# Ecosystem & Socioeconomic Profile: GOA Pacific Cod Report Card

Kalei Shotwell and Russel Dame, November Groundfish Plan Team 2024

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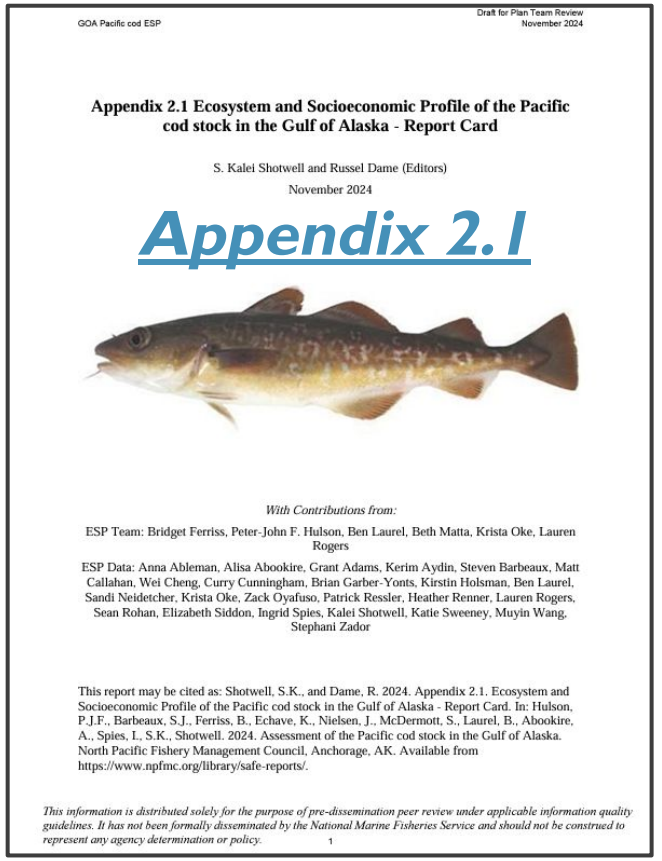
NOAA FISHERIES

# Overview

- Appendix 2.1 in SAFE Report
  - Full/partial ESPs in 2020-2021
  - Report Cards in 2021-2024
- Report Card in 2024
  - Updated organization, new categories for ecosystem, new, modified, and removed indicators
  - CEATTLE model and indicators updated to 2024 projection



GOA Pacific cod ESP

Draft for Plan Team Review
November 2024

**Appendix 2.1 Ecosystem and Socioeconomic Profile of the Pacific cod stock in the Gulf of Alaska - Report Card**

S. Kalei Shotwell and Russel Dame (Editors)

November 2024

***Appendix 2.1***

*With Contributions from:*

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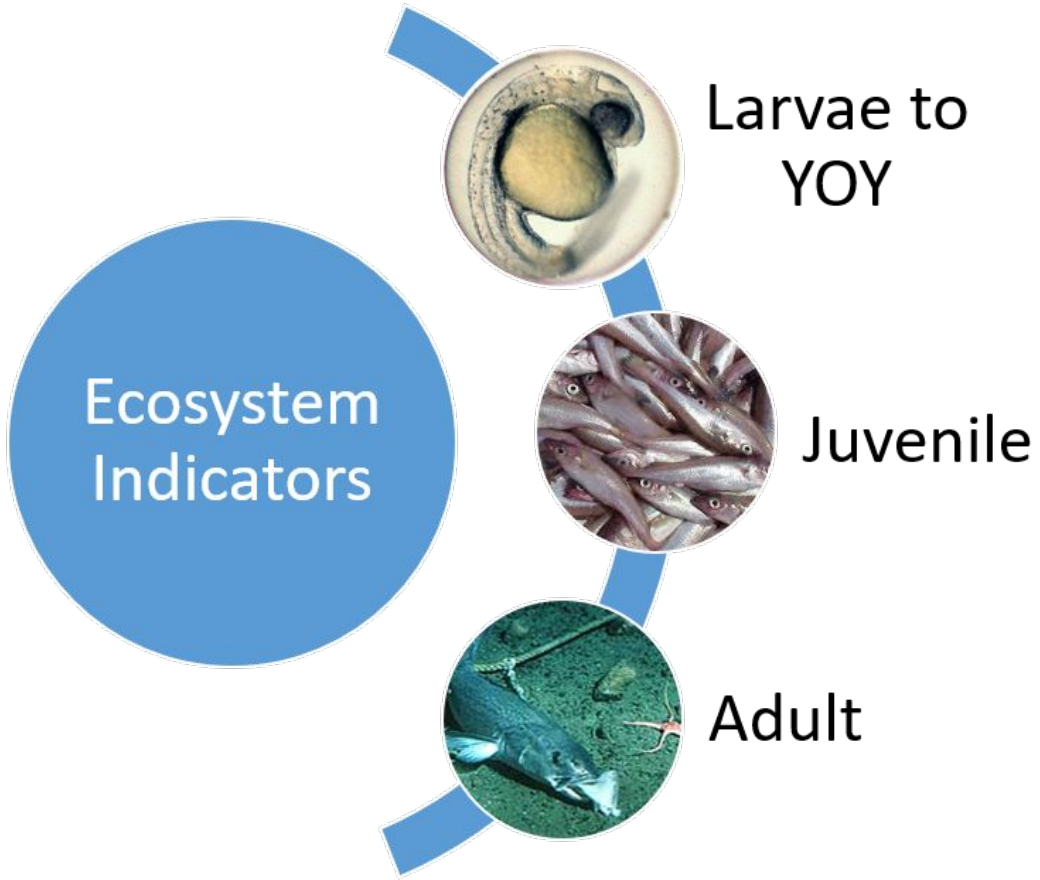
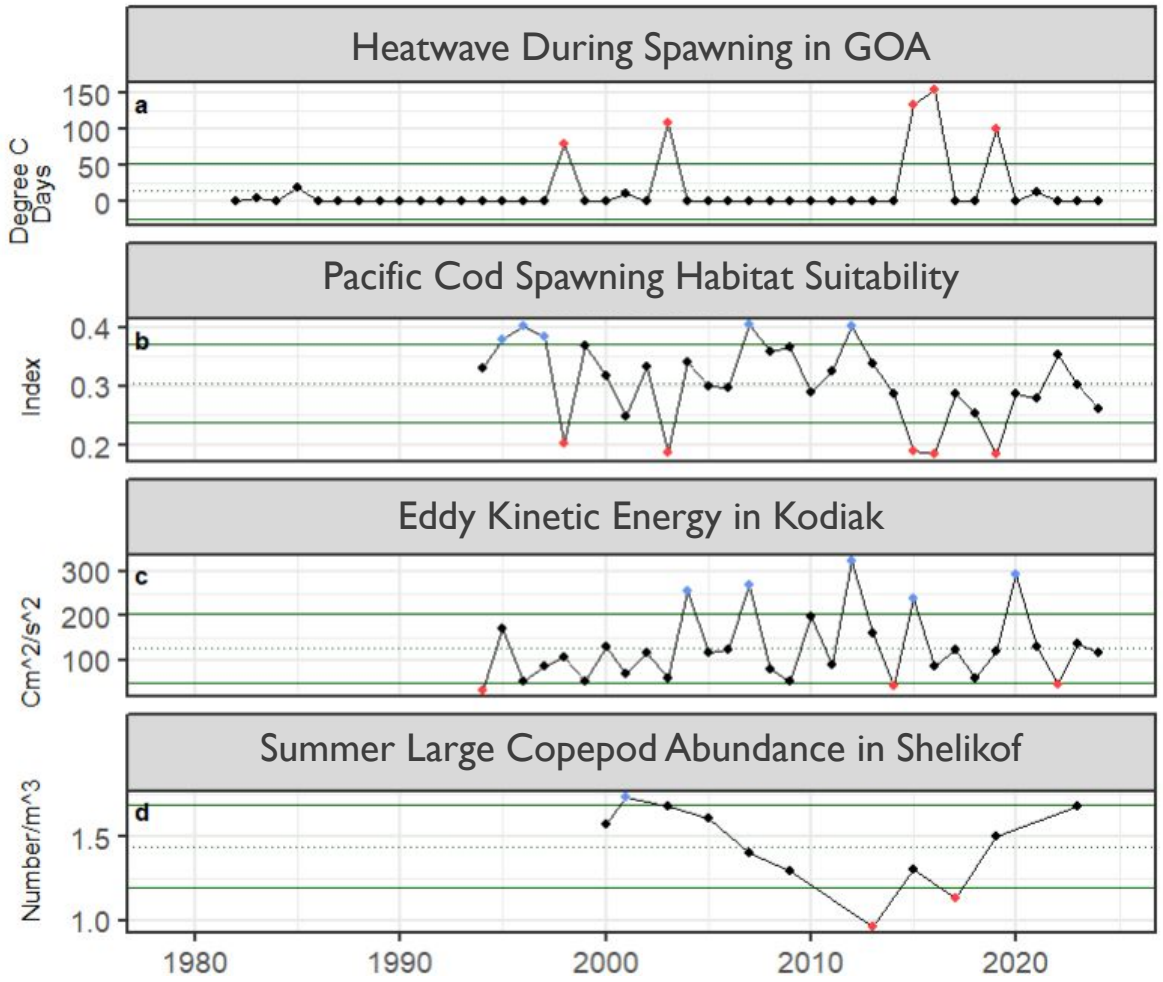
# Ecosystem Indicators



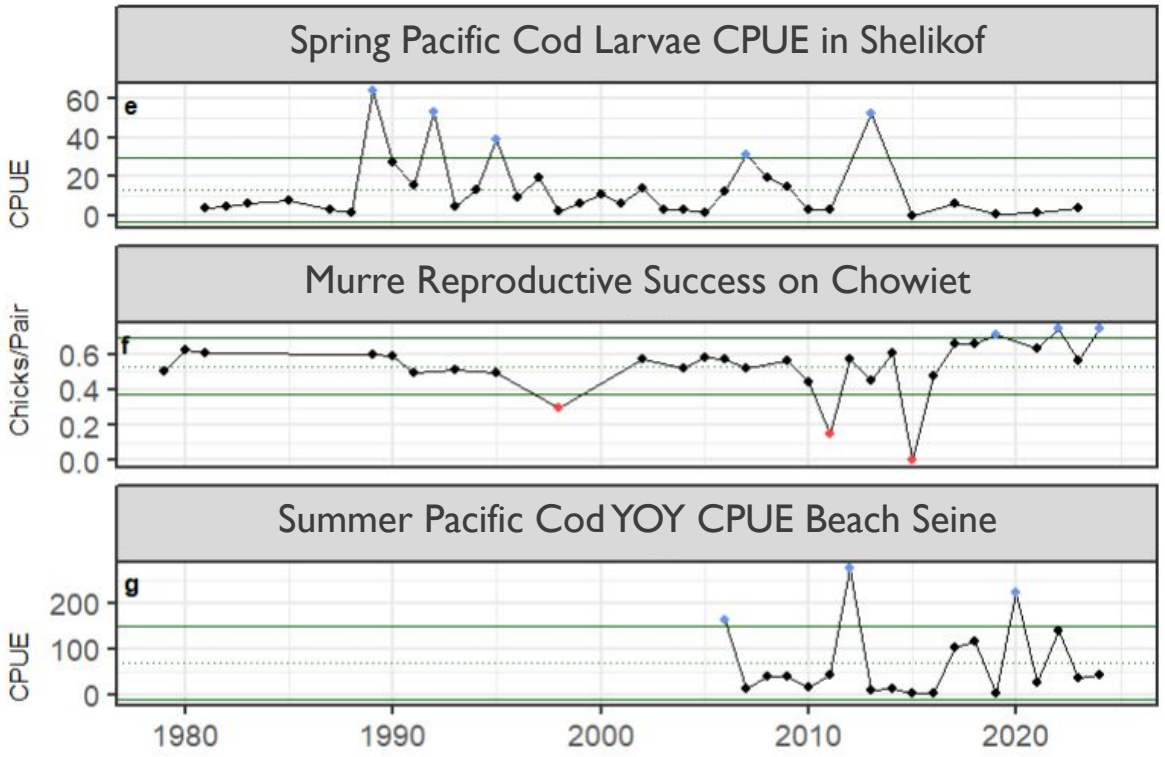

1. Marine heatwave index spawning, -
2. Spawning habitat suitability, +
3. Eddy kinetic energy, +
4. Summer copepods (EcoFOCI), +
5. Spring Pacific cod larvae (EcoFOCI), +
6. Common murre reproductive success, +
7. YOY Pacific cod CPUE (Beach Seine), +
8. **Age-1 natural mortality** (CEATTLE), -
9. Bottom temperature shelf CFSR, -
10. *Juvenile condition* (BTS), +
11. *Adult condition* (BTS), +
12. **Annual Pacific cod ration** (CEATTLE), -
13. Center of gravity, northeast (VAST), -
14. Area occupied (VAST), +
15. **Biomass eaten of Pacific cod** (CEATTLE), -
16. Adult Steller sea lion counts, -

# Larval Indicators



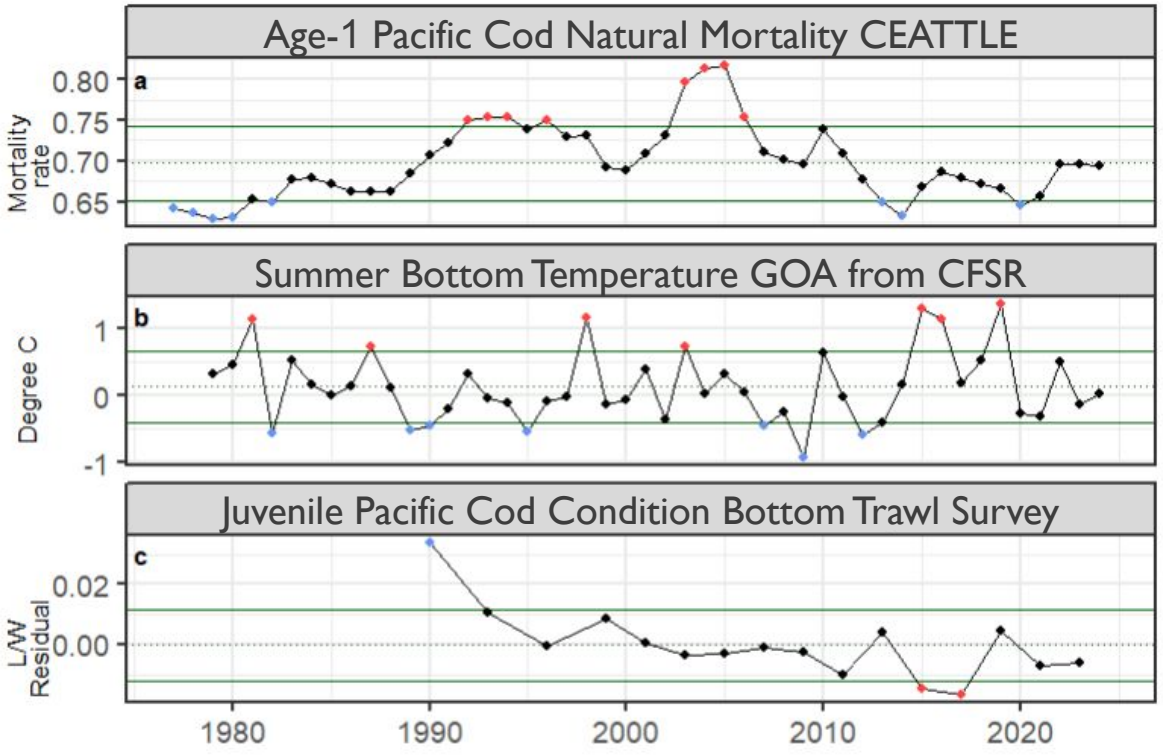

- No marine heatwave events but habitat suitability was again slightly lower than average due to slightly warmer than average temperature at depth, which may have a small effect on egg survival
- Annual eddy kinetic energy was slightly below average so far in 2024, implying reduced larval retention and cross-shelf transport to suitable nearshore nursery environments

# Larval Indicators



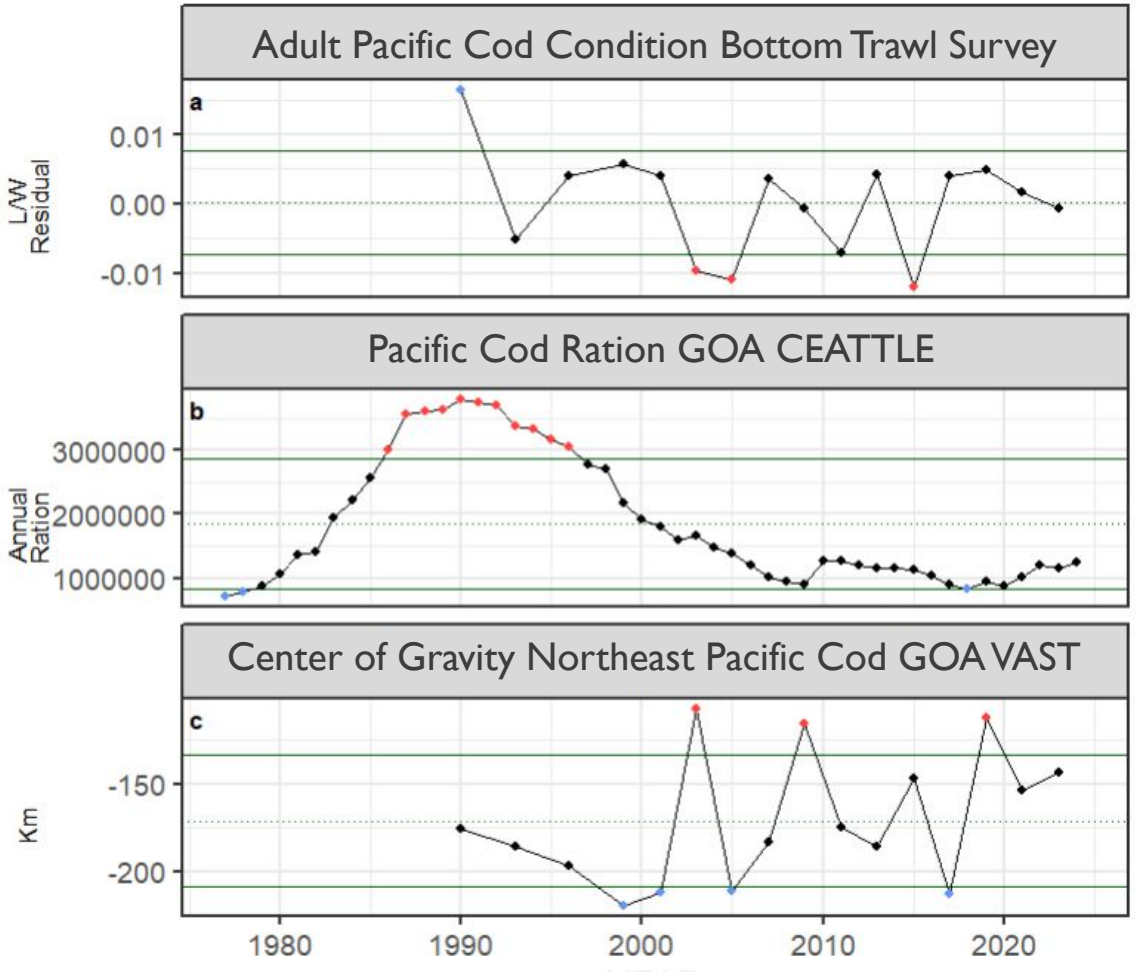

- Reproductive success of piscivorous seabirds has remained above average since 2017 suggesting sufficient forage fish prey resources
- Nearshore abundance of young-of-the-year (YOY) Pacific cod increased slightly to just below average

# Juvenile Indicators



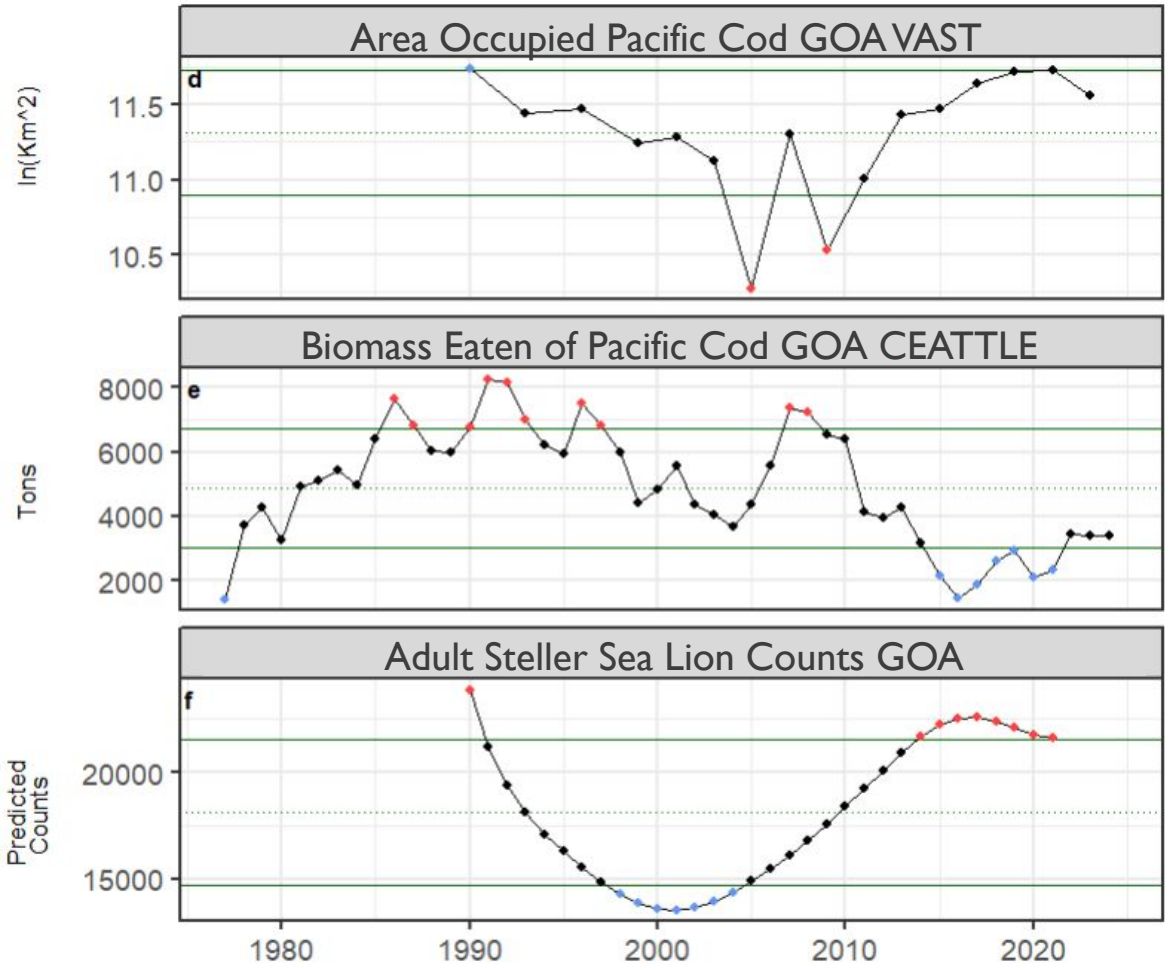

- Evidence of time-varying natural mortality for age-1 Pacific cod within the CEATTLE multispecies model that has been consistently above the operational stock assessment model estimate
- Bottom temperature from CFSR model increased slightly from last year but still below average

# Adult Indicators




- Predation demand of GOA Pacific cod for prey based on the CEATTLE model has been steadily decreasing since 1990 and has been below average since 2002, reflecting decreasing population trends of GOA Pacific cod

# Adult Indicators



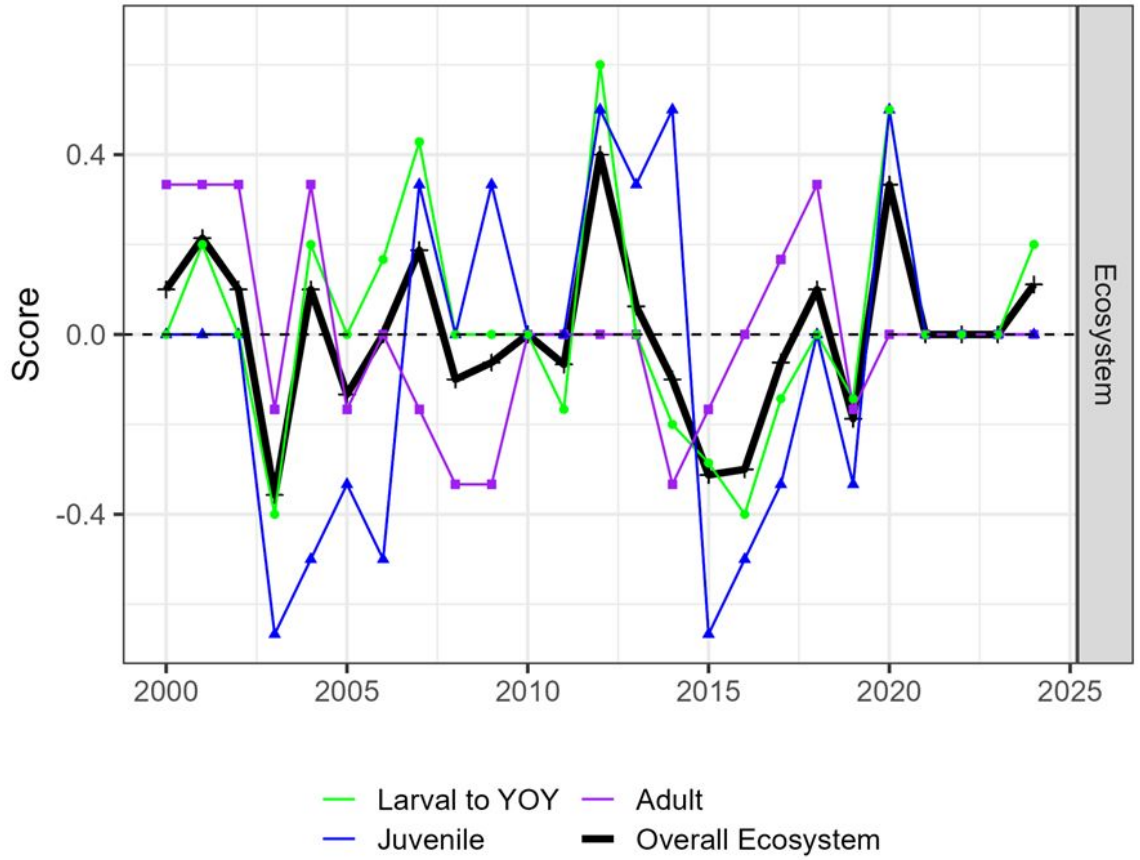

- Biomass consumed of GOA Pacific cod as prey by all predators in the CEATTLE model remains low reflecting the lower population trends of predators in the CEATTLE model and low predation from pollock, arrowtooth flounder, and conspecifics

# Ecosystem Summary Table

| Indicator category | | Indicator | 2020 Status | 2021 Status | 2022 Status | 2023 Status | 2024 Status |
|---|---|---|---|---|---|---|---|
| Larval_YOY | | Spawning Heatwave GOA Model | neutral | neutral | neutral | neutral | neutral |
| | | Winter Spring Pacific Cod Spawning Habitat Suitability GAK1 Model | neutral | neutral | neutral | neutral | neutral |
| | ✻ | Annual Eddy Kinetic Energy Kodiak Satellite | *high* | neutral | **low** | neutral | neutral |
| | | Summer Large Copepod Abundance Shelikof Survey | NA | NA | NA | neutral | NA |
| | | Spring Pacific Cod CPUE Larvae Shelikof Survey | NA | neutral | NA | neutral | NA |
| | | Annual Common Murre Reproductive Success Chowiet Survey | NA | neutral | *high* | neutral | *high* |
| | | Summer Pacific Cod CPUE YOY Nearshore Kodiak Survey | *high* | neutral | neutral | neutral | neutral |
| Juvenile | | Pacific Cod Predation Mortality Age1 GOA Model | *low* | neutral | neutral | neutral | neutral |
| | ✻ | Summer Temperature Bottom GOA Model | neutral | neutral | neutral | neutral | neutral |
| | | Summer Pacific Cod Condition Juvenile GOA Survey | NA | neutral | NA | neutral | NA |
| Adult | | Summer Pacific Cod Condition Adult GOA Survey | NA | neutral | NA | neutral | NA |
| | | Annual Ration Pacific Cod GOA Model | neutral | neutral | neutral | neutral | neutral |
| | | Summer Pacific Cod Center Gravity Northeast WCGOA Model | NA | neutral | NA | neutral | NA |
| | | Summer Pacific Cod Area Occupied WCGOA Model | NA | neutral | NA | neutral | NA |
| | | Annual Biomass Consumed Pacific Cod GOA Model | *low* | *low* | neutral | neutral | neutral |
| | | Annual Steller Sea Lion Adult GOA Survey | **high** | **high** | NA | NA | NA |

# Indicator Analysis - Overall Score

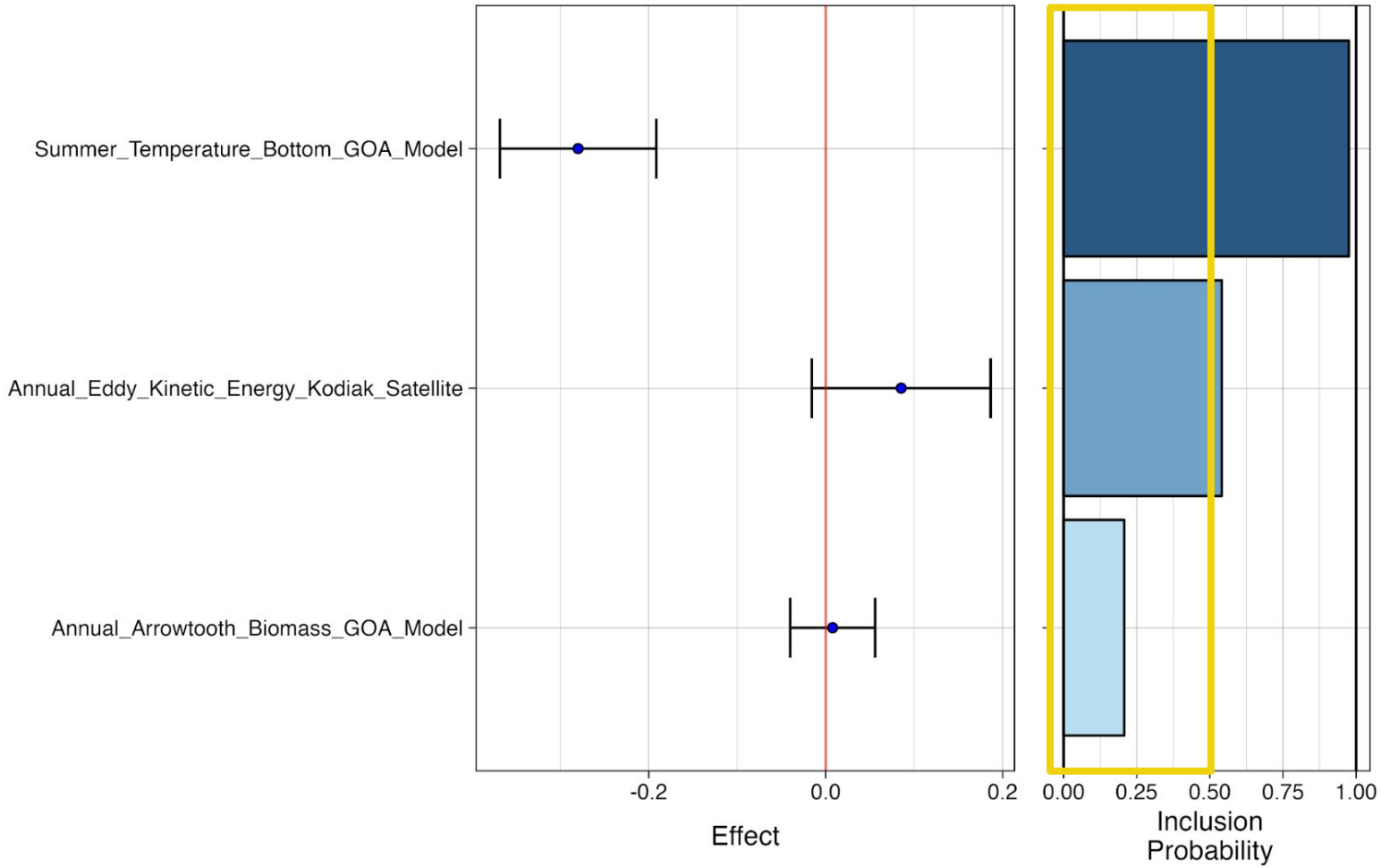
- Overall
  - 9 of 16 indicators updated
  - Increase from average to above average
- Category
  - Larval to YOY > from average to above average
  - Juvenile remained average
  - Adult remained average



# Indicator Analysis - Importance Test

Two indicators with importance > 0.5, same indicators as last year:

- Summer bottom temperature
- Annual eddy kinetic energy Kodiak
- 1994-2019 year class



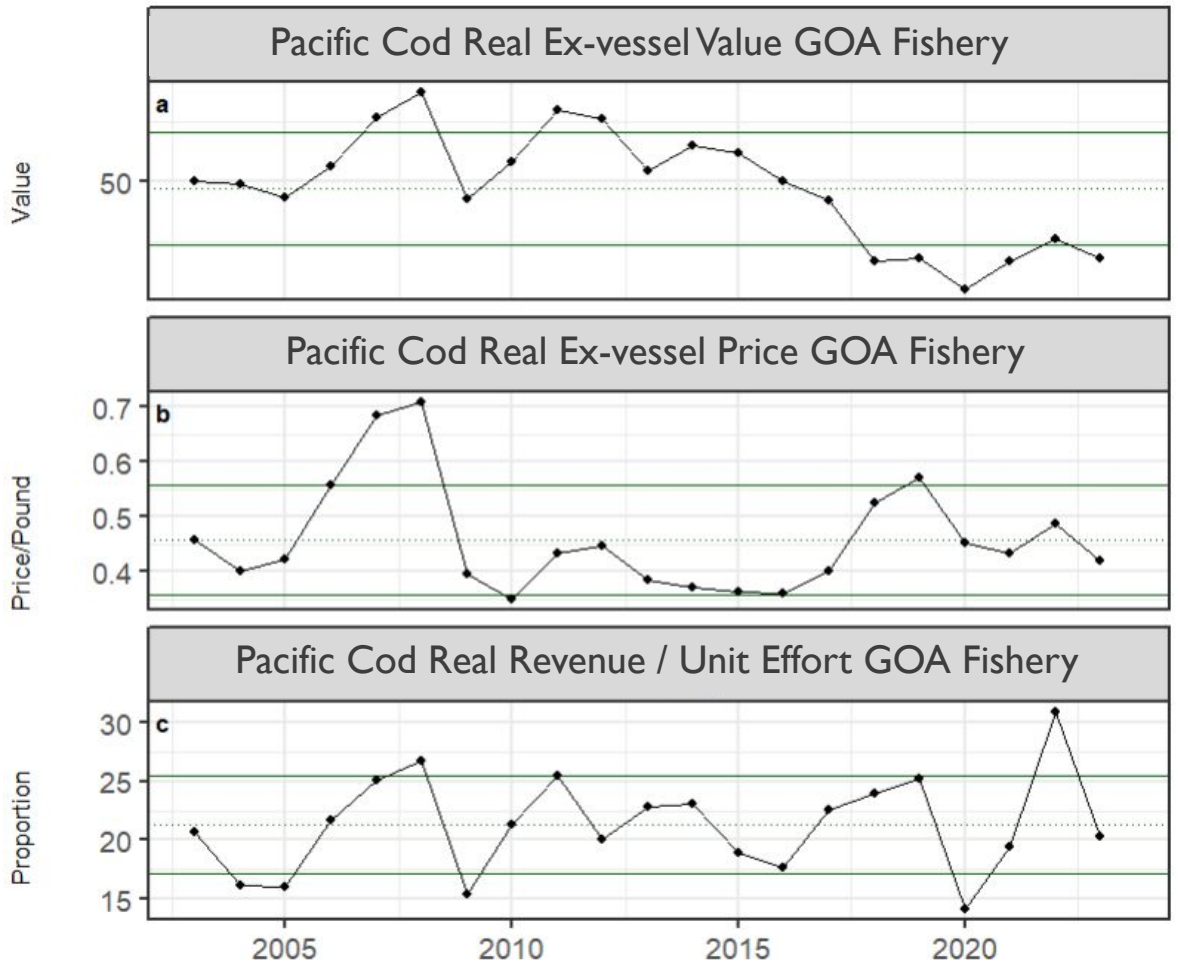
# Indicator Monitoring Analysis - Advanced

- CEATTLE Multispecies Model (Adams et al., 2022, Adams et al., 2024)
  - Based in part on most recent stock assessment model, 1979-present, of Pacific cod, pollock, arrowtooth, halibut
  - Developed to understand trends in total natural mortality
- Temperature Linkage Project (Oke et al., *in prep*)
  - New project evaluating several temperature metrics at depth to investigate environmental linkages to growth, recruitment, and natural mortality for GOA and eastern Bering Sea Pacific cod, results used for guiding future ecosystem linked alternative operational models

# Socioeconomic Indicators


1. Ex-vessel value
2. Ex-vessel price per pound
3. Revenue per unit effort

# Economic Indicators




- Ex-vessel value decreased by 27% from 2022, falling below one-standard deviation of the historical range for the fifth time in the last six years
- Ex-vessel price decreased to below the historical average, but remains within one-standard deviation of the historical range
- Revenue-per-unit-effort decreased from the historical high recorded in 2022, falling slightly below the historical average

# Summary and Stickers!!!

## Ecosystem (ABC Information):

- No heatwave, below average habitat suitability, reduced energy and transport
- Sufficient prey, nearshore YOY just below average
- Age-1 natural mortality consistently above the operational model
- Below average bioenergetic demand, low biomass consumed

## Socioeconomic (TAC Information):

- Ex-vessel value low for five of last six years
- Price decreased and below avg
- Revenue/unit effort < from historic high to below avg

# Planned ESP Developments

1) Request for Indicators (RFI) in 2025, use ESP data gaps and research priorities list, indicators submitted in February

2) Data modernization project begins in early 2025 to expand the ESP data management system (hosted by AKFIN) and streamline the AK-ESP R package for multiple templates (e.g., one-pager)

3) Indicator monitoring analysis for groundfish and crab ecosystem indicators presented to authors in the spring (likely May).

4) National ESP workshops to identify support systems that will work toward operationalizing ESPs

# Questions?

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