Ecosystem Socioeconomic Profile (ESP)

GOA Pacific Cod

Review of draft full ESP, introduction, processes, indicator suite and analysis, ecosystem and socioeconomic considerations, next steps

NOAA FISHERIES

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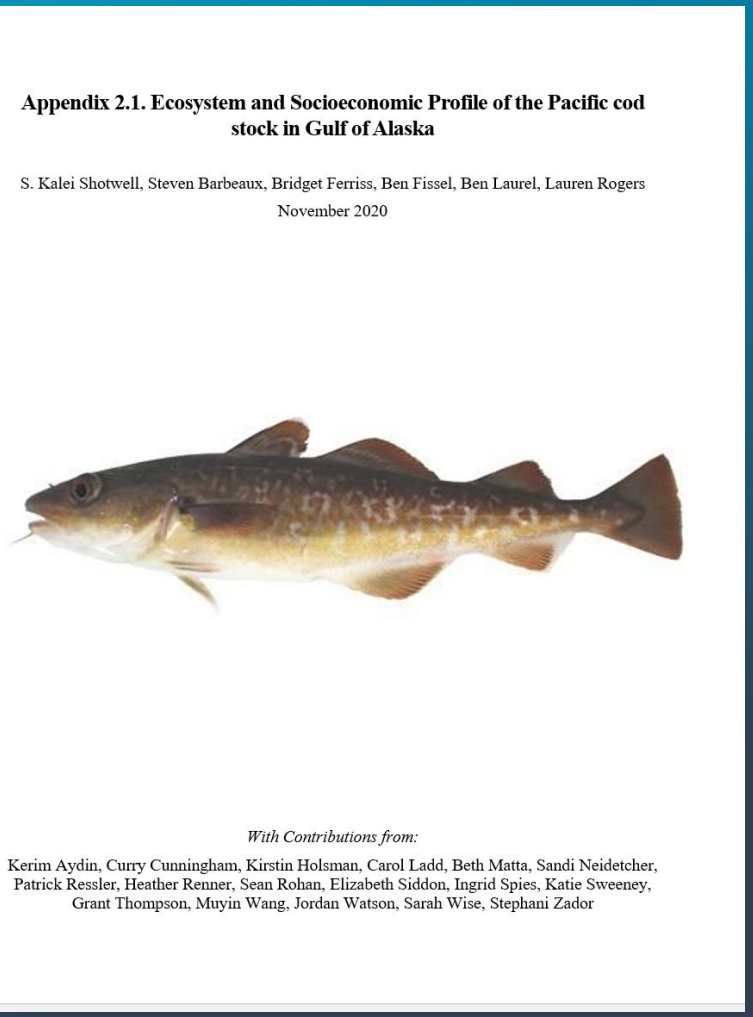
Overview

Appendix in SAFE report

- First Full ESP 2020 (draft)
- Complete full 2021
- 6 editors, 17 contributors
- Recommendations: complete an ESP as time allows



Appendix 2.1. Ecosystem and Socioeconomic Profile of the Pacific cod stock in Gulf of Alaska

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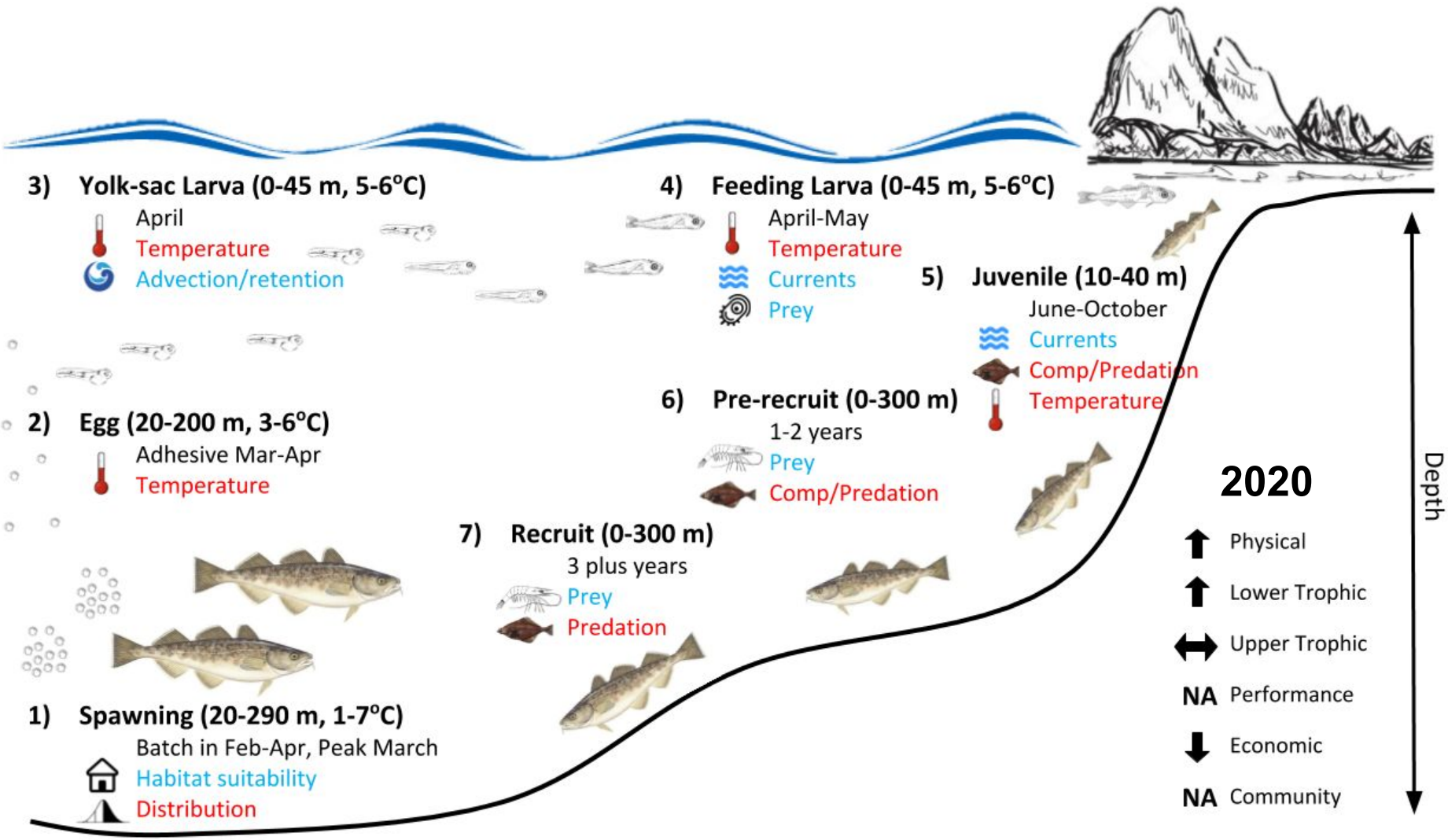
With Contributions from:

Kerim Aydin, Curry Cunningham, Kirstin Holsman, Carol Ladd, Beth Matta, Sandi Neidetcher, Patrick Ressler, Heather Renner, Sean Rohan, Elizabeth Siddon, Ingrid Spies, Katie Sweeney, Grant Thompson, Muyin Wang, Jordan Watson, Sarah Wise, Stephani Zador

Introduction

- Justification
  - High commercial importance and EL habitat requirements
  - Data-rich stock with high current ecosystem classification
  - AFSC priority to improve understanding of Pcod dynamics
- Data Sources
  - RACE, REFM, ABL, EcoFOCI, RPA, MML, FMA, PMEL
  - CoastWatch (satellite), CFSR, EFH, ISRC (seabirds)
  - Many contributions derived from ESR contributions
  - AKRO, ADF&G, FAO via AKFIN (thank you Jean Lee!!!)

Ecosystem Processes



Ecosystem Processes

Stage	Habitat & Distribution	Phenology	Age, Length, Growth	Energetics	Diet	Predators/Competitors
Recruit	Shore to Shelf (0-500 m), depth varies by age then size(24), sublittoral-bathyal zone, move w/in, between LMEs(24)	Recruit to survey and fishery age-1, length 20-27 cm(24)	Max: 25 yrs, 147♀/134♂ cm L_inf=94 cm, K= 0.2 (24,AFSC)		Opportunistic, small on inverts, large on fish(20, 21, 24, AFSC)	Halibut, Steller sea lions, whales, tufted puffins, fisheries(24); shelf groundfish(24)
Spawning	Shelf (40-290 m)(13-16,24), semi-demersal in shelf areas(13,15,16), seasonal migrations variable duration(26)	Winter-spring, peak mid-March, 13 wks (1,20,25)	1st mature: 2 yr, 26♀/36♂cm, 50%: 4-5yr, 45-65cm (24,AFSC)	Oviparous, high fecundity (250-2220· 10^3) eggs (13,15), range 4-6 °C(14,16)	Opportunistic (20,21)	Halibut, Steller sea lions, whales, tufted puffins, fisheries(24); shelf groundfish(24)
Egg	Shelf (20-200 m), demersal, adhesive eggs(13,15-17,24)	Incubation is ~20 days, 6 wks(14,22)	Egg size: 0.98-1.08 mm (Laurel et al 2008)	Optimal incubation 3-6°C, 13-23 ppt, 2-3ppm dO_2 (LR, 2020)	Yolk is dense and homogenous (AFSC)	
Yolk-sac Larvae	Epipelagic, nearshore shelf, coastal, upper 45 m, semi-demersal at hatching(13-15,18,24)	Spring, peak end April, 14 wks(22)	3-4.5 mm NL at hatch (13-15,24)	1-2 weeks before onset of feeding	Endogenous	Share larval period with pollock(13)
Feeding Larvae	Epipelagic, nearshore shelf(13-15,24), 0-45 m(24)	Late spring(22)	25-35 mm SL at transformation (3,13-15,24)	1-2 weeks before onset of feeding	Copepod eggs, nauplii, and early copepodite stages (Strasburger et al. 2014)	Share larval period with pollock(13)
Juvenile	Nearshore (2-110 m), 15-30 m peak density, inside bays, coastal, mixed, structural complexity (1-6,11,21)	Nearshore settlement in June, deeper water migrations in October(3,13-15)	YOY: 35-110 mm FL(2), age 1+: 130-480 mm FL(1,3,4,6,10); growth sensitive to temp	Energy density ↑ with length, lower in pelagic stage,	Copepods, mysids, amphipods(2), small fish(10), crabs(19-21)	Pollock, halibut, arrowtooth flounder(19,20); macroalgae, eelgrass, structural inverts, king crab, skate egg case, juvenile pollock (1-5,7-9)
Pre-Recruit	Nearshore, shelf (10-216 m)(4), inside bays, coastal, mixed, mud, sand, gravel, rock pebble(1,2,4,6)	Age-2 may congregate more than age-1(25)	Begin to mature age 2-3, 480-490 mm FL (15)	Energy density and condition lower than in pelagic stage	Opportunistic, benthic invert, pollock, small fish, crabs(19-21)	Pacific cod, halibut, salmon, fur seal, sea lion, porpoise, whales, puffin(24); macroalgae, macroinvertebrate, king crab, skate egg case(4-5,7-9)

Ecosystem Processes

Stage	Processes Affecting Survival	Relationship to EBS Pacific cod
Recruit	1. Competition 2. Predation 3. Temperature	Increases in main predator of Pacific cod would be negative but minor predators may indicate Pacific cod biomass increase. Increases in overall prey biomass would be positive for Pacific cod but generalists.
Spawning	1. Ice Dynamics 2. Spawning Habitat Suitability 3. Distribution	Temperatures outside the 3-6 C range contribute to poor hatching success and may impact physiological and behavioral aspects of spawning. Spring bottom temperatures outside this range are linked to observed pre-recruits and recruitment estimates (Laurel and Rogers 2020)
Egg	1. Temperature	Eggs are highly stenothermic (Laurel and Rogers 2020)
Yolk-sac Larvae	1. Temperature 2. Timing of spring bloom 3. Onshore shelf transport	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 Pacific cod.
Feeding Larvae	1. Temperature 2. Prey availability 3. Onshore shelf transport	Increases in temperature would increase metabolic rate and may result in poor condition if feeding conditions are not optimal. Onshore transport to nursery habitat would be positive for Pacific cod while predation increases would be negative.
Juvenile	1. Competition 2. Predation 3. Temperature	Evidence of density-dependent growth in coastal nurseries (Laurel et al., 2016) would suggest that increases in competitors or predators would be negative for Pacific cod condition and therefore survival. Temperature increases may amplify risk of food availability and energy allocation (Laurel et al. 2017)
Pre-Recruit	1. Competition 2. Predation 3. Temperature	Evidence of density-dependent growth in coastal nurseries (Laurel et al., 2016) would suggest that increases in competitors or predators would be negative for Pacific cod condition and therefore survival. Temperature increases may amplify risk of food availability and energy allocation (Laurel et al. 2017)

Socioeconomic Processes

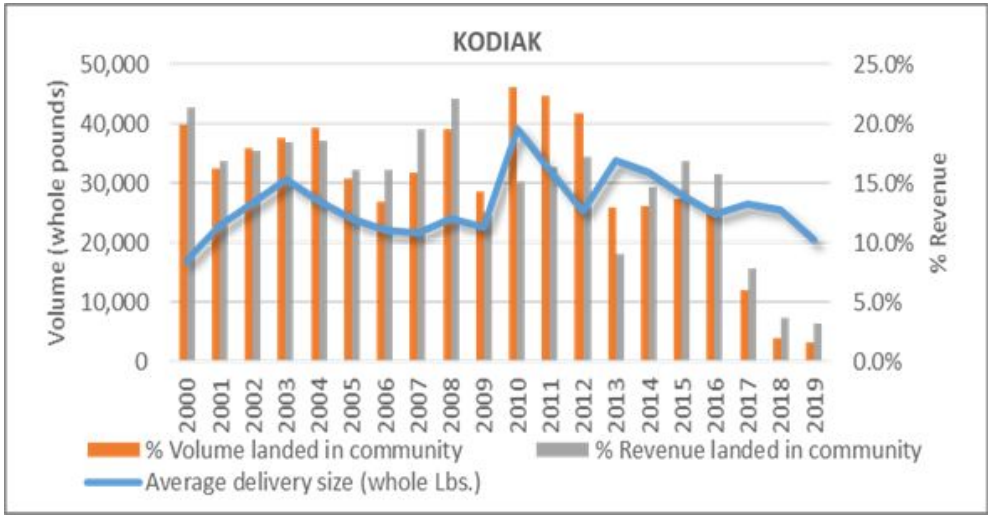
- Economic Performance
  - Paired down version of EPR in assessment report
  - Highlight fishery status
    - Recent < value, > price
    - Projection both down
- Tables (national to global)
  - Five year breakdown of various economic metrics

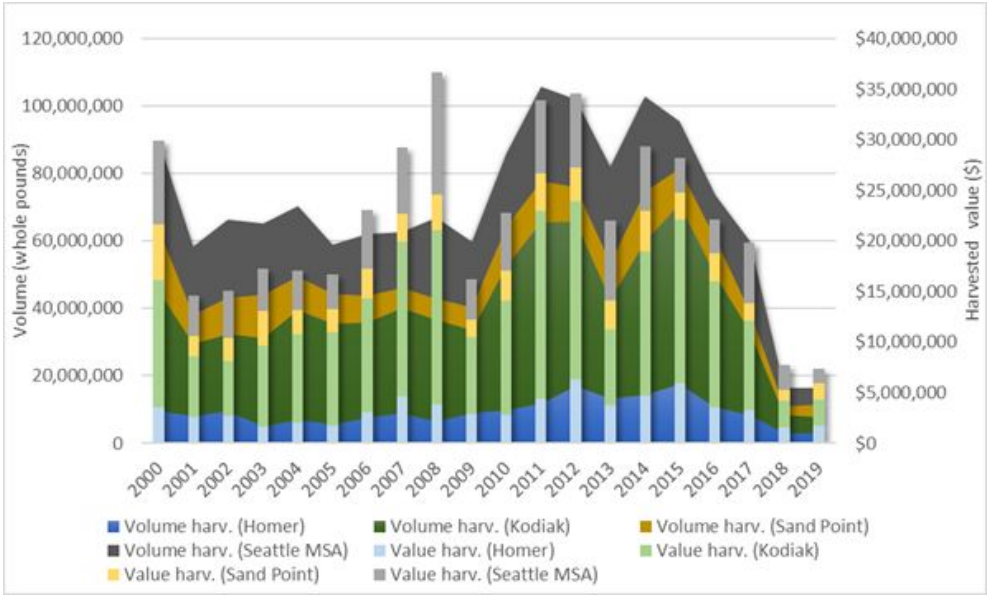
	Avg 10-14	2015	2016	2017	2018	2019
Total catch K mt	79.06	79.5	64.1	48.7	15.2	15.7
Retained catch K mt	75.7	77.5	63.1	48.0	14.4	14.5
Ex-vessel value M $	$50.8	$50.3	$41.0	$35.3	$14.5	$15.7
Ex-vessel price lb $	$0.304	$0.293	$0.294	$0.334	$0.452	$0.492
Hook & line share of catch	25%	21%	17%	18%	23%	23%
Pot gear share of catch	49%	52%	60%	55%	53%	52%
Central Gulf share of catch	61%	60%	53%	43%	47%	47%
Shoreside share of catch	90%	92%	92%	87%	88%	89%
Vessels #	421.4	386	360	246	154	176

		Avg 10-14	2015	2016	2017	2018	2019
Global cod catch K mt		1,631	1,762	1,789	1,761	1,633	-
U.S. P. cod share of global catch		18.5%	18.0%	18.0%	16.9%	14.2%	-
Europe share of global catch		74.7%	74.8%	74.9%	75.9%	78.3%	-
Pacific cod share of U.S. catch		97.8%	99.3%	99.5%	99.5%	99.7%	-
U.S. cod consumption K mt (est.)		97	108	114	118	114	106
Share of U.S. cod not exported		29%	26%	29%	32%	36%	37%
Export volume K mt		103.8	113.2	105.3	92.8	73.1	65.1
Export value M US$		$325.2	$335.0	$312.0	$295.5	$253.4	$218.1
Export price lb US$		$1.421	$1.342	$1.344	$1.445	$1.571	$1.519
Frozen (H&G)	volume Share	81%	91%	94%	94%	91%	92%
	value share	81%	90%	92%	92%	90%	91%
Fillets	volume Share	7%	3%	3%	4%	5%	5%
	value share	9%	4%	4%	5%	6%	6%
China	volume Share	44%	53%	55%	52%	48%	41%
	value share	41%	51%	52%	50%	46%	40%
Japan	volume Share	17%	13%	14%	16%	15%	12%
	value share	17%	14%	15%	18%	17%	13%
Europe*	volume Share	27%	19%	17%	17%	16%	22%
	value share	29%	19%	18%	18%	18%	23%

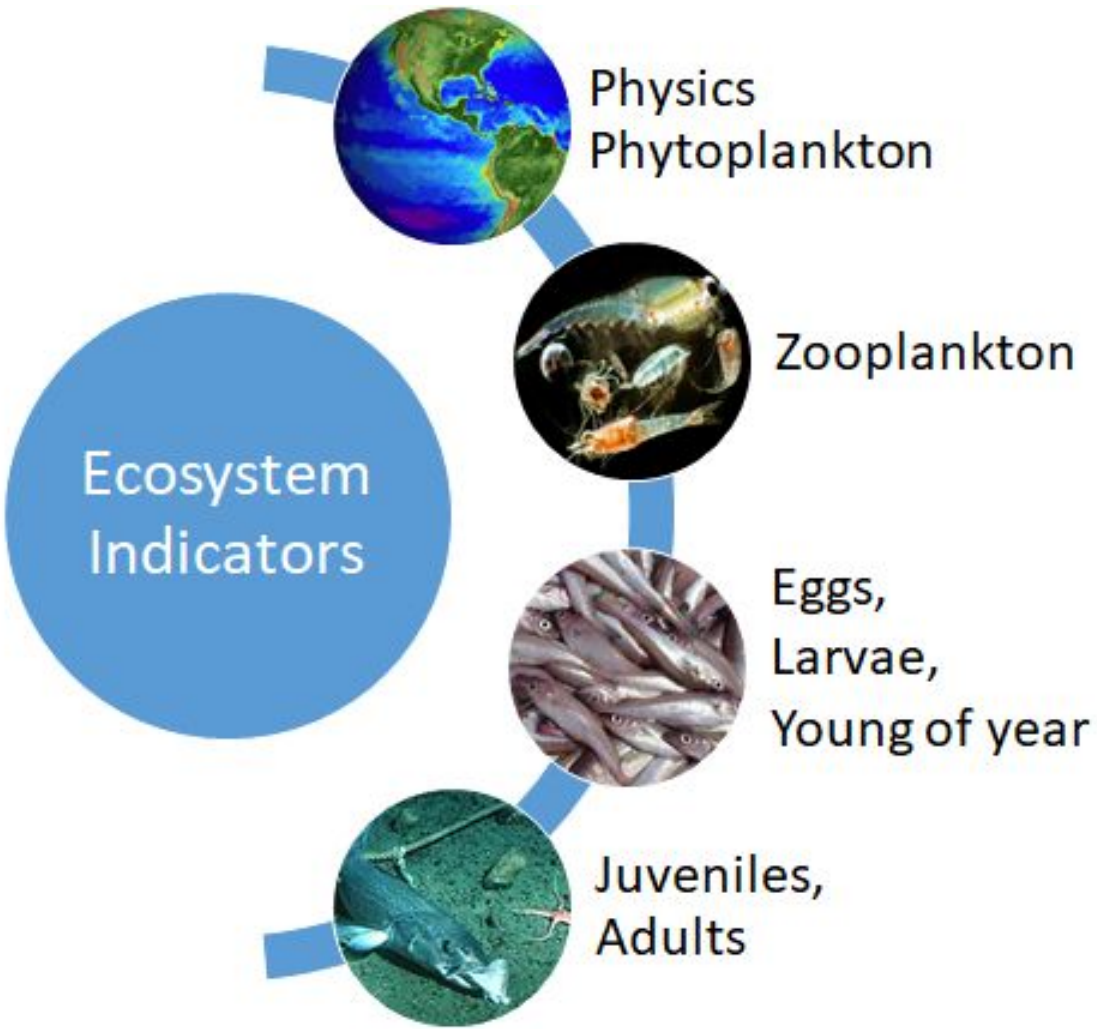
Socioeconomic Processes

- Communities
  - Top communities: Kodiak 47%, Sand Point, King Cove, Akutan combined 53% of value attributed to GOA Pacific cod
- Engagement metrics
  - Regional quotient for processing and harvesting





Current Ecosystem Indicators



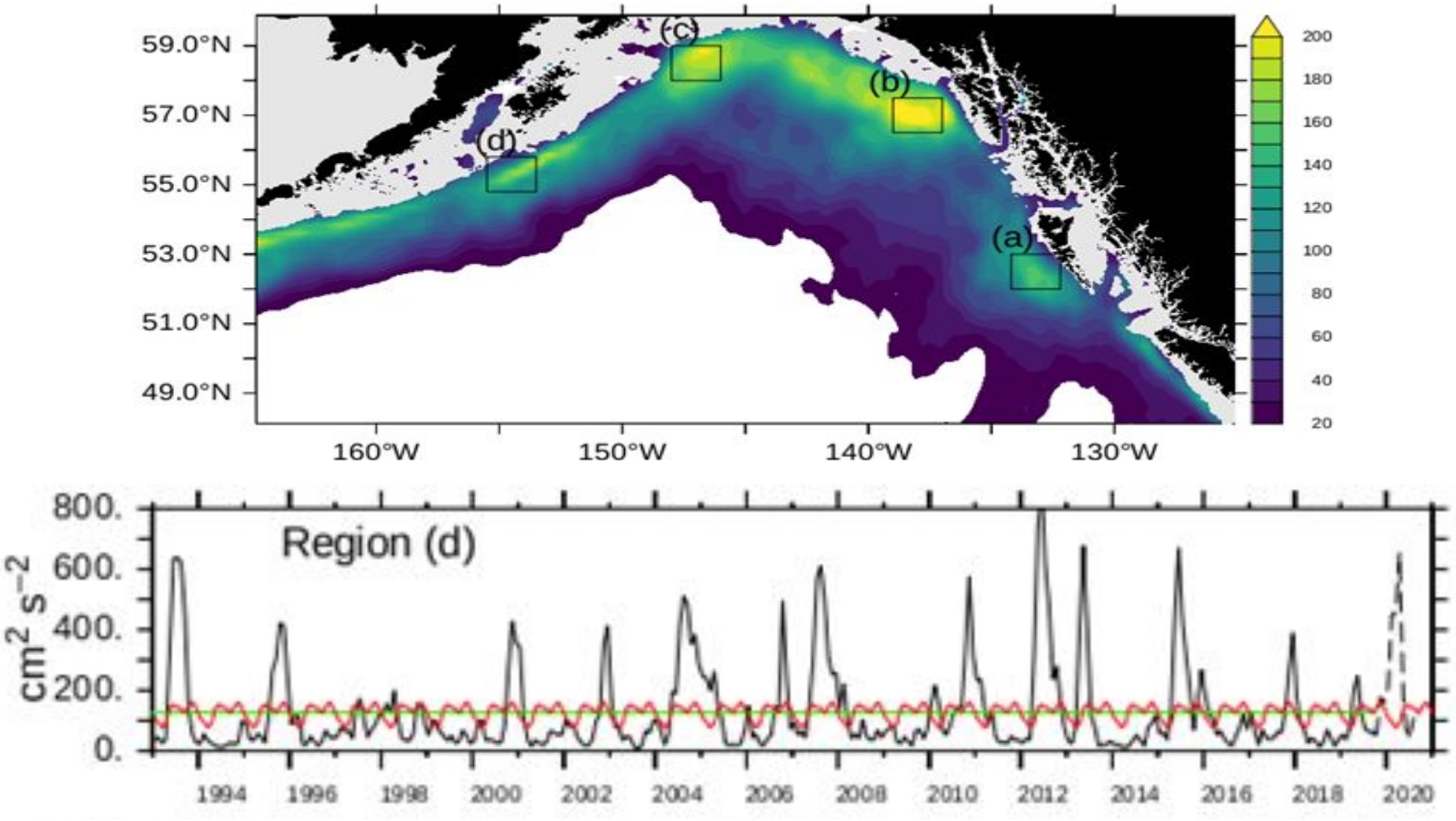
1. Marine heatwave index spawning
2. Spawning habitat suitability
3. Bottom temperature shelf CFSR
4. Eddy kinetic energy
5. Spring bloom peak timing (satellite)
6. Summer copepods (EcoFOCI)
7. Euphausiids (acoustic backscatter)
8. Spring Pacific cod larvae (EcoFOCI)
9. Nearshore pollock CPUE (Kodiak)
10. Common murre reproductive success
11. Condition juvenile, adult survey
12. COG northeast, area occupied (VAST)
13. Arrowtooth total biomass
14. Adult Steller sea lions counts

Current Socioeconomic Indicators

1. Ex-vessel value
2. Ex-vessel price per pound
3. Revenue per unit effort
4. Processing RQ Kodiak
5. Harvesting RQ Kodiak
6. Processing RQ small comm.
7. Harvesting RQ small comm.

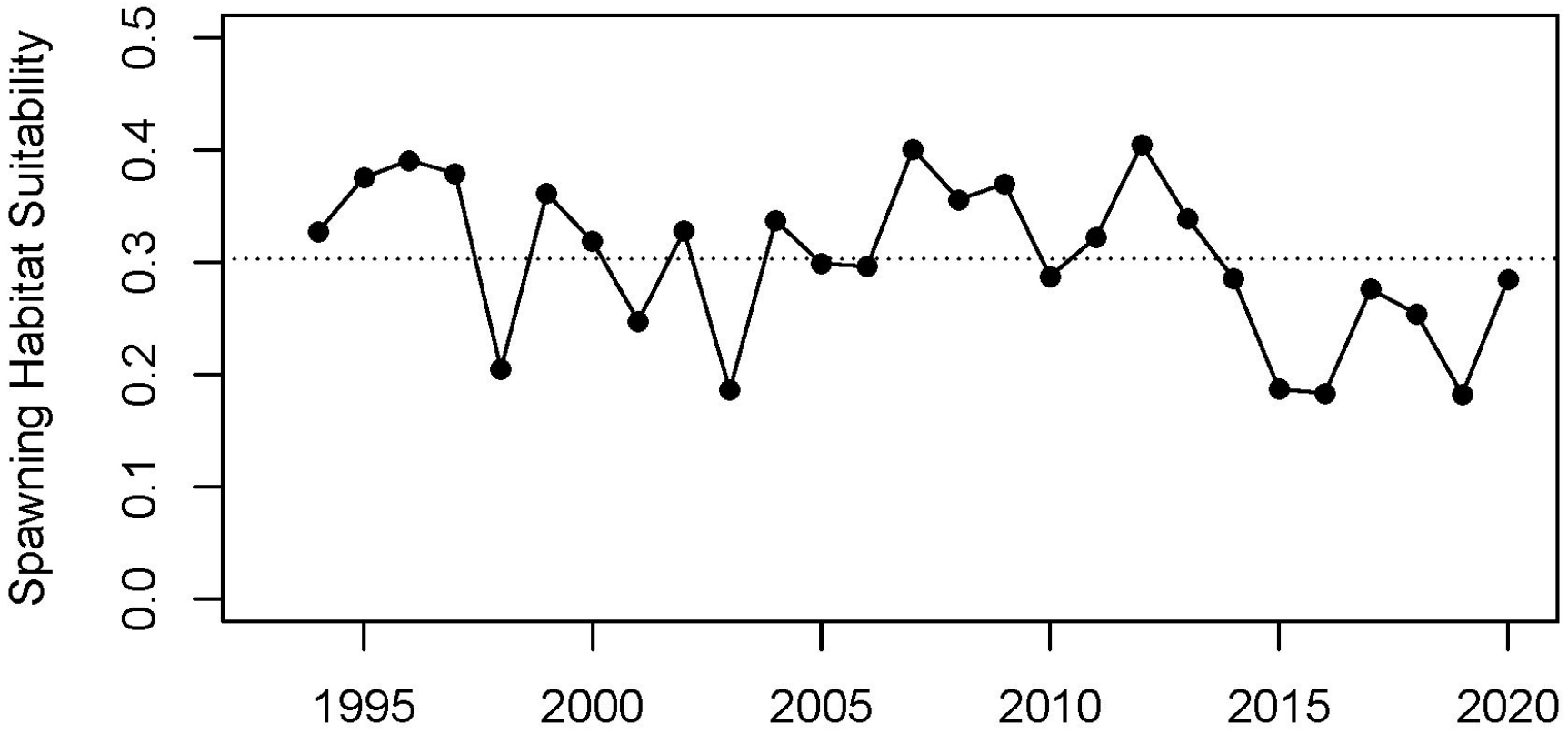
Physics - Eddies

Courtesy Ladd



Spawning Habitat

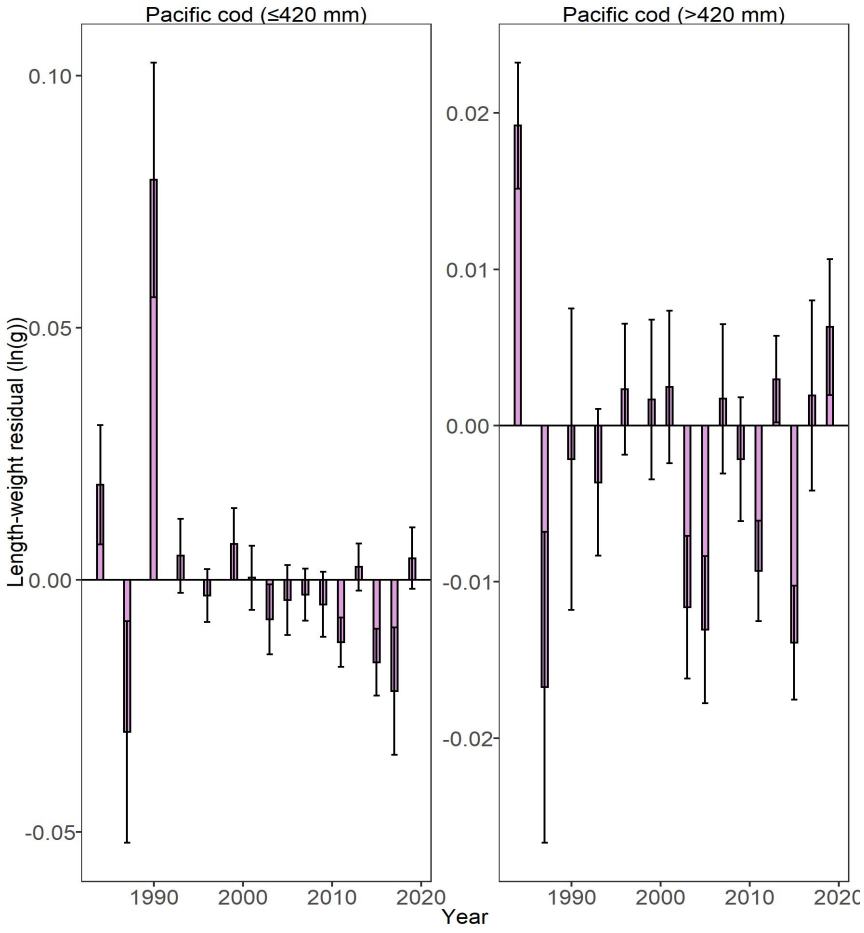
Courtesy Laurel, Rogers



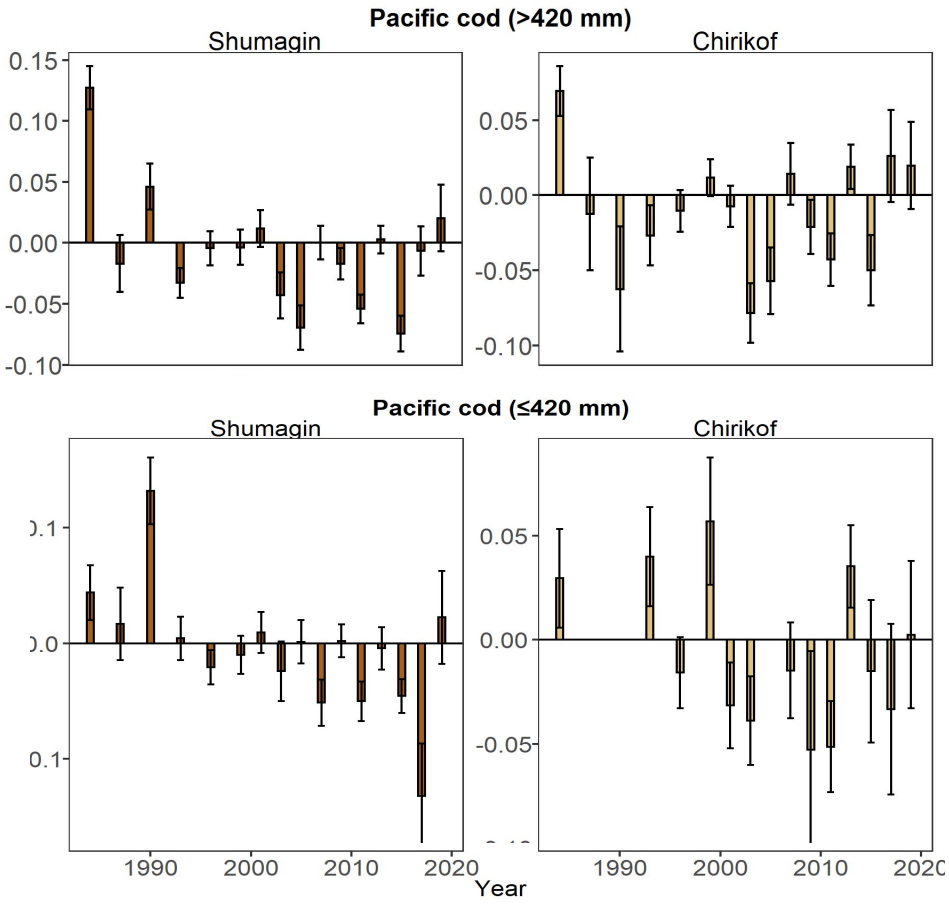
BTS Condition

Courtesy Rohan, Laman

Gulf-wide

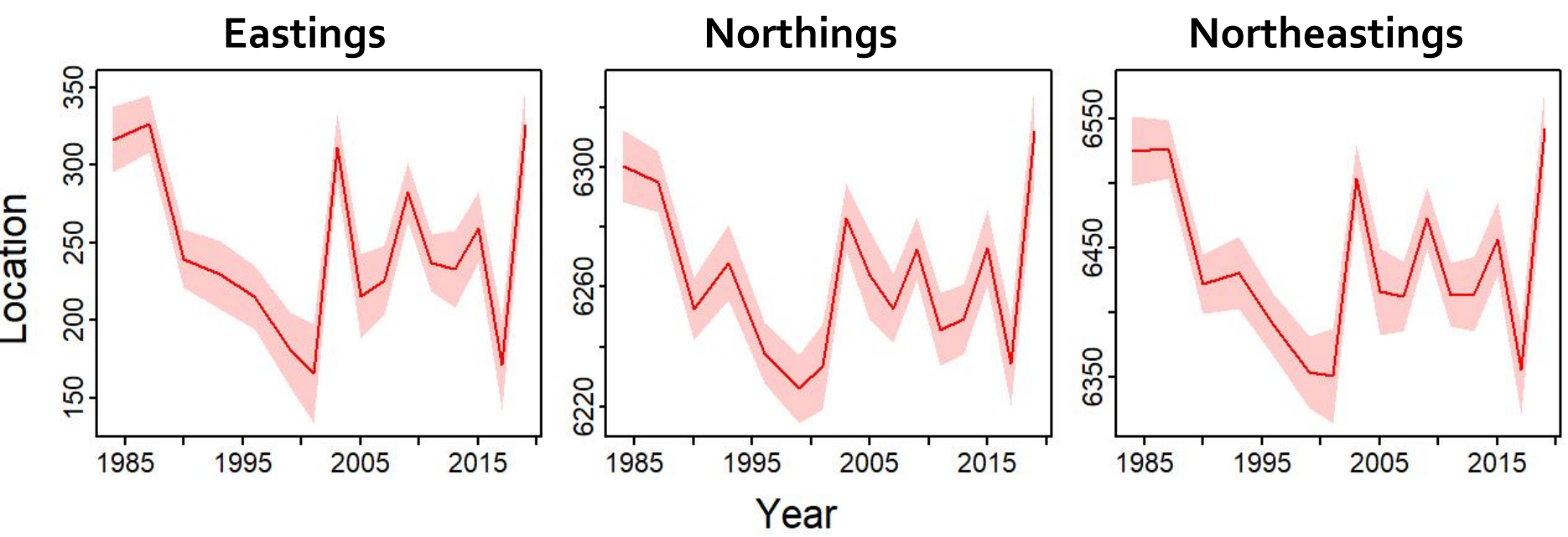


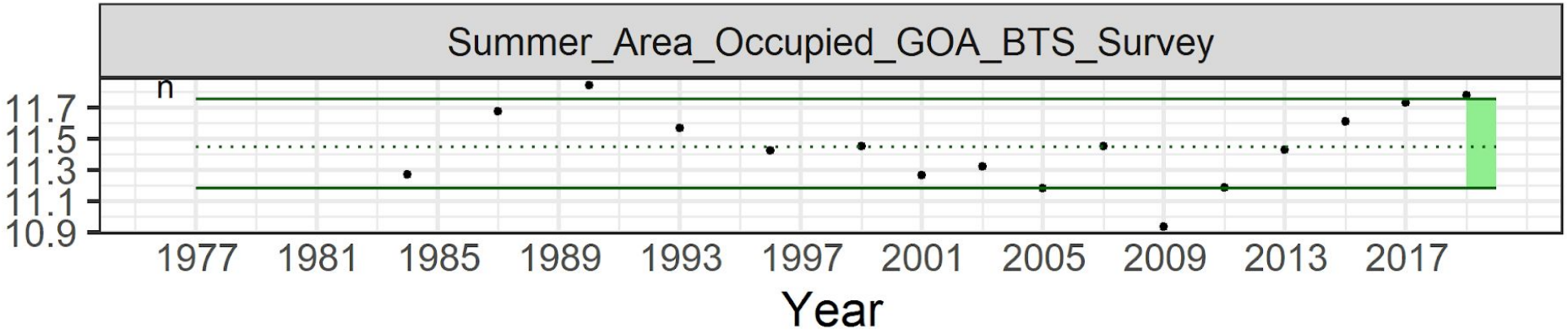
Area-wide



VAST-ness

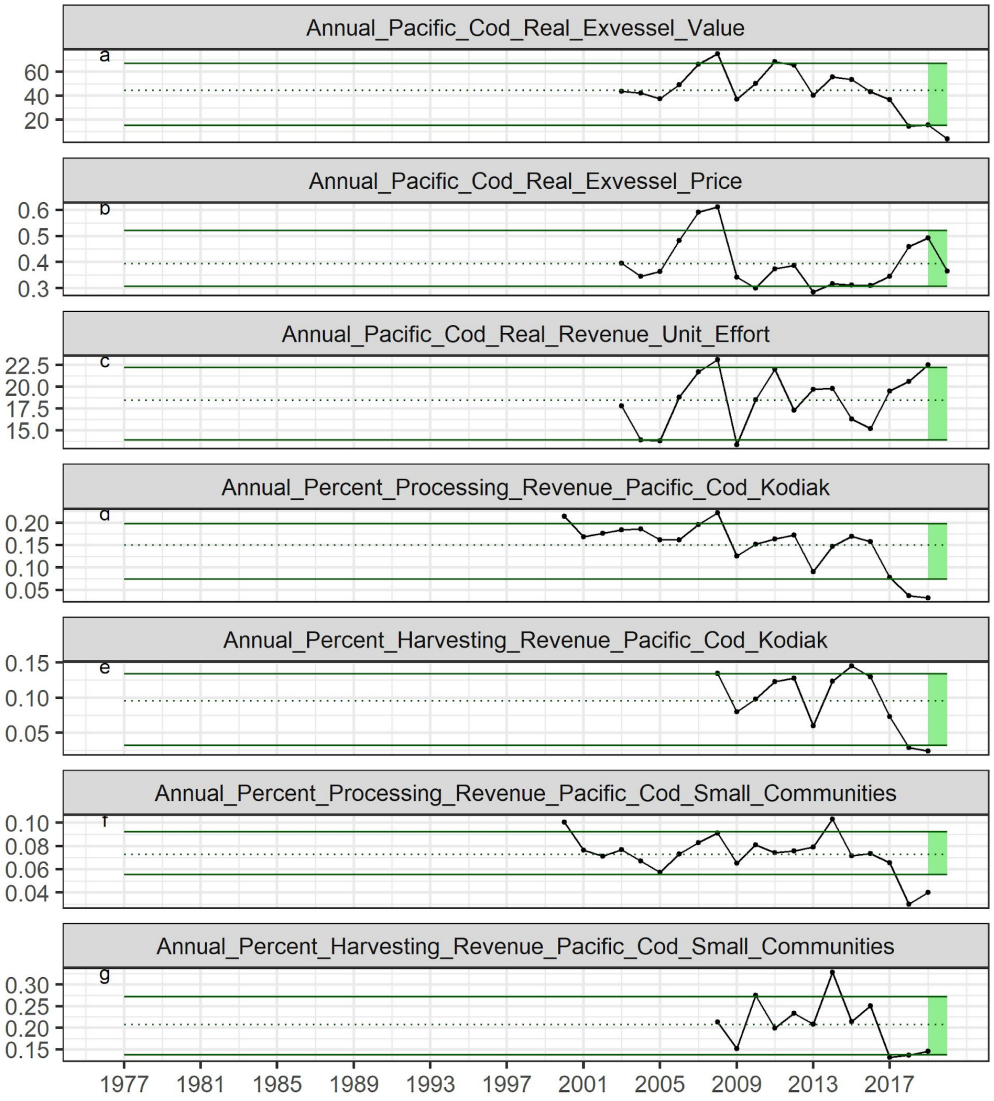
Courtesy O'Leary





Socioeconomics

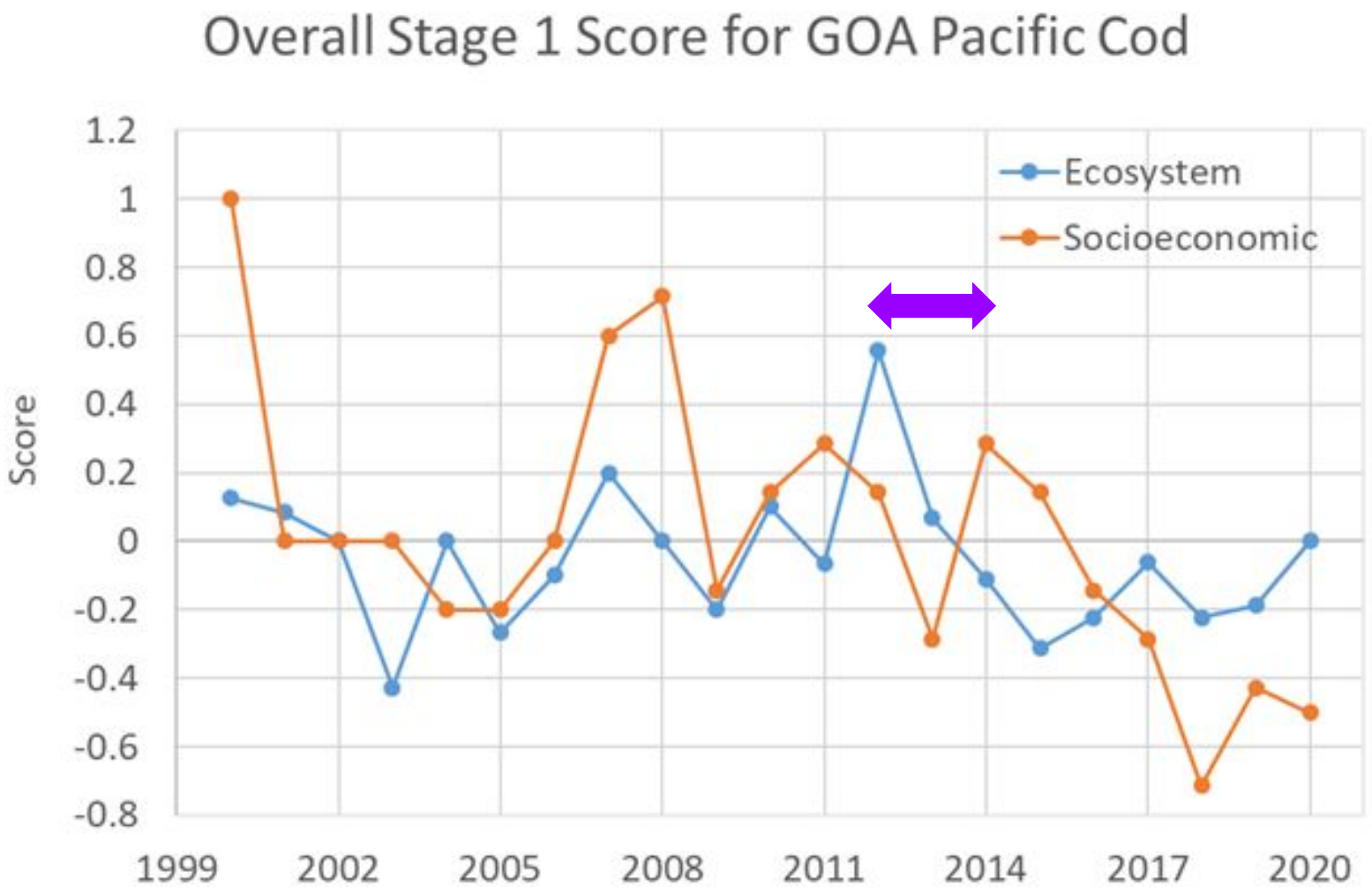
Courtesy Fissel, Wise



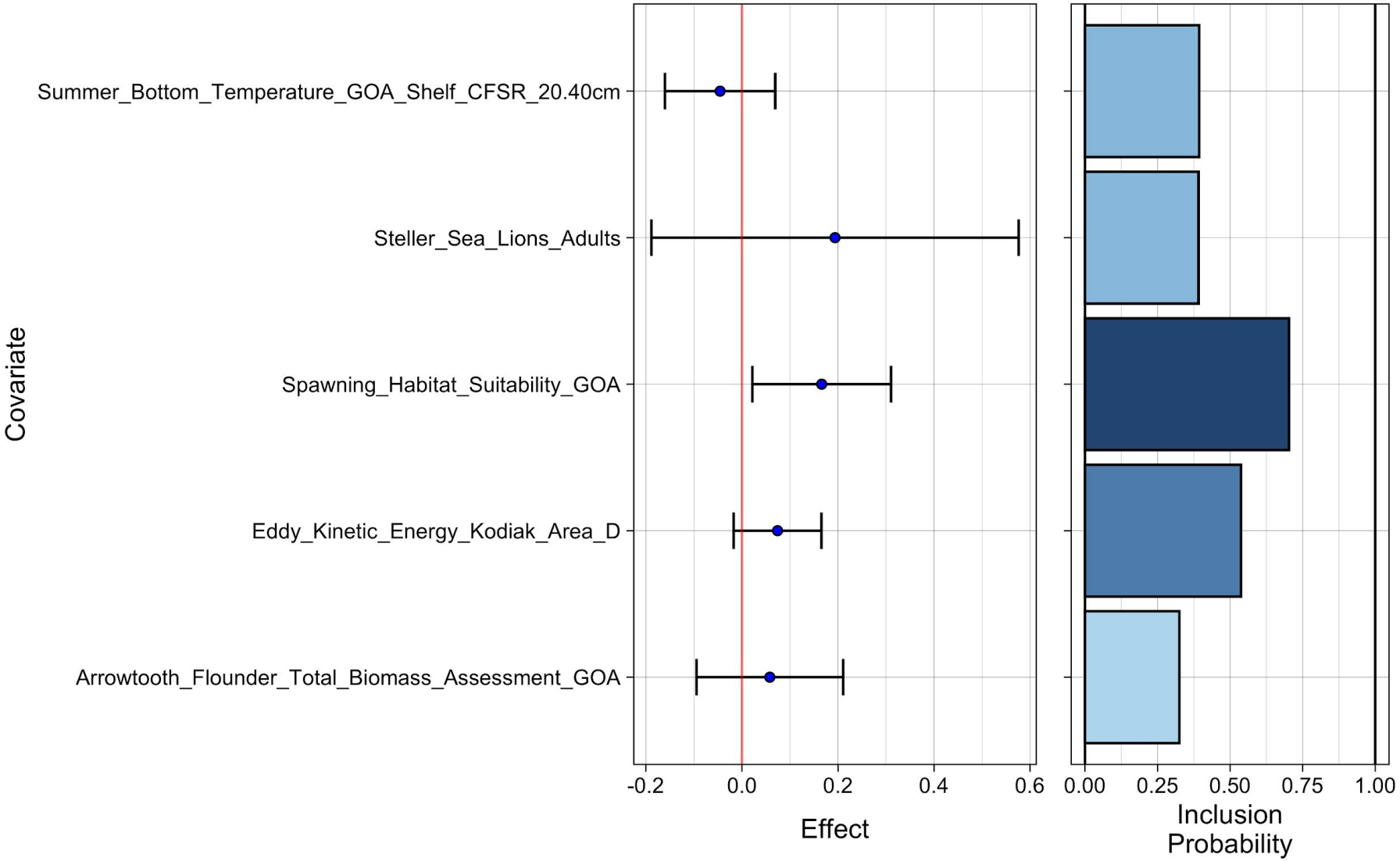
Indicator Analysis

- 1st Stage Simple Score
  - Requested by SSC for ESPs in February 2020
  - Based on value compared to 1 sd from mean of series
  - Use +1, -1, 0 to count G/P/S then / by total indicators
  - Evaluate by category and overall total
- Historical Score
  - Provide a table of scores for last 20 years by category
  - Provide graphic of ecosystem and socioeconomic total

Indicator Analysis - Stage 1 Score



Indicator Analysis - Stage 2 BAS



ESP Considerations

- Ecosystem Summary
  - Hatch success temp dependent, decrease spawning habitat
  - Population center moved northwest with sea ice retreat
  - Condition varies by area, ⬇️⬇️ for juv & adult in Shumagins
  - Physical and lower ⬆️, upper stable, SE lag by ~2 years
- Socioeconomic Summary
  - Ex-vessel value ⬇️, price/pound & revenue/effort ⬆️ 2016-19
  - Small community process & harvest RQ ⬇️ before Kodiak

Next Steps

- Workshops
  - Advice Workshop, spring 2021
  - Create technical memorandums, guidelines for indicator analysis, rapid template
- Data and Coordination
  - Continue developing dashboard on AKFIN
  - Standard suite of indicators (e.g., follow ECSA?)
  - Automate full, partial reporting templates
- ESP Manuscripts, overview and workshop


Questions?