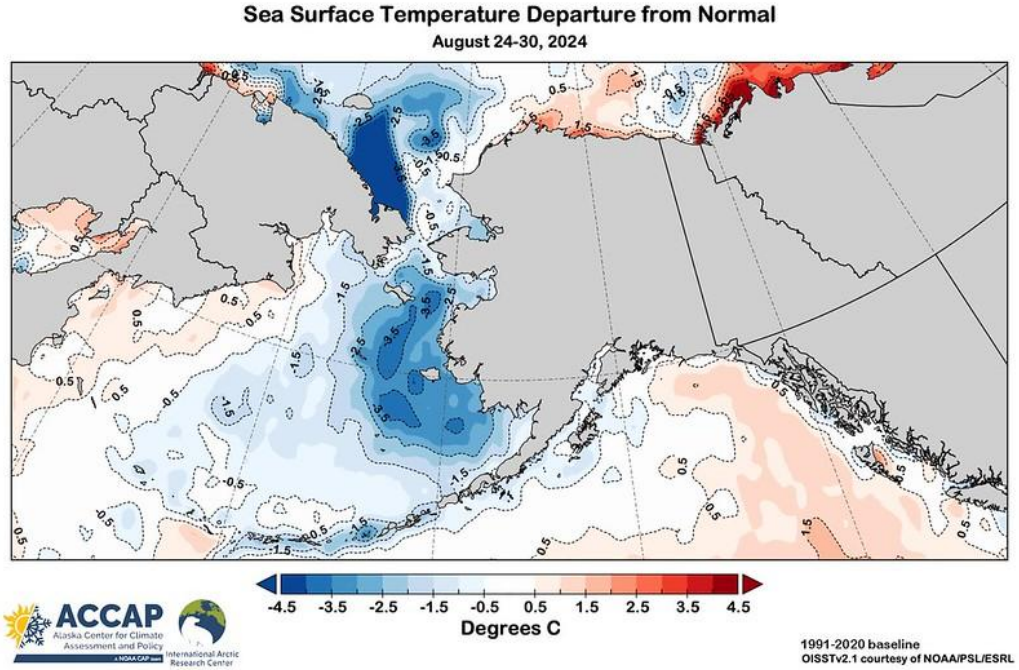
Eastern Bering Sea
ECOSYSTEM STATUS REPORT

NPFMC Crab Plan Team
September 9, 2024

Elizabeth Siddon

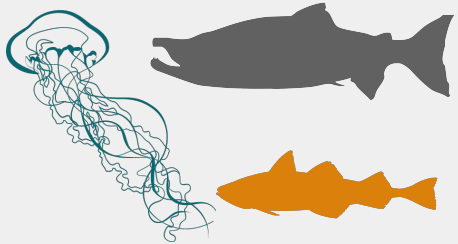


Crab-relevant ecosystem information

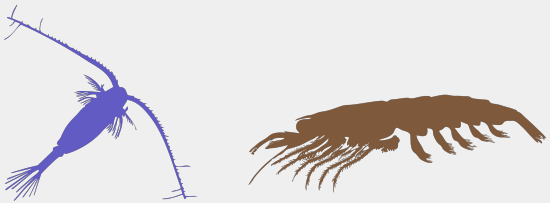
- Pelagic and benthic stages
- Environmental processes, prey, competitors, predators
- 2024 (where available) in context

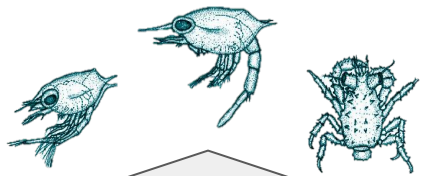
Pelagic larval indicators

PREDATORS

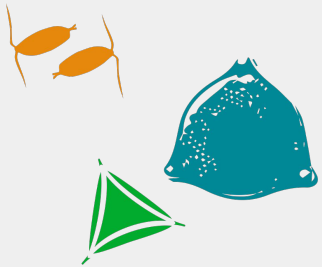


COMPETITORS





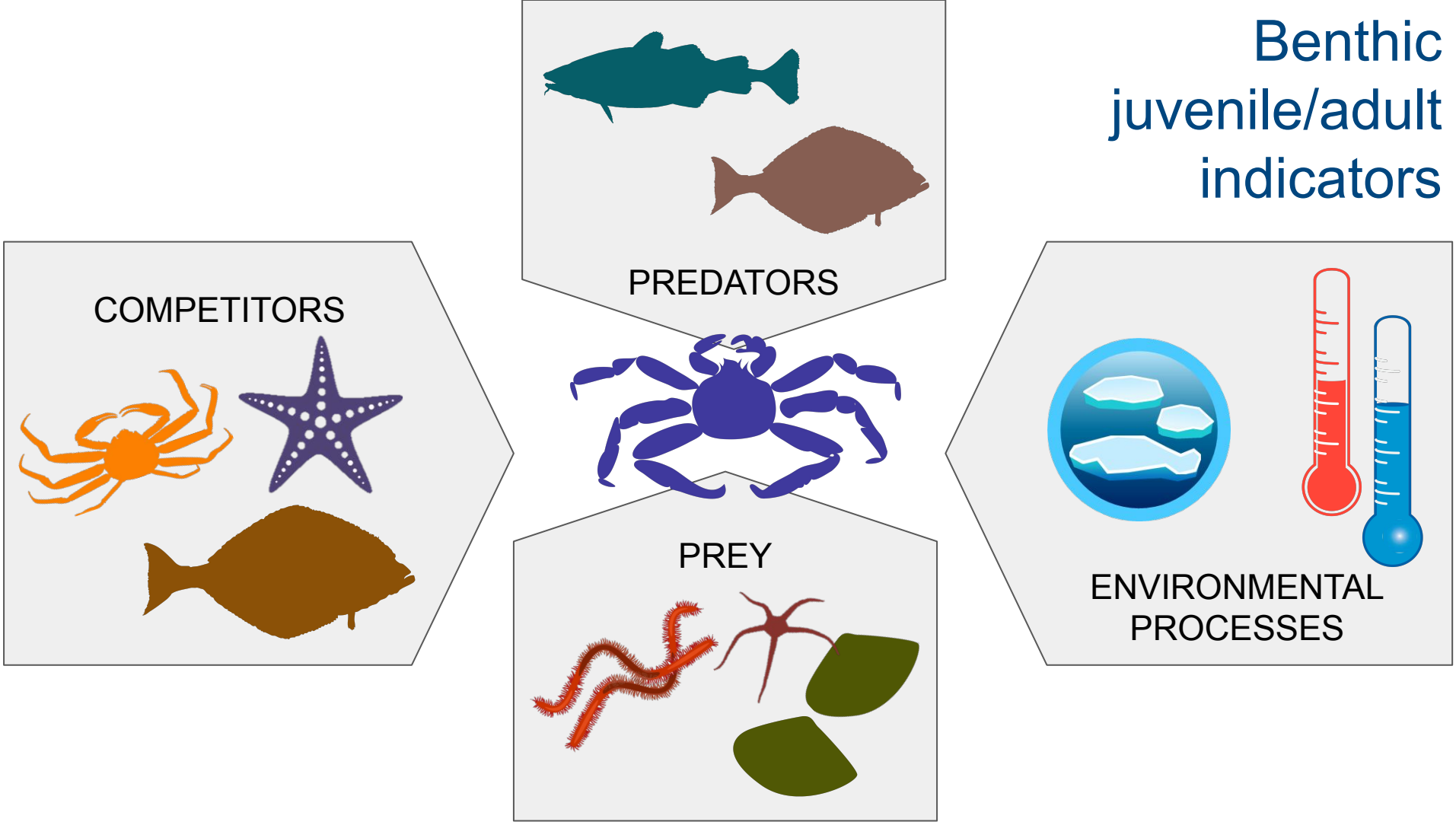
PREY

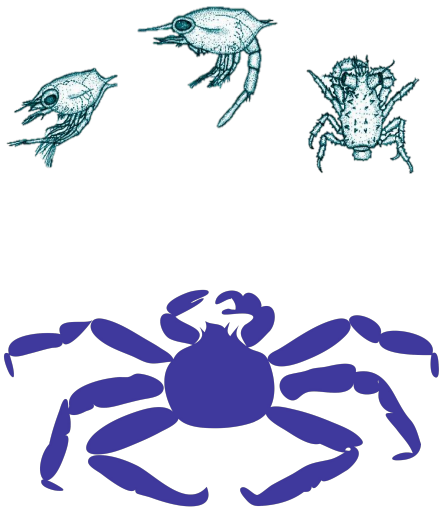


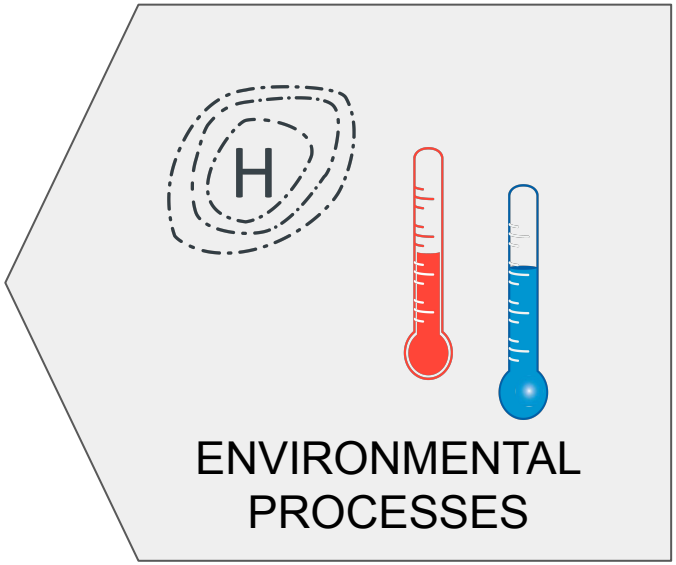
H

ENVIRONMENTAL PROCESSES

Benthic juvenile/adult indicators

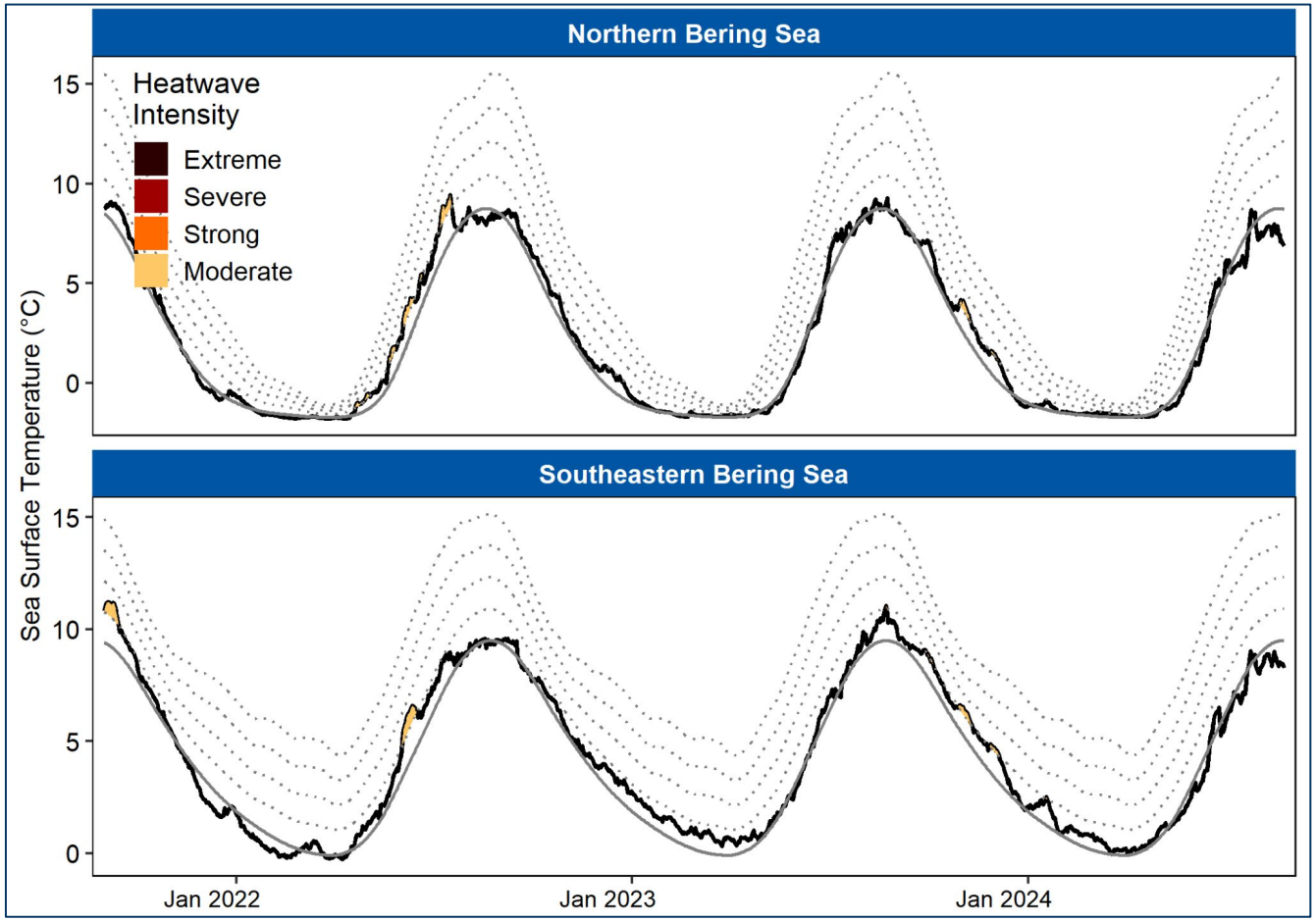





H
ENVIRONMENTAL
PROCESSES

Marine Heatwave Index

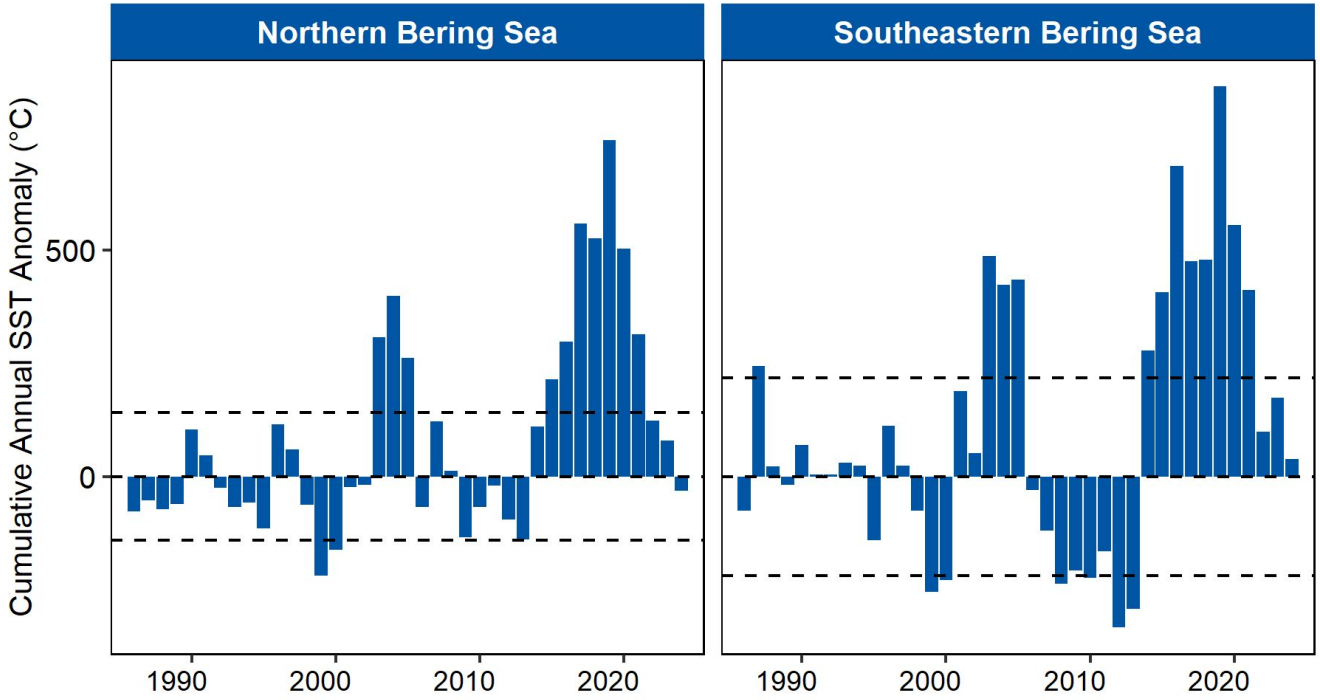
Callahan & Lemagie



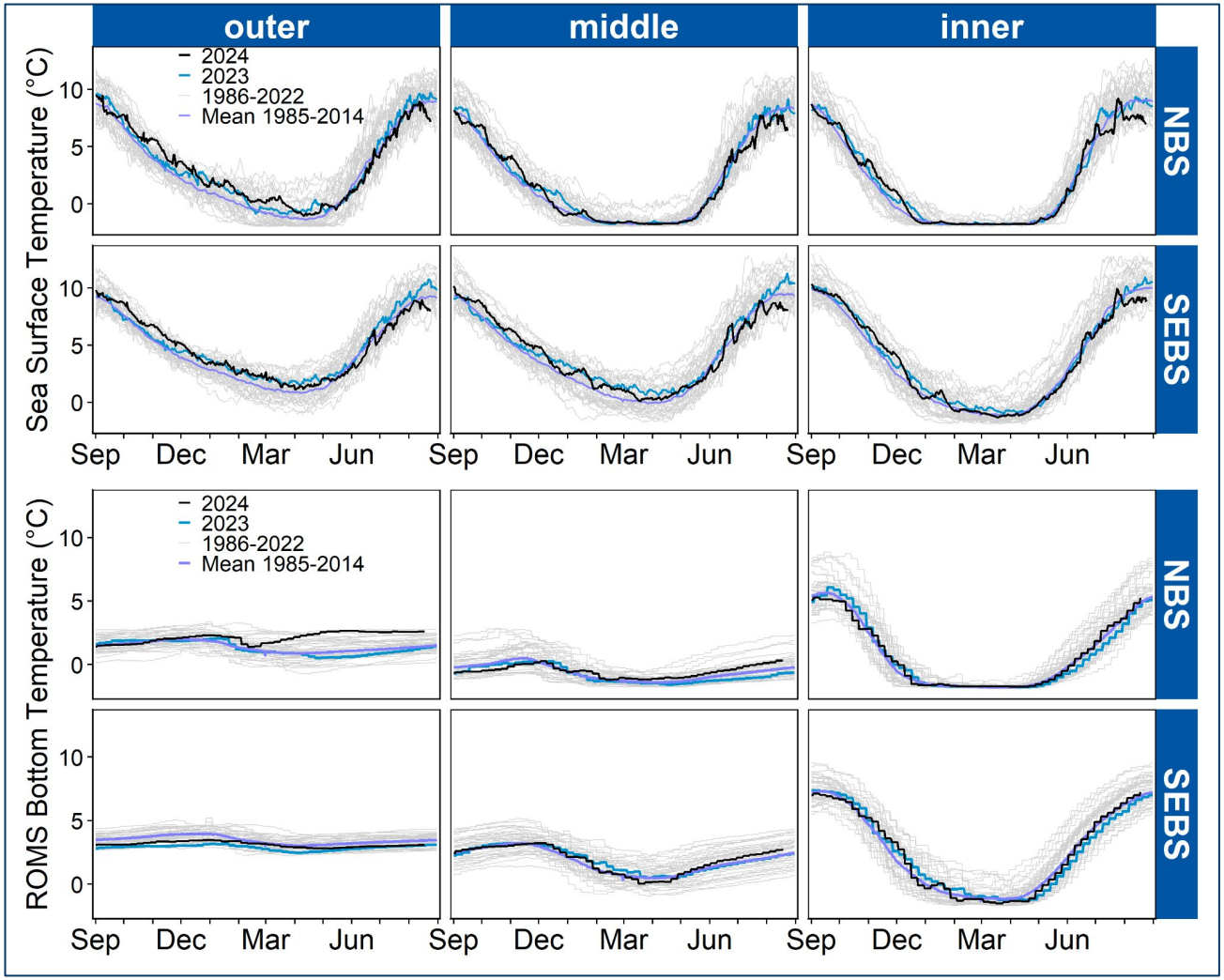
- MHWs have been brief and infrequent since 2021

Sea Surface Temperatures

Callahan & Lemagie

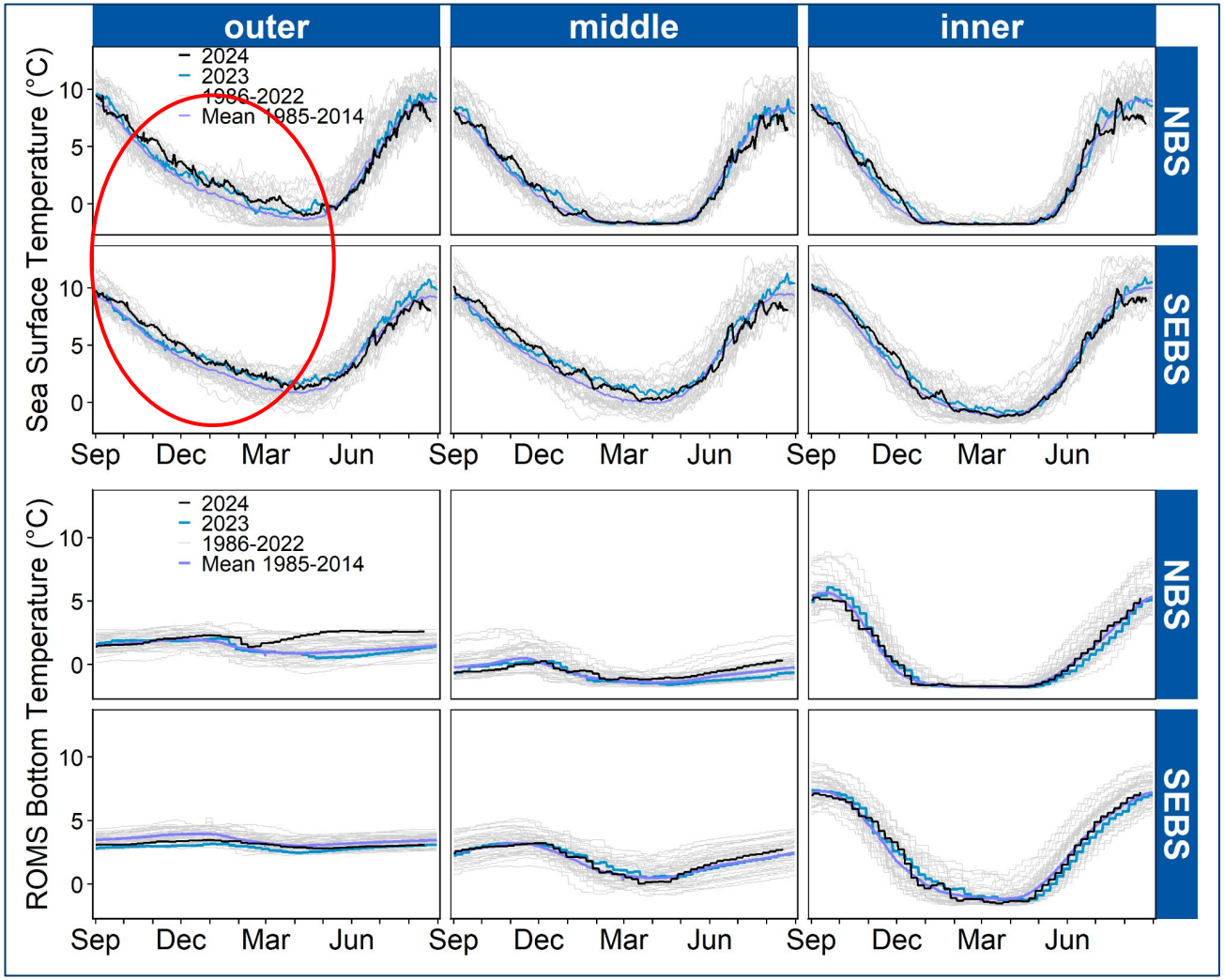


- SST anomalies continued to be within ±1SD of the mean; baseline = 1985-2014)



SST & Bottom Temps

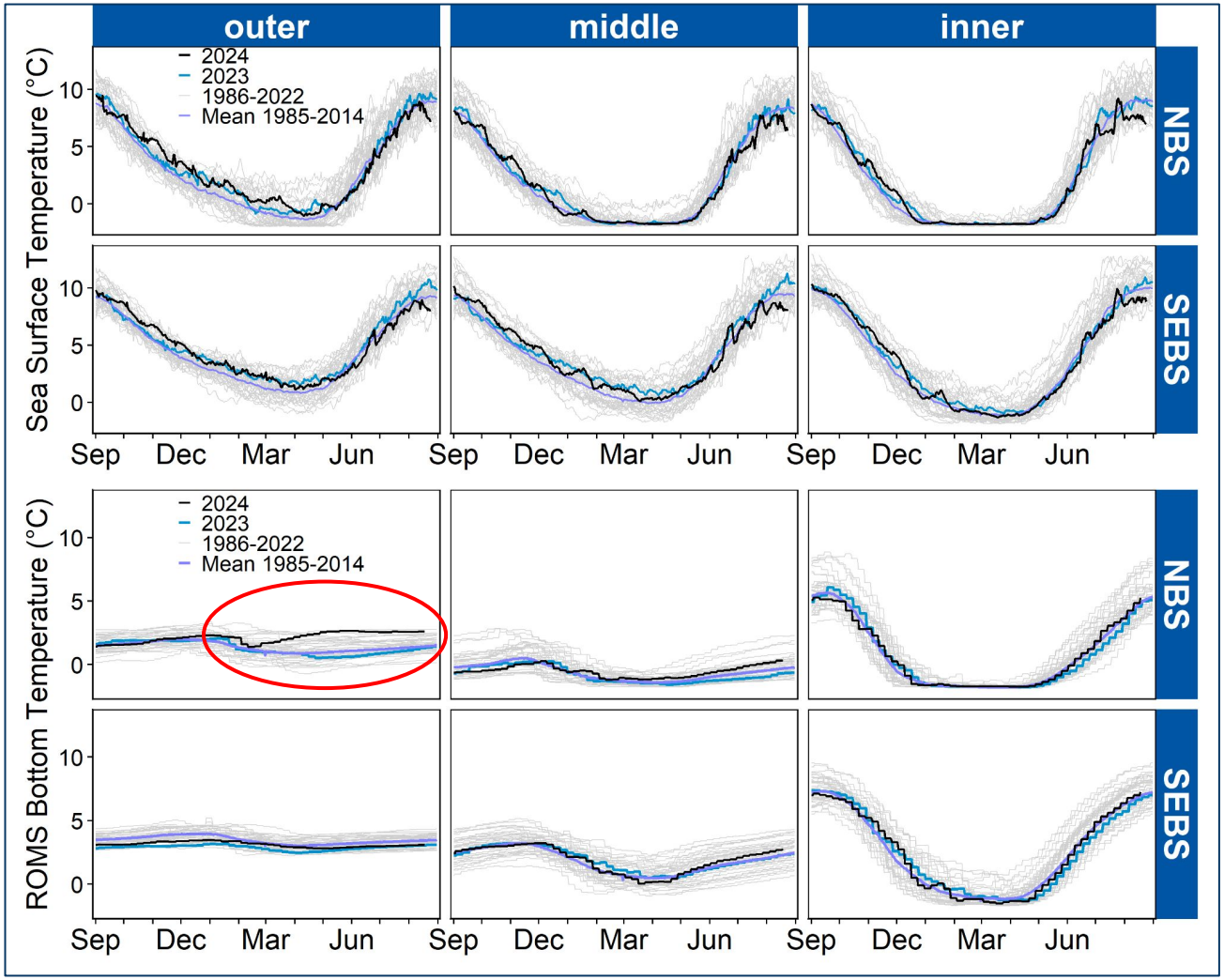
Callahan, Kearney & Lemagie



SST & Bottom Temps

Callahan, Kearney & Lemagie

- SSTs were warm in the outer domain in fall -> spring; near the long-term mean in all regions by summer



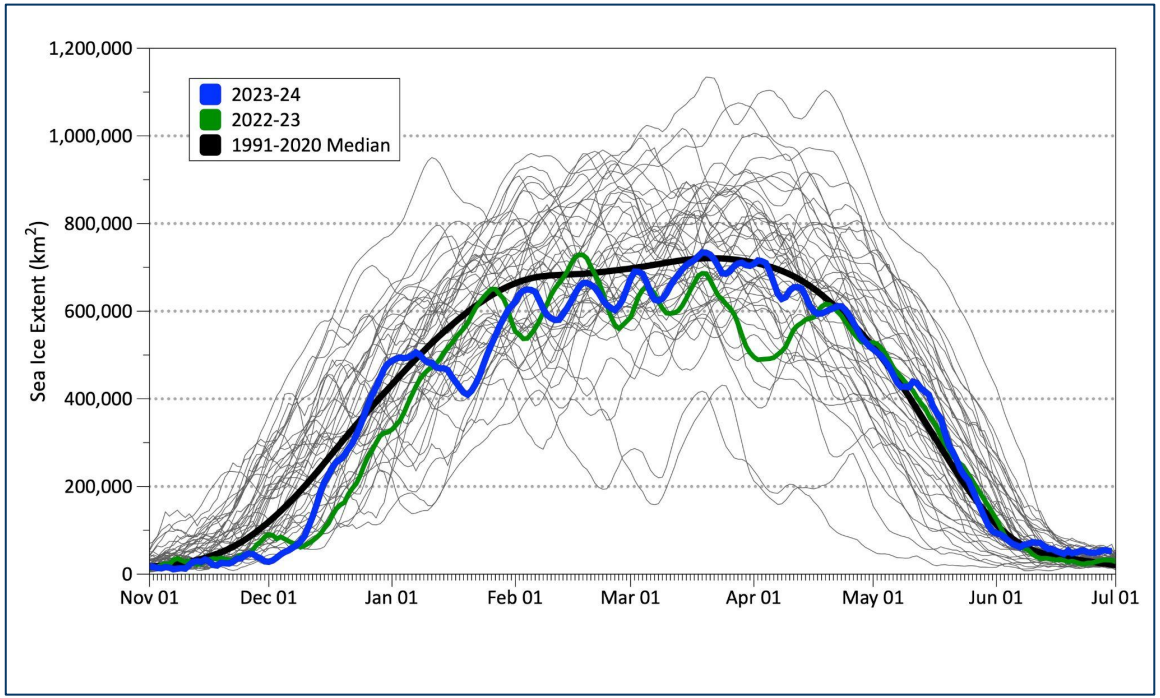
SST & Bottom Temps

Callahan, Kearney & Lemagie

- SSTs were warm in the outer domain in fall -> spring; near the long-term mean in all regions by summer
- Unusually warm bottom temperatures in the NBS outer domain started in spring

2023-2024 Sea Ice

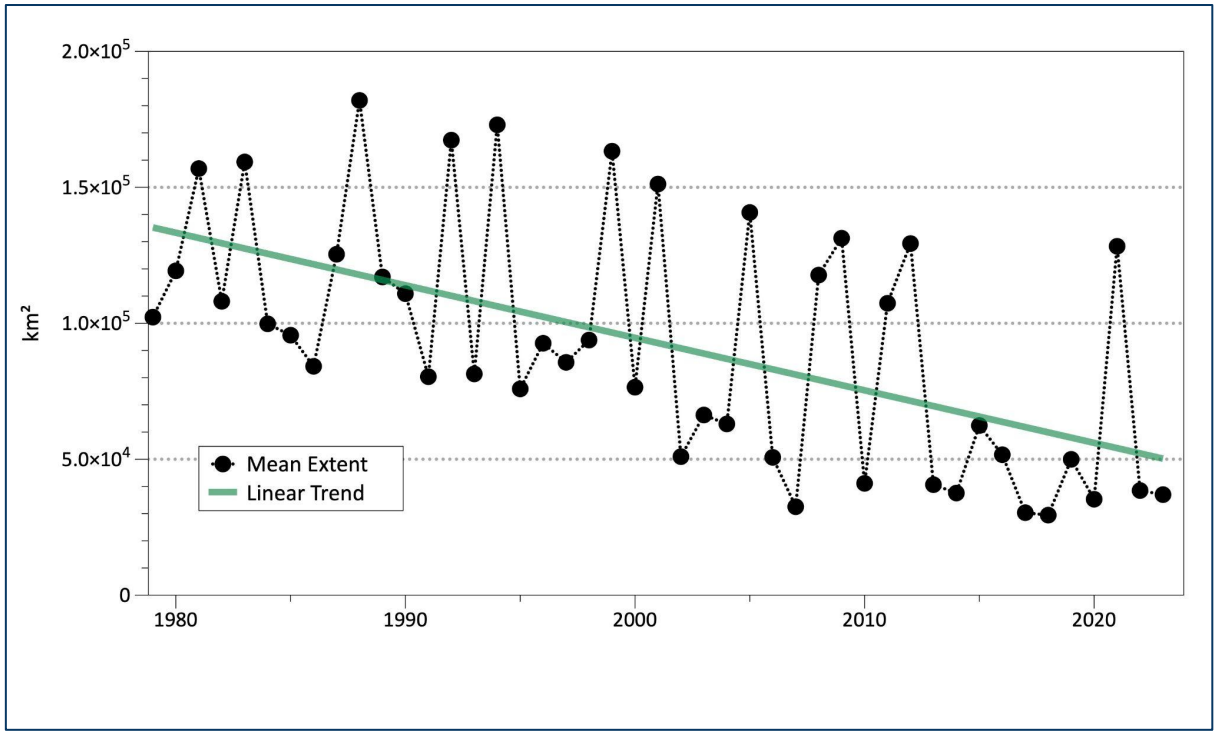
Thoman



- Delayed sea ice growth in fall
- Large increase mid-December
- Sea ice “wiggles” due to repeated shifts in weather patterns
- Highest May ice extent since 2013; max extent 14% below mean
- Maximum ice extent occurred in late March; sea ice reached St. Paul Island for 2 days

Early Season Ice Extent (Oct - Dec)

Thoman

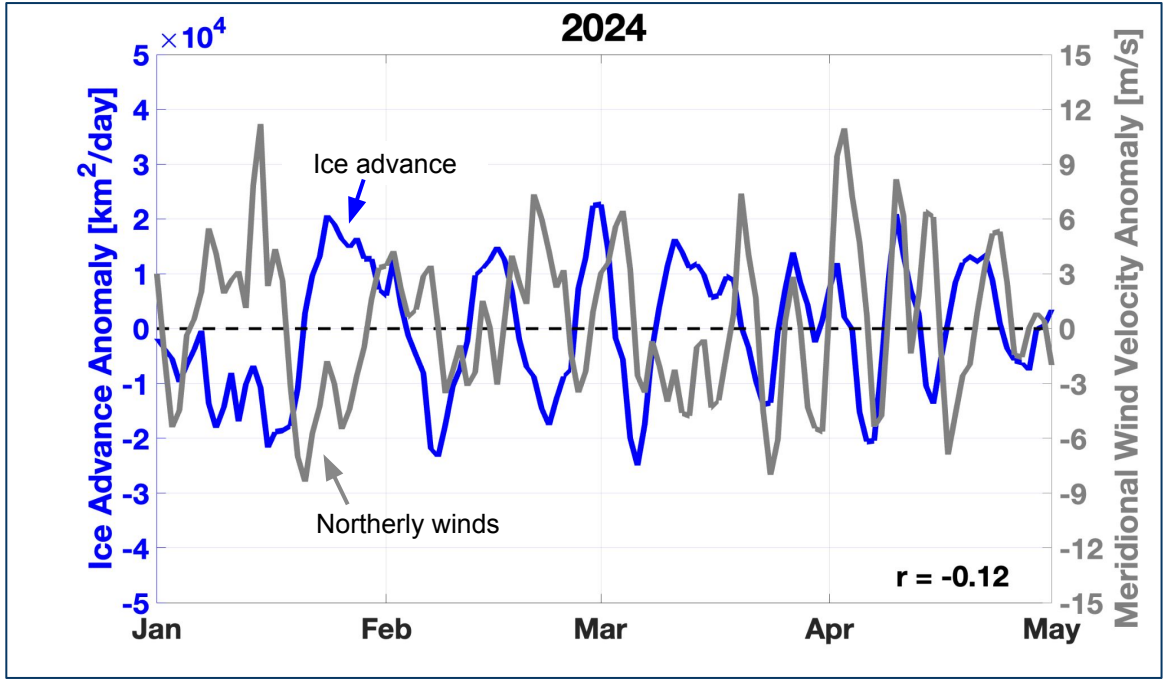


- 2023 was similar to most years since 2013 (except 2021)
- 2023 was lower than any year prior to 2007
- Early season ice extent has decreased 63% over 46-year time series

Source: Alfred Wegener Institute, https://www.meereisportal.de/en/

Winds & Sea Ice

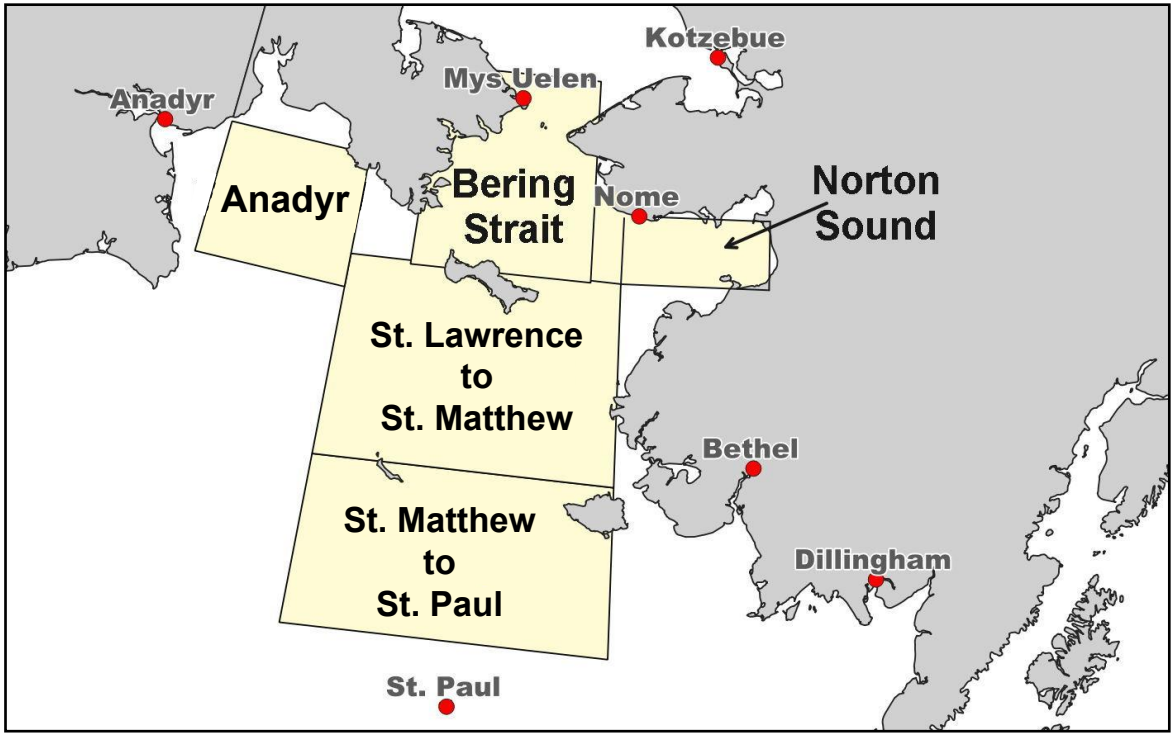
Hennon



- Ice generally **advances** with **northerly** (from the north) winds and **retreats** with **southerly** winds
- Weak correlation in 2024 due to short-term variability in weather patterns

Bering Sea Ice Thickness

Thoman



- 3rd week of March
- Ice thickness is related to duration or residency of ice over the shelf

Source: Alfred Wegener Institute, https://www.meereisportal.de/en/

Bering Sea Ice Thickness

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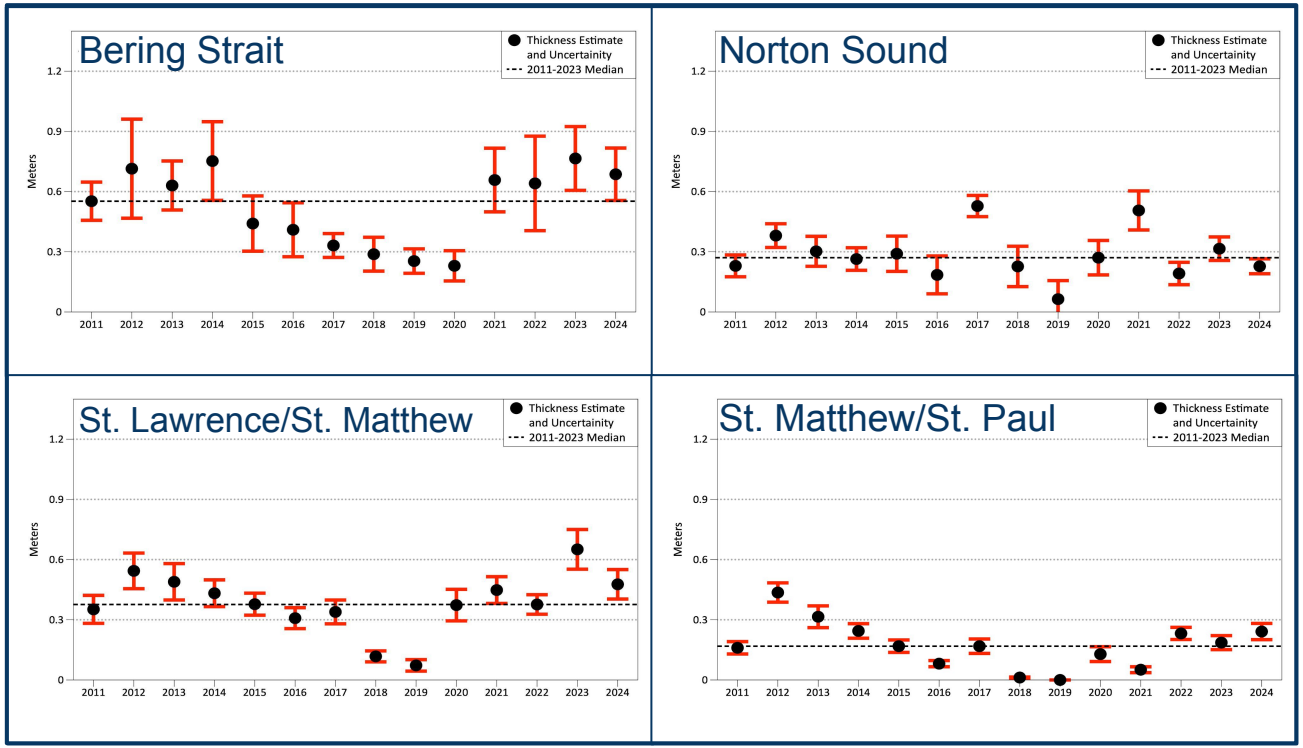

- 3rd week of March
- Ice thickness is related to duration or residency of ice over the shelf
- Sea ice thickness in most regions slightly lower than in 2023

Source: Alfred Wegener Institute, https://www.meereisportal.de/en/

Sea Ice shinyapp

Bak-Hospital

Motivation

- Provide sea ice satellite data for use in fisheries management
- Provide a tool for monitoring real-time sea ice changes

Product:

- Daily sea ice extent time series
- Sea ice extent anomalies
- Data Tables and Plots to download
- Code in R and Python

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Sea Ice shinyapp

Bak-Hospital

PolarWatch
A NOAA COASTWATCH NODE

Sea Ice @ Alaska

Main
Alaskan Arctic
Eastern Bering
Northern Bering
ShinyFIN (SST)
PolarWatch

Sea ice extent in Eastern Bering

Updated on September 06, 2024

The time series plot and data summary below present statistics on sea ice extent within eastern Bering Sea computed from the remote sensing data from NOAA/NSIDC on PolarWatch:

- Mean (1985-2015): Represents the average sea ice extent from 1985 to 2015.
- Upper and Lower Bounds of Error Band (1985-2015): Reflect the uncertainty of the Mean (1985 to 2015).
- Current and Previous Year: Show the daily sea ice extent values for the current and previous year within the area.

Plots are interactive!

- **To zoom in and out, reset or download the plot**, hover on the plot to see the option on the top right corner.
- **To turn on and off data series**, click on the data series title in the legend located below each plot.

On this page

- Daily Sea ice extent time series
- Sea ice extent anomalies
- Data access and method description
- More resources

Sea Ice shinyapp

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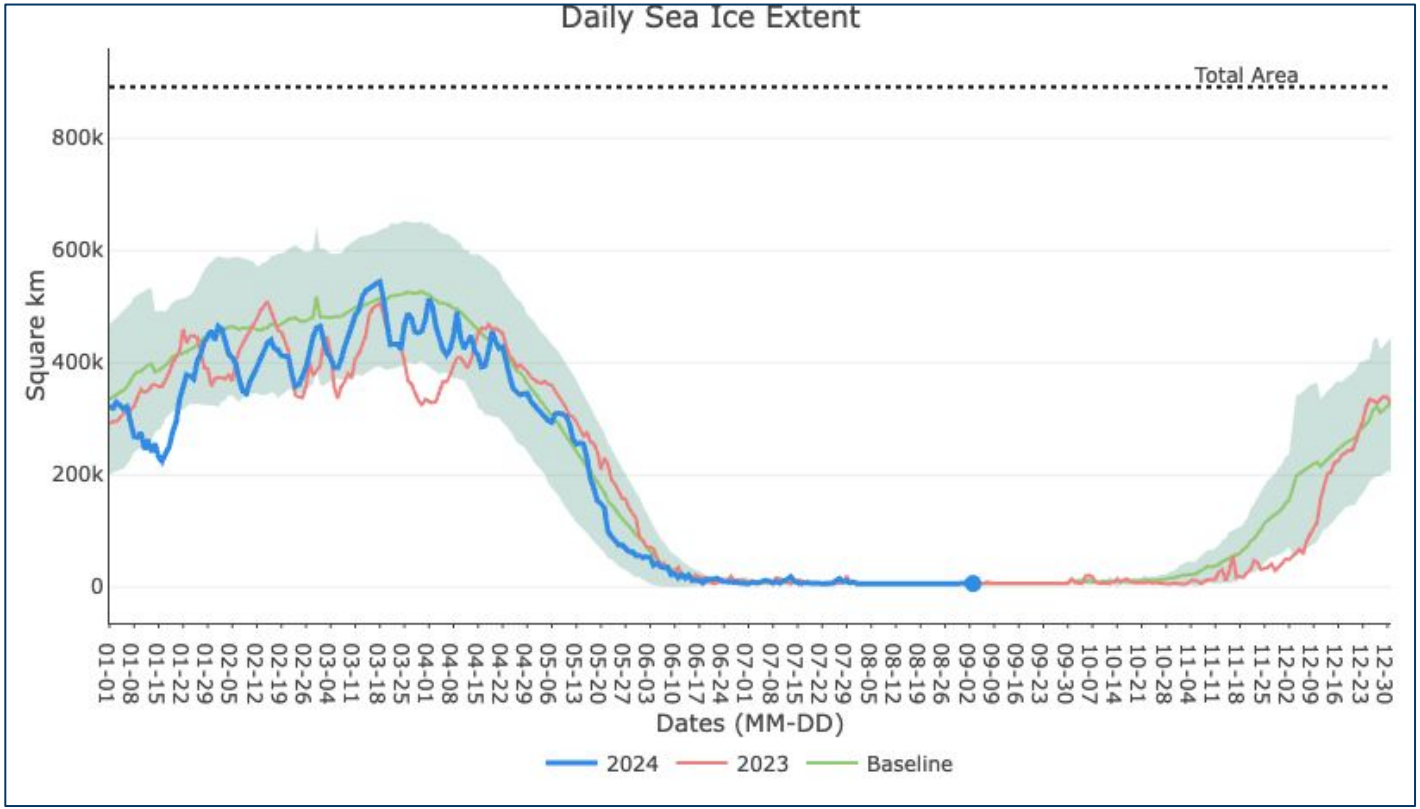

Sea Ice shinyapp

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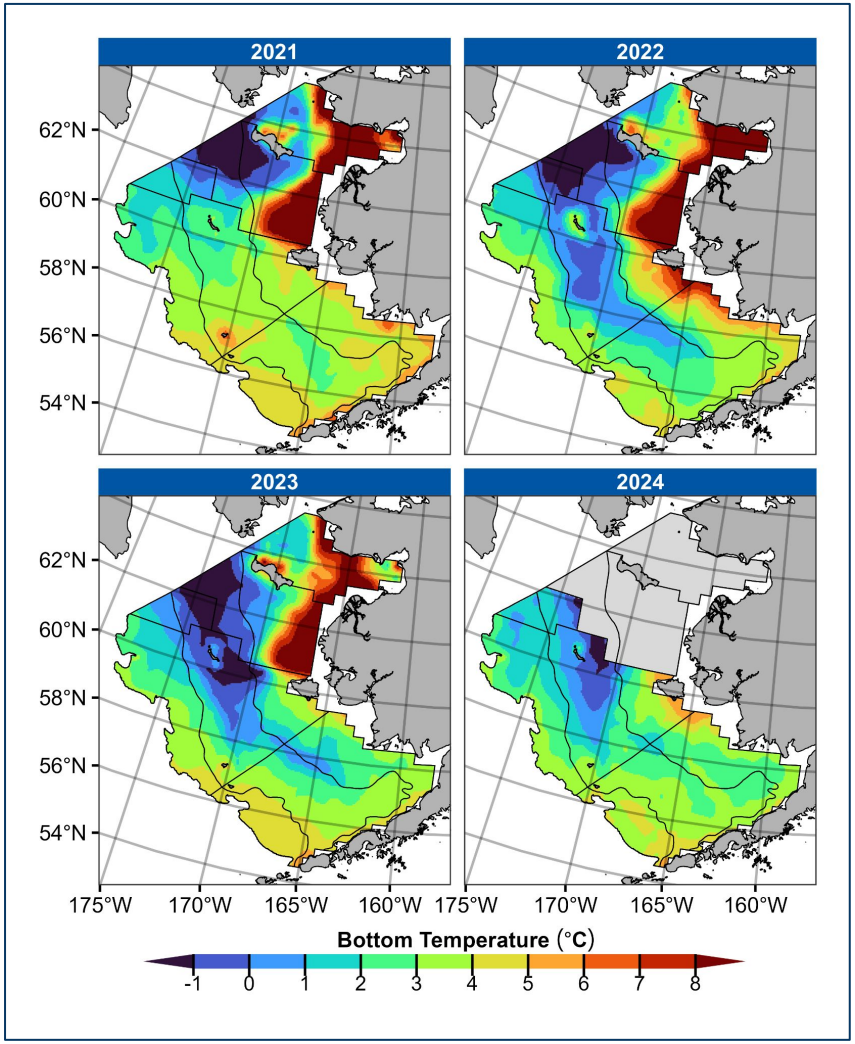
Data access and method description

The chart data is available for download, and the data sources and calculation methods can be found on the methods page:

- Methods
- Daily sea ice extent baseline time series (1985-2015), metadata [.csv format]
- Daily sea ice extent time series (current, last year), metadata [.csv format]
- Daily sea ice concentration satellite data (CDR), metadata [link to data portal]
- Daily sea ice concentration satellite data (Near-Real-Time), metadata [link to data portal]

Cold Pool

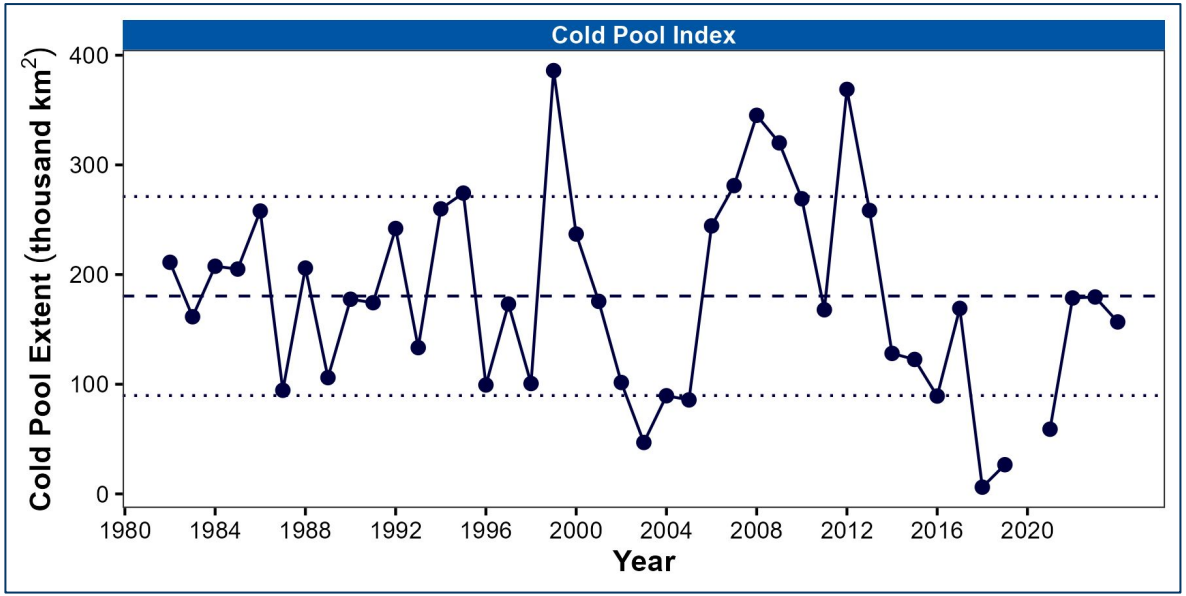
Rohan & Barnett



- 2024 bottom temperatures within the standard grid were near the time series average and slightly warmer than 2023

Cold Pool

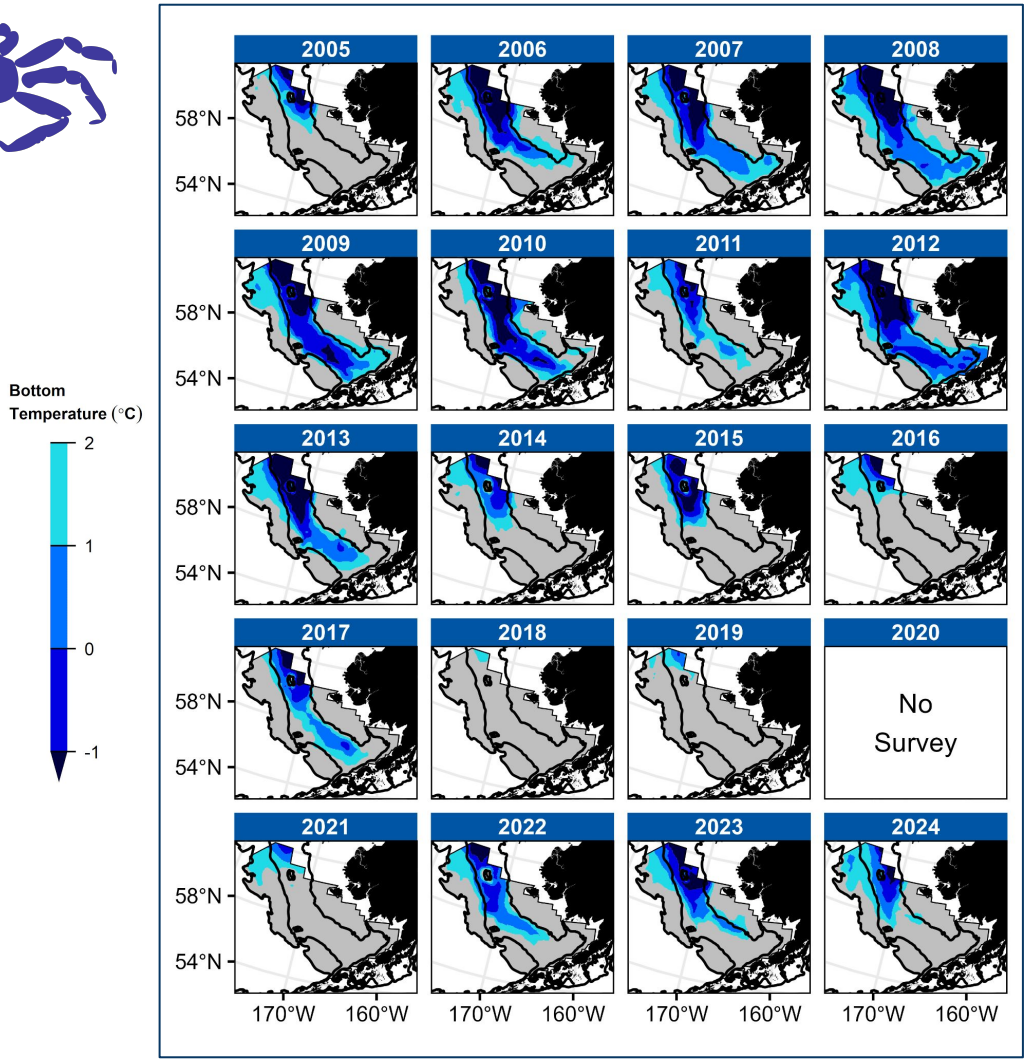
Rohan & Barnett



- 2024 cold pool extent (<2°C; km^2) within the standard grid was near the time series average
- 11% smaller than 2023

Cold Pool

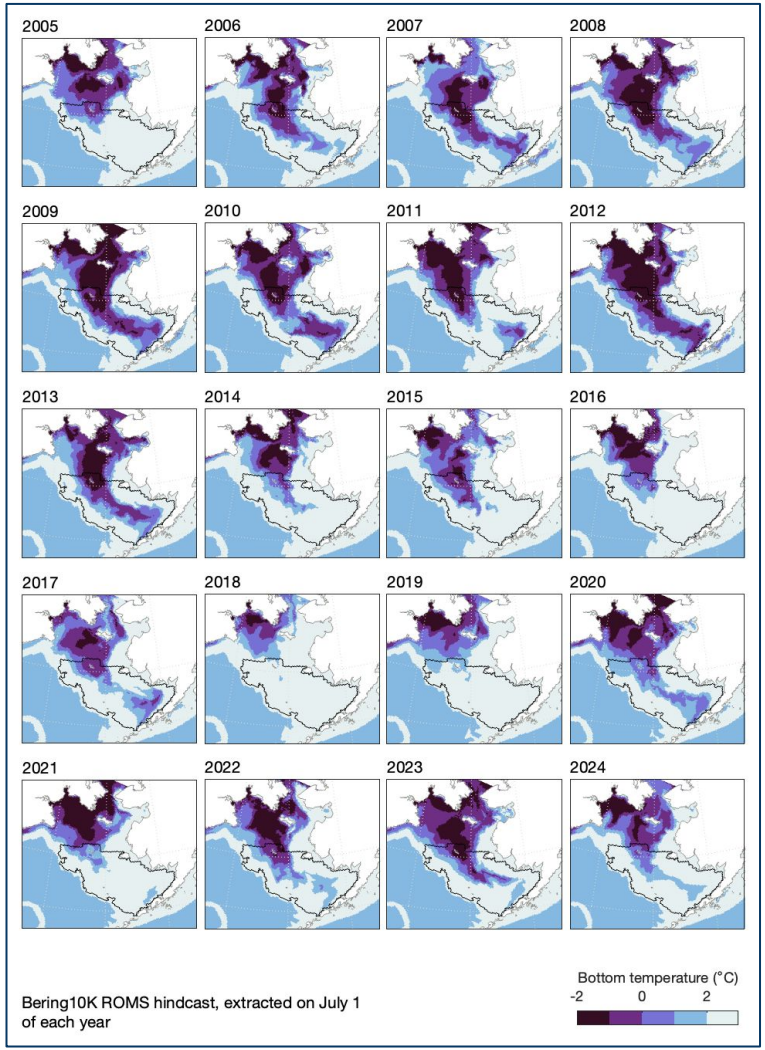
Rohan & Barnett



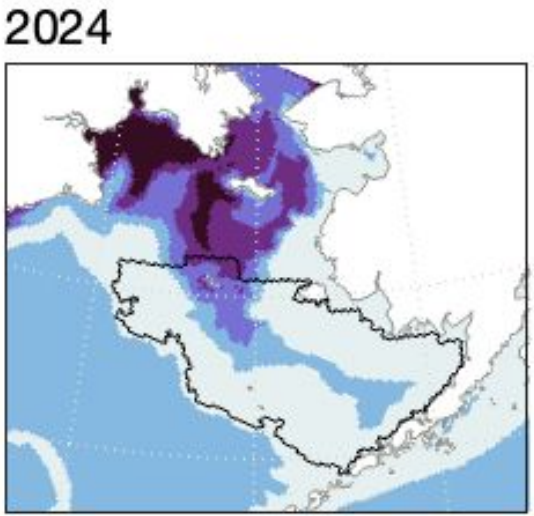
- 2024 cold pool extent (<2°C; km^2) within the standard grid was near the time series average
- 11% smaller than 2023

Cold Pool

Kearney

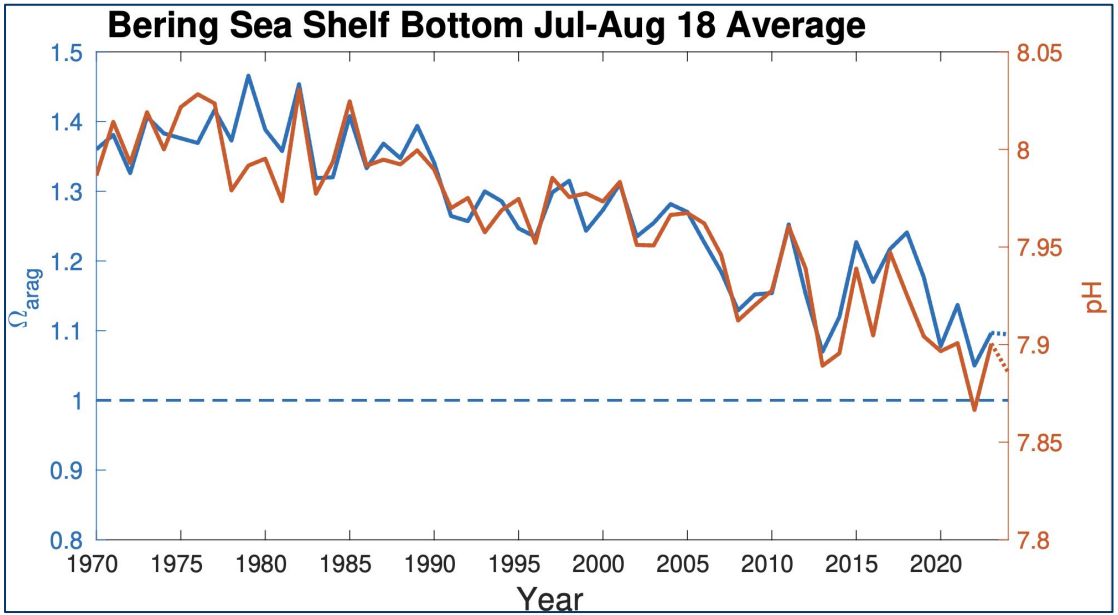


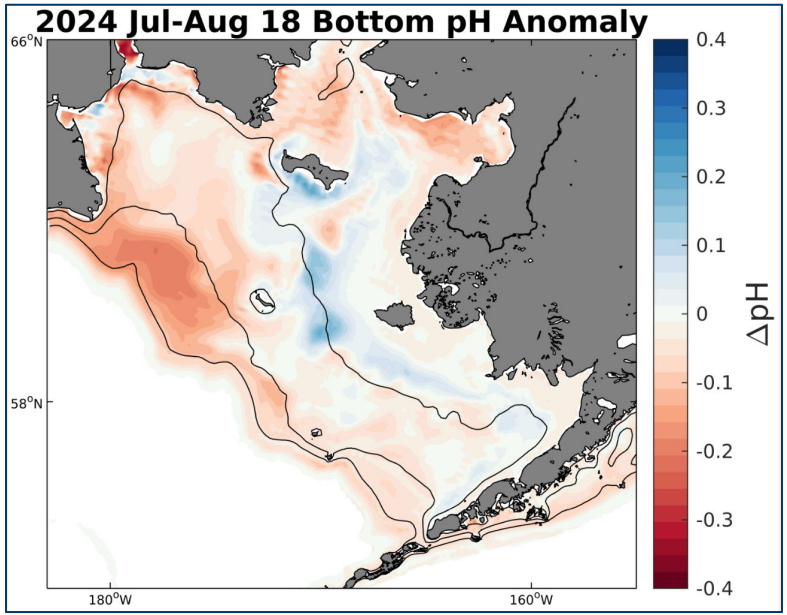
- 2024 bottom temperatures neutral/warm
- Narrow tongue of <2°C water along the middle shelf



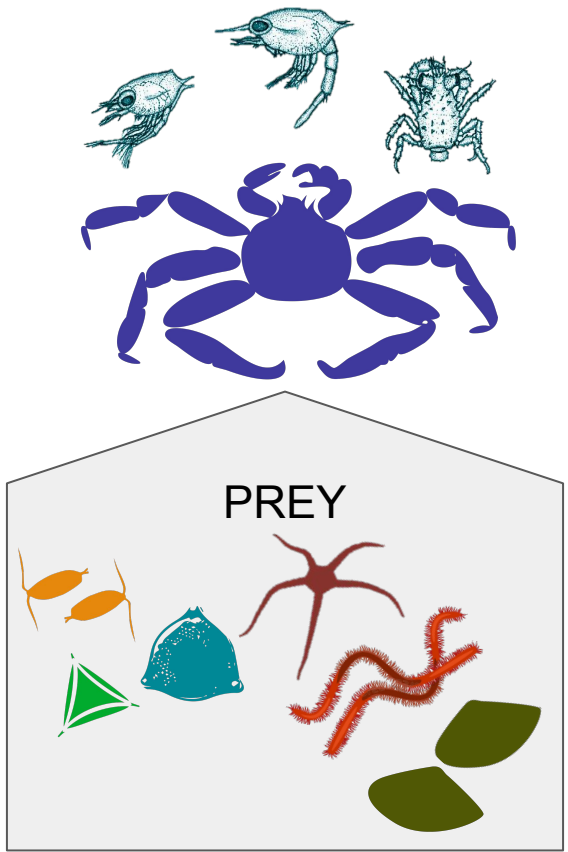
EBS Ocean Acidification

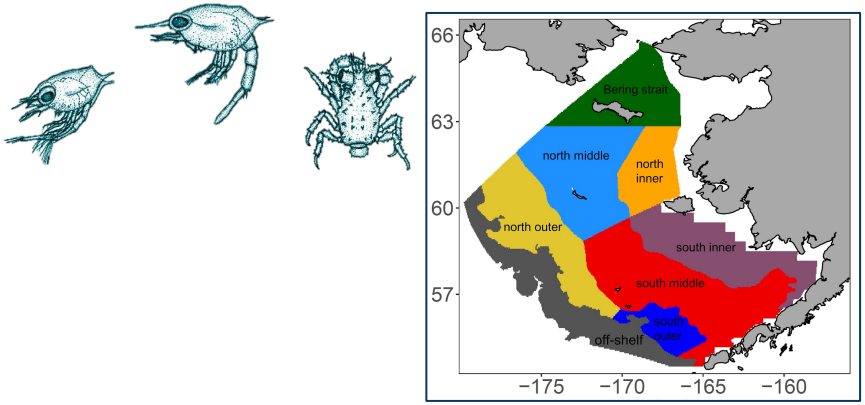
Pilcher & Monacci





- Summer 2024 bottom Ω_{arag} similar to 2023, pH slightly lower
- Multi-year outer shelf low pH anomaly still present, most prominent in northwest
- Bottom waters near 50m isobath have slightly higher pH values

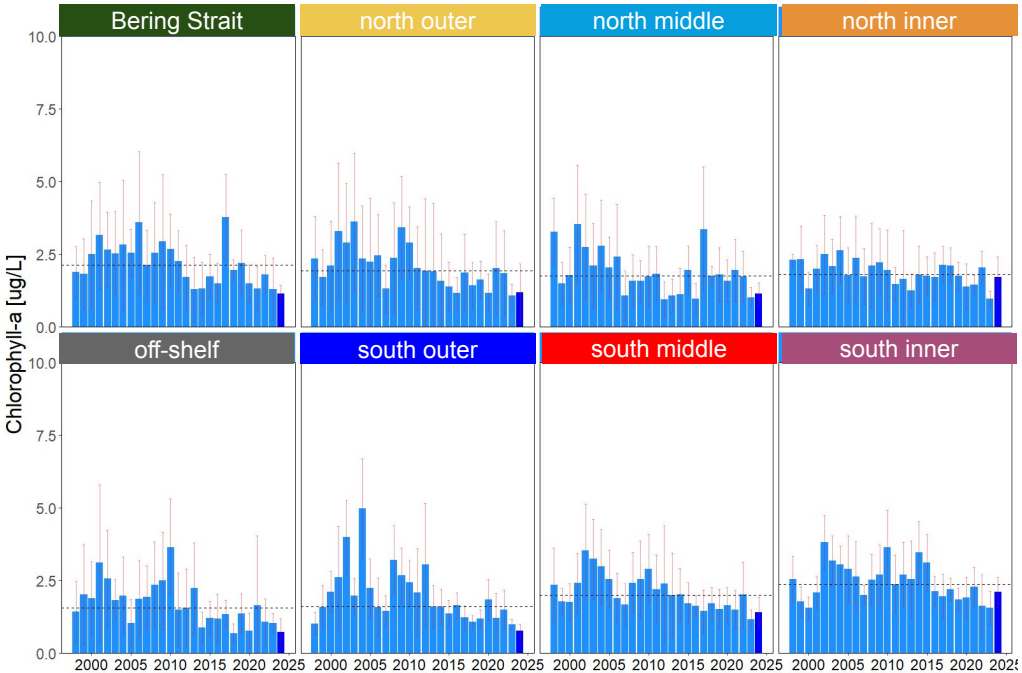

PREY

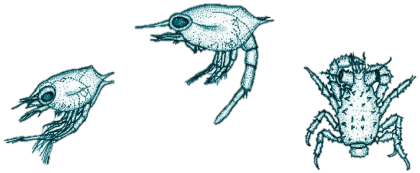


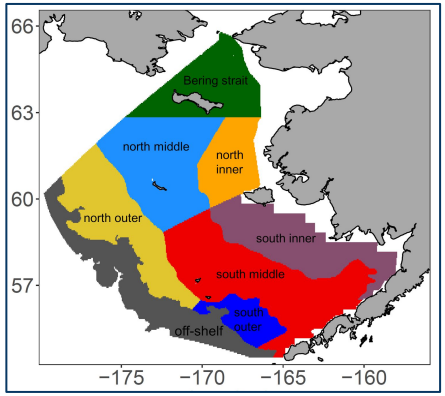
2024 Spring Bloom

Nielsen, Callahan

- *Interpretation based on preliminary data; slight changes could occur after final processing*
- Chl-*a* biomass again below the long term average in some regions; other regions (inner domain) showed increases compared to 2023
- Bloom timing late in most regions; average in the south inner domain







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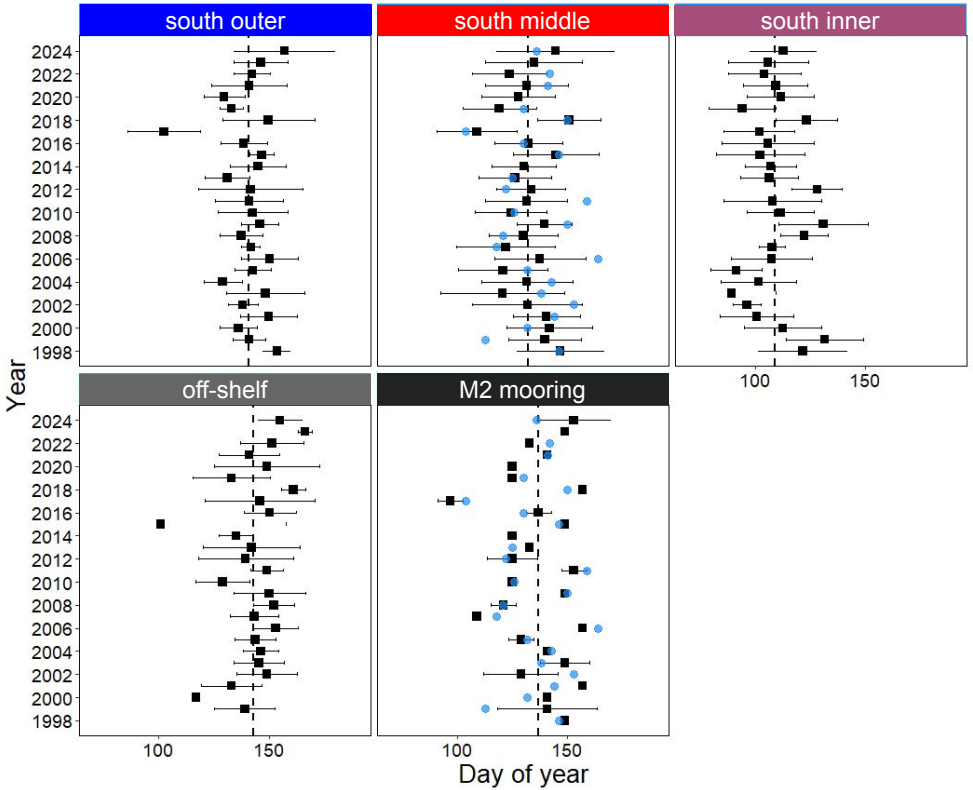
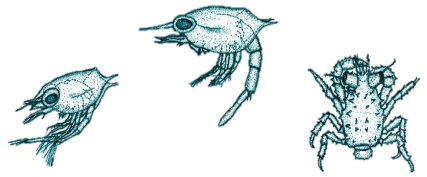
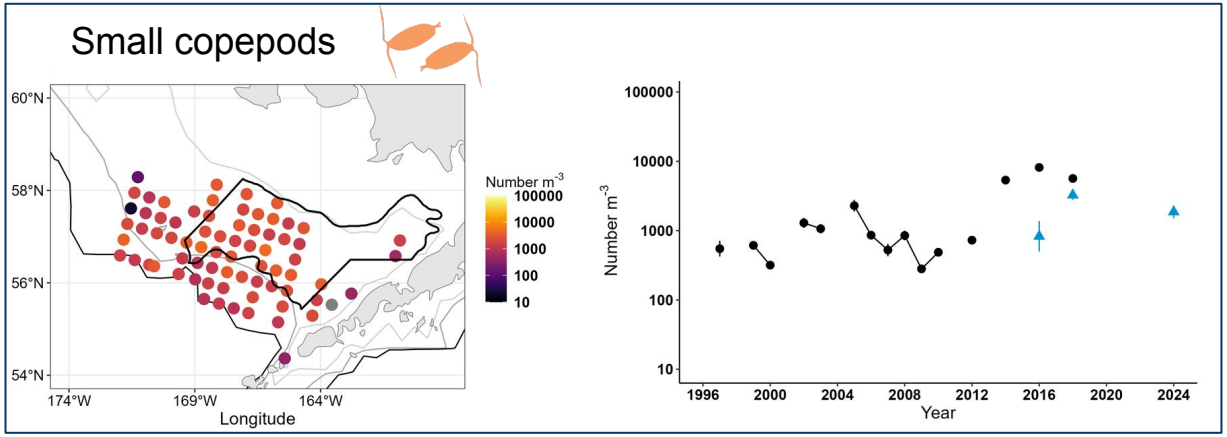
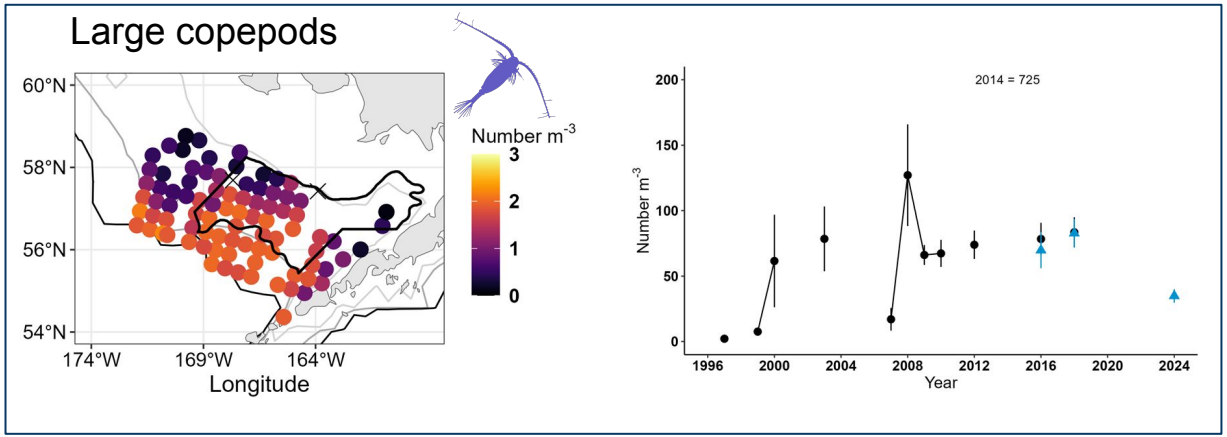


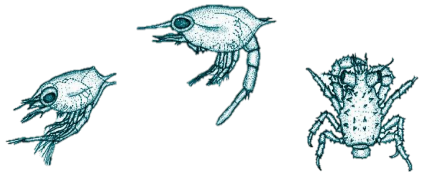


Spring 2024
Rapid Zooplankton Assessment
Kimmel



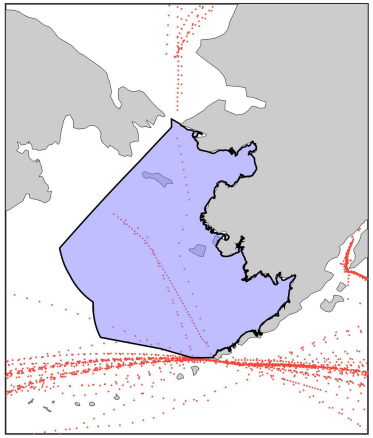


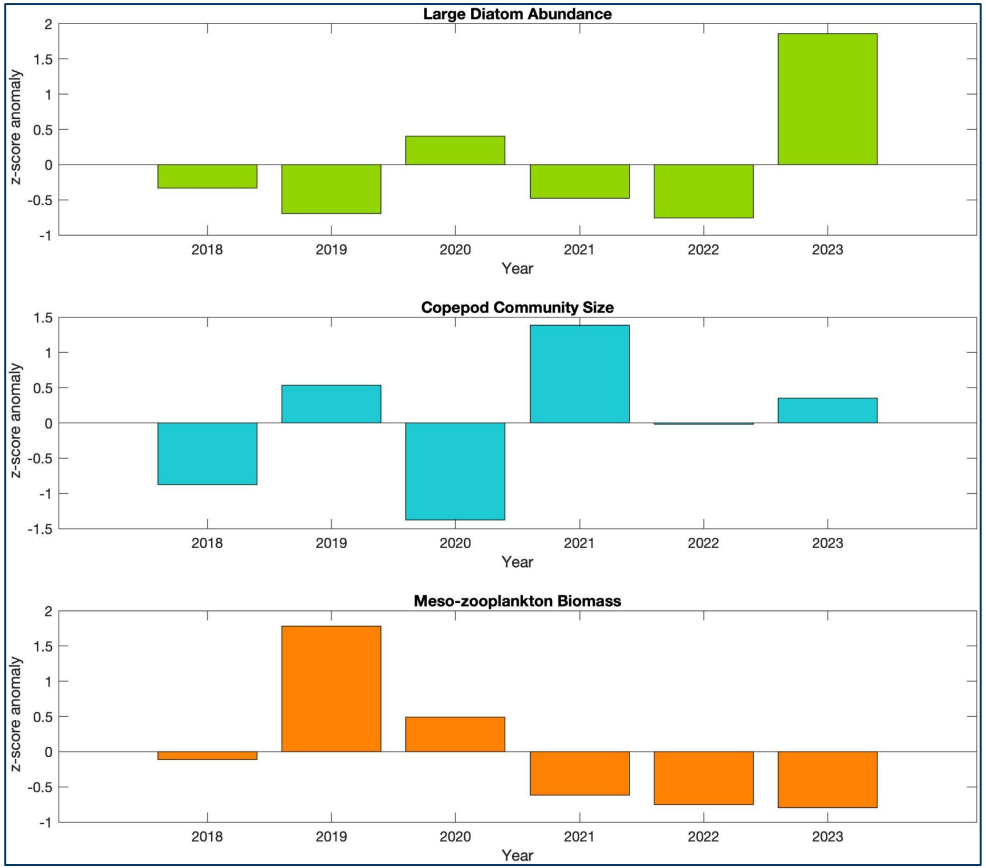
- Small copepod abundances lower than recent warm years, but higher than cold year abundances
- Large copepods low, similar to cold years after warm periods (note map scale is log10)
- Euphausiid numbers (not shown) very low, typical of spring



2023 Continuous Plankton Recorder

Ostle & Batten

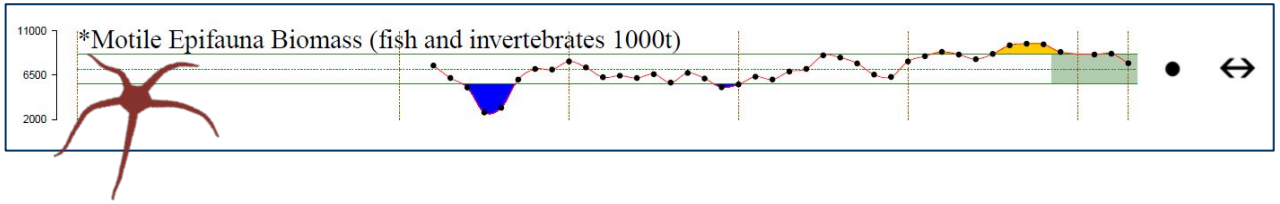


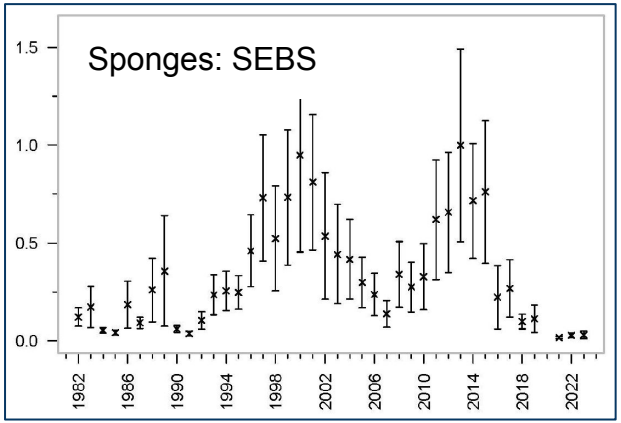


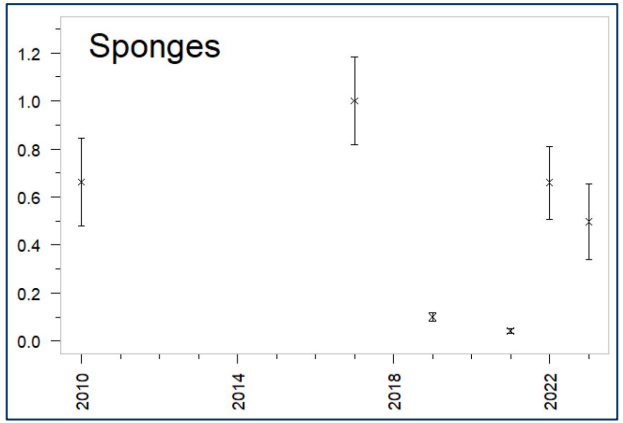
- Diatom abundance was positive in 2023
- Copepod community size was slightly positive in 2023, where it had been neutral in 2022
- Mesozooplankton biomass continued a negative trend since 2019

2023 Echinoderms and Sponges

Whitehouse, Buser

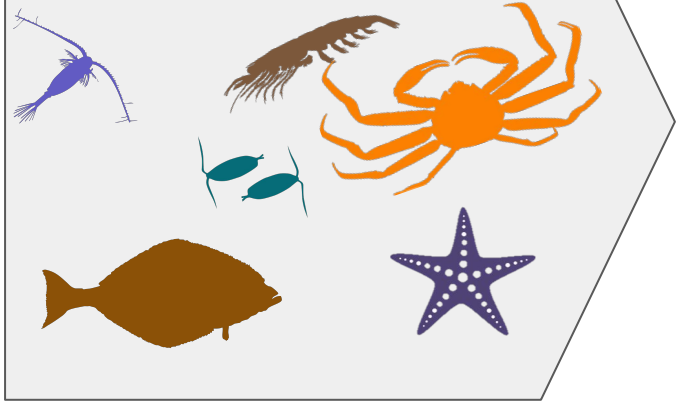


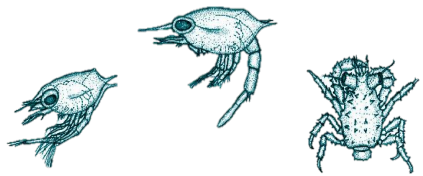


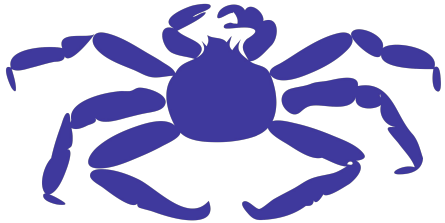


- Echinoderms account for more than 50% of the biomass in the motile epifauna guild
- All remain above their long term means
- Catch rate of sponges in the SEBS continued to be very low in 2023; catch rate in NBS variable, but higher in 2023

COMPETITORS



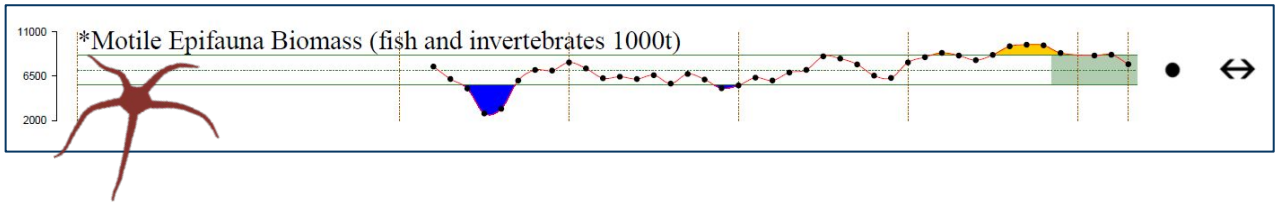


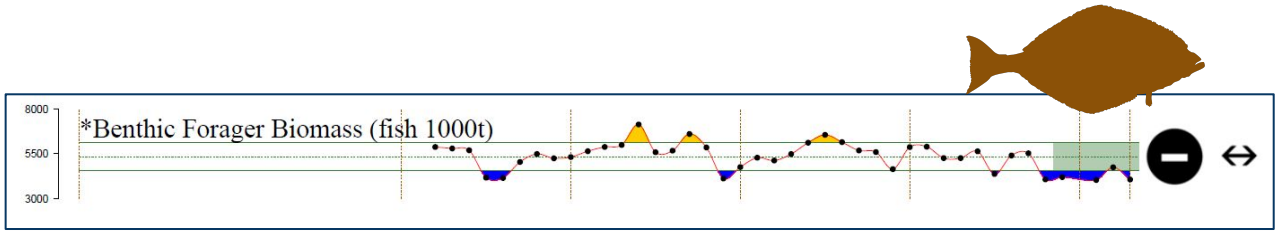


2023 Motile Epifauna and Benthic Foragers

Whitehouse

Motile epifauna and benthic foragers are competitors with benthic crab for prey and space



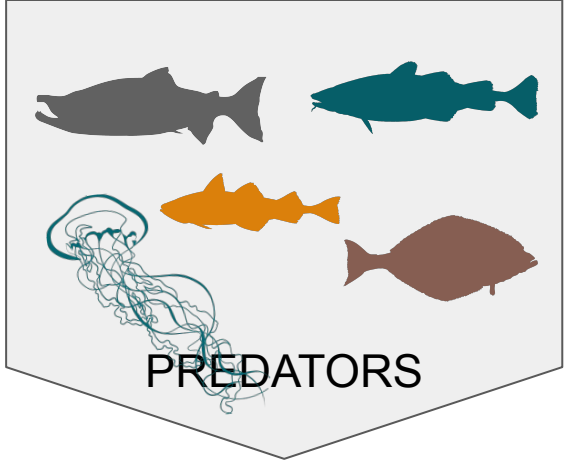


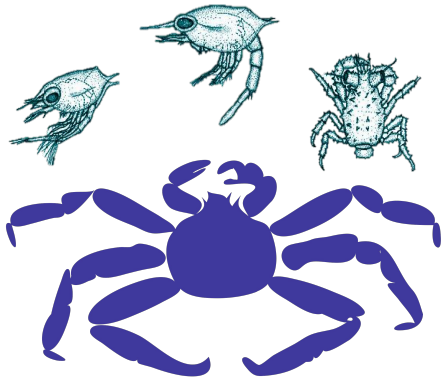
Indicates benthic productivity

- Motile epifauna biomass peaked in 2017 and remains above the long-term mean, but declined from 2022 to 2023

Indirect indicator of infauna

- Benthic foragers biomass decreased from 2022 to 2023 and remained below the long-term mean

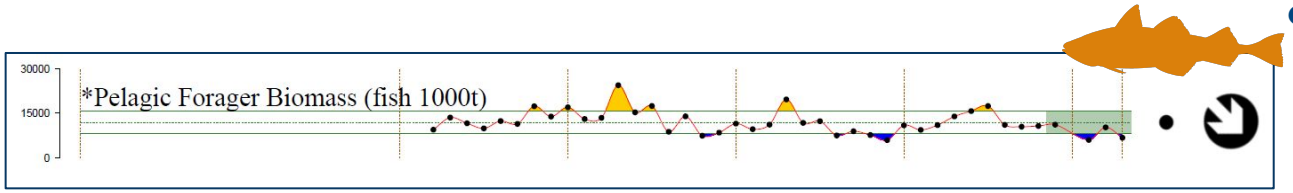

PREDATORS



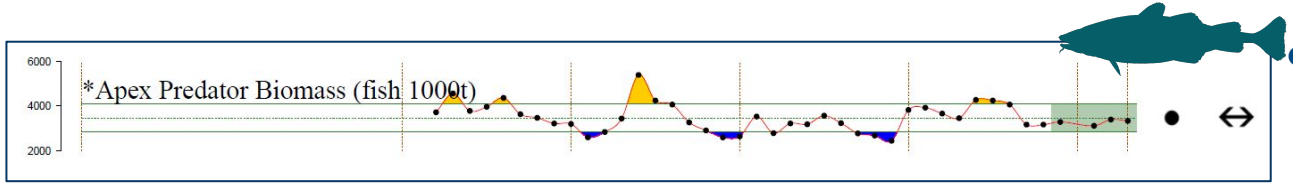
2023 Pelagic Foragers and Apex Predators

Whitehouse

Pelagic foragers are predators of larvae while apex predators consume small benthic crab stages



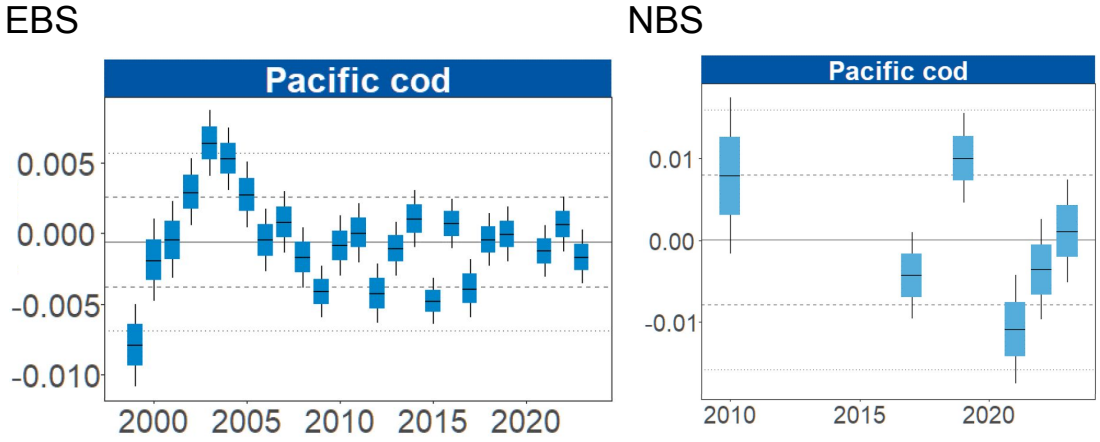
- Pelagic foragers (pollock and herring) decreased from 2022 to 2023 and remained below the long-term mean



- Apex predators (P. cod and ATF) were at their long-term mean in 2023

2023 Adult Pacific Cod Condition

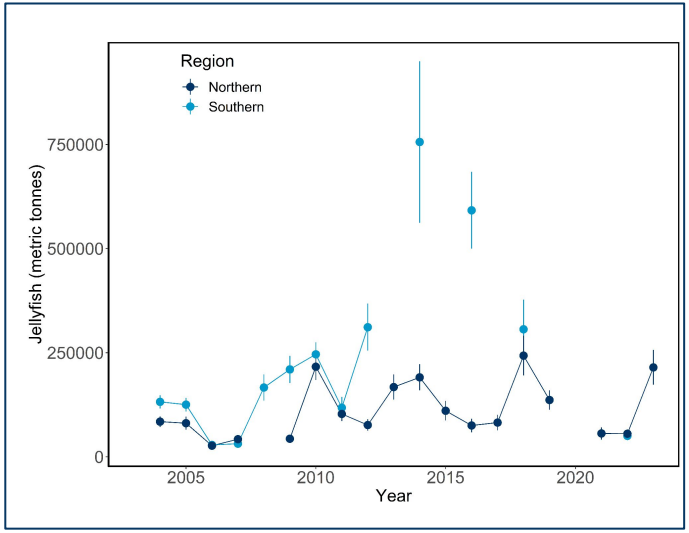
Prohaska & Rohan

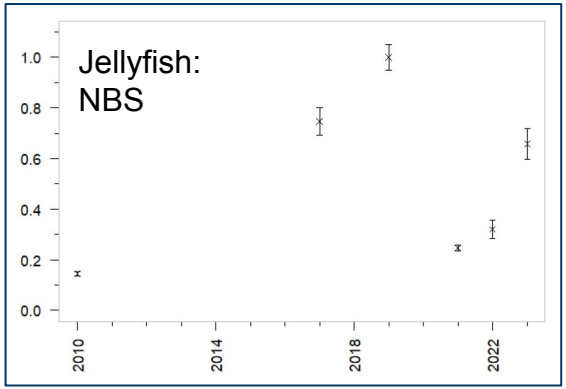


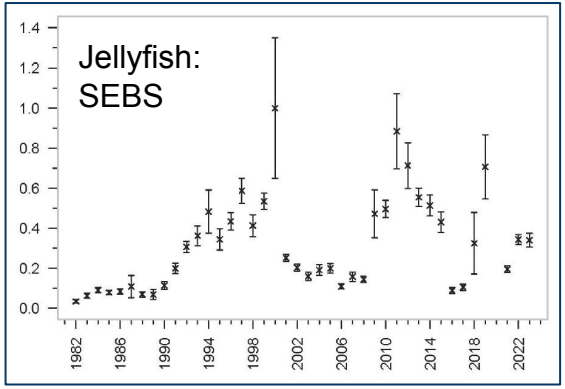
- EBS: PCod condition negative and lower than 2022
- NBS: PCod condition increased from 2022 to 2023

2023 Jellyfish

Yasumiishi, Buser







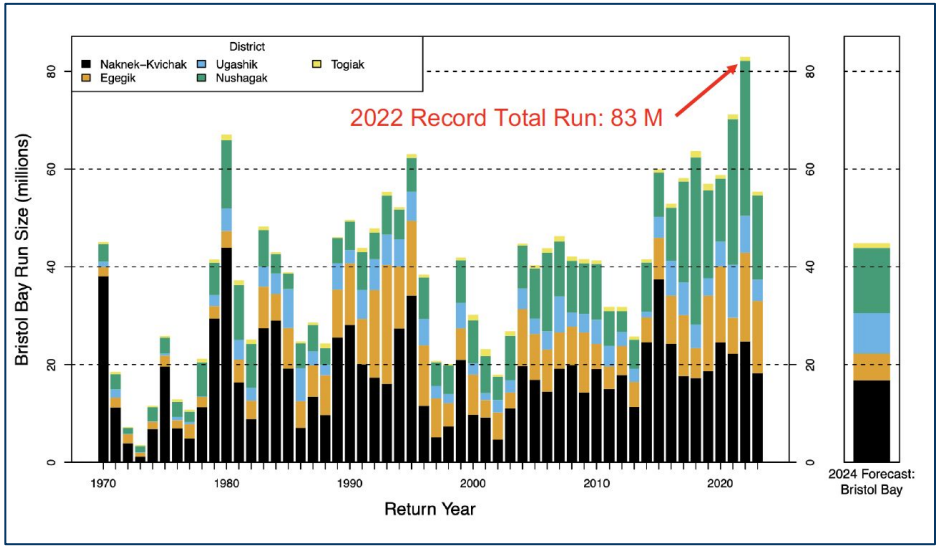
- NBS: Abundance of jellyfish increased
- SEBS: Abundance of jellyfish was average

2024 Bristol Bay Sockeye Salmon

Cunningham

- 2024 forecast of **44.9 million** sockeye salmon is 25% *below* the 10-year average, 10% *below* the 20-year average, and similar to the long-term average (since 1980)

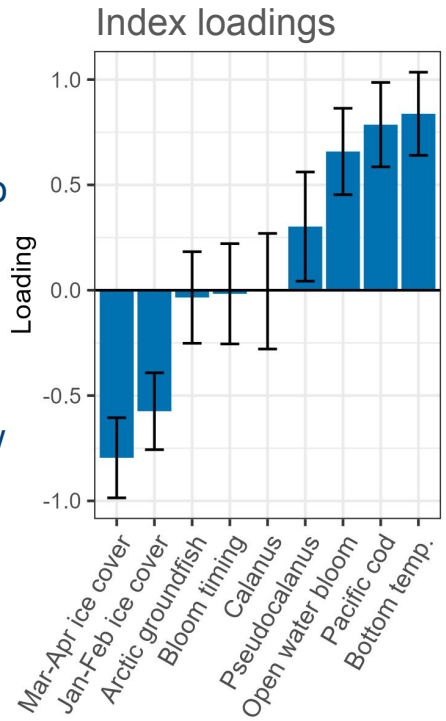
- Juvenile sockeye feed on zooplankton and age-0 pollock in warm years; adults feed on zooplankton and krill

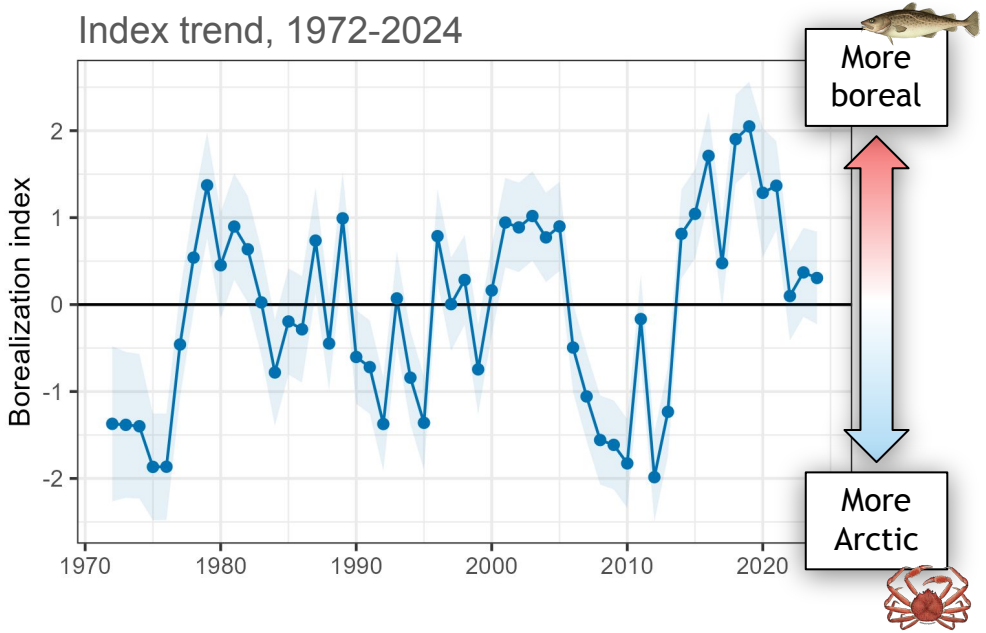


Borealization index

Litzow, Fedewa, Ryznar, Nielsen, Kimmel

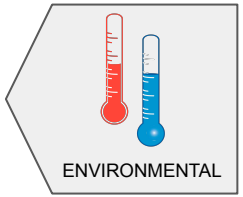
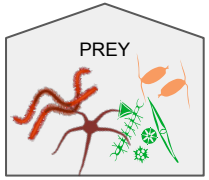
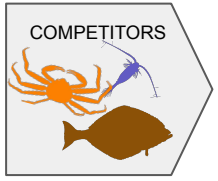
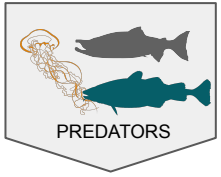
- Calculated for core EBS snow crab range
- DFA summary of 9 physical & biological time series expected to track Arctic -> boreal transition
- Outperforms bottom temperature for predicting annual snow crab abundance
- 2022-2024 values at time series mean





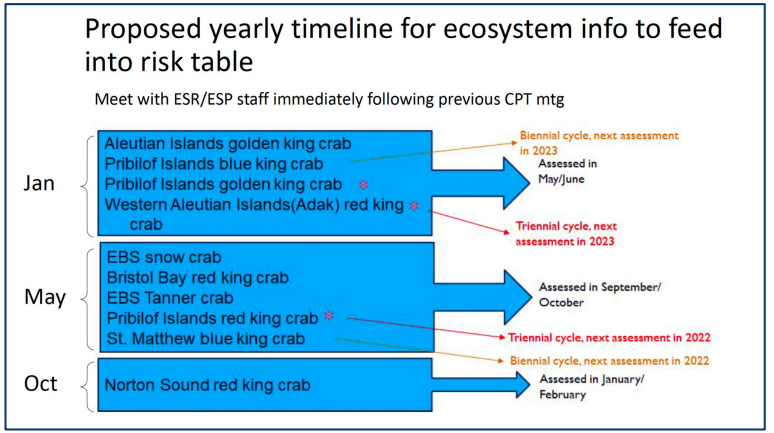
Error bars & ribbon = 95% CI

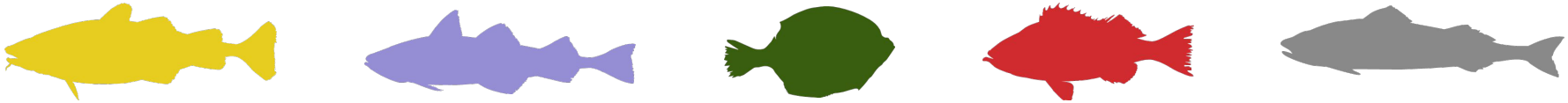
Summary

	• El Niño to La Niña transition • Continued average SST conditions • Impact of variable winds unknown • OA trends concerning, though not considered to be driving crab declines	• El Niño to La Niña transition • Average BT and cold pool extent • OA trends concerning, though not considered to be driving crab declines
	• Continued low chl-a biomass; increases in inner domain • Impact of late bloom timing unknown • Moderate small copepod abundance; low large copepod & euphausiids	• *Indirect* measurement based on 2023 benthic forager guild indicates continued low availability • Echinoderms above their long-term means; sponges low in 2023
	• Moderate/low abundance of zooplankton	• Motile epifauna decreased in 2023 • Benthic forager guild remained low in 2023
	• Pelagic fish foragers decreased in 2023 • Jellies average in SEBS; increased in NBS in 2023 • 2024 Bristol Bay sockeye salmon similar to the long-term average (since 1980)	• Predators of benthic crab were at their long-term mean in 2023 with mixed trends in condition of Pacific cod between the SEBS and NBS

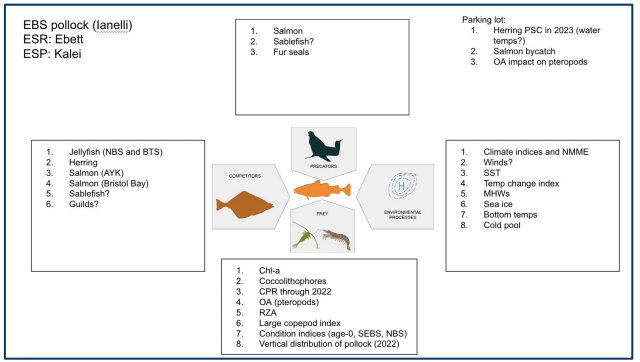
Risk Tables for crab assessments

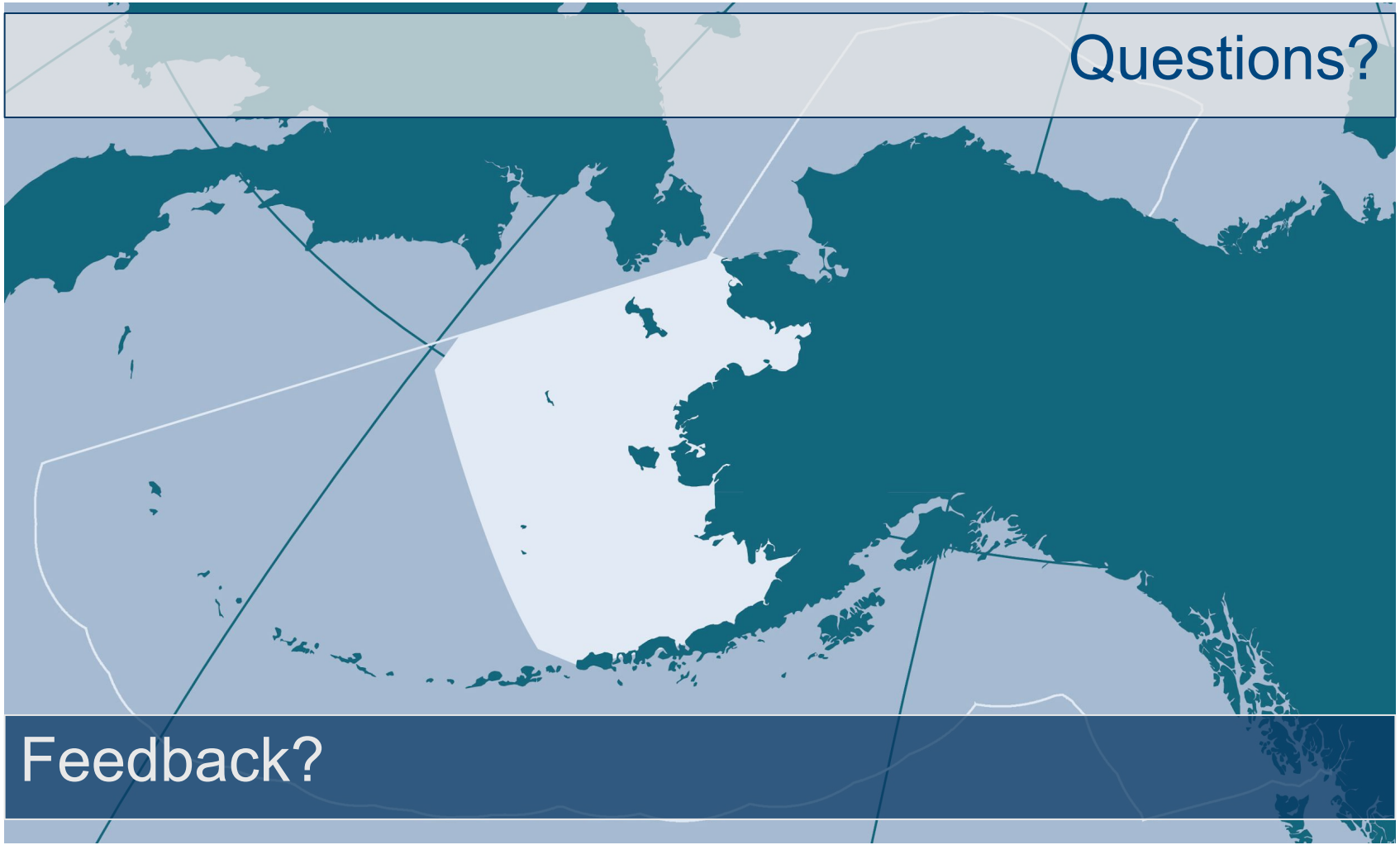
"The presenters suggested a proposed timeline for assessment authors to meet with the ESR/ESP group for information on the ecosystem category which aligned with the CPT meeting where proposed models for that stock were considered."
[CPT Report January 2024]





- Conducted for all Full & Update assessments
- Meet with each assessment author to review relevant ecosystem information
  - ESP lead joins for stocks with ESPs
- Write-ups and recommendations provided to assessment authors




Questions?
Feedback?