

Ecosystem & Socioeconomic Profile: GOA Pacific Cod Report Card

Kalei Shotwell, November Groundfish Plan Team 2023



Editors: S. Kalei Shotwell

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Overview

- Appendix 2.1 in SAFE Report
 - Draft/Full ESP in 2020 - 2021
 - Report Card in 2021 - 2023
- Report Card in 2023
 - Simplified template, current data
 - Ecosystem and socioeconomic indicator assessment and analysis
 - 5 editors, 23 contributors

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

S. Kalei Shotwell (Editor)

Bridget Ferriss, Peter-John F. Hulson, Ben Laurel, Beth Matta, and Lauren Rogers (Team)

November 2023

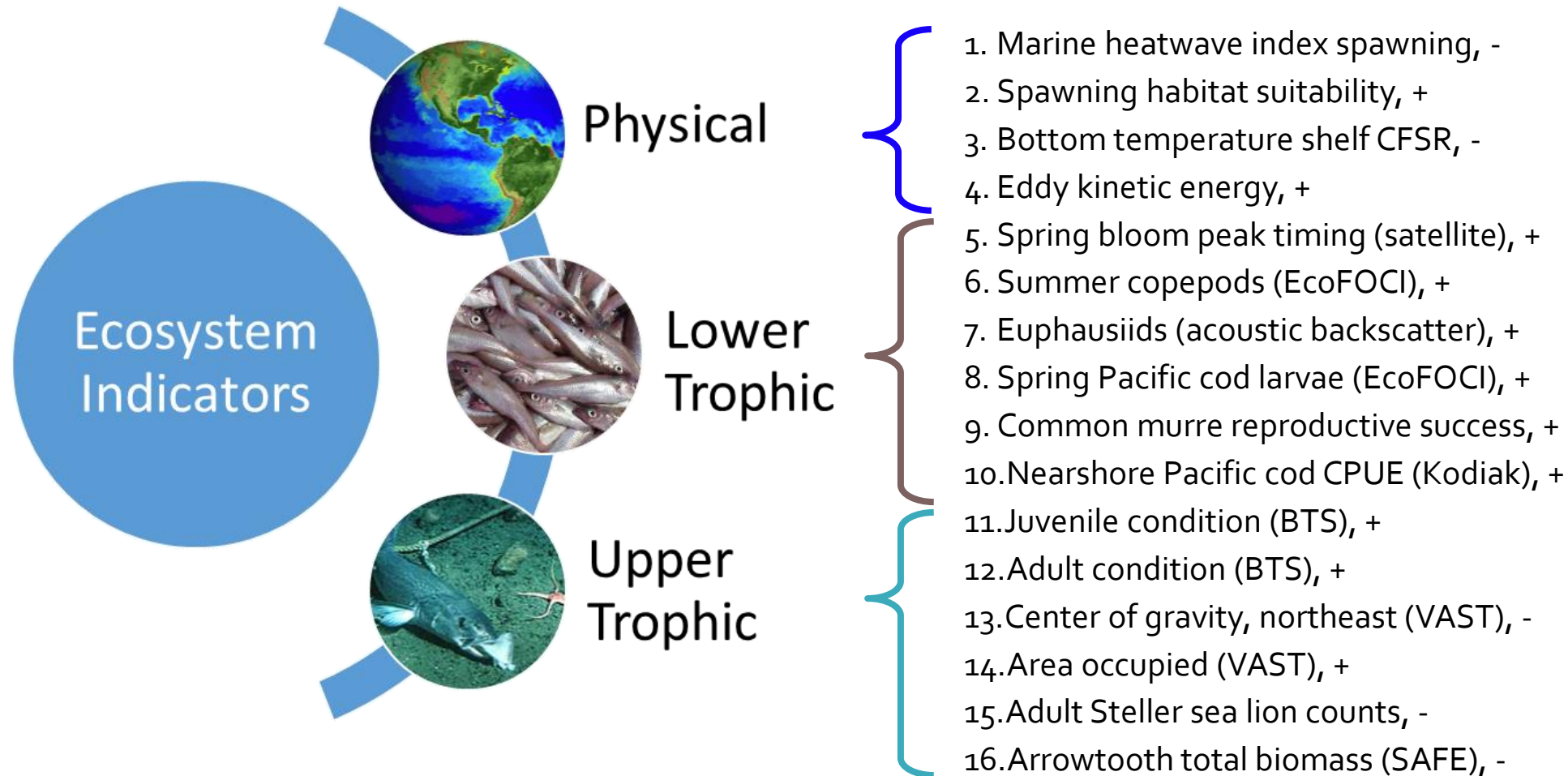


Appendix 2.1

With Contributions from:

Anna Ableman, Grant Adams, Kerim Aydin, Steven Barbeaux, Matt Callahan, Wei Cheng, Curry Cunningham, Brian Garber-Yonts, Kirstin Holsman, Ben Laurel, Sandi Neidetcher, Krista Oke, Zack Oyafuso, Patrick Ressler, Heather Renner, Lauren Rogers, Sean Rohan, Elizabeth Siddon, Ingrid Spies, Kalei Shotwell, Katie Sweeney, Muyin Wang, Stephani Zador

Ecosystem Indicators



Ecosystem Summary Table

Category	Indicator	2019 Status	2020 Status	2021 Status	2022 Status	2023 Status
Physical	Spawning Heatwave GOA Model	high	neutral	neutral	neutral	neutral
	Winter Spring Pacific Cod Spawning Habitat	low	neutral	neutral	neutral	neutral
	Summer Temperature Bottom GOA Model	high	neutral	neutral	neutral	neutral
	Annual Eddy Kinetic Energy Kodiak Satellite	neutral	high	neutral	neutral	neutral
Lower Trophic	Spring Chlorophyll a Peak WCGOA Satellite	high	neutral	neutral	neutral	high
	Summer Large Copepod Abundance Shelikof Survey	neutral	NA	NA	NA	neutral
	Summer Euphausiid Abundance Kodiak Survey	neutral	NA	NA	NA	NA
	Spring Pacific Cod CPUE Larvae Shelikof Survey	neutral	NA	neutral	NA	neutral
	Annual Common Murre Reproductive Success	high	NA	neutral	high	neutral
	Summer Pacific Cod CPUE YOY Nearshore Kodiak	neutral	high	neutral	neutral	neutral
Upper Trophic	Summer Pacific Cod Condition Juvenile GOA Survey	neutral	NA	neutral	NA	neutral
	Summer Pacific Cod Condition Adult GOA Survey	neutral	NA	neutral	NA	neutral
	Summer Pacific Cod Center Gravity Northeast	high	NA	neutral	NA	neutral
	Summer Pacific Cod Area Occupied WCGOA Model	neutral	NA	neutral	NA	neutral
	Annual Arrowtooth Biomass GOA Model	neutral	low	low	NA	NA
	Annual Steller Sea Lion Adult GOA Survey	neutral	neutral	neutral	NA	NA

Ecosystem Considerations

- Heatwave events were low, summer bottom temperatures decreased to below average and habitat suitability was again slightly lower than average, unlikely limiting for survival.
- Annual eddy kinetic energy remains in a low energy period, implying reduced larval retention and cross-shelf transport to suitable nearshore nursery environments.
- Spring bloom timing is very delayed which may have implications for mismatch between larval life stages and average zooplankton abundances, but may be tempered in cooler thermal environment, suggesting sufficient prey resources.
- Abundance of Pacific cod larvae was again low, suggesting another poor year class, although abundances may have been higher outside the surveyed region and reproductive success of piscivorous seabirds remained above average suggesting sufficient forage fish prey resources.
- Nearshore abundance of young-of-the-year (YOY) Pacific cod decreased to below average consistent with the low abundance of larval Pacific cod in the spring survey.
- Juvenile Pacific cod condition remained below average while adult Pacific cod decreased slightly to average from the previous bottom trawl survey.
- Center of gravity shifted slightly to the northeast concurrent with a decrease in the effective area occupied implying a slightly contracted spatial distribution.



Socioeconomic Indicators



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

Explorations: environmentally linked fishery-dependent data (Watson and Callahan, 2021)



Socioeconomic Summary Table

Category	Indicator	2019 Status	2020 Status	2021 Status	2022 Status	2023 Status
Economic	Annual Pacific Cod Real Exvessel Value GOA Fishery	low	low	low	neutral	NA
	Annual Pacific Cod Real Exvessel Price GOA Fishery	high	neutral	neutral	neutral	NA
	Annual Pacific Cod Real Revenue Per Unit Effort GOA Fishery	high	low	neutral	high	NA



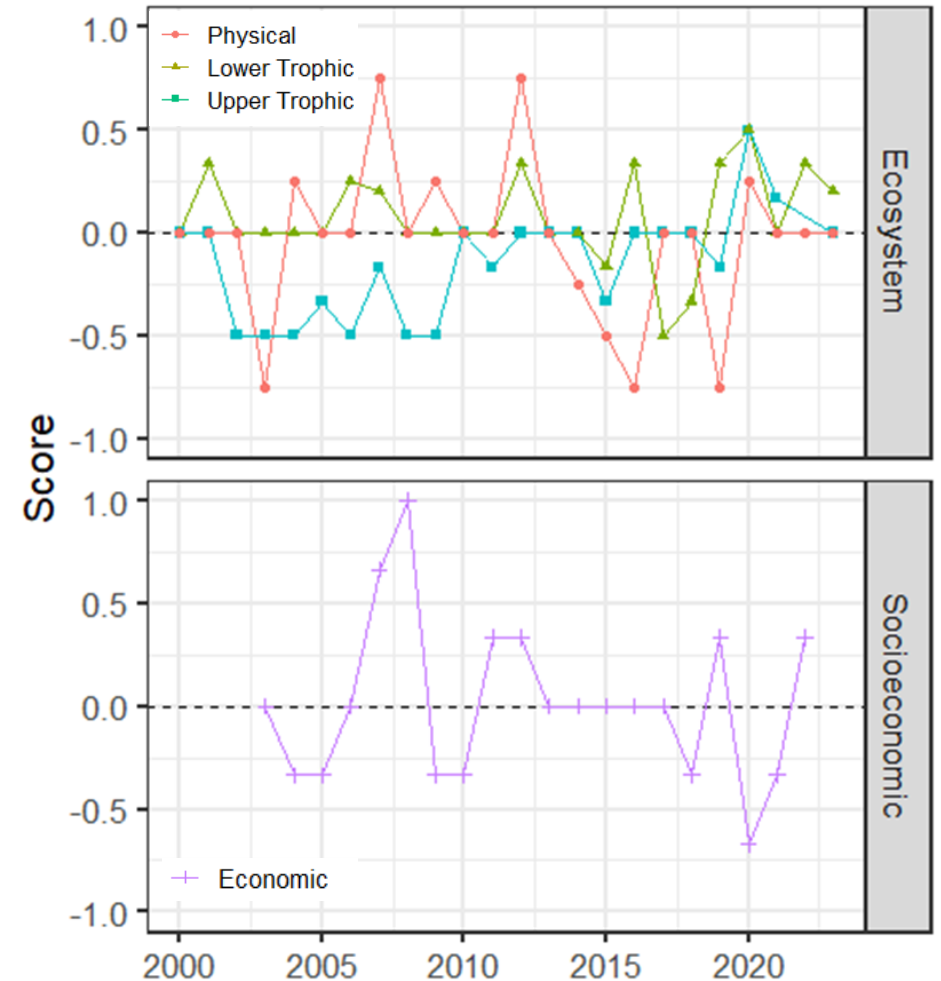
Socioeconomic Considerations

- Ex-vessel value increased from 2021 values but was still below average, and has been low since 2018
- Ex-vessel price increased to above average, but revenue-per-unit-effort increased to the highest value in the time series.



Indicator Analysis - Overall Score

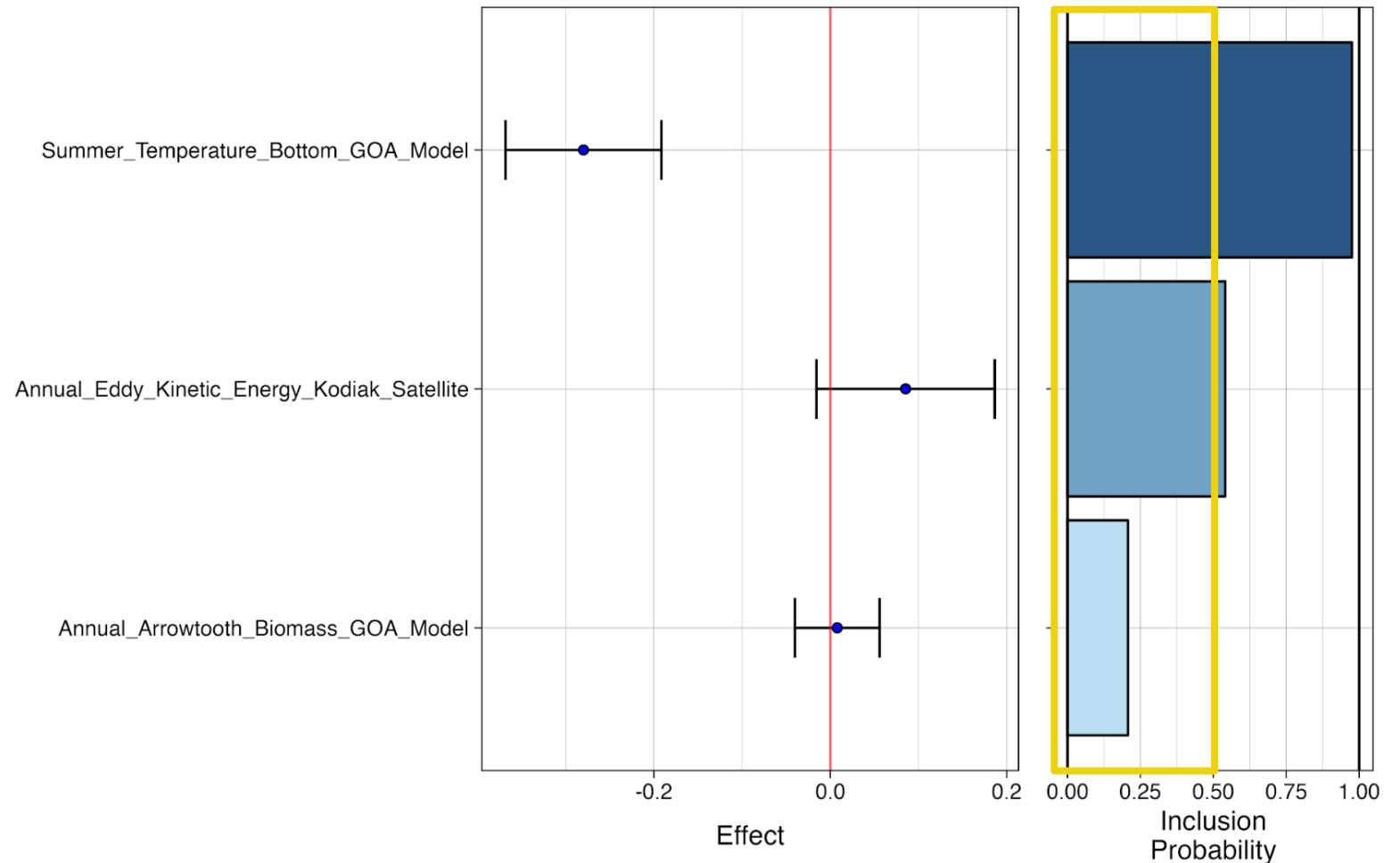
- Ecosystem (13 of 16 total)
 - Physical remained average
 - Lower trophic < but still above average
 - Upper trophic < to average
- Socioeconomic (3 of 3 total)
 - Economic > to above average



Indicator Analysis - Importance Test

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

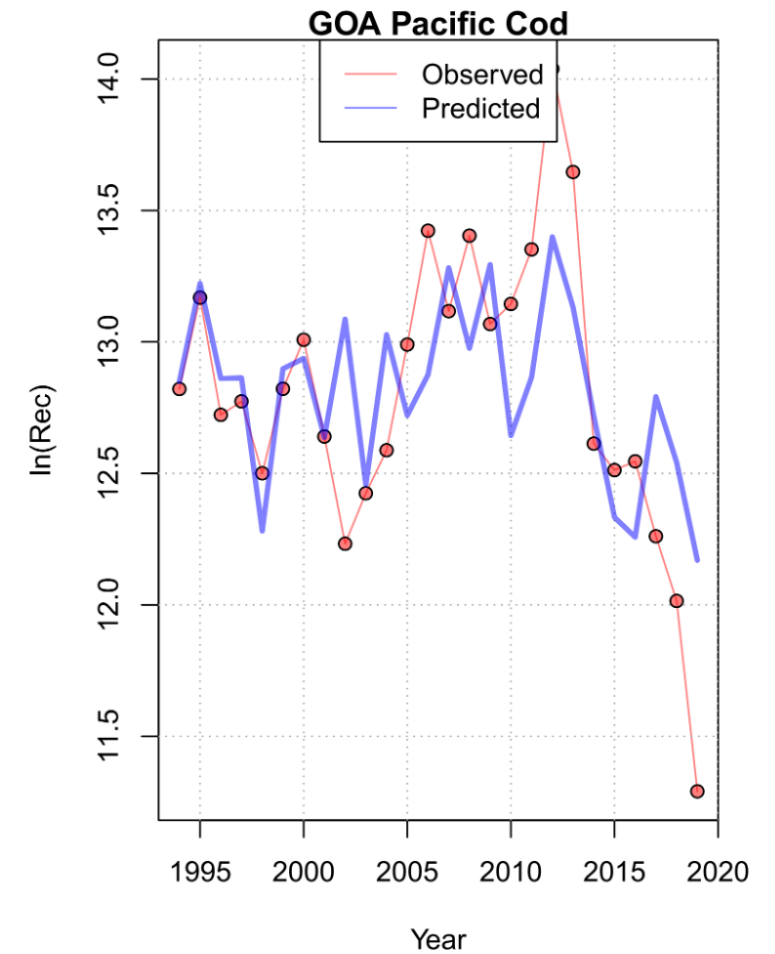
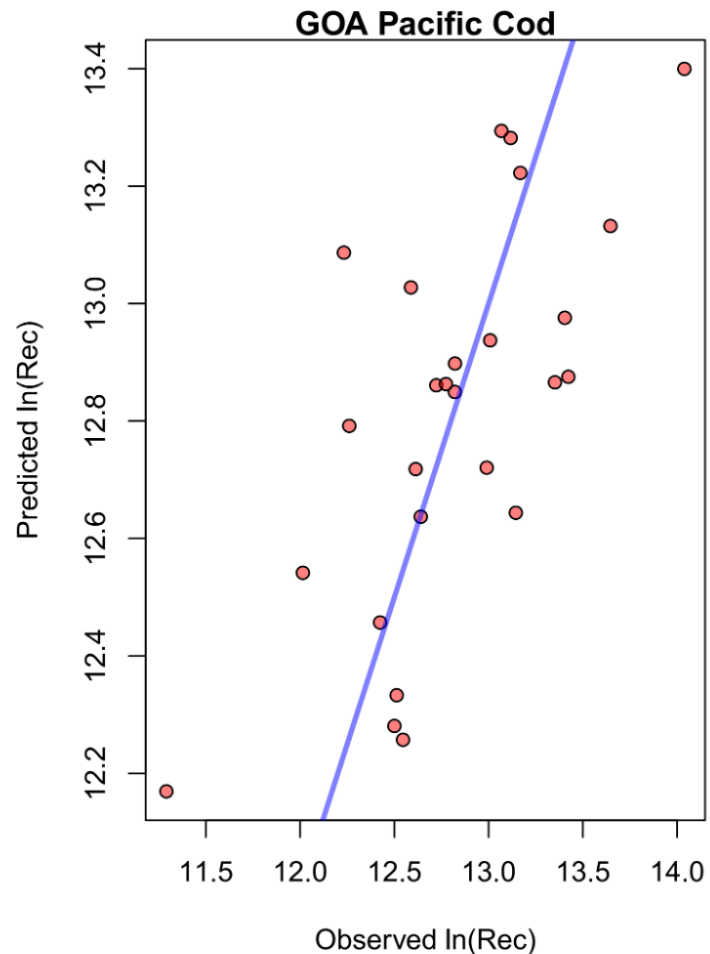
- Summer bottom temperature
- Annual eddy kinetic energy Kodiak
- 1994-2019 year class



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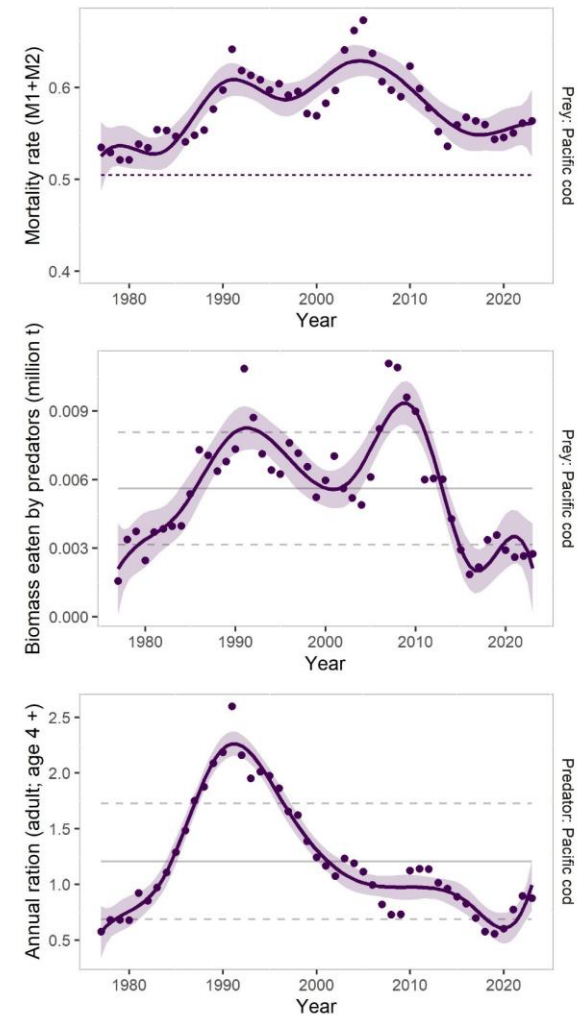
Indicator Analysis - Advanced Test

■ CEATTLE

- Multi-species model of Pacific cod, pollock, arrowtooth, total M trends
- Based in part on most recent stock assessment model, 1979-present

■ Results

- Age-I natural mortality for Pacific cod increased recently but remains below average and above the single species estimate, possibly due to \leq arrowtooth
- Total biomass consumed by modelled predators has increased in recent years but is still low
- Ration for adult (age 4+) Pacific cod has steadily decreased since mid-1990s increased since 2020 but is still below average.





Planned ESP Developments

- 1) Request for Indicators (RFI) in 2024, use ESP data gaps and research priorities list, submitted in January, reviewed in February
- 2) Consider how to use the GOA R-CEATTLE model output in the ESP to identify other indicators for monitoring, evaluate predation M or bioenergetics indicators to compare with the bottom trawl condition, compare recruitment indicators with BAS output
- 3) New project developing ecosystem research models using indicators of temperature linked to time varying growth (K. Oke)
- 4) Socioeconomic indicators evaluation with several groups, also part of the National ESP Initiative

Questions?



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Ecosystem & Socioeconomic Profile (ESP) Highlights - GOA Pacific cod



- Management Summary:

- Heat wave events low, bottom temperatures below average, habitat suitability slightly below average, suggesting temperatures unlikely limiting survival, eddy kinetic energy remains low suggesting lower retention, reduced transport
- Spring bloom very delayed, but may be tempered by cooler environment, zooplankton resources average, suggests sufficient prey but larvae CPUE was low, and YOY below average suggesting poor 2023 year class
- Juvenile condition below average, adult average, population moved slightly to northeast with slightly contracted spatial distribution
- Ex-vessel value increased but still below average, price above average and revenue per unit effort highest in time series in 2022

- Modeling Summary:

- Two potential covariates for recruitment, summer bottom temp from CFSR model, annual eddy kinetic energy in Kodiak area, 1994-2019 year class
- Ecosystem research models of time-varying growth, new 2-year project
- CEATTLE model update: age-1 M increased but below mean, total biomass consumed below average, ration increased but still below average

