Ecosystem Status Report: Eastern Bering Sea 2026

Elizabeth Siddon



With contributions from:

Grant Adams, Don Anderson, Alex Andrews III, Daniel Auerbach, Kelia Axler, Kerim Aydin, Diana Baetscher, Sunny Bak-Hospital, Steve Barbeaux, Cheryl Barnes, Lewis Barnett, Sonia Batten, Jessica Beck, Shaun W. Bell, Emily Bowers, Mike Brosnahan, Thaddaeus Buser, Matt W. Callahan, Chelsea Campbell, Jack Carroll, Patricia Chambers, Maggie Chan, Patrick Charapata, Wei Cheng, Craig Chythlook, Bryan Cormack, Jessica Cross, Curry Cunningham, Alex De Robertis, Lukas DeFilippo, Andrew Dimond, Lia Domke, Diloola Erickson, Evangeline Fachon, Thomas Farrugia, Erin Fedewa, Emily Fergusson, Sarah Gaichas, Jeanette C. Gann, Sabrina Garcia, Tom Gelatt, Ben Gray, Colleen E. Harpold, Shannon Hennessey, Kirstin K. Holsman, Kathrine Howard, Jim Ianelli, Nicholas Jacuk, Kelly Kearney, Julie Keister, Esther Kennedy, David G. Kimmel, Trond Kristiansen, Carey Kuhn, Gulce Kurtay, Jesse Lamb, Ben Laurel, Caroline Lawrence, Dustin Colson Leaning, Kimberly Ledger, Elizabeth Lee, Kathi Lefebvre, Emily Lemagie, Justin Leon, Cory Lescher, Aaron Lestenkof, Mike Levine, Mike Litzow, Josh London, W. Christopher Long, Brandyn Lucca, Katie Luxa, Andrew Magel, Jacek Maselko, Ryan M. McCabe, Elizabeth McHuron, Dallas Melovidov, Paul Melovidov, Todd Miller, Natalie Monacci, Calvin W. Mordy, Jacqueline Muehlbauer, Franz Mueter, Zoe Munson, Jim Murphy, Janessa Newman, Jens M. Nielsen, Kaitlyn O'Brien, Clare Ostle, Johanna Page, Melanie M. Paquin, Mrunmayee Pathare, Robert Pickart, Darren Pilcher, Cody Pinger, Drew Porter, Steven Porter, Bianca Prohaska, Rolf Ream, Patrick Ressler, Jonathan Reum, Jon Richar, Erin Richmond, Lauren A. Rogers, Sean Rohan, Matthew Rustand, Erik Schoen, Gay Sheffield, Kalei Shotwell, Elizabeth Siddon, Jim Simon, Kevin Siwicke, Adam H. Spear, Phyllis J. Stabeno, Jeremy Sterling, Raphaela Stimmelmayr, Michelle Stratton, Anna Sulc, Florence Sullivan, Rob Suryan, Hillary Thalmann, Rick Thoman, Cathy Tide, Rod Towell, Cooper Van Vranken, Terese Vicente, Vanessa von Biela, Muyin Wang, George A. Whitehouse, Megan Williams, Michael Williams, Stephani Zador, and Tonya Zeppelin



Outline

- Ecosystem Considerations for Risk Tables
- New and Noteworthy Topics
- Ecosystem Assessment
  - 2021-2025 near-average thermal conditions
  - 2026 cool conditions

Ecosystem Considerations for Risk Tables

Lowered from Level 2 to Level 1



• Pacific cod

Improved prey availability and fish condition; reduced predation pressure

Sustained Level 1

• EBS Pollock
• Yellowfin sole
• Greenland turbot
• Skates
• Sablefish

Ecosystem Highlights

• **Transition to Cool Thermal Conditions:** After several years of near-average conditions (2021–2025), 2026 shifted to cool thermal conditions driven by a weak winter Aleutian Low and extensive sea ice in March/April.

• **Extensive Cold Pool:** The 2°C cold pool expanded by ~150% from 2025 to the 5th largest cold pool in the survey time series.

• **Increased Secondary Productivity & Prey Quality:** Fall abundance and lipid content of large copepods and euphausiids increased in 2026, providing high-quality prey for pelagic consumers.

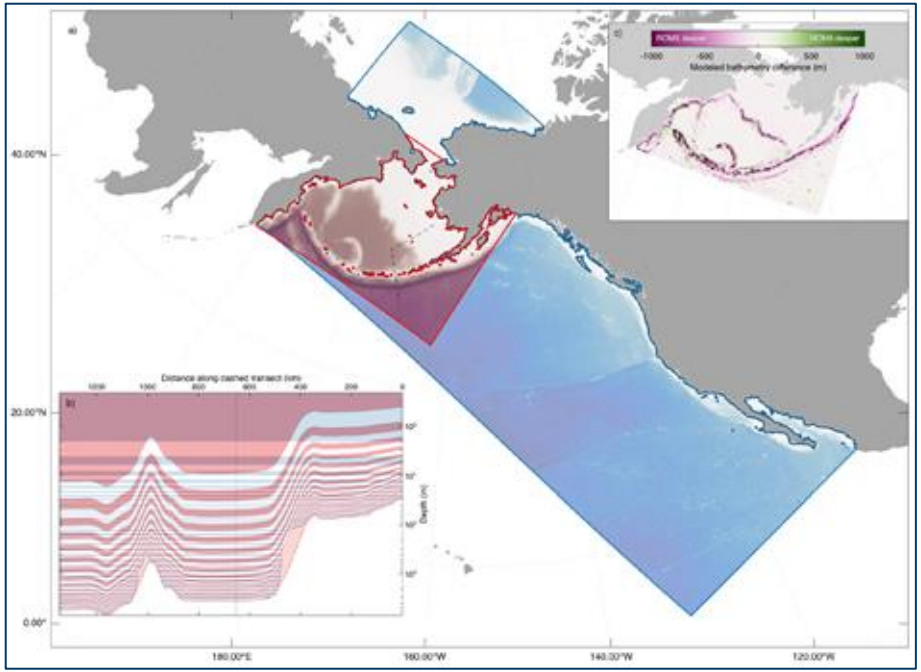
• **Increased Groundfish Condition:** Reduced thermal stress and increased prey quantity and quality resulted in increased condition of fish across groundfish guilds.

• **Positive Seabird & Mammal Indicators amid Emerging Stressors:** Seabirds had a strong reproductive year; fur seal moms had their shortest foraging trip durations and pup mass was above-average. However, OA metrics reached shelf-wide minimums and a dense *Alexandrium* bloom expanded for a 3rd consecutive year in the SEBS.

New and Noteworthy Topics

Introducing MOM6 to the Alaska regional modeling framework

- How the transition from ROMS to MOM6 may impact model-informed products presented to decision-makers.
- Maps of skill metrics for the MOM6-NEP hindcast simulation for surface & bottom temperatures.
- NOAA-wide support associated with the CEFI program = more rapid and comprehensive development, more skillful and stable model implementations.

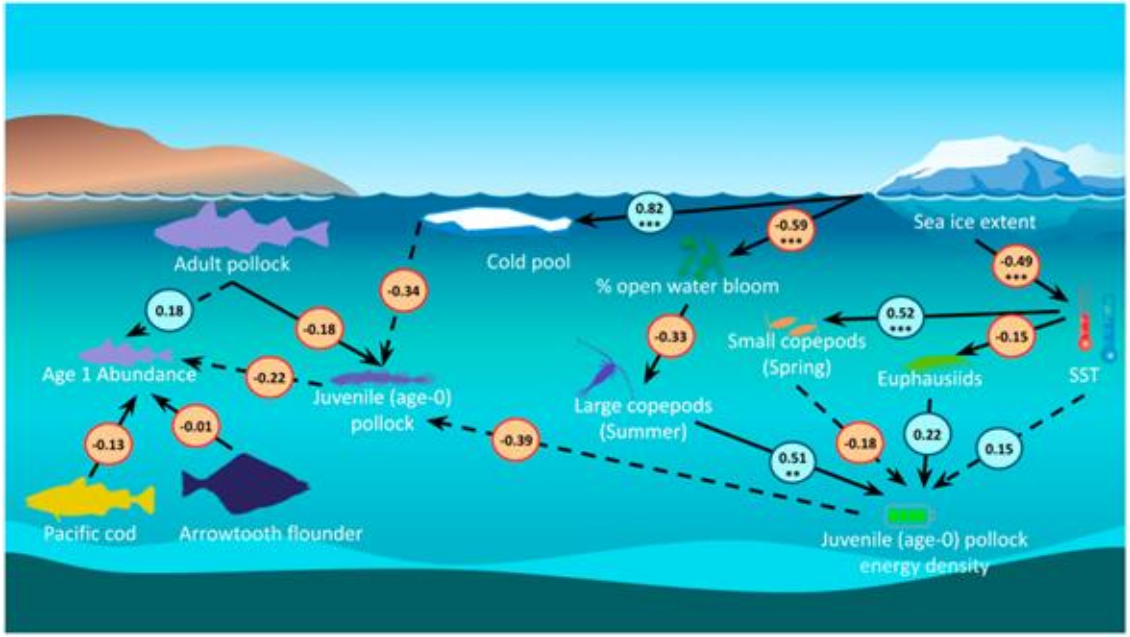


Kelly Kearney (AFSC) and **Wei Cheng** (PMEL)

New and Noteworthy Topics

Eastern Bering Sea Walleye Pollock Early Survival Pathways

- Response to December 2024 SSC request
- Pollock Workshop
- Ecosystem “Tiger” Team
- Process studies
- External application: ecosystem-level dynamics of prey availability
- Internal application: integrates DSEM to test environmental linkages in specific assessment model parameters

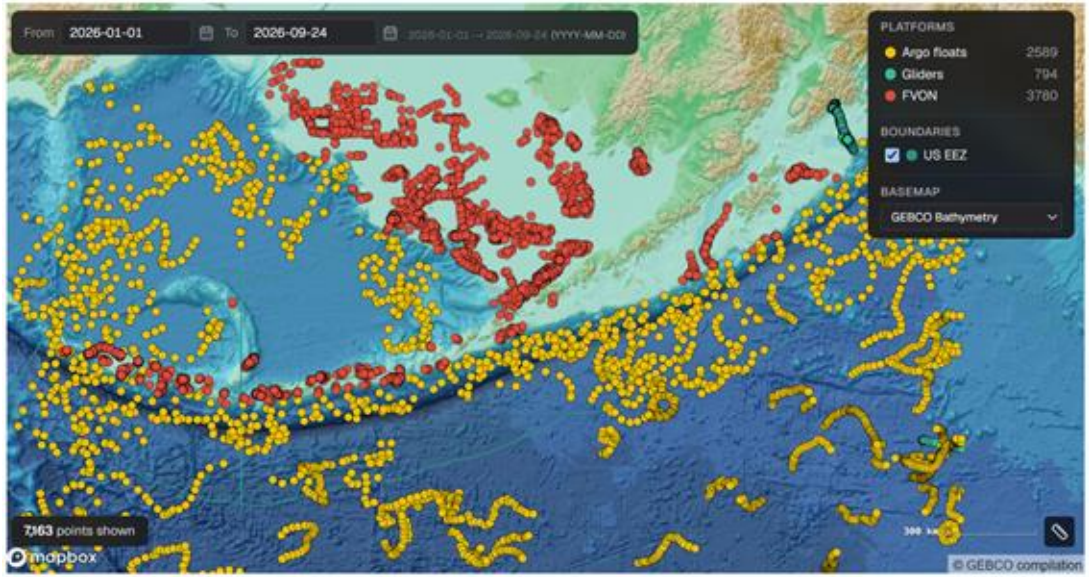


Elizabeth Siddon, Kalei Shotwell, and **Jim Ianelli**
Alaska Fisheries Science Center, NOAA Fisheries

New and Noteworthy Topics

Oceanography On Deck: Industry-driven data collection fills spatial & temporal information gaps

- Data collection started in the EBS in 2025
- Multiple fleets and gear types: longline, pot, pelagic trawl, and non-pelagic trawl
- Spatial and temporal expansion of observations
- MOM6 validation efforts

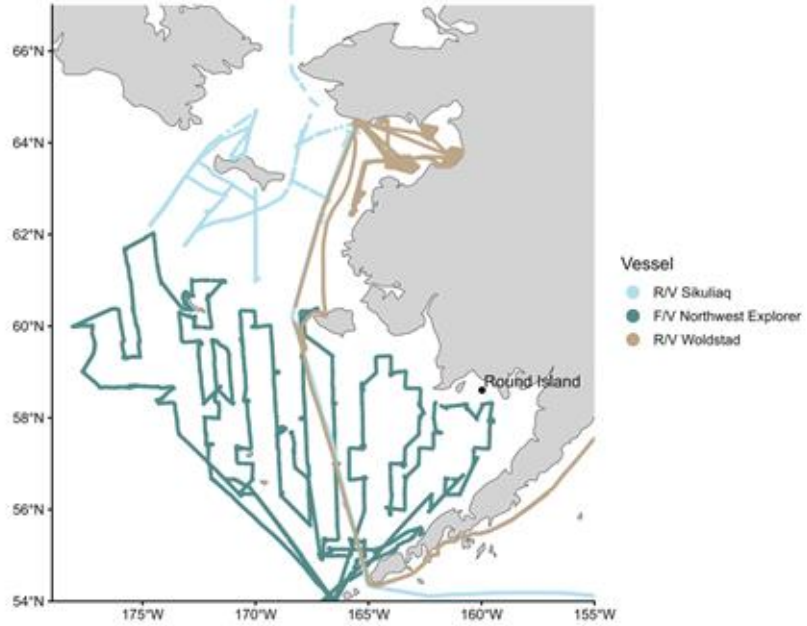


Jack Carroll (Ocean Data Network), **Cooper Van Vranken** (ODN & Fishing Vessel Ocean Observing Network), **Kelly Kearney** (AFSC), **Wei Cheng** (NOAA/PMEL), **Cory Lescher** (Alaska Bering Sea Crabbers), **Michelle Stratton** (Alaska Marine Community Coalition), **Dustin Colson Leaning** (Environmental Defense Fund & FVON), **Elizabeth Siddon** (AFSC, NOAA Fisheries)

New and Noteworthy Topics

Imaging FlowCytobot (IFCB): Phytoplankton, Lower Trophic Dynamics, and Survey Modernization

- What is an IFCB?
- Characterizes lower trophic level dynamics
- Detects Harmful Algal Blooms (HABs)
- Summarizes current and on-going collaborations within the HAB network (i.e., AHAB)

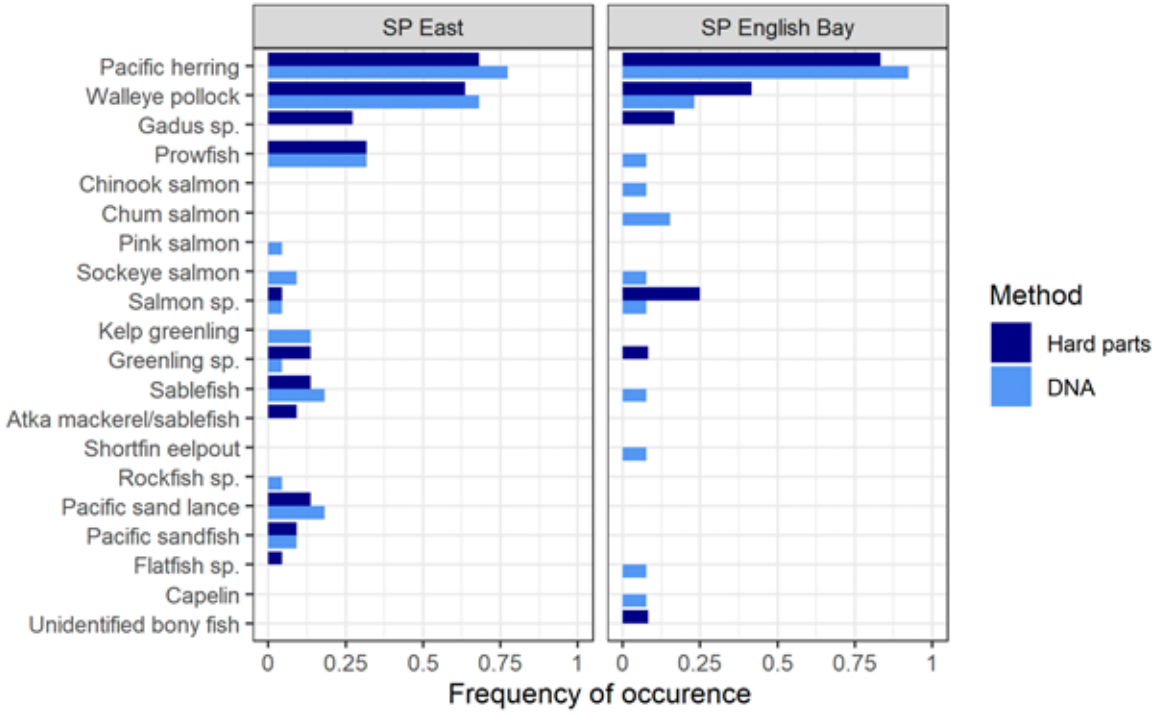


Jeanette Gann (AFSC), **Gulce Kurtay** and **Calvin Mordy** (CICOES/PMEL),
Jens Nielsen (CICOES/AFSC), **Thomas Farrugia** (AOOS),
Evie Fachon, Mrunmayee Pathare, and **Mike Brosnahan**
Woods Hole Oceanographic Institute

New and Noteworthy Topics

DNA metabarcoding of northern fur seal scats improves species-level prey identification and tests scalability of efficient data generation

- Proof of concept
- Side-by-side comparison (2025 samples)
- Consistent species ID
- Improved species resolution (i.e., gadids, salmonids)

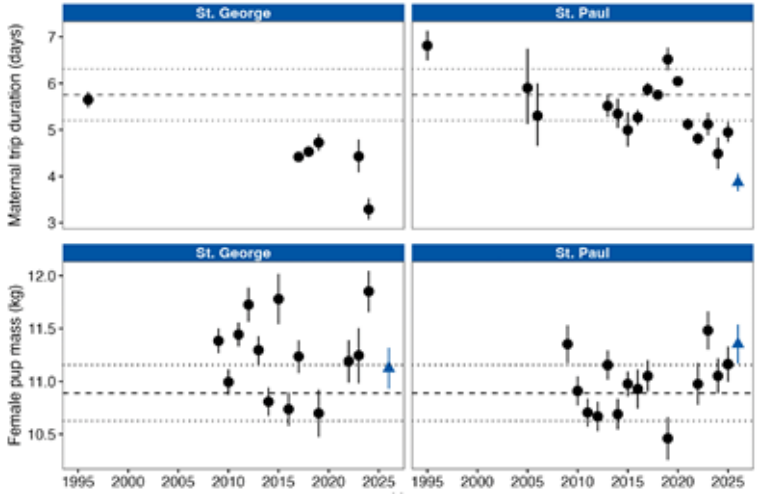


Diana Baetscher (AFSC),
Tonya Zeppelin and **Katie Luxa** (MML)

New and Noteworthy Topics

Integrated Marine Mammal Information

- Northern fur seals:
  - Maternal trip duration
  - Female pup mass
  - Prey occurrence
  - Pup production
- Harbor seals:
  - Population abundance

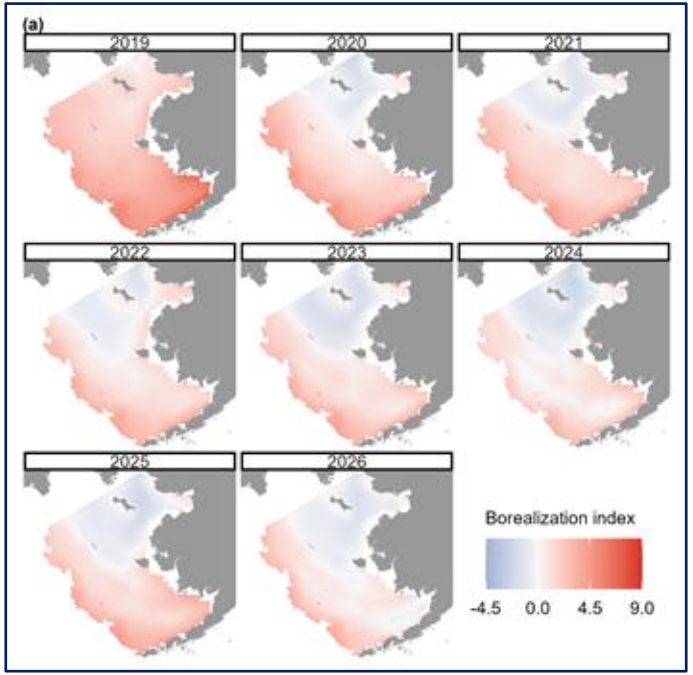


Aaron Lestenkof, Chelsea Campbell, Dallas Melovidov, Paul Melovidov
Aleut Community of St. Paul Island
Carey Kuhn, Erin Richmond, Jeremy Sterling, Josh London, Katie Luxa, Rod Towell, Rolf Ream, Tom Gelatt, Tonya Zeppelin
AFSC MML
Michael Williams
AKRO PRD
*Synthesis compiled by **Elizabeth McHuron***
CICOES

New and Noteworthy Topics

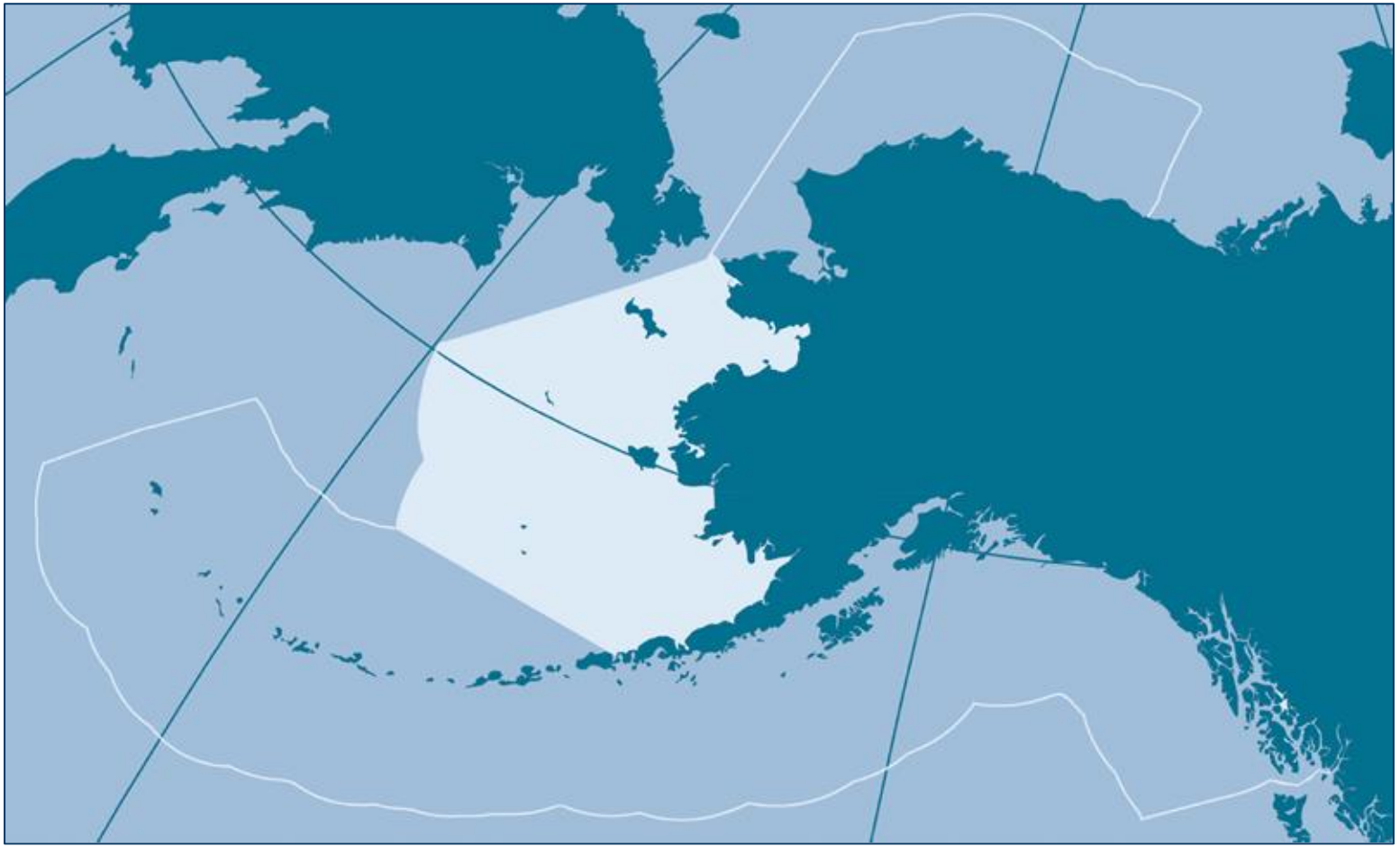
A Spatially Resolved Borealization Index for the Bering Sea

- Extends original analysis to a Spatial DFA (SDFA); allows evaluation of spatiotemporal trends
- Physical variables
  - Water temperature (summer surface & bottom)
  - Sea ice cover (Jan-Feb and Mar-Apr)
  - Salinity (summer bottom values)
  - Open-water duration (days between ice retreat and fall freeze up)
- Biological variable
  - Peak spring phytoplankton bloom timing

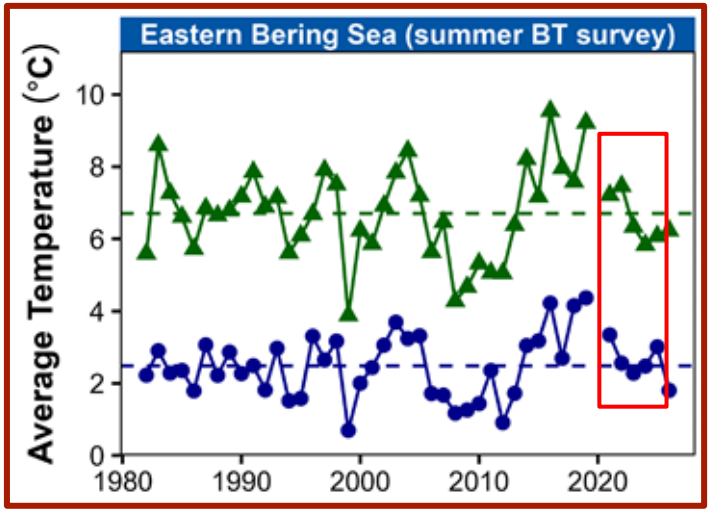


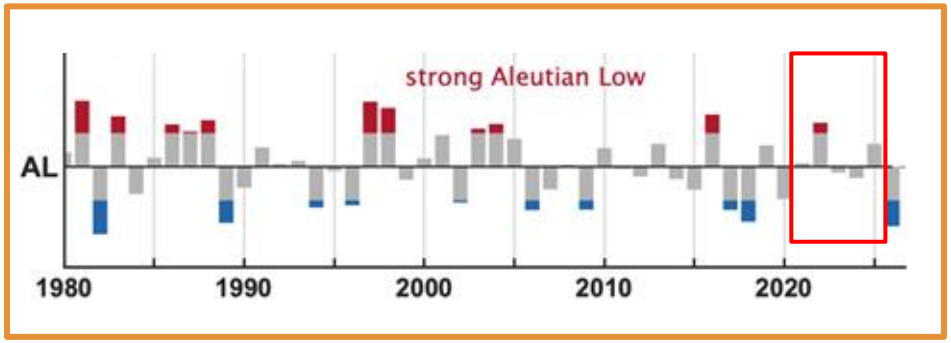
Kaitlyn O'Brien (UAF), **Mike Litzow** (Alaska Coastal Observations and Research), **Franz Mueter** (UAF), **Erin Fedewa** (AFSC), **David Kimmel** (AFSC), **Trond Kristiansen** (Farallon Institute for Advanced Ecosystem Research), **Jens Nielsen** (CICOES/AFSC), and **Emily Ryznar** (AFSC)

Ecosystem Assessment



2021 - 2025: *near-average thermal conditions*
2026: *cool conditions*

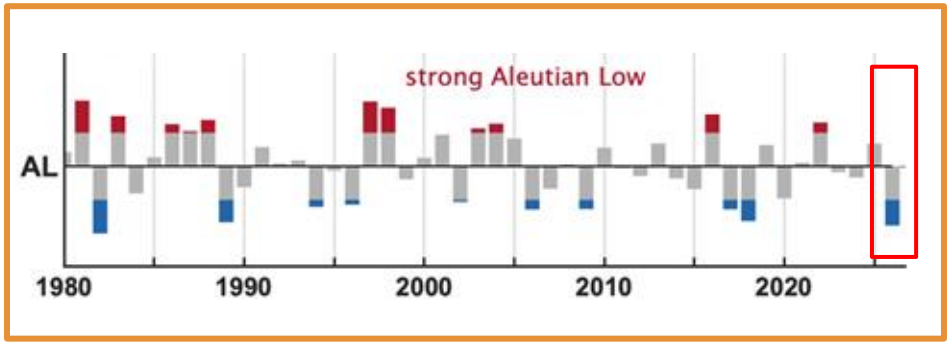




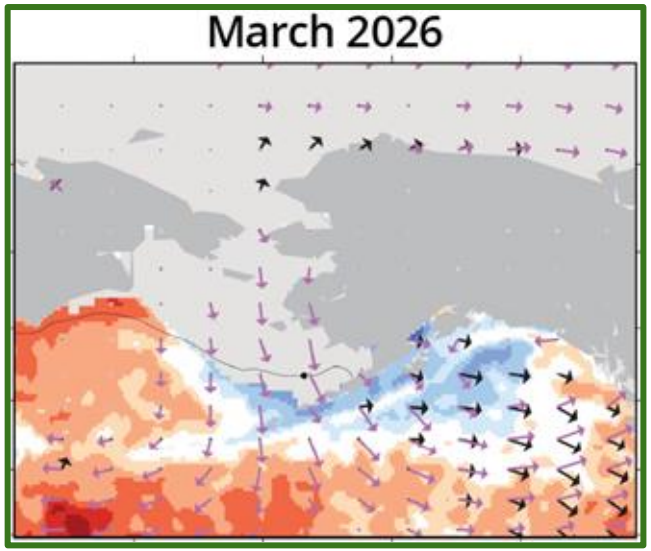
- 2014-2021: extended warm period
- 2021-2025: near-average thermal conditions
  - SST and bottom temperatures
  - Aleutian Low index

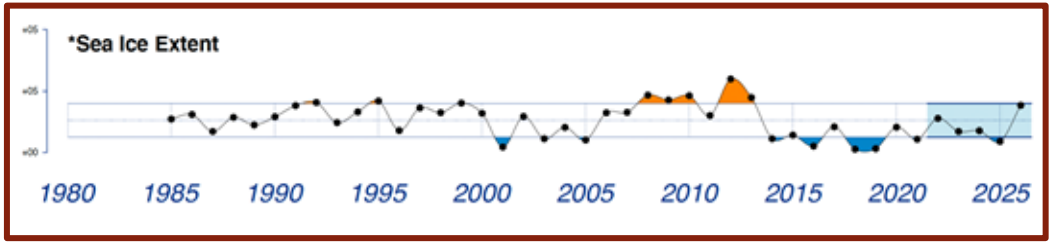
Rohan and Barnett Fig 45; Lemagie Fig. 25

2021 - 2025: *near-average thermal conditions*
2026: *cool conditions*



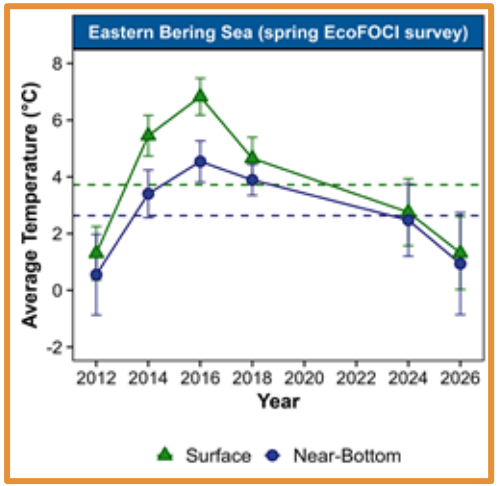
- 2014-2021: extended warm period
- 2021-2025: near-average thermal conditions
  - SST and bottom temperatures
  - Aleutian Low index
- 2026: transition to cool conditions
  - Weak winter ALPs
  - Strong north-to-south winds
  - Sea ice expansion (largest since 2013)

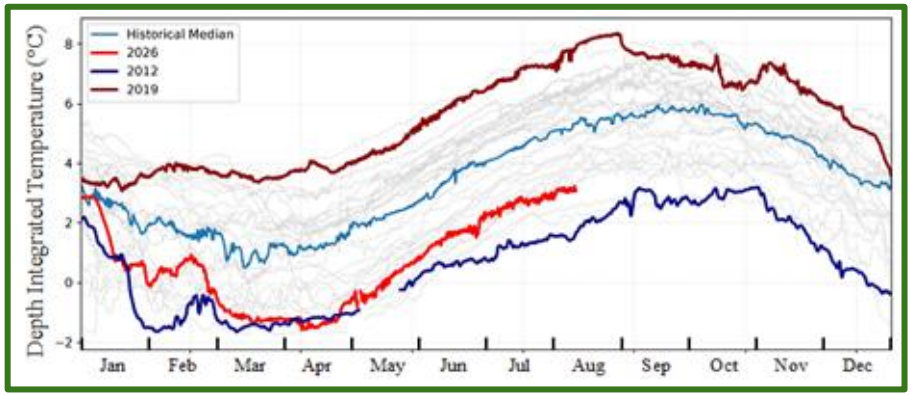




Lemagie Fig. 25 and Fig. 27, SEBS Report Card

2021 - 2025: *near-average thermal conditions*
2026: *cool conditions*

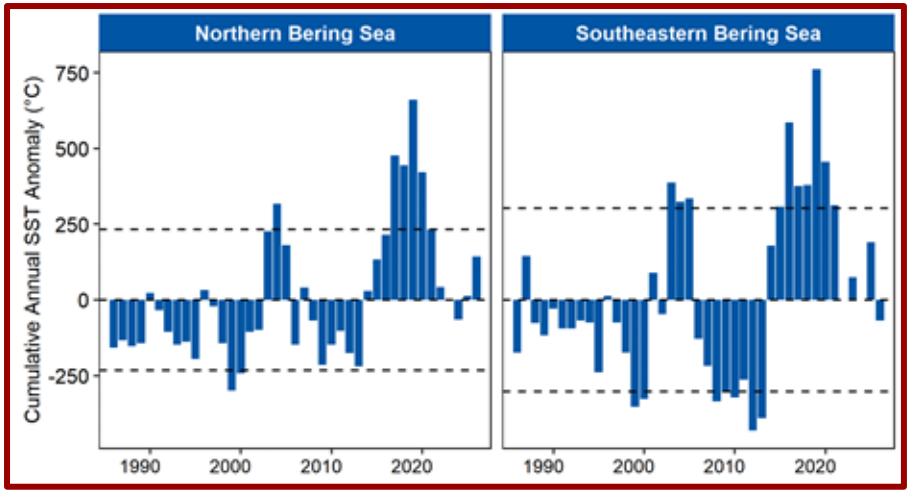




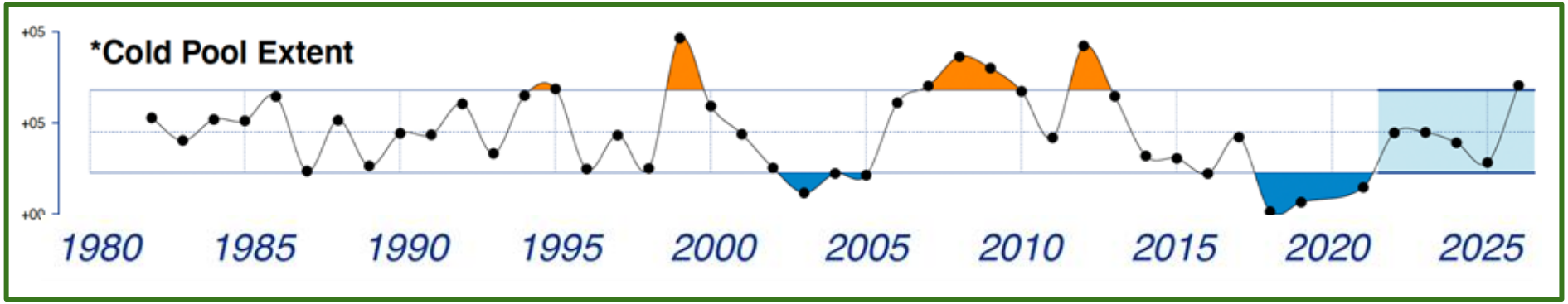
- 2026: transition to cool conditions
  - Spring: coldest since 2012
  - M2: >2°C below average through late summer

Axler & Rogers Fig. 43, McCabe et al. Fig. 50

2021 - 2025: *near-average thermal conditions*
2026: *cool conditions*

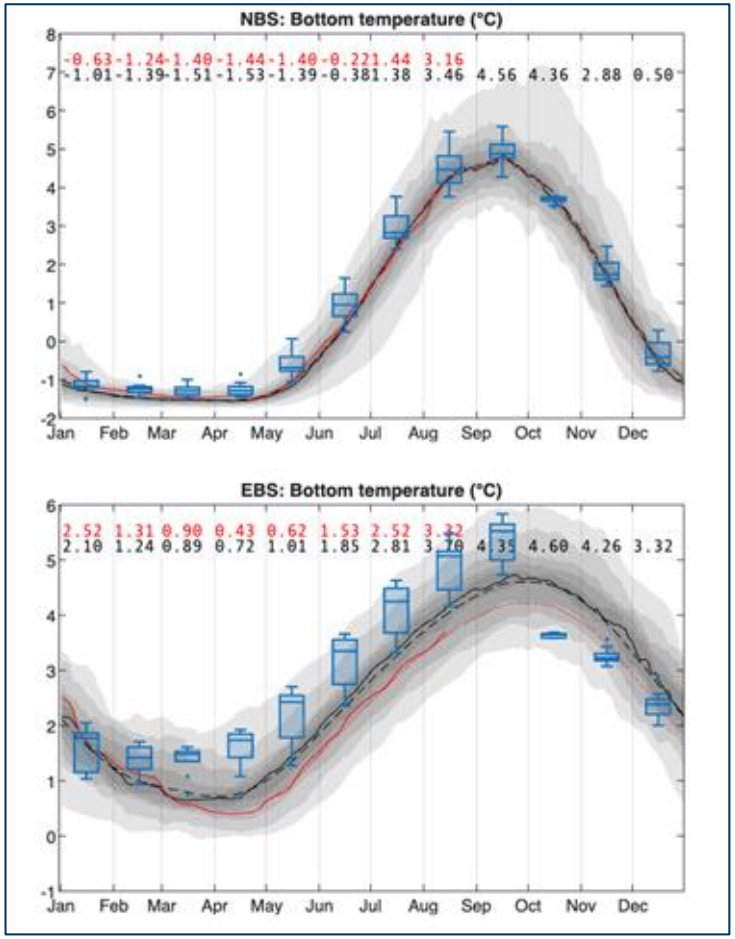


- 2026: transition to cool conditions
  - Spring: coldest since 2012
  - M2: >2°C below average through late summer
  - No marine heatwaves (SEBS or NBS)
  - SST anomaly: lowest since 2014 (SEBS)
  - Cold pool: 5th largest in survey time series



Lemagie & Callahan Fig. 54, SEBS Report Card

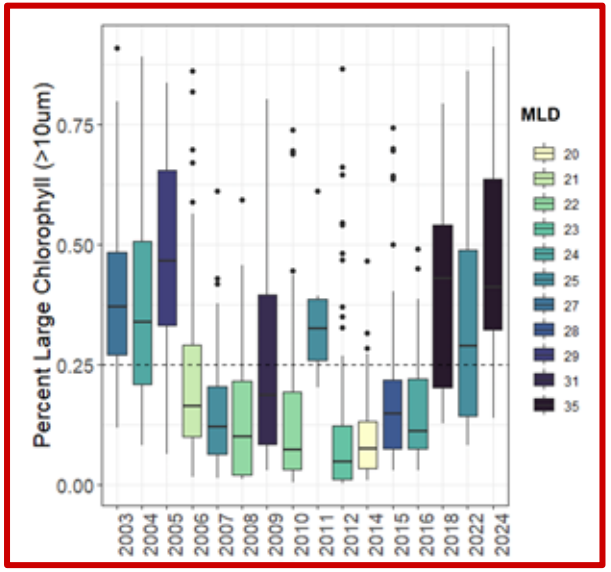
2027: *TBD*



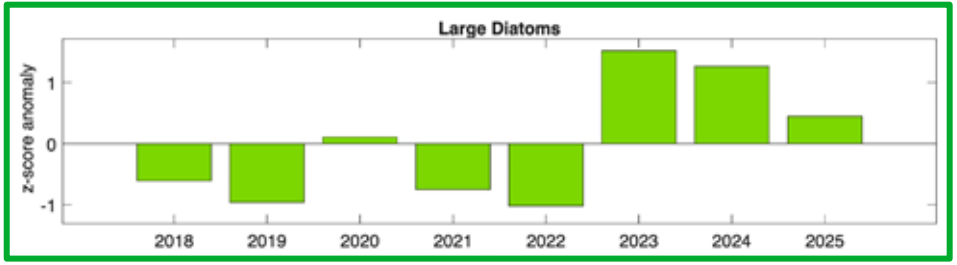
- Currently, the broader North Pacific is experiencing a ‘Very Strong’ El Niño
  - Warm anomalies predicted in EGOA in winter 2026/2027
  - EBS conditions governed by the Aleutian Low Pressure System and regional wind dynamics (read: TBD)
  - NBS: ensemble spread from cool to warm
  - SEBS: ensemble spread from near neutral to quite warm

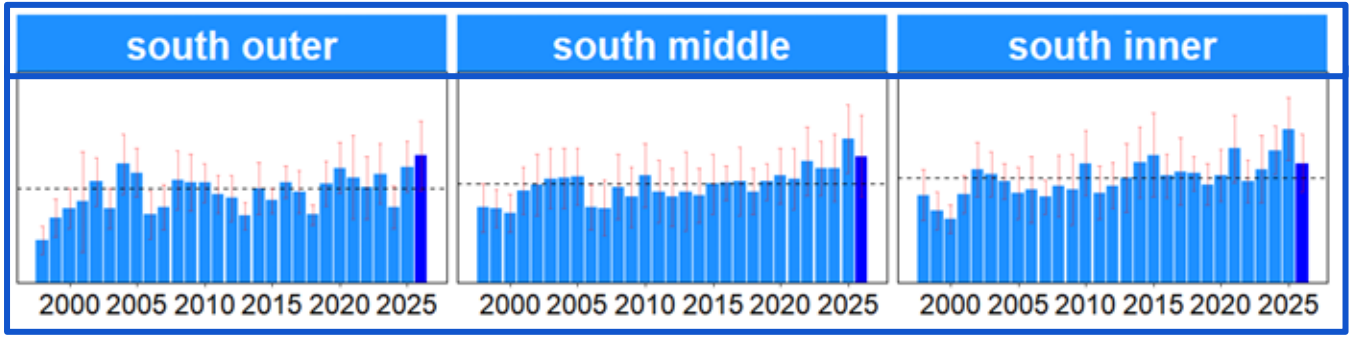
K. Kearney, AFSC

*Productive, ice-associated blooms supported good-quality food and efficient energy transfer to secondary consumers**



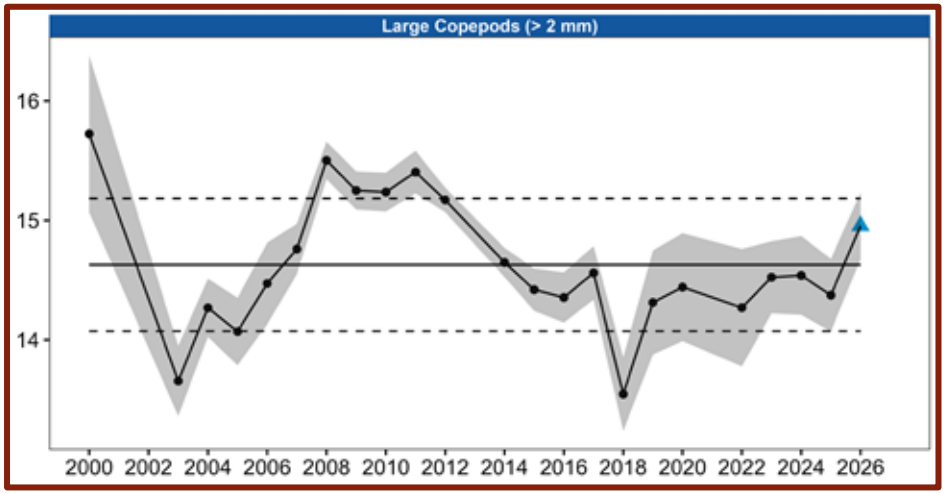
- Percent large chlorophyll (>10 µm) above average 2022 & 2024
- Large diatom abundance above average 2023 - 2025
- Spring chlorophyll concentrations above average in 2025 & 2026
- *2026 observations are limited



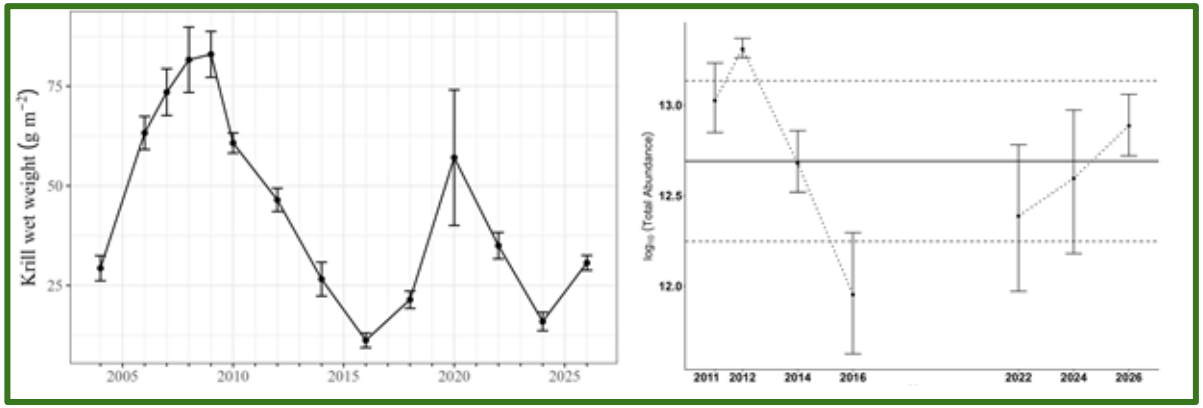


Gann Fig. 62,
Ostle & Batten Fig. 68,
Gann et al. Fig. 68

2026: good quantity and quality of secondary prey resources for pelagic consumers

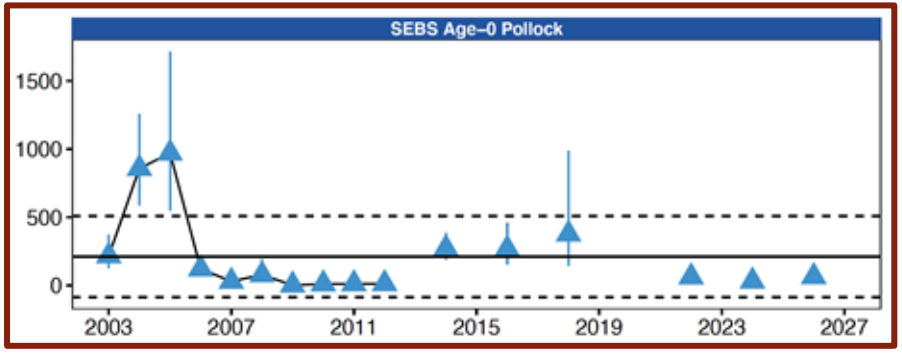


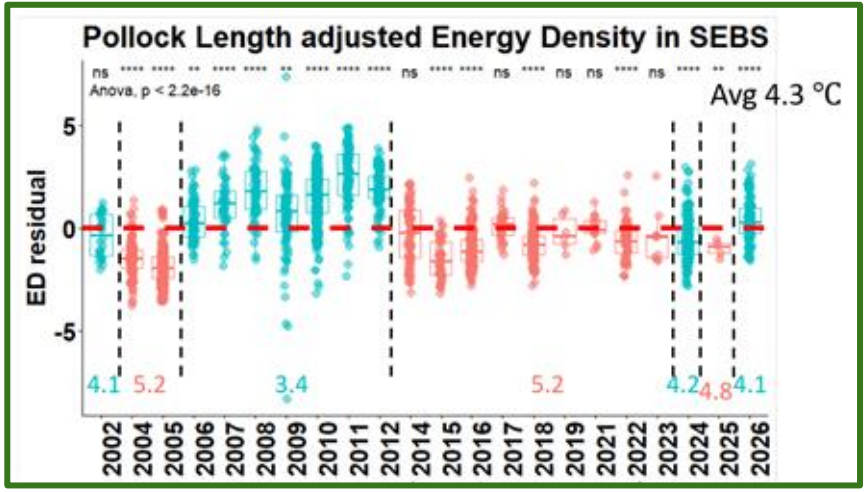
- 2021-2025: Secondary producers took several years to rebound after the extended warm stanza
- 2026: Fall large copepod abundance above average
- 2026: Euphausiid abundance increased (summer and late summer surveys)
- 2026: Lipid content increased (not shown)



Kimmel et al. Fig. 73, Levine et al. Fig. 79, Spear et al. Fig. 81, Pinger et al. Fig. 76

SEBS: low biomass of capelin, herring, and age-0 pollock; high energy density of age-0 pollock

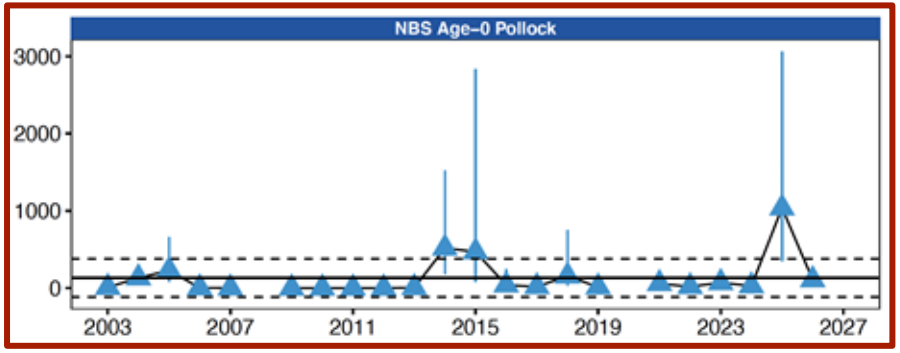


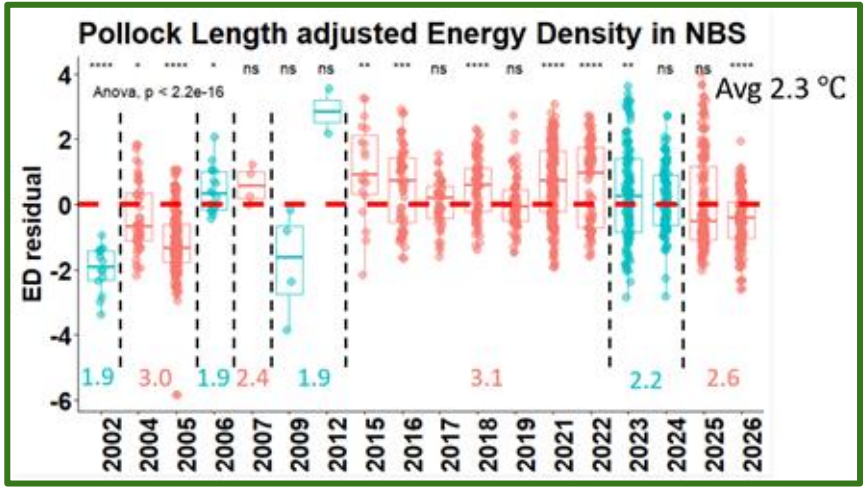


- Southeastern Bering Sea
  - Capelin below average since 2014
  - Herring below average (except 2018)
  - Age-0 pollock
    - Above average biomass 2014-2018
    - Below average biomass 2022-2026
    - Below average energy density 2014-2025
    - Above average ED in 2026

Andrews et al. p. 173,
Andrews et al. Fig. 95,
Page et al. Fig. 99

NBS: average biomass of capelin and age-0 pollock; herring remained low

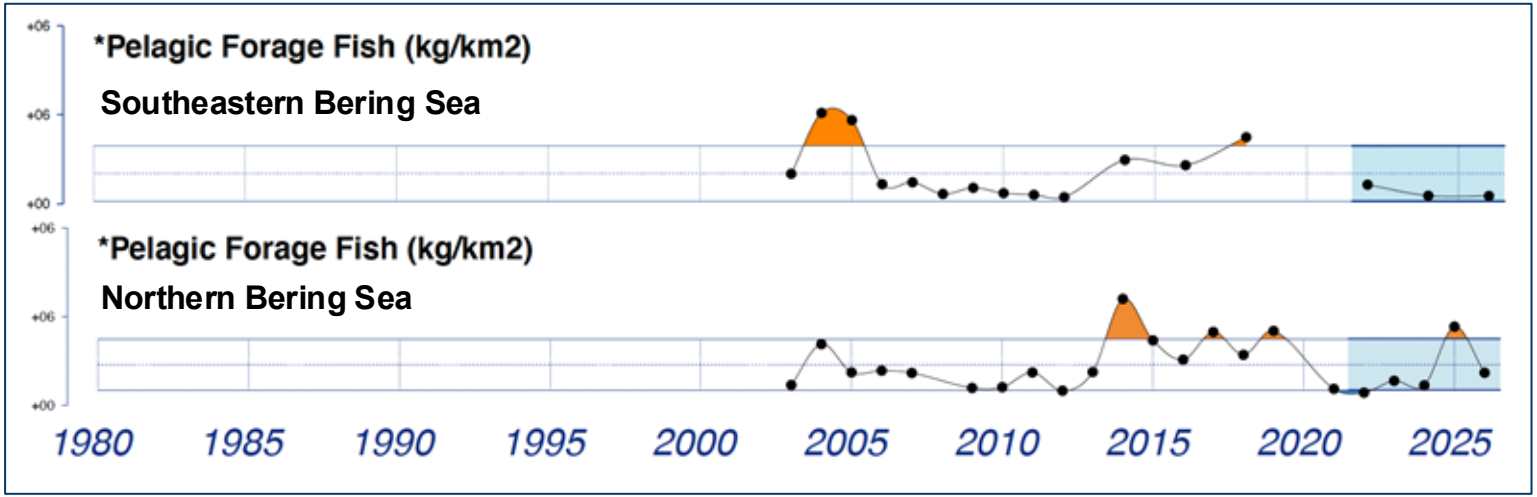




- Northern Bering Sea
  - Capelin biomass average in 2026
  - Herring below average since 2021 with a slight increase in 2026
  - Age-0 pollock
    - Peaked in 2025
    - Average in 2026
    - Below average ED in 2026

Andrews et al. p. 173, Andrews et al. Fig. 95, Page et al. Fig. 99

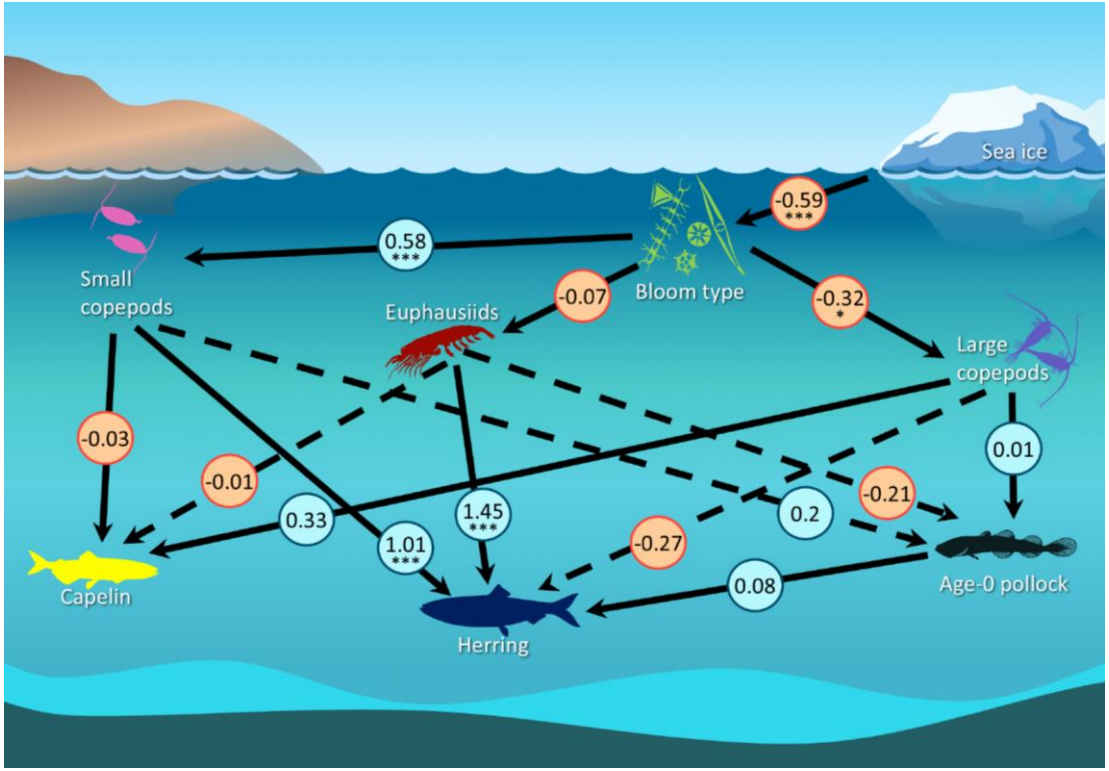
Forage fish: mixed signals (survey vs predators-as-samplers)



- Surveys capture a brief temporal window and are limited in their spatial extent.
- Indicators of forage fish by upper trophic level consumers provide broader temporal and spatial integration of forage conditions and all show positive trends over the EBS shelf in 2026:
  - Groundfish condition
  - Seabird reproductive success
  - Northern fur seal trip durations and pup weights

SEBS & NBS Report Cards

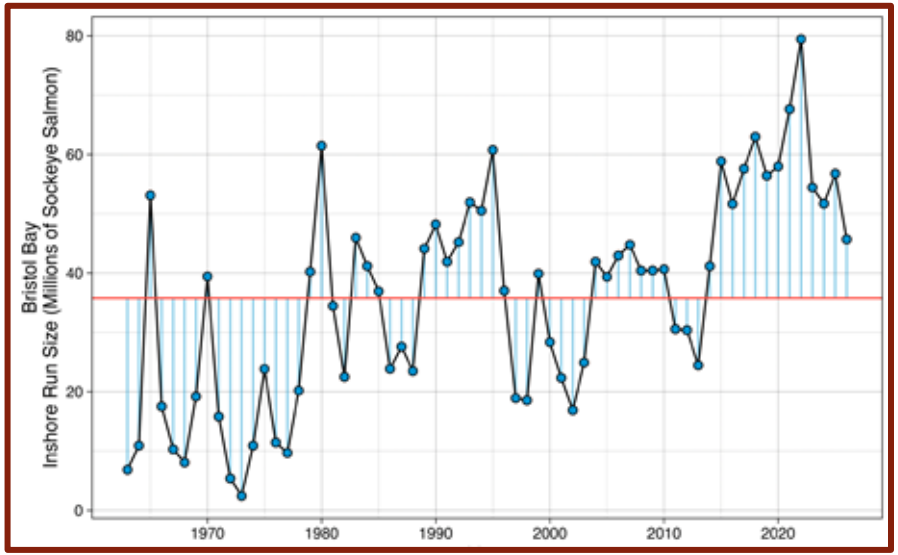
Forage fish: mixed signals (survey vs predators-as-samplers)



- Expected: Open water blooms positively associated with small copepods and negatively associated with large copepods
- Warm years: low sea ice, more open-water blooms, small copepods, and herring
- Cool years: high sea ice, more ice-associated blooms, large copepods, and capelin
- Unexpected: no effect of large copepods on age-0 pollock; negative effect of euphausiids on age-0 pollock

Domke et al. p. 154

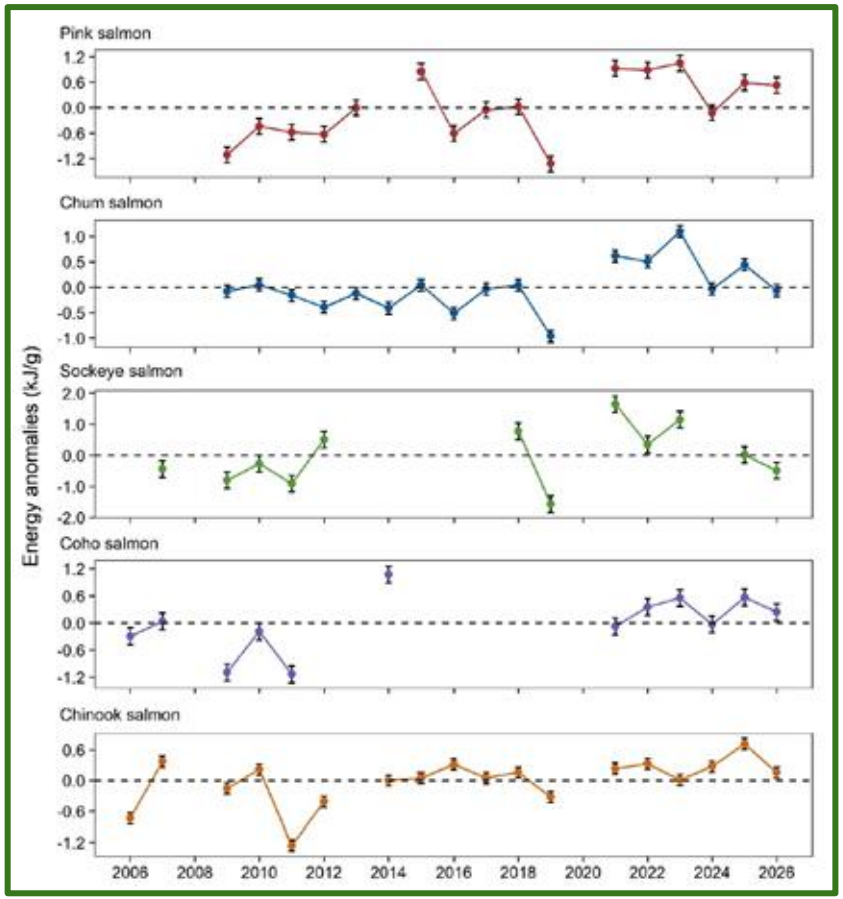
SEBS: energy density low; adult returns declined, but above average



- Southeastern Bering Sea
  - Energy density remained low
  - Bristol Bay sockeye salmon continued to decline; modest runs expected

Fergusson et al. p. 106, Cunningham et al. Fig. 110

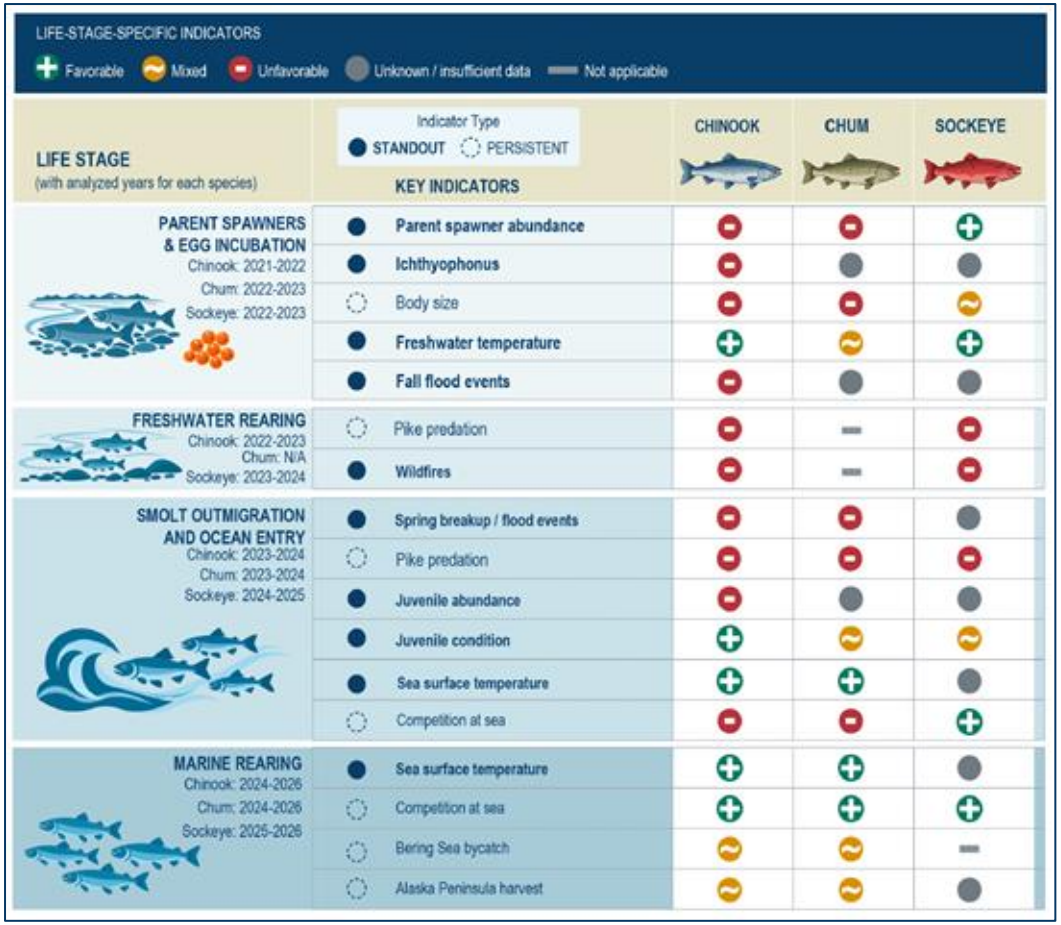
NBS: higher energy density; signs of recovery



- Southeastern Bering Sea
  - Energy density remained low
  - Bristol Bay sockeye salmon continued to decline; modest runs expected
- Northern Bering Sea
  - ED mostly average to above average
  - Chum salmon: neutral response to thermal conditions
  - Chinook salmon: signs of recovery; run sizes could improve in next 3-4 years

Fergusson et al. p. 105, DeFilippo p. 175

Synthesizing Indicators of Yukon and Kuskokwim Salmon Health and Abundance for a 2027 Outlook

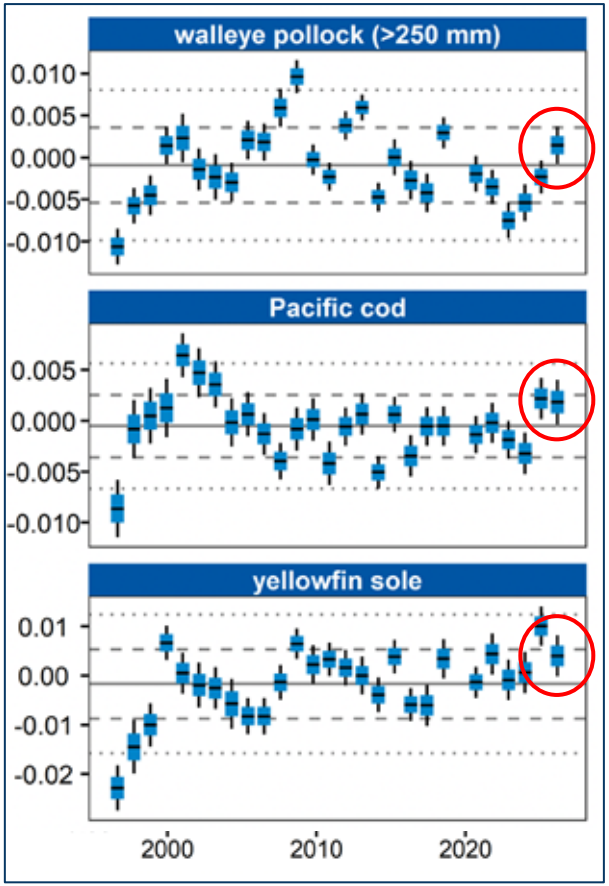


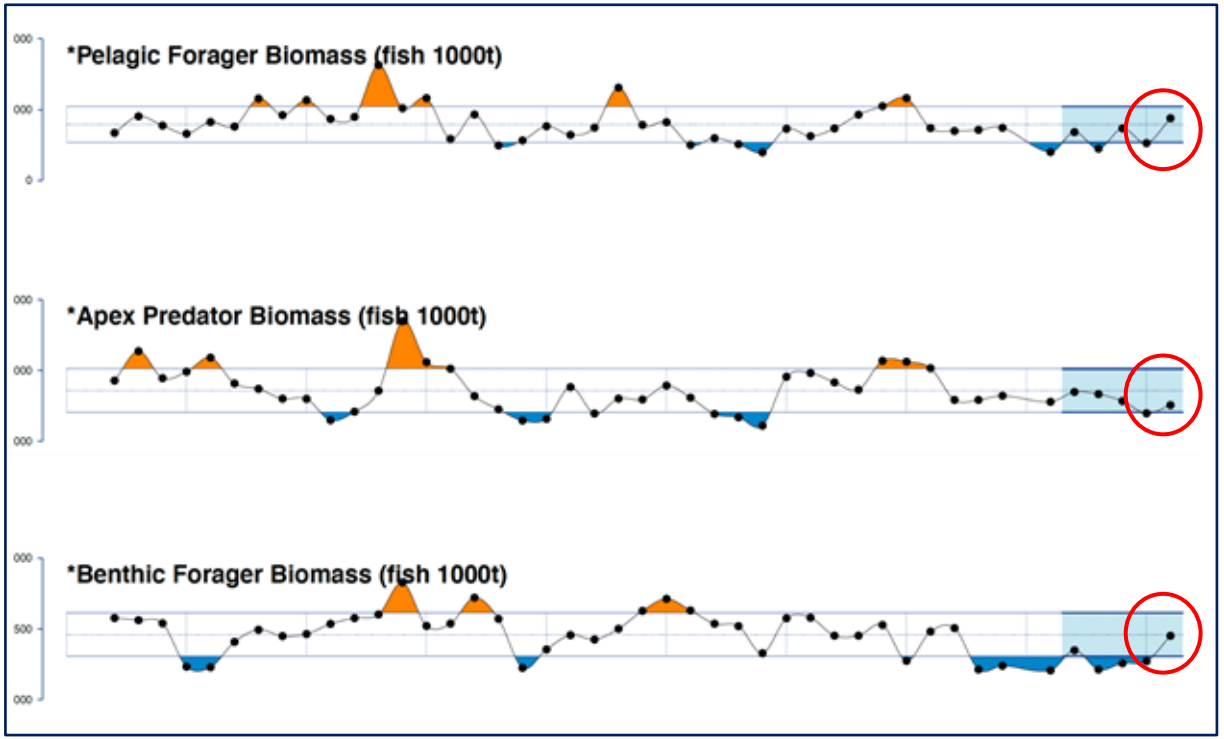


Contributed by Terese Vicente[1], Vanessa von Biela[2], Janessa Newman[3], Diloola Erickson[4], Jacqueline Muehlbauer[4], Erik Schoen[5], Megan Williams[6], Justin Leon[1], Andrew Magel[1], Patricia Chambers[6], Daniel Auerbach[1], Nicholas Jacuk[6], Craig Chythlook[3], and Jim Simon[3]

[1]Kuskokwim River Inter-Tribal Fish Commission (KRITFC), Bethel, AK
[2]U.S. Geological Survey, Alaska Science Center, Anchorage, AK
[3]Yukon River Inter-Tribal Fish Commission (YRITFC), Fairbanks, AK
[4]Tanana Chiefs Conference, Fairbanks, AK
[5]International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK
[6]Arctic & Northern Waters Program, Ocean Conservancy, Anchorage, AK

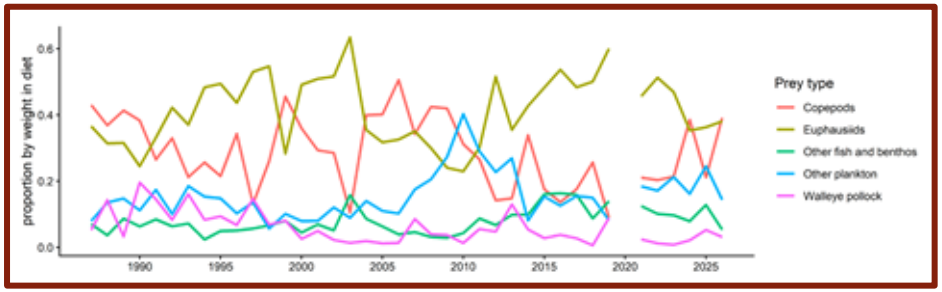
Groundfish: increased biomass and condition across major groundfish species representing pelagic foragers, apex predators, and benthic foragers



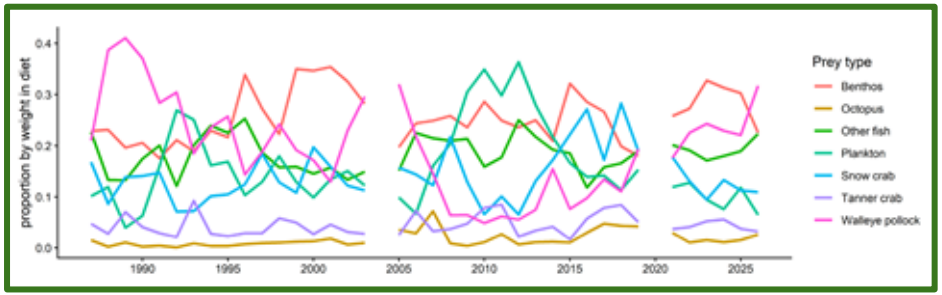


Prohaska & Rohan Fig. 120, SEBS Report Card

Groundfish: cooler conditions + decline of older, piscivrous fish = decline in predation mortality



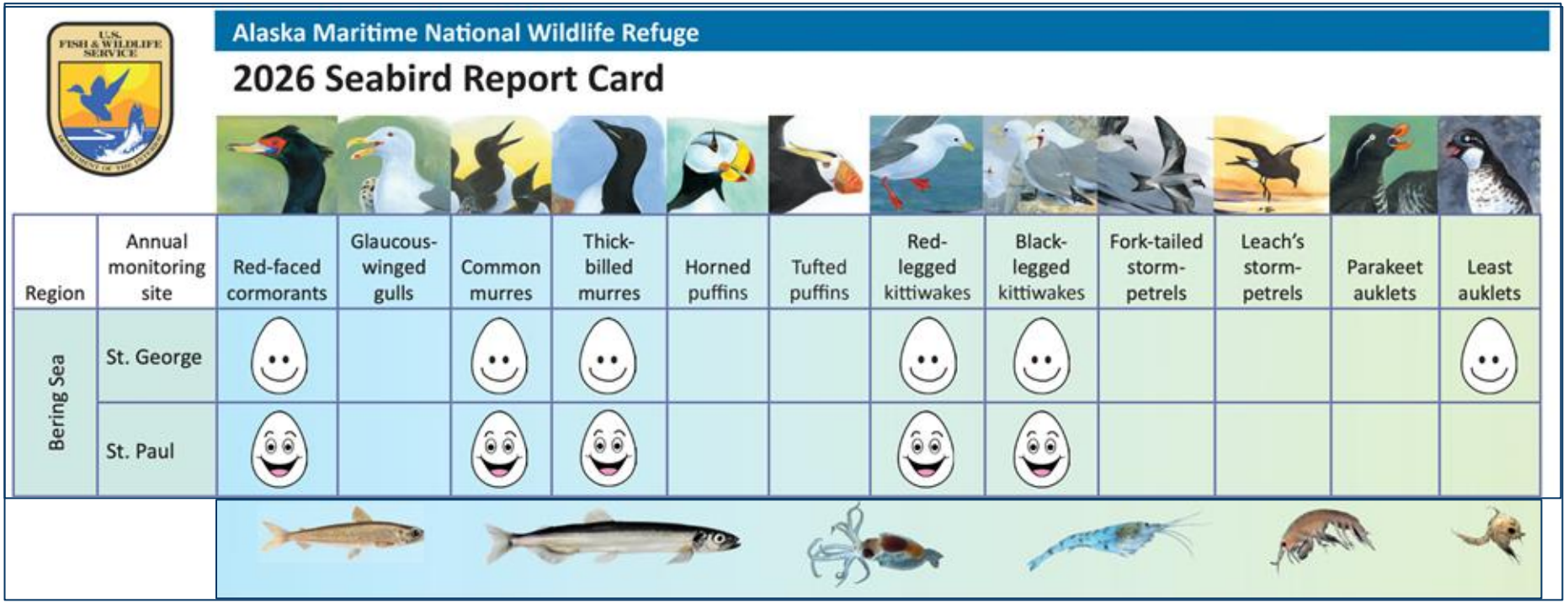
- Pollock
  - Copepods and euphausiids
  - Low rate of cannibalism, but high total biomass consumed due to robust 2025 year class



- Pacific cod*
  - Pollock was largest proportion of diets
  - Since 2018, samples dominated by larger cod, which are more piscivorous
  - *updated multispecies model information

Aydin Fig. 115 and Fig. 116

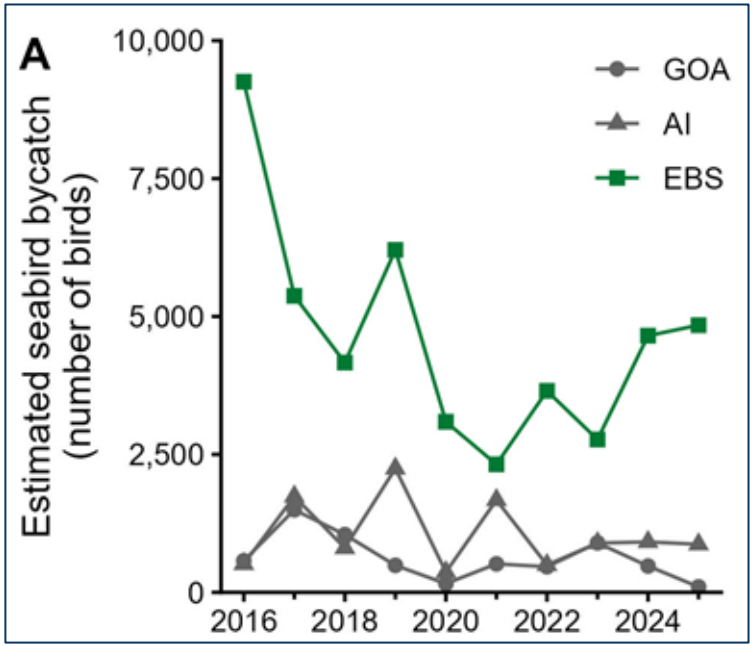
Seabirds: 2026 was a productive year for seabirds at the Pribilof Islands



Region	Annual monitoring site	Red-faced cormorants	Glaucous-winged gulls	Common murres	Thick-billed murres	Horned puffins	Tufted puffins	Red-legged kittiwakes	Black-legged kittiwakes	Fork-tailed storm-petrels	Leach's storm-petrels	Parakeet auklets	Least auklets
Bering Sea	St. George	☺		☺	☺			☺	☺				☺
	St. Paul	☺		☺	☺			☺	☺				

- St. George Island: productivity was average, reflecting stable but typical breeding conditions.
- St. Paul Island: above-average productivity; particularly favorable foraging and good chick survival.

Seabirds: increased bycatch 2024 & 2025 and HAB mortality events 2025 & 2026

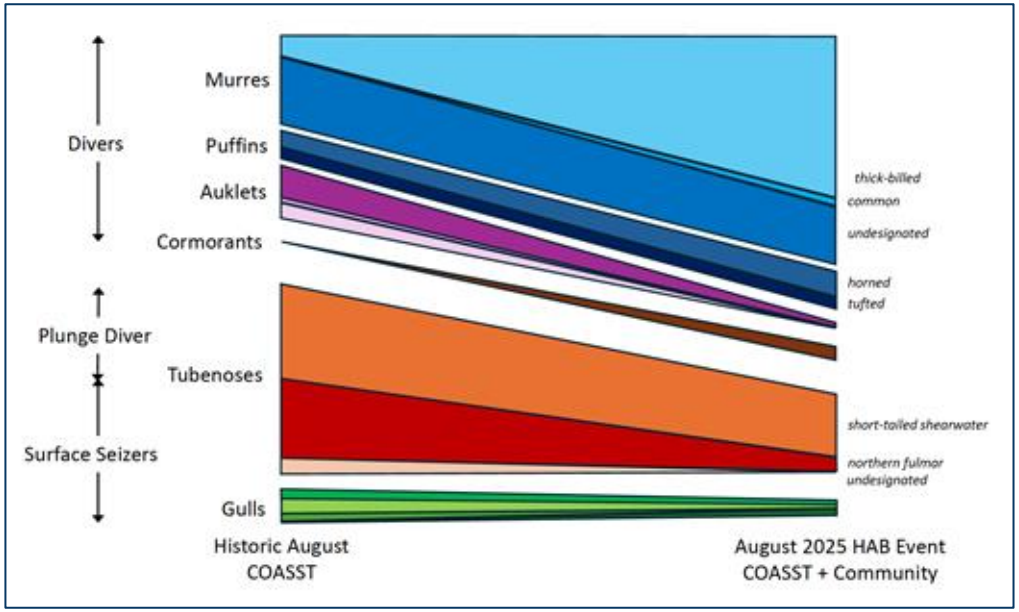




- 2025: In the SEBS, seabird bycatch was 22% above average
  - Primarily Laysan albatross and Northern fulmars
- 2025: In the NBS, seabird bycatch was 87% below average
  - Driven by Northern fulmars and shearwaters
- 2025: UME of thick-billed murres on St. George linked to HAB event
- 2026: low mortality rates; localized HAB event at Round Island

Beck et al. p. 162, Seabird Synthesis p. 233

Seabirds: increased bycatch 2024 & 2025 and HAB mortality events 2025 & 2026



- 2025: In the SEBS, seabird bycatch was 22% above average
  - Primarily Laysan albatross and Northern fulmars
- 2025: In the NBS, seabird bycatch was 87% below average
  - Driven by Northern fulmars and shearwaters
- 2025: UME of thick-billed murres on St. George linked to HAB event

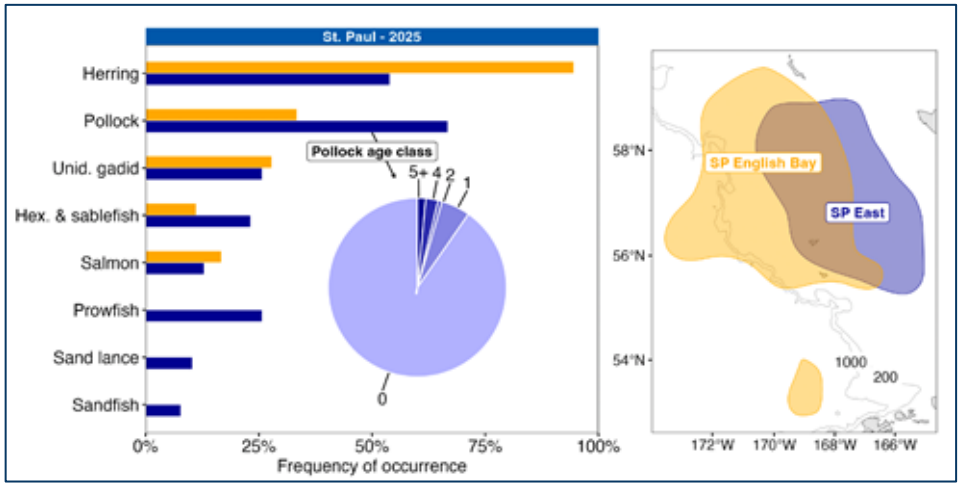


- 2026: low mortality rates; localized HAB event at Round Island

Beck et al. p. 162, Seabird Synthesis p. 233

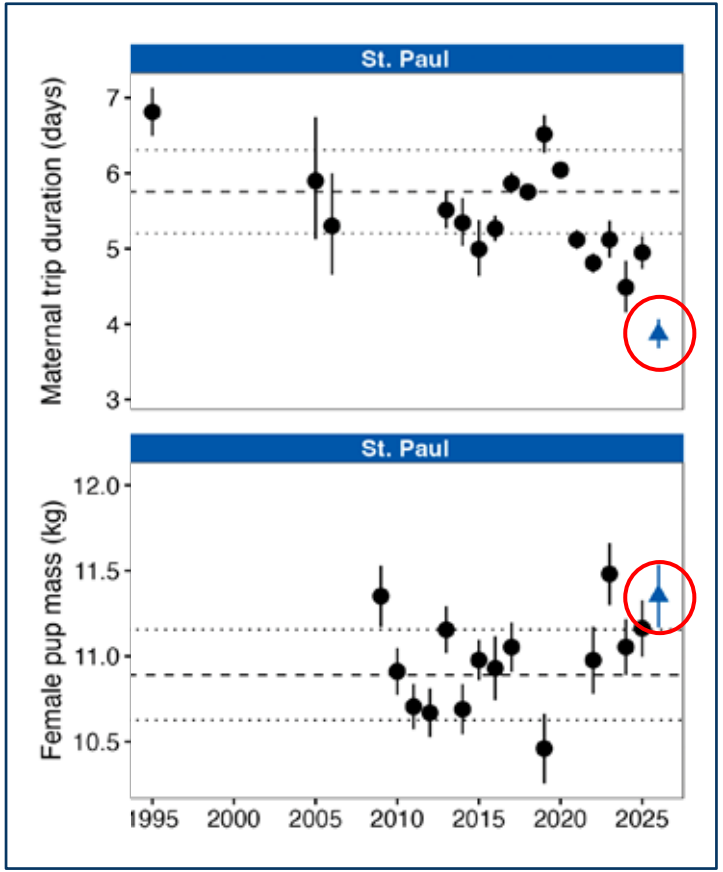
Northern fur seals: 2026 was a productive year for fur seals at the Pribilof Islands

- 2025: Diets dominated by Pacific herring and pollock (predominantly age-0)



Marine Mammal Synthesis p. 240

Northern fur seals: 2026 was a productive year for fur seals at the Pribilof Islands

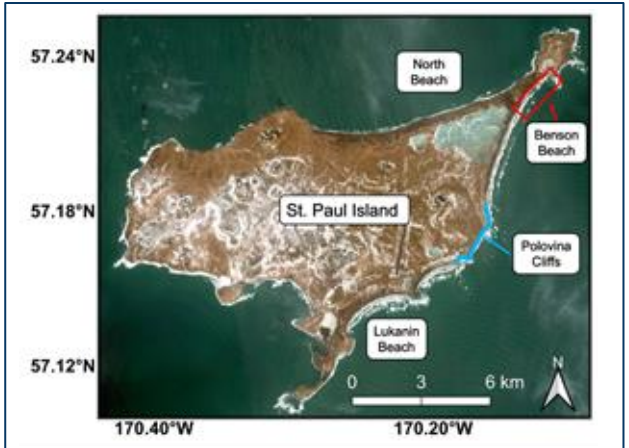


- 2025: Diets dominated by Pacific herring and pollock (predominantly age-0)

- 2026: below-average maternal foraging trip durations
- 2026: Above-average female pup masses
- Indicates favorable feeding over the middle and outer shelf

Marine Mammal Synthesis p. 240

Northern fur seals: HAB mortality events 2024 & 2025





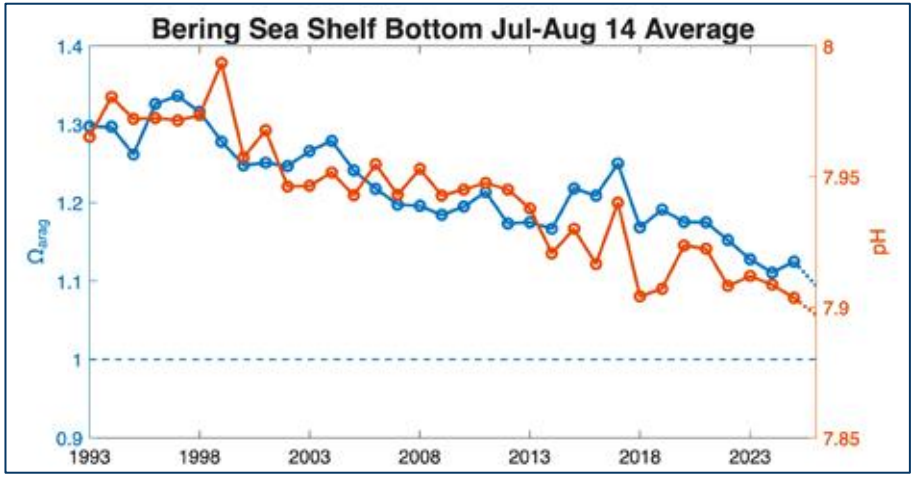
- 2025: Diets dominated by Pacific herring and pollock (predominantly age-0)

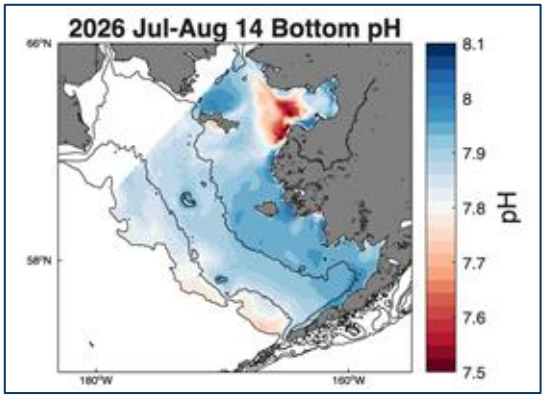
- 2026: below-average maternal foraging trip durations
- 2026: Above-average female pup masses
- Indicates favorable feeding over the middle and outer shelf

- 2024 and 2025: mortality events caused by saxitoxin poisoning

Lefebvre et al. Fig. 158

Ocean Acidification: could negatively impact crab growth, shell hardening, and survival

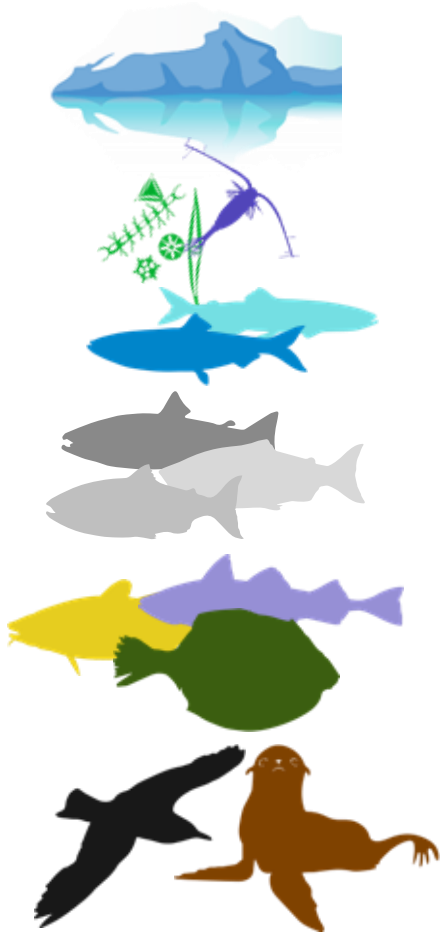




- 2026: pH and aragonite saturation reached shelf-wide minimums
- 'Hotspot' near the Yukon River delta due to freshwater runoff and carbon loading
- Corrosive bottom waters over the middle and outer shelf; shallow inner shelf remains well-buffered
- Crab stocks likely most vulnerable, especially Norton Sound red king crab (assessment in November)

Pilcher et al. p. 256

2026 Summary and *implications*



- Cooler thermal conditions, especially over the southern shelf
  EBS entering El Niño event from relatively lower heat content
- Positive indicators of pelagic productivity
  Good quantity and quality of prey for bottom-up trophic pathways
- Mixed signals for forage fish
  Positive indicators in upper trophic level consumers of forage fish
- Mixed signals for salmon
  Variable age structure and complex life cycles; response to cooler and more productive conditions will vary by species
- Positive indicators for groundfish
  Across major groundfish species representing pelagic foragers, apex predators, and benthic foragers
- Seabirds & fur seals: Positive signals, but HAB mortality impacts
  HABs are propagating through the EBS food web