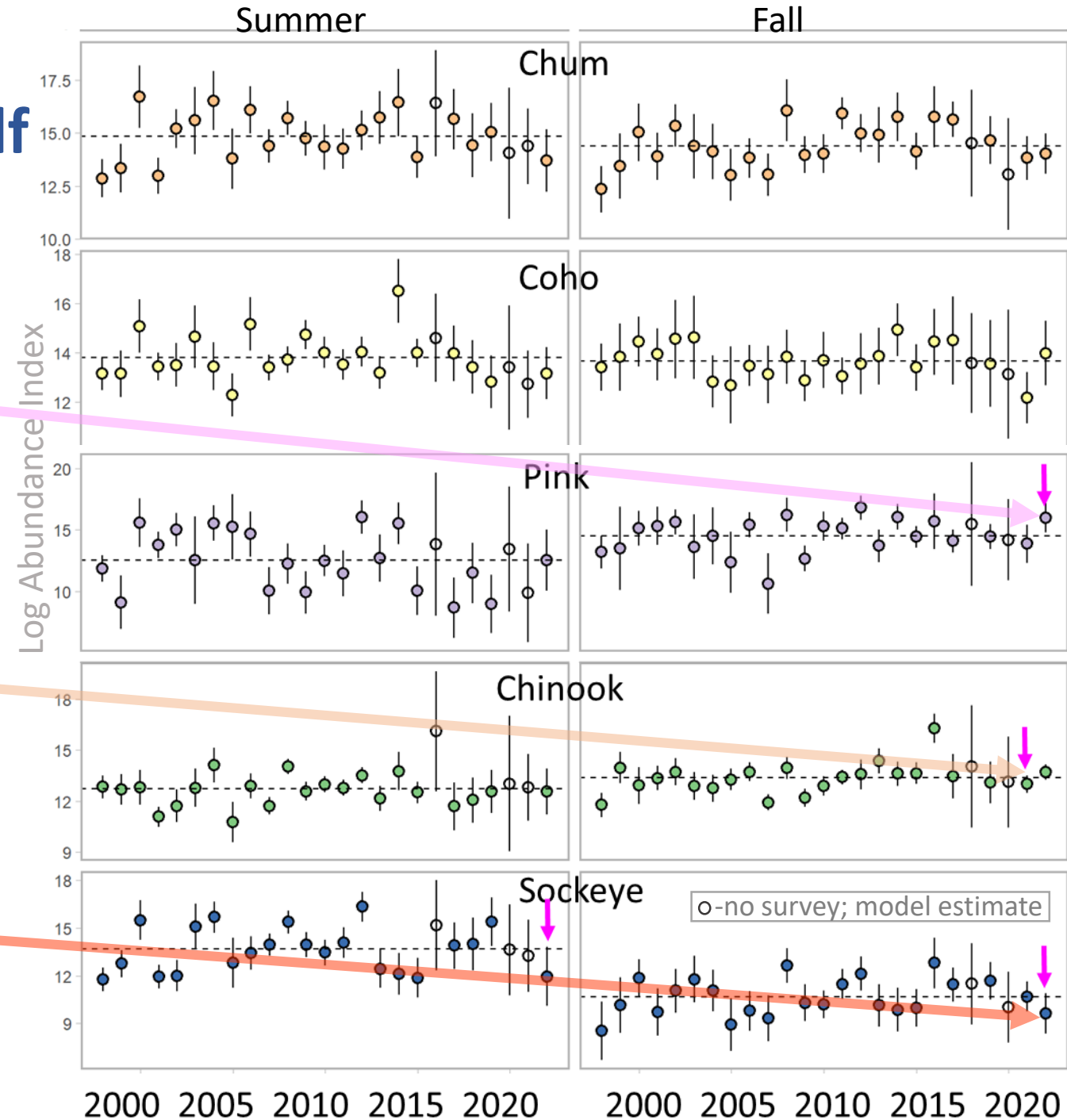
# Juvenile salmon indices on the Vancouver Island continental shelf

## 2023 Returns

- Pink in 2022 fall survey:
  - abundance index above average
  - fatter than normal

## 2024 Returns

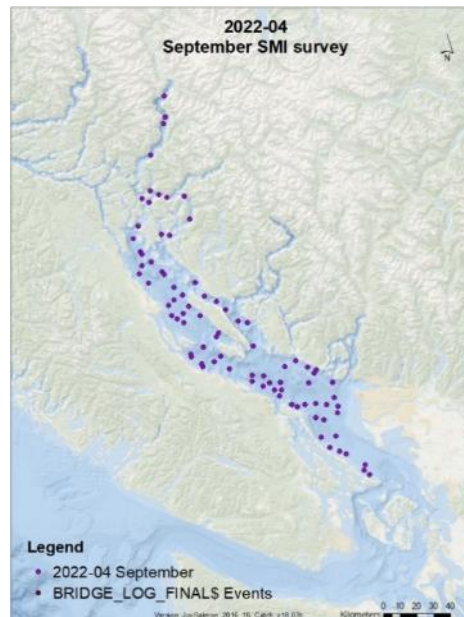
- Chinook in 2021 fall survey:
  - below average; predominately WCVI ocean-type stocks
  - average condition
- Sockeye in 2022 surveys:
  - below average in summer and fall; predominately WCVI stocks (summer) SOG stocks (fall) returning in 2024
  - average condition



# Juvenile salmon indices in the Strait of Georgia

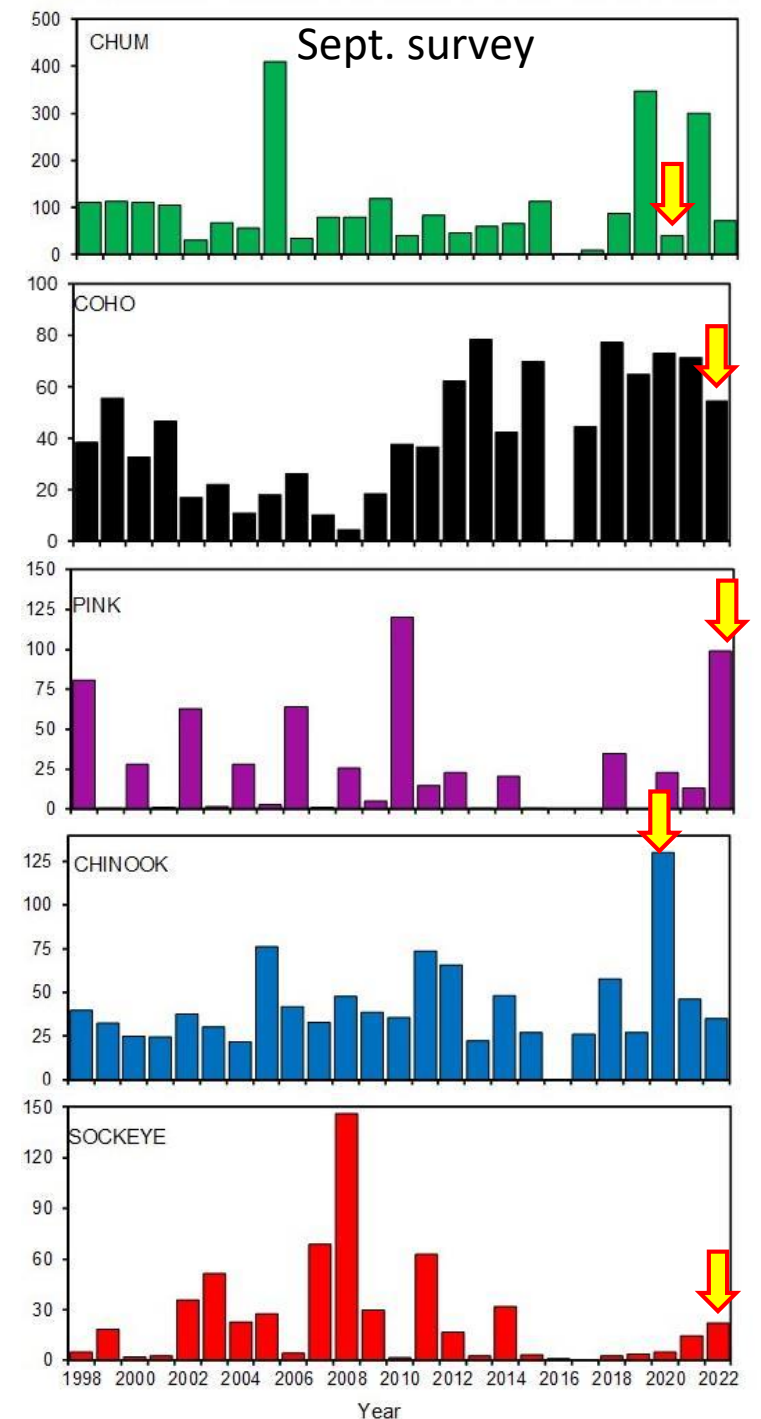
## 2023 returns:

- Chum: low 2020 survey CPUE\*
- Coho: high 2022 survey CPUE; good condition
- Pink: high 2022 survey CPUE\*
- Chinook: high 2020, avg. 2021 survey CPUE; primarily South Thompson
- Sockeye: low 2022 survey CPUE; primarily Harrison



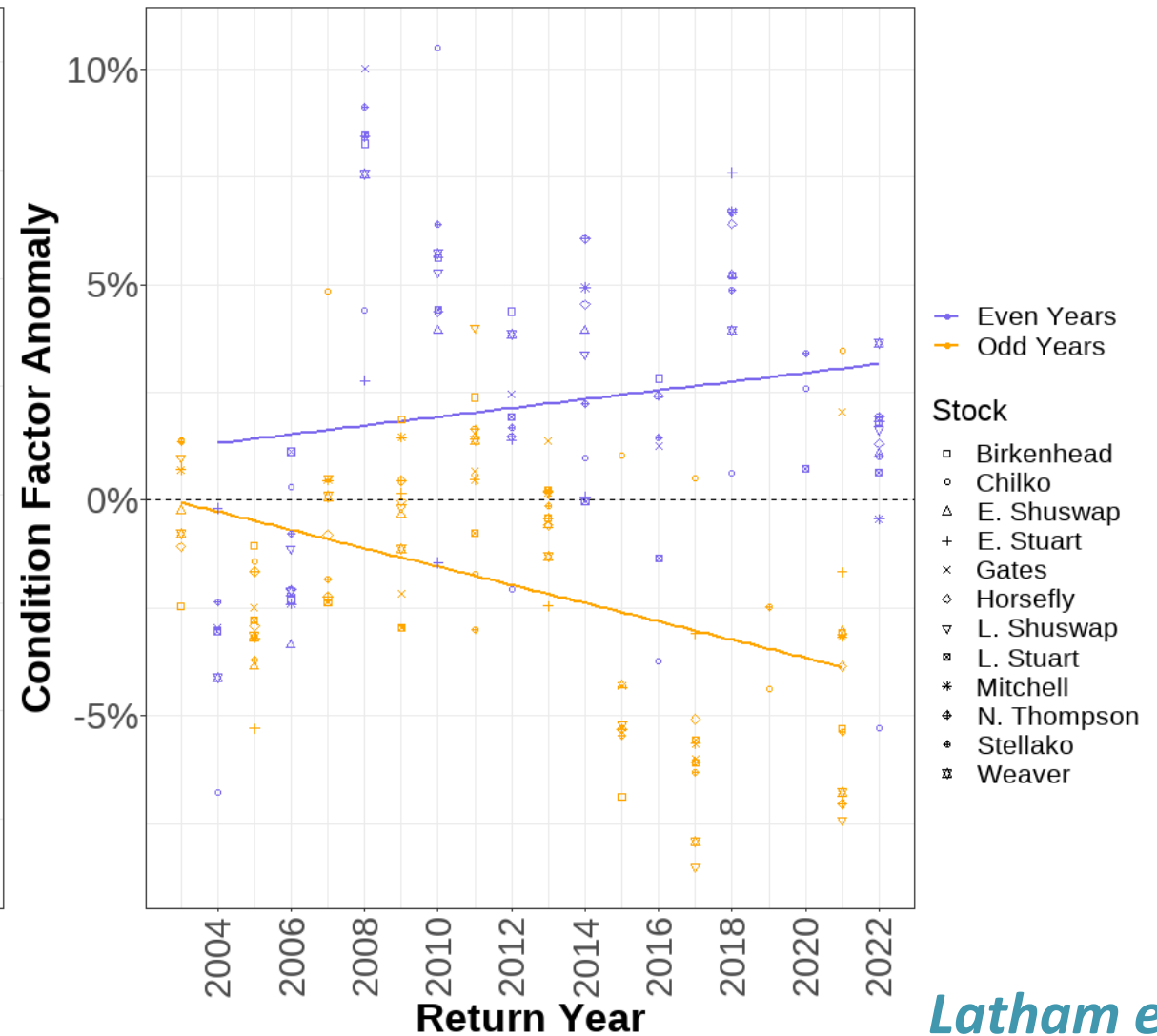
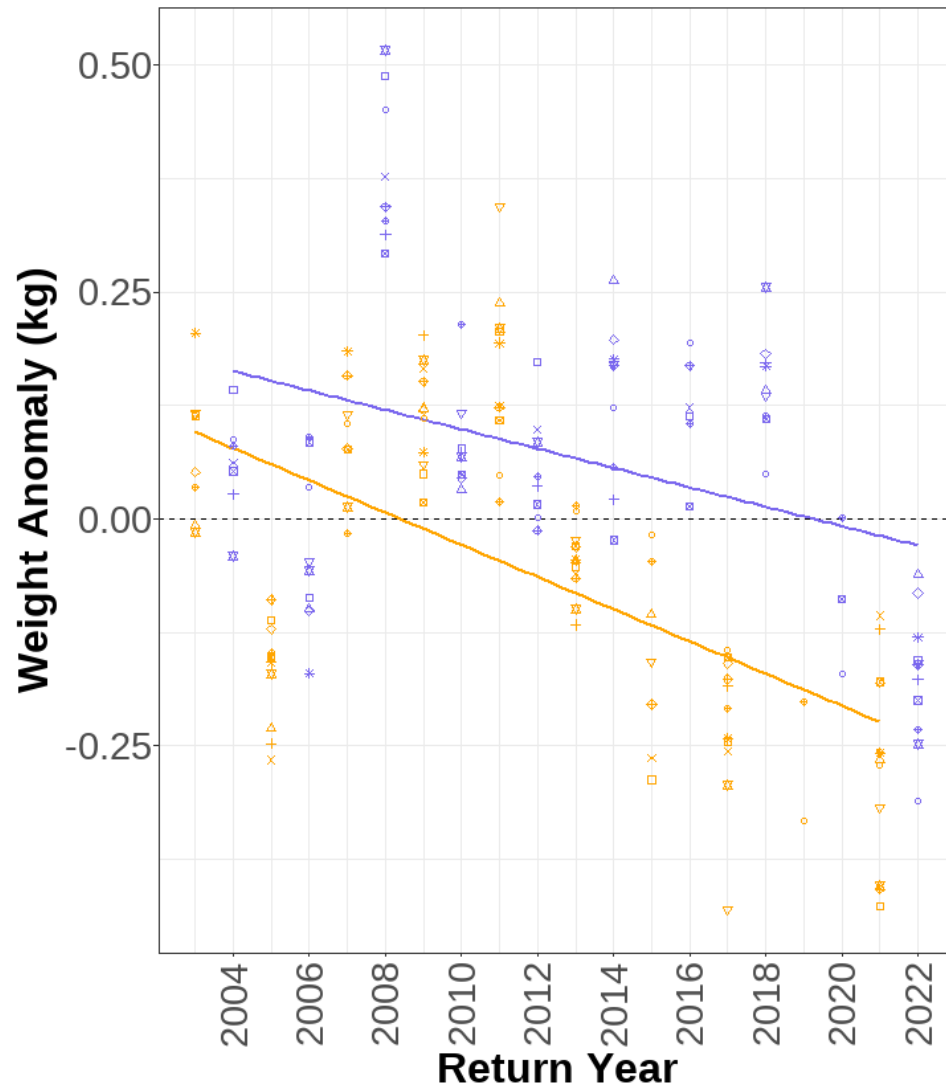
\*there is limited understanding of the proportion of chum and pink are in the September survey

*Neville*

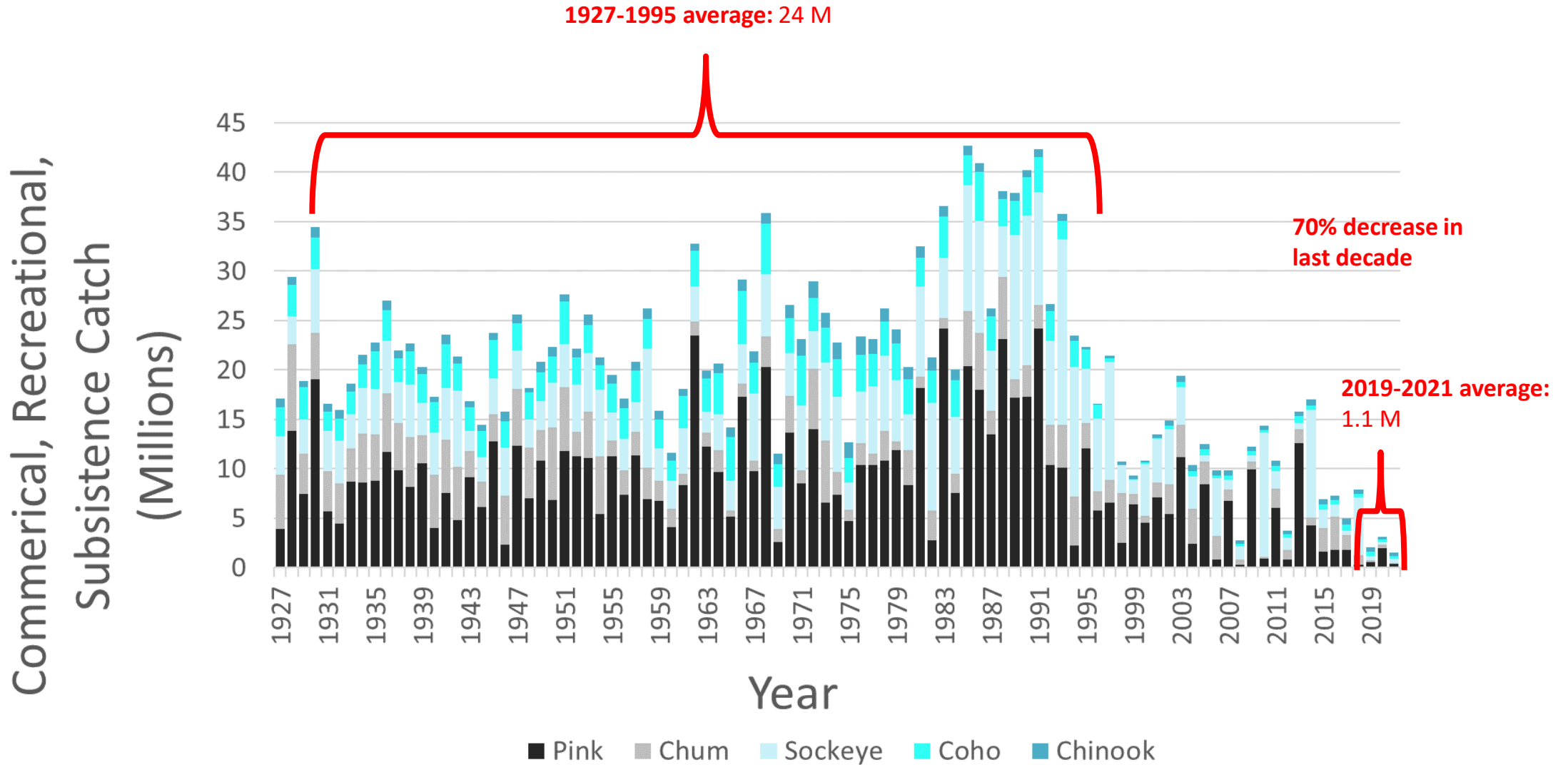


# 2022 Fraser River Sockeye Salmon were small

- Lengths ranked 10th and 6th smallest for 2-ocean and 3-ocean ages, respectively, since 1964.
- Among even-numbered years, lengths for both age classes were 2nd smallest behind 2020.



# Large Declines in Canadian Pacific Salmon Catch\*

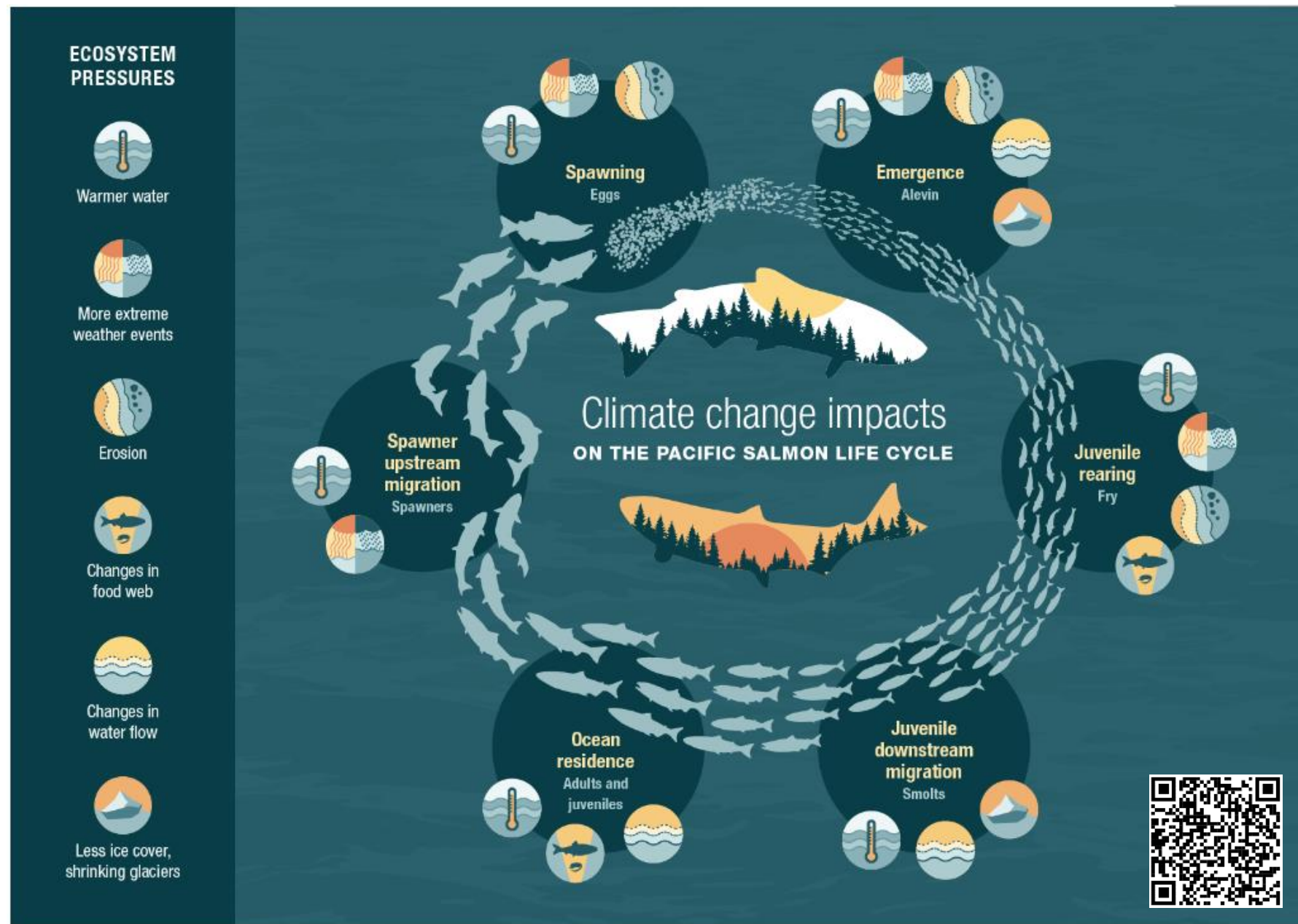


\*note, only catch is consolidated and made available annually for all Pacific salmon stocks; we are considering ways to consolidate return information in the future, but this is currently not available.

# Summary

Climate change is a dominant pressure acting on the NE Pacific

Changes to the environment have impacts on the food web and higher trophic levels



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Canada