Ecosystem Status Report: Gulf of Alaska 2026



Bridget Ferriss

Alaska Fisheries Science Center, NOAA Fisheries

With contributions from:

Anna Abelman, Shaun Bell, Erendira Aceves Bueno, Mayumi Arimitsu, Kerim Aydin, Kelia Axler, Brenda Ballachey, Sonia Batten, Brian Brettschneider, Jessica Beck, Piper D. Bishop, Dana F. Bloch, James Bodkin, Brian Brettschneider, Mariela Brooks, Matt W. Callahan, Reuben Cash, Maggie Chan, Wei Cheng, Heather Coletti, Daniel Cushing, Seth Danielson, Sherri Dressel, Brie Drummond, Erica Ebert, George Esslinger, Stacie Evans, Emily Fergusson, Thomas Farrugia, Bridget Ferriss, Teresa Fish, Tara Flood, Christine Gabriele, Sarah Gaichas, Jeanette C. Gann, Scott Hatch, Madison Haumschild, Claudine Hauri, Gwenn Hennon, Tyler Hennon, David Hill, Russell Hopcroft, Katrin Iken, John J. Jansen, Robert Kaler, Kelly Kearney, David Kimmel, Kim Kloecker, Brenda Konar, Gulce Kurtay, Emily Lemagie, Mike Levine, Josh M. London, Carley Lowe, Jenna Malek, Brett M. McClintock, Denise McKelvey, Kay McMonigal, Sara Miller, John Moran, Janet Neilson, Clare Ostle, Remi Pages, Melanie Paquin, Alia Payne, Andrew Piston, Meredith Pochardt, Isaac Reister, Heather Renner, Patrick Ressler, Lauren Rogers, Nora Rojek, Joshua R. Russell, Akash Sastri, Quinn Smith, Hank Statscewich, William Stockhausen, Wesley Strasburger, Janice Straley, Florence Sullivan, Robert Suryan, Rick Thoman, Troy Thynes, Cathy Tide, Sarah Traiger, Scott C. Vulstek, Muyin Wang, Shannon Whelan, George A. Whitehouse, Carrie Worton, Stephani Zador

NOAA FISHERIES

GOA GPT Nov 2024 Minutes (1/2):

The Team made no formal recommendations but discussed the following ideas for future work:

- *Suggestion from the Team to the author that recapping highlights from the previous year's ESR at the beginning of the presentation would be a helpful refresher to facilitate Team discussion.*

-Recapping minutes and 2025 Main ESR Messages in presentation

- *Developing composite indicators that combine multiple indicators that are currently included and are intended to represent some higher-level process, e.g., using pink salmon and other species to create a composite indicator for the nearshore community biomass.*

- Arimitsu et al.: Combine seabird diets from 4 colonies as indicators of forage fish in the GOA (tinyVAST, NMDS); highlights trends in capelin, herring, sand lance

-Fergusson et al.: Multivariate analysis of Icy Strait juvenile salmon diet highlighting dominant zooplankton species

-Ferriss et al.: updated ecosystem state analyses across different ecosystem groups (based on Ferriss et al., 2025: dynamic factor analyses, hidden Markov models)

GOA GPT Nov 2024 Minutes (2/2):

- *Validate conceptual models either by replicating hypothesized linkages using a linear regression of the predictor and response variables that are included in the ESR, or using dynamic structural equations to synthesize these linkages.*

-**Ferriss et al. (In Prep): GOA climate indices (northern GOA Index and Gulf of Alaska Downwelling Index) and recruitment of GOA walleye pollock, P. cod, arrowtooth flounder, northern rockfish.**

-Other DSEM type analyses are occurring around the Center and GOA ESR will integrate results when applicable

- *Explore the use of Loreau et al. (2008, Eq. 9) index for portfolio effects to quantify whether community-wide consumption has been more stable than expected by chance given the variance in each individual species.*

-(Relative to groundfish food habits contribution Aydin 2024); Explored these analyses; not presented in 2026 ESR as the contribution evolved to different metrics; Food habits lab CIE review in 2027

- *Exploration of ecosystem dynamics between EGOA (closed to trawling) and CGOA/WGOA (open to trawling) was discussed*.

- Not addressed

Last Year Recap: GOA 2025 Key Messages

[implications for P. cod]



1. Warm at surface and depth, winter, spring and fall

- [*winter spawning; egg/larval survival; incr. demand for prey*]



2. Reduced lower trophic level productivity

- [*less productive food web to directly and indirectly support cod prey]*



3. Moderate upper trophic level productivity

- [*cod body condition below average but some prey base and upper trophic indicators ok]*

4. Some similarities 2014-2016 in physical and lower trophic levels

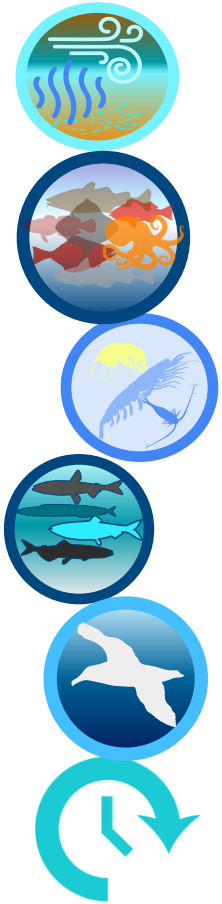
- [*elevated concerns of cumulative ecosystem response to warm year*]



5. Cooling in 2026 but concerns of residual heat & cumulative ecosystem effects

- [*potential increased thermal and food web stress for cod]*

GOA 2026: Key Messages



1. GOA big picture: warming, consistent ecosystem state

2. Ocean temperatures cool/average in 2026

3. Energy-rich prey base (zooplankton and forage fish)

4. Highlight: reduced seabird bycatch, marine mammals, ocean fertilization trials

5. 2027 will be warmer (El Niño)

GOA Full & Update Assessment Risk Tables: Environmental/ Ecosystem Considerations

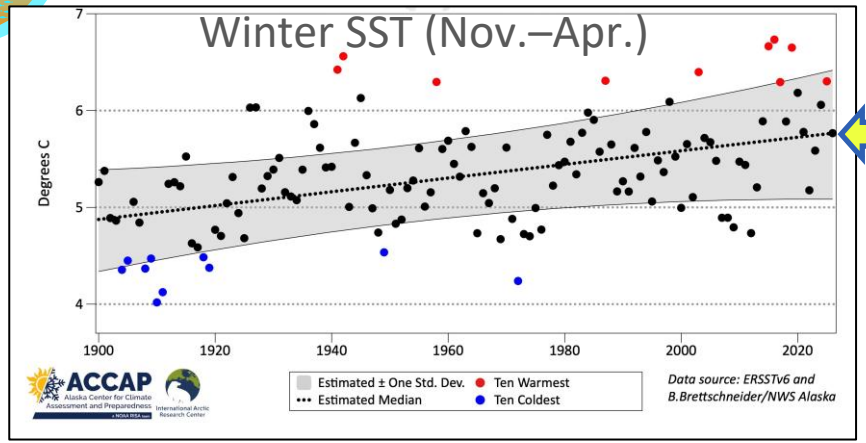
Level 1

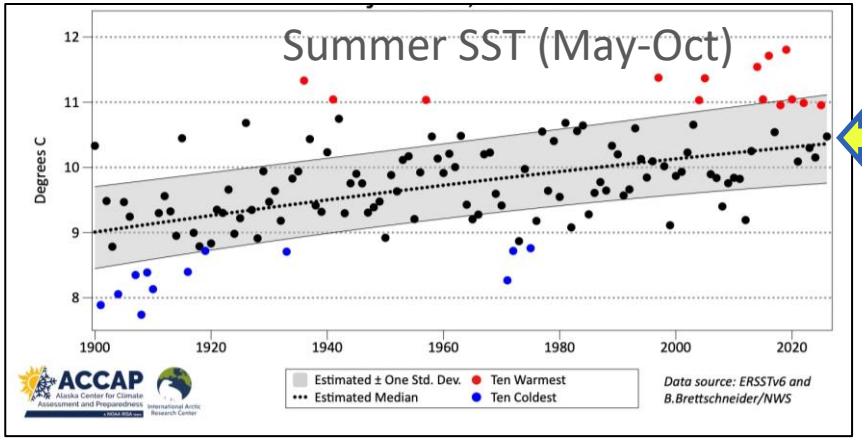
(No apparent environmental/ ecosystem concerns)

Sablefish *(+ESP)*
Pacific cod *(+ESP)*
Pollock *(+ESP)*
Northern rockfish
Pacific ocean perch
Rougheye & blackspotted rockfish
Shortraker rockfish
Thornyheads
Demersal shelf rockfish
Other rockfish
Sept 2026 GPT (Skates, Arrowtooth flounder, Rex sole)

1. Big Picture: Warming & Changes in Salinity

R. Thoman

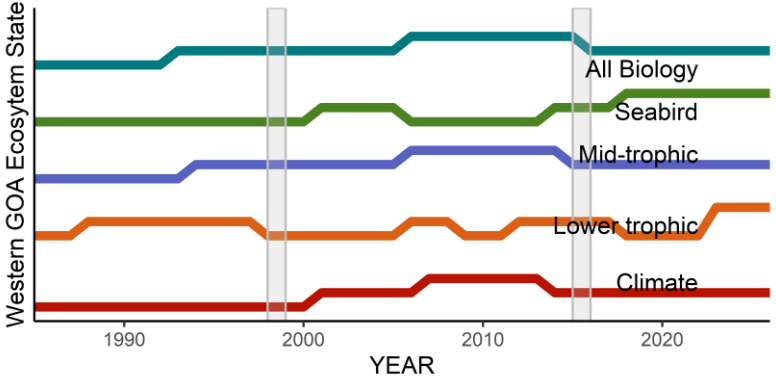


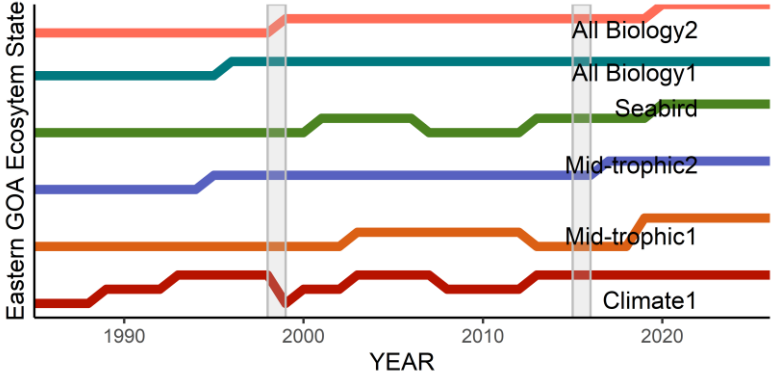


- Long-term warming of GOA shelf surface waters in winter and summer (1990-2026)

1. Big Picture: Consistent ecosystem state except WGOA lower trophic

B. Ferriss, M. Hunsicker





- Ecosystem state remained constant, within sub-models, from ~2020 through 2025/2026 except WGOA lower trophic level
  - Larval groundfish (EcoFOCI spring survey), spring chl-a biomass & bloom time, spring copepod biomass (Seward Line)

- Ecosystem state analyses run through 2026 (updated from 2022, Ferriss et al., 2025)
  - Dynamic factor analyses identify 1-2 common trends within each sub-model
  - Hidden Markov Models identify thresholds (ecosystem state) in each trend

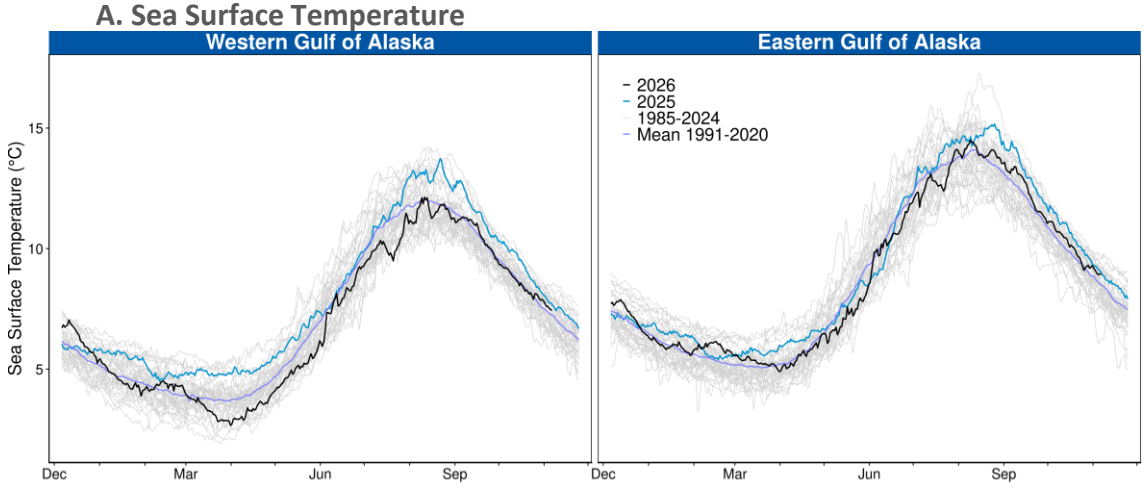
Ecosystem states of climate, lower trophic, mid-trophic, seabird, and all biology sub models. Step change = ecosystem state change (within model).(Ferriss et al.)

2. Ocean temperatures cool/average in 2026

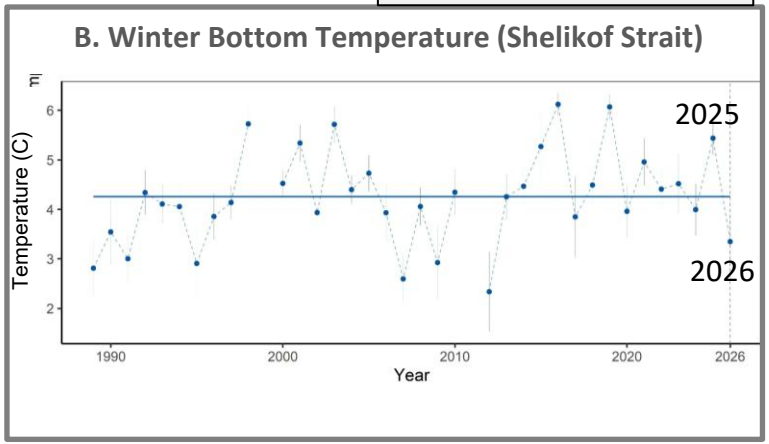
M. Callahan, E. Lemagie, M. Levine, D. McKelvey, C. Worton, W. Strasburger

- Average/Cool 2026
- Warm Exceptions:
  - At depth on Seward Line (northern GOA)
  - At surface in Southeast AK

Good for larval walleye pollock, P. cod, northern rock sole



Satellite-derived sea surface temperature (M. Callahan)



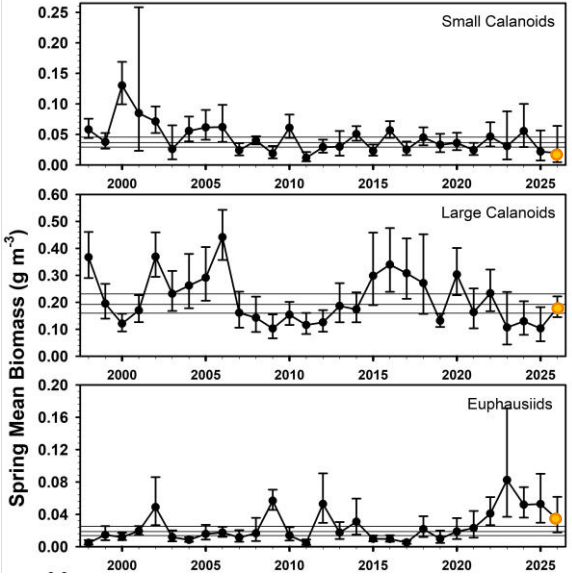
Bottom temperature (NOAA MACE winter acoustic survey) (D. McKelvey, M. Levine)

3. Productive prey base (zooplankton) spring 2026

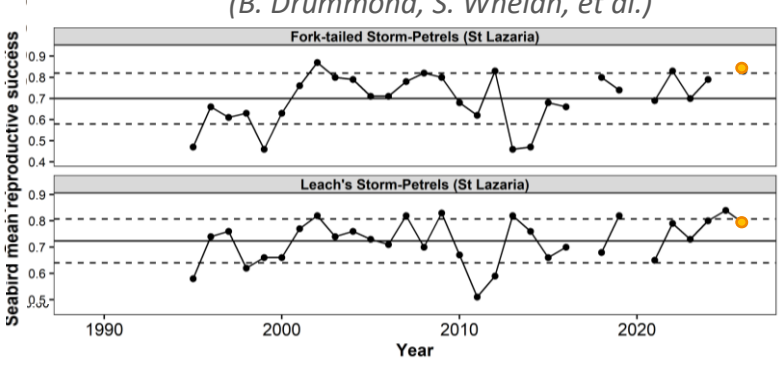
G. Hennon; R. Hopcroft; B. Drummond, R. Kaler, S. Whelan, S. Hatch, E. Fergusson, W. Strasburger

- Larger size phytoplankton
- Above-average euphausiid biomass (Seward Line)
- Average/Above-average reproductive indicators zooplankton-eating seabirds (across GOA)
- Juvenile salmon energy density ~average (Icy Strait)

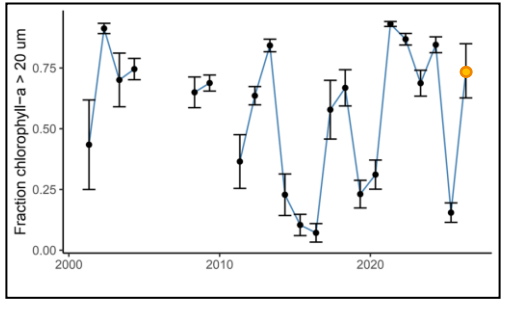
Gulf Watch spring zooplankton community size (R. Hopcroft)



Seabird reproductive success St. Lazaria Isl., EGOA (B. Drummond, S. Whelan, et al.)



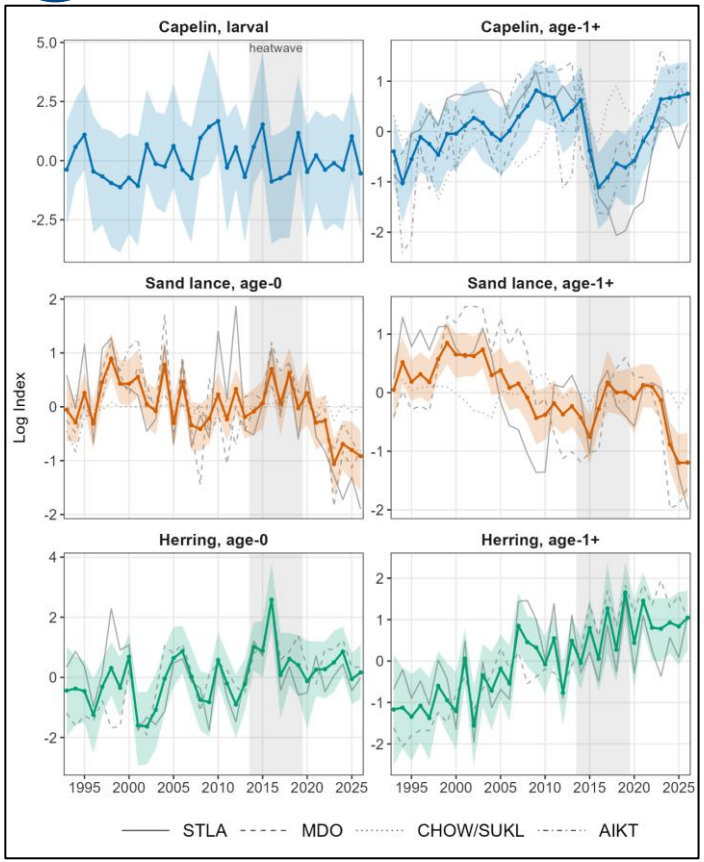
Gulf Watch spring phytoplankton community size (G. Hennon)



Juv. groundfish & salmon
Adult walleye pollock
Dusky rockfish
Northern rockfish
Pacific ocean perch

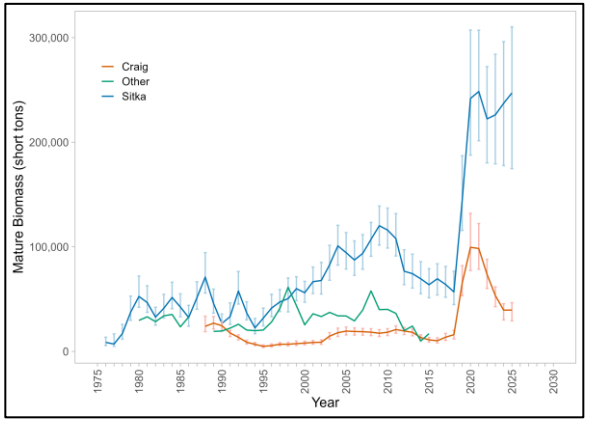
3. Productive forage fish prey base

Y. Arimitsu. S. Whelan, S. Hatch, N. Rojek, B. Drummond,
M. Brooks, H. Renner, D. Cushing; Q. Smtih, S. Dressel, S. Miller, T. Thynes



Index of capelin, sand lance, herring in seabird diets across GOA shelf (Arimitsu et al.)

- Capelin and herring present in seabird diets (but not sand lance)
- SEAK Sitka and Craig herring stocks elevated
- Good fish-eating seabird reproductive success

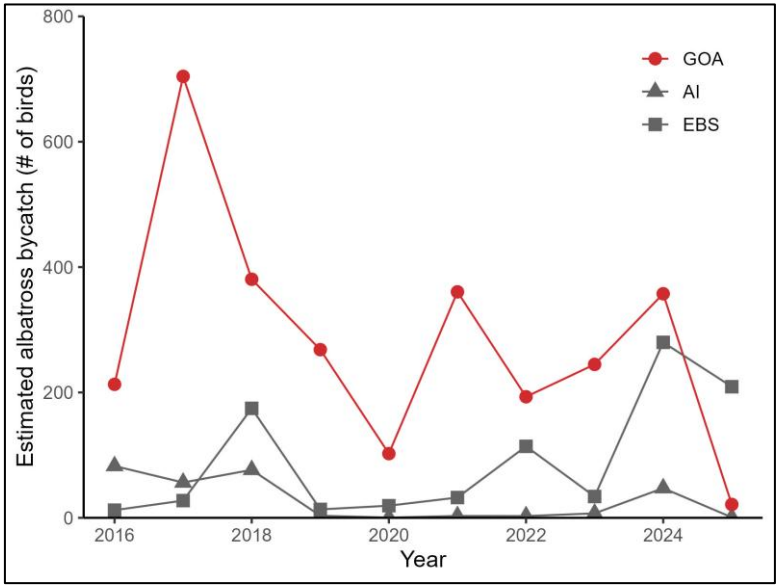


Estimated mature herring biomass (Sitka and Craig stocks). (Smith et al.)

Walleye pollock
Pacific cod
Arrowtooth flounder
Sablefish
Some flatfish/rockfish

4. Highlight: Reduction in 2025 black-footed albatross bycatch in GOA

J. Beck, M. Chan, C. Tide

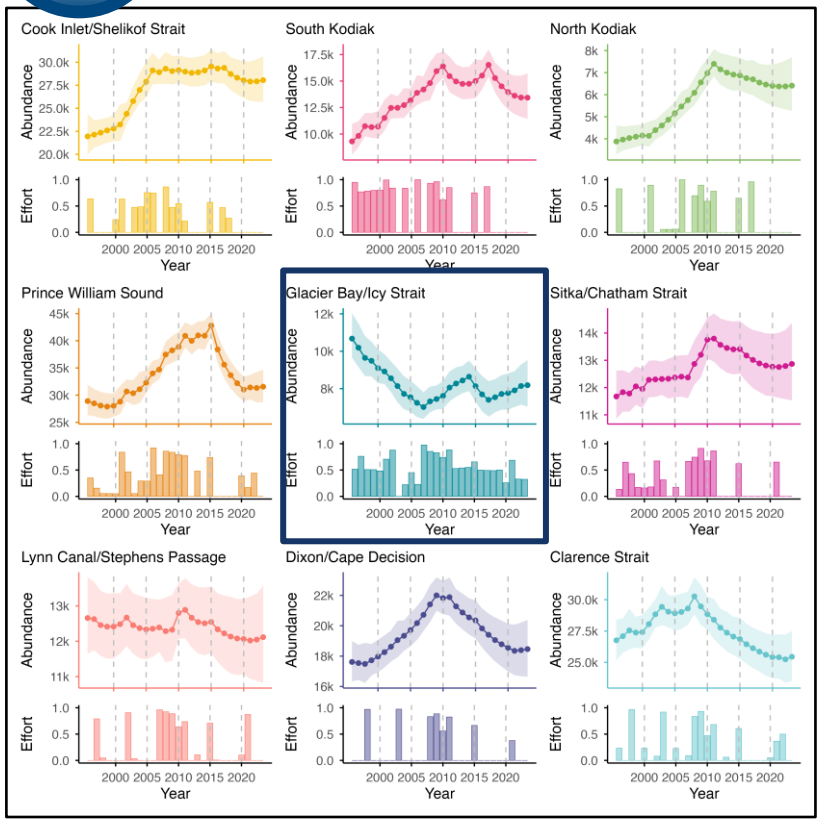


Bycatch of all albatross (bottom) in AK (Beck et al.)

- Black-footed albatross bycatch from 327 birds in 2024 to **0 in 2025**
- 1993 was last year of 0 bycatch
- Also reduction in Laysan albatross, northern fulmars, gulls
- Winds, storms, fishing industry behavior

4. Highlight: Marine mammals

J. London, B. McClintock, J. Jansen; C. Gabriele, J. Neilson, P. Bishop, D. Bloch.; J. Moran; J. Malek, C. Lowe



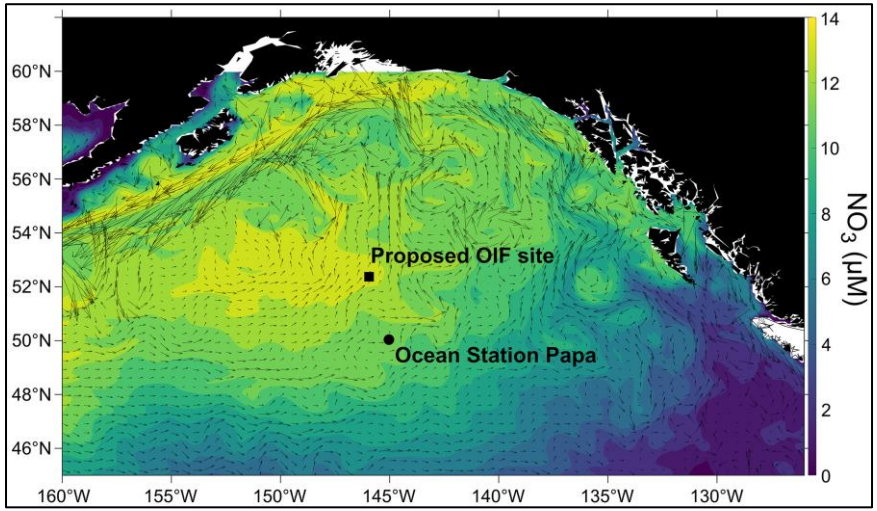
Abundance estimates and survey effort of GOA harbor seal populations. J. London, B. McClintock, J. Jansen

- **GOA harbor seal** populations declining 8-year trend 2016-2023 except Glacier Bay/Icy Strait
- **Glacier Bay/Icy Strait humpback whales** missing reproductive females from 2014-2019 would have produced their first calf in 2026-2032
- **Prince William Sound humpback whale** 2026 survey: highest number of whales per mile since 2014 and increased calf production
- **Gray whale** 67 strandings reported in AK from 2024-2026 (54 in the GOA); 2019-2023 Unusual Mortality Event

4. Highlight: Ocean fertilization trials in GOA

T. Flood, A. Payne, E. Aceves Bueno

- Large-scale addition of iron to prompt phytoplankton blooms and draw down CO^2 from atmosphere to store at ocean depths
- Questions around regional productivity, trophic wide interactions, and fisheries beyond the immediate study area



Buesseler, K. O., et al. (2026). Dialogues on Climate Change.

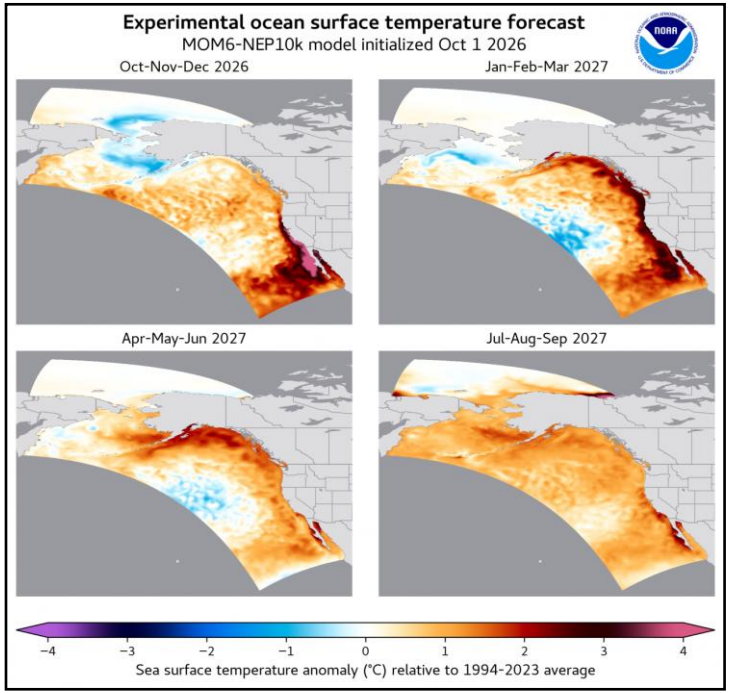
- Ongoing permit applications for field trials in GOA (ExOIS hosted by Woods Hole Oceanographic Institution); 700 km offshore of Alaska with target concentrations of about 1.0 - 2.0 nM Fe; 30 x 30 km Fe patch

5. Forecast warm SST in 2027 winter/spring

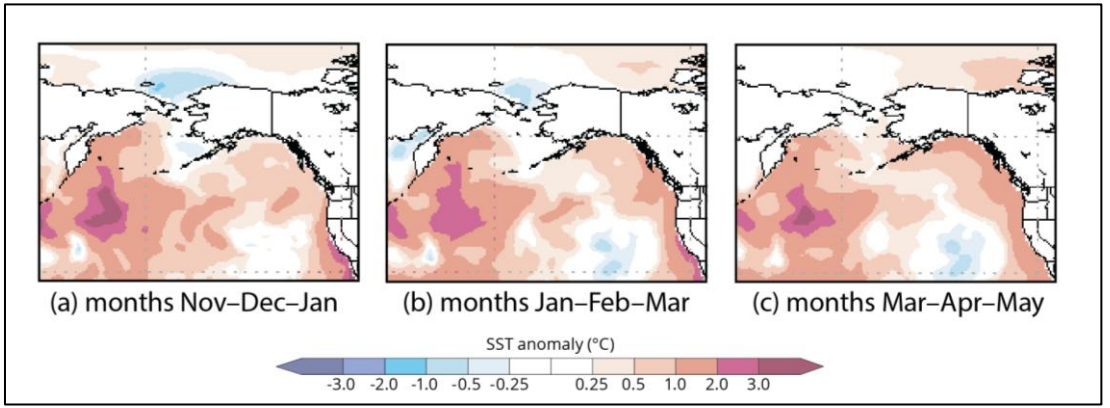
E. Lemagie, S. Bell, T. Hennon, S. Danielson, E. Drenkard et al.

- NMME/MOM6 warm anomalies Jan-March 2027: **WGOA 0.25 to 1ºC; EGOA: 0.5 to 2ºC**
- Warm anomaly **1.5ºC** in April ‘27 from April ‘26 (GAK1 integrated water column: Danielson et al. 2026)

MOM6 SST Anomalies



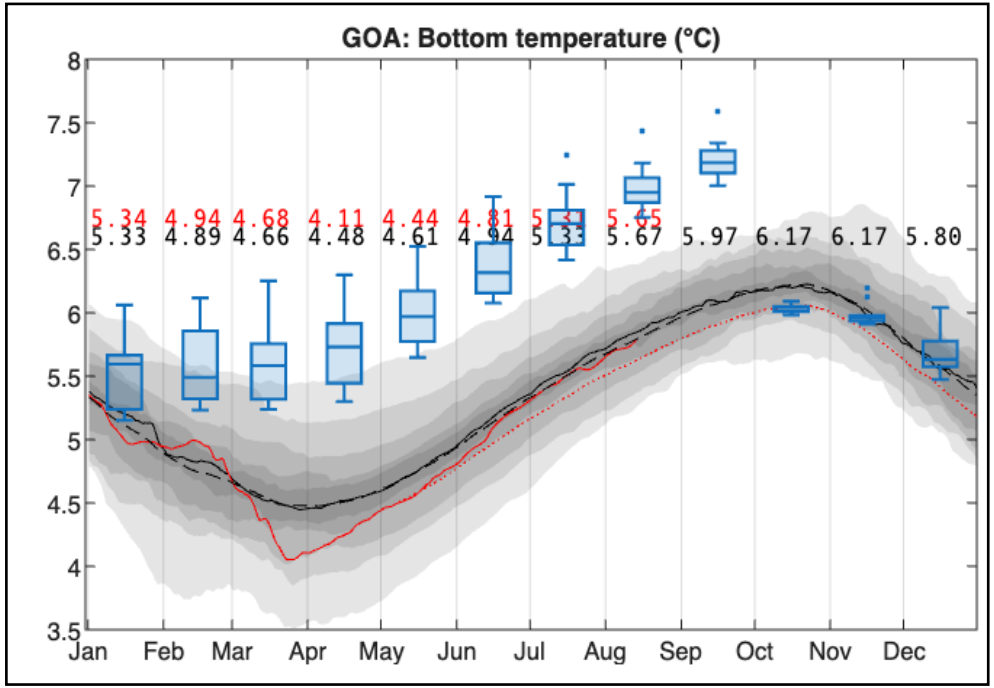
National Multi-Model Ensemble SST Anomalies



MOM6; baseline 1994-2023
NMME: baseline 1991-2020

5. MOM6 Forecast warm bottom temperature winter/spring 2027

K. Kearney



- **Blue boxplots**: October-initiated dynamic seasonal forecast, running from Oct 2026-Sep 2027; boxes indicate spread across the 10-member ensemble
- **Black solid line** (median across 1993–2026)
- Numbers indicate the values on the first of the month in the climatological mean (bottom, black) and in 2026 (red, top).
- Red line (2026), red dotted line (spring-initiated persistence forecast), black dashed line (climatological. 1993–2022, mean), shaded gray (1993–2026 percentiles: lightest = 0–10% and 90– 100%, darkest = 40–60%)

5: El Niño 2026/2027

- *Based on past strong, one-year El Nino's in the GOA (e.g., 1997/1998)*
- *This El Niño may be beyond our record of observations – lots of uncertainty*

Oceanography

- Warming Dec. '26 through summer '27;
- Moving from eastern to western GOA, surface to depth
- Shallower mixed layer depth
- Stronger shelf circulation, stronger Aleutian Low

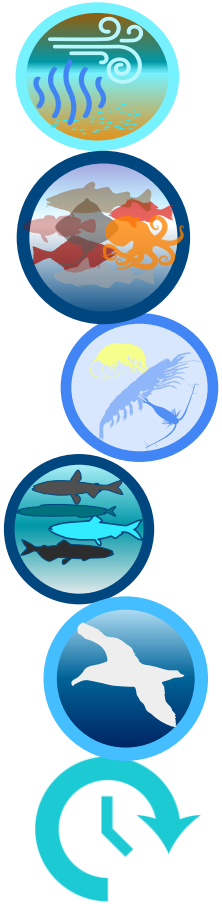
Ecosystem

- **Phytoplankton**: increased smaller, flagellates (less efficient energy transfer)
- **Zooplankton**: shift from large to small copepods, reduced euphausiids
- **Forage fish**: potentially reduced capelin?
- **Seabirds**: reduced reproductive success, potential mortalities

Groundfish

- **Larval groundfish** survival may be reduced (early spring shelf spawners: P. cod, walleye pollock, northern rock sole) or enhanced (spring and summer larvae: rockfish, sablefish)
- **Adult distribution** may shift deeper (P. cod, arrowtooth flounder, walleye pollock)
- **Adult groundfish condition** may get skinnier (increased metabolism, decreased prey)

GOA 2026: Key Messages



1. GOA big picture: warming, consistent ecosystem state

2. Ocean temperatures cool/average in 2026

3. Energy-rich prey base (zooplankton and forage fish)

4. Highlight: reduced seabird bycatch, marine mammals, ocean fertilization trials

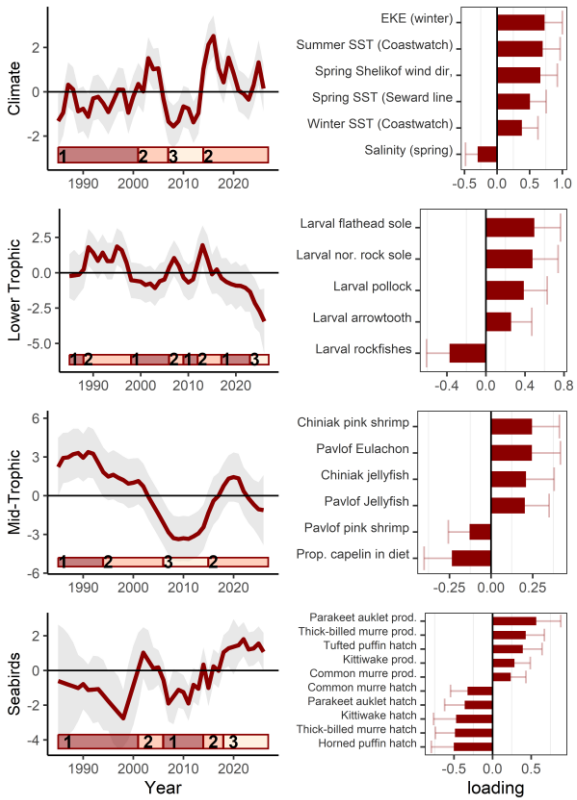
5. 2027 will be warmer (El Niño)

EXTRA

Extra Slide: Ecosystem State Analyses

B. Ferriss, M. Hunsicker

Western GOA



Eastern GOA

