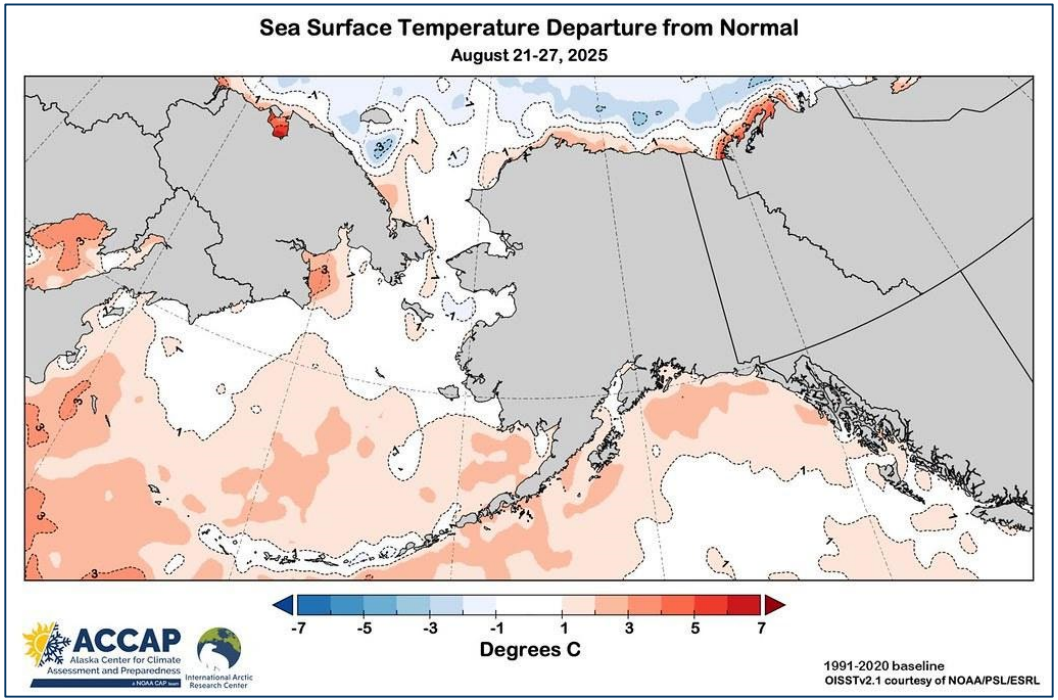
Eastern Bering Sea
Ecosystem Status Report

NPFMC Crab Plan Team
September 8, 2025

Elizabeth Siddon



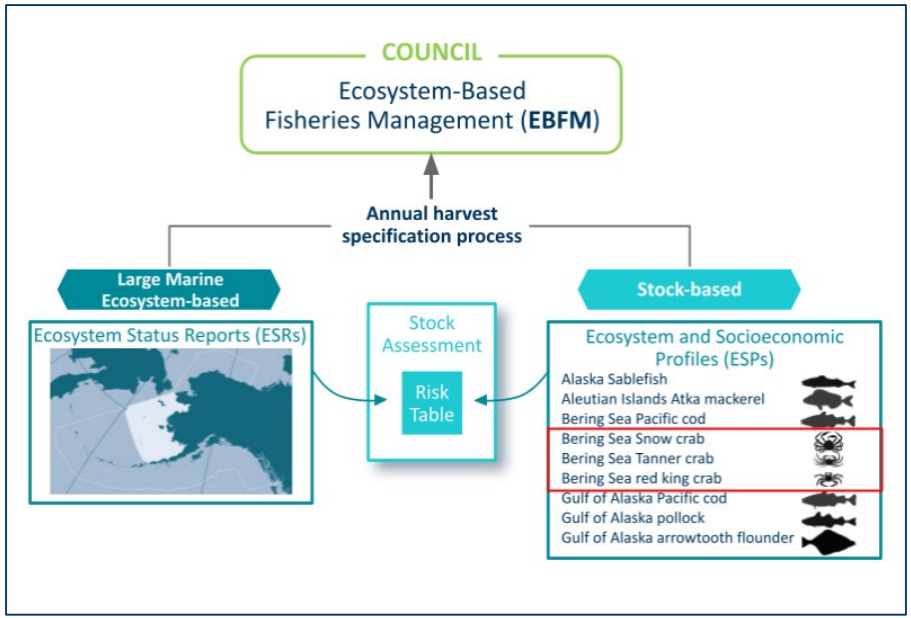
Outline

- ESRs and ESPs are complementary
- Environmental processes, prey, competitors, predators
- Pelagic and benthic stages
- 2024 and 2025 (where available) information

Ecosystem Status Reports (ESRs) & Ecosystem and Socioeconomic Profiles (ESPs)

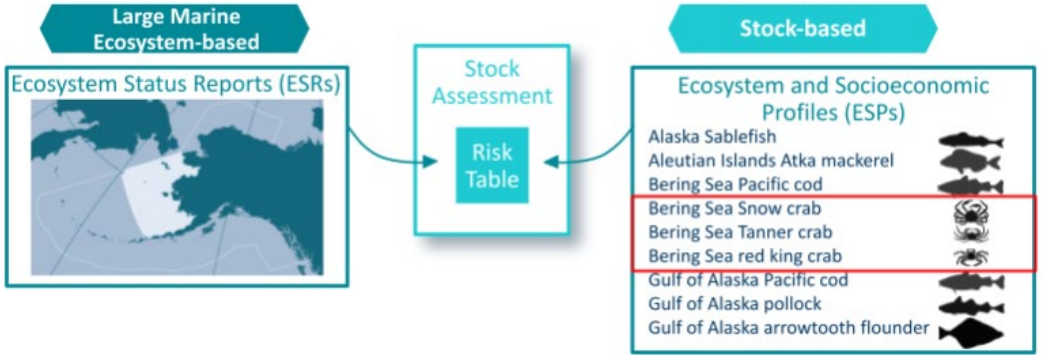
Both ESRs and ESPs allow for incorporating ecosystem information into management decisions. They inform the SSC's ABC and OFL recommendations, as well as final TAC determination.

- ESRs provide Large Marine Ecosystem scale status and trends
- ESRs provide contextual assessments that reflect ecosystem components ranging from physical oceanography up through the food web



- ESPs are stock-specific and appended to stock assessments
- ESPs identify key ecosystem and socioeconomic indicators relevant to the stock assessment model

Risk Tables



- Developed a standardized template for crab Risk Tables
- Collaborated across ESR and ESP teams
- Presented to assessment authors for feedback
- ESRs and ESPs jointly informed 3 Risk Tables
    - ESR informed PIBKC and PIRKC

Risk Table Summary for Eastern Bering Sea Tanner Crab

The following is a synthesis and interpretation of the most recent ecosystem and socioeconomic information available for Eastern Bering Sea (EBS) Tanner crab from the ecosystem and socioeconomic profile (ESP, Hennessey and Garber-Yonts, 2025) and the Eastern Bering Sea Ecosystem Status Reports (ESR, Siddon, 2024; Siddon, 2025, in press). This information may be helpful for evaluating risk table score levels and is organized below by the proposed risk table categories.

We have identified three predictive indicators in the ESP that quantitatively predict recruitment using a Bayesian Adaptive Sampling importance method. These predictive indicators explain a large amount of variation in EBS Tanner crab recruitment using survey design-based estimates ($R^2 = 0.76$) and are emphasized below in **BOLD** (see Hennessey and Garber-Yonts, 2025 for more details).

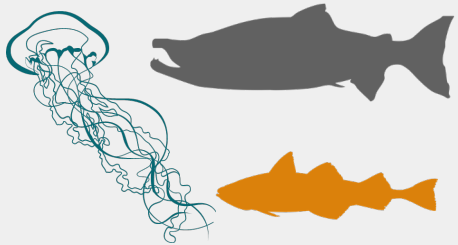
Category Summary:

The summarized results of the risk table for EBS Tanner crab are in the table below. All scores of Level 1 suggesting no need to set the ABC below the maximum permissible.

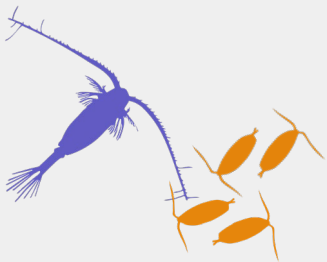
Assessment-related Considerations	Population Dynamics Considerations	Ecosystem Considerations	Fishery-informed Stock Considerations
Level 1: TBD	**Level 1:** Normal	**Level 1:** Normal	**Level 1:** Normal
Note: SSC stated that uncertainty in quantification of reproductive output should go in this section, rather than population dynamics	The majority of stock-specific ecosystem indicators related to natural mortality, growth, and recruitment suggest no additional concerns. While bitter crab disease prevalence was high, the magnitude of impact on the stock remains unknown.	Warm conditions with a reduced cold pool extent in 2024; forecast to be warm with delayed sea ice arrival in 2025. While bottom waters were warm in 2025, ecosystem concerns are minor with uncertain impacts on the stock. Corrosive bottom waters remain a concern for growth and survival. Competitive pressure may be low, while predation pressure may be increasing.	Fishery-informed indicators generally support stable stock condition relative to the most recent seasons and the post-2005 historical record. No considerations observed in the most recent fishery suggest greater than normal risk of overfishing, independent of other considerations captured in the assessment and risk table.

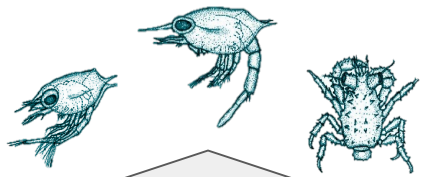
Pelagic stage indicators

PREDATORS

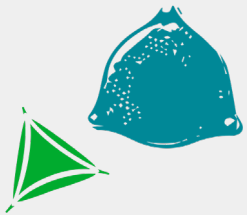


COMPETITORS





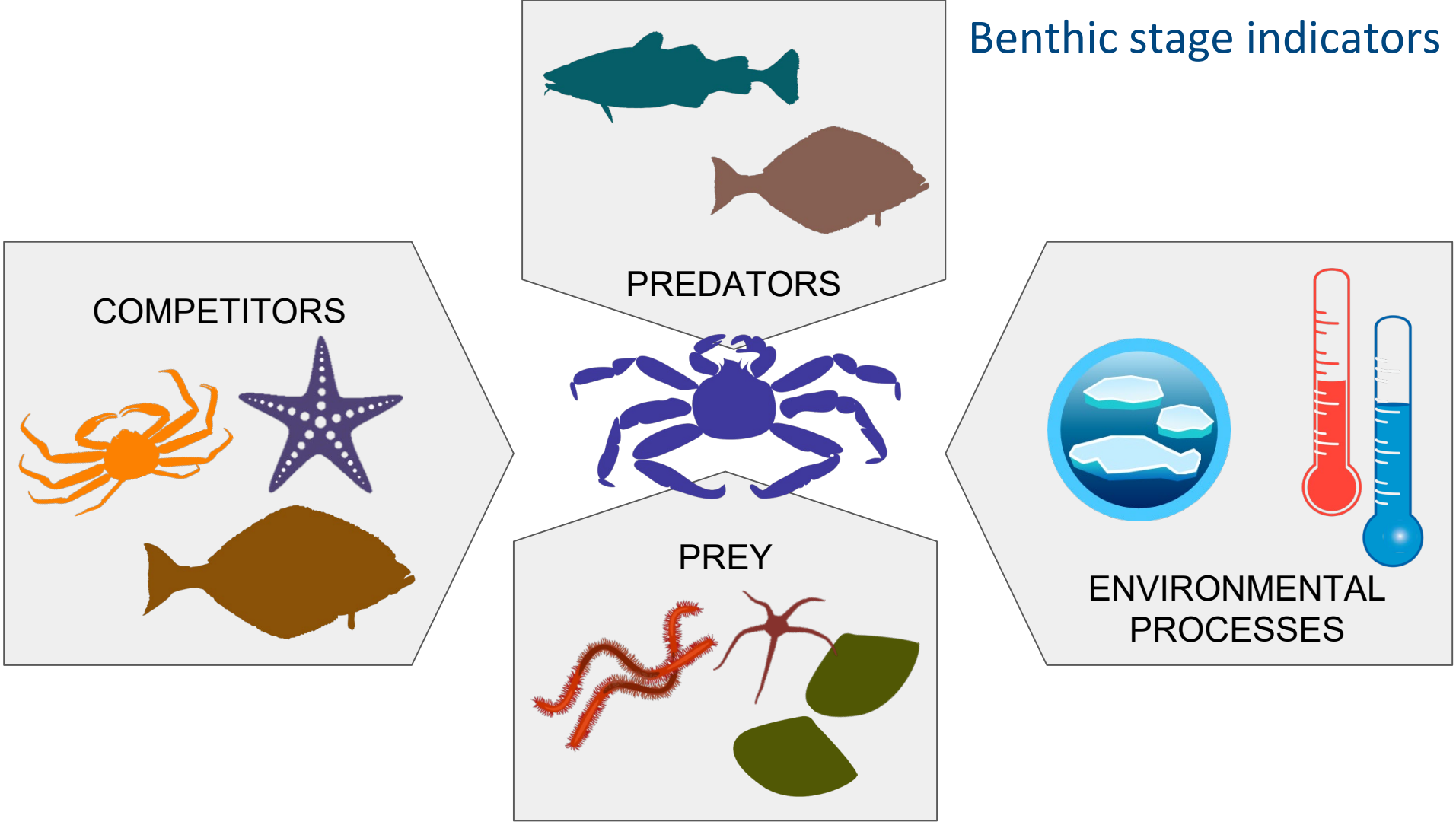
PREY

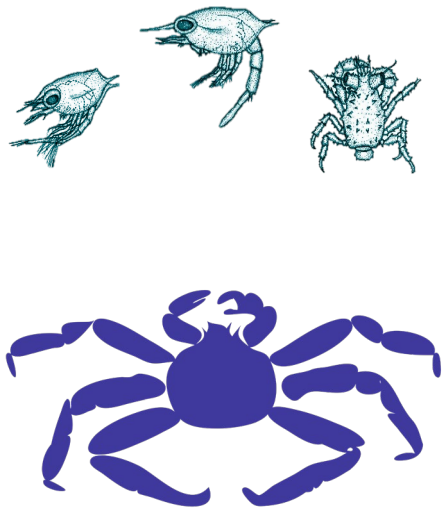


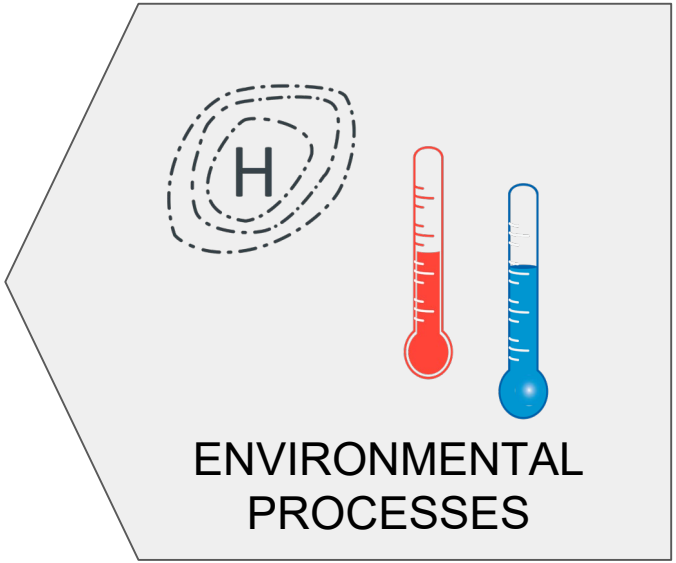
H

ENVIRONMENTAL PROCESSES

Benthic stage indicators

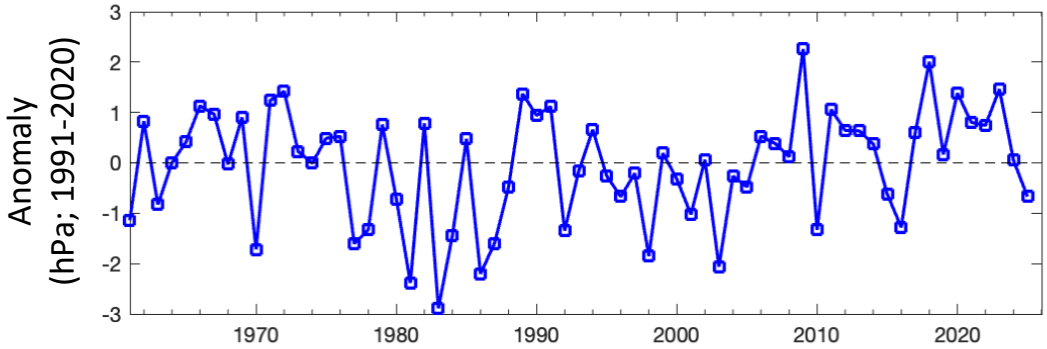




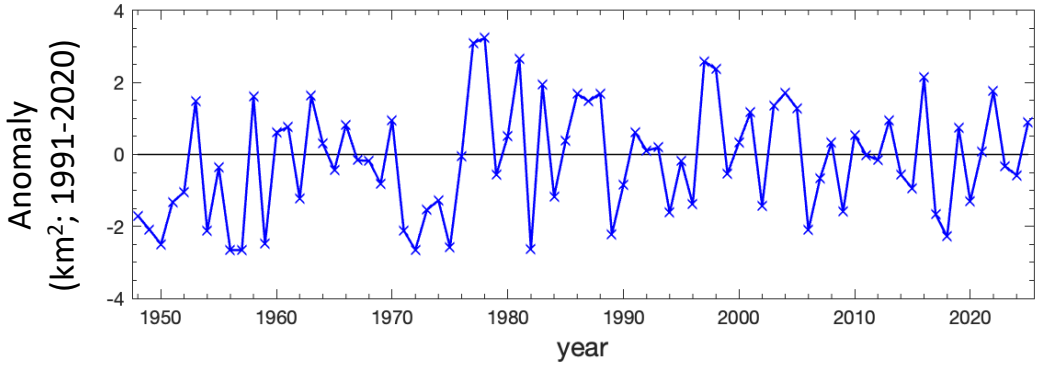

H
ENVIRONMENTAL
PROCESSES

Atmospheric Conditions

North Pacific Index (Nov-Mar)



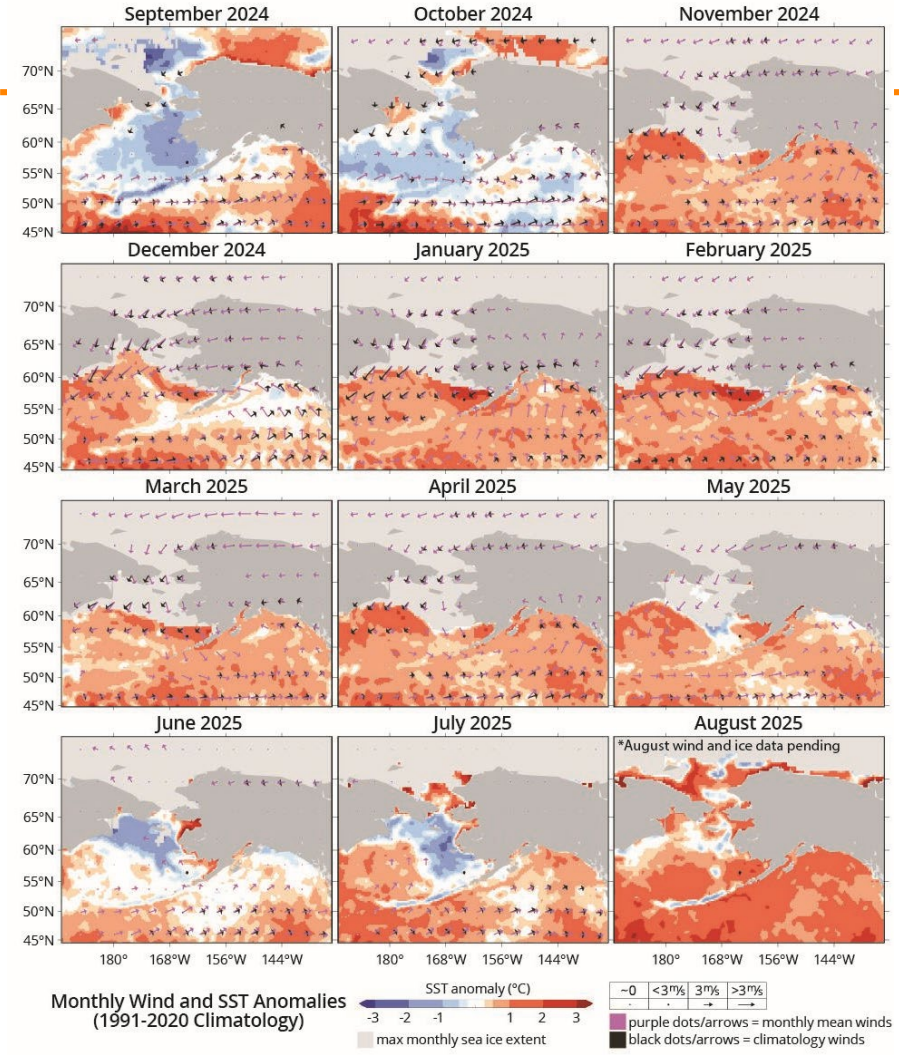
Aleutian Low Index (Jan-Feb)



- Winter 2024-2025 North Pacific Index was negative
  - 1st time in 9 years
- Aleutian Low Index was positive
- The Bering Sea was ***warm, stormy, and had less sea ice***

(Wang)

Sea Surface Temperature and Winds



Fall 2024

- Deep mixed layer resulted in cool SST anomalies over warm temperature anomalies at depth

Winter 2024/2025

- Winds mixed the water column bringing warm temperature anomalies to the surface
- Sea ice arrival is a ‘competition’ between cool winds from the north and melting over warm SSTs; Dec and Feb storms pushed ice north

Spring 2025

- Warm SSTs persisted
- Sea ice ‘stalled’ at 60°N

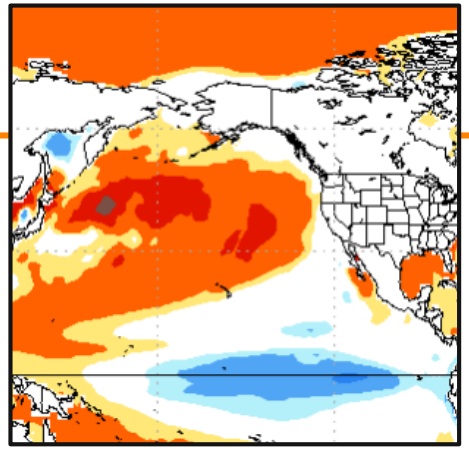
Summer 2025

- Sea ice retreat resulted in cooler SSTs in early summer, increasing to warm over the season

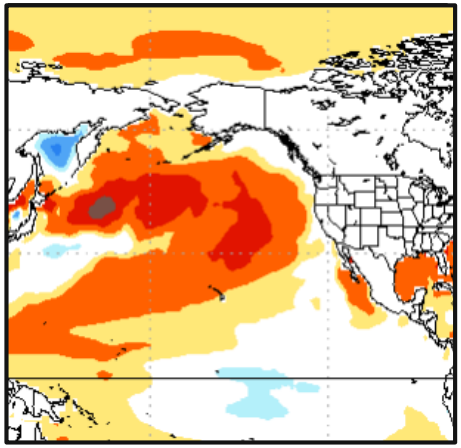
(Lemagie)

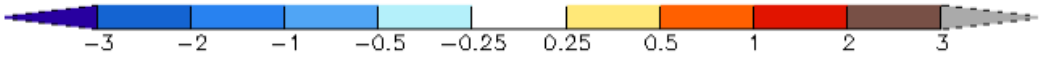
SST Projections from the National Multi-Model Ensemble

Nov 2025 - Jan 2026



Jan - Mar 2026

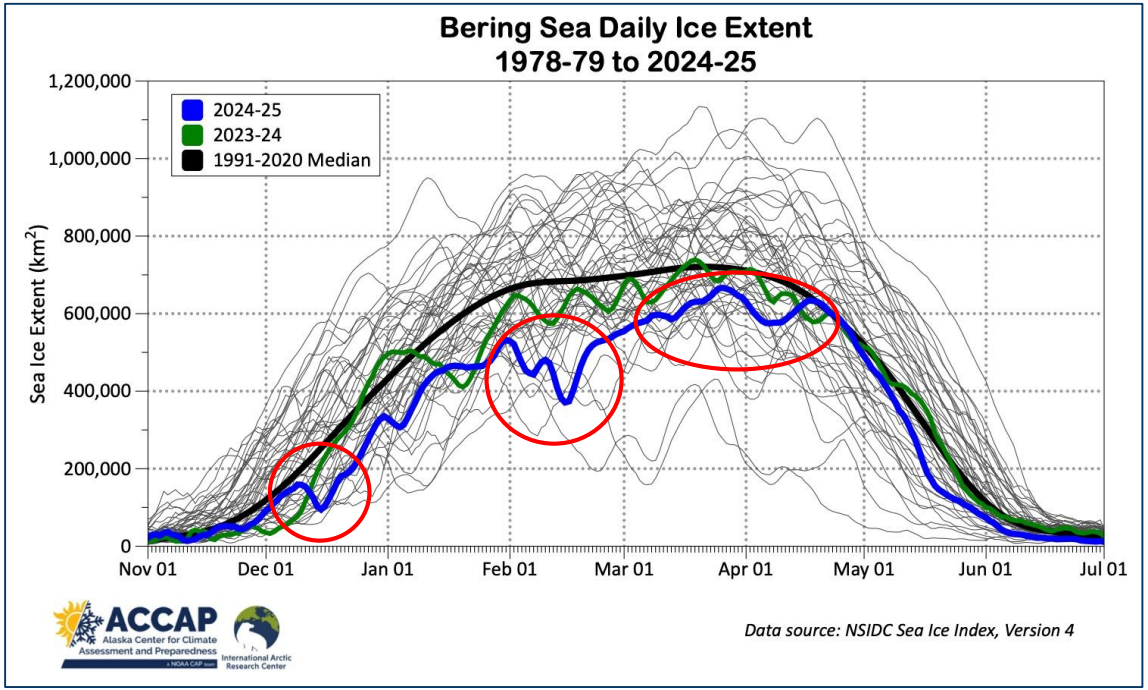




- ENSO-neutral conditions are projected to continue for the next several months
- ***Warm SST*** anomalies are projected to continue over the western-central north Pacific, Aleutian Islands, and southern Bering Sea
- SST anomalies along much of the coastal Gulf of Alaska, northern Bering Sea, and coastal U.S. Arctic are projected to ***remain near the historical mean***

(Lemagie)

Sea ice extent was below average for most of winter 2024/2025; spring ice persisted, but was thin over the southern shelf

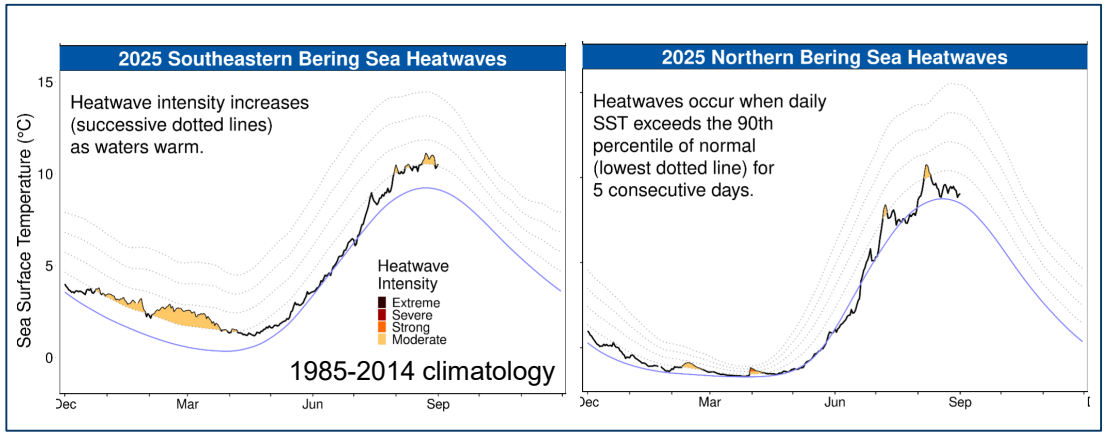


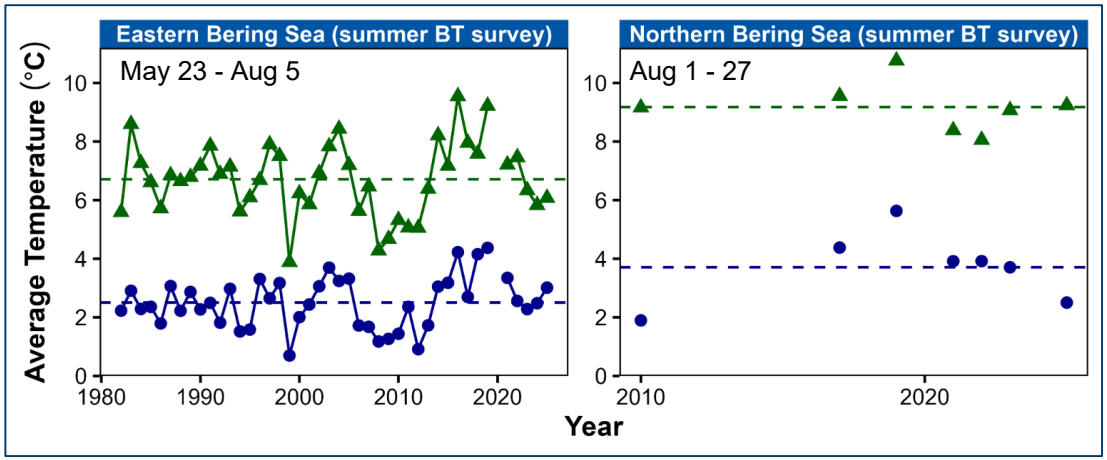
- Sea ice arrived late in fall 2024
- December and February storms led to ice retreat
- Ice stalled at ~60°N in March/April

- Ice is ***expected to arrive later*** in winter 2025/2026 than 2024/2025 due to low ice currently in the Chukchi Sea

(Thoman)

SSTs were warm in the winter-spring 2024/2025 and average in summer 2025



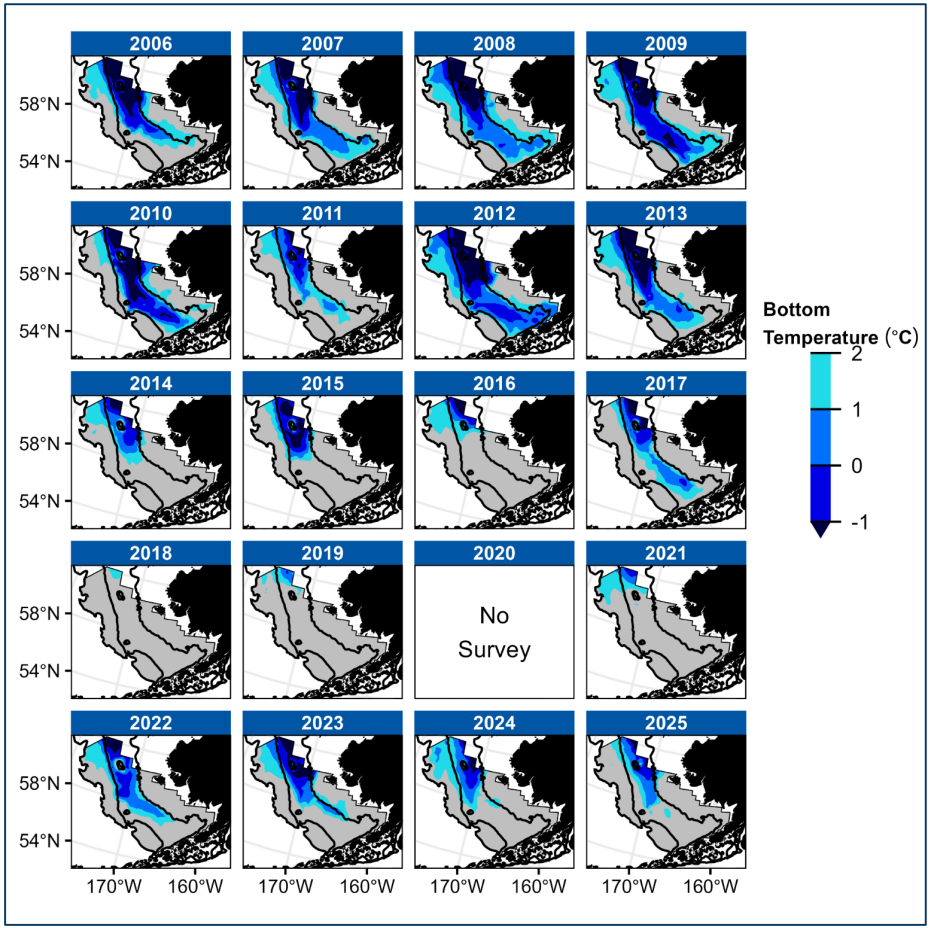


- SEBS: winter-spring MHW event; cooler summer
- NBS: brief and infrequent MHWs

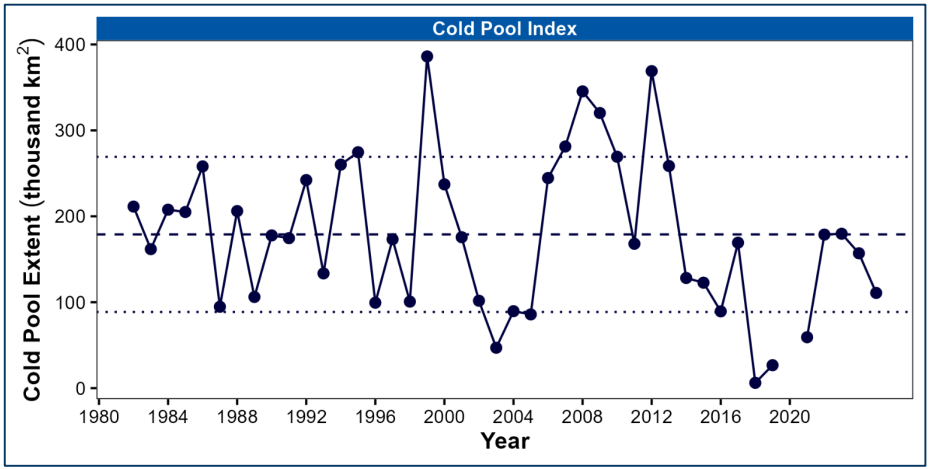
- SEBS survey: SSTs were slightly cool; bottom temps slightly warm
- NBS survey: SSTs were average; bottom temps were coldest since 2017

(Callahan, Rohan)

SEBS: cold pool extent was below average in 2025

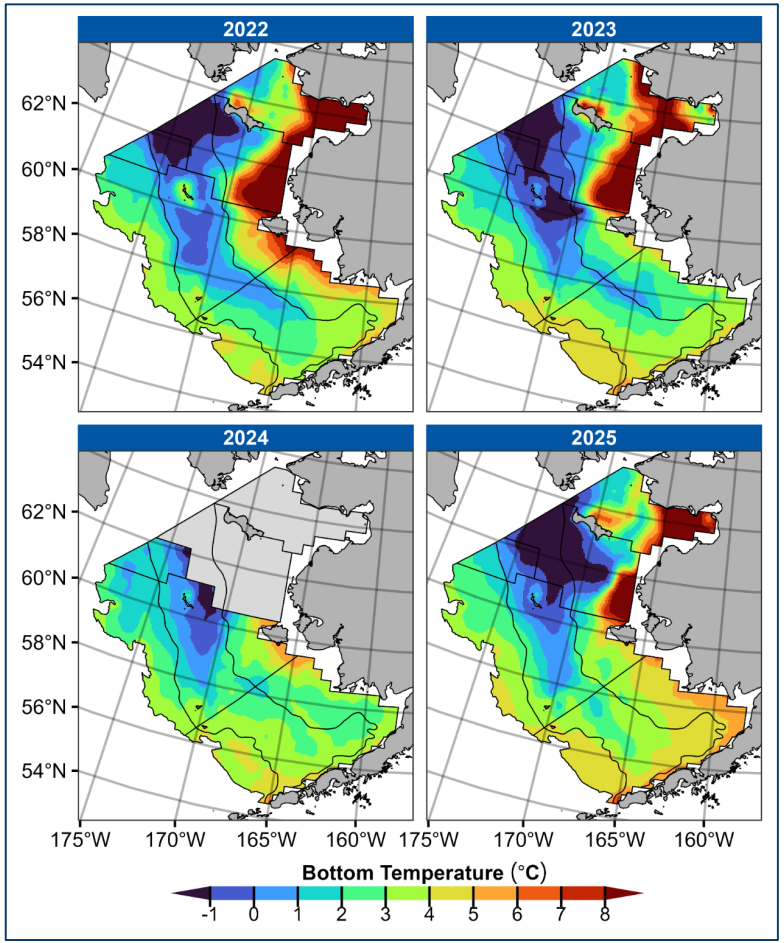


- Cold pool extent below average in 2025
- A 29% decrease from 2024
- Confined to the middle shelf of the SEBS



(Rohan)

NBS: 2025 bottom temperatures were the coldest observed since 2017

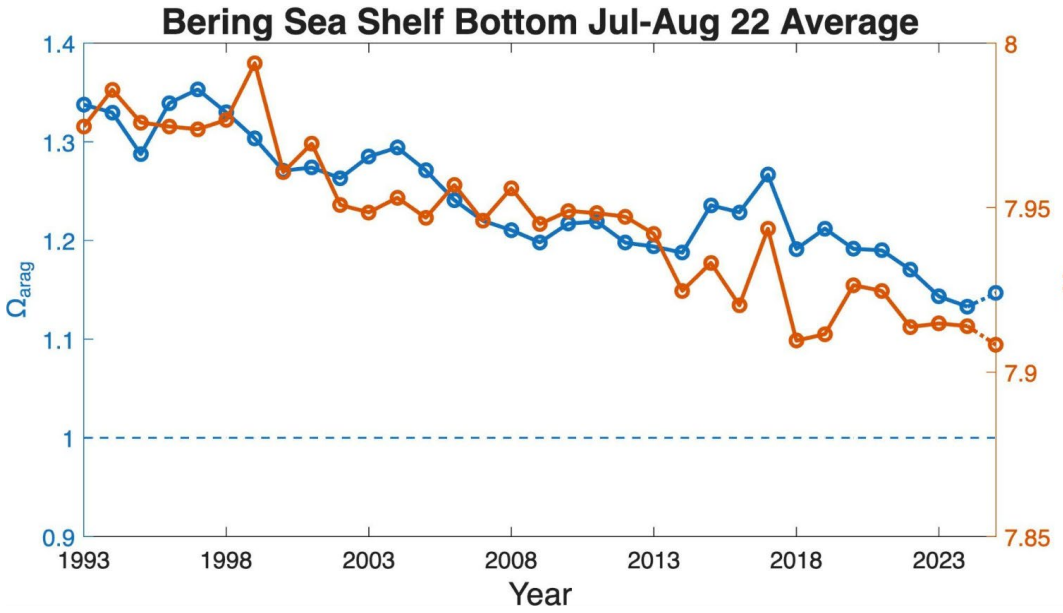


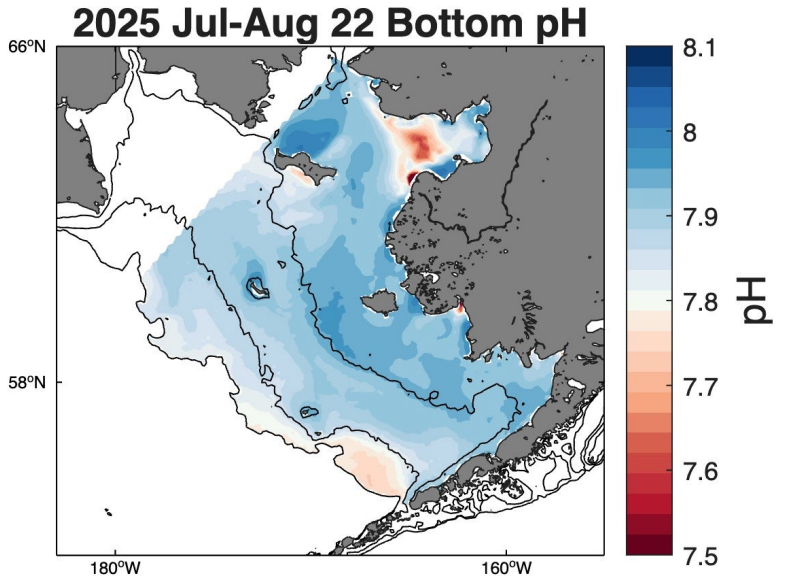
- 2025 had the coldest bottom temperatures since 2017 (2010 had colder bottom temps)
- The cold pool extended further east into the inner domain

(Rohan)

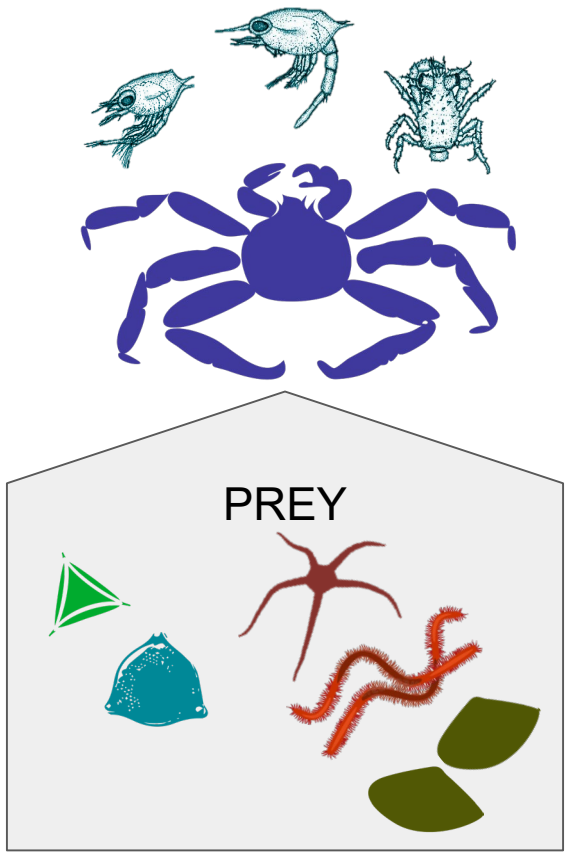
Corrosive bottom waters could impact growth & survival.
Red king crab may be more impacted; snow crab appear resilient to OA.

- Summer 2025 bottom pH slightly lower than 2024
- Inner and middle domain and Bristol Bay relatively well buffered (pH>7.8)
- Slope waters, southeastern outer shelf, and Norton Sound pH<7.8





(Pilcher & Monacci)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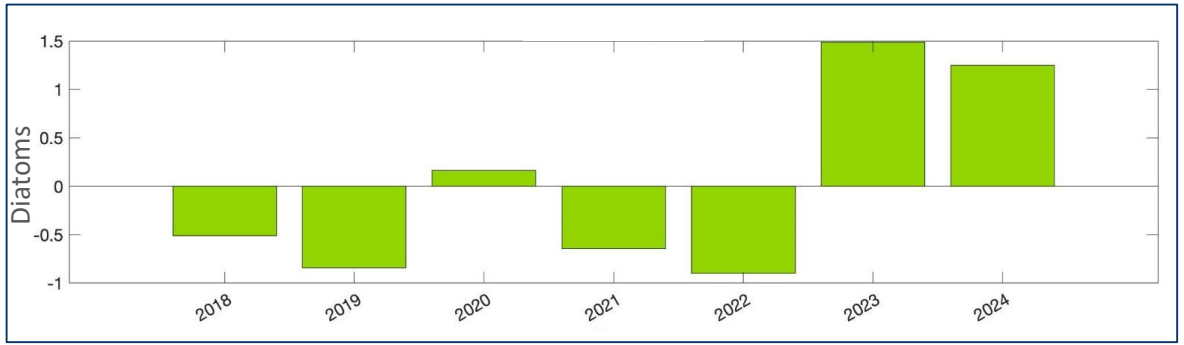
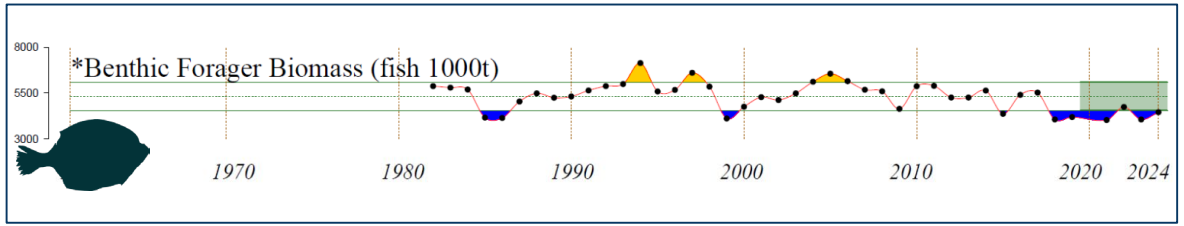
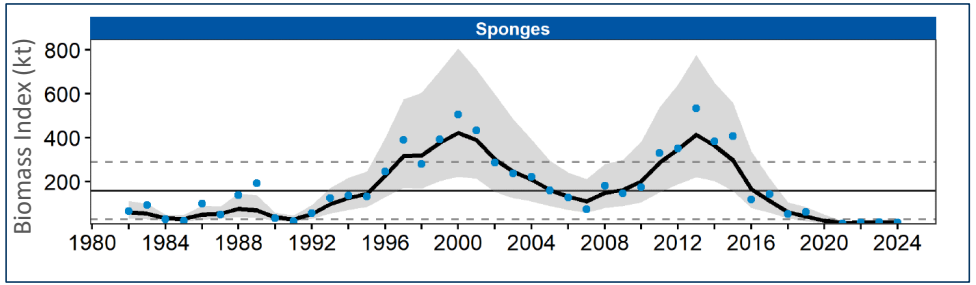
Pelagic stage: *above-average feeding conditions in 2023 and 2024*
Benthic stage: *continued low availability of prey in 2024*



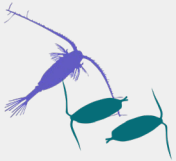


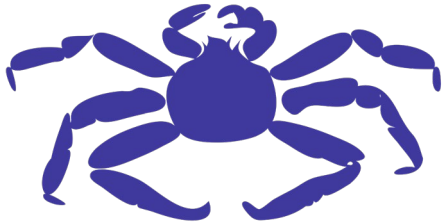


- Diatom abundance anomalies were positive in 2023 and 2024
- Benthic foragers increased from 2023 to 2024, but remain below the long term mean
- Sponges continued to be very low in 2024 in the SEBS

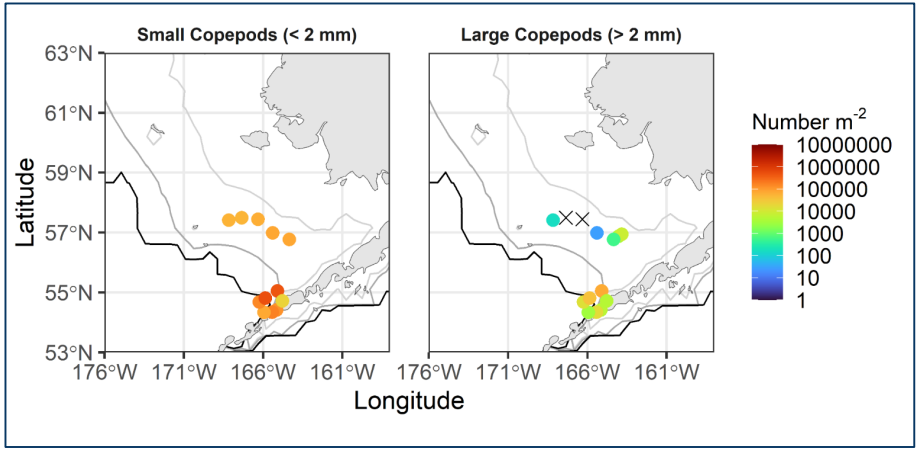
(Ostle, Whitehouse, Buser)

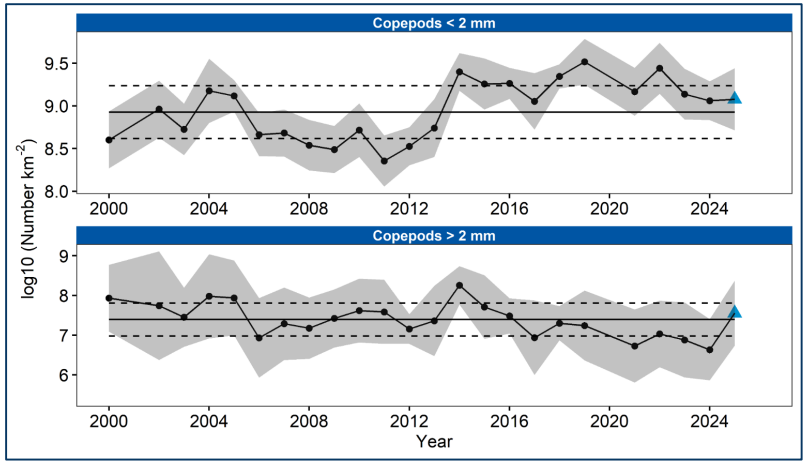
COMPETITORS





Above average abundance of small copepods during spring; low abundance of large copepods over the shelf.



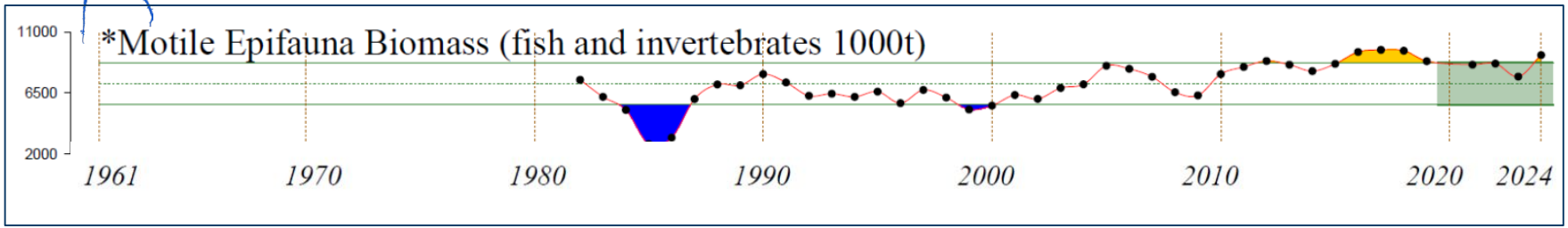


- Small copepods were abundant near Unimak pass and slightly lower on the shelf
  - Similar to recent warm years
  - Warmer temperatures fuel faster development

- Large copepods were abundant near Unimak Pass, but low on the shelf
  - Abundances decreased to the north

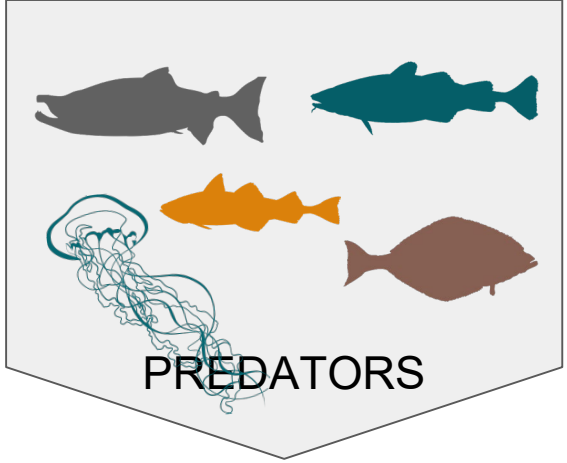
(Kimmel)

In 2024, competition for space remained high

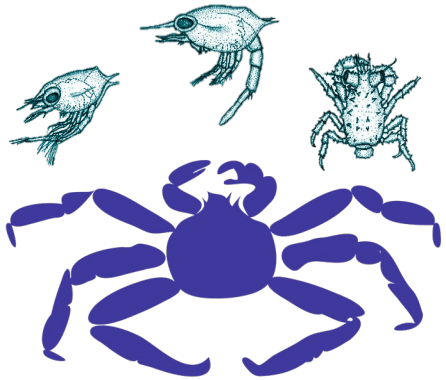


- Motile epifauna increased in 2024 and remained above the long term mean
  - Echinoderm biomass above average
  - Crab biomass below average

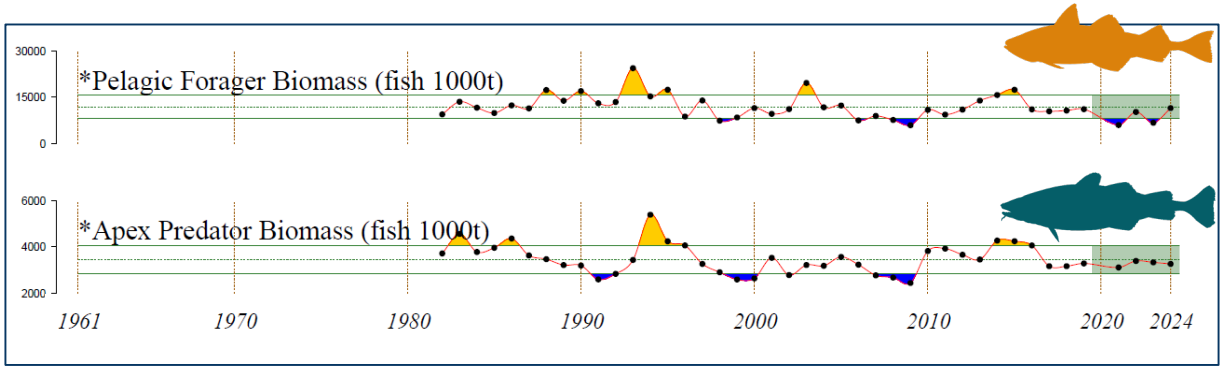
(Whitehouse)

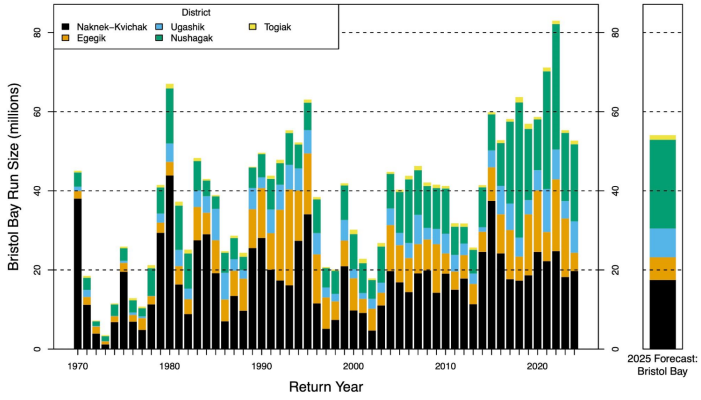


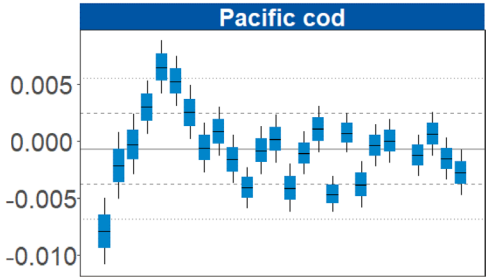
PREDATORS



Indicators of predation pressure are mixed in 2024 and 2025





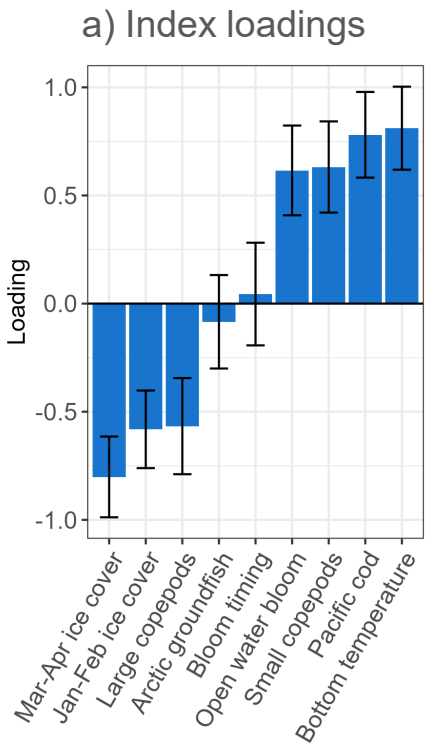


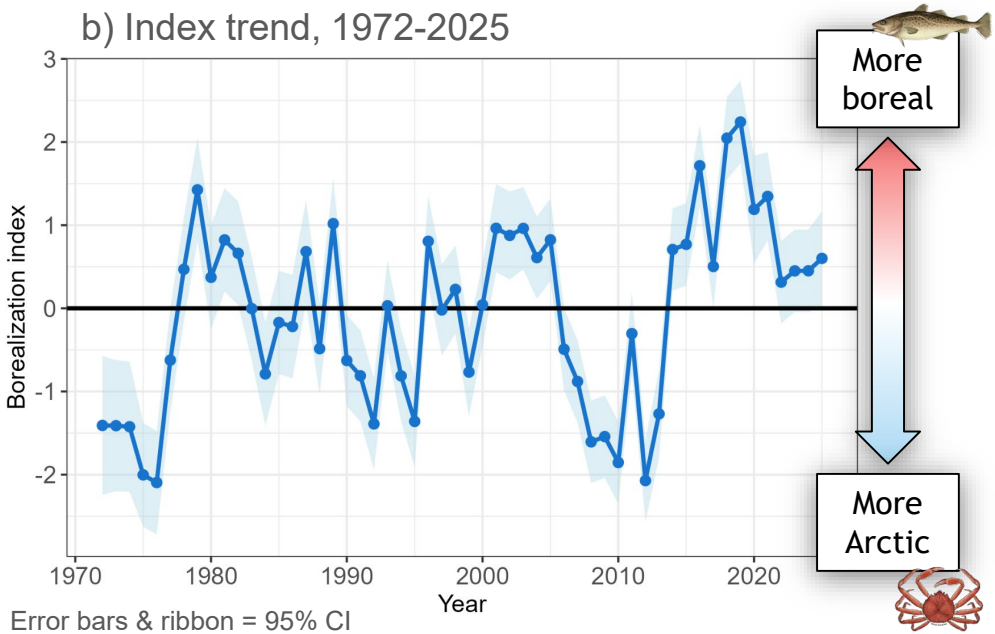
- 2024: Pelagic foragers increased to the mean
- 2024: Jellyfish were above average in the NBS; average in the SEBS
- 2025: Bristol Bay sockeye salmon forecast is below the 10-year average
- 2024: Apex predator biomass remained at the mean
- 2024: Pacific cod condition decreased from 2022 to 2024

(Whitehouse, Cunningham, Prohaska)

The borealization index in 2025 was 0.6, indicating a more boreal system

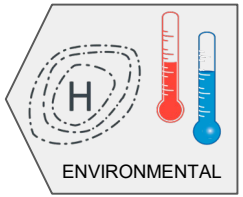
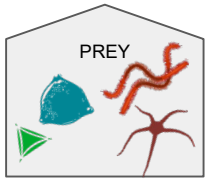
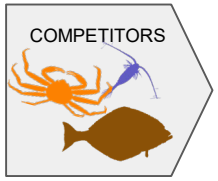
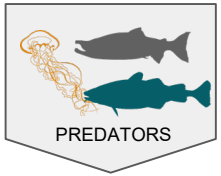
- Calculated for core snow crab range
- DFA summary of 9 physical & biological time series expected to track the Arctic to boreal transition
- Outperforms bottom temperature for predicting annual snow crab abundance
- 2022-2025 values at time series mean

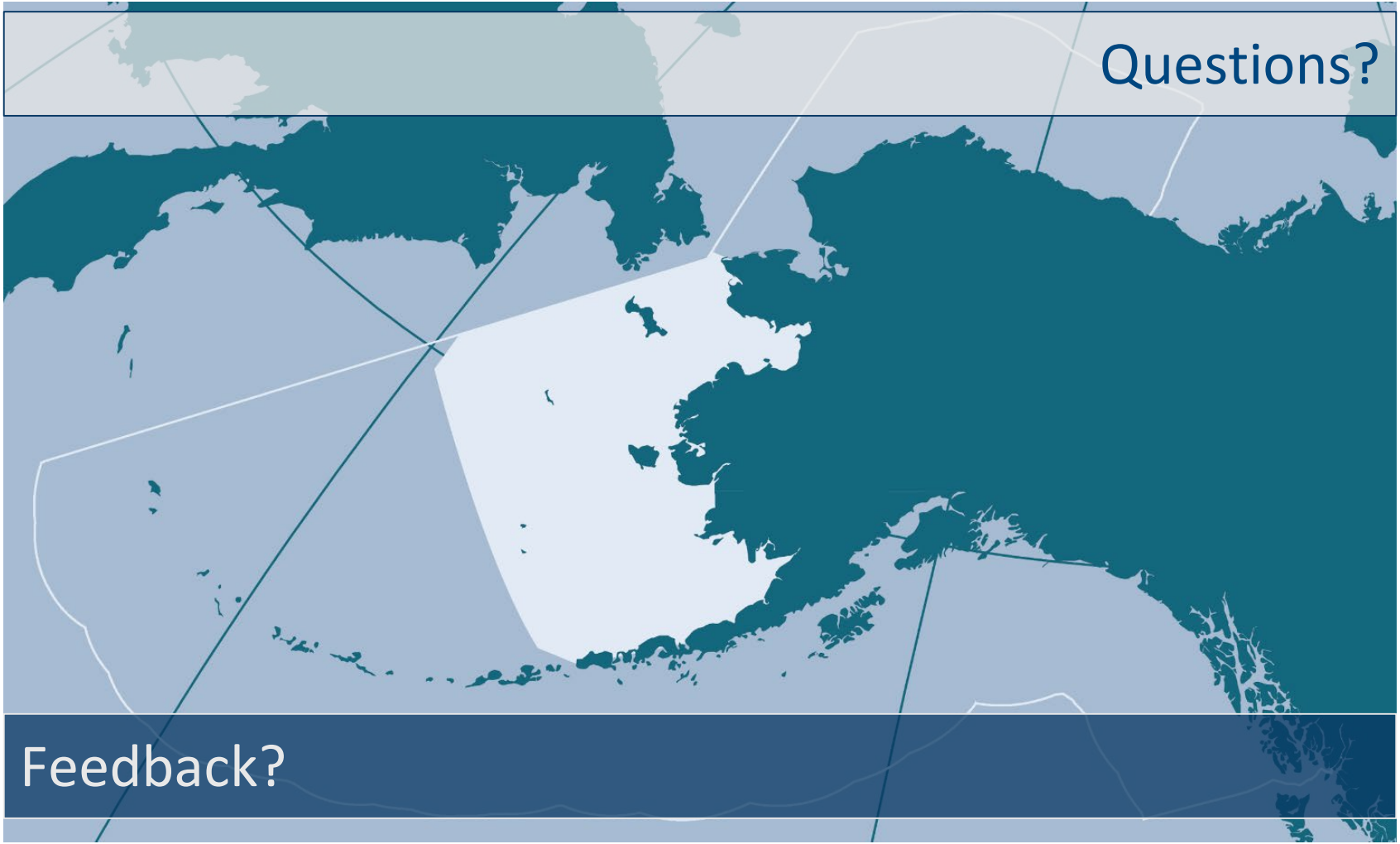




(Ryznar, Litzow, Fedewa, Nielsen, Kimmel)

Summary

	• Positive ALPS: winter 2024/2025 was warm, stormy, and had less sea ice • Warm winter SSTs; cooler summer	• Positive ALPS: warm, stormy, and less sea ice • Warm winter SSTs; cooler summer • Below average cold pool (-29% from 2024) • 2025 bottom pH slightly lower than 2024
	• Diatom abundance anomalies were positive in 2023 and 2024	• *Indirect* evidence indicates continued low availability of prey in 2024 • Sponges remained low in 2024
	• Above average abundance of small copepods • Low abundance of large copepods	• Motile epifauna increased in 2024 • Competition for space remained high
	• Pelagic foragers increased in 2024 • Jellies average in SEBS; above average in NBS in 2024 • 2025 Bristol Bay sockeye salmon below the 10-year average	• Predators of benthic crab remained at their long-term mean in 2024 • Pacific cod condition decreased in the SEBS from 2022 through 2024


Questions?
Feedback?