Ecosystem Status Report: Eastern Bering Sea 2024

Elizabeth Siddon

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NOAA FISHERIES

Outline

- Ecosystem Considerations for Risk Tables
- New and Noteworthy Topics
- Ecosystem Assessment
  - Southeastern Bering Sea
  - Northern Bering Sea

Ecosystem Considerations for Risk Tables

Level 1

No apparent ecosystem concerns related to biological status (e.g., environment, prey, competition, predation), or minor concerns with uncertain impacts on the stock.

EBS Pollock
Yellowfin sole
Northern rock sole
Greenland turbot
Kamchatka flounder
Alaska plaice
Flathead sole
Other flatfish
+ESP Sablefish

Level 2

Indicator(s) with adverse signals related to biological status (e.g., environment, prey, competition, predation).

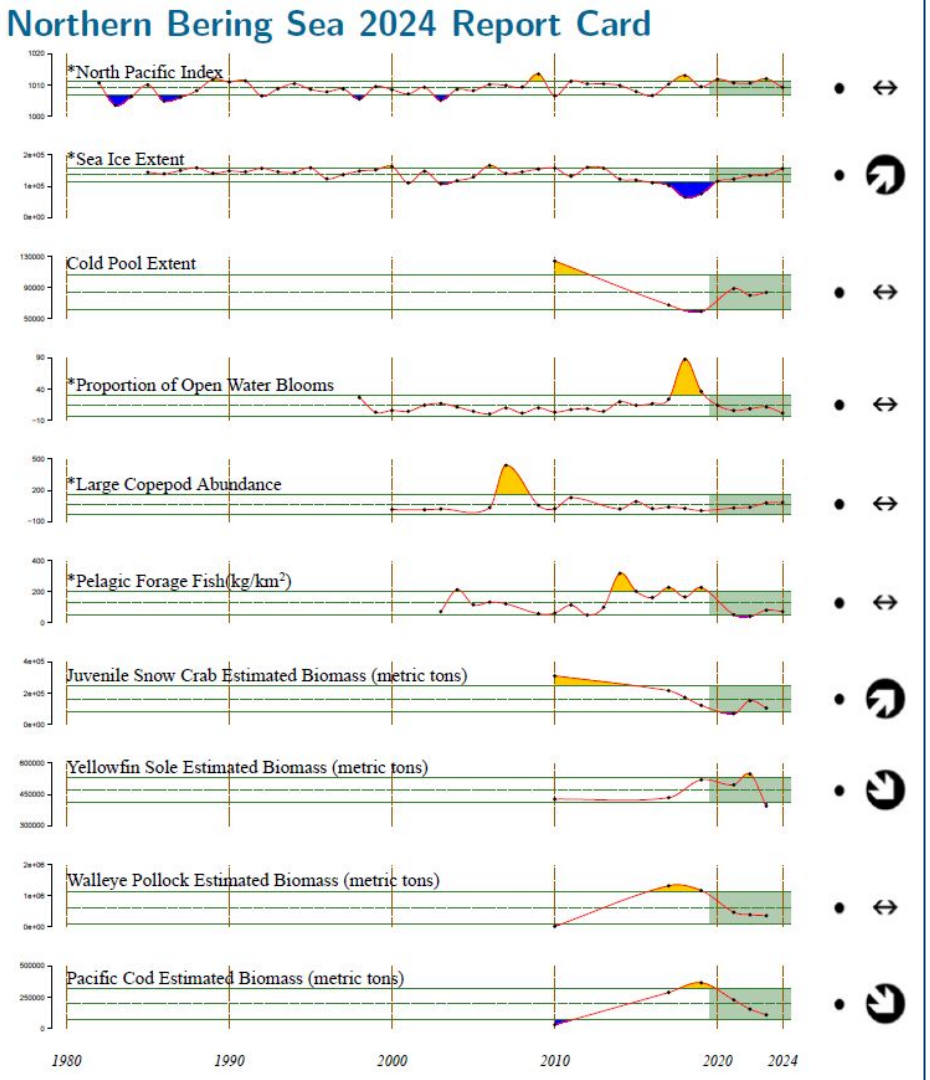
EBS Pacific cod +ESP

Environment: Oceanographic conditions were largely average based on multiple metrics

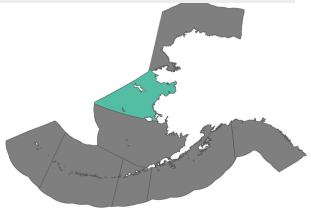
Prey: Prey conditions over the SEBS shelf potentially more limiting than over the NBS. Pcod condition continued to decrease over the SEBS from 2022 to 2024. The majority of the Pcod biomass has been over the SEBS in recent years.

Competitors: Competitors of Pcod increased substantially from 2023 to 2024, including arrowtooth flounder (+26%) and pollock (+74%), especially over the SEBS.

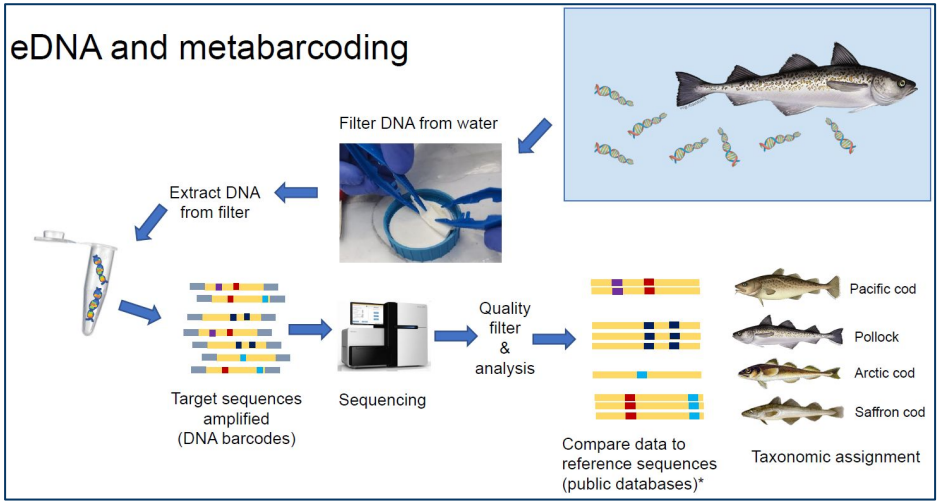
Predators: The 2023 CEATTLE model indicated above average predation pressure on Pcod; that trend reversed in 2024.

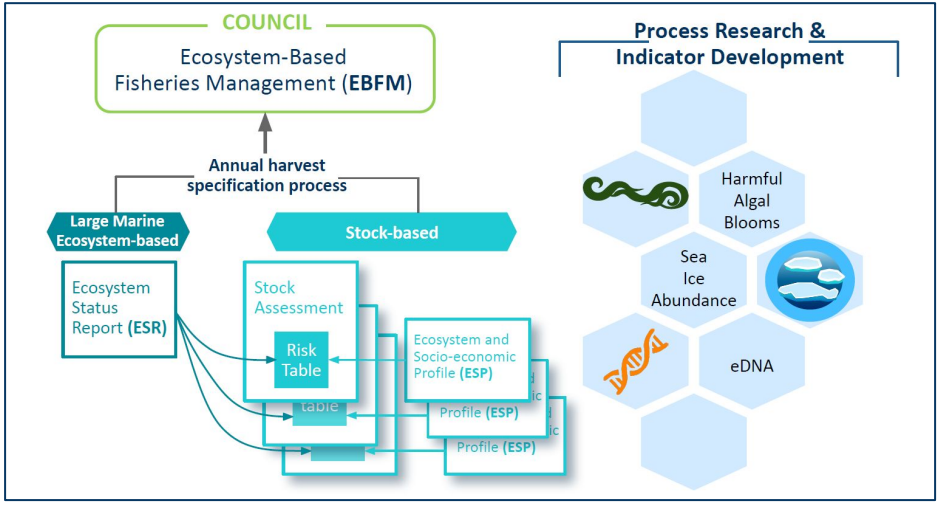


New in 2024



- Sea ice extent now available by sub-region
  - PolarWatch Shinyapp: https://polarwatch.github.io/alaska-seaice/
- Juvenile snow crab biomass
  - immature females + small males
- Foraging guilds (e.g., motile epifauna) not available for NBS
  - No ecopath-estimated catchability coefficient



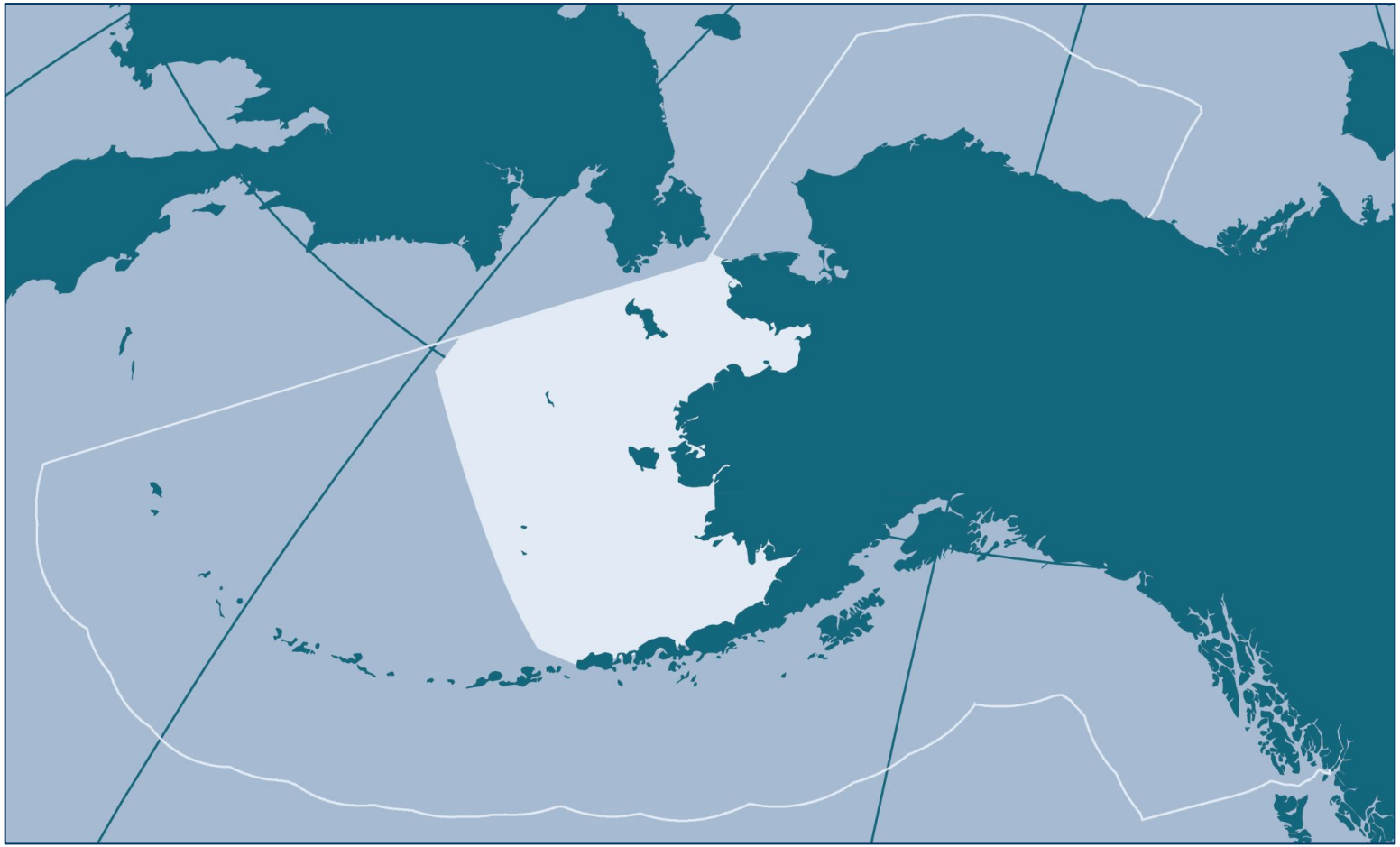


Noteworthy

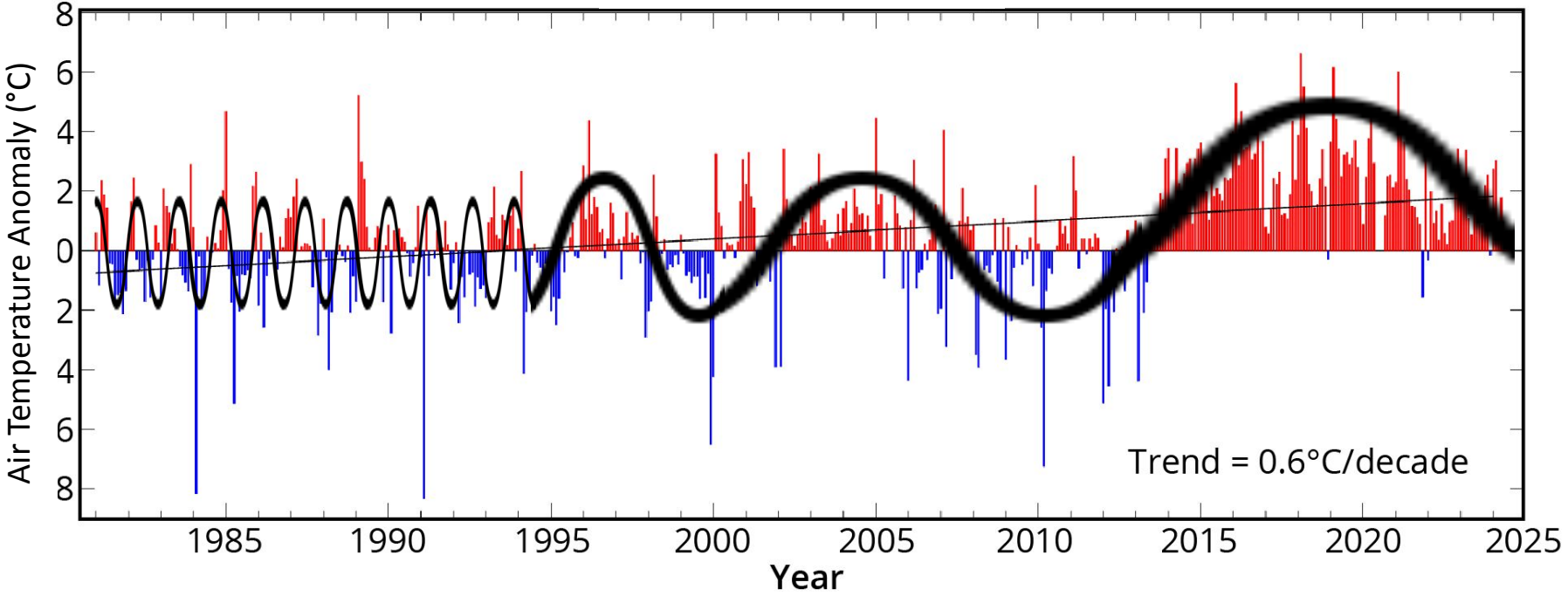
- Single-species quantitative PCR (qPCR)
  - eDNA concentration
- Multi-species metabarcoding
  - Relative abundance
- Advantages
  - Easy/efficient to collect
  - Fill spatial/temporal survey gaps
  - Detects species that avoid nets
- Drawbacks
  - Size/age class
  - Effective area sampled
  - Comparing to survey data sources
- Current collaborations
  - Arctic gadid distributions
  - Paired sampling on trawl surveys
  - Northern fur seal & Steller sea lion diets
  - Ice seal surveys

Baetscher & Ledger, p. 29

Ecosystem Assessment

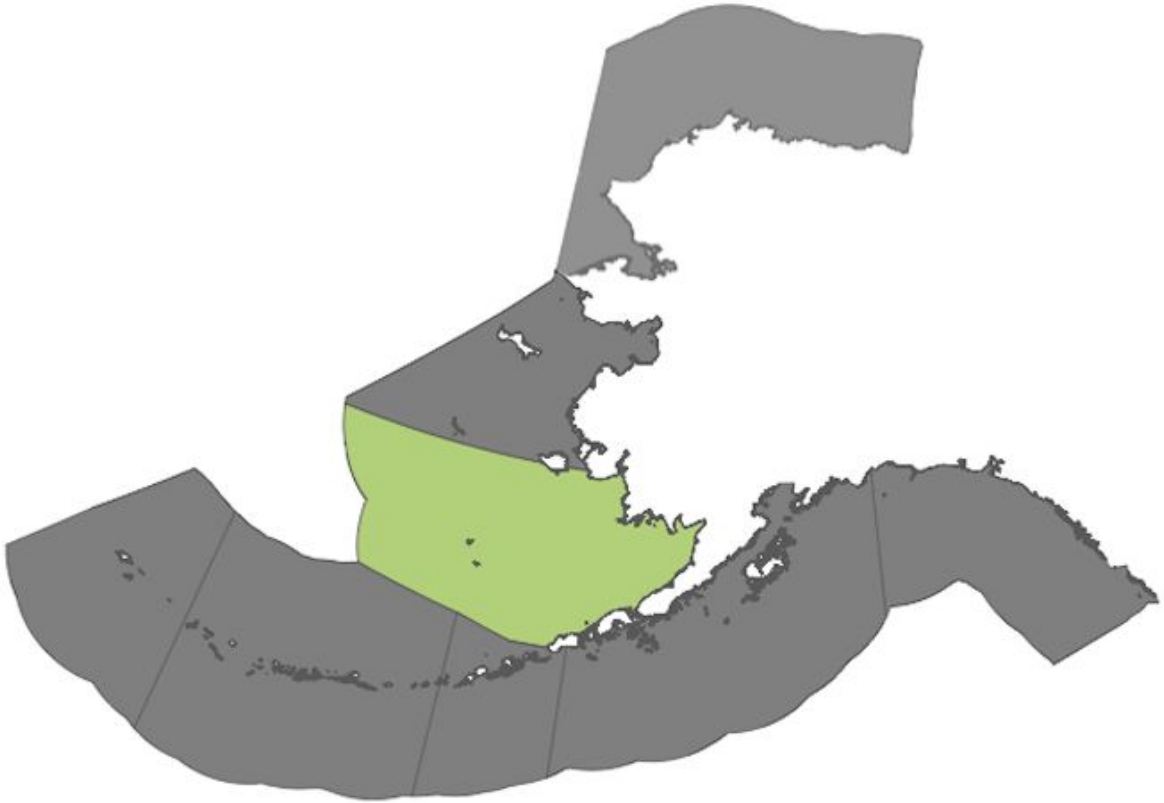


*The Bering Sea has cooled to **average** thermal conditions*



Overland & Wang, p. 55

Southeastern Bering Sea



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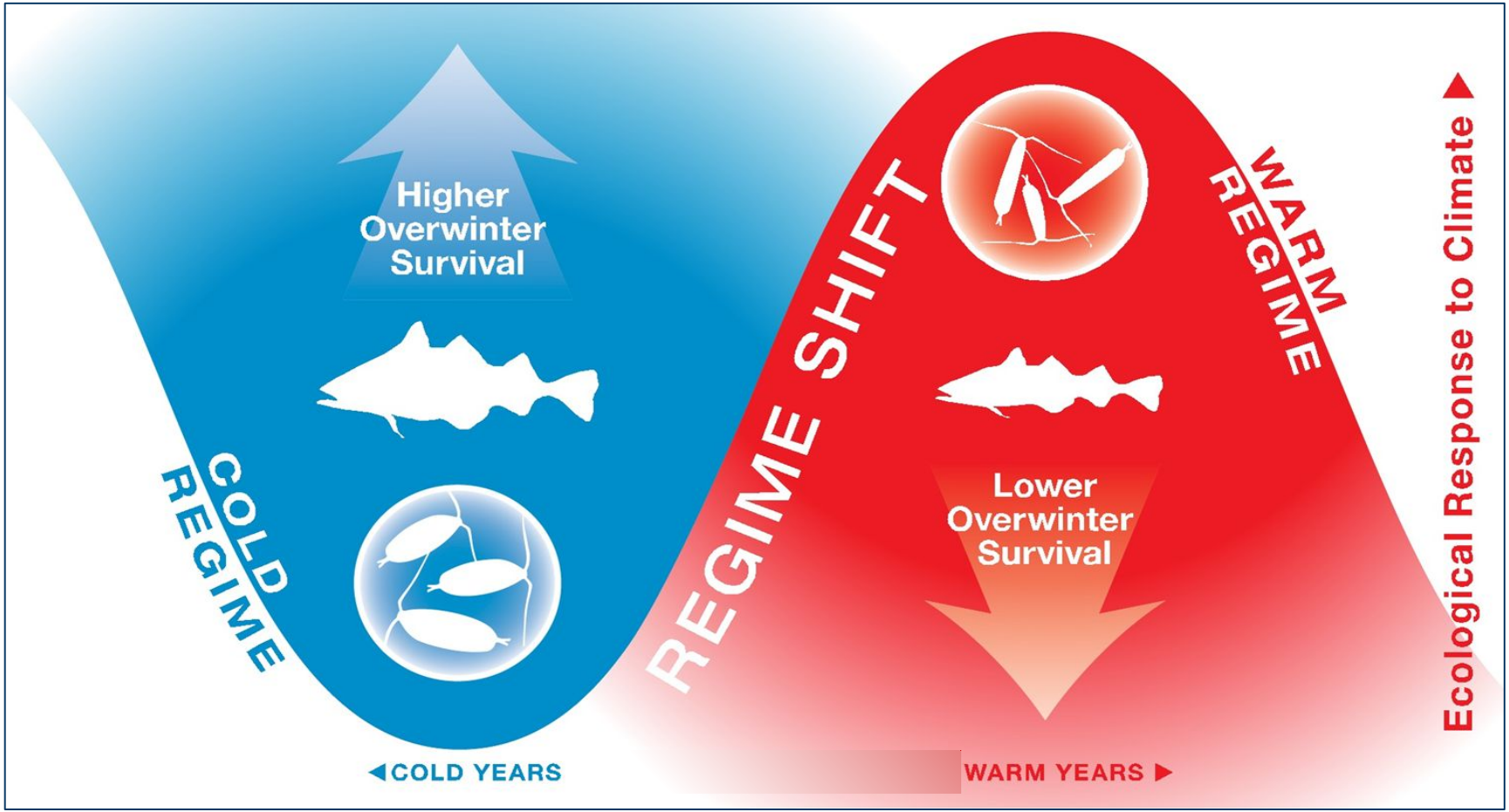
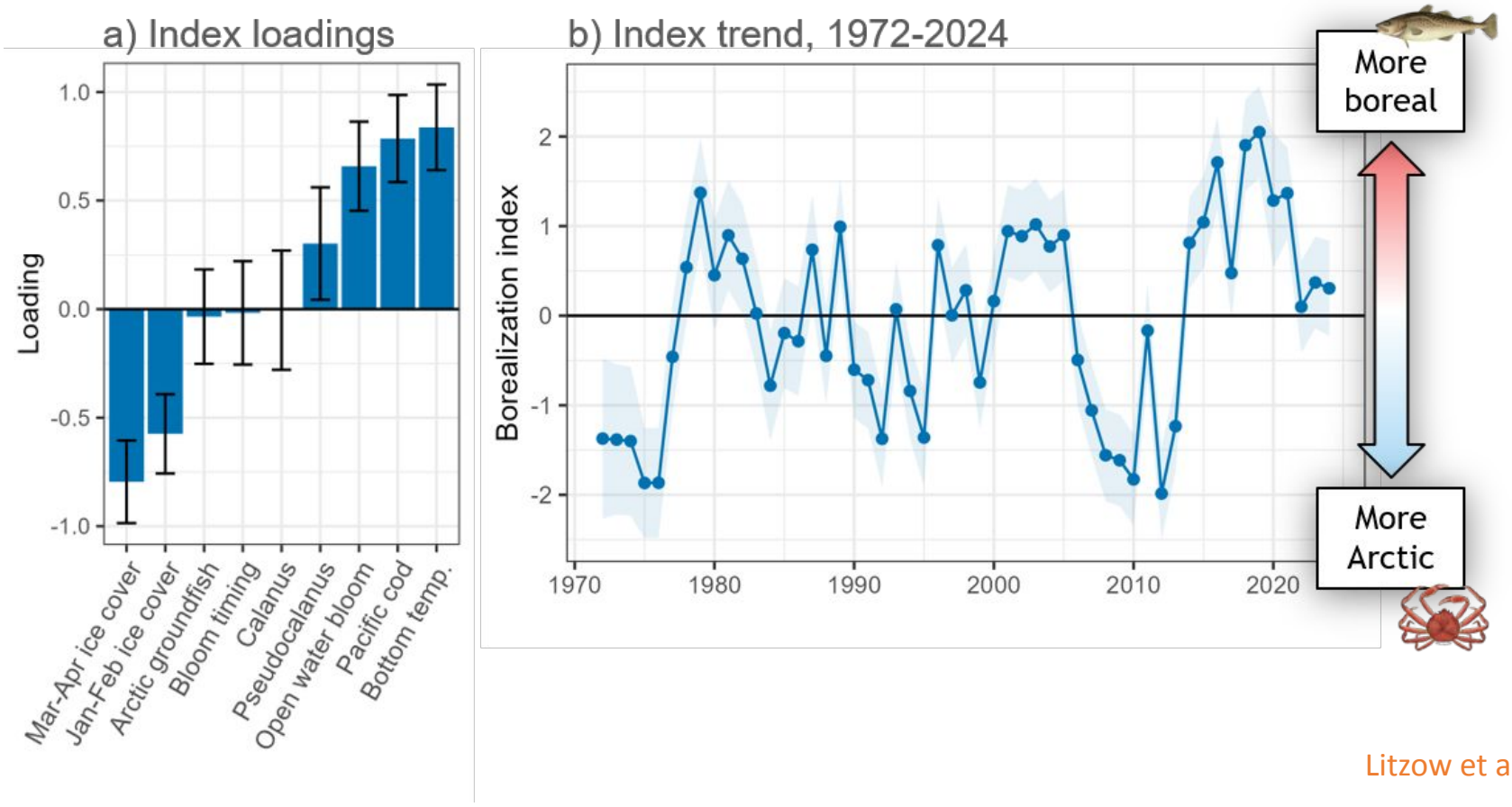
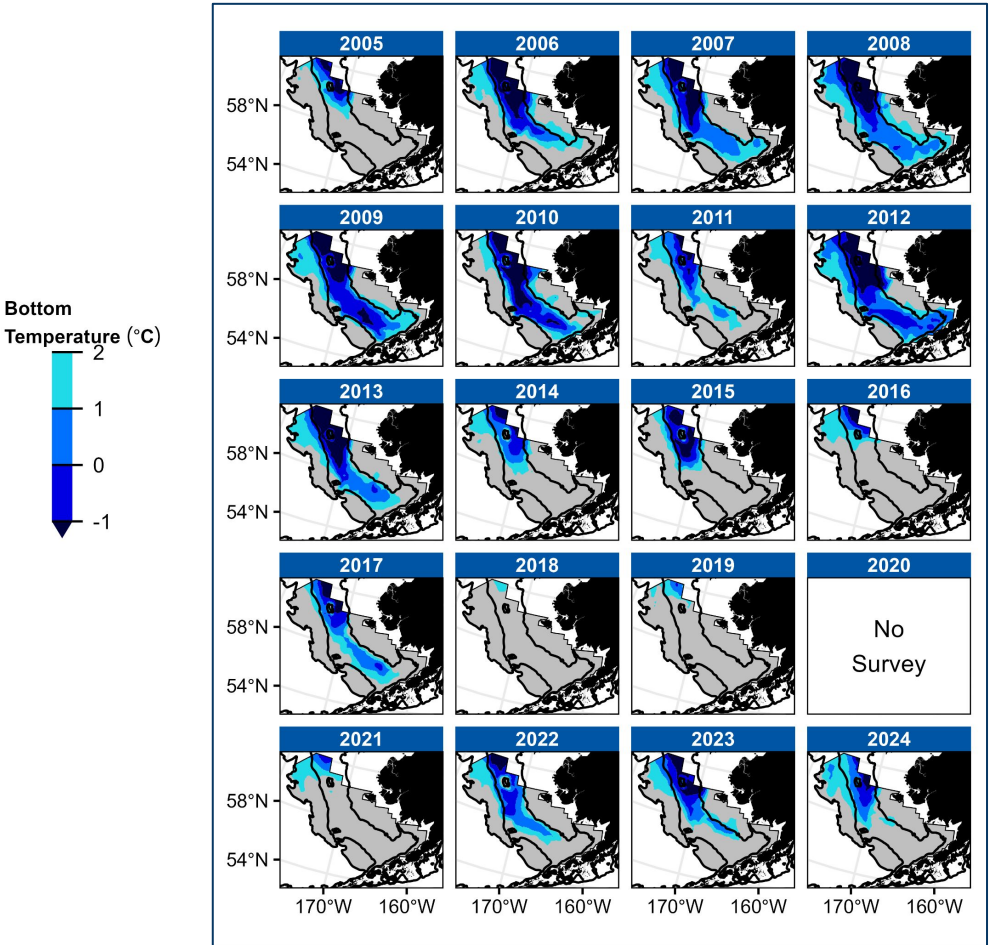


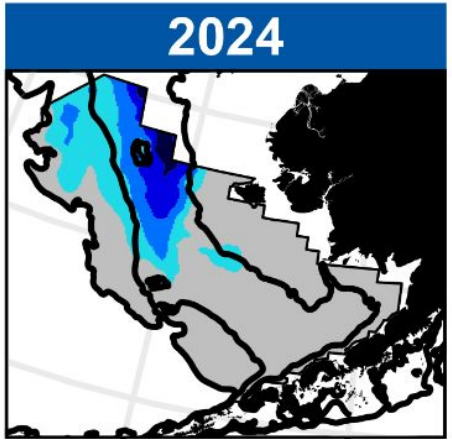
The borealization index for the SEBS has reverted to the mean during 2022–2024



Litzow et al., p. 35

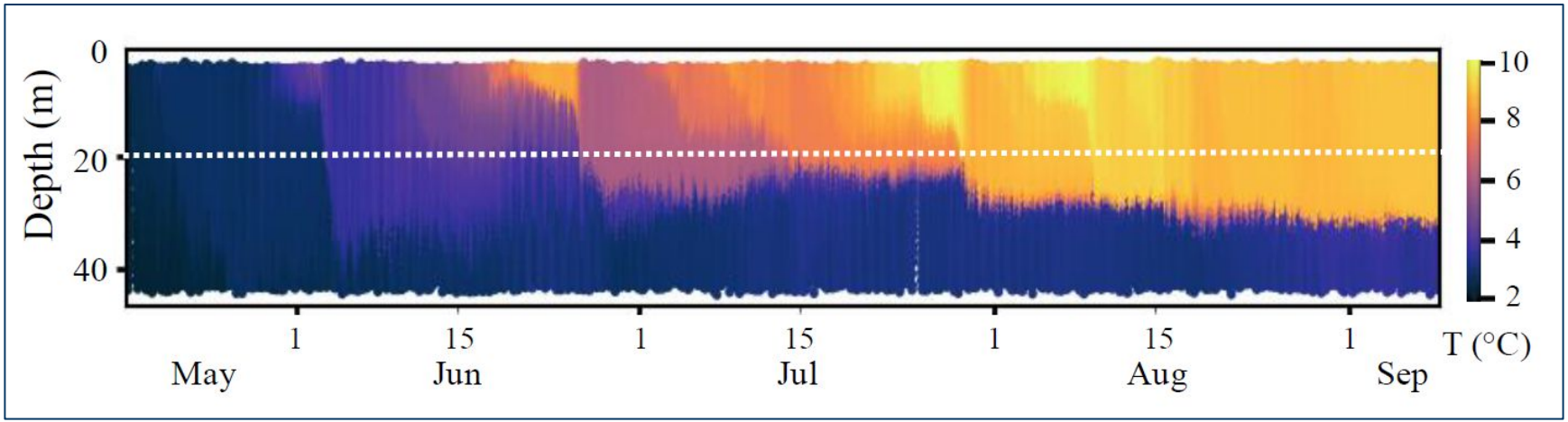
The cold pool (<2°C) extent was average; the coldest bottom waters (<0°C, <-1°C) were similar to a warm year





Rohan & Barnett, p. 75

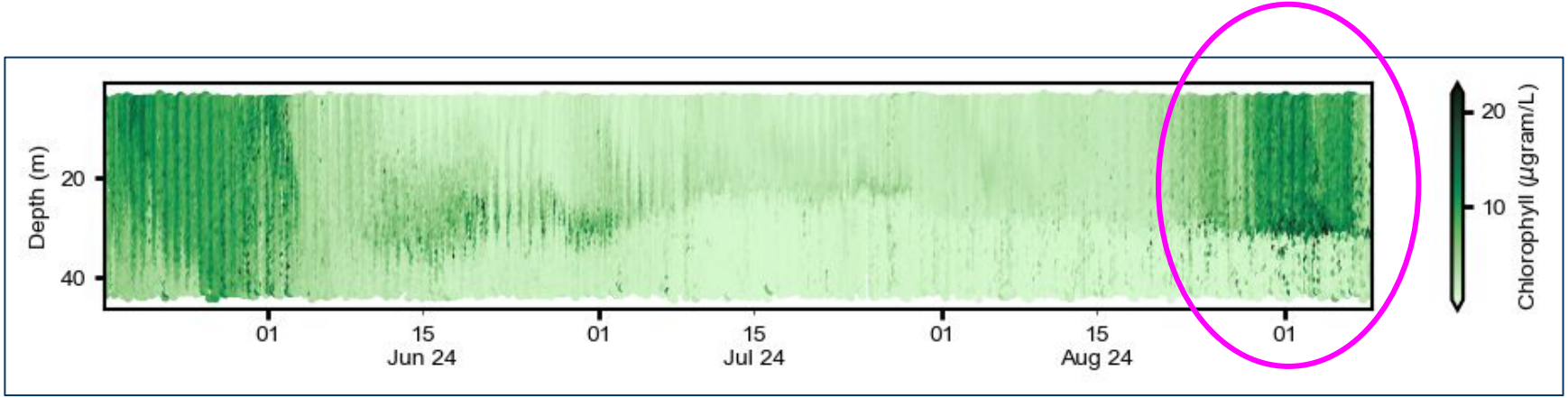
Storms → deeper mixed layer → cooler SSTs



- Persistent storms mixed the surface layer deeper
  - Mixed cooler water from depth
  - Same heat content as a warm year, but spread over more water
  - SSTs remained cooler

Stabeno, p. 62

Storms → weaker stratification & nutrients → early fall bloom

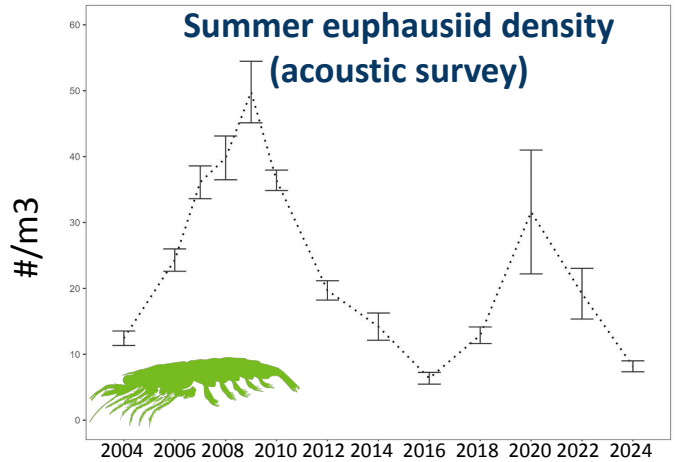


- Persistent storms resulted in weaker stratification
  - Mixing brought nutrients to the surface
  - Early fall bloom
  - Reduced coccolithophore bloom
  - May provide a sustained prey resource for zooplankton through the fall

Stabeno et al., p. 84

Pelagic prey dominated by small copepods

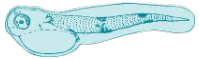
	Spring	Summer	Fall
Small copepods	Moderate	Low	Moderate
Large copepods	Low	Near-zero	Near-zero
Small euphausiids	Near-zero	Moderate	Low



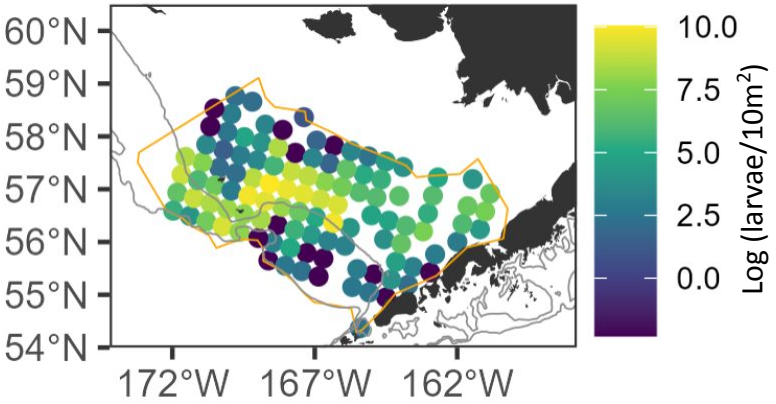
- Pelagic prey was dominated by small copepods
  - southern middle domain
- Euphausiid density (summer acoustic survey) declined to the second-lowest value
- Jellyfish biomass remained low to average
  - no significant change in competitive pressure for planktivorous predators
- Seabird reproductive success was mixed
  - higher on St. George Island than on St. Paul Island

Kimmel et al., p. 89, Levine & Ressler, p. 102, Yasumiishi et al., p. 105, Buser & Rohan, p. 107, Lindsey et al., p. 192

Unexpected patterns for pollock?



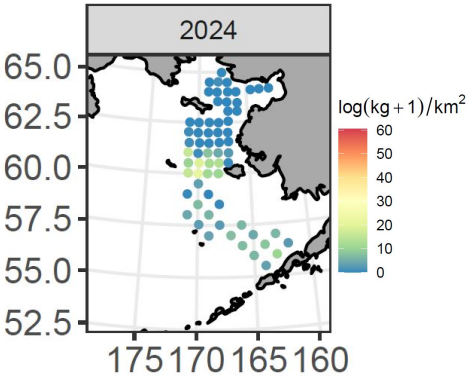
- Larval pollock (May)
  - Highest estimated abundance since 2012 (warm or cold)

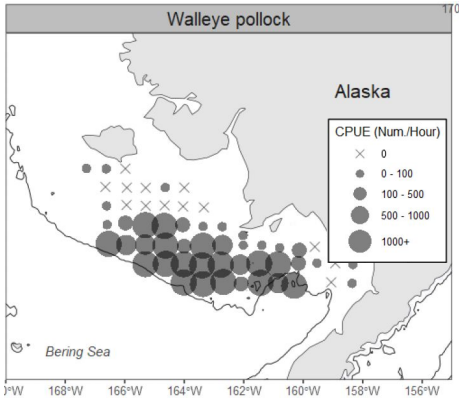


Rogers et al., p. 109, Andrews et al., p. 121, Garcia et al., p. 32, Spear & Andrews, p. 124, Aydin, p. 164

Unexpected patterns for pollock?

- Age-0 pollock (late-summer)
  - Low estimated abundance (middle domain)
  - Most numerous non-salmonid (inner domain)
  - Shallower distribution (similar to warm years)





Rogers et al., p. 109, Andrews et al., p. 121, Garcia et al., p. 32, Spear & Andrews, p. 124, Aydin, p. 164

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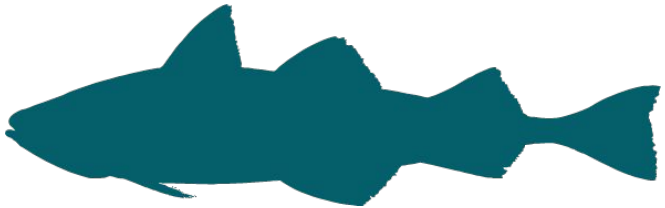
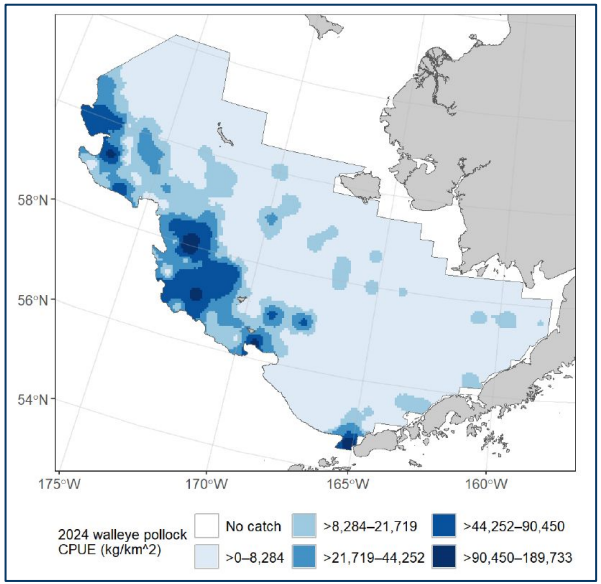
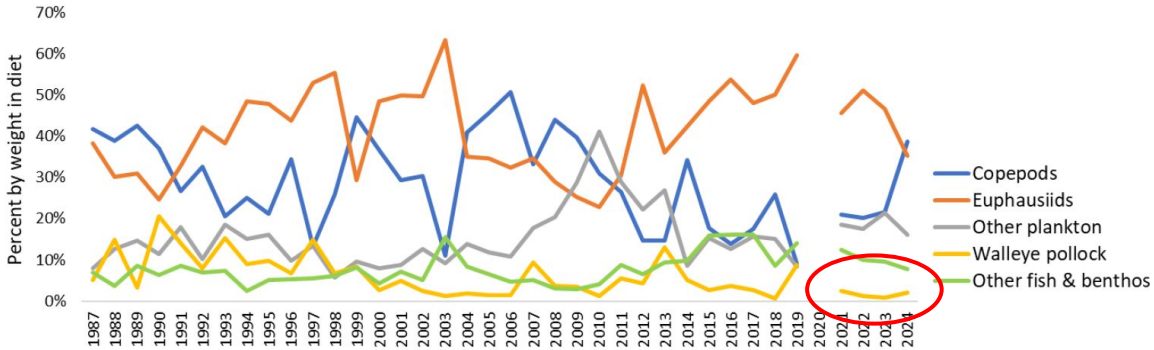


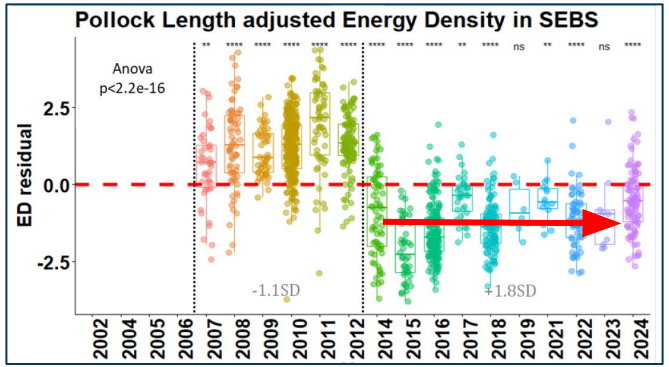
- Summer adult pollock
  - Food Habits: more copepods than euphausiids
  - Rates of cannibalism low between 2021-2024

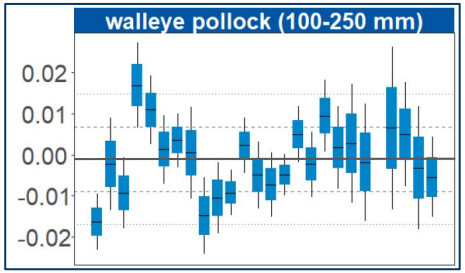


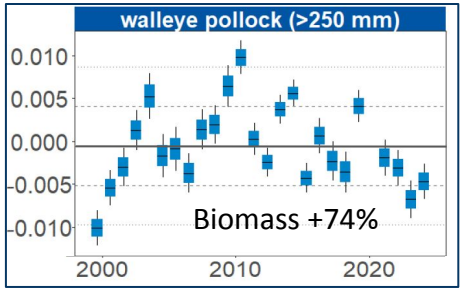


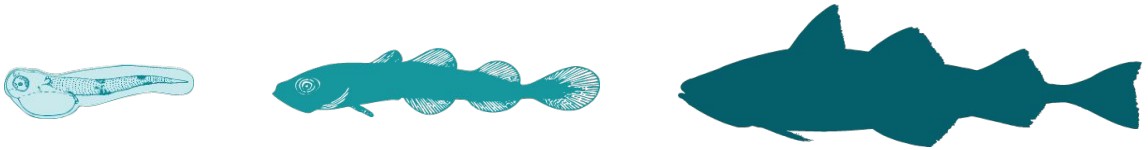
Rogers et al., p. 109, Andrews et al., p. 121, Garcia et al., p. 32, Spear & Andrews, p. 124, Aydin, p. 164

Individual fish condition low, population biomass buoyed by previous year classes





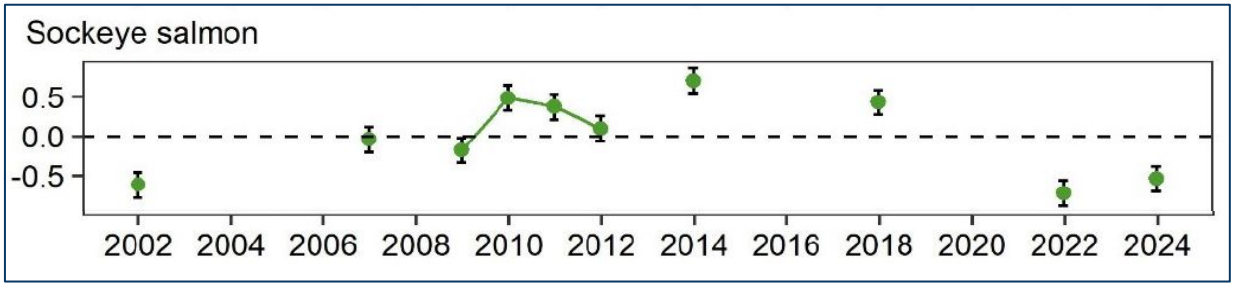


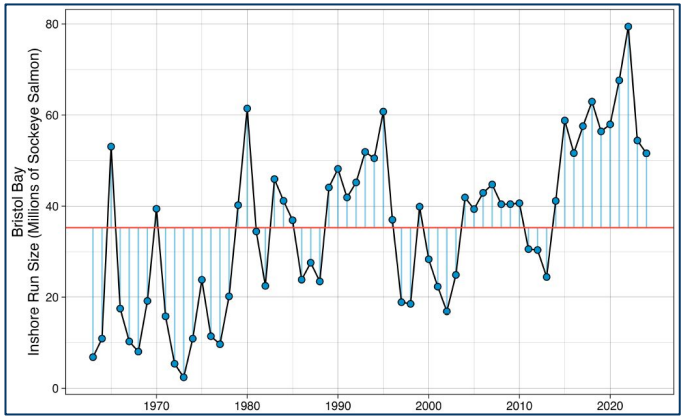


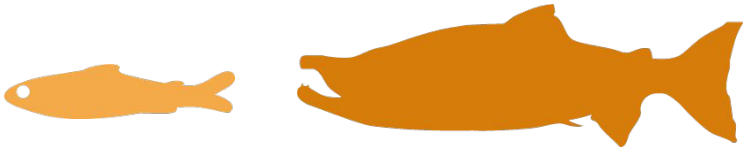
- Age-0 pollock energy density has been lower since 2014
- Age-1 & 2 pollock condition has declined since 2021
- Adult pollock condition remains below average in 2024

Page et al., p. 126, Prohaska et al., p. 156, Fergusson et al., p. 144, Cunningham et al., p. 150

Individual fish condition low, population biomass buoyed by previous year classes



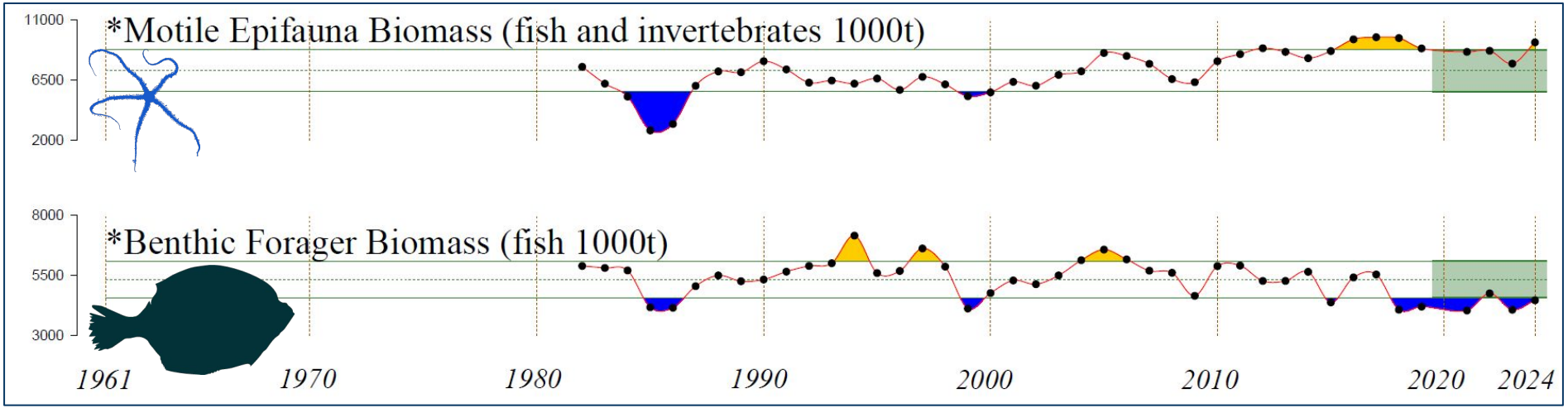




- Juvenile sockeye energy density low
- Bristol Bay sockeye abundance above average since 2015

Page et al., p. 126, Prohaska et al., p. 156, Fergusson et al., p. 144, Cunningham et al., p. 150

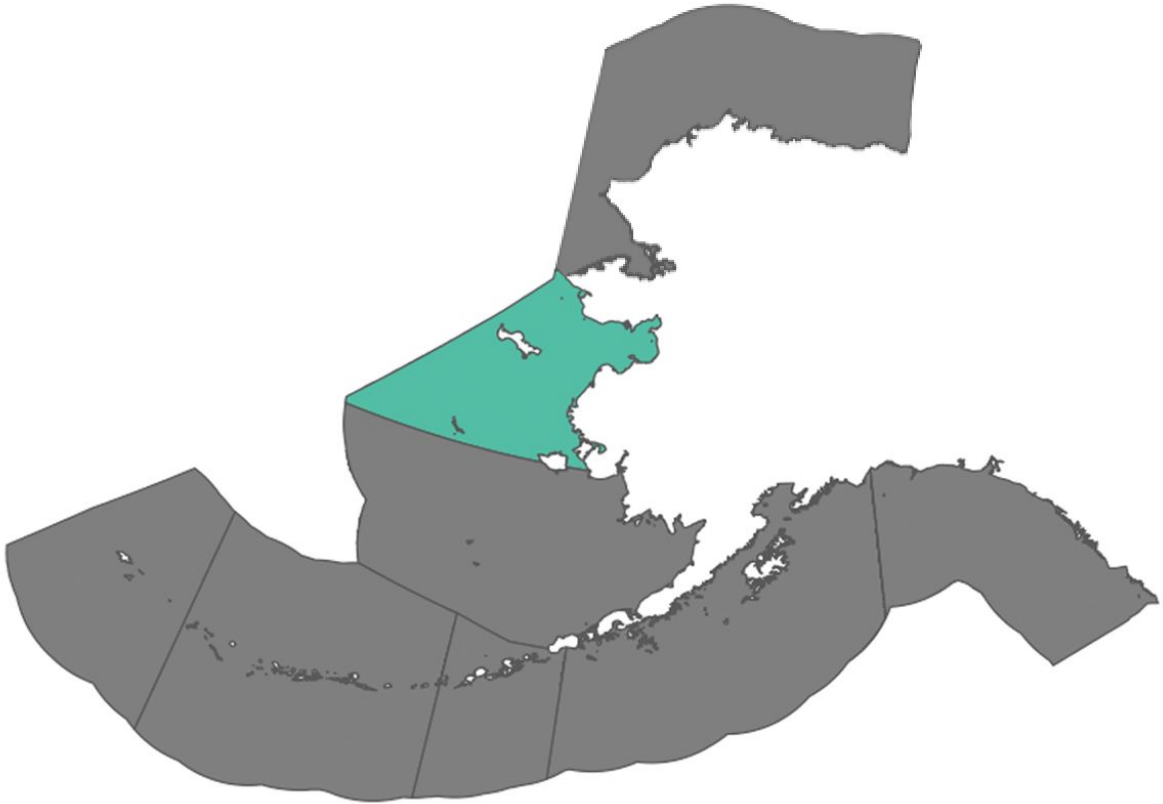
Benthic epifauna dominated by echinoderms



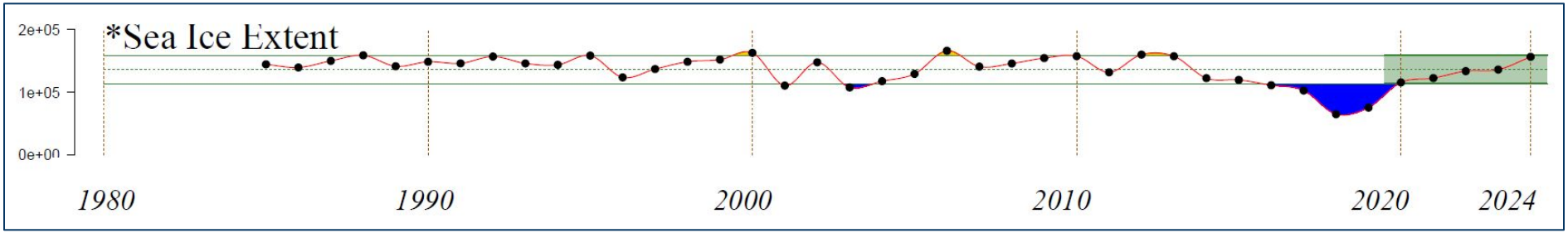
- Motile epifauna remain above the long-term mean
  - Echinoderm biomass above average
  - Crab biomass below average
- Benthic foragers (e.g., small-mouthed flatfishes) remain below the long-term mean
  - Estimates of biomass mixed in 2024 (YFS +8%, NRS +4%, plaice -3%)
  - Condition of small-mouthed flatfishes has been mixed since 2021

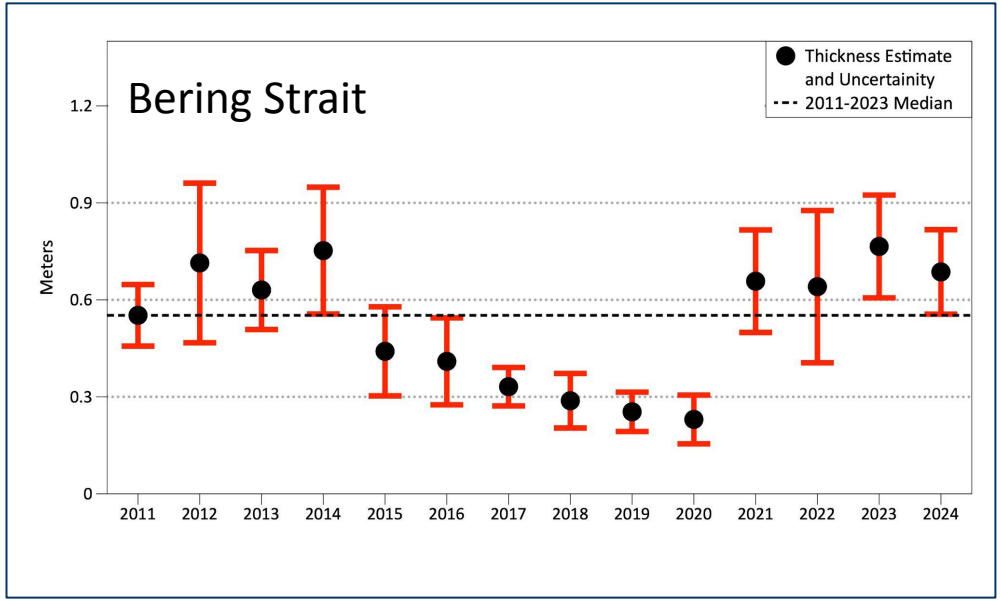
Whitehouse Fig. 2, GAP/SAP BTS, Prohaska Fig. 95

Northern Bering Sea



Steady increase in sea-ice extent since 2018; step-change increase in sea-ice thickness since 2021



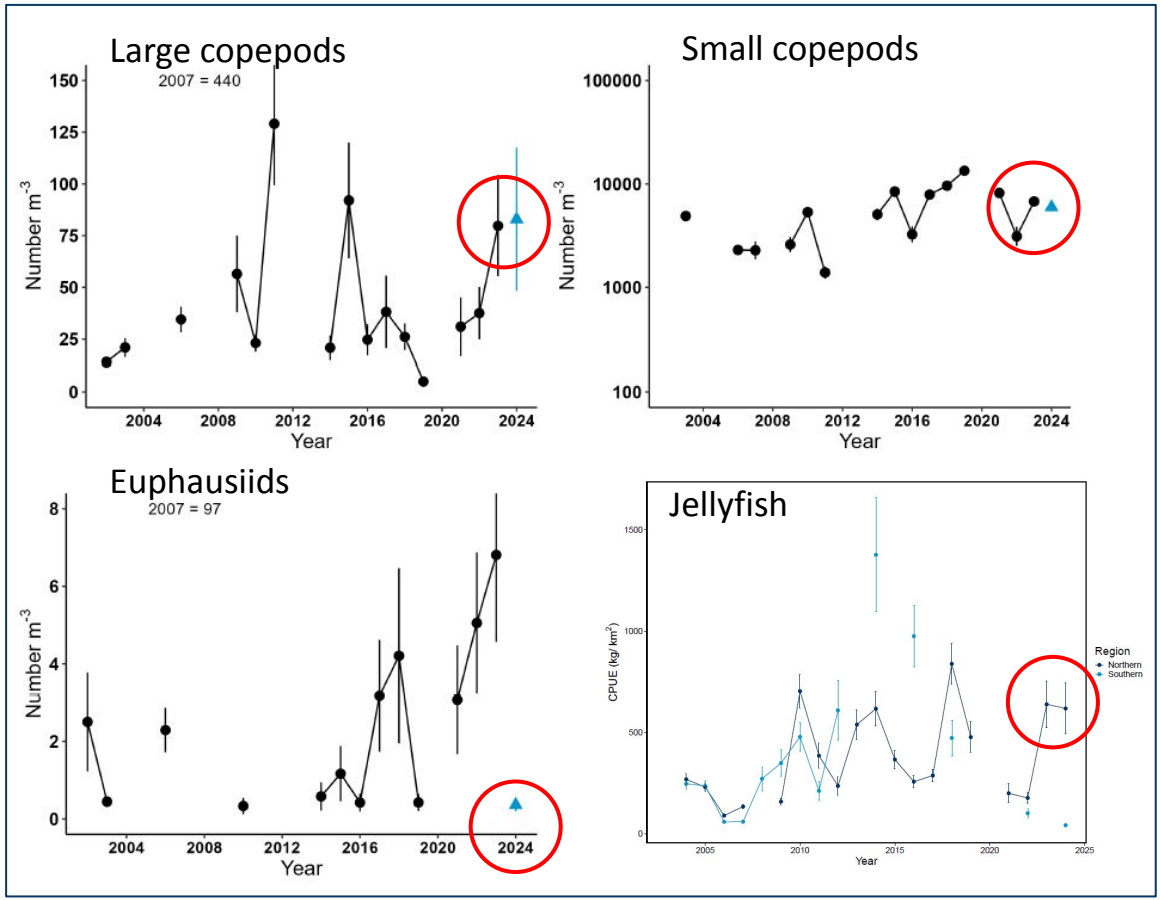


- Steady increase in ice extent since 2018
- Increase in ice thickness since 2021

Ice thickness → residency time → ice algae → productivity of NBS ecosystem

Bak-Hospital, Fig 3, Thoman, page 70

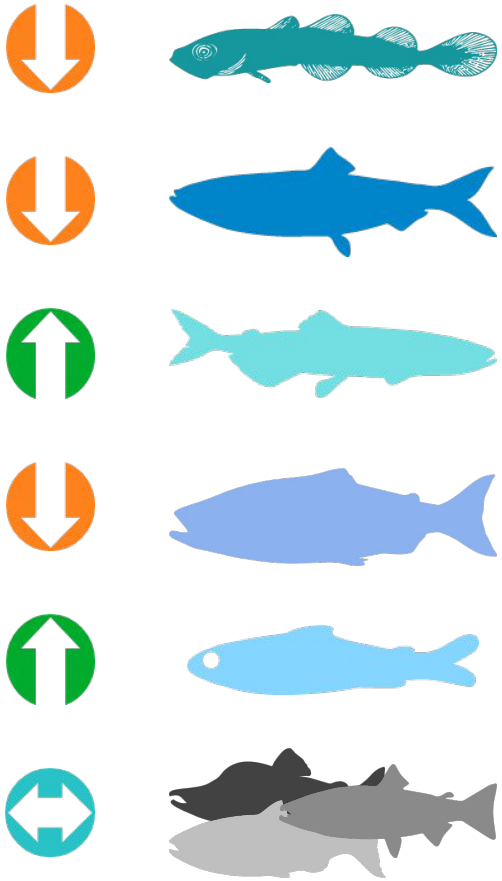
Signs of improved pelagic forage in 2023 and 2024



- Large copepod abundance increased in 2023 and remained high in 2024
- Small copepod abundance remained high and shows less variability over time
- Jellyfish biomass increased in 2023 and remained high in 2024
- Euphausiid abundance was near zero; ends an upward trend since 2021

Kimmel et al., p. 89,
Yasumiishi et al., p. 105

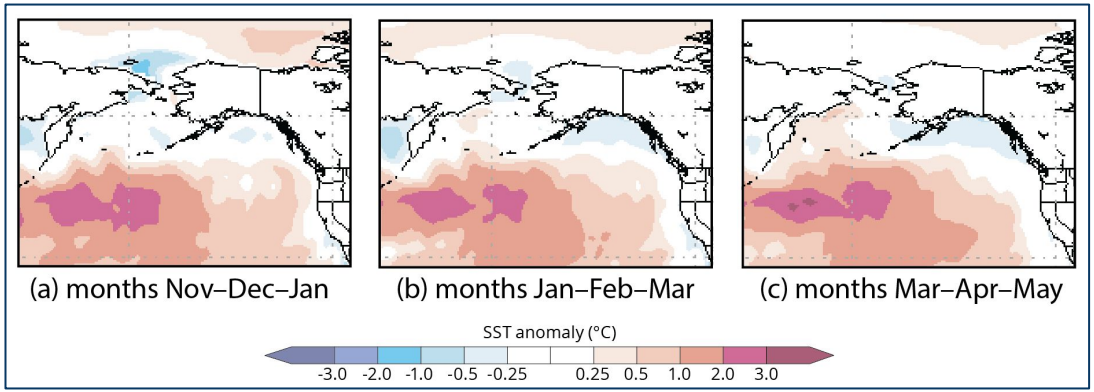
Pelagic productivity has been mixed



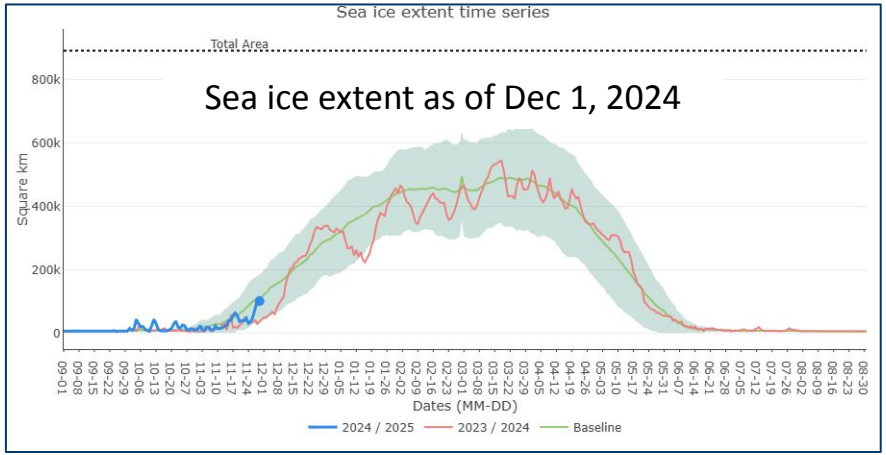
- Age-0 pollock
  - Low abundance, low weight, low energy density, average % lipid
- Herring abundance low
- Capelin abundance increasing; significant increase in 2024
- Juvenile Chinook salmon abundance decreasing; record low in 2024
- Fall juvenile chum abundance at record high in 2024
- Juvenile pink, chum, and coho salmon condition decreased from positive to average; Chinook salmon condition increased from average to positive

Andrews et al., p. 121, Page et al., p. 126, Andrews et al., p. 131, Murphy et al., p. 147, Fergusson et al., p. 144

Looking ahead to 2025



- Expected transition to La Niña
  - continued cooler conditions (within 0.25°C of normal)



- Cooler conditions in early ice season (Oct - Dec) may contribute to earlier formation of sea ice
- But fall storms may no entrain relatively warmer water into surface layer and delay ice formation

Lemagie, Fig. 16, Bak-Hospital shinyapp

2024 Summary and *implications*

The Bering Sea has cooled to **average** thermal conditions

Individual species thermal preferences may result in a new balance in the ecosystem

Southeastern Bering Sea: in ecological transition

Persistent storms mixed the water column

Cooler SSTs, but heat content similar to a warm year;

Increased nutrients and early fall phytoplankton bloom

Small copepods over the middle domain; large copepods over the outer domain

Spatial distribution of fish and match-mismatch with prey

Benthic epifauna dominated by echinoderms

Declines in prey quality for crabs and small-mouthed flatfishes?

Northern Bering Sea: some signs of recovery

Step-change increase in sea-ice thickness since 2021

May indicate increased platform for ice algae and increased productivity

Signs of improved pelagic forage in 2023 and 2024

Mixed trends in pelagic foragers since 2021