Ecosystem Socioeconomic Profile (ESP)

EBS Pacific Cod

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NOAA FISHERIES

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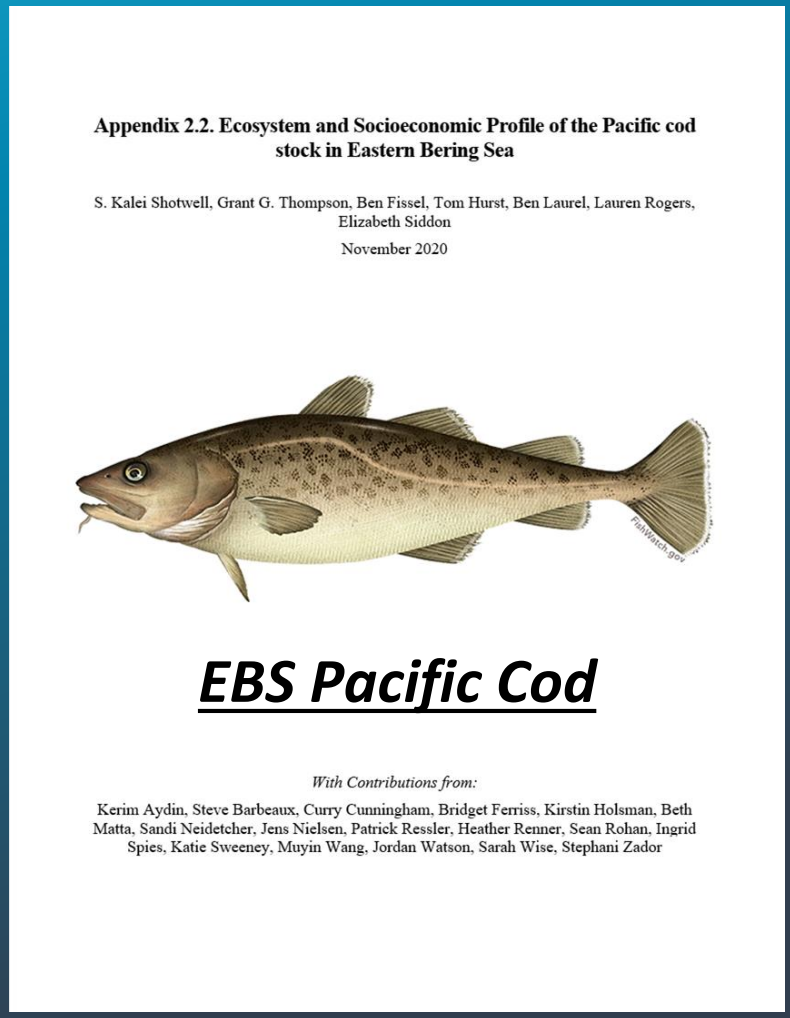
Overview

2021 EBS Pacific Cod ESP

- Recommended Dec 2019
- Team formed in Jan 2020
- Draft Full ESP in Nov 2020
- Final Full ESP Sep 2021
  - Allow for more team review
  - Updated comments, life history tables, literature cited
- 7 editors, 17 contributors



Appendix 2.2. Ecosystem and Socioeconomic Profile of the Pacific cod stock in Eastern Bering Sea

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November 2020

EBS Pacific Cod

With Contributions from:

Kerim Aydin, Steve Barbeaux, Curry Cunningham, Bridget Ferriss, Kirstin Holsman, Beth Matta, Sandi Neidetcher, Jens Nielsen, Patrick Ressler, Heather Renner, Sean Rohan, Ingrid Spies, Katie Sweeney, Muyin Wang, Jordan Watson, Sarah Wise, Stephani Zador

ESP Full Template

Stock/Complex:

Outline for Ecosystem and Socioeconomic Profile (ESP)

Executive Summary

- ❑ Short description of an ESP and summary of ecosystem and socioeconomic considerations from the recommendations section
- ❑ Response to Plan Team and SSC Recommendations
- ❑ Table of model performance where applicable

Introduction

Start with a short description of the ESP process with references

Justification & Data

- ❑ Stock-specific regional research priorities
- ❑ Scores in relevant national initiatives, stock assessment classification
- ❑ Brief description of data streams used, reference main SAFE
- ❑ Table of data sources, short description, references

Metrics Assessment

Identifies main processes, highlights mechanisms that lead to indicators

National Metrics

- ❑ Description and graph of relevant stock-specific measures collected in the national initiatives and associated stock vulnerabilities

Ecosystem Processes

- ❑ Summary of ecosystem processes that identify dominant pressures on the stock, evaluate by life history stage where possible with associated life history conceptual model and tables

Socioeconomic Processes

- ❑ Summary of socioeconomic processes that identify dominant pressures on the stock, evaluate by life history stage where possible with associated table of socioeconomic performance information

Indicators Assessment

Identifies the indicator suite and reviews the monitoring analyses

Indicator Suite

- ❑ Brief literature review on indicators previously explored for stock
- ❑ Description of indicator suite based on mechanisms identified in the metric assessment and literature review with time series graph

Indicator Monitoring Analysis

- ❑ Description of statistical tests for monitoring indicator suite (e.g., traffic light, importance methods, research ecosystem linked model)
- ❑ Supportive graphs and tables of statistical tests where relevant
- ❑ Table of model performance metrics (e.g. retrospective trends)

Recommendations

Summary of ecosystem and socioeconomic considerations for use in the main stock assessment

Ecosystem & Socioeconomic Considerations

- ❑ Summary conclusions from metric and indicator assessment

Data Gaps and Future Research Priorities

Description of metric or indicator data gaps, priorities for ecosystem and socioeconomic research that would support future versions of the ESP

Acknowledgements & Literature Cited

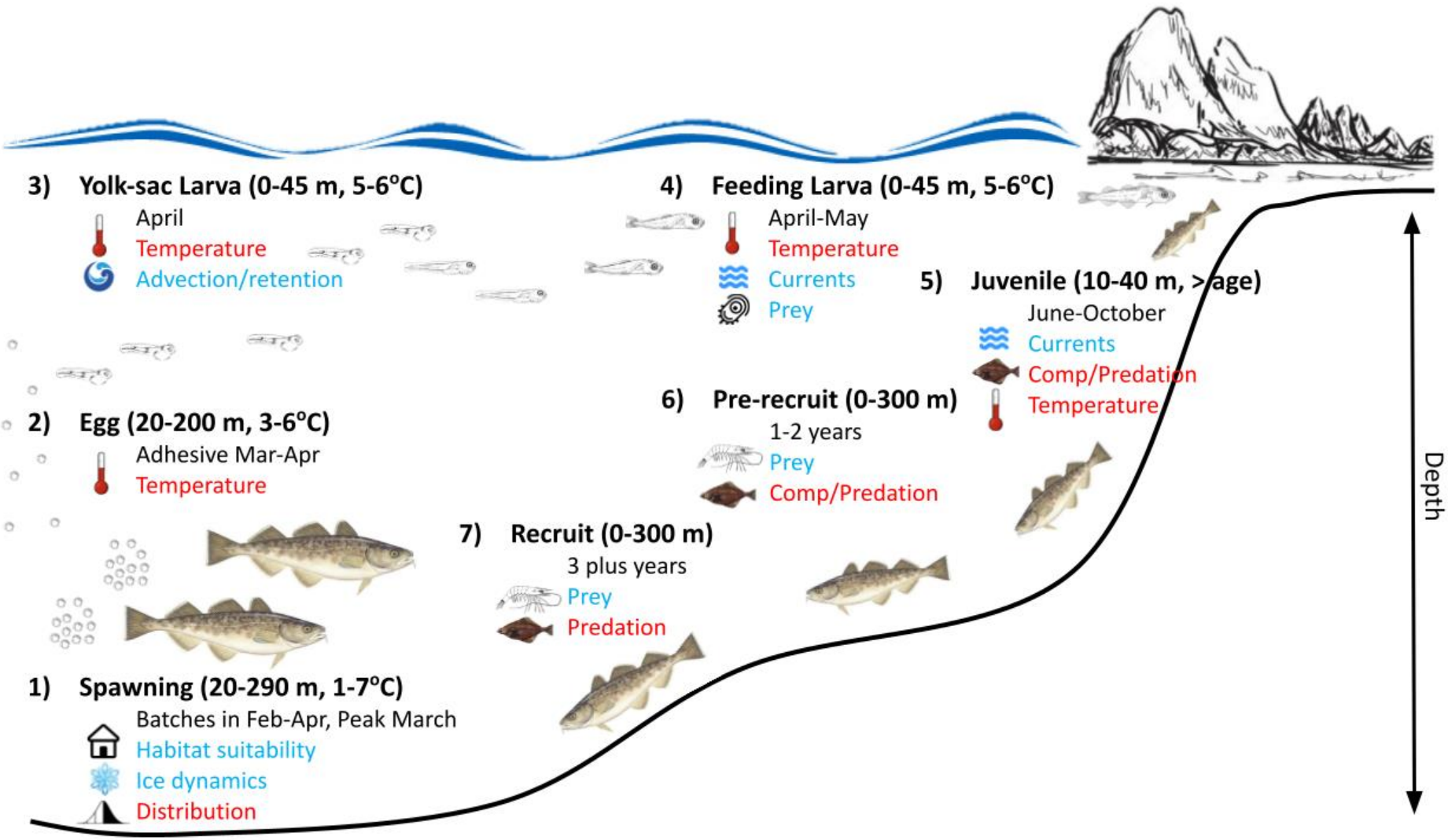
PT/SSC Comments

- Comments on ESPs in General
  - Develop method to aggregate indices into a score (SSC)
  - Do not rely on uninformed weighting, interpret indicators to be species-specific and not over-generalize, reevaluate 3-stage analysis in future (PT,SSC)
  - Support ESP dashboard, suggest staged approach to data not thoroughly vetted and published (PT, SSC)
  - Recommend continued inclusion of community engagement and dependency indicators, potential to use as early indicators of large ecosystem changes (SSC)

PT/SSC Comments

- Comments Specific to this ESP
  - Prioritize development of ESP for EBS Pacific cod (SSC)
  - Provide an index of movement to validate movement indices in the model (e.g., northern stations or VAST estimates such as area occupied) (PT,SSC)
  - Collate fishery information in the ESP (PT, see SAFE)
  - Consider aggregating small communities and display with limited number of larger communities to portray EBS Pacific cod community engagement trends (SSC)

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, 46-65cm (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 (28)	Optimal incubation 3-6°C, 13-23 ppt, 2-3ppm dO_2 (27)	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 mid May, 14 wks(22,29)	3-4.5 mm NL at hatch (13-15,24,28)	Hatch temperature 4.5-5.8°C(2)	Endogenous	Share larval period with pollock(13)
Feeding Larvae	Epipelagic, nearshore shelf(13-15,24), 0-45 m (24)	Late spring, April – June, (22	25-35 mm SL at transformation (3,13-15,24)	1-2 weeks before onset of feeding(28,29)	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 (1-6,10,11,21)	Nearshore settlement in June, deeper water migrations in October(3,10,13-15)	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 (1-5,7-9,11)
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(27)
Egg	1. Temperature(14,18,29,30)	Eggs are highly stenothermic(27)
Yolk-sac Larvae	1. Temperature(14,18,29,30) 2. Timing of spring bloom(13) 3. Onshore shelf transport(13,31,32)	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(14,18,29,30) 2. Prey availability 3. Onshore shelf transport(13,31,32)	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(33) 2. Predation(33) 3. Temperature(34)	Evidence of density-dependent growth in coastal nurseries(33) 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(34)
Pre-Recruit	1. Competition(33) 2. Predation(33) 3. Temperature(34)	Evidence of density-dependent growth in coastal nurseries(33) 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(34)

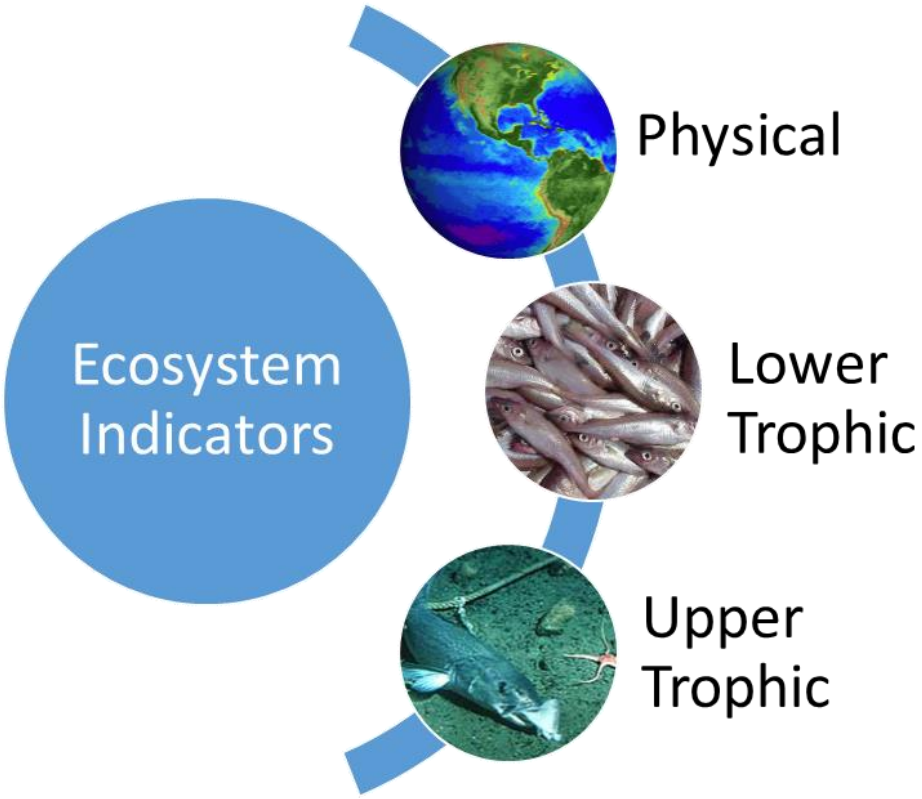
Socioeconomic Processes

- Economic & Community
  - Paired down version of EPR in assessment report
  - Stock-specific engagement from ACEPO report
- Future Streamlining
  - Focus on understanding stock health, fishery behavior
  - Not redundant with Econ SAFE or ACEPO

	Avg 10-14	2015	2016	2017	2018	2019
Total catch K mt	228.52	242.1	260.9	253	220.3	197.9
Retained catch K mt	224.1	239.0	257.7	250.1	218.0	195.8
Vessels #	168.4	150	162	173	193	196
CP H&L share of BSAI catch	51%	54%	49%	50%	46%	45%
CP trawl share of BSAI catch	16%	15%	14%	13%	14%	13%
Shoreside retained catch K mt	67.7	68.4	86.0	88.0	82.5	77.5
Shoreside catcher vessels #	116.4	101	110	128	144	149
CV pot gear share of BSAI catch	12%	13%	15%	17%	19%	22%
CV trawl share of BSAI catch	18%	16%	18%	18%	18%	17%
Shoreside ex-vessel value M $	$38.2	$34.1	$44.6	$54.1	$65.1	$62.3
Shoreside ex-vessel price lb $	$0.278	$0.248	$0.264	$0.316	$0.399	$0.418
Shoreside fixed gear ex-vessel price premium	$0.03	$0.06	$0.04	$0.05	$0.06	$0.11

		Avg 10-14	2015	2016	2017	2018	2019
All products	volume K mt	111.82	120.47	126.40	119.54	107.41	94.97
All products	Value M $	$ 330.7	$ 365.0	$ 388.3	$ 434.7	$ 458.8	$ 346.5
All products	price lb $	$ 1.34	$ 1.37	$ 1.39	$ 1.65	$ 1.94	$ 1.65
Fillets	volume K mt	7.23	6.28	10.03	10.01	10.36	8.02
Fillets	value share	14%	10%	19%	19%	21%	20%
Fillets	price lb $	$ 2.86	$ 2.67	$ 3.37	$ 3.70	$ 4.12	$ 3.92
Head & Gut	volume K mt	91.55	100.82	98.68	92.38	79.04	70.25
Head & Gut	value share	79%	83%	72%	74%	71%	72%
Head & Gut	price lb $	$ 1.30	$ 1.36	$ 1.29	$ 1.57	$ 1.86	$ 1.60
At-sea	value share	72%	76%	69%	70%	64%	67%
At-sea	price premium ($/lb)	-$0.07	$0.07	-$0.32	-$0.33	-$0.51	-$0.36

Ecosystem Indicators

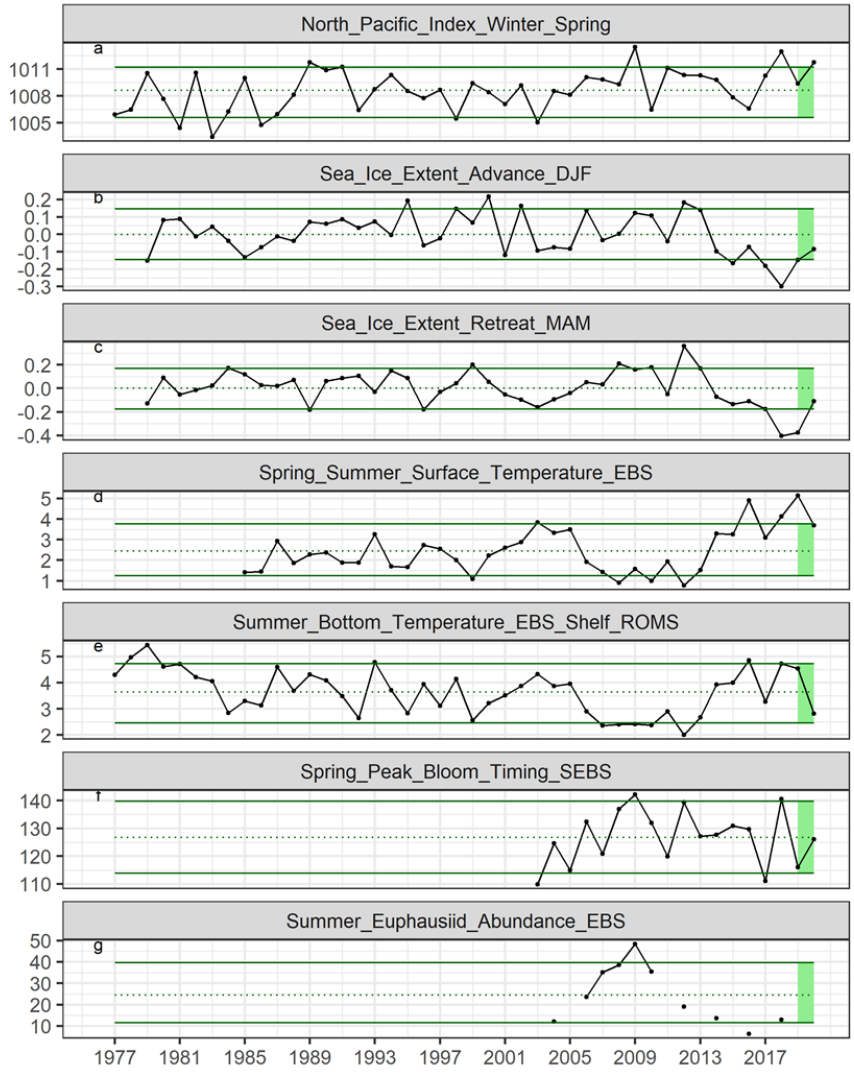


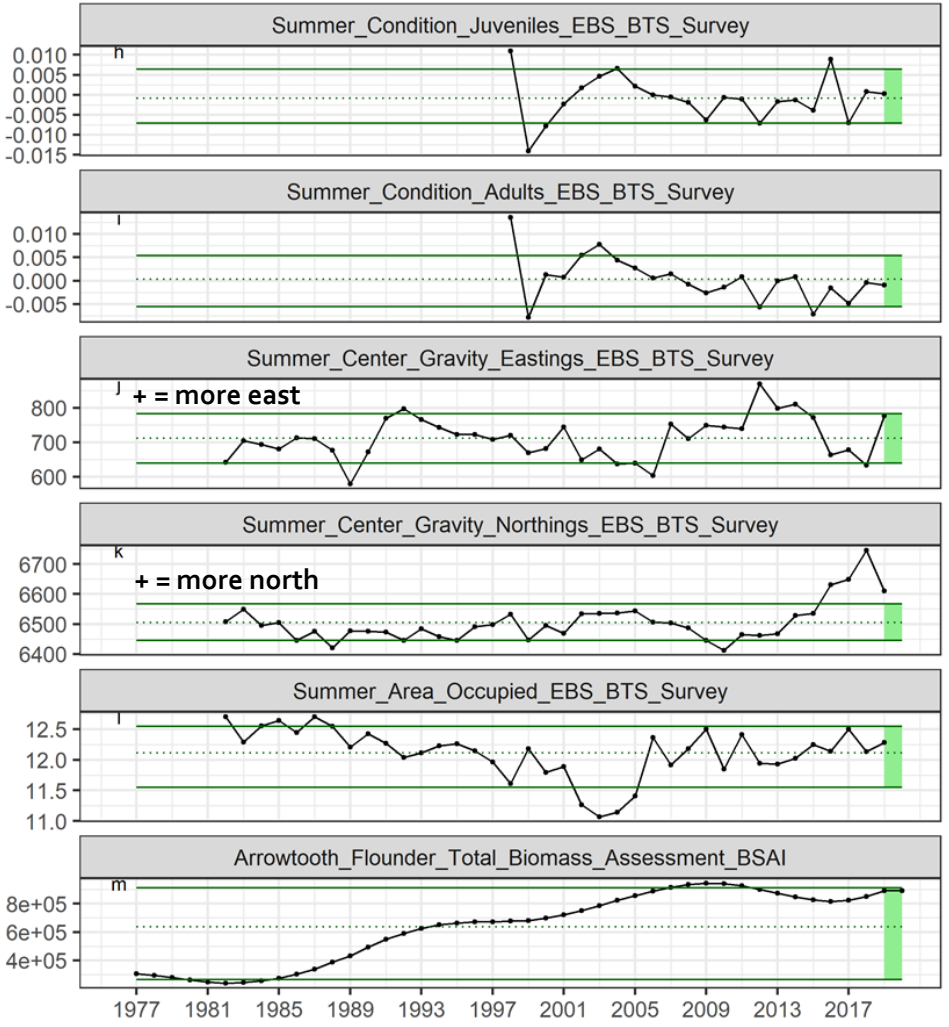
+ 1. North Pacific Index (NDJFM, ESR)
+ 2. Sea ice extent (DJF, NSIDC)
+ 3. Sea ice advance (MAM, NSIDC)
- 4. Sea surface temperature (satellite)
- 5. Summer bottom temperature (ROMS)
+ 6. Spring bloom peak timing (satellite)

+ 7. Euphausiids (acoustic backscatter)

+ 8. Juvenile condition (BTS)
+ 9. Adult condition (BTS)
+ 10. Center of gravity, eastings (VAST)
- 11. Center of gravity, northings (VAST)
+ 12. Area occupied (VAST)
- 13. Predator biomass, arrowtooth (SAFE)

Ecosystem Indicators



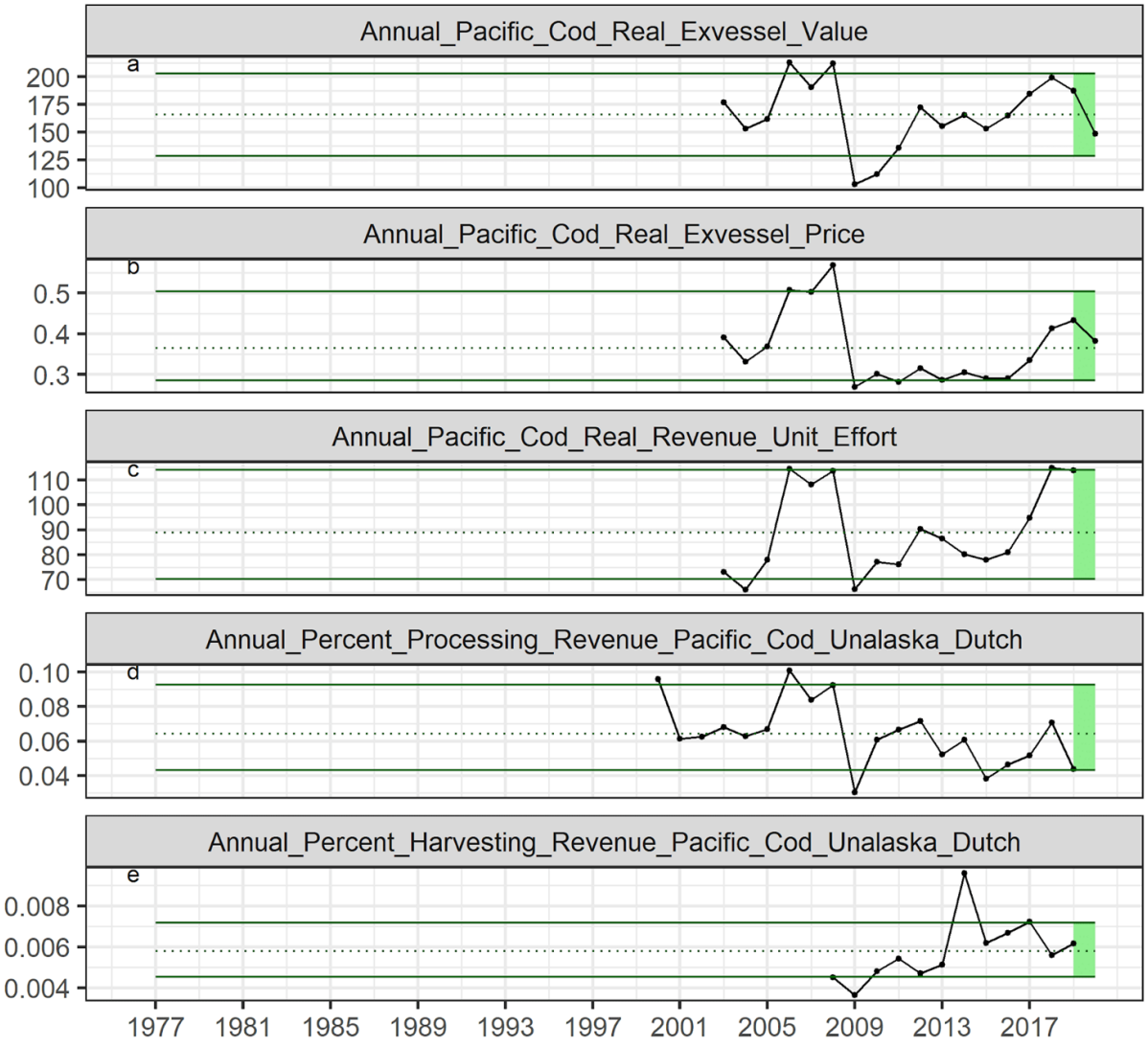


Socioeconomic Indicators

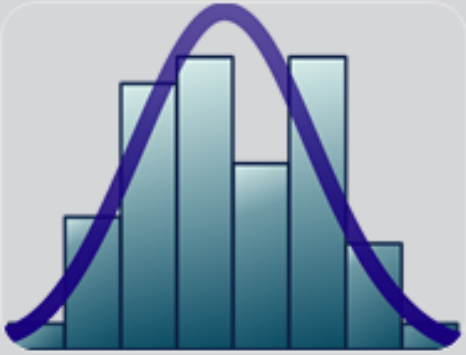
1. Ex-vessel value
2. Ex-vessel price per pound
3. Revenue per unit effort

4. Processing regional quotient for Unalaska/Dutch Harbor
5. Harvesting regional quotient for Unalaska/Dutch Harbor

Socioeconomic Indicators



Indicator Analysis Stages

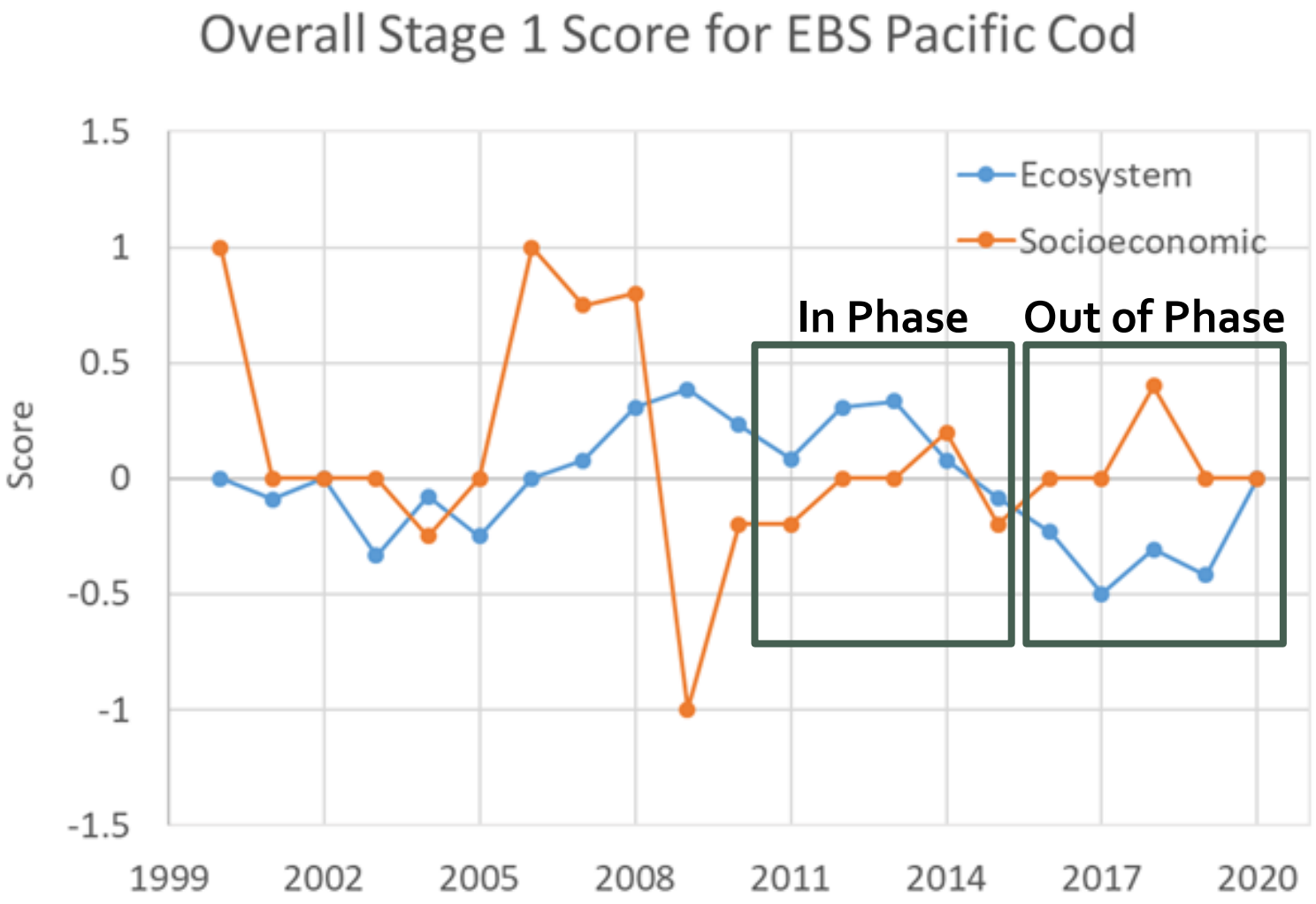
Beginning Stage	Intermediate Stage	Advanced Stage
		
Traffic Light • Historical simple score (SSC) • Current year trends relative to mean of series • Evaluate whole suite utility	**Importance** • Regression R^2 • Direction, magnitude, uncertainty, inclusion weight • Prediction performance	**Ecosystem Model Run** • Comparison w/ operational • Retrospective • Prediction performance • Terminal SSB

Note: new this year for report card

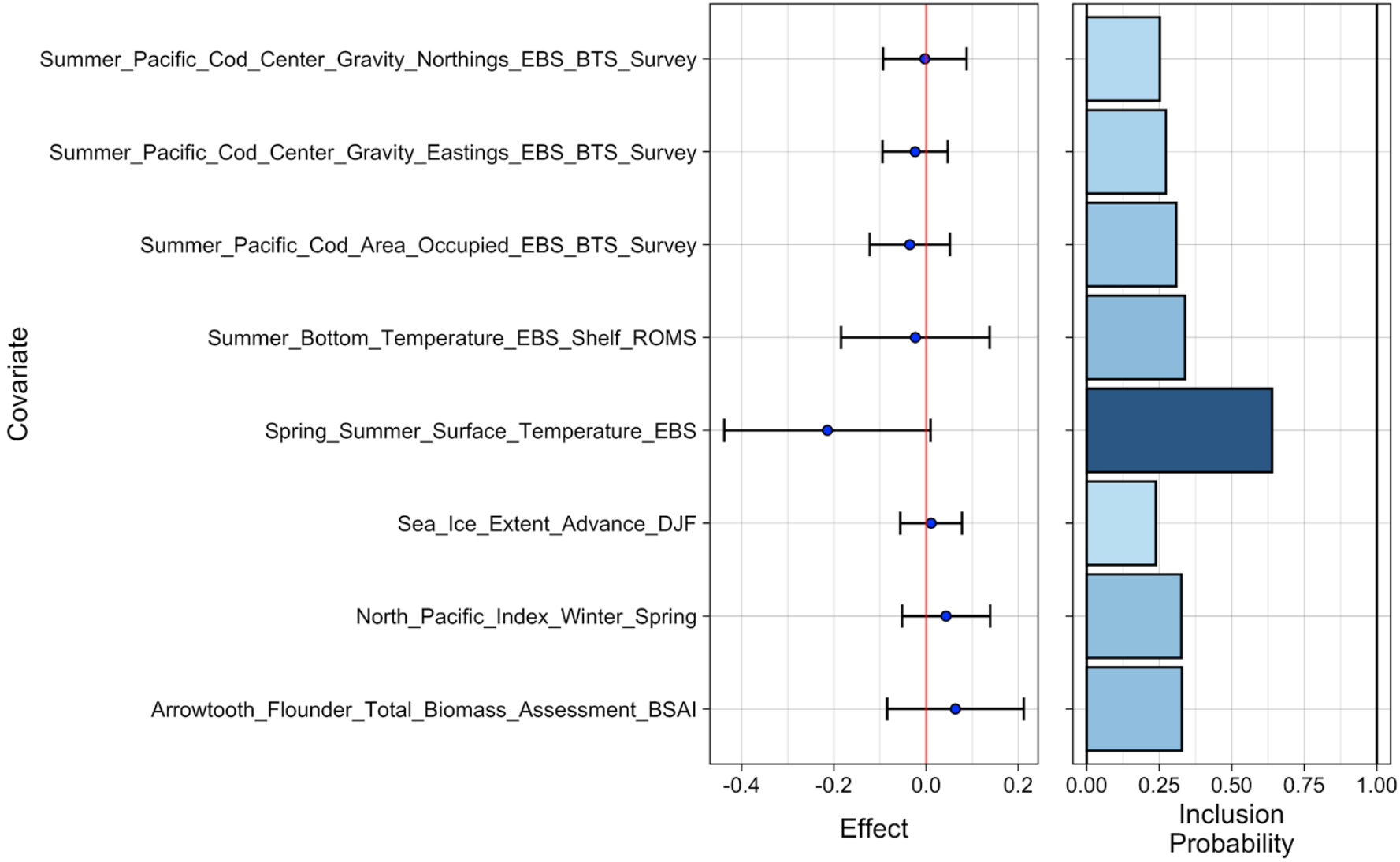
Traffic Light Table

Indicator	2016 Status	2017 Status	2018 Status	2019 Status	2020 Status
North Pacific Index Winter Spring	neutral	neutral	high	neutral	high
Sea Ice Extent Advance DJF	neutral	low	low	low	neutral
Sea Ice Extent Retreat MAM	neutral	low	low	low	neutral
Spring Summer Surface Temperature EBS	high	neutral	high	high	high
Summer Bottom Temperature EBS Shelf ROMS	high	neutral	high	high	neutral
Spring Peak Bloom Timing SEBS	neutral	low	high	low	neutral
Summer Euphausiid Abundance EBS	low	NA	neutral	NA	NA
Summer Condition Juveniles EBS BTS Survey	high	low	neutral	neutral	NA
Summer Condition Adults EBS BTS Survey	neutral	low	neutral	neutral	NA
Summer Center Gravity Eastings EBS BTS Survey	neutral	neutral	low	high	NA
Summer Center Gravity Northings EBS BTS Survey	high	high	high	high	NA
Summer Area Occupied EBS BTS Survey	neutral	neutral	neutral	neutral	NA
Arrowtooth Flounder Total Biomass Assessment BSAI	neutral	neutral	neutral	high	high
Annual Pacific Cod Real Exvessel Value	neutral	neutral	high	neutral	neutral
Annual Pacific Cod Real Exvessel Price	neutral	neutral	neutral	neutral	neutral
Annual Pacific Cod Real Revenue Unit Effort	neutral	neutral	high	high	NA
Annual Percent Processing Revenue Pacific Cod Unalaska Dutch	neutral	neutral	neutral	low	NA
Annual Percent Harvesting Revenue Pacific Cod Unalaska Dutch	neutral	neutral	neutral	neutral	NA

Traffic Light Score



Importance Statistics



Ecosystem Considerations

- Summary 2020
  - Ice extent < since 2014, concurrent with temperature >
  - Hatch success temp dependent, impacts spawning habitat
  - Population center moved northwest with sea ice retreat
  - Condition moderate to below avg in SEBS, ↑ in NBS
  - Overall ecosystem indicators poor since 2013
- 2021 Preliminary*
  - NPI +, sea ice advance <, retreat >, SST warm, < cold pool
  - Diet shifts (snow crab), new competitors (sablefish)

Special thanks to: Bridget Ferriss, Elizabeth Siddon, Nick Bond, Rick Thoman, Jordan Watson, Kelly Kearney, Erin Fedewa, Kerim Aydin, and Kevin Siwicke for presentations at CPT and GPT

Socioeconomic Considerations

- Socioeconomic Summary
  - Ex-vessel value, price/pound, revenue/effort trending upward from 2015-19
  - Projections for 2020 value and price were decreased
  - Unalaska/Dutch Harbor processing RQ ↓, harvesting ↑
- 2020 Preliminary*
  - Actual ex-vessel value and price seem similar to 2019
  - 2020 values still being finalized until Dec 1, 2021
  - Community information to be evaluated in RFI

**Special thanks to: Ben Fissel for his presentation at GPT and link to a new web page for data exploration*

Next Steps

- 2021 Report Card (November PT)
  - Includes current year ecosystem indicators
  - Socioeconomic indicators lagged, 2020 prelim
  - Update traffic light and hopefully importance
- 2022 Request for Indicators
  - Use ESP data gaps and research priorities
  - ESP team creates and submission in Jan
  - All indicators reviewed by teams in Feb
  - Unless partial initiated, report card in Nov

Questions?

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