Ecosystem Status Report: Gulf of Alaska 2024

Bridget Ferriss

Alaska Fisheries Science Center

NOAA Fisheries

With contributions from:

Grant Adams, Mayumi Arimitsu, Kelia Axler, Kerim Aydin, Brenda Ballachey, Lewis Barnett, Sonia Batten, Heather Bauscher, Jessica Beck, Shaun Bell, James Bodkin, Maile Branson, Matt W. Callahan, Allison Carl, Reuben Cash, Shannon Cellan, Wei Cheng, Heather Coletti, Deana Crouser, Daniel Cushing, Seth Danielson, Lauren Divine, Sherri Dressel, Brie Drummond, Kelly Drummond, Daniel Esler, Stacie Evans, Thomas Farrugia, Will Fennie, Emily Fergusson, Teresa Fish, Christine Gabriele, Sarah Gaichas, Scott Hatch, Claudine Hauri, Kyle Hebert, Gwenn Hennon, Tyler Hennon, Holly K. Hoffbauer, Kirstin Holsman, Russell Hopcroft, Peter Hulson, Katrin Iken, Darin Jones, Robert Kaler, Julie Keister, Parkes Kendrick, Mandy Keogh, David Kimmel, Kim Kloecker, Brenda Konar, Elizabeth Labunski, Jesse Lamb, Kari Lanphier, Emily Lemagie, Mike Levine, Mandy Lindeberg, Jackie Lindsey, Jenna Malek, Jasmine Maurer, Jackie McConnell, David W. McGowan, Cole Monnahan, Daniel Monson, John Moran, Jennifer Morella, Janet Neilson, M. Padraig New, Clare Ostle, Remi Pages, John Piatt, Andrew Piston, Julie Scheurer, W. Scott Pegau, Meredith Pochardt, Maya Reda-Williams, Heather Renner, Patrick Ressler, C. L. Roberts, Brian Robinson, Lauren Rogers, Nora Rojek, Joshua R. Russell, Kim Schuster, Kalei Shotwell, Brooke Snyder, William Stockhausen, Janice Straley, Wesley Strasburger, Hank Statscewich, Robert Suryan, Rick Thoman, James T. Thorson, Cathy Tide, Sarah Traiger, Chris Tran, Scott C. Vulstek, Andy Wall, Muyin Wang, Benjamin Weitzman, Shannon Whelan, George A. Whitehouse, Kresimir Williams. Carrie Worton. Bruce Wright, Kasie-Jo Wright, Stephani Zador, Joshua Zahner, and Adam Zaleski

Response to SSC 2023 minutes and Sept 2024 minutes

1. …**to sustain efforts in addressing prior comments from the SSC regarding how different species might respond to changing temperatures**…**life stage phenology and temperature thresholds**

New ESR contribution from Parkes Kendrick (species-specific summer bottom temperature)

2. **…more focus on multi-year patterns and whether they are similar to other periods**
3. **…identifying step changes in times series that might indicate a new "baseline" or "regime"**
4. …**the process of selecting and refining indicators to minimize redundancy and ensure key information is included.**

The GOA ESR 2025 will include an updated analysis exploring ecosystem state & common indicator trends based on Ferriss et al. (Submitted)

5. …**evaluate ways to present a time series of the position of the Aleutian Low.**

New ESR contribution from Drs. Overland and Wang describing the strength and position of the Aleutian Low

6. …**continued monitoring of El Niño development and potential ecosystem affects**

The ESR team monitored the El Niño event through the winter of 2023/2024 including satellite-derived sea surface temperatures, NOAA's winter acoustic-trawl survey in Shelikof Strait, and presentations of various monitoring, industry, and community observations at our spring Preview of Ecosystem and Economic Conditions workshop. The ESR team was prepared to discuss developing impacts at the Council's June meeting if deemed necessary.

Response to SSC Dec 2023 and Sept 2024 minutes

7. …**encourages the use of trans-disciplinary approaches for linking ESR and ESPs to stock assessments in the future. The GOA pollock assessment was suggested as a potential case study**
A research model is presented in the GOA pollock assessment Appendix 1E (Monnahan et al., 2024) that explores incorporating environmental data into the GOA pollock stock assessment.

8. **[satellite-derived chlorophyll-a time series]…identify what calibration efforts have occurred, what additional calibrations might be needed, and how interpretation…might be affected**.
In 2024, new cross-product comparisons showed relatively larger discrepancies among products than those from previous years. Consequently, contributors have paused contributions of satellite-derived chla trends to this year's ESRs until they have confidently resolved what is causing these discrepancies.

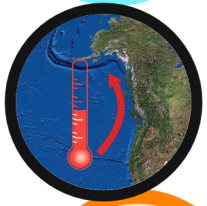
9. **The SSC suggests plotting Sitka air temperature anomalies with one or two other baselines (in addition to the GAK1 Ocean Temperature Anomaly that was presented) could be helpful for depicting more recent relative changes in the time series.**
Investigators agree and will work on this in 2025

10. (Oct 2024).**The SSC recommended investigating potential competitive interactions associated with changes in pink salmon abundance, in addition to potential bottom-up effects on upper trophic levels.**
The 2024 GOA ESR includes a brief literature review of pink salmon competitive interactions in the pink salmon noteworthy contribution. The editor will develop the topic in the 2025 ESR.

GOA 2024: Key Messages

1. Long-term trends in oceanography and groundfish community

- Warming through water column, less saline at surface & more at depth (incr. stratification)
- Groundfish dominated by planktivorous predators
- Response to 2014-2016 MHW still observed



2. Winter 2024: moderate El Niño in GOA

- Some oceanographic responses; No ecological shocks

3. Above-average, spatially consistent (where data available) pelagic prey base (zooplankton, forage fish); increased from 2023

- Potentially good larval & adult feeding conditions for numerous groundfish species

4. Low pink salmon returns

- Coastal shelf environment and potential competition in ocean gyre

5. Looking ahead to 2025 (weak La Niña)

- Neutral to cooling 2025 SST; 2024 good prey and fall temperature leading into 2025

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

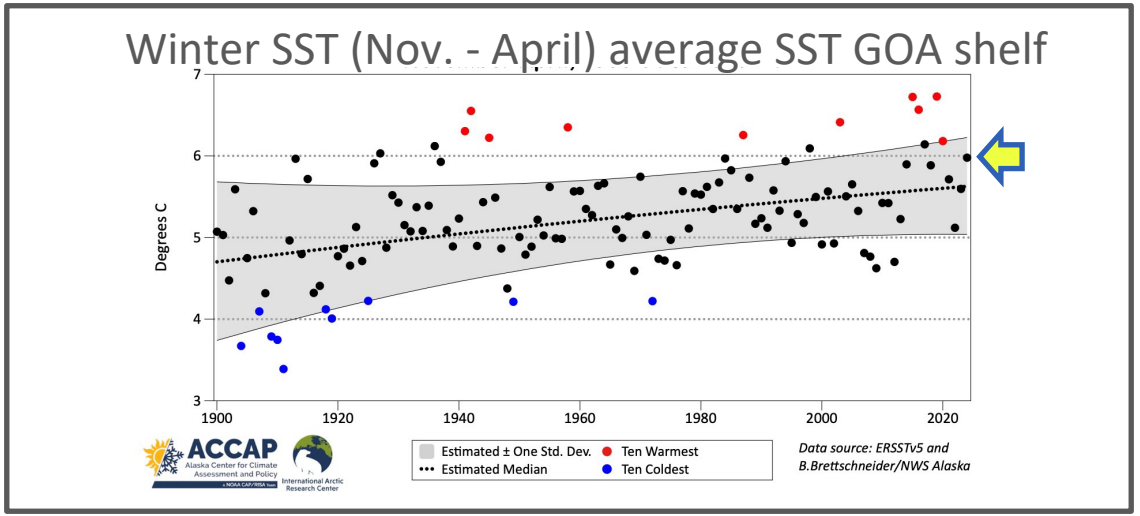
Level 1

(No apparent environmental/ ecosystem concerns)

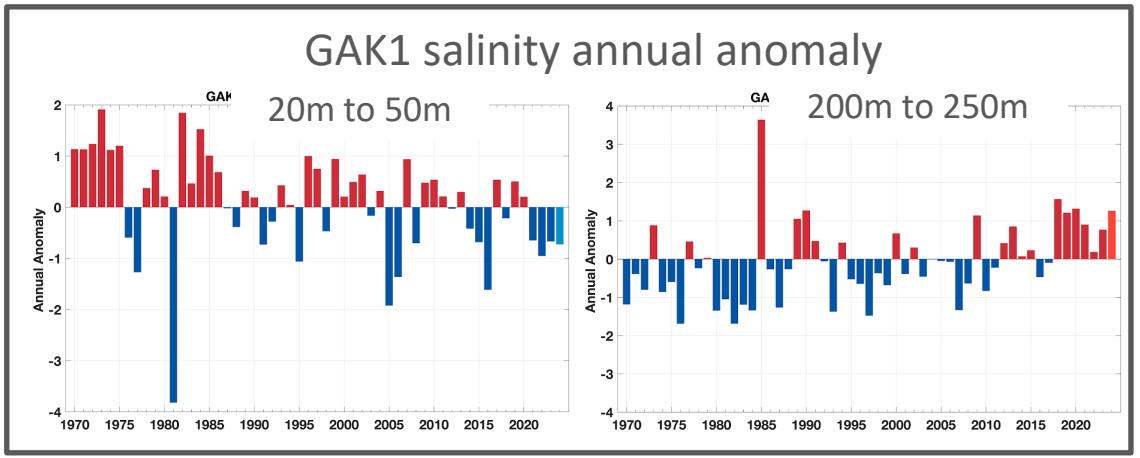
1. Walleye pollock *(+ESP)*
2. Pacific cod *(+ESP)*
3. Sablefish (statewide) *(+ESP)*
4. Dusky rockfish
5. Northern rockfish
6. Demersal shelf rockfish
7. Thornyhead rockfish

Message 1. Long-term Trends: Warming & Changes in Salinity

1. Warming of GOA shelf surface waters in winter and summer: 2024 warm winter
(R. Thoman, S. Danielson)



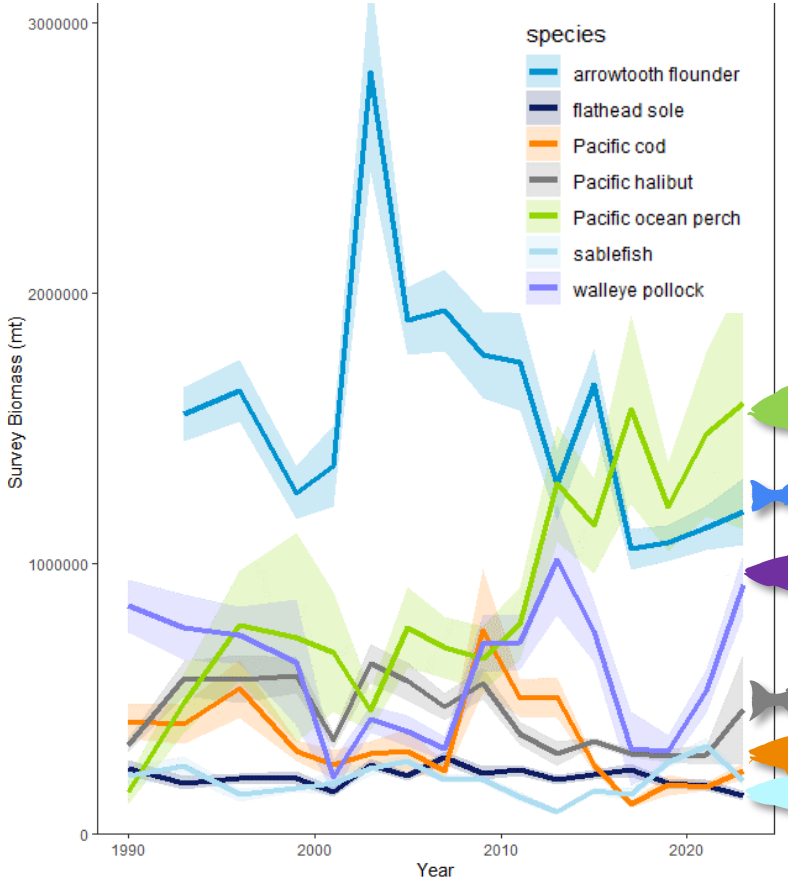
2. Less saline at surface and more saline at depth (GAK1)
(S. Danielson)



Message 1. Long-term Trends: Changing Groundfish Community

M. Callahan
L. Barnett

NOAA bottom trawl survey-estimated biomass (mt) top GOA groundfish species through 2023

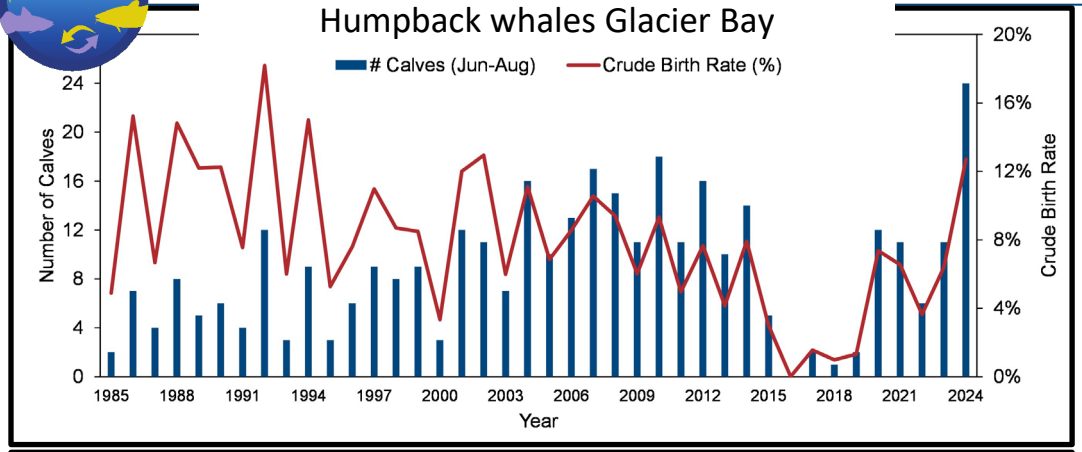


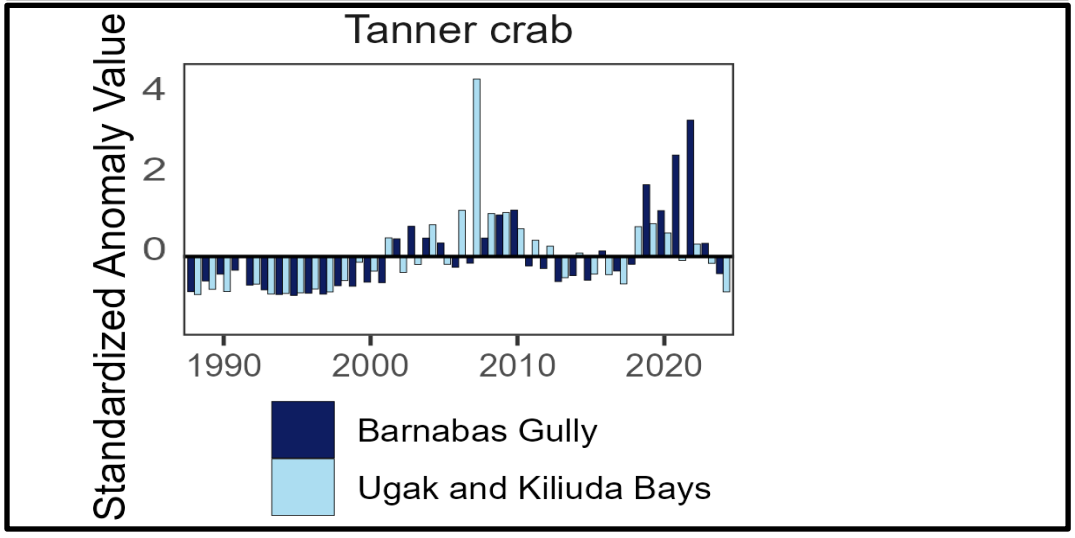
1. P. ocean perch
2. Arrowtooth flounder
3. W. pollock
4. P. halibut
5. P. cod
6. Sablefish
7. Flathead sole

- Planktivorous predators (POP, pollock) dominate top groundfish biomass (add pink salmon in odd years)
- POP replaced arrowtooth flounder as most dominant by biomass in 2017

Key Message 1. Ongoing responses to 2014-2016 MHW

C. Gabriele, J. Neilson, H. Hoffbauer, C. Worton

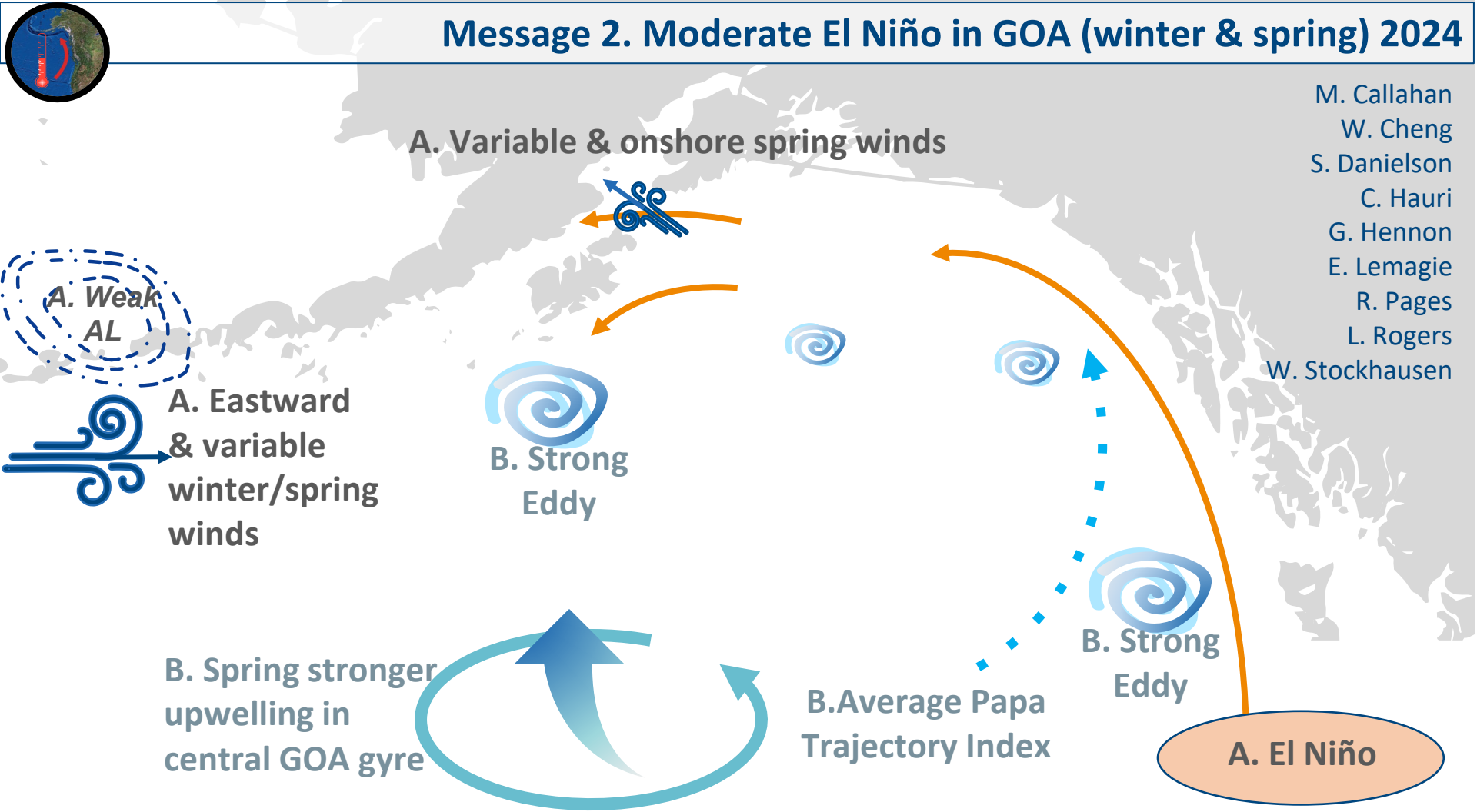




- Humpback whale crude birth rate returned to pre-2014 levels
- Capelin continues to be observed in ecosystem (2nd year)
- Tanner crab declining around Kodiak (2019 large year class)

Message 2. Moderate El Niño in GOA (winter & spring) 2024

M. Callahan
W. Cheng
S. Danielson
C. Hauri
G. Hennon
E. Lemagie
R. Pages
L. Rogers
W. Stockhausen



Message 2. Moderate El Niño in GOA (winter & spring) 2024

T. Farrugia, H. Coletti, B. Drummond, S. Whelan, authors on forage fish slide, M. Keogh

➢ No ecological signals of major warming event in 2024 (associated with strong El Niño's)

- Harmful algal blooms: no increase in intensity, frequency, duration
- Intertidal communities maintained local spatial variability
- No observed forage fish decline
- No large-scale seabird die-offs; seabird productivity was average/above average
- No increased marine mammal strandings
- Other indicators

➢ Revisiting 2023 predictions of 2024 El Niño potential impacts. Will know more in 2025 but…

Predicted Benefit (*incr. cross shelf transport, favorable EGOA late spring, summer warm SST)?* **✓True?**

- Larval/juv. ATF, rex sole, P. halibut, rockfish, sablefish (slope spawned larvae) (*larval transport*)
- Larval rockfish and sablefish (*warm waters*)

Predicted Vulnerable *(spring SST too high & persists; and reduced zooplankton)?* ✖ **Not true?**

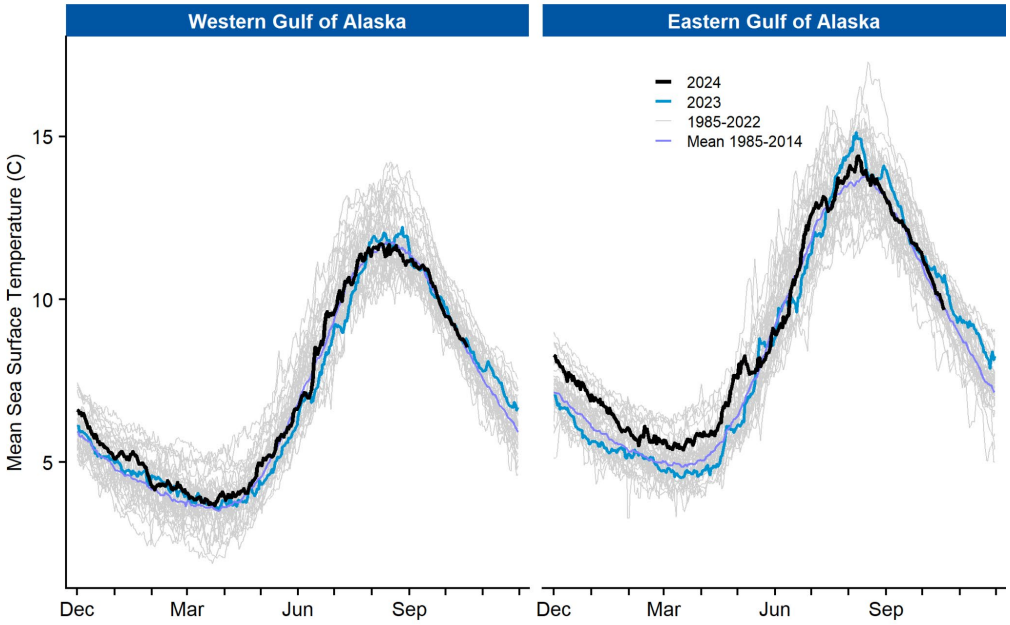
- Larval/juv. P. cod, walleye pollock, and northern rock sole
- Adult walleye pollock, Pacific Ocean perch, dusky & northern rockfish
- Deeper adult habitat could warm if heat event persists

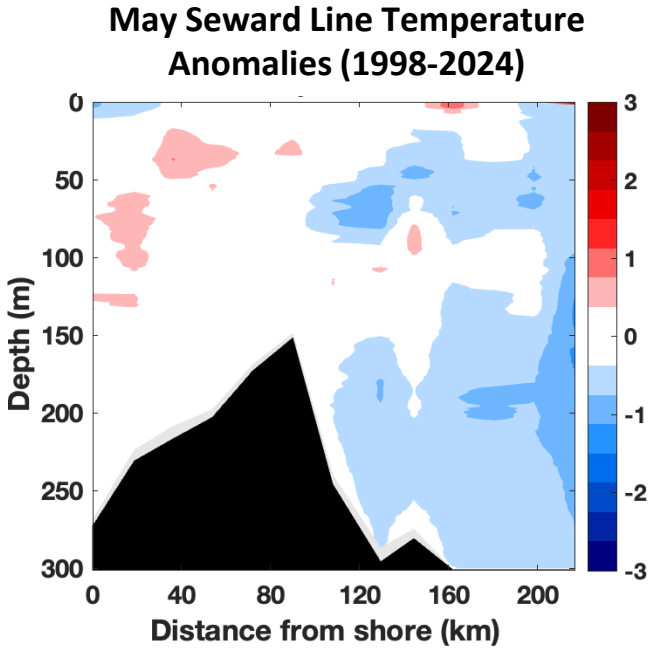
Message 2. Temperature 2024- winter & spring warm at surface

E. Lemagie & M. Callahan
S. Danielson et al.

- Sea surface temperature:
- WGOA: warm winter, average spring, summer & fall
- EGOA: warm winter & spring, average warm summer, average fall

- Ocean temperature shelf bottom: average to cooler (winter and spring)



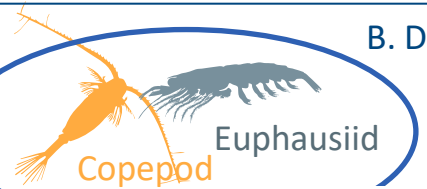


Message 3. Above-average productivity 2024: Primary and secondary

B. Drummond, S. Whelan, M. Arimitsu
G. Hennon
R. Hopcroft
R. Pages, C. Hauri

Planktivorous seabird reproductive success (Chowiet Isl., Middleton Isl., St. Lazaria Isl.)

Seward Line Spring Survey



Increased mesozooplankton vs. microzooplankton

Seward Line Spring Survey

Increased diatom vs. nanophytoplankton

NO_3^- **Increased nitrate on shelf**

North Gulf of Alaska Oscillation Index

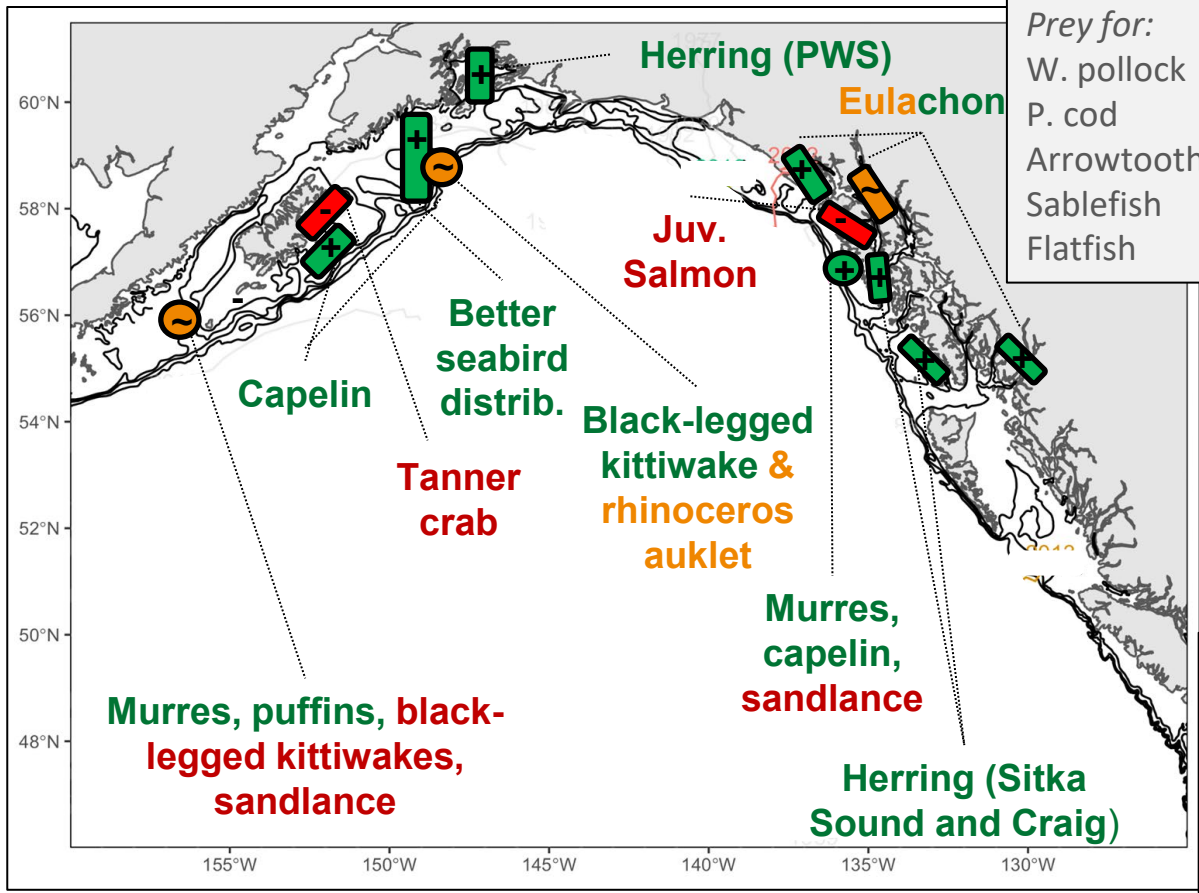
Spring stronger upwelling in central GOA gyre

Prey for:
W. pollock
P. ocean perch
Dusky rockfish
N. rockfish
Juv. groundfish

Conceptual model based on Conte et al. 2024

Message 3. Forage fish average/above-average 2024

B. Drummond, D. Cushing, S. Hatch, K. Hebert, S. Pegau, E. Pochardt, W. Strasburger, C. Worton



Prey for:
W. pollock
P. cod
Arrowtooth fl.
Sablefish
Flatfish

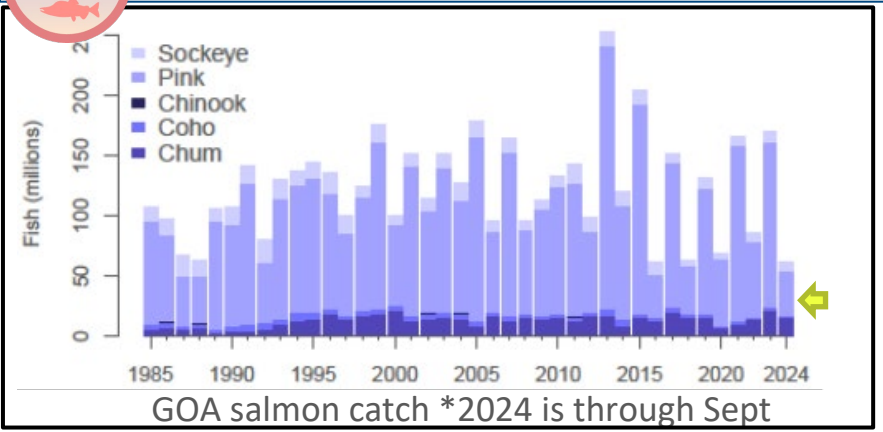
- Survey baselines from 1990's/early 2000's to present)
- Average to above average
- Incr.: capelin, herring, some eulachon
- Decr.: sandlance, juv. salmon, Tanner crab

Legend

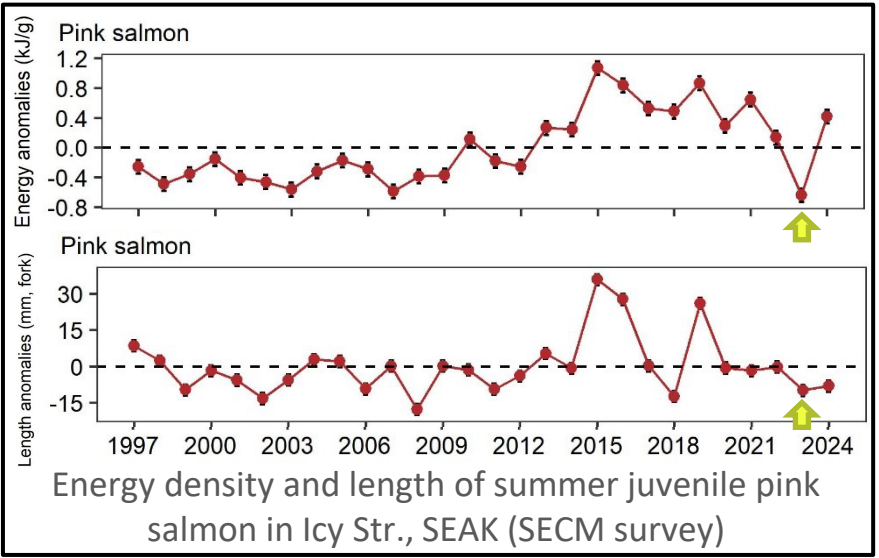
- *Surveys*
- *Seabird Reproductive Success*
- \+ *Above Average*
- ~ *Average*
- \- *Below Average*

Message 4: Low Pink Salmon Returns 2024

A. Whitehouse, E. Fergusson, W. Strasburger



GOA salmon catch *2024 is through Sept



Energy density and length of summer juvenile pink salmon in Icy Str., SEAK (SECM survey)

- Some of lowest pink salmon returns since 1985; driven by Prince William Sound

X **Freshwater** (Affected hatchery and wild stocks)

✓ **Nearshore** (2023)

- Low zooplankton biomass but elevated large copepod biomass
- SEAK juv. pinks were smaller and lower energy density
- SEAK forecast (based on previous year juvenile survey) was more accurate than other AK (based on 2 year previous returns)

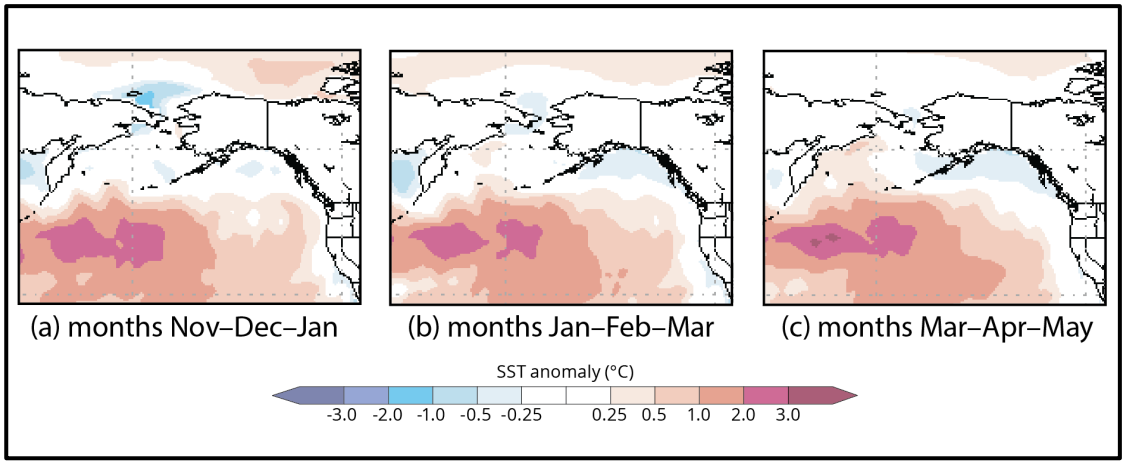
? **Ocean** (2023/2024)

- Competition with hatchery fish and with 2023 large cohort of returning adults (Ruggerone et al., 2023, Connors et al. 2024)

Message 5: Looking ahead to 2025 (weak La Niña): cool-ish SST

E. Lemagie, S. Bell, T. Hennon, S. Danielson

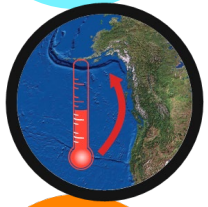
- National Multi-Model Ensemble predict cooler sea surface temperatures in winter/spring 2025 (baseline: 1991-2020)
- La Niña is late in developing (more likely to be weak or neutral)
- Groundfish entering 2025 from a relatively good 2024 (temperature and pelagic prey availability)



GOA 2024: Key Messages

1. Long-term trends in oceanography and groundfish community

- Warming through water column, less saline at surface & more at depth (incr. stratification)
- Groundfish dominated by planktivorous predators
- Response to 2014-2016 MHW still observed

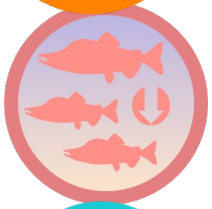


2. Winter 2024: moderate El Niño in GOA

- Some oceanographic responses; No ecological shocks

3. Above-average, spatially consistent (where data available) pelagic prey base (zooplankton, forage fish); increased from 2023

- Potentially good larval & adult feeding conditions for numerous groundfish species



4. Low pink salmon returns

- Coastal shelf environment and potential competition in ocean gyre

5. Looking ahead to 2025 (weak La Niña)

- Neutral to cooling 2025 SST; 2024 good prey and fall temperature leading into 2025