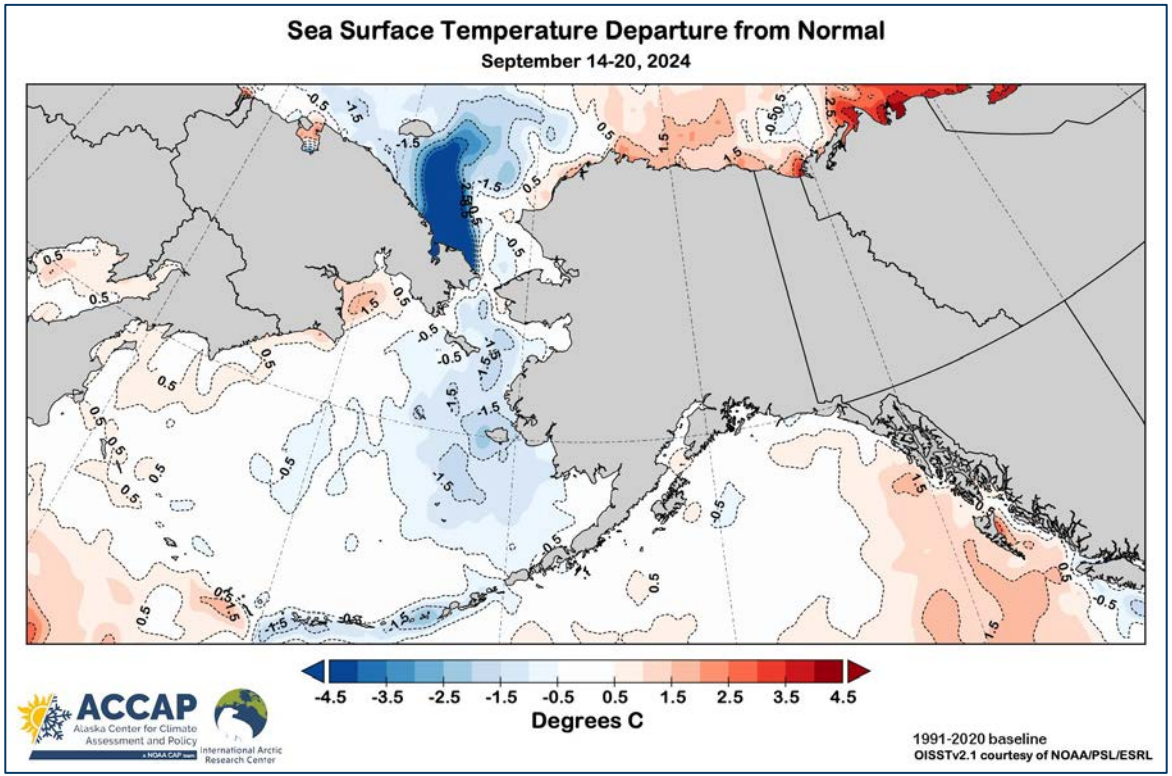
ECOSYSTEM STATUS REPORTS

Scientific & Statistical Committee
September 30, 2024

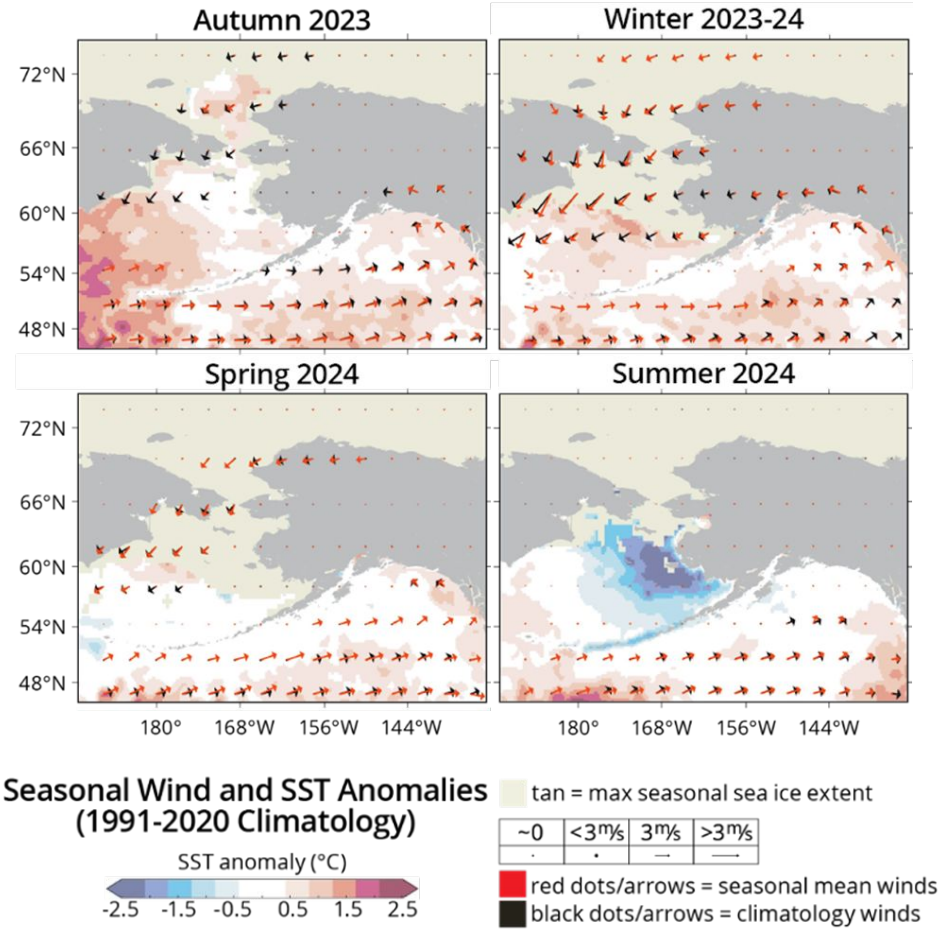
Elizabeth Siddon
Ivonne Ortiz
Bridget Ferriss
Stephani Zador



- Alaska-wide climate overview
- 2024 Previews
    - Gulf of Alaska
    - Aleutian Islands
    - Eastern Bering Sea
- AI crab-relevant ecosystem indicators
- EBS crab-relevant ecosystem indicators

Alaska-wide Climate Overview

Lemagie



- **Autumn**: Warm SST anomalies from El Niño conditions
- **Winter**: Remnant warm SST anomalies with strong winds from the arctic and sea ice near long-term mean
- **Spring**: General cooling throughout Alaska with winds from the arctic keeping sea-ice over the eastern Bering Sea. Continuing eastward winds south of the Aleutians generating southward currents opposing typical northward flow through eastern passes and warm SSTs in Gulf of Alaska
- **Summer**: weakened winds from arctic, strengthening winds from the North Pacific but still mostly eastward with warming along southern margins: Western Aleutians and eastern Gulf of Alaska

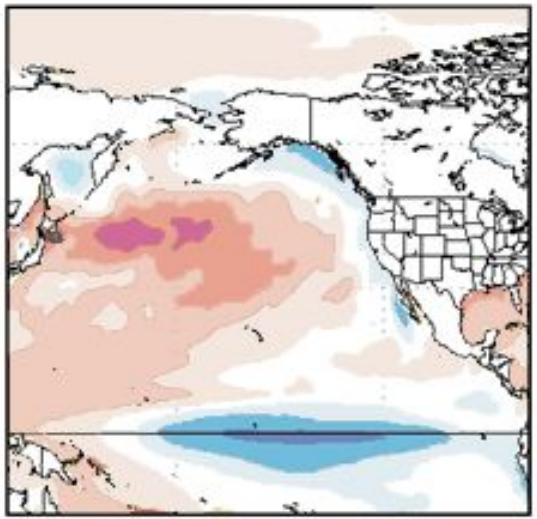
NOAA FISHERIES

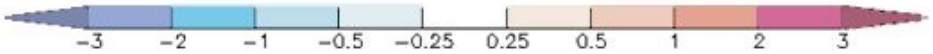
Alaska-wide Climate Overview

Lemagie

The North Pacific started 2024 under El Niño conditions, transitioned to current neutral conditions, and is expected to move to weak La Niña by mid-Fall

Jan - Mar 2025





- ENSO-neutral continued through August, with La Niña favored to emerge during September-November (71% chance) and persist through winter 2024-25
- Jan-Mar 2025: near-normal SSTs predicted across most of Alaska's marine ecosystems with cool anomalies expanding from EGOA into WGOA in spring 2025 and some warm waters persisting in WAI

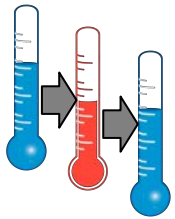
Full **ESR Climate Update** presentation to the September 2024 Groundfish Plan Teams is available at:

ESR Climate Update

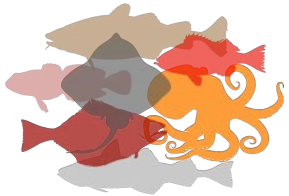
- Alaska-wide: slides 3-22
- Aleutian Islands: slides 23-31
- EBS: slides 32-42
- GOA: slide 43-51

2024 GOA Preview

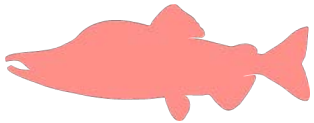
Bridget Ferriss



- Strong El Niño but moderate response in the GOA
- Shift in multiyear pattern:
  - 2020-2023: average/cool ocean temperatures
  - 2023/2024 warm winter (WGOA)/ year (EGOA)
  - 2025 predicted to cool



- No known concerns for groundfish environment and prey base **given data so far**



- Pink salmon unexpected low returns across GOA except southeast AK

2024 AI Preview

Ivonne Ortiz

Sea Surface Temperature (SST)

- Among ten warmest winters on record (s.28)
- Cooling in spring and summer with near/ long-term mean SST except WAI (s.30)
- Sustained SST above average across AI for last 10 years (s.31)

Bottom Temperature (BT)

- Cooler than past years, near or below 1991-2012 mean (s.35 updated since CPT)

Cooling in current year offers a reprieve from past years with sustained warmer SST, BT which may have longer impacts on phenology, productivity

Transport

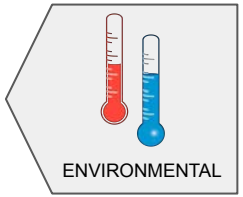
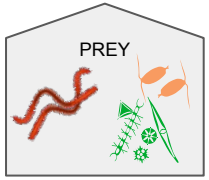
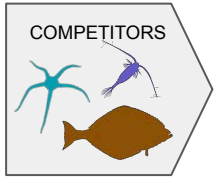
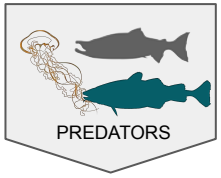
- WAI: Above long-term mean beginning 2024 (s.37)
- Currently near or below long-term mean throughout the chain (s.36, 37)

Likely lower than average volume, heat, salt and nutrient fluxes to the Bering Sea

- No generalized concerns for northern rockfish, skates or arrowtooth (with data so far) but for NRKF lowest condition on record (below one std. dev. of long term mean), new info for SSC.

Aleutian Islands crab-relevant indicator summary

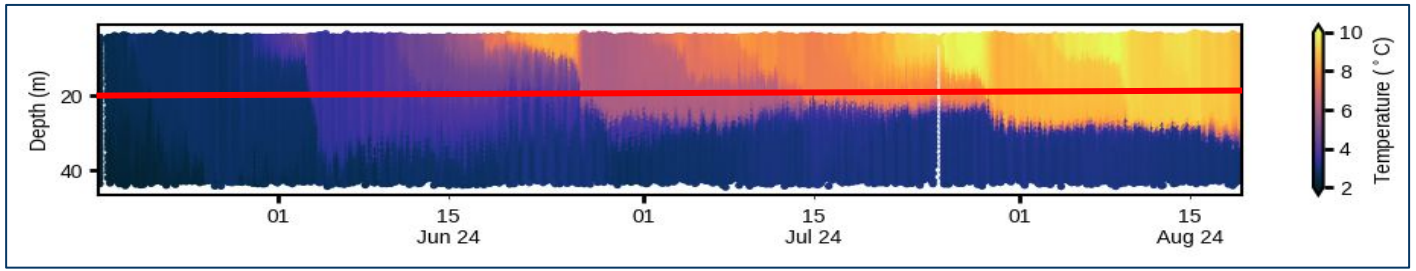
purple indicates updated since CPT with 2024 data
s. # indicates slide number in this presentation
GPT s. # indicates slide number in GPT climate update

	• El Niño to La Niña transition (GPT s.7-22) • SST cooled to average conditions (s.27-32) • Consistent eastward winds would advect larvae in shallow depths towards the east and south (s.36)	• El Niño to La Niña transition (GPT s.7-22) • Bottom temp. near or below 1991-2012 mean (GPT s.28)
	• Higher small copepod abundance in 2023 (s.39)	• unknown trend in invertebrates (s. 41)
		
	• Potential increase of jellyfish (s.44)	(s. 43, 45-46) • 2% increase in Pacific cod biomass (BTS) • stable Irish Lord sculpins but low overall biomass • Continuing high abundance of rockfish that don't feed on golden king crab

2024 EBS Preview

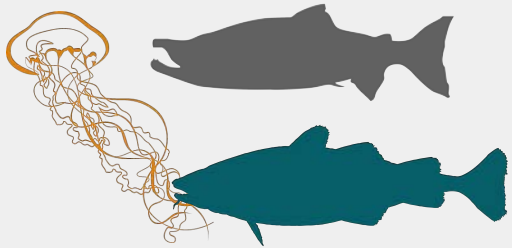
Elizabeth Siddon

- Oceanographic conditions near long-term averages
  - more on this during the crab-focused slides
- Cooler SSTs due to deep mixed layer
  - implications for productivity?

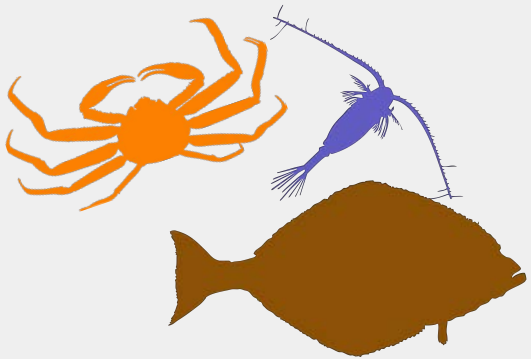


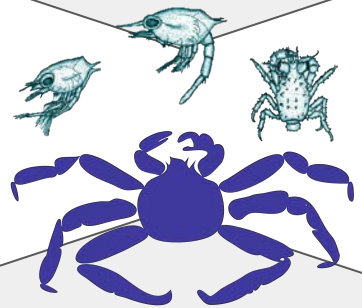
- Ecosystem response to cooler conditions?

PREDATORS

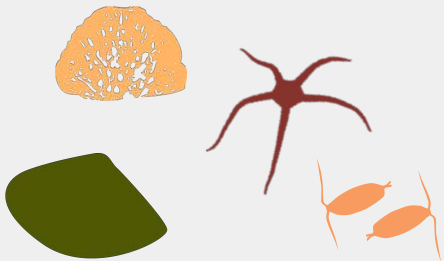


COMPETITORS

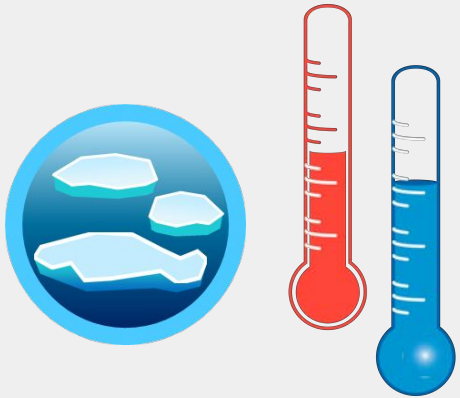




PREY



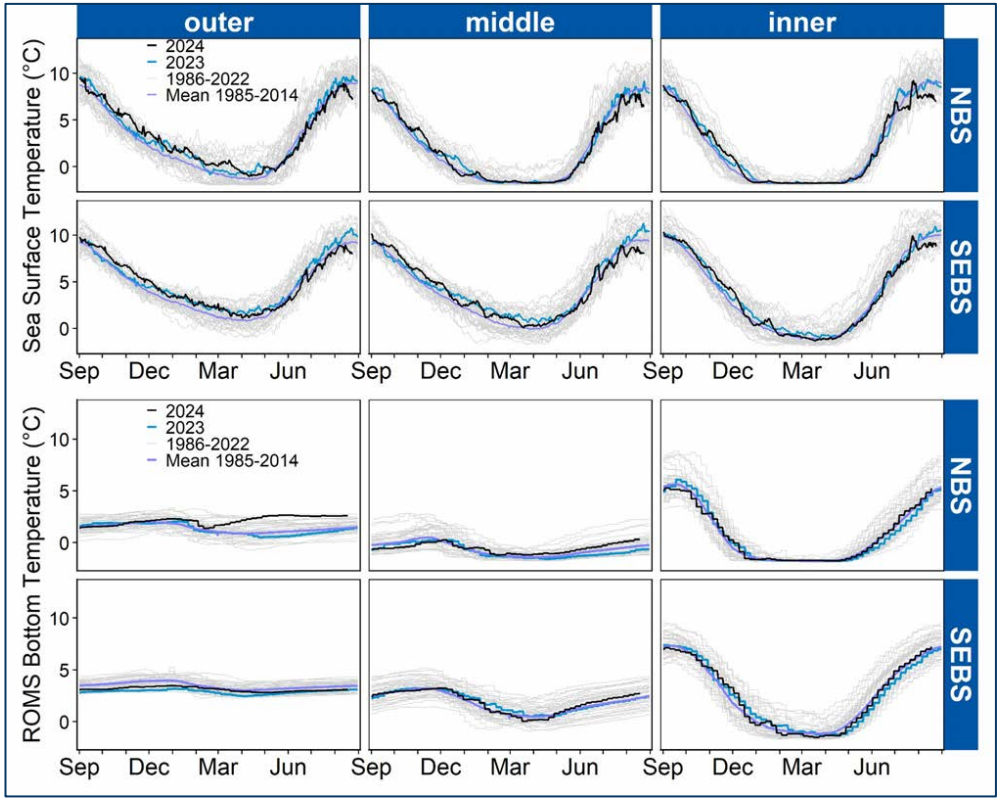
ENVIRONMENTAL PROCESSES



Environmental processes

Broad-scale climate patterns reflect a transition from El Niño to La Niña.
Strength and location of the ALPS were near historical means.
Short-term variability in weather winter patterns; persistent summer storms.

ESR Climate Update (slides 3-22)



- MHWs brief and infrequent since 2021
- SSTs were warm in the outer domain fall 2023 → spring 2024
- SSTs near the long-term mean in all regions by summer 2024
- Unusually warm bottom temperatures in the NBS outer domain since spring 2024 (intrusion of shelf water?)

Callahan & Lemagie (slides 54-58)

Environmental processes

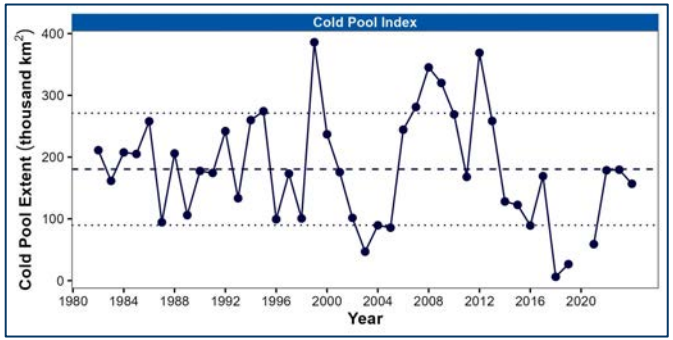
Delayed sea ice growth in fall 2023.
Highest May ice extent since 2013.
2024 cold pool near historical average.

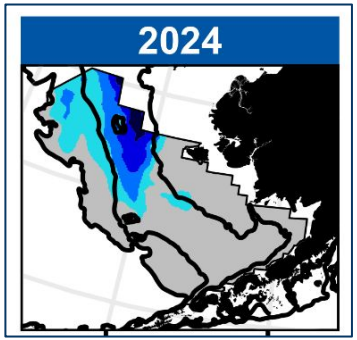
- Early season ice extent has decreased 63% since 1979
- Sea ice “wiggles” in winter due to short-term variability in weather patterns
- Ice thickness at or above average (2011-2024); slightly lower than 2023

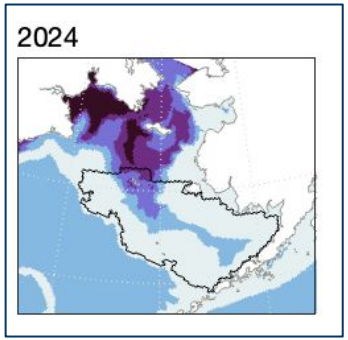
Thoman, Hennon (slides 59-63)

- New [sea ice shinyapp]

Bak-Hospital (slides 64-68)







- 2024 cold pool extent was near the time series average (std grid; 1982-2024)
  - Narrow tongue of <2°C water along the middle shelf (ROMS model)

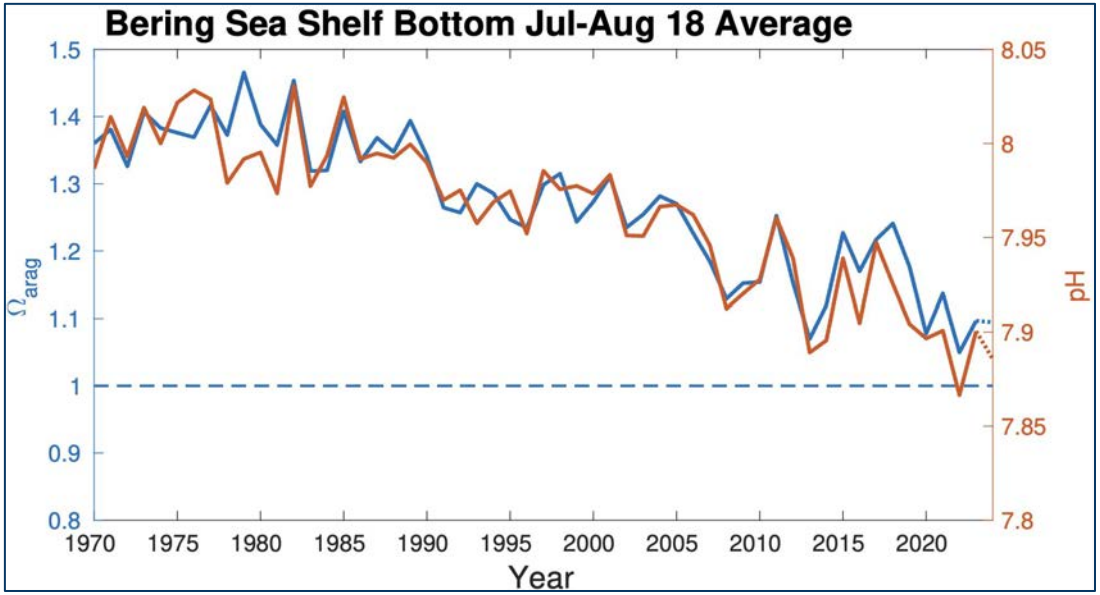
Rohan & Barnett, Kearney (slides 69-72)

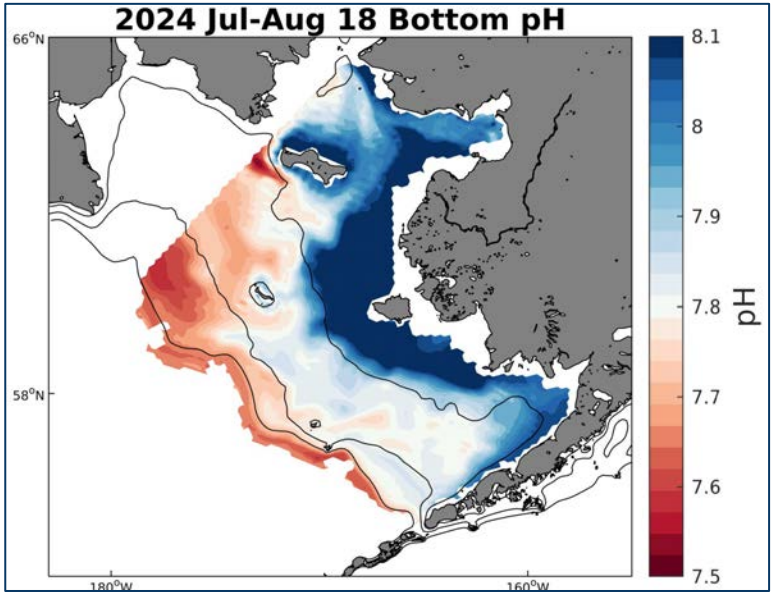
Environmental processes

Expansion of corrosive bottom water conditions
experimentally shown to negatively impact pteropods and red king crab.
Snow crab appear resilient to OA; Bristol Bay nearshore regions appear buffered.

- Summer 2024 bottom Ω_{arag} similar to 2023, pH slightly lower
- Inner domain and Bristol Bay relatively well buffered (pH>7.8)
- Slope waters and northwest shelf pH<7.8

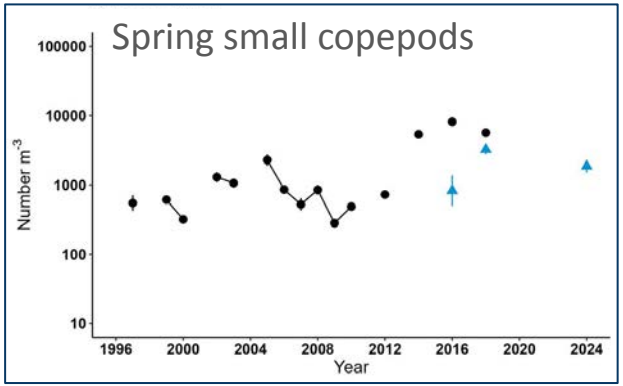
Pilcher & Monacci (slide 73)

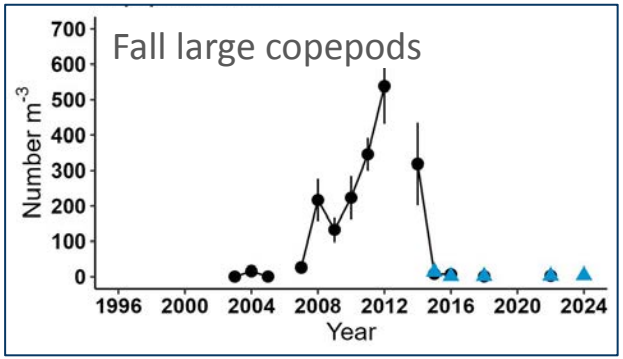




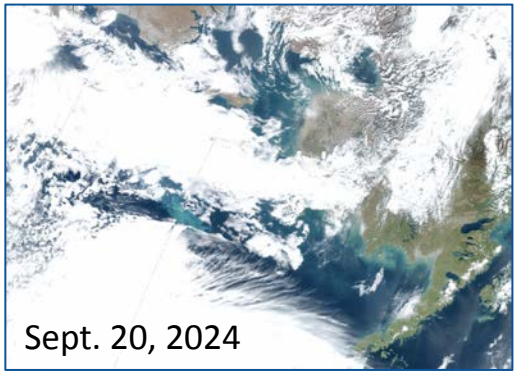
Prey

Prey conditions for pelagic crab stages buoyed by small copepods; current phytoplankton bloom may provide fall productivity boost.





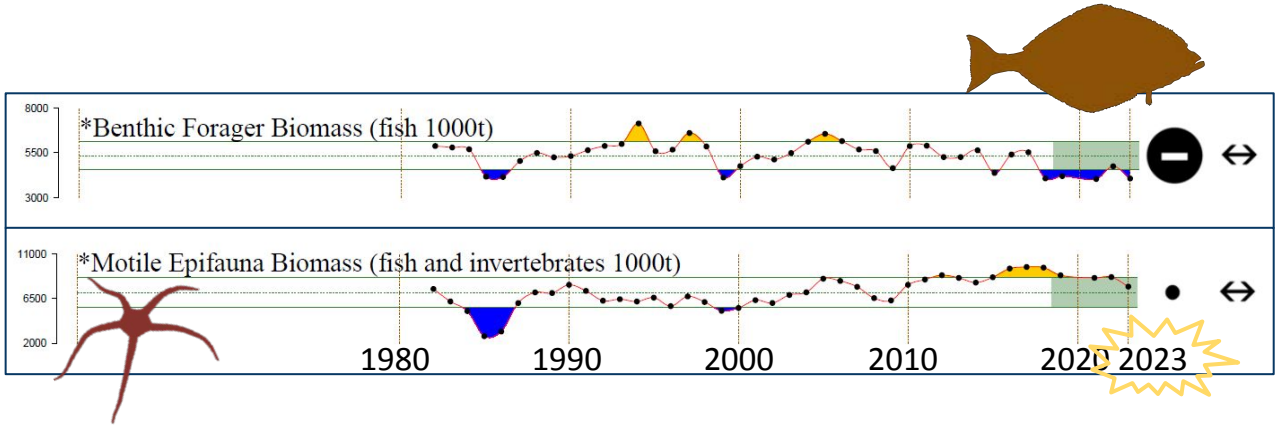
- Spring: small copepod abundances were moderate; large copepods and euphausiids were low — Kimmel et al. (slide 77)
- Fall: small copepod abundances remained moderate; large copepods were very low; observed many euphausiids — Kimmel et al. (new since CPT)
- Large fall phytoplankton bloom; potential coccolithophore bloom

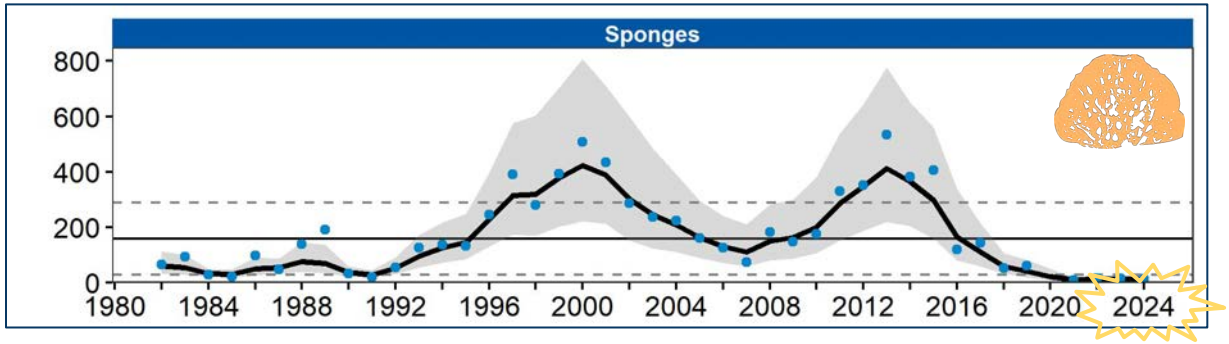


New since CPT

Prey

Prey conditions for benthic crab stages appear mixed over the southern shelf





- *Indirect:* Benthic forager biomass remained below the long-term mean in 2023

  Whitehouse (slide 81)

- Echinoderms account for more than 50% of the biomass in the motile epifauna guild and remain above their long term means

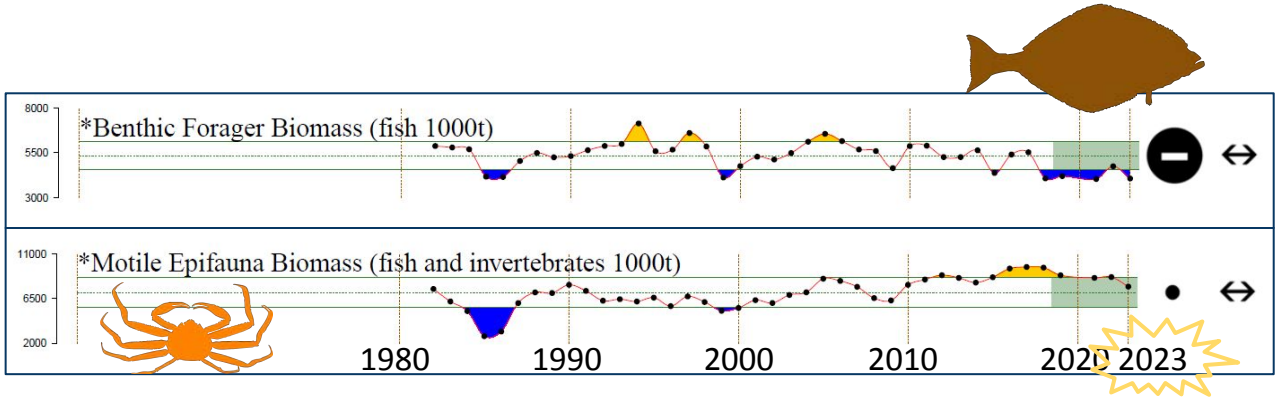
  Whitehouse (slide 79)

- Catch rate of sponges in the SEBS continued to be very low in 2024

  Buser (new since CPT)

Competitors for pelagic crab (i.e., zooplankton) were moderate in 2024. Competitors for benthic crab were reduced in 2023.

Benthic foragers and motile epifauna are competitors with benthic crab for prey and space



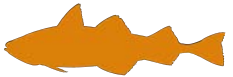
- Benthic forager biomass remained below the long-term mean in 2023
- Motile epifauna biomass remained above the long-term mean in 2023; echinoderms remain high while crab indices all below long-term means

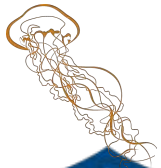
Whitehouse (slide 81)

Predators

Predation pressure on pelagic crab stages has decreased. Predator abundance of benthic crab stages was average, though predator condition has decreased.

- Pelagic forager biomass (e.g., pollock and herring) remained below the long-term mean in 2023 — Whitehouse (slide 83)
- Bristol Bay sockeye salmon returns are projected to be similar to their long-term mean in 2024 — Cunningham (slide 86)
- Jellyfish biomass was at the long-term mean in 2024 — Buser (new since CPT)



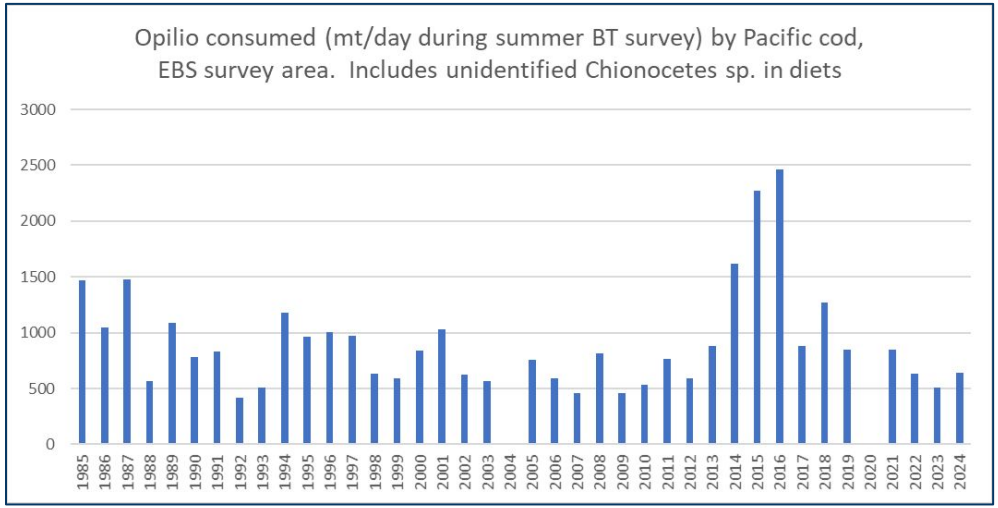


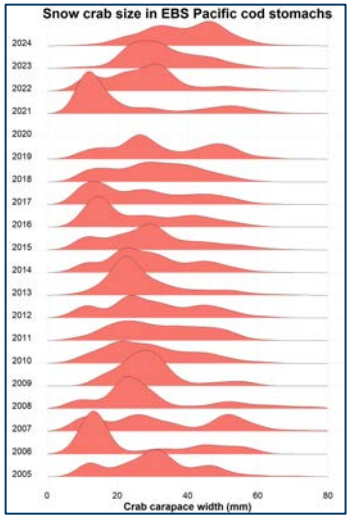
- Apex predator biomass (e.g., PCod and ATF) was at the long-term mean in 2023 — Whitehouse (slide 83)

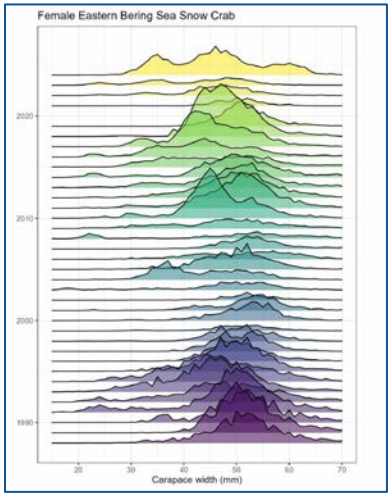
- Pacific cod and ATF condition was below average in 2023 & 2024, even though thermal conditions have been cooler — Prohaska & Rohan (new since CPT)

Predators

Pacific cod predation of snow crab relatively low in 2024.





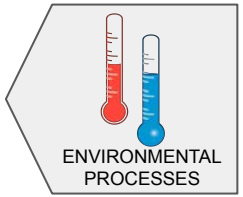
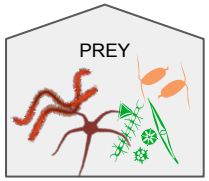
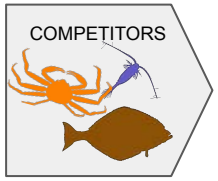
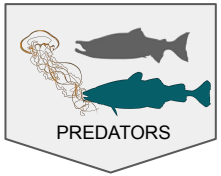


- Size distribution of snow crab in PCod stomachs reflects that observed in the survey
- Few small snow crab in PCod stomachs

Aydin (new since CPT)

Summary

ESPs available

	• El Niño to La Niña transition • Continued average SST conditions • Impact of deeper mixed layer unknown	• El Niño to La Niña transition • Average BT and cold pool extent • OA trends concerning, pH approaching potentially critical levels for king crab
	• Spring: moderate small copepods; low large copepod & euphausiids • Fall: moderate small copepods; few large copepods; many euphausiids; large fall phytoplankton bloom	• *Indirect* measure of infaunal prey based on 2023 benthic foragers indicates continued low availability • Echinoderms above long-term means in 2023 • Sponges remain low in 2024
	• Moderate abundance of zooplankton	• Motile epifauna high in 2023; echinoderms high while crab all below long-term means • Benthic foragers remained low in 2023
	• Pelagic foragers remained low in 2023 • 2024 Bristol Bay sockeye salmon similar to the long-term average • Jellyfish average in SEBS; increased in NBS in 2023	• Apex predators were at their long-term mean in 2023 • Pcod and ATF fish condition was below average in 2024 • Pcod predation of snow crab low in 2024

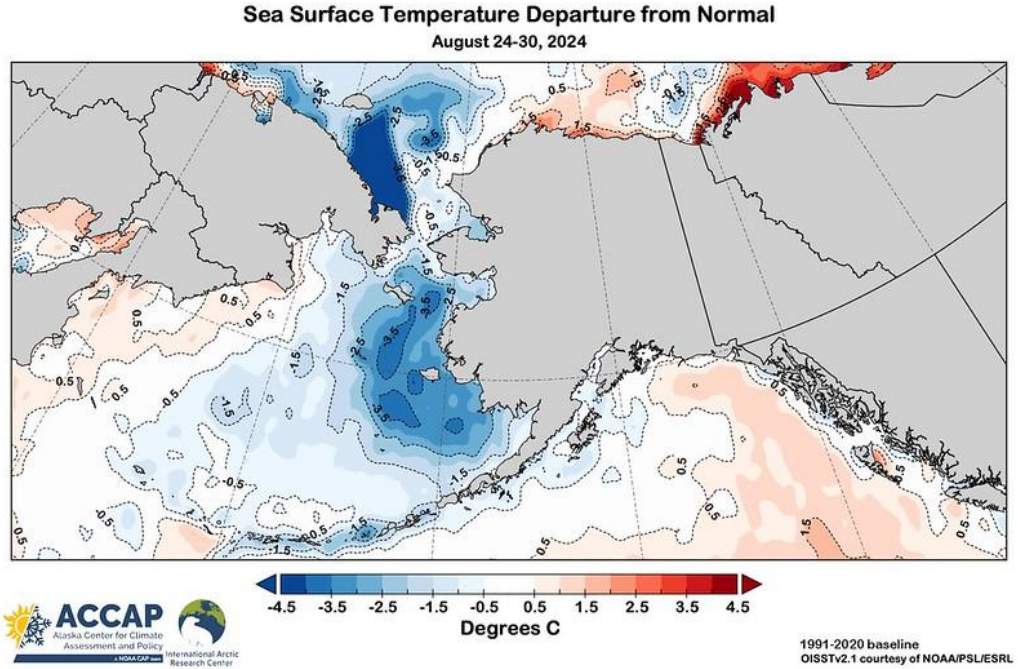

Questions?
Feedback?

Full presentations to September CPT appended below

Aleutian Islands
ECOSYSTEM STATUS REPORT

NPFMC Crab Plan Team
September 9, 2024

Ivonne Ortiz
Stephani Zador

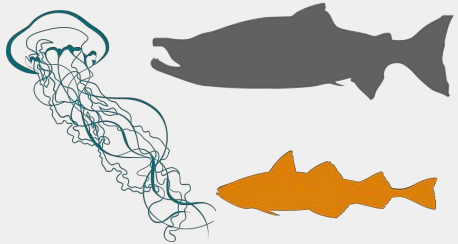


Crab-relevant ecosystem information

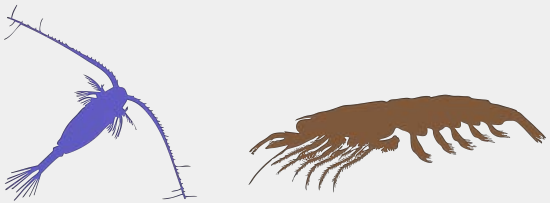
- Pelagic and benthic stages
- Environmental processes, prey, competitors, predators
- 2024 (where available) in context

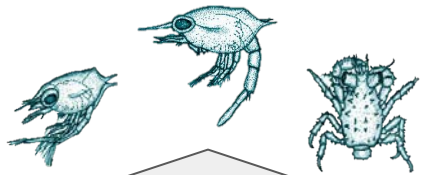
Pelagic larval indicators

PREDATORS

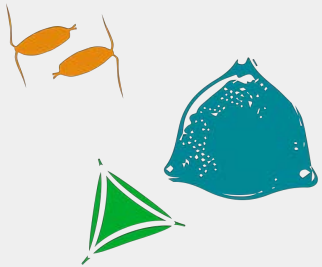


COMPETITORS





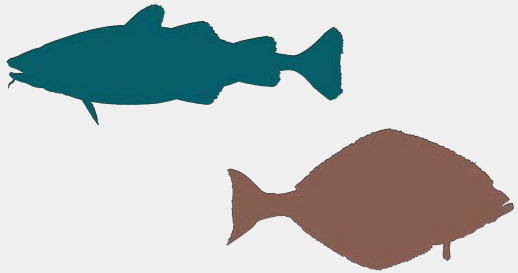
PREY



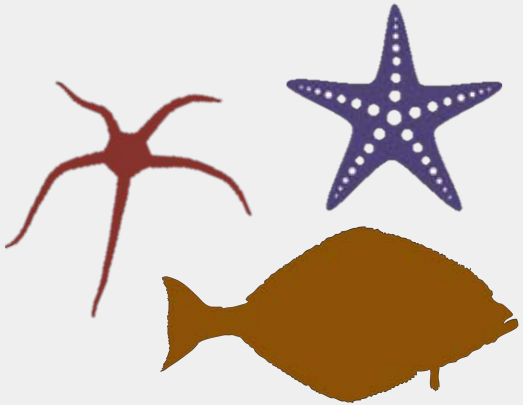
ENVIRONMENTAL PROCESSES

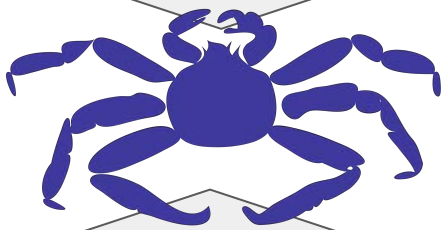
Benthic juvenile/adult indicators

PREDATORS

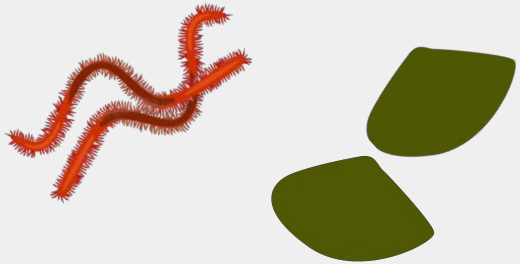


COMPETITORS

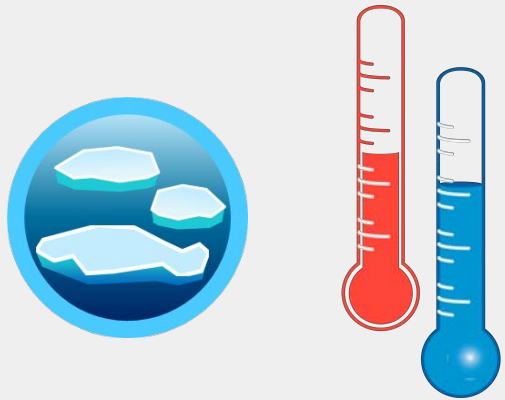


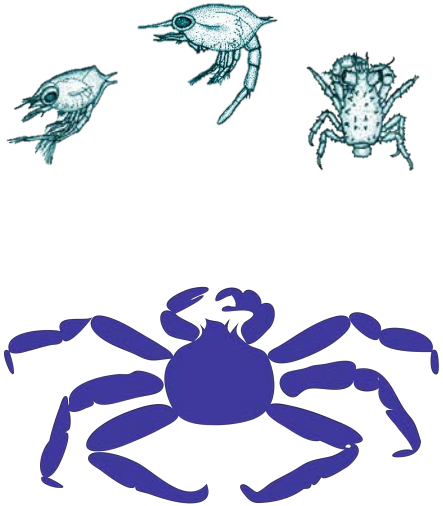


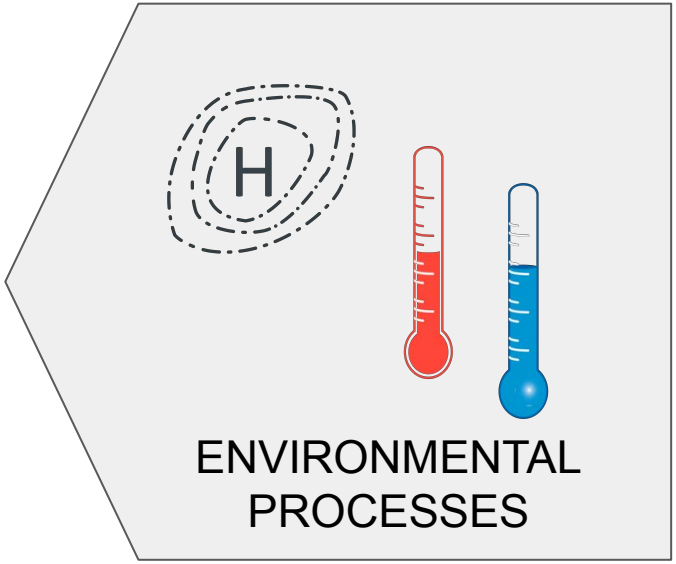
PREY



ENVIRONMENTAL PROCESSES

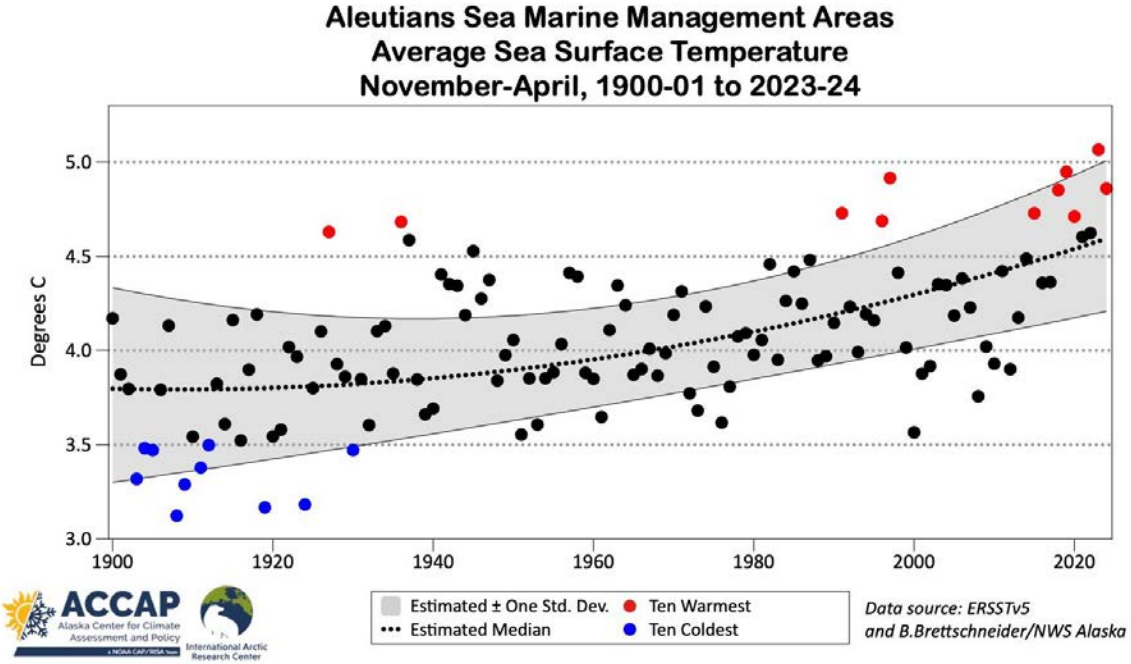





H
ENVIRONMENTAL
PROCESSES

Long-term Sea Surface Temperature

Thoman

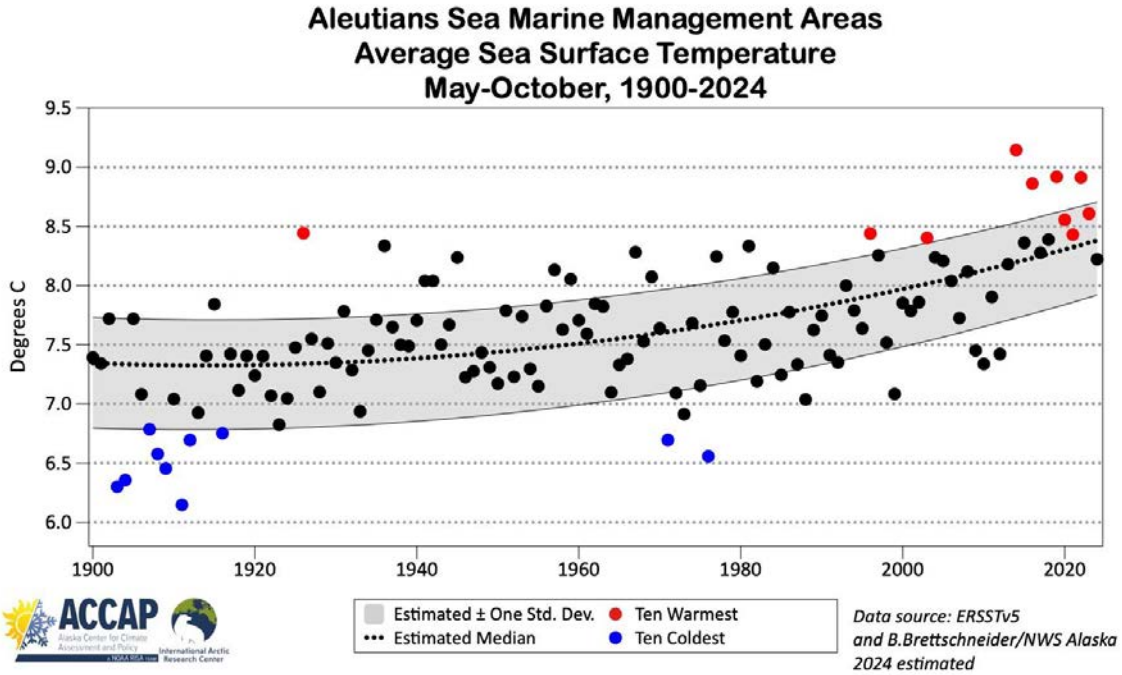


Winter

- SSTs winter lower than last year but still among 10 warmest

Long-term Sea Surface Temperature

Thoman

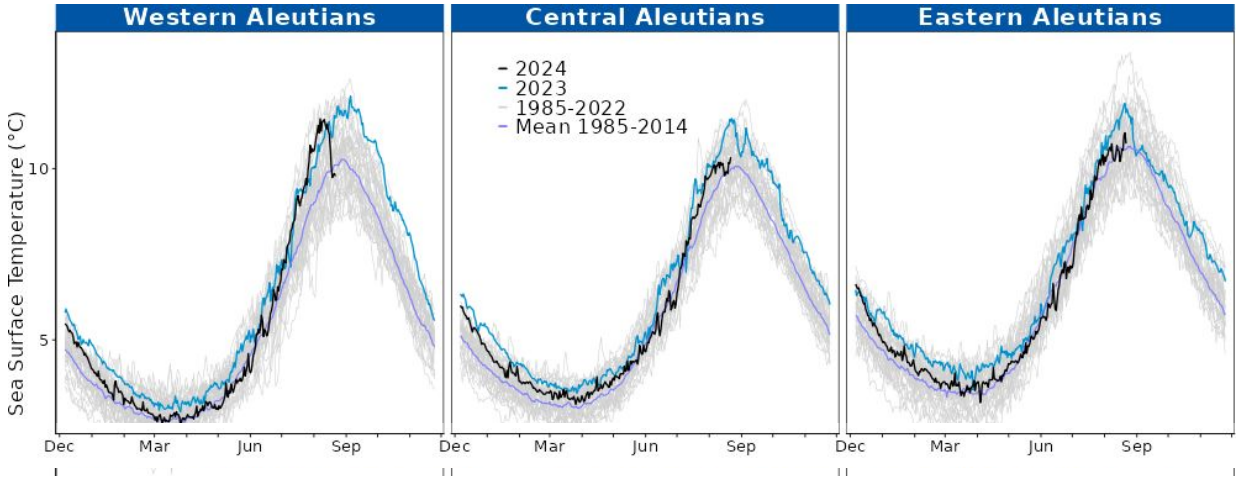


Summer

- SSTs close to long-term mean, slightly below

Sea Surface Temperature and Marine Heat Wave

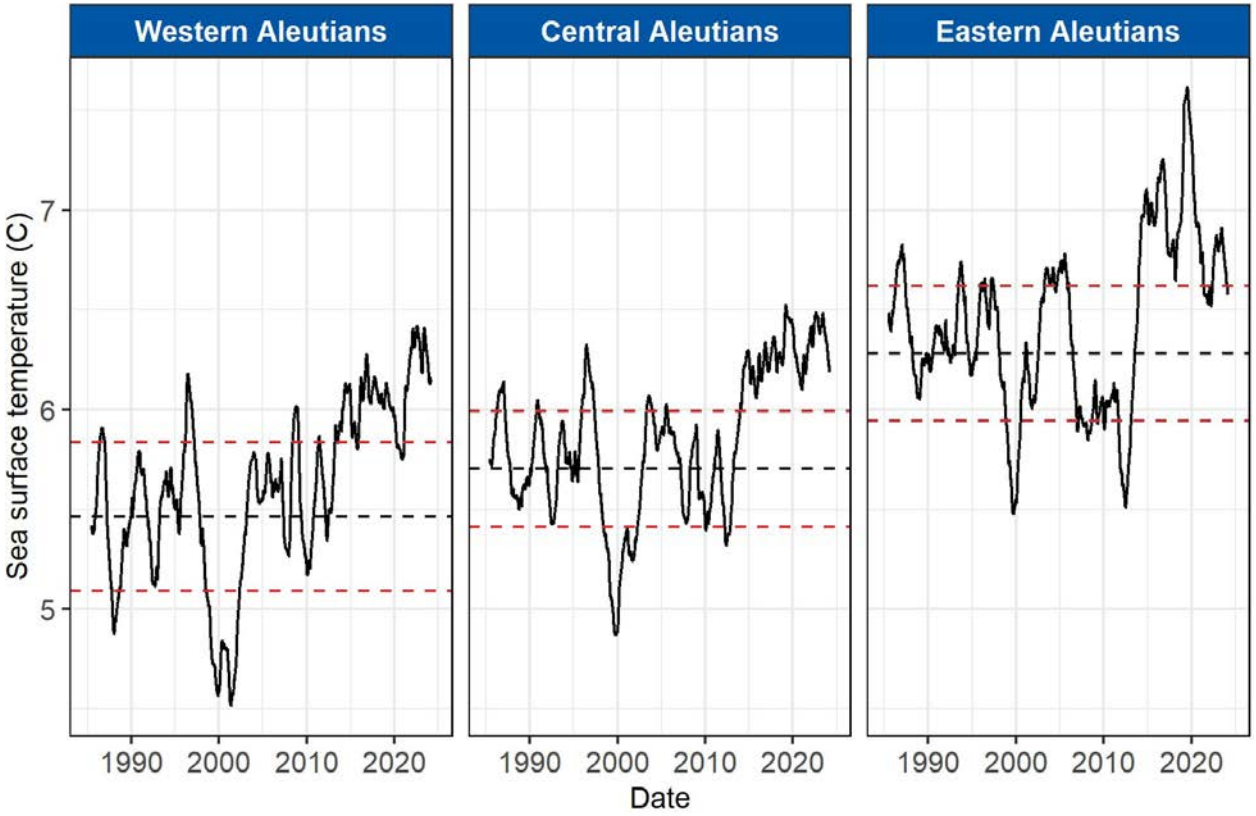
Lemagie & Callahan



- WAI-CAI: SST above long-term mean in winter and summer
- EAI: SSTs above long-term average in winter, near mean through fall

Sea Surface Temperature Trend

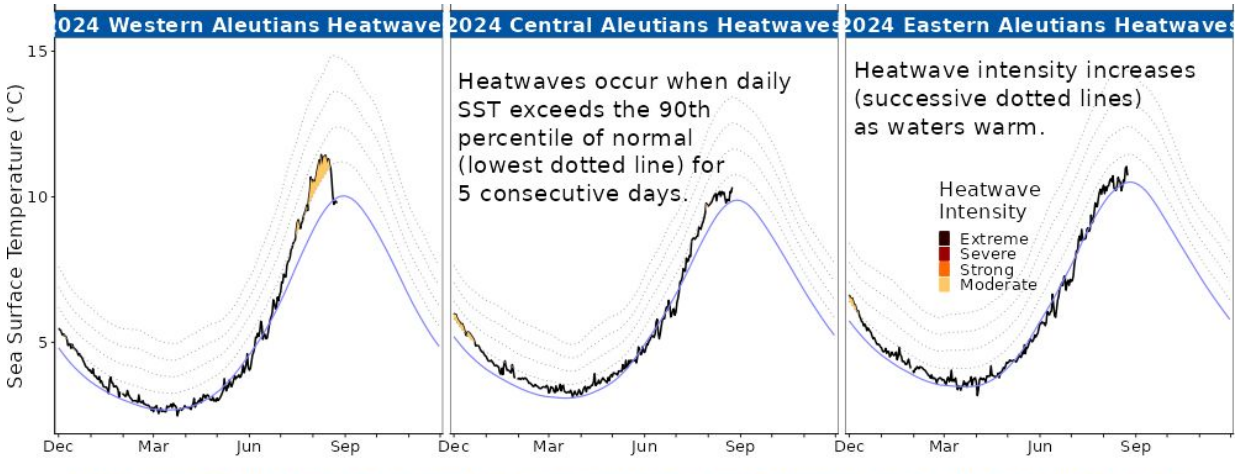
Lemagie & Callahan



- Through May 2023
- Step-increase in 2014
- SST above 1 std. dev.

Marine Heatwave Index

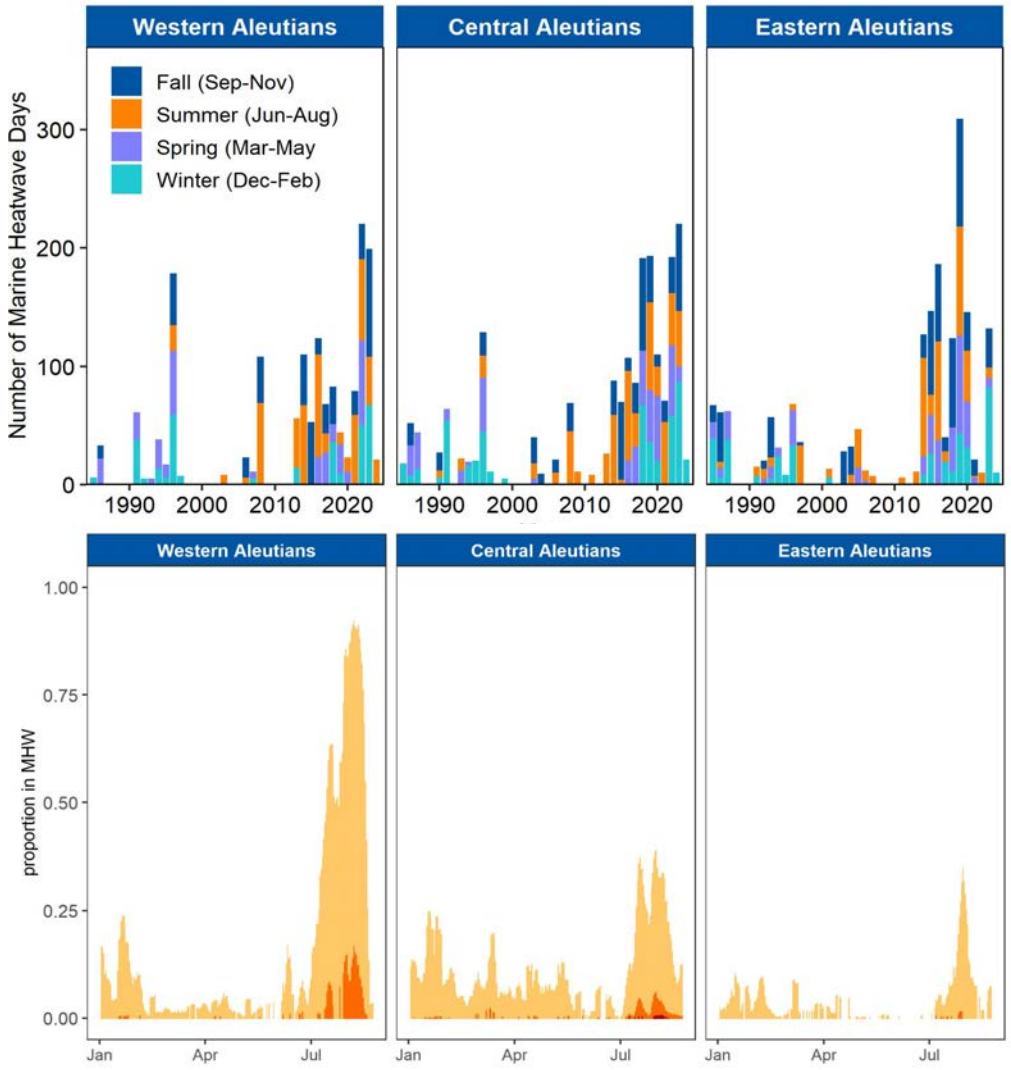
Lemagie & Callahan



- MHWs moderate events in winter & summer

Marine Heatwave Index

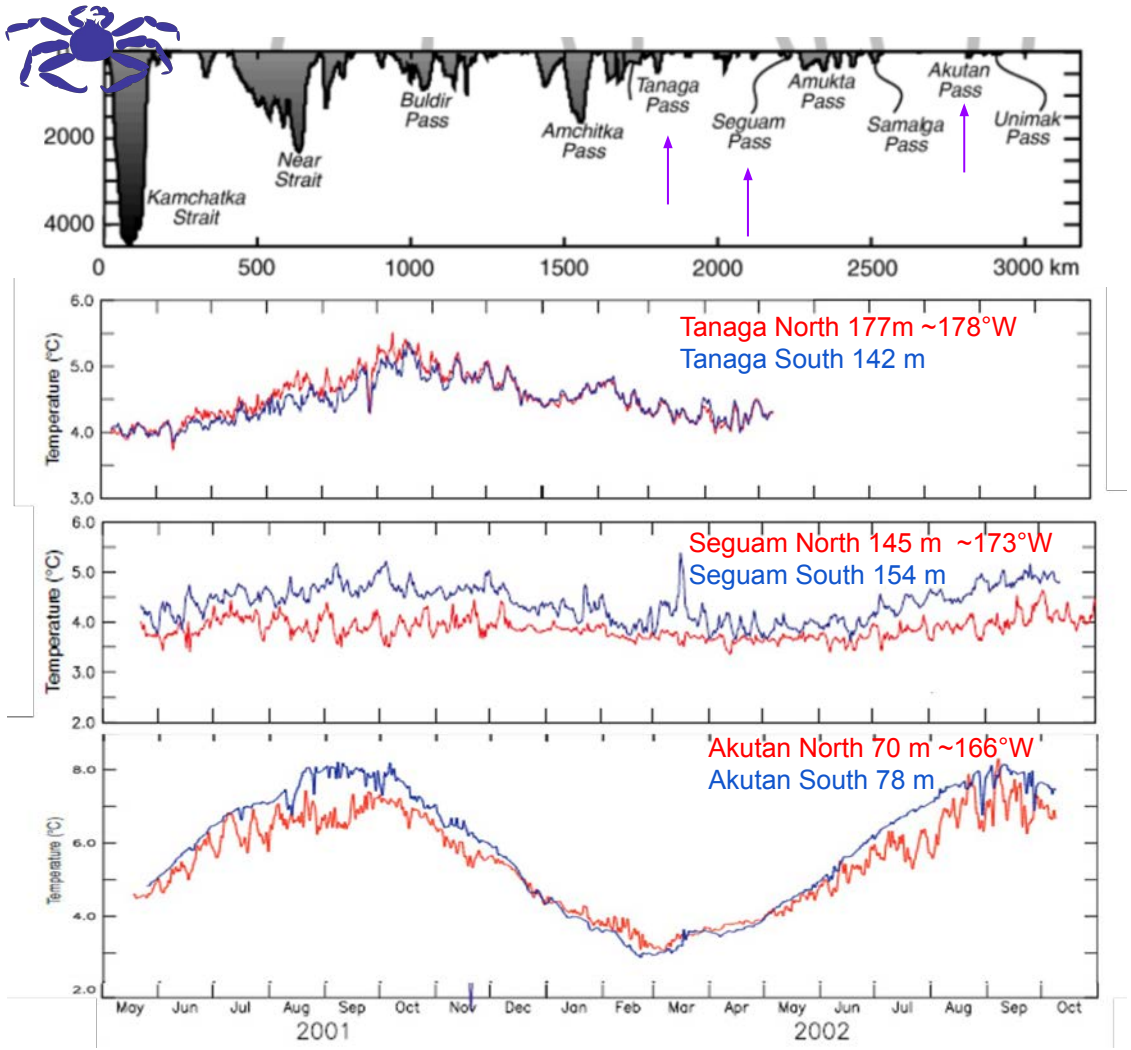
Lemagie & Callahan



- TOP panel: number of days under MHW status in Aleutians
- WAI in summer, CAI and EAI in winter
- Bottom panel: proportion of NMFS region under MHW
- MHWs more extensive in west, smaller towards east

Bottom temperature

O'Leary and Laman



Bottom temperature seasonality

Top panel
depth profile of Aleutian passes:

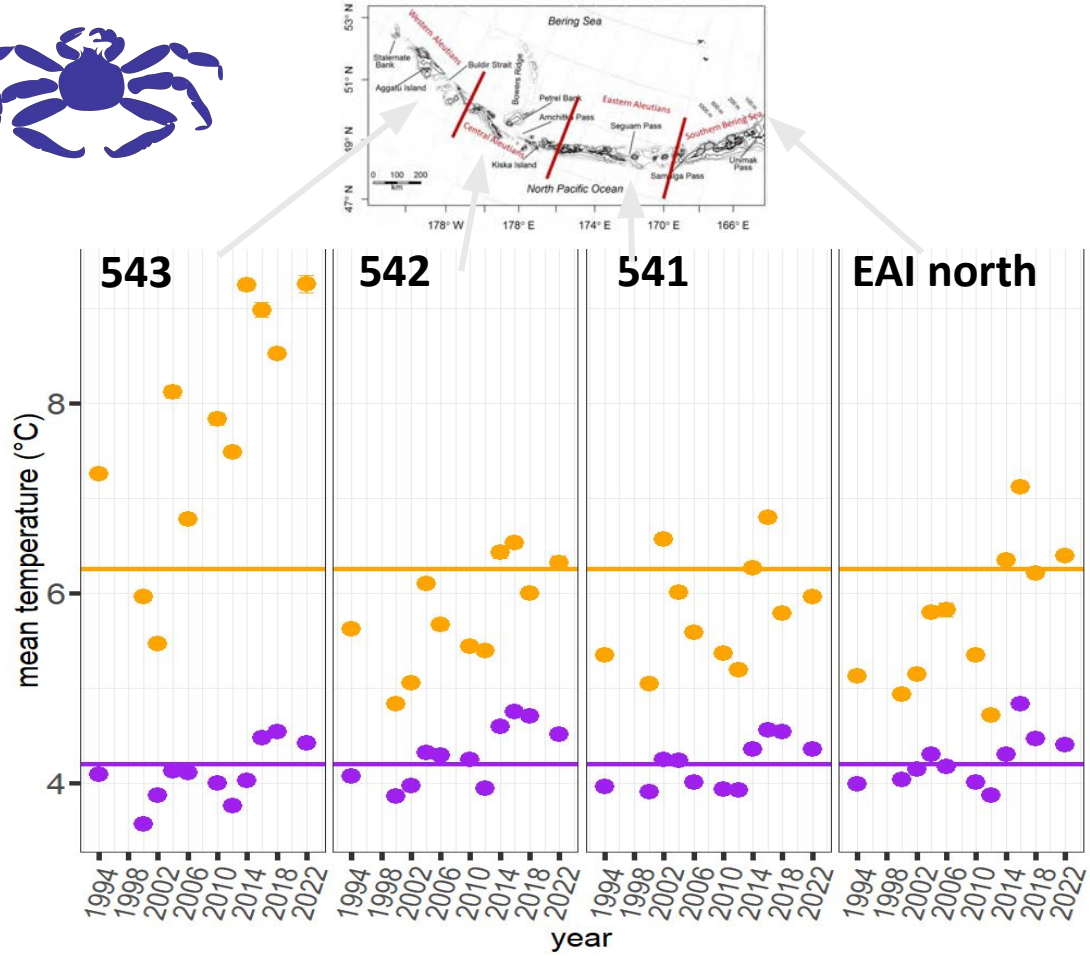
shallower narrower towards east

- east: shallow and narrow
- west: deeper and wider
- warmest on WAI 543

Image modified from Stabeno et al 1999 for passes depth and Stabeno el al.) 2005 for mooring temperatures

Bottom temperature

O'Leary and Laman

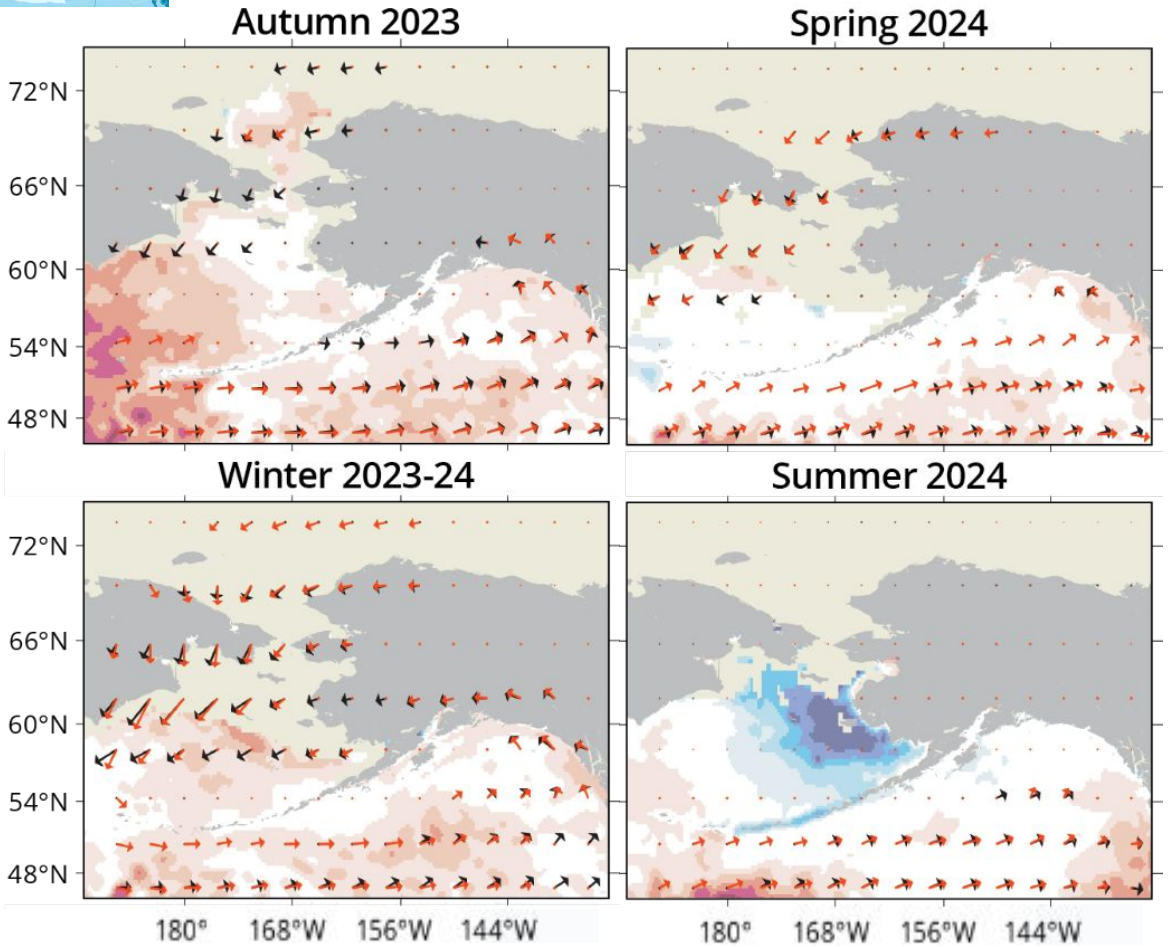


Bottom survey data

- Surface temperatures warming trend in summer
- warmest on WAI 543
- Bottom temperatures step change in 2014

Winds

Lemagie



- Dominant eastward winds south of the Aleutian Islands
- southward transport opposes mean currents over eastern Aleutian Islands

Seasonal Wind and SST Anomalies (1991-2020 Climatology)

SST anomaly (°C)

-2.5 -1.5 -0.5 0.5 1.5 2.5

tan = max seasonal sea ice extent

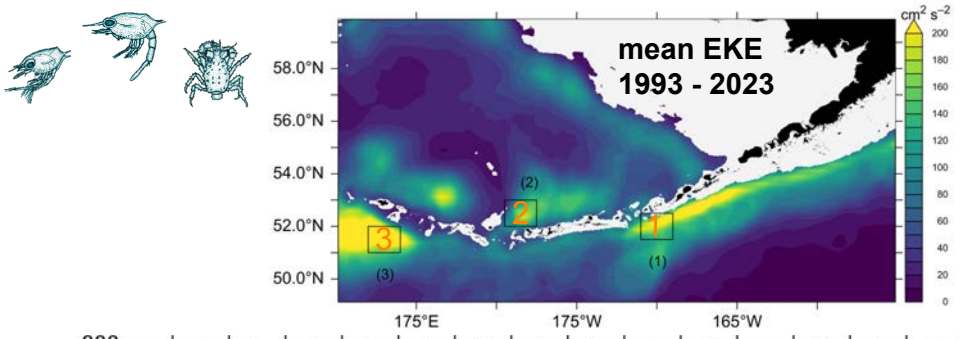
~0	<3 m/s	3 m/s	>3 m/s

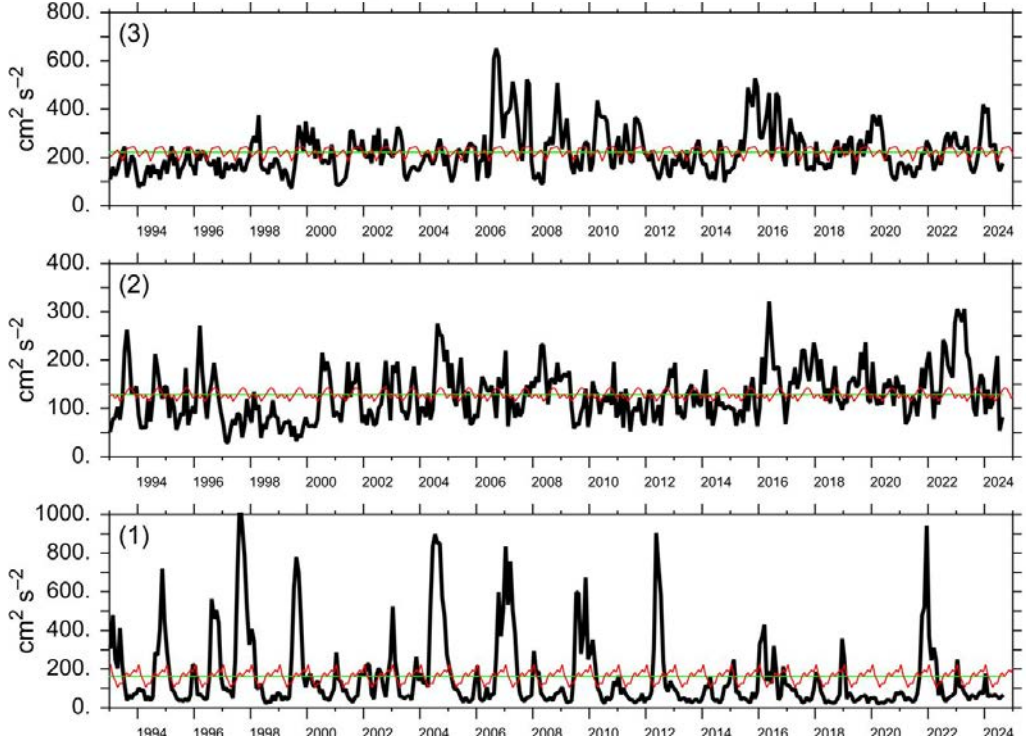
red dots/arrows = seasonal mean winds

black dots/arrows = climatology winds

Eddy Kinetic Energy

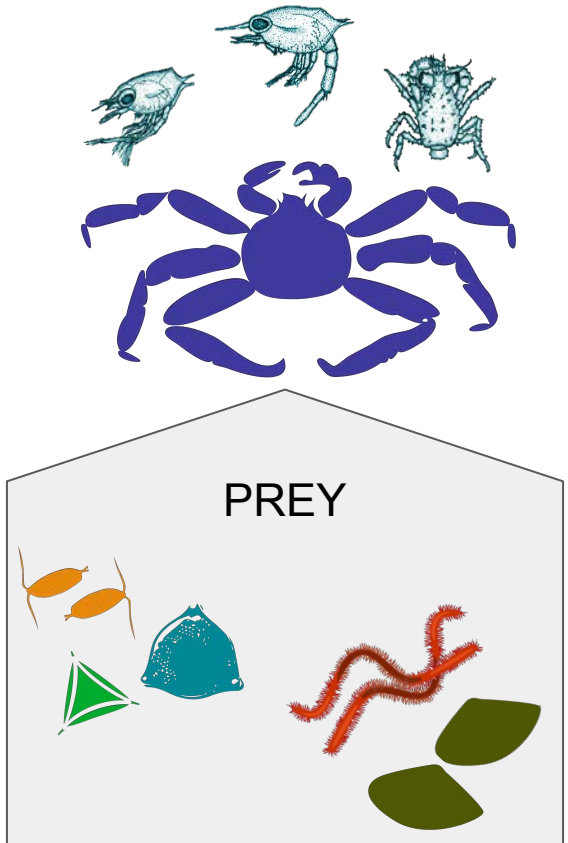
Cheng





- EKE around or below long-term mean across chain
- average transport of heat, nutrients and salinity

— monthly EKE time series
— monthly climatology of EKE
— long-term (1993-2022) average of EKE

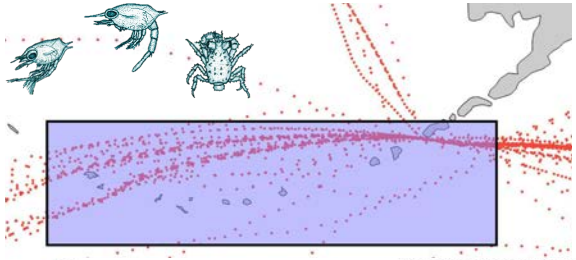


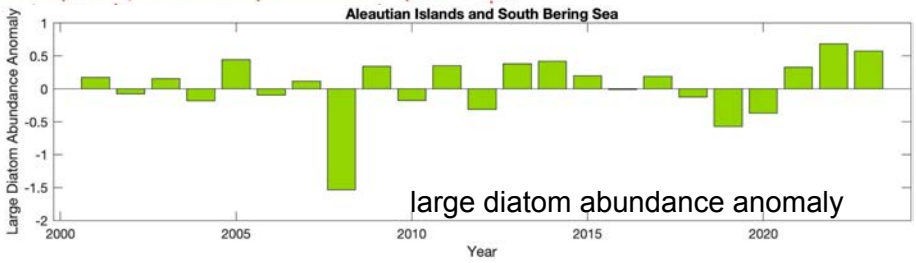
larvae do not feed, they have yolk sac

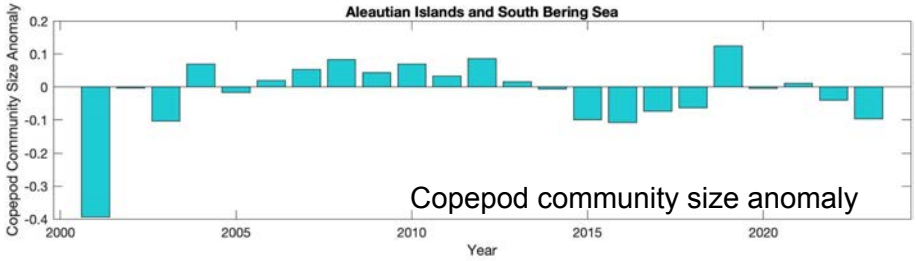
They do not need to synchronize hatch time with planktonic food availability but do need energy reserves to develop to the first crab stage (Long and Van Sant, 2015)

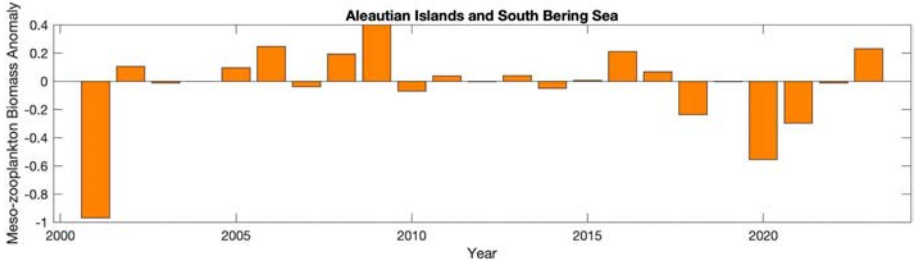
2023 Continuous Plankton Recorder

Ostle & Batten





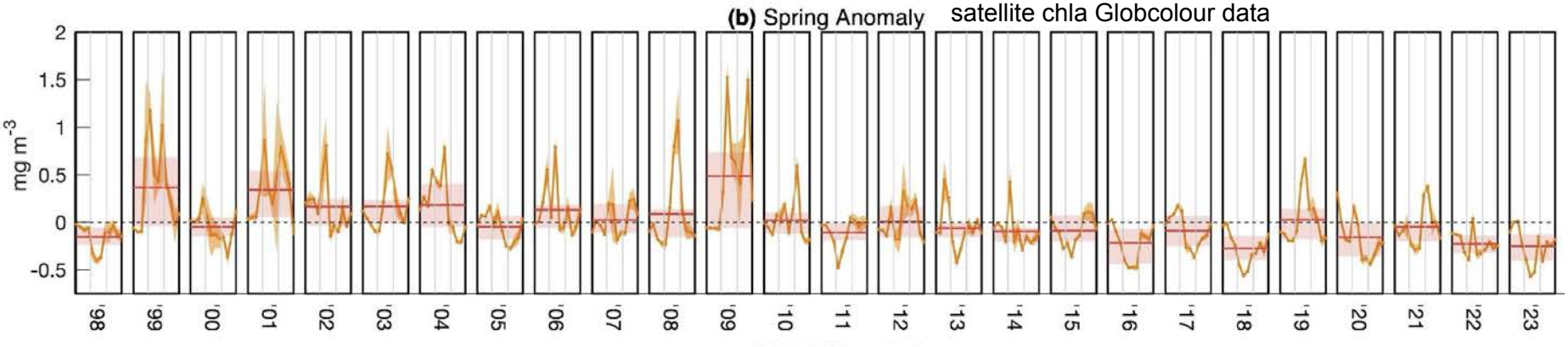




- Samples Apr-Sep crossing north to BS a Unimak Pass and south to NP west of Attu Is.
- The mean large diatom abundance was positive in 2023
- Copepod community size negative tendency may indicate true increase in abundance of smaller species of copepods
- Mesozooplankton biomass was positive in 2023

2023 Spring Bloom

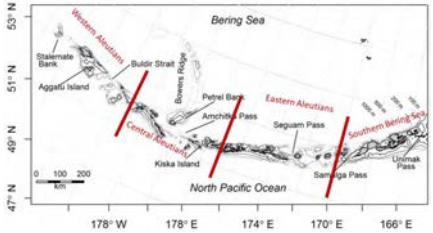
Pelland, Callahan

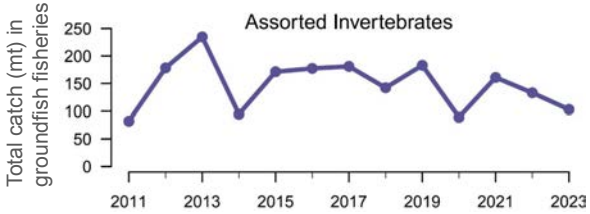


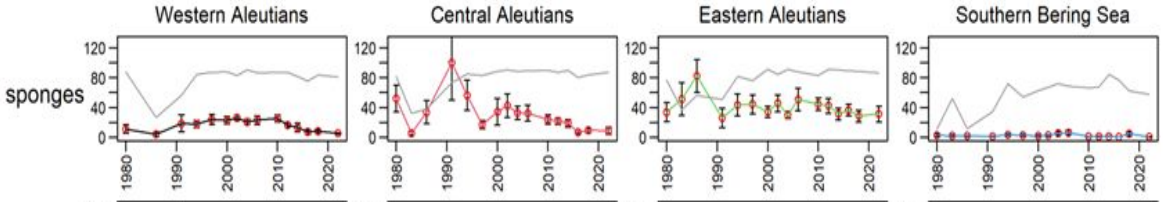
- Chl-*a* proxy for phytoplankton biomass
- 2023 was below the long term average (dashed black dots); mostly negative anomalies are evident since 2016
- A strongly above-average spring bloom has not been observed since 2009
- Biennial pattern might be influenced by eastern Kamchatka pink salmon

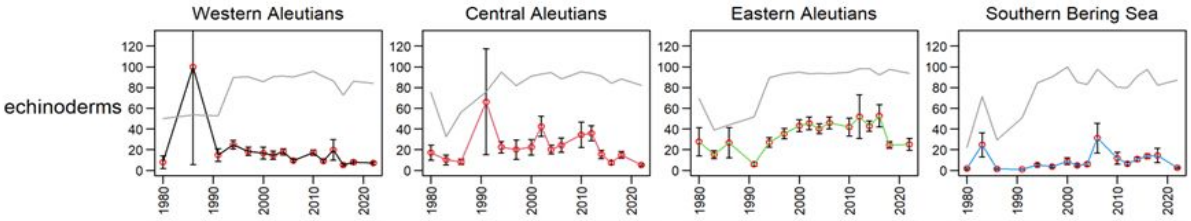
2022 Sponges, Echinoderms, 2023 Invertebrates

Laman and Whitehouse

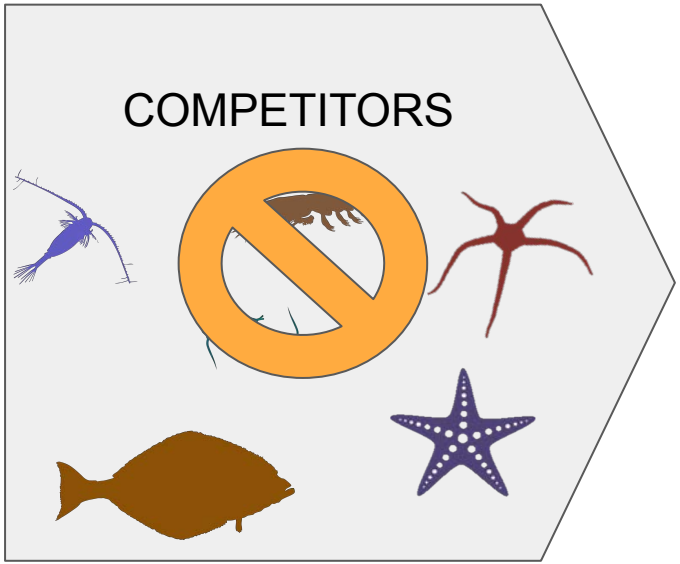


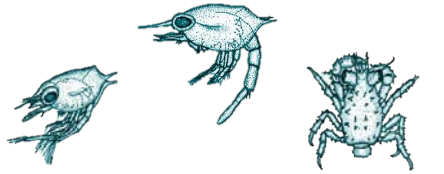


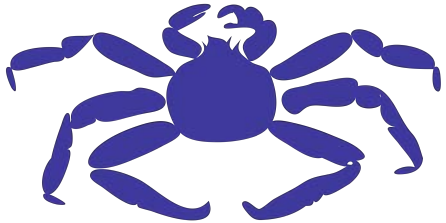


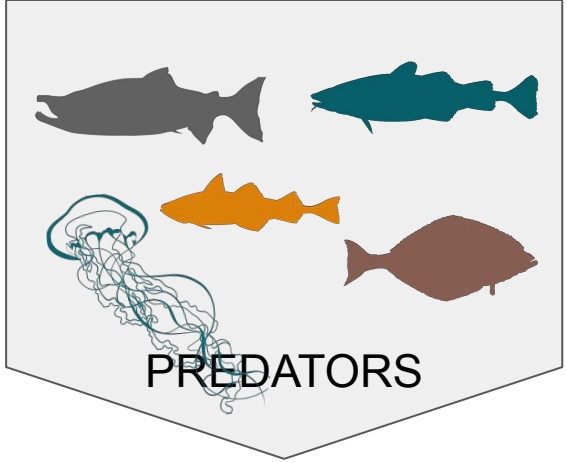


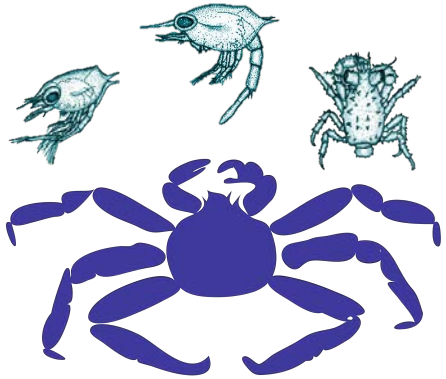
- Groundfish fisheries: Assorted invertebrates (bivalves, brittle stars, sea stars)
- Survey data: Higher abundances in Eastern and Central Aleutians
- decreasing trends in all time series might indicate true decrease


COMPETITORS







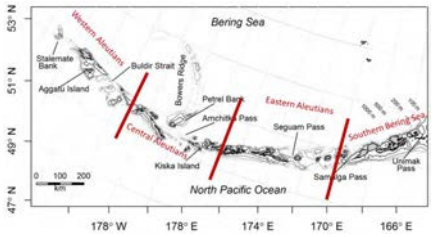


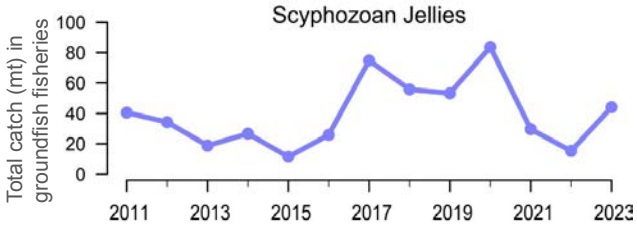
From foodlab database (golden king crab and/or
king crab (genus only):

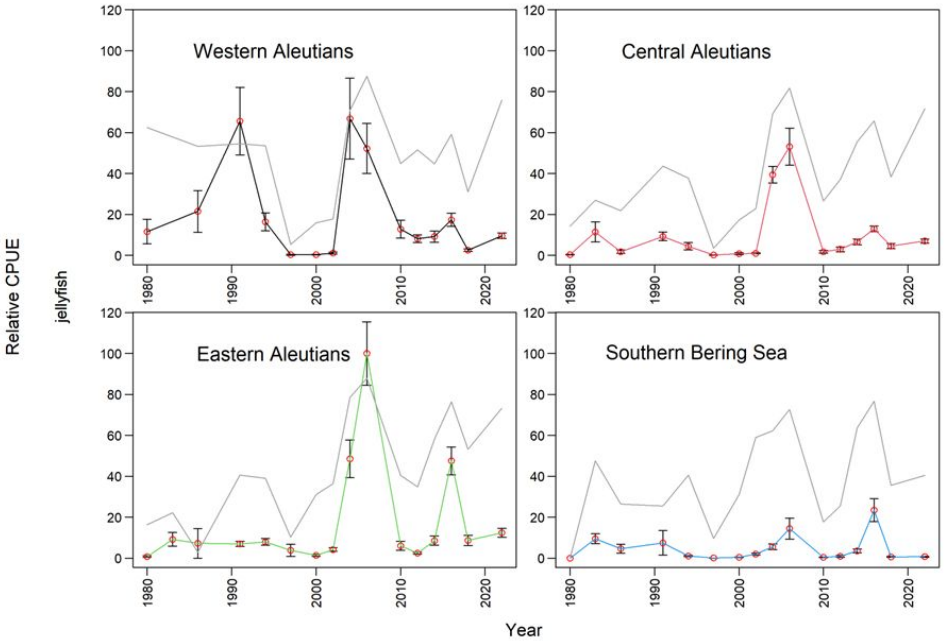
- Shortspine thornyheads
- Pacific cod
- Great sculpin
- Yellow Irish Lord
- Pacific halibut
- white blotched skate, walleye pollock, darkfin sculpin

2022 & 2023 Jellyfish

Laman and Whitehouse







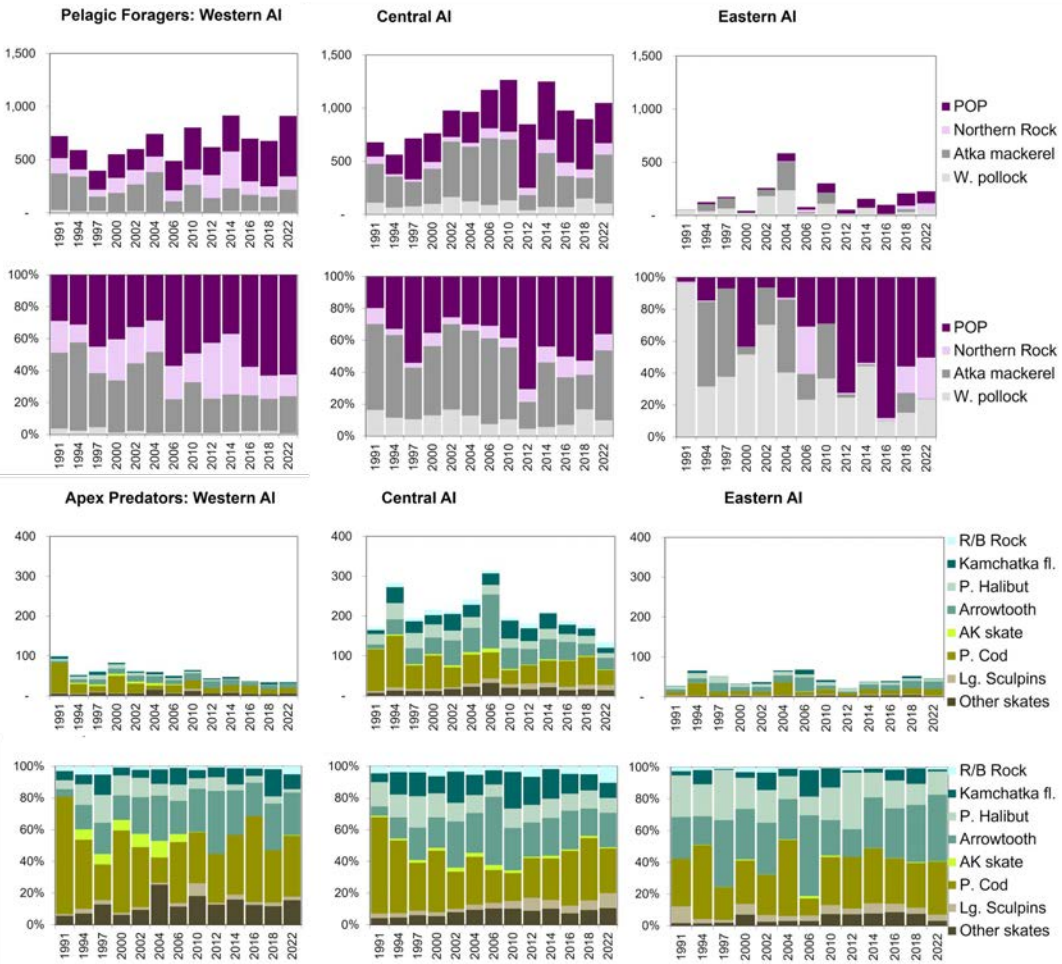
- Groundfish fisheries: Scyphozoan Jellies increasing
- Survey data: Higher abundances east of Samalga Pass
- Trend uncertain

percentage of non zero catches

2022 Pelagic Foragers and Apex Predators

Ortiz

Pelagic foragers are predators of larvae
apex predators eat small benthic crab stages.



Pelagic Foragers Biomass

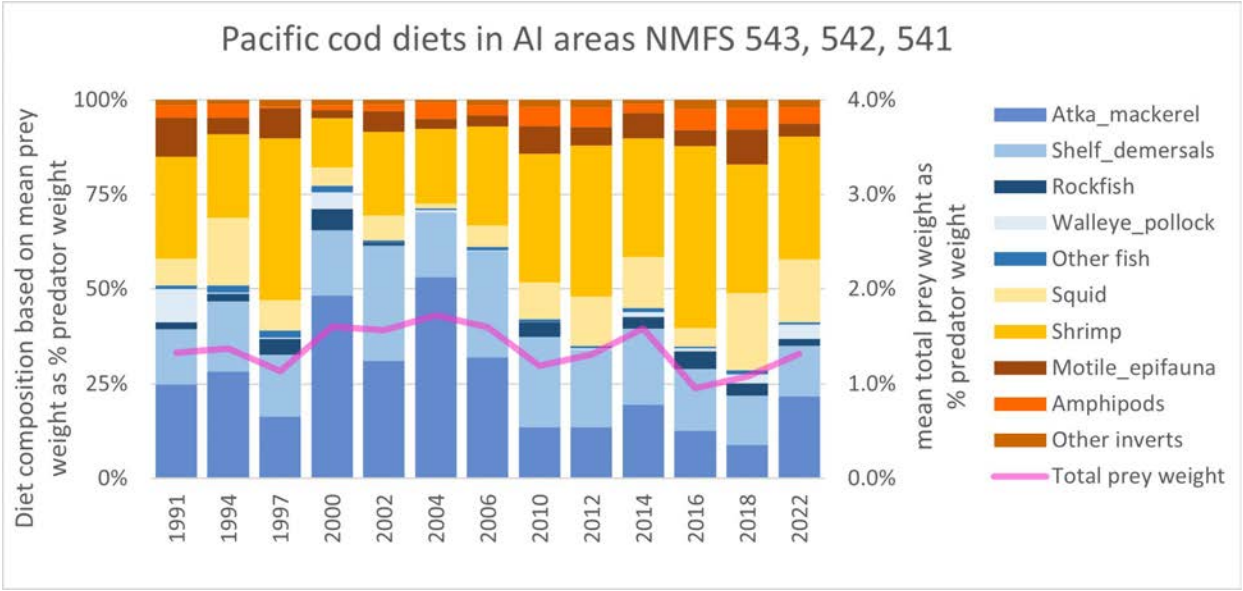
- Rockfish dominate
- Atka mackerel did increase in WAI-CAI
- Pollock increased in EAI

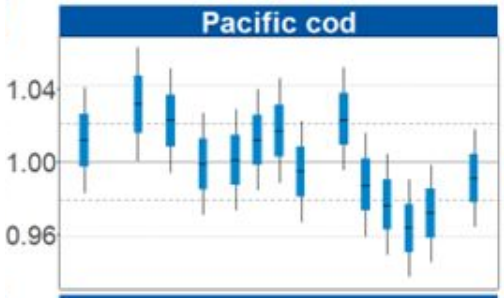
Apex Predator Biomass

- Large flatfish, Pacific cod decreased
- Large sculpins increased

2022 Adult Pacific Cod Diet & Condition

Rohan & Prohaska, Aydin & Ortiz

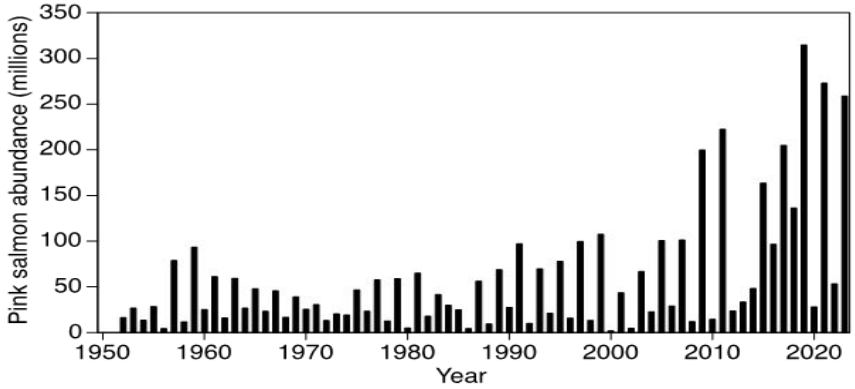




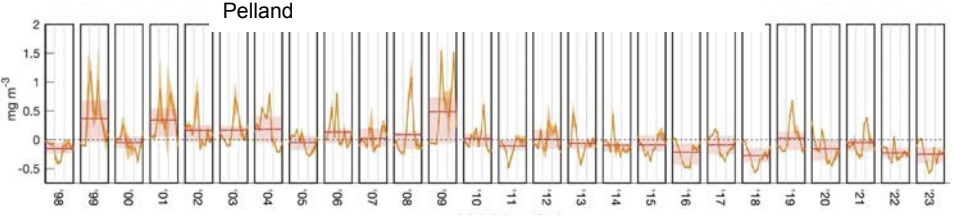
- Pacific cod diets: Apparently more invertebrates but really eating less fish (less Atka mackerel)
- Overall consuming less prey and lower fish condition
- Combined effect of higher bioenergetics due to warmer temperatures and/or lower availability of prey (lower prey abundance or higher competition)

Eastern Kamchatka pink salmon in odd years

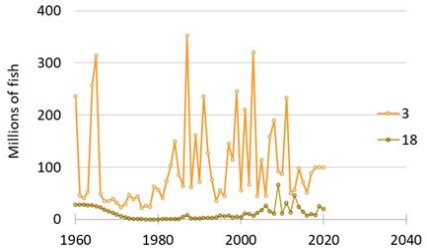
Multi-year patterns



Spring (Apr-Jun) satellite chla anomaly GlobColour, Pelland



Pacific Ocean perch Age 3 and 18

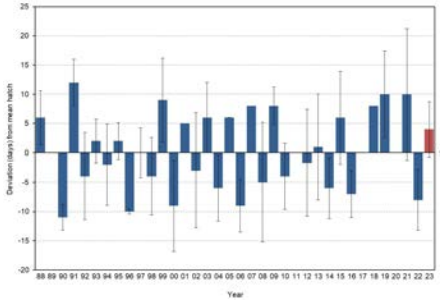


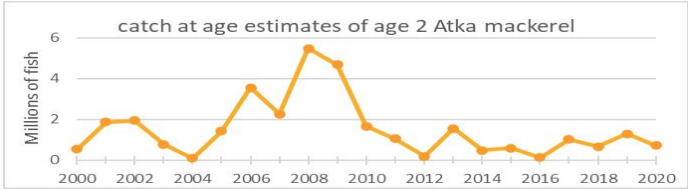
Spencer et al. 2020

Eastern Kamchatka pink salmon

- Continued high level for a low abundance year
- Biennial pattern at several trophic levels from diverse sources
- No statistical analysis has been conducted
- Potential thresholds: 2009 for high abundance years

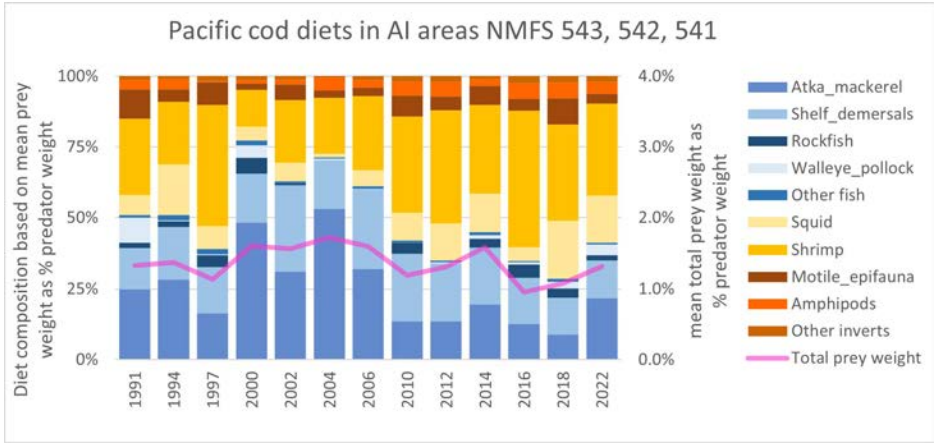
Tufted puffin hatch date anomaly at Buldir, Rokek et al.
no effect on reproductive success



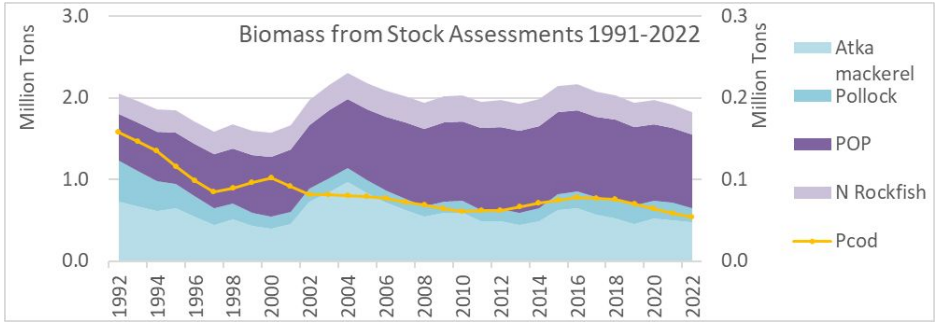


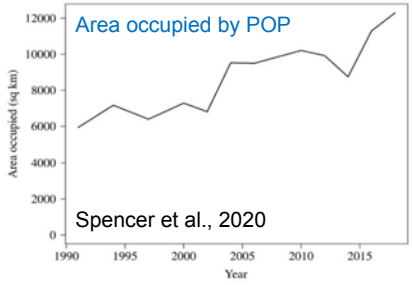
Lowe et al. 2021

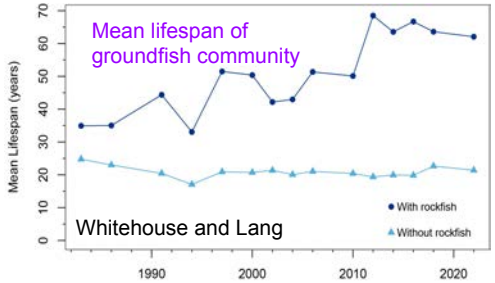
POP and Northern Rockfish as main pelagic foragers ulti-year patterns



- Increased competition with other fish feeding on zooplankton, changes in cod diet may be due to decreasing Atka mackerel
- POP expanding area occupied
- Longer mean lifespan of groundfish community (35 to 60 years) means a slower turnover rate & dampened effects of environmental variability (increased ecological stability)
- Spatial competition with Atka mackerel, pollock?







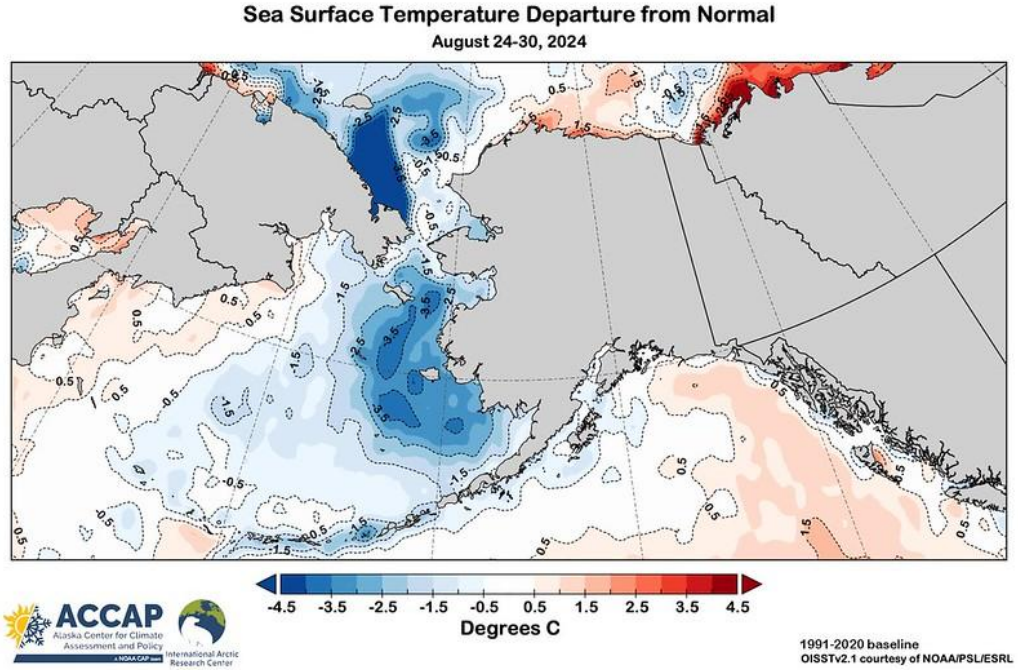
Summary

ENVIRONMENTAL	• El Niño to La Niña transition • SST cooled to average conditions • Consistent eastward winds would advect larvae in that direction	• El Niño to La Niña transition • BT above long-term mean since 2014
PREY	• Continued low chl-a biomass; • Higher small copepod abundance	• *Potential decrease* of invertebrates
COMPETITORS		
PREDATORS	• Unknown trend of jellies •	• Lower biomass of Pacific cod • increased sculpins but low overall biomass • Higher abundance of rockfish that don't feed on golden king crab)

Eastern Bering Sea
ECOSYSTEM STATUS REPORT

NPFMC Crab Plan Team
September 9, 2024

Elizabeth Siddon



EBS

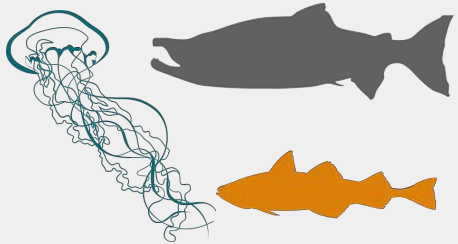
Crab-relevant ecosystem information

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

EBS

Pelagic larval indicators

PREDATORS



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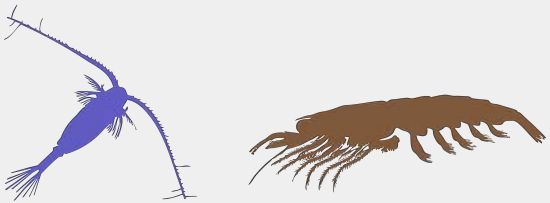
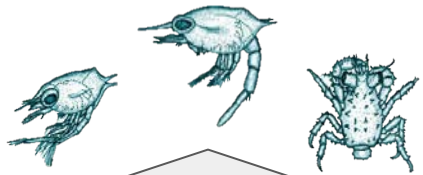
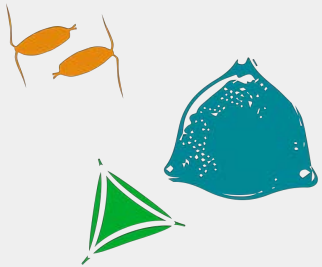




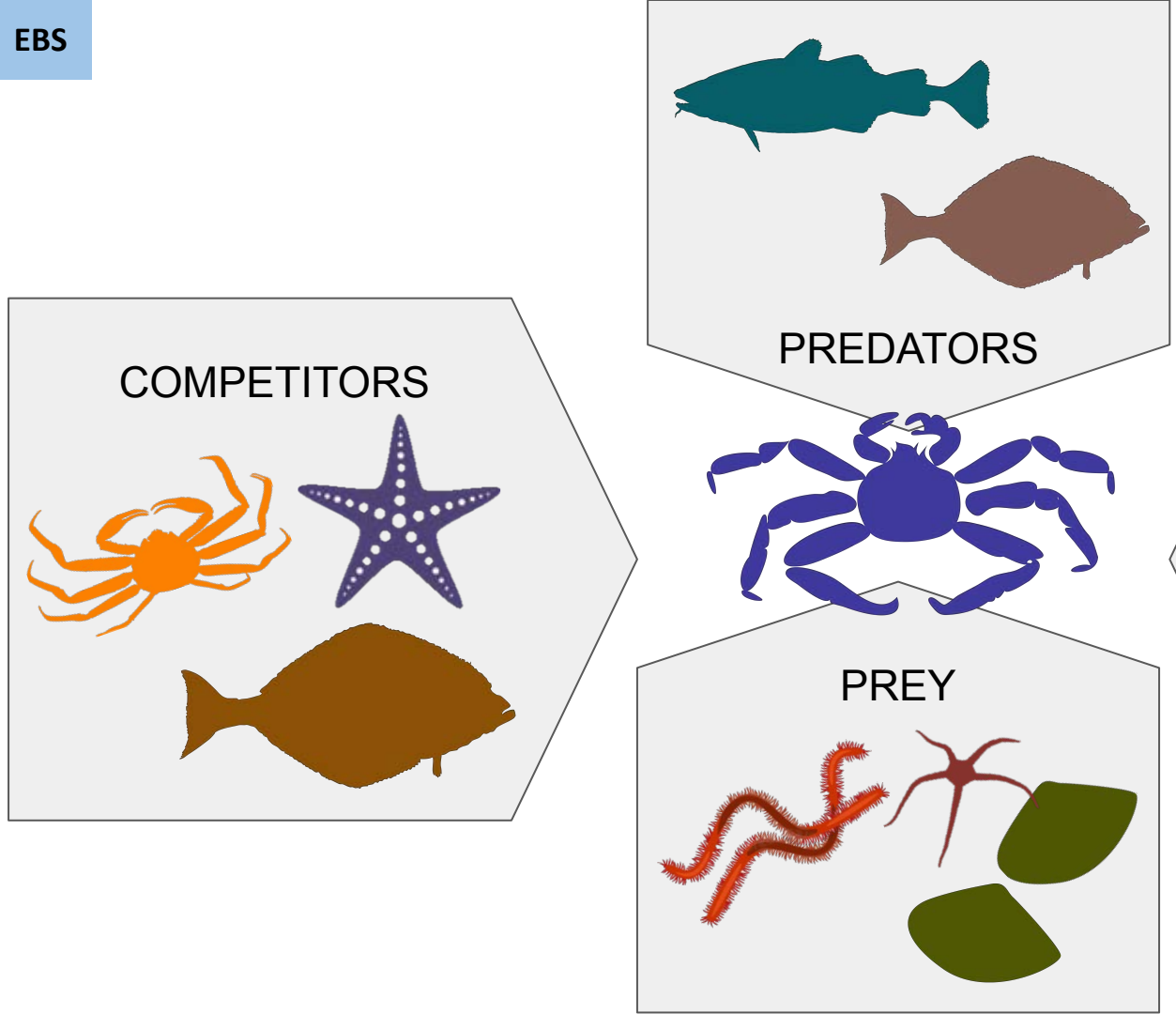
PREY



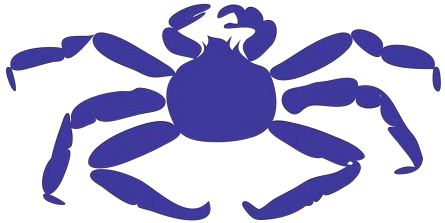
ENVIRONMENTAL PROCESSES

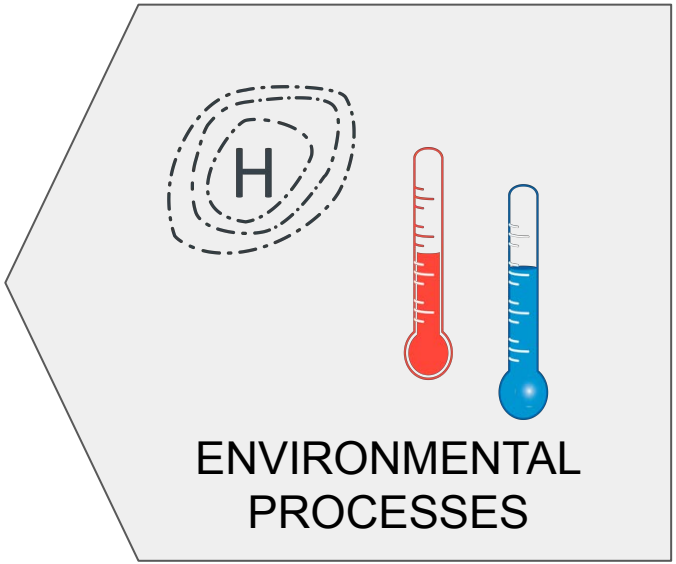
EBS

Benthic juvenile/adult indicators



EBS

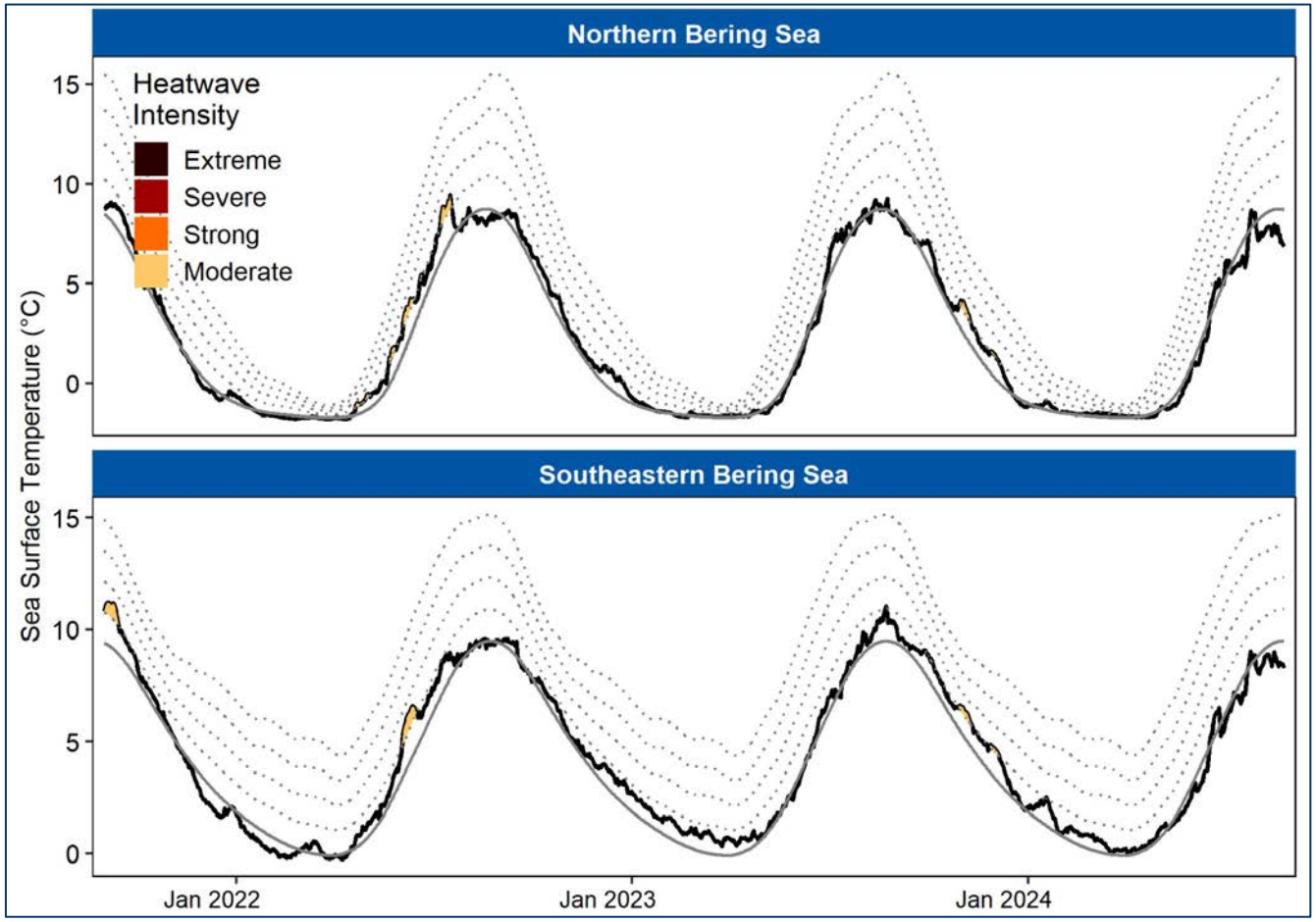




EBS

Marine Heatwave Index

Callahan & Lemagie

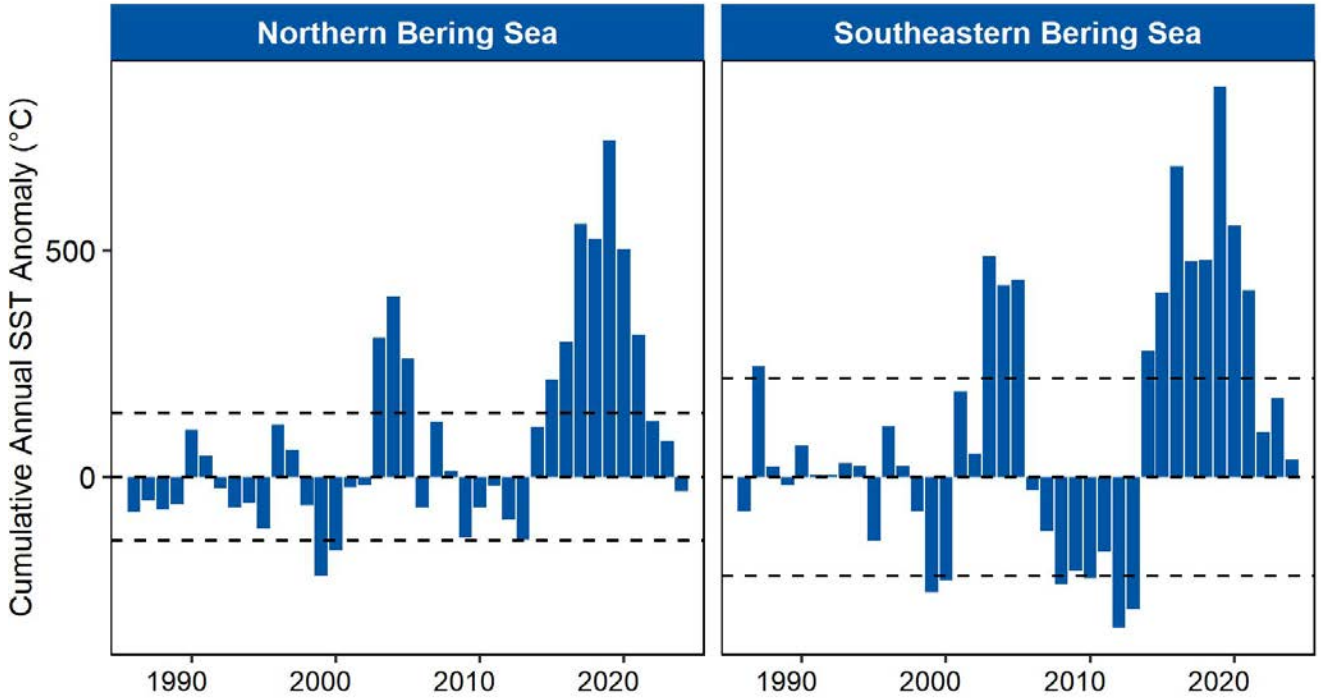


- MHWs have been brief and infrequent since 2021

EBS

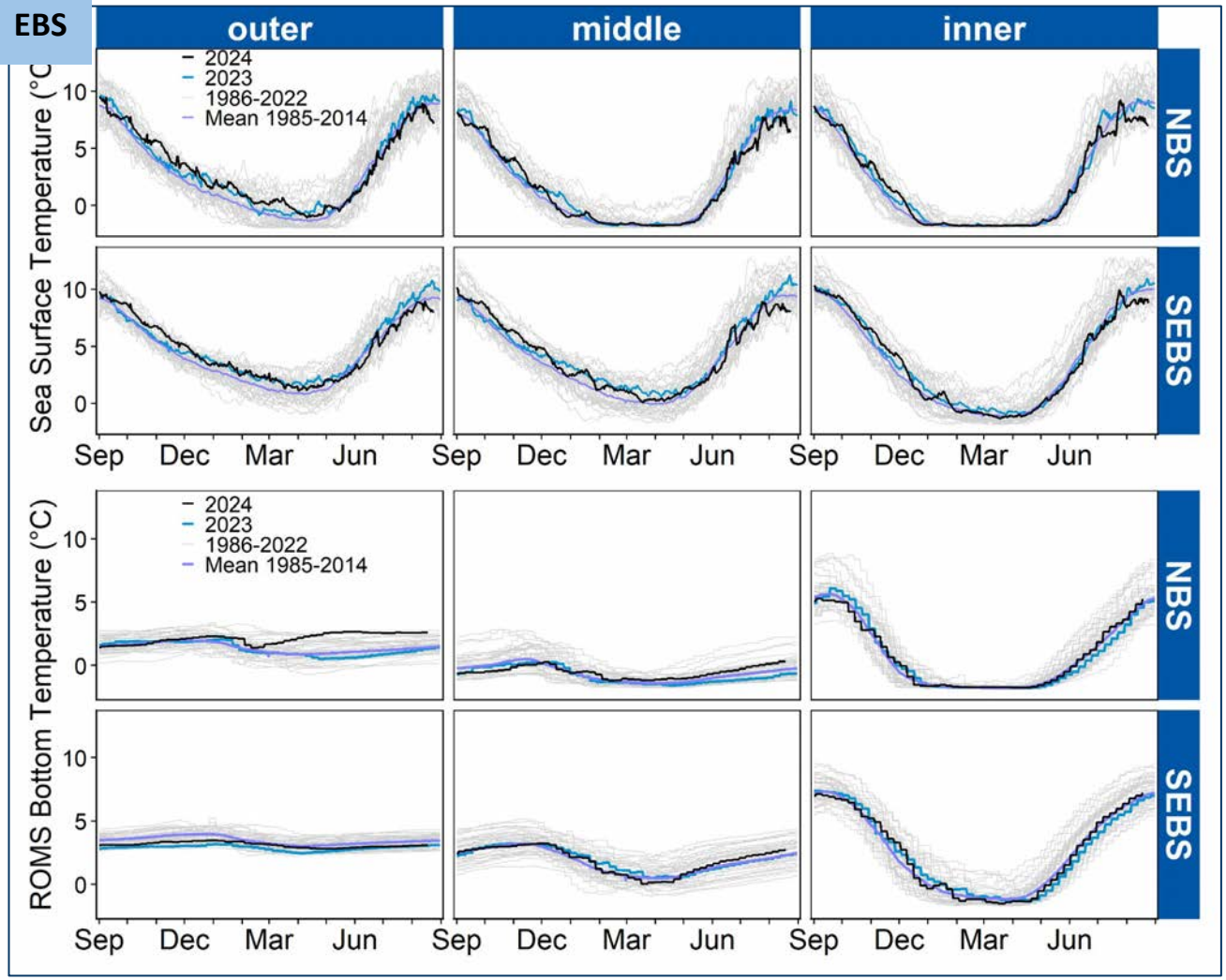
Sea Surface Temperatures

Callahan & Lemagie



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

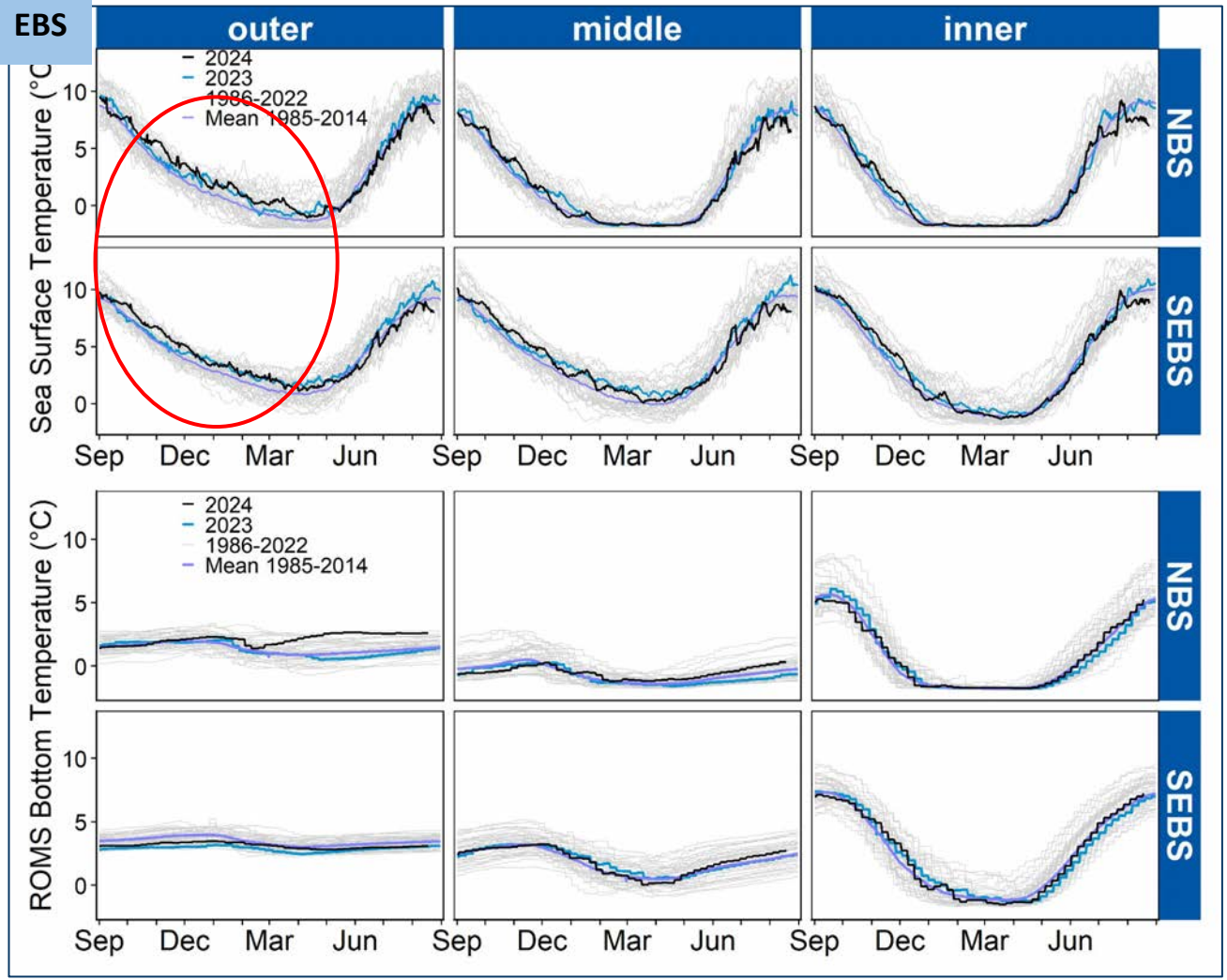
EBS



SST & Bottom Temps

Callahan, Kearney & Lemagie

EBS

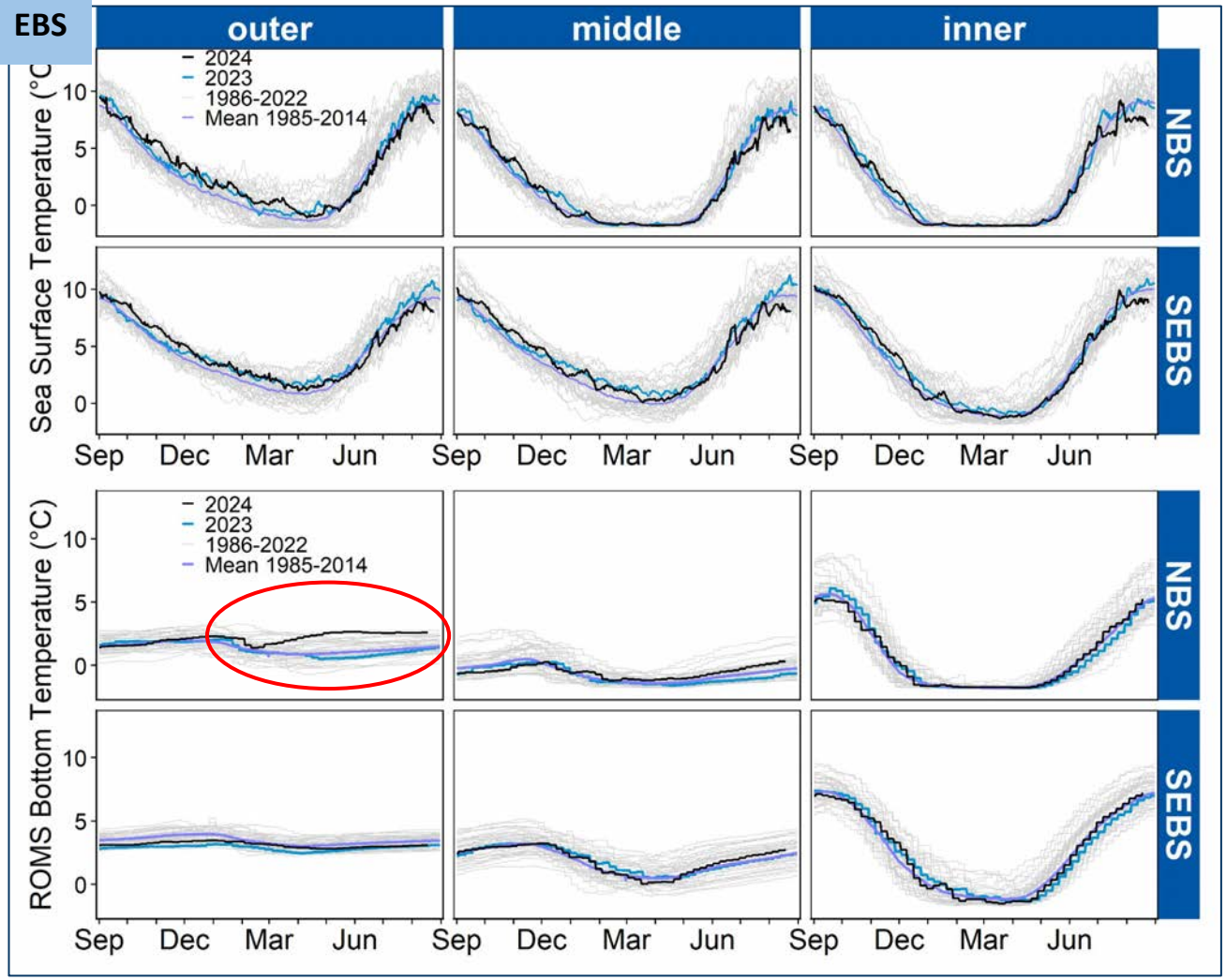


SST & Bottom Temps

Callahan, Kearney & Lemagie

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

EBS



SST & Bottom Temps

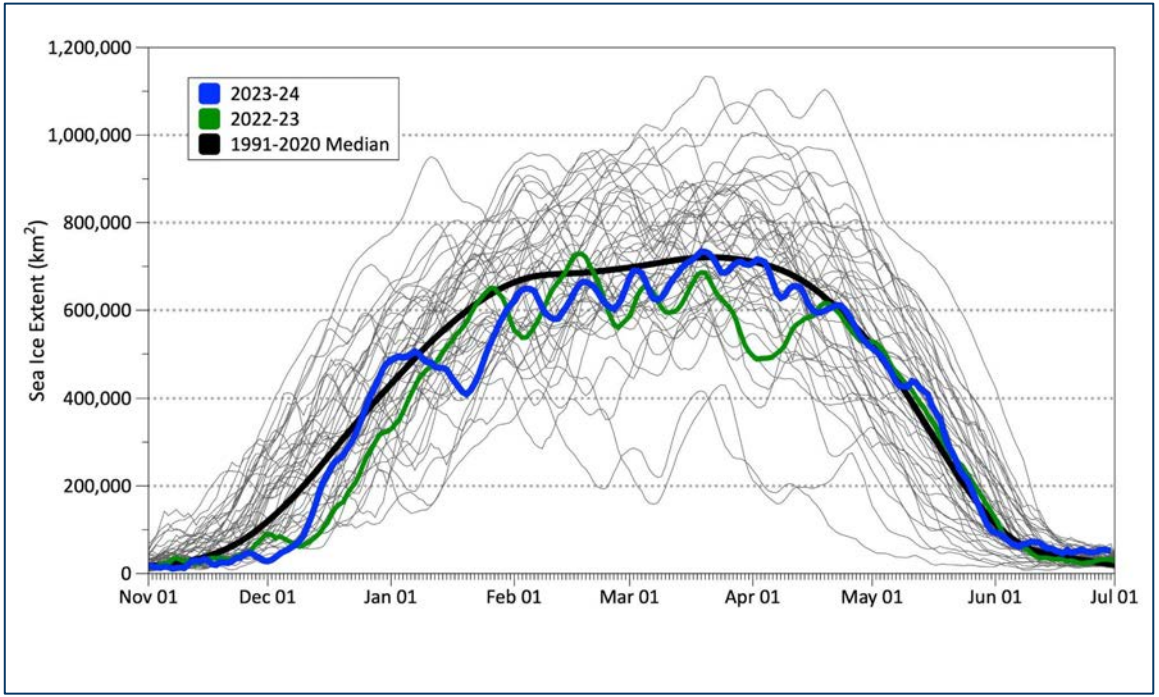
Callahan, Kearney & Lemagie

- 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

EBS

2023-2024 Sea Ice

Thoman

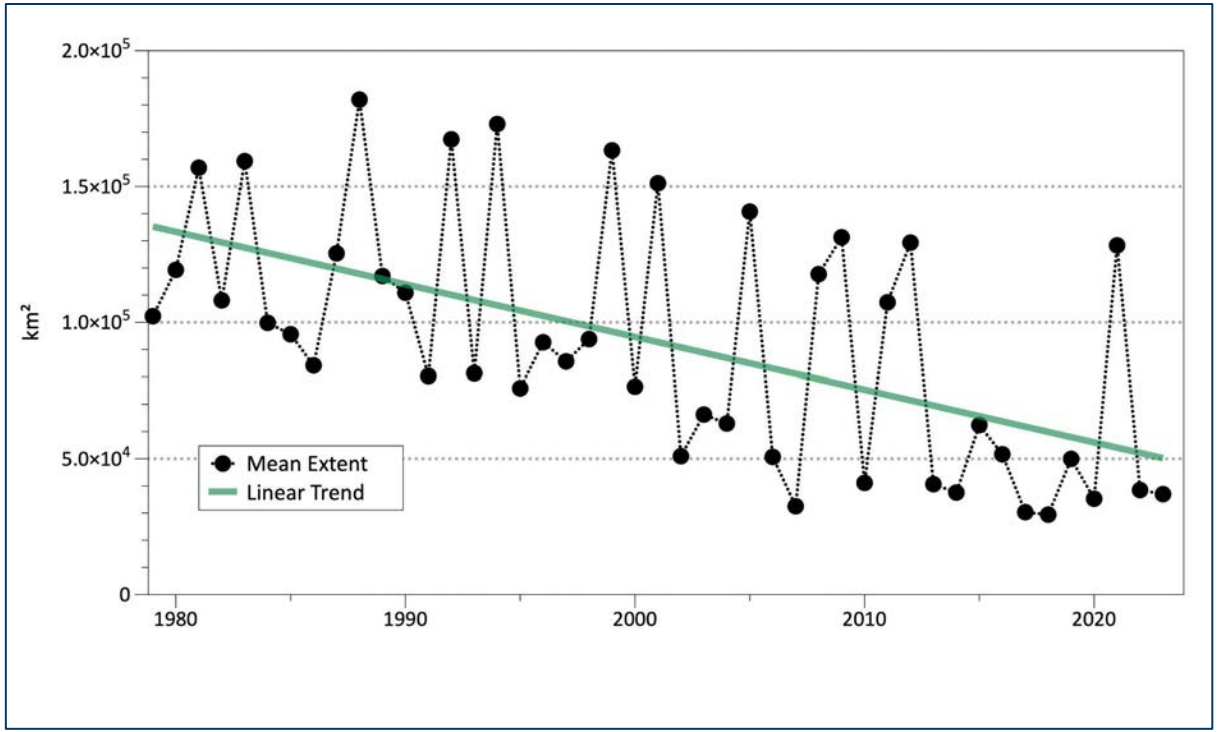


- Delayed sea ice growth in fall
- Large increase mid-December
- Sea ice “wiggles” due to repeated shifts in weather patterns
- Highest May ice extent since 2013; max extent 14% below mean
- Maximum ice extent occurred in late March; sea ice reached St. Paul Island for 2 days

EBS

Early Season Ice Extent (Oct - Dec)

Thoman



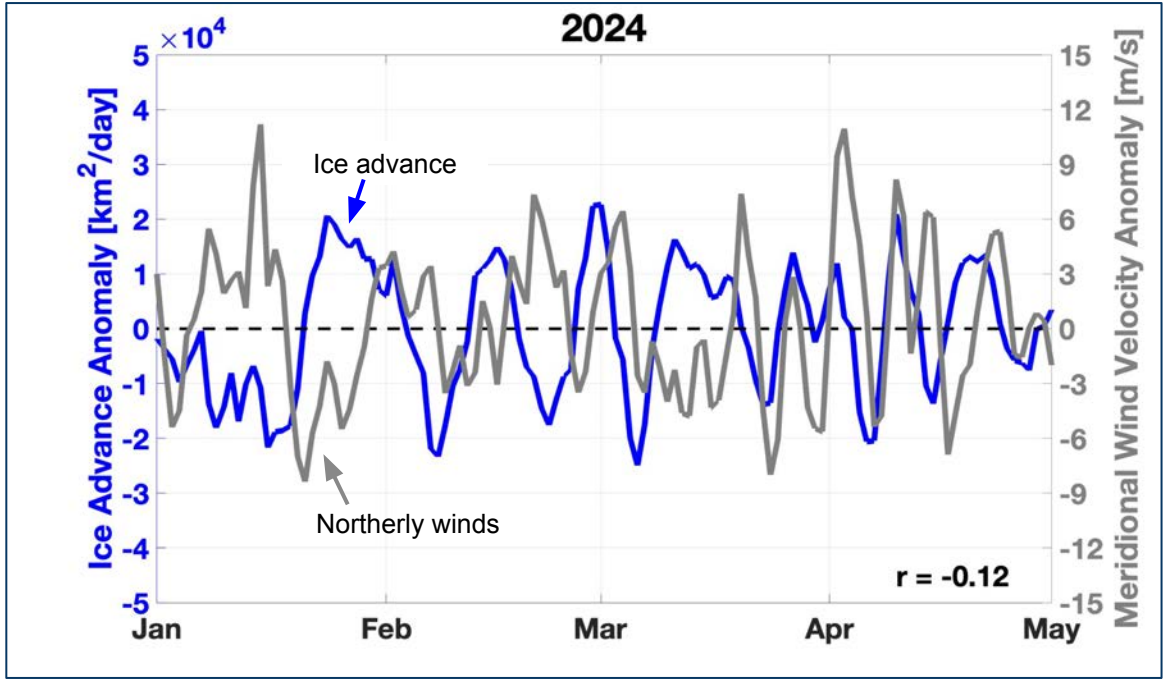
- 2023 was similar to most years since 2013 (except 2021)
- 2023 was lower than any year prior to 2007
- Early season ice extent has decreased 63% over 46-year time series

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

EBS

Winds & Sea Ice

Hennon

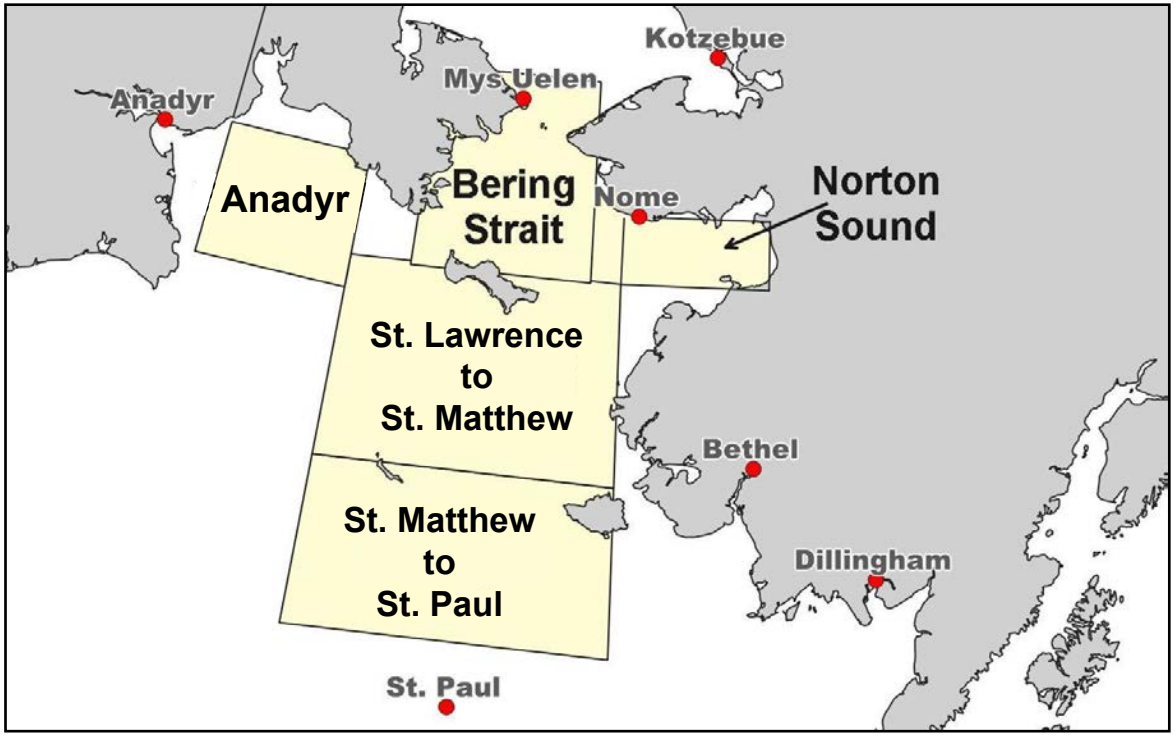


- Ice generally **advances** with **northerly** (from the north) winds and **retreats** with **southerly** winds
- Weak correlation in 2024 due to short-term variability in weather patterns

EBS

Bering Sea Ice Thickness

Thoman



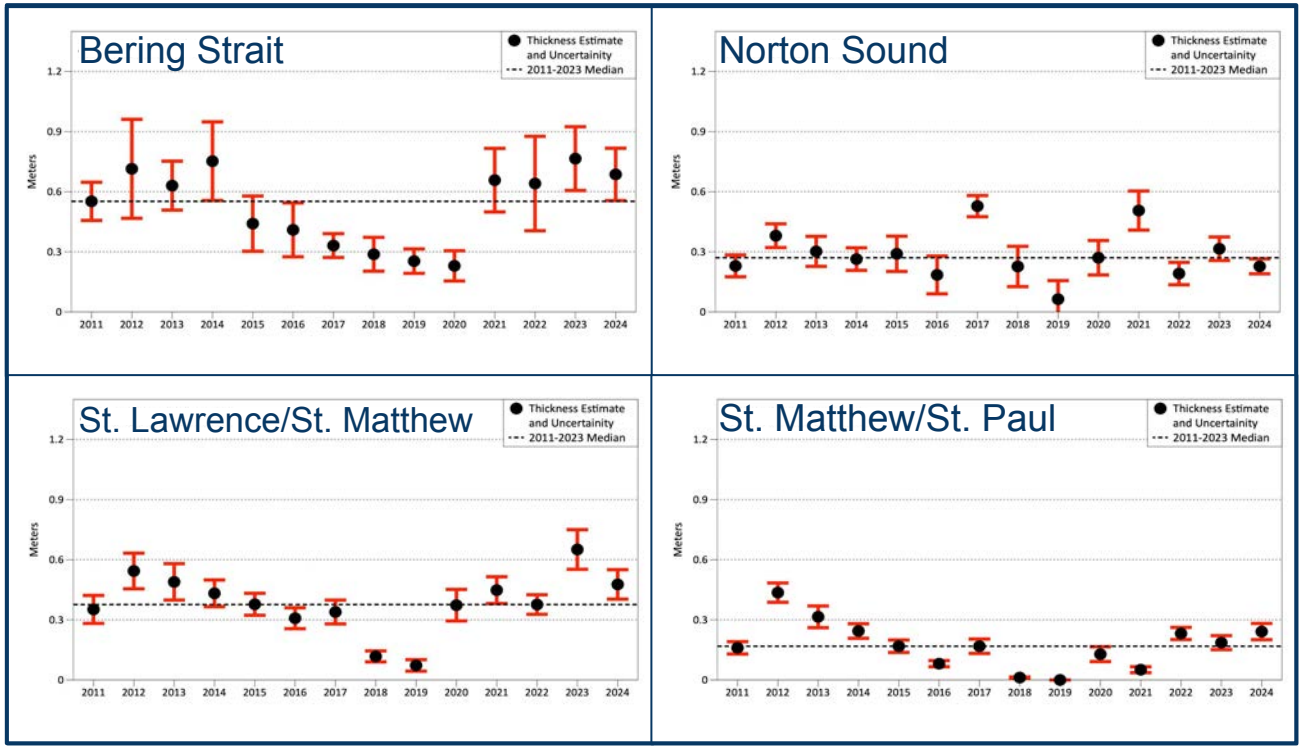
- 3rd week of March
- Ice thickness is related to duration or residency of ice over the shelf

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

EBS

Bering Sea Ice Thickness

Thoman



- 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/

EBS

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

EBS

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EBS

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

EBS

Sea Ice shinyapp

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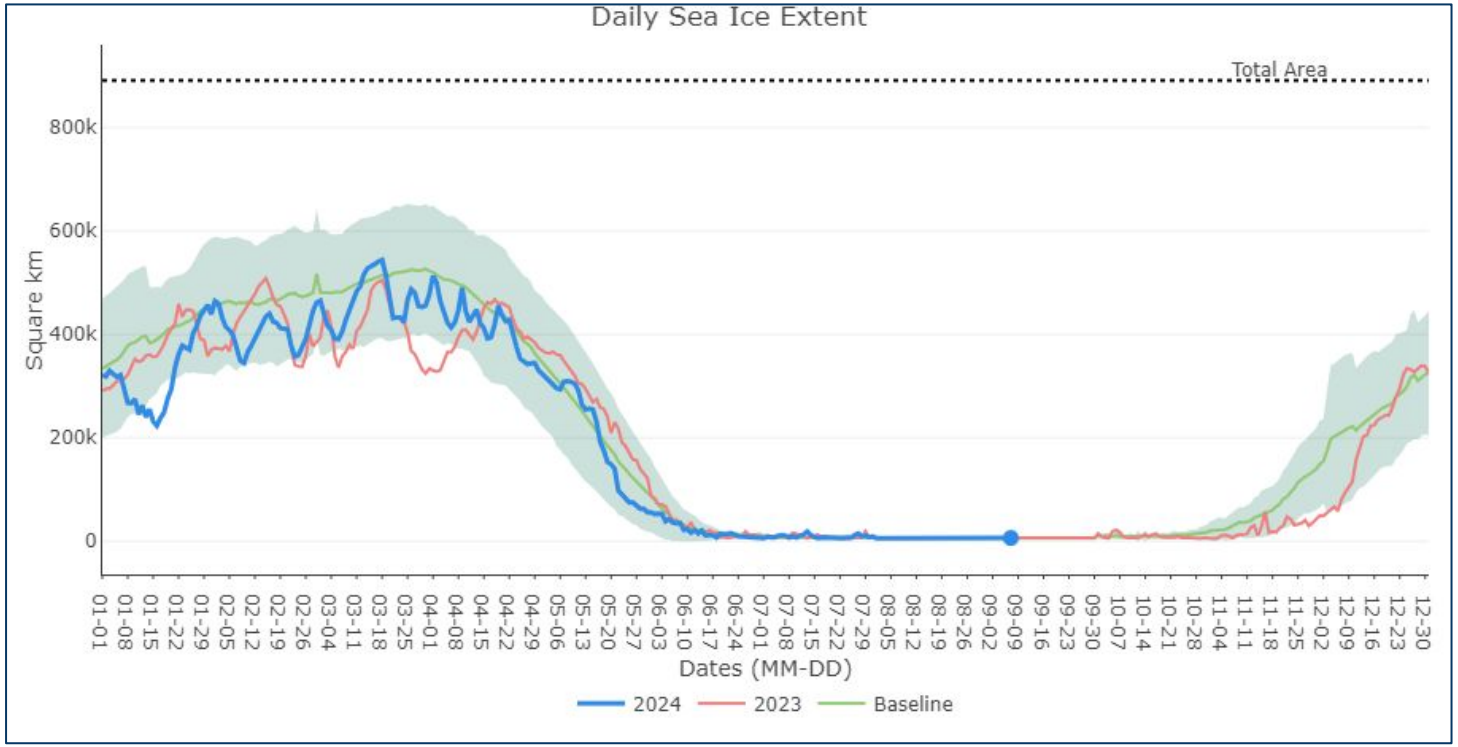

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Sea Ice shinyapp

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Data access and method description

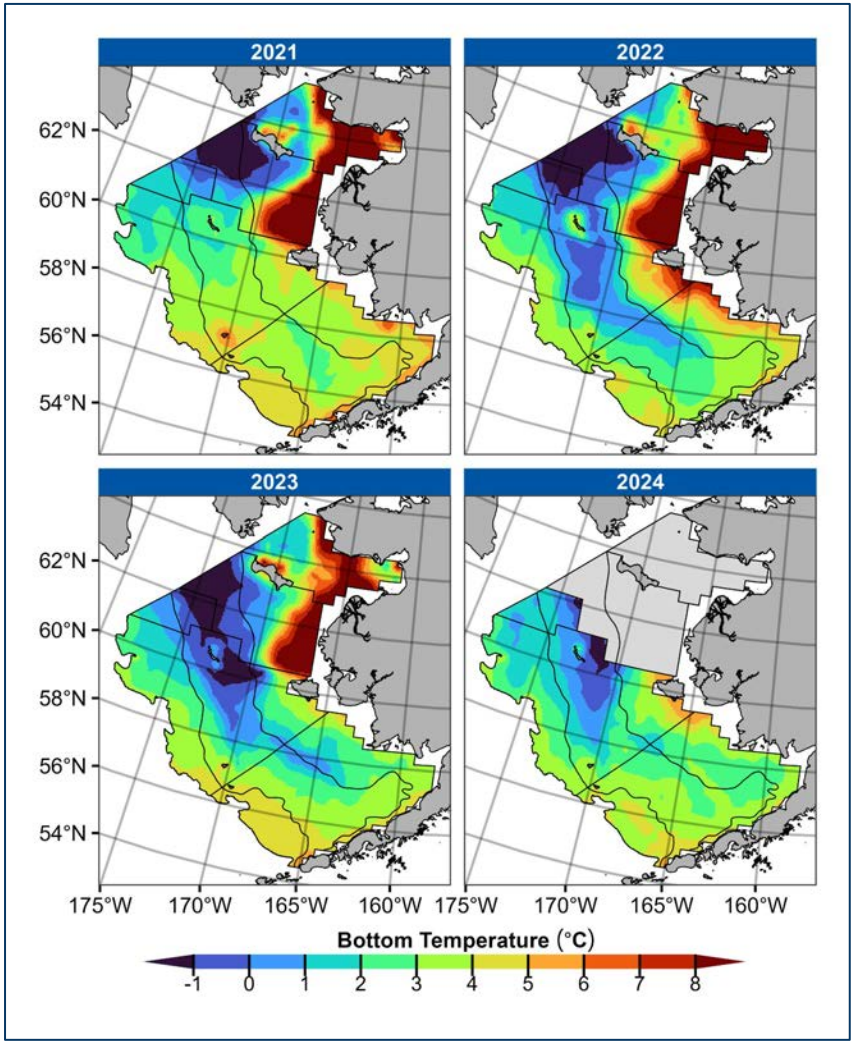
The chart data is available for download, and the data sources and calculation methods can be found on the methods page:

- 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]

EBS

Cold Pool

Rohan & Barnett

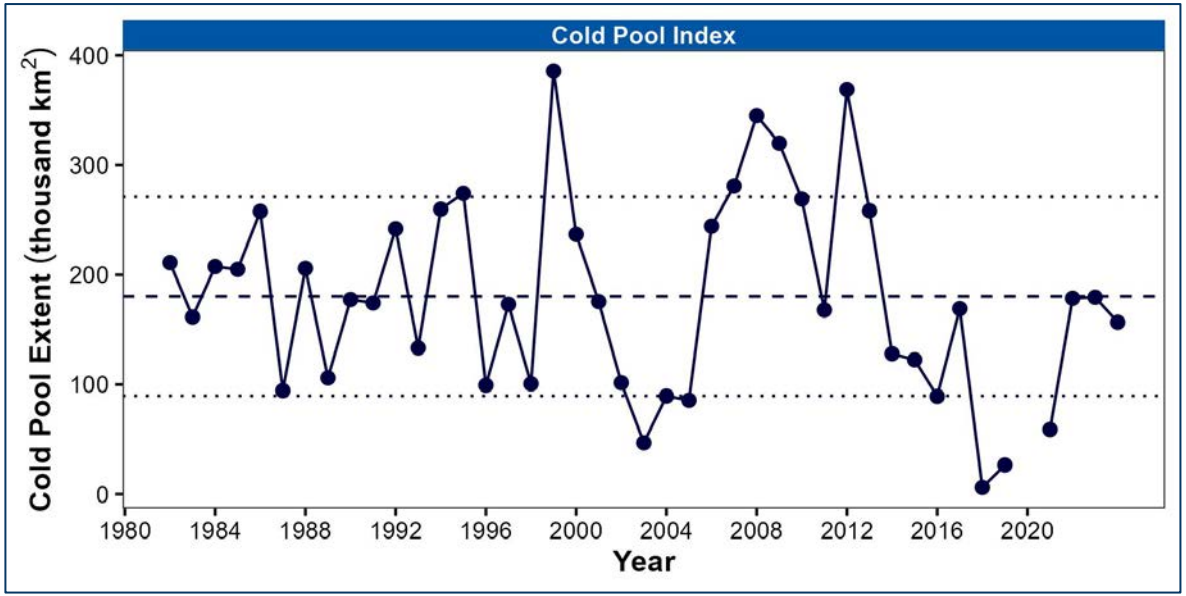


- 2024 bottom temperatures within the standard grid were near the time series average and slightly warmer than 2023

EBS

Cold Pool

Rohan & Barnett

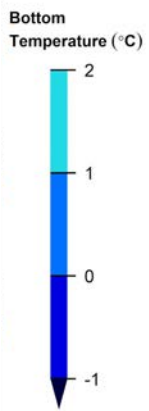


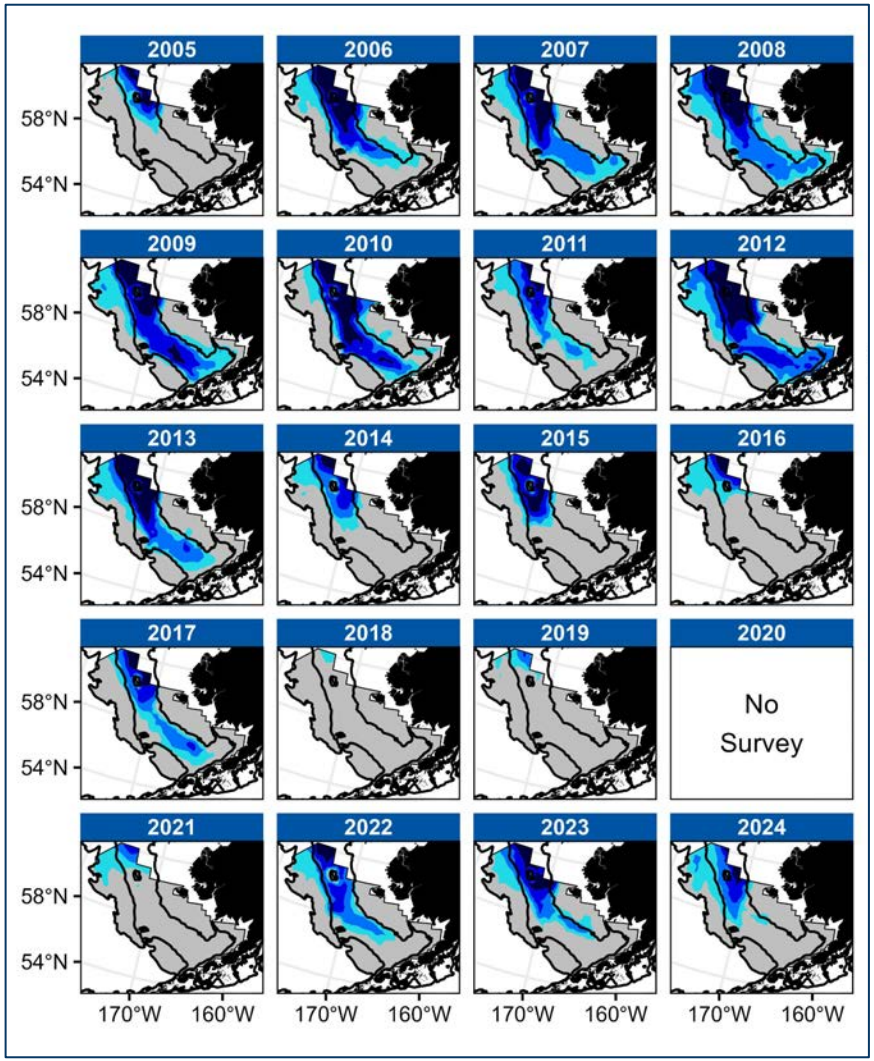
- 2024 cold pool extent (<2°C; km^2) within the standard grid was near the time series average
- 11% smaller than 2023

EBS

Cold Pool

Rohan & Barnett



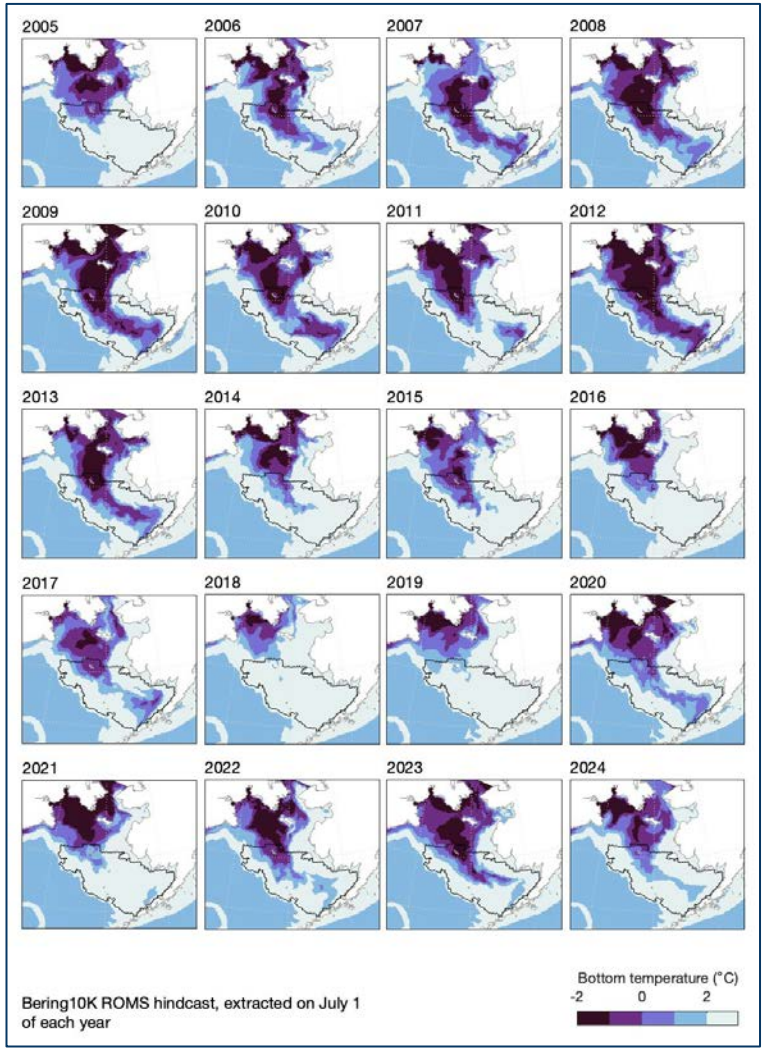


- 2024 cold pool extent (<2°C; km^2) within the standard grid was near the time series average
- 11% smaller than 2023

EBS

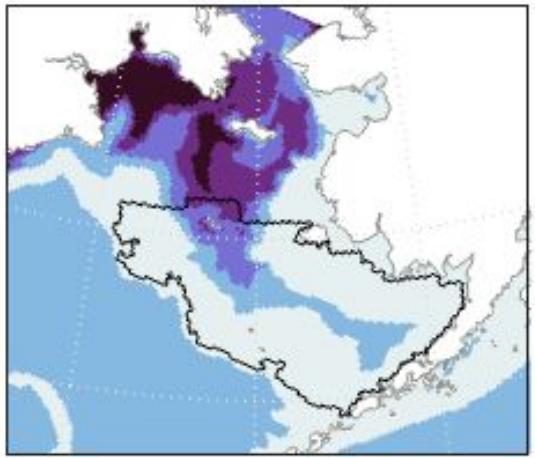
Cold Pool

Kearney



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

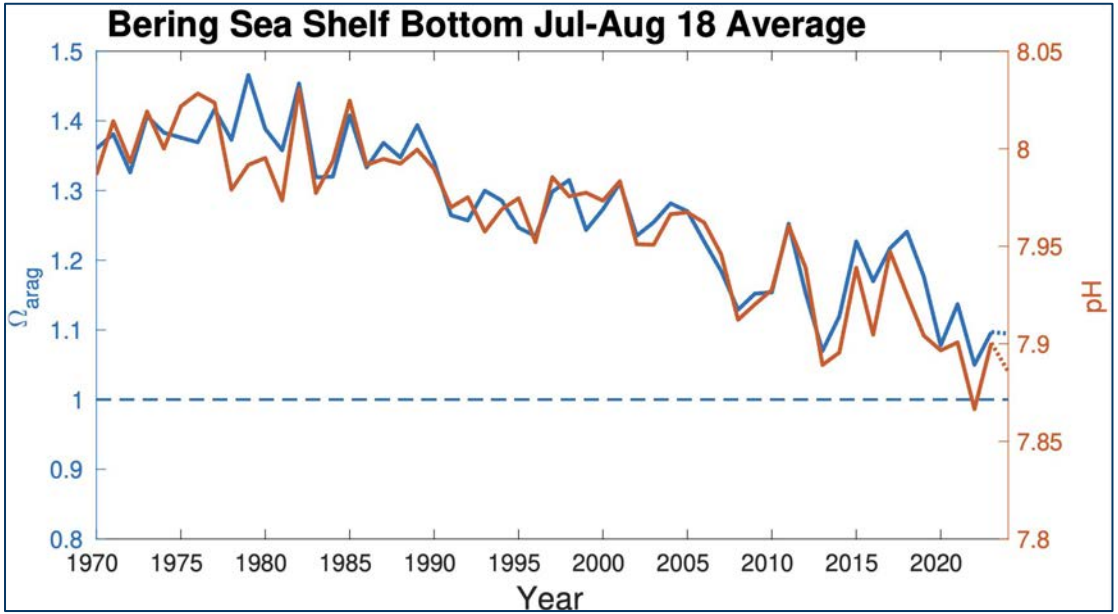
2024

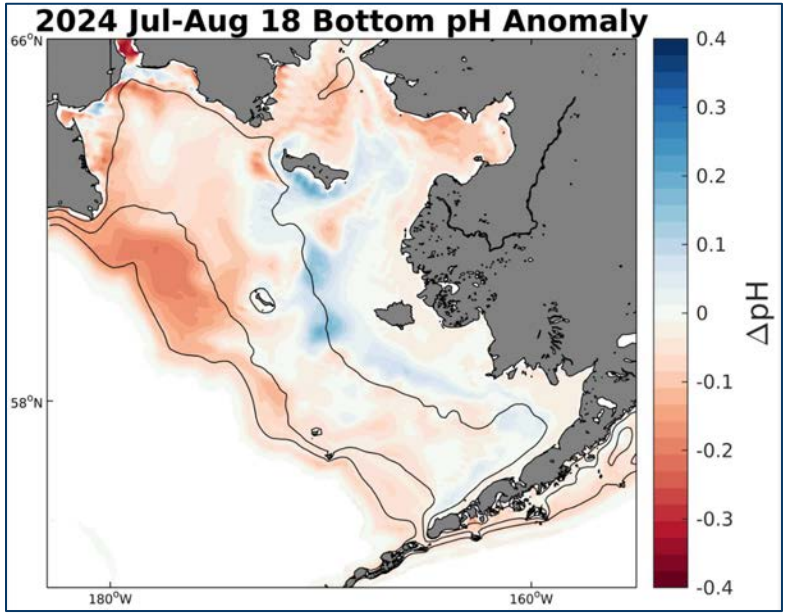


EBS

EBS Ocean Acidification

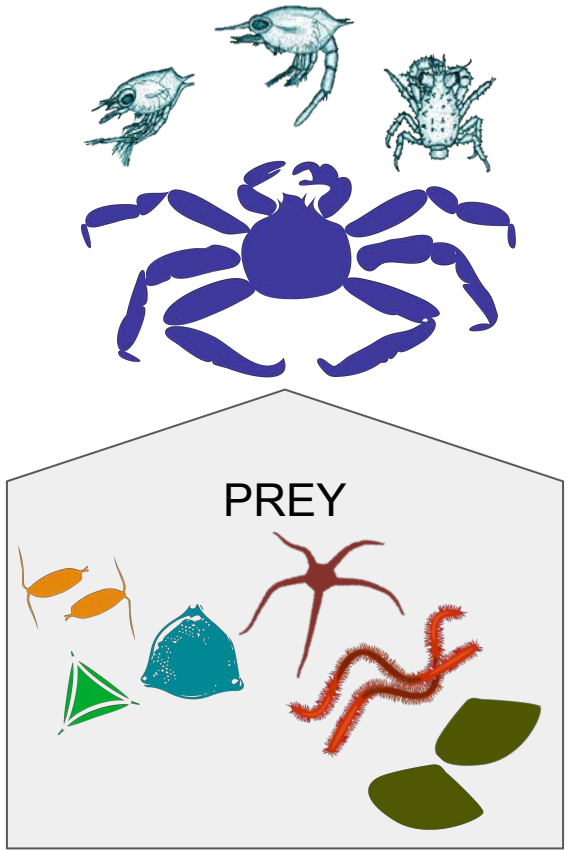
Pilcher & Monacci





- 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

EBS



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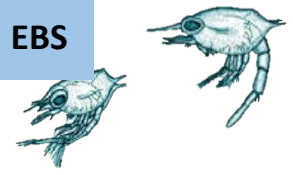
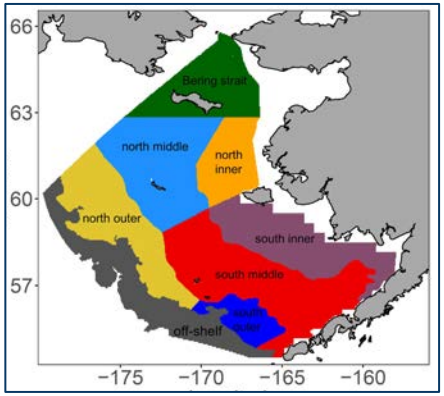
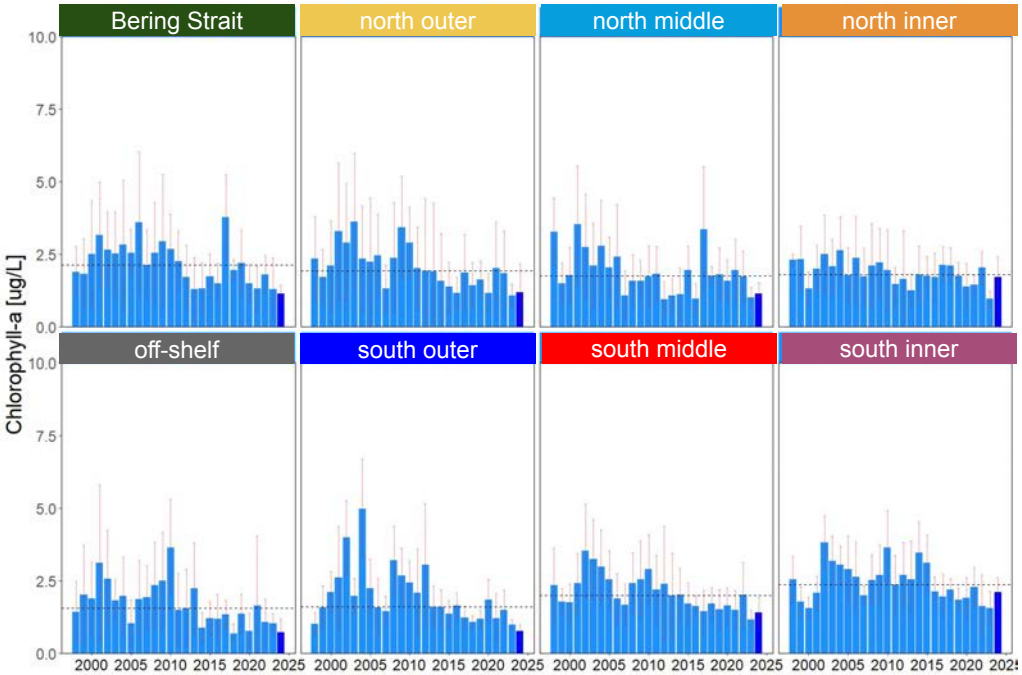




2024 Spring Bloom

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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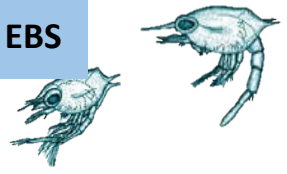

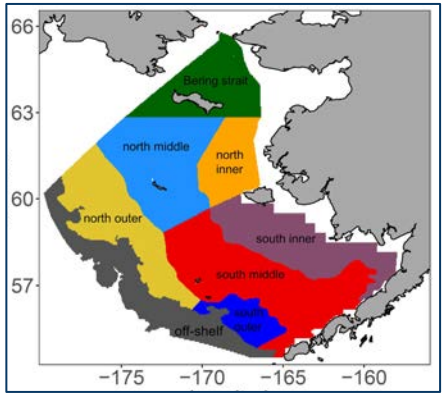

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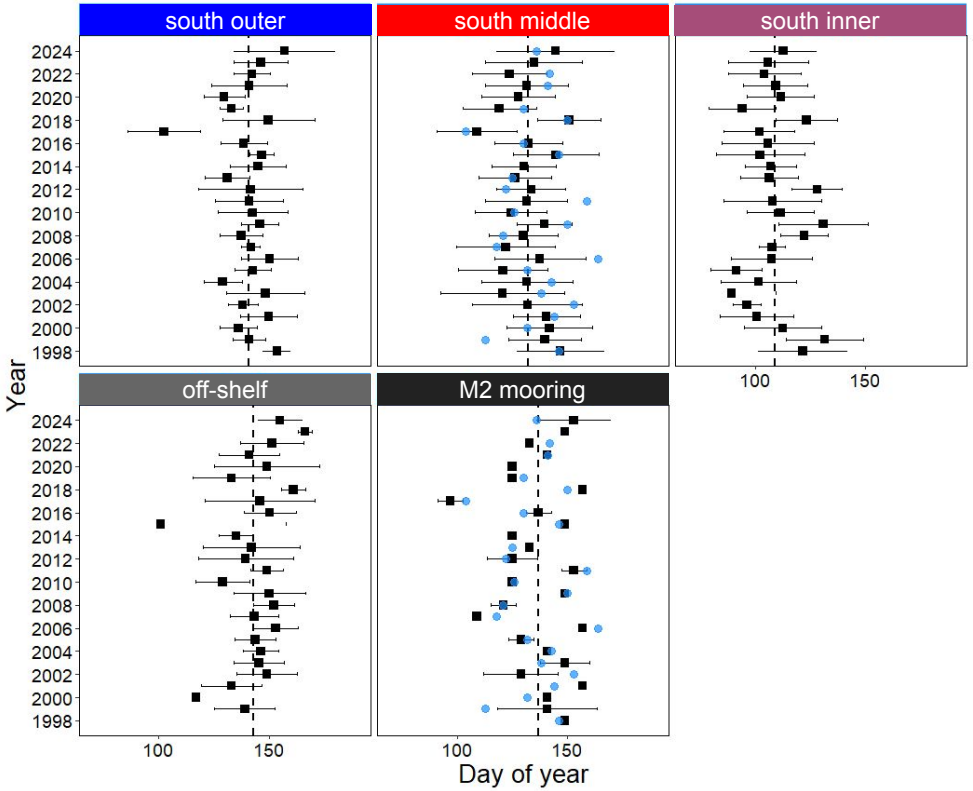
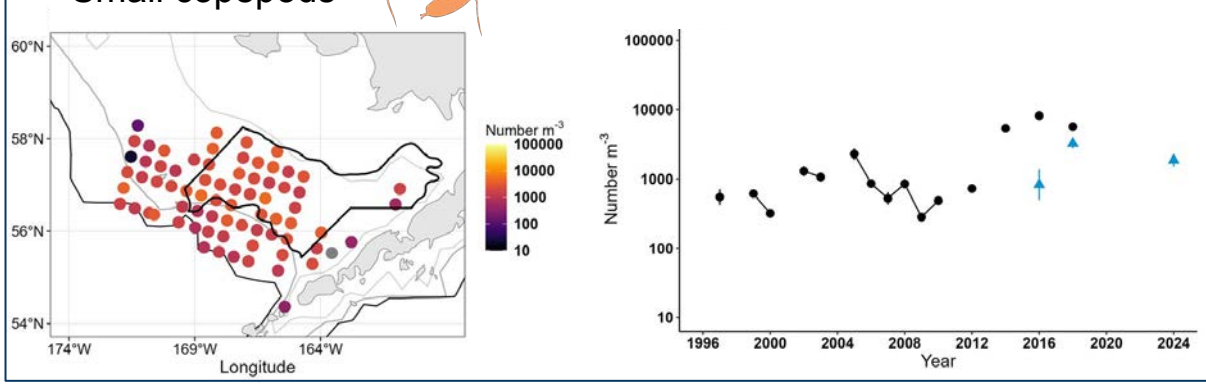


EBS

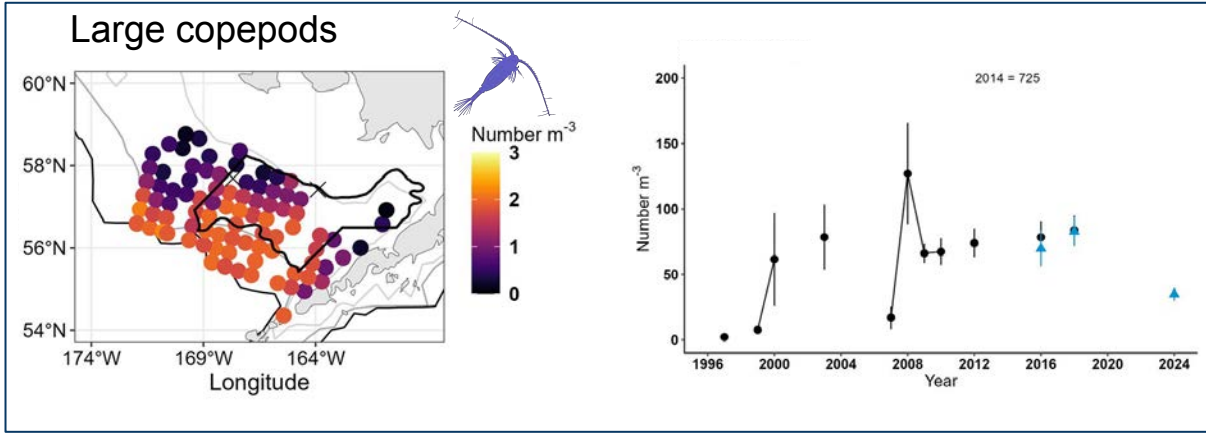
Spring 2024
Rapid Zooplankton Assessment

Kimmel

Small copepods



Large copepods

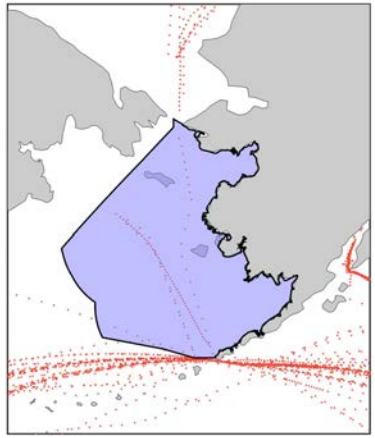


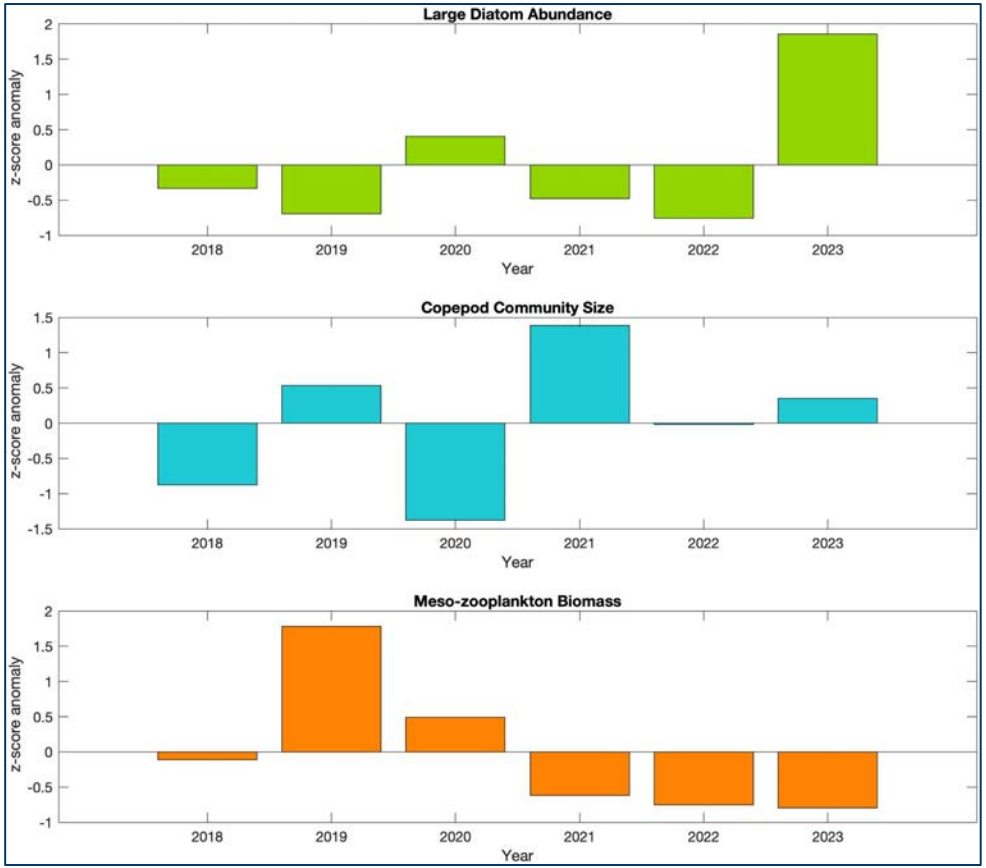
- Small copepod abundances lower than recent warm years, but higher than cold year abundances
- Large copepods low, similar to cold years after warm periods (note map scale is log10)
- Euphausiid numbers (not shown) very low, typical of spring

EBS

2023 Continuous Plankton Recorder

Ostle & Batten



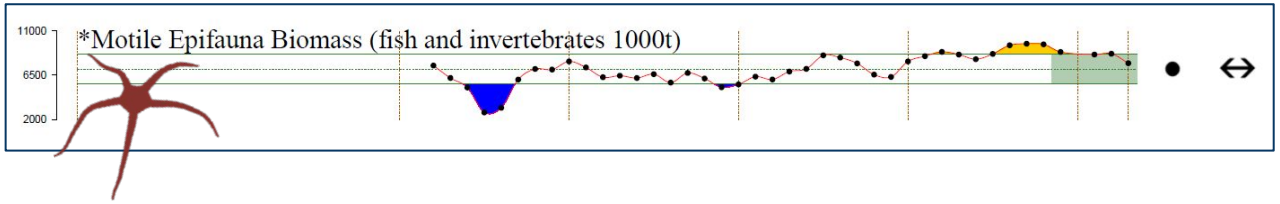


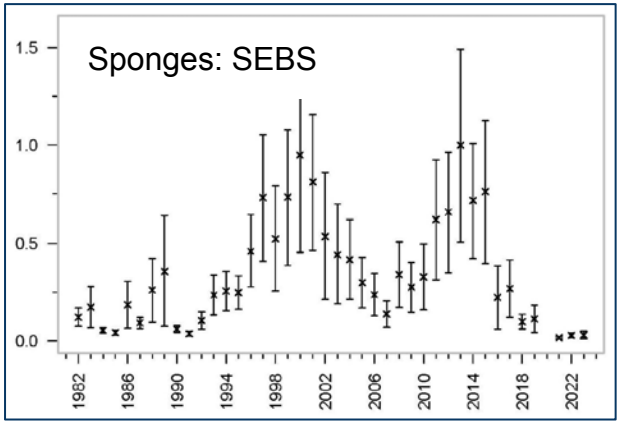
- Diatom abundance was positive in 2023
- Copepod community size was slightly positive in 2023, where it had been neutral in 2022
- Mesozooplankton biomass continued a negative trend since 2019

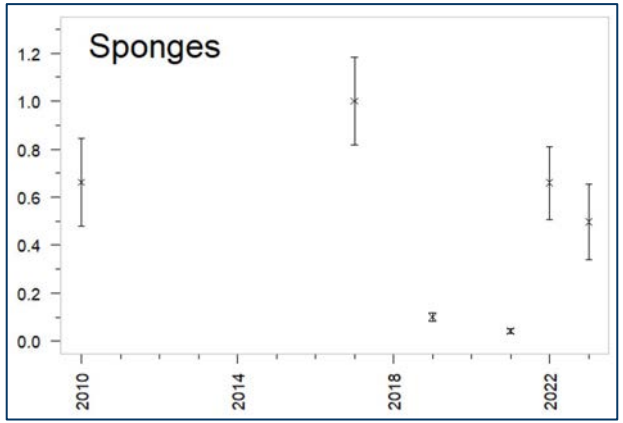
EBS

2023 Echinoderms and Sponges

Whitehouse, Buser



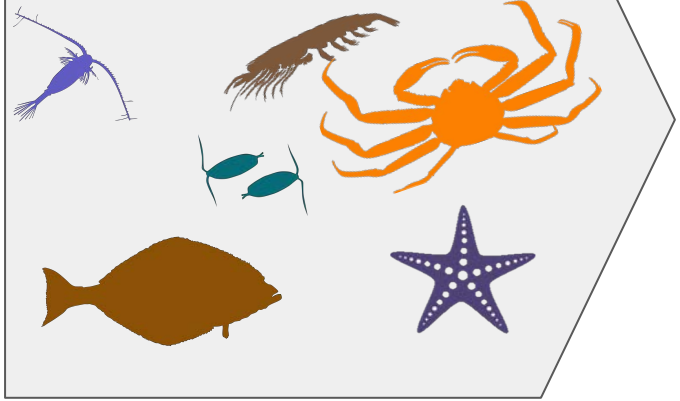


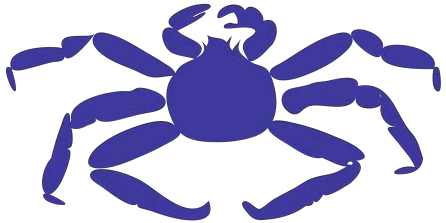


- Echinoderms account for more than 50% of the biomass in the motile epifauna guild
- All remain above their long term means
- Catch rate of sponges in the SEBS continued to be very low in 2023; catch rate in NBS variable, but higher in 2023

EBS

COMPETITORS



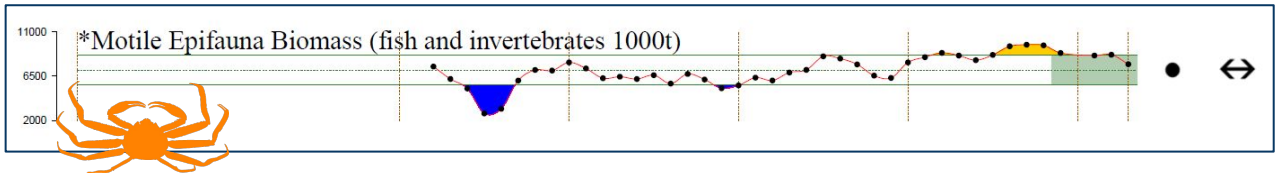


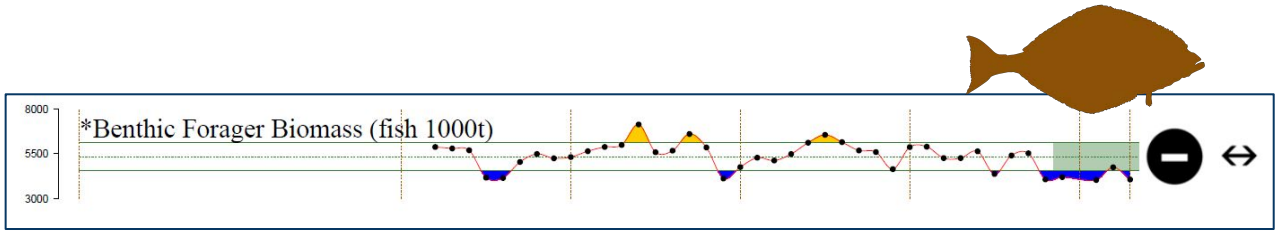
EBS

2023 Motile Epifauna and Benthic Foragers

Whitehouse

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





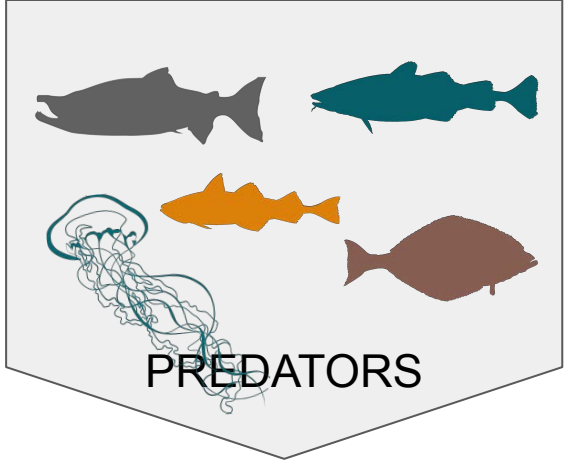
Indicates benthic productivity

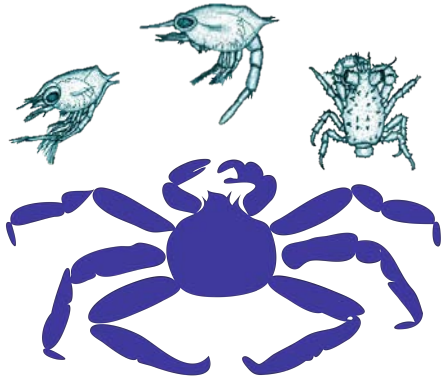
- Motile epifauna biomass peaked in 2017 and remains above the long-term mean, but declined from 2022 to 2023

Indirect indicator of infauna

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

EBS



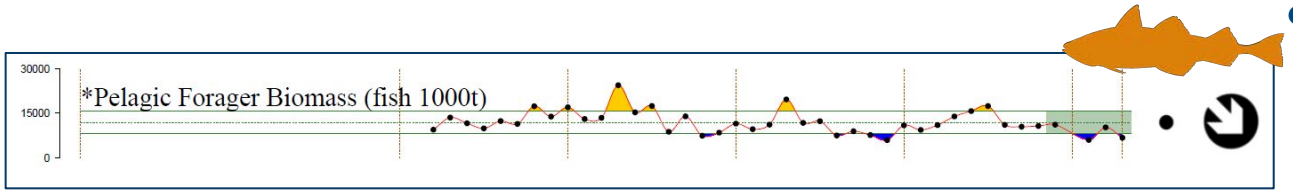


EBS

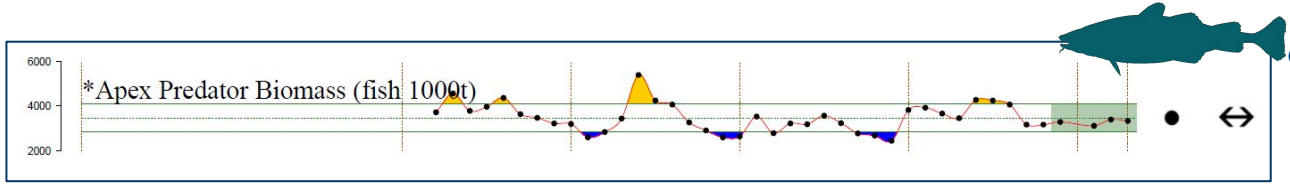
2023 Pelagic Foragers and Apex Predators

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

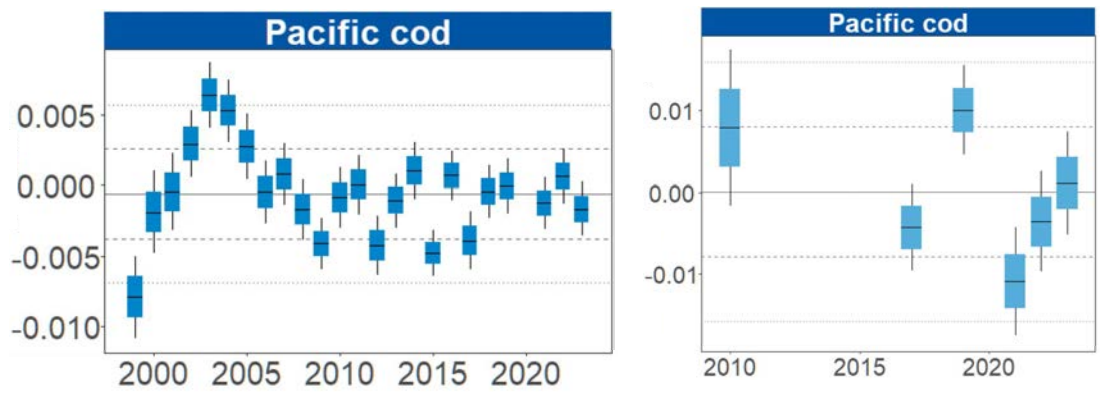


- Apex predators (P. cod and ATF) were at their long-term mean in 2023

EBS

2023 Adult Pacific Cod Condition

Prohaska & Rohan

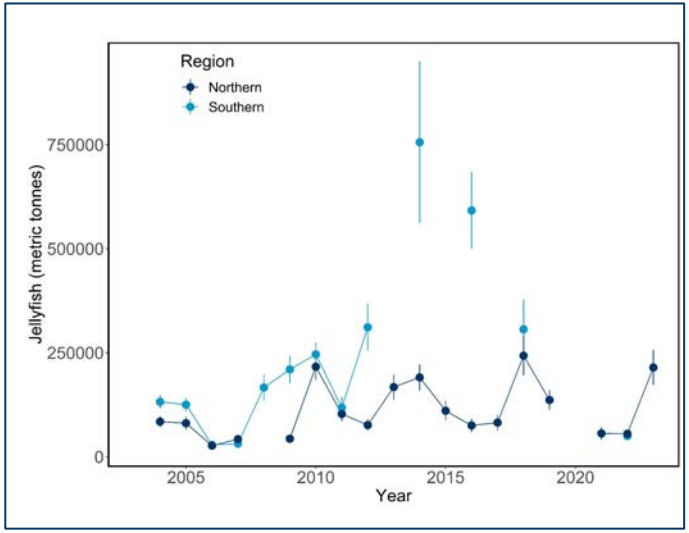


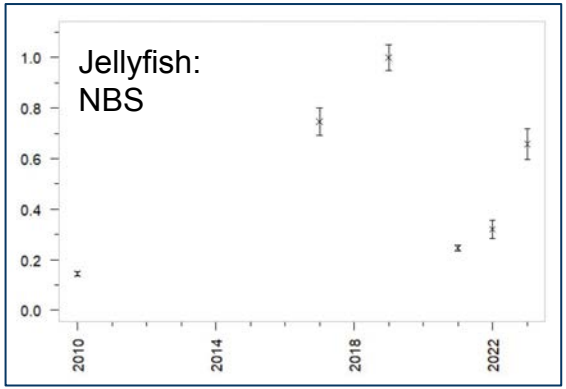
- EBS: PCod condition negative and lower than 2022
- NBS: PCod condition increased from 2022 to 2023

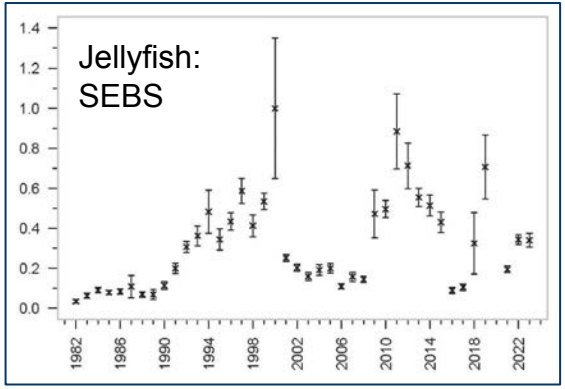
EBS

2023 Jellyfish

Yasumiishi, Buser







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

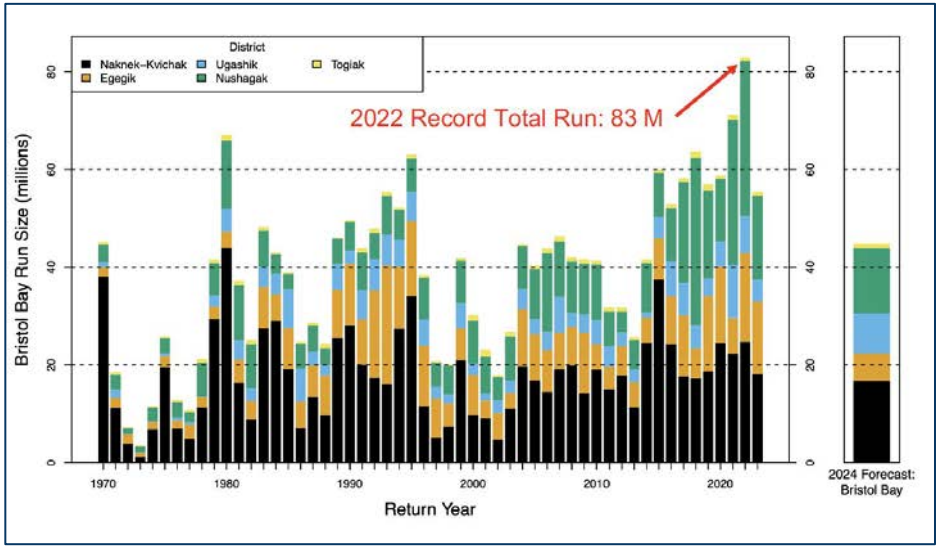
EBS

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

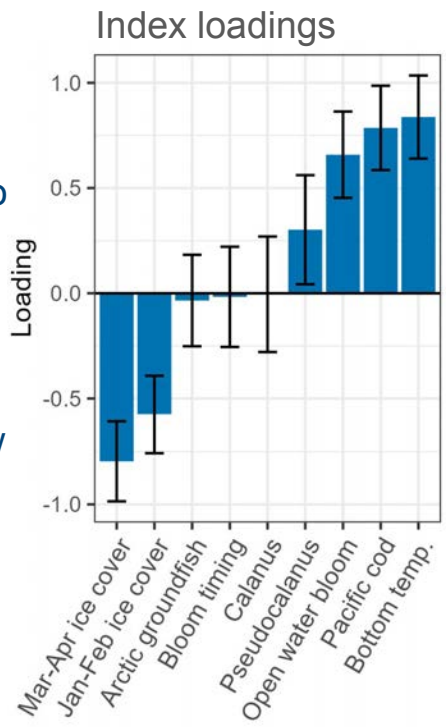


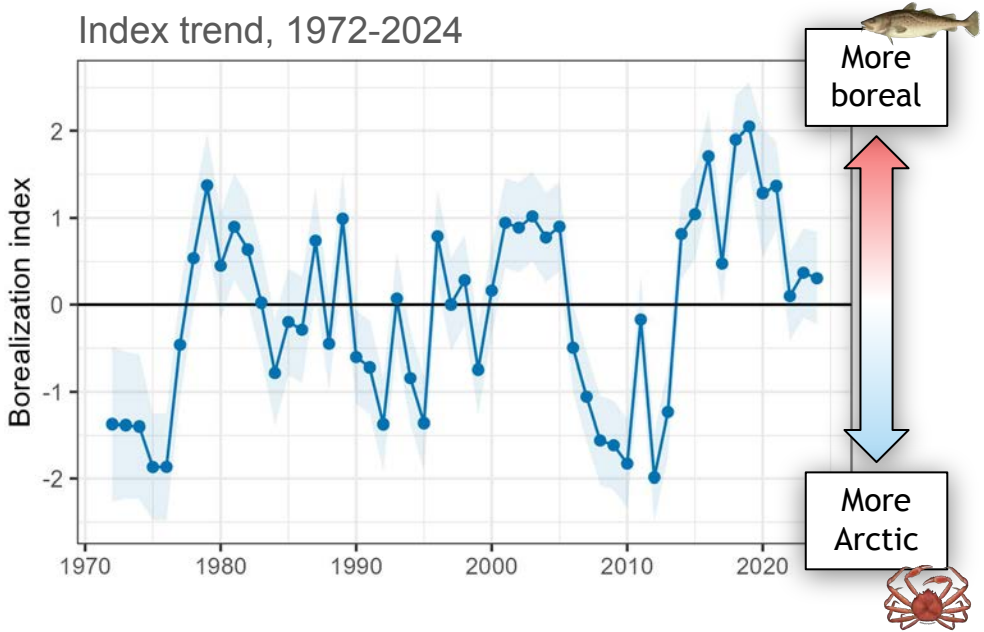
EBS

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

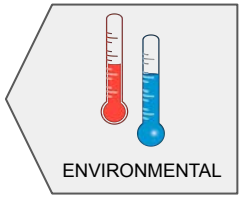
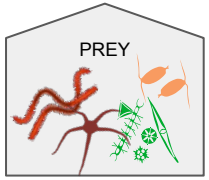
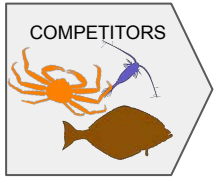
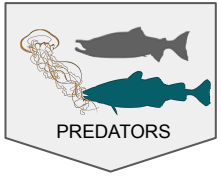




Error bars & ribbon = 95% CI

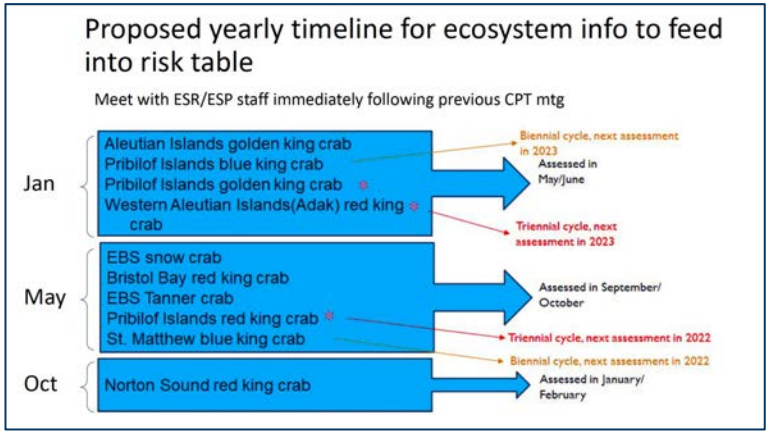
EBS

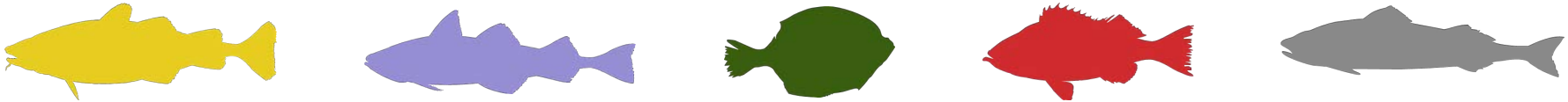
Summary

	• 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