

GOA Pollock Ecosystem Socioeconomic Profile (ESP)

Review of ESP report for Gulf of Alaska pollock including indicators, analysis, considerations, data gaps, and future research priorities



NOAA
FISHERIES

Editors: Kalei Shotwell, Martin Dorn,
Alison Deary, Ben Fissel, Lauren Rogers,
and Stephani Zador

ESP Report

Appendix in SAFE report

- 1) Intro: justification, data
- 2) Metrics assessment: national, processes
- 3) Indicators assessment: time series, analyses
- 4) Recommendations; data gaps, future priorities

Appendix 1A. Ecosystem and Socioeconomic Profile of the Walleye Pollock stock in the Gulf of Alaska

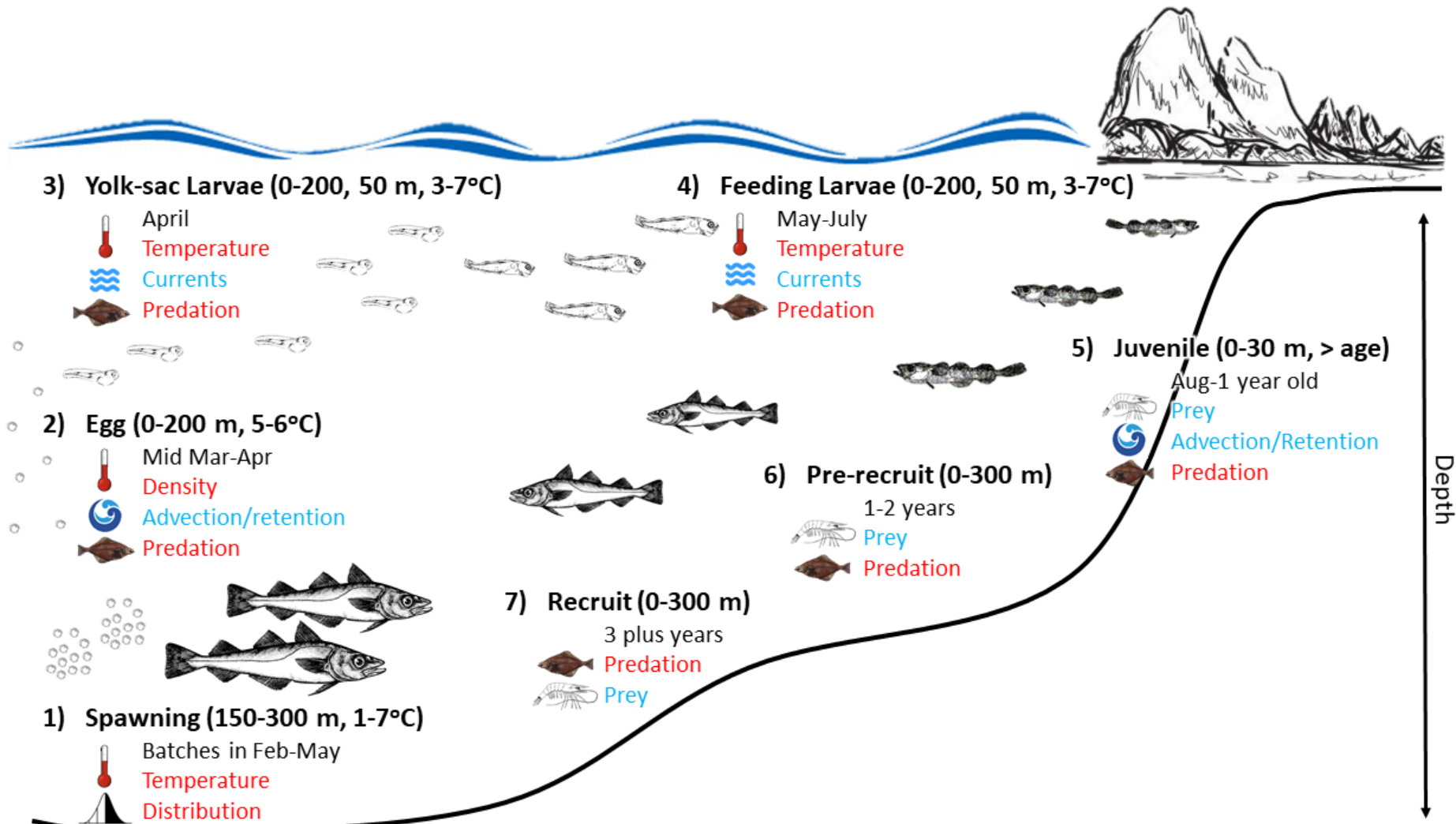
S. Kalei Shotwell, Martin Dorn, Alison L. Deary, Ben Fissel, Lauren Rogers, and Stephani Zador
November 2019



With Contributions from:

Grant Adams, Mayumi Arimitsu, Kerim Aydin, Steve Barbeaux, Lewis Barnett, Curry Cunningham, Dana Hanselman, Kirstin Holsman, David Kimmel, Ben Laurel, Jodi Pirtle, Patrick Ressler, Dale Robinson, Rob Suryan, James Thorson, Johanna Vollenweider, Cara Wilson, Sarah Wise

Ecosystem Processes



Ecosystem Processes

Stage		Processes Affecting Survival	Relationship to GOA Pollock
Adult	Recruit	<ol style="list-style-type: none"> 1. Top-down predation increase on age 3+ 2. Bottom-up control on juvenile consumption 	Increases in main predator of pollock would be negative but minor predators may indicate pollock biomass increase. Increases in primary prey biomass would be positive for pollock but may increase competition.
	Spawning	<ol style="list-style-type: none"> 1. Distribution 2. Surface and bottom temperature₁₀ 	Increased distribution spread of adult pollock may be negative as pollock would experience non-preferred habitat and potentially lower quality prey options. Increases in temperature may be negative causing early maturation, mismatch with spring bloom.
Offshore to Nearshore Pelagic	Egg	<ol style="list-style-type: none"> 1. Water column density 2. Advection/retention 3. Predation 	Increases in density, advection, and predation would be negative for egg stage resulting in sinking or dispersal from preferred habitat and adequate zooplankton prey.
	Yolk-sac Larvae	<ol style="list-style-type: none"> 1. Temperature-mediated metabolic rate 2. Currents that facilitate nearshore transport (6,8,10) 3. Predation 	Increases in temperature would increase metabolic rate and may result in rapid yolk-sac absorption that may lead to mismatch with prey. Current direction to preferred habitat would be positive for pollock while predation increases would be negative.
	Feeding Larvae	<ol style="list-style-type: none"> 1. Temperature-mediated metabolic rate 2. Currents that facilitate nearshore transport (6,8,10) 3. Predation 	Increases in temperature would increase metabolic rate and may result in poor condition if feeding conditions are not optimal. Current direction to preferred habitat would be positive for pollock while predation increases would be negative.
	Juvenile	<ol style="list-style-type: none"> 1. Spring/summer/fall abundance of zooplankton prey⁽¹¹⁾ 2. Advection/retention (offshore) 3. Predation 	Increases in preferred zooplankton prey would be positive for pollock condition and relative biomass of pollock may also be measured by minor predators of pollock. Advection offshore may be positive for pollock to arrive at preferred habitat. Predation would be negative for pollock.
	Pre-Recruit	<ol style="list-style-type: none"> 1. Bottom-up control juvenile consumption 2. Top-down predation increase on age 3+ 	Increases in main predator of pollock would be negative but minor predators may indicate pollock biomass increase. Increases in primary prey biomass would be positive for pollock but may increase competition.

Indicator Suite

- Organization

- By trophic level following ecosystem status report
- GOA pollock life history stages and socioeconomics

- Summary

- 21 total ecosystem: 15 current year, 6 not updated
- 5 total socioeconomic: 3 current year, 2 not updated

Category	Total	2019	Gap
Physical	4	3	1
Zooplankton	4	4	0
Larval & YOY	5	4	1
Juvenile	2	0	2
Adult	6	4	2
Socioecon	5	3	2

Ecosystem Indicators

Title	Category/Description	Time series	Recent
Annual Heatwave GOA	Regional daily mean sea surface temperatures from NOAA climate model processed following Hobday et al., 2016 to obtain marine heatwave cumulative intensity (Barbeaux, 2019)		+
Spring Sea Surface Temperature WCGOA	Western/central GOA spring (Apr-May) sea surface temperature from Pathfinder v5.3 gridded monthly dataset (Casey et al., 2010, GHRSSST, CoastWatch)		+
Summer Bottom Temperature WCGOA	Average summer bottom temperature (°C) over all hauls of the RACE GOA shelf bottom trawl survey. Available from AKFIN or online survey database.		+
Spring Peak Phytoplankton Production WCGOA	Western/central GOA peak (May) derived chlorophyll <i>a</i> from Ocean Colour CCI v4.0 gridded monthly dataset (Jackson et al., 2017, European Space Agency, CoastWatch)		-
Spring Copepods Larvae Shelikof	Mean abundance of small copepods (< 2 mm) in core Shelikof area measured in log scale numbers per meter cubed with associated rapid zooplankton assessment (Kimmel et al., 2019)		●
Summer Copepods YOY Shelikof	Mean abundance of large copepods (> 2 mm) in core Shelikof area measured in log scale numbers per meter cubed with associated rapid zooplankton assessment (Kimmel et al., 2019)		●
Summer Euphausiid Abundance Kodiak	Acoustic backscatter per unit area classified as euphausiids and integrated over the water column and across Kodiak core survey area from MACE summer survey (Ressler et al., 2019)		●

Ecosystem Indicators

Title	Description	Time series	Recent
Auklet Reproductive Success Chowiet	Proportion of parakeet auklet nest sites with fledged chicks from total nest sites with eggs laid, Chowiet Island (Higgins et al., 2018)		●
Spring Pollock CPUE Larvae Shelikof	Mean abundance of larval pollock taken in bongos from core sampling area in Shelikof Strait during EcoFOCI spring survey with rapid assessment (Dougherty et al., 2019)		—
Summer Pollock CPUE YOY Shelikof	Mean abundance of YOY pollock taken in midwater trawl from core area in WGOA area during EcoFOCI summer survey with rapid assessment (Rogers et al., 2019b)		●
Summer Pollock Condition YOY Shelikof	Body condition of YOY pollock taken in midwater trawl from core area in WGOA area during EcoFOCI summer survey with rapid assessment (Rogers et al., 2019a)		●
Summer Pollock CPUE YOY Kodiak	Catch per unit effort of YOY pollock in beach seine from fixed sites in nearshore Kodiak survey (Laurel et al., 2019)		—
Pollock Relative Biomass YOY Aiktak	Relative biomass of pollock measured from screening burrows of tufted puffins diets at Aiktak Island (Youngren et al., 2019)		●
Summer Pollock Predation Age-1	Predation mortality estimates of age-1 pollock from multiple data sources and models (Barnes et al., <i>In Review</i>)		●

Ecosystem Indicators – Adults

Title	Description	Time series	Recent
Summer Pollock Euphausiid Diet Juvenile	Proportion-by-weight of euphausiids in the diets of juvenile pollock collected on summer bottom trawl survey samples in GOA (Aydin et al., 2007)		—
Fall Pollock Condition Adult Fishery	Length-weight regression of pollock sampled by observers in the fall pollock fishery (M. Dorn, <i>pers. commun.</i>)		●
Winter Pollock Condition Adult Acoustic	Length-weight regression of pollock sampled in Shelikof Strait during the late winter MACE acoustic survey (M. Dorn, <i>pers. commun.</i>)		●
Summer Pollock Center of Gravity Northeast	Biomass-weighted avg location of grid cells in northeasting direction from spatio-temporal model of pollock in summer bottom trawl survey (Thorson and Barnett, 2017)		●
Summer Pollock Area Occupied	Area required to contain the population at its average biomass from spatio-temporal model of pollock in the summer bottom trawl survey (Thorson and Barnett, 2017)		●
Arrowtooth Biomass Assessment	Total biomass estimates from arrowtooth flounder stock assessment model output (Spies et al., 2017)		●
Steller Sea Lion Adult Counts	Non-pup estimates of Steller sea lions from the GOA portion of the western Distinct Population Segment (Sweeney, 2017)		●

1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019

Socioeconomic Indicators

Title	Description	Time series	Recent
Winter-Spring Pollock CPUE Fishery	Catch of pollock in tons/hour from the winter-spring (first trimester) of the pollock fishery (M. Dorn, <i>pers. commun.</i>)		
Summer-Fall Pollock CPUE Fishery	Catch of pollock in tons/hour from the summer-fall (third trimester) of the pollock fishery (M. Dorn, <i>pers. commun.</i>)		
Annual Pollock Real Ex-vessel Price	Estimate of real ex-vessel value in price per pound inflation adjusted to 2018 USD (Fissel et al., 2019)		
Annual Pollock Roe per unit Catch	Roe per-unit-catch calculated as $1000 * (\text{roe production}) / (\text{retained catch})$ (Fissel et al., 2019)		
Annual Percent Revenue Pollock in Kodiak	Percentage of the total revenue Kodiak gets from the GOA pollock fishery (aka, local quotient) (S. Wise, <i>pers. commun.</i>)		

1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019

Traffic Light

- Evaluated for current year
 - Ecosystem: 5 poor, 12 stable
 - Socioecon: 1 good, 2 stable
- Summary
 - Physical indicators poor with increased heat, prey stable
 - Larvae/YOY poor, but adult condition, predators stable
 - Good/stable socioecon

Category	Good	Poor	Stable
Physical		3	
Zooplankton			4
Larval & YOY		2	2
Juvenile			
Adult			4
Socioecon	1		2

Indicator Considerations

- 2012 Year Class
 - CPUE larvae and YOY high following first overwinter, and seabird diets show high amounts, good YOY conditions
 - Major heatwave started in 2014, warm temps mixed from surface to bottom, peak production downward trend
 - Small copepods dominate zooplankton, large copepods and euphausiids low, and lower % in age-I pollock diet
 - Poor feeding for juveniles, poor condition when recruited to fishery/survey, increased spatial changes, pred stable

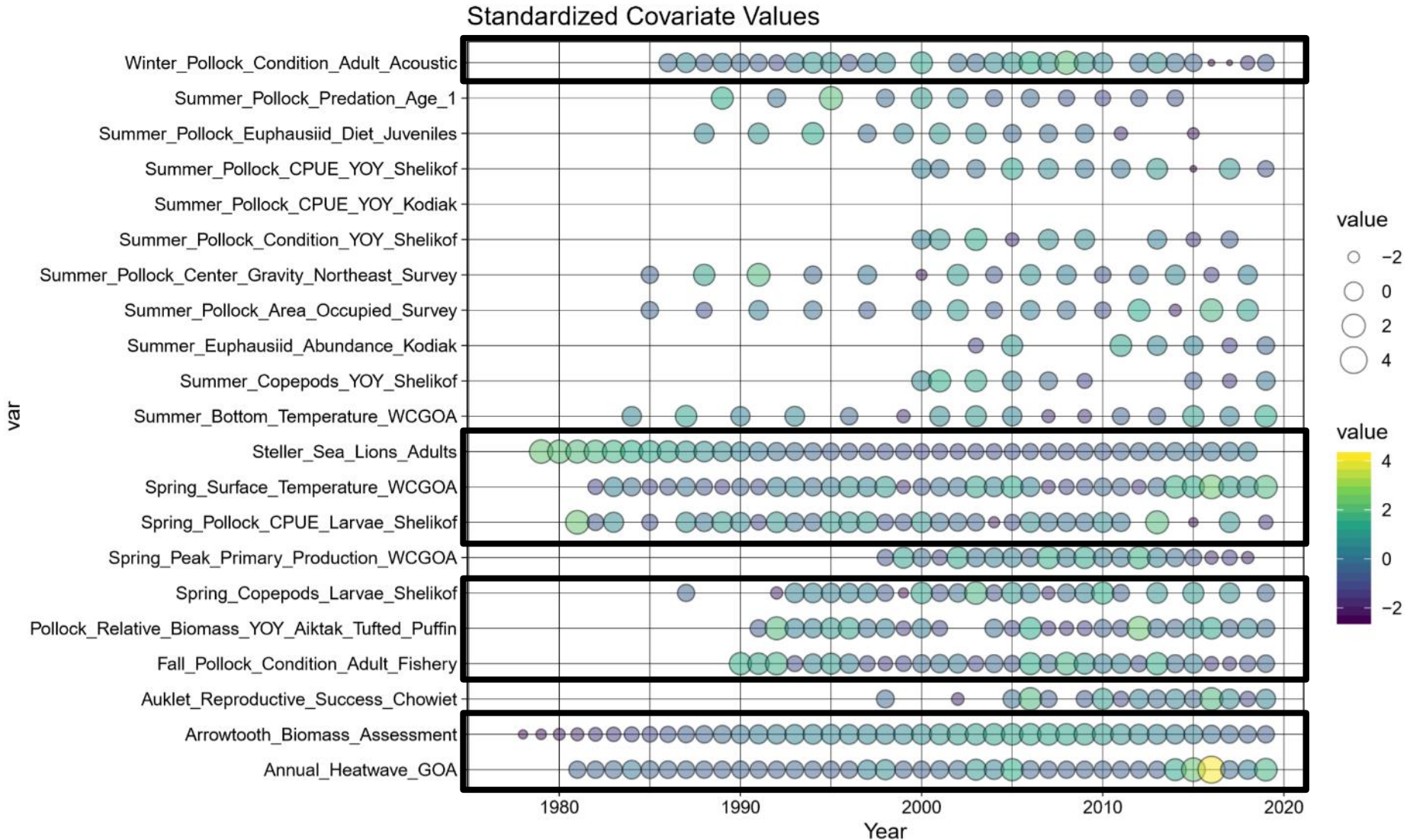
Indicator Considerations

- Subsequent year classes
 - Return to heatwave conditions, recently abated but surface and bottom temps high in 2019 survey
 - Prey for 2017 or 2018 year class similar to 2012 year class although some recovery in 2019
 - CPUE larvae/YOY were high in 2017 and 2018 but low in 2019 for both offshore and nearshore surveys
 - Condition of adult pollock steadily increasing since 2016/17 low, spatial distribution average, pred low

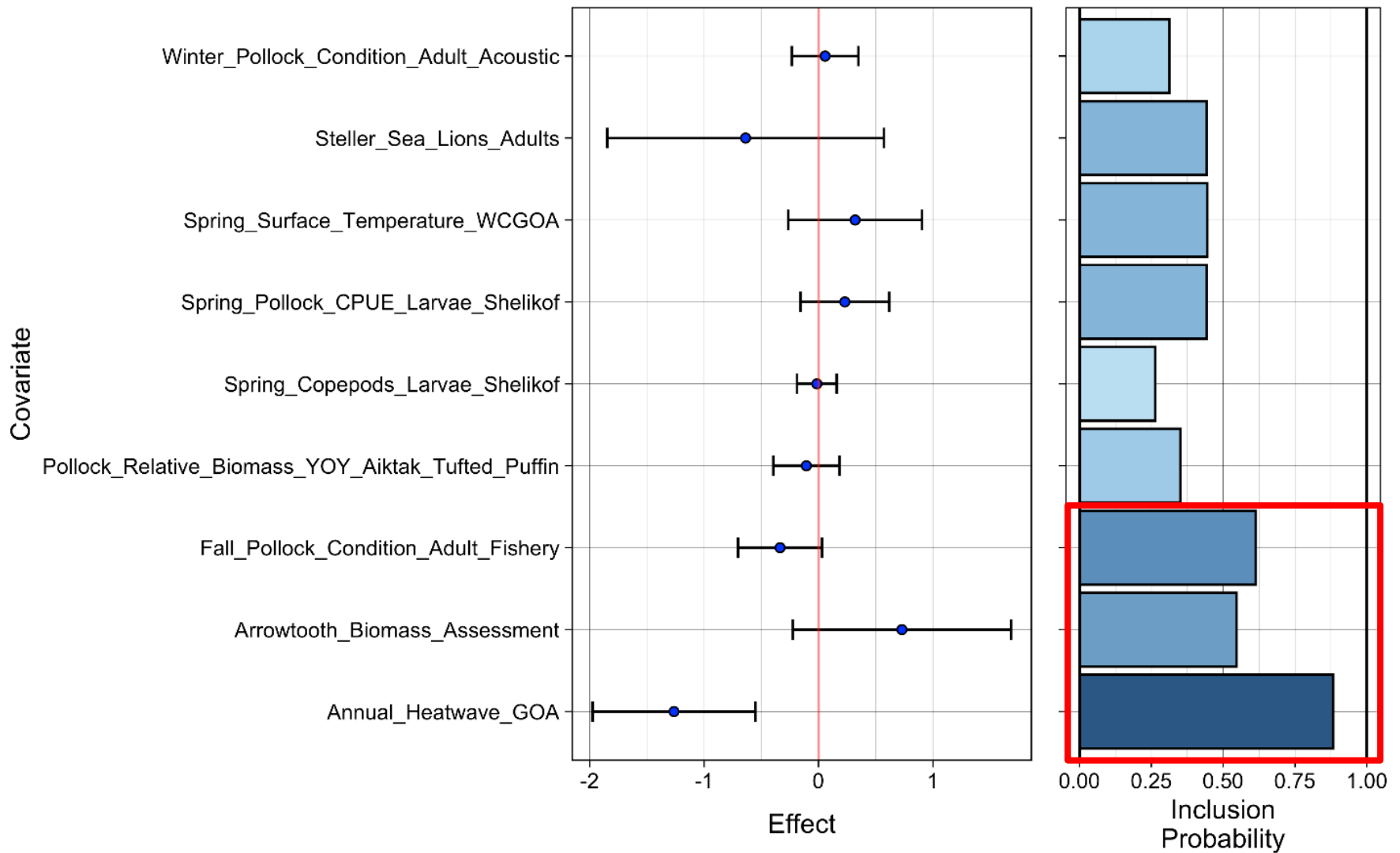
Indicator Considerations

- Socioeconomic
 - Fishery CPUE above average since 2016, consistent with stock biomass levels
 - Precipitous drop ex-vessel price and in roe per-unit catch in 2014/2015 that rebounded in 2018/2019 and may be related to poor body condition of adult pollock since 2015
 - Percent revenue in Kodiak from GOA pollock reached high in 2018, suggesting high level of reliance on GOA pollock fishery by Kodiak residents

Modeling Application



Bayesian Adaptive Sampling



Gaps & Future

- Indicator Gappiness
 - Investigate remote sensing, climate model options
 - Refinement of GOA CEATTLE model
- Alternative Indicators
 - Upcoming competitors (sablefish, POP)
 - Condition, energy density at edges of range
- Next Year
 - ESP modeling workshop (March 10-12, 2020)
 - Potentially conduct partial ESP

Questions?

