Ecosystem & Socioeconomic Profile Update Report

Kalei Shotwell, Erin Fedewa, Brian Garber-Yonts



May 2024, Presentation to the Crab Plan Team

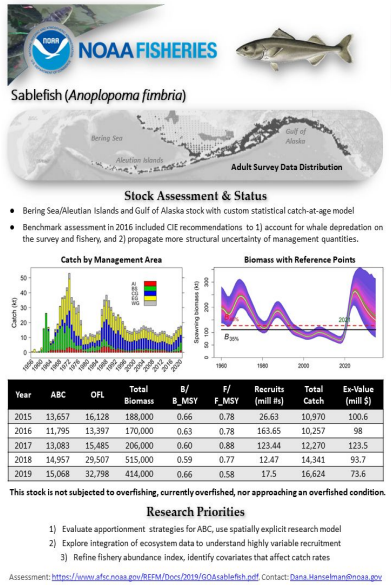
ESP Definition

Process

Important ecosystem and socioeconomic indicators are identified and analyzed at the stock level

Product

Supplemental report that synthesizes the results of the indicator analysis and communicates drivers of stock dynamics


NOAA FISHERIES

Sablefish (*Anoplopoma fimbria*)

Adult Survey Data Distribution

Stock Assessment & Status

- Bering Sea/Aleutian Islands and Gulf of Alaska stock with custom statistical catch-at-age model
- Benchmark assessment in 2016 included CIE recommendations to 1) account for whale depredation on the survey and fishery, and 2) propagate more structural uncertainty of management quantities.

Catch by Management Area

Biomass with Reference Points

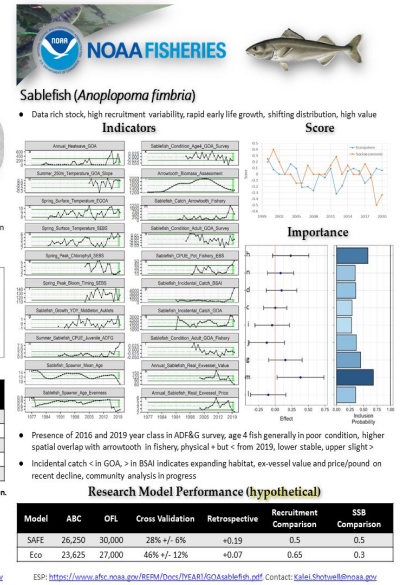
Year	ABC	OFL	Total Biomass	B/ B_MSY	F/ F_MSY	Recruits (mill #s)	Total Catch	Ex-Value (mill $)
2015	13,657	16,128	188,000	0.66	0.78	26.63	10,970	100.6
2016	11,795	13,397	170,000	0.63	0.78	163.65	10,257	98
2017	13,083	15,485	206,000	0.60	0.88	123.44	12,270	123.5
2018	14,957	29,507	515,000	0.59	0.77	12.47	14,341	93.7
2019	15,068	32,798	414,000	0.66	0.58	17.5	16,624	73.6

This stock is not subjected to overfishing, currently overfished, nor approaching an overfished condition.

Research Priorities

1) Evaluate apportionment strategies for ABC, use spatially explicit research model
2) Explore integration of ecosystem data to understand highly variable recruitment
3) Refine fishery abundance index, identify covariates that affect catch rates

Assessment: https://www.afsc.noaa.gov/REFM/Docs/2019/GOAsablefish.pdf Contact: Dana.Hanselman@noaa.gov


NOAA FISHERIES

Sablefish (*Anoplopoma fimbria*)

- Data rich stock, high recruitment variability, rapid early life growth, shifting distribution, high value

Indicators

Score

Importance

- Presence of 2016 and 2019 year class in ADF&G survey, age 4 fish generally in poor condition, higher spatial overlap with arrowtooth in fishery, physical + but < from 2019, lower stable, upper slight >
- Incidental catch < in GOA, > in BSAI indicates expanding habitat, ex-vessel value and price/pound on recent decline, community analysis in progress

Research Model Performance (hypothetical)

Model	ABC	OFL	Cross Validation	Retrospective	Recruitment Comparison	SSB Comparison
SAFE	26,250	30,000	28% +/- 6%	+0.19	0.5	0.5
Eco	23,625	27,000	46% +/- 12%	+0.07	0.65	0.3

ESP: https://www.afsc.noaa.gov/REFM/Docs/[YEAR]/GOAsablefish.pdf Contact: Kalei.Shotwell@noaa.gov

ESP Decisions

Qualitative

additional context

- Risk Tables
- Rebuilding Plans
- TAC Discussions
- Survey Planning
- Research Priorities
- Request for Proposals

Quantitative

assumptions

- Mechanistic linkages
- Consistency with stock life history
- Biological realism

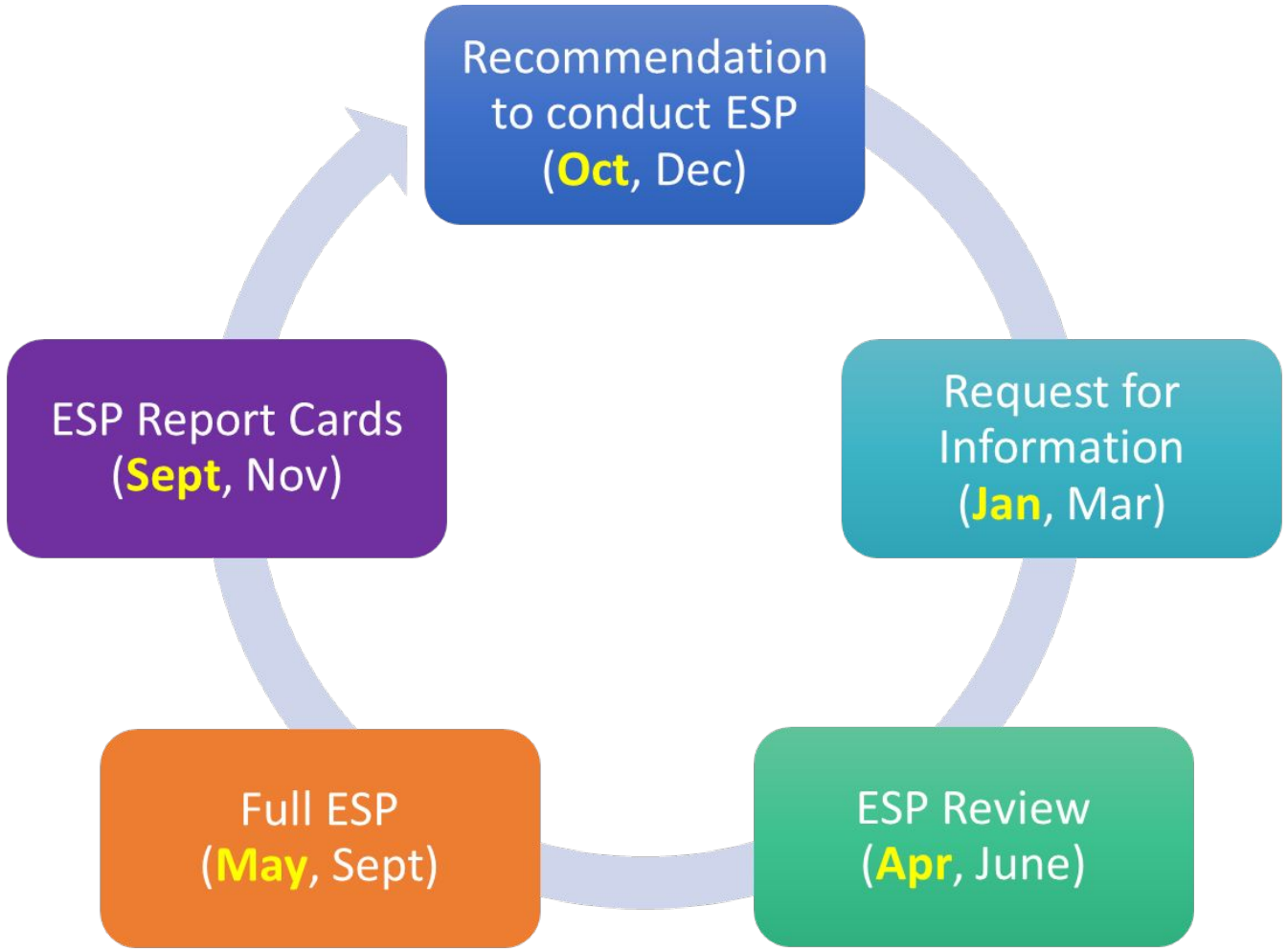
choices

- Inform data conditioning
- Time blocks
- Parameter values consistent with existing info

covariates

- Indicator time series directly included in model (e.g. Woods Hole Assessment Model)

General Timeline



Update

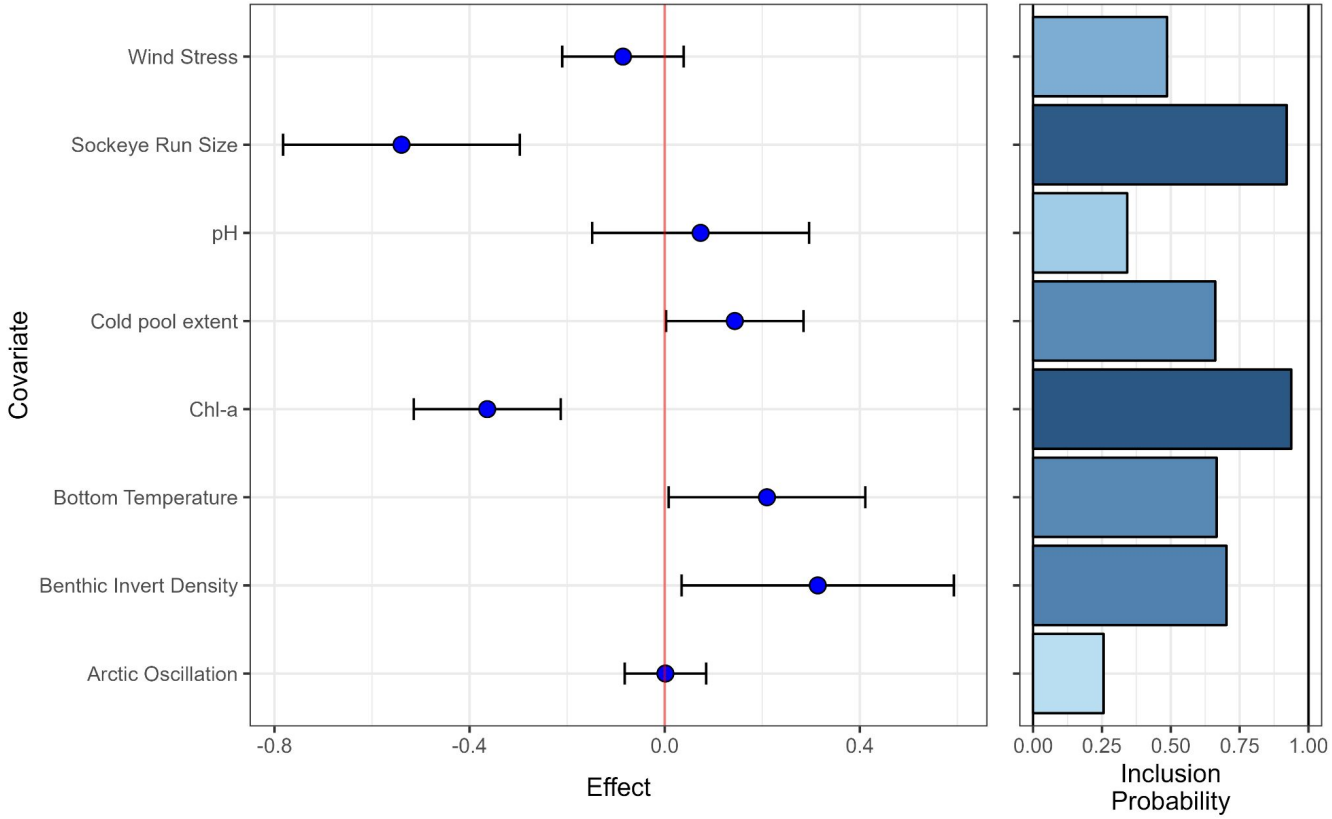
Timeline	Changes to delivery of ESP statistical products, report card alignment with risk tables
National	Coordination project, climate readiness, data management and reproducibility project
Capacity	Developing socioeconomic indicators, creating general ESP report cards for all stocks

Importance Methods Project - Transition Year 2024

- Evaluating statistical methods for sablefish (Oke et al., *in prep*)
  - Bayesian adaptive sampling (BAS)
  - Boosted regression trees (BRT)
  - General additive models (GAMs)
  - Dynamic factor analysis (DFA) + robust regression
  - Dynamic structural equation modeling (DSEM)*
- Apply some of these methods on stocks with full ESPs
- Results presented in May for crab assessment authors

Importance Example - Bristol Bay Red King Crab

May Importance Result



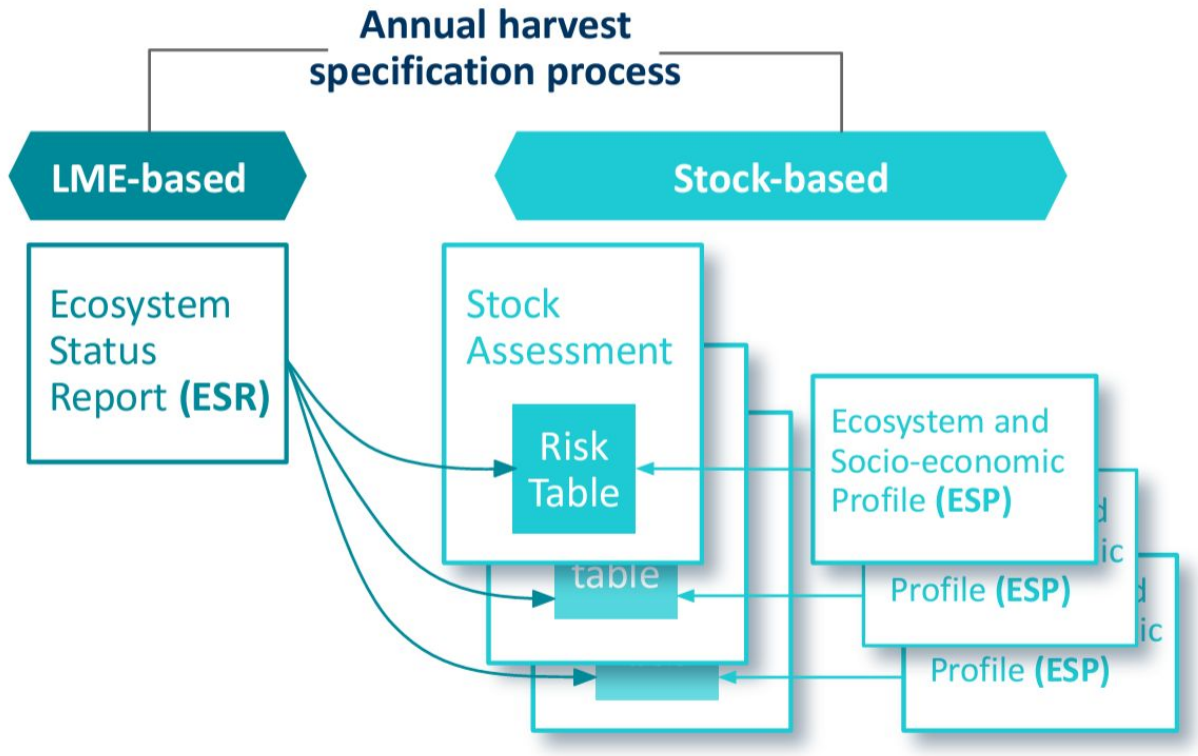
September Report Card

	Indicator	2019 Status	2020 Status	2021 Status	2022 Status	2023 Status	
	Winter Spring Arctic Oscillation Index Model	neutral	*high*	neutral	neutral	neutral	
	Summer Cold Pool SEBS BBRKC Survey	**low**	NA	**low**	neutral	neutral	
	Summer Temperature Bottom BBRKC Survey	*high*	NA	neutral	neutral	neutral	
	Spring pH BBRKC Model	**low**	**low**	**low**	**low**	**low**	
	Summer Wind Stress BBRKC Satellite	**high**	neutral	**high**	neutral	neutral	
*	Spring Chlorophylla Biomass SEBS Inner Shelf Satellite	neutral	neutral	neutral	**low**	**low**	**0.94**
*	Summer Sockeye Salmon Abundance EBS Survey	NA	NA	NA	**high**	NA	**0.92**
	Summer Pacific Cod Density BBRKC Survey	*low*	NA	neutral	neutral	NA	
*	Summer Benthic Invertebrate Density BBRKC Survey	neutral	NA	neutral	neutral	NA	**0.70**
	Summer Red King Crab Male Area Occupied BBRKC Model	**high**	NA	neutral	**high**	neutral	
	Summer Red King Crab Female Area Occupied BBRKC Model	**high**	NA	**high**	neutral	neutral	
	Annual Red King Crab Catch Distance Shore BBRKC Fishery	*high*	neutral	neutral	neutral	NA	

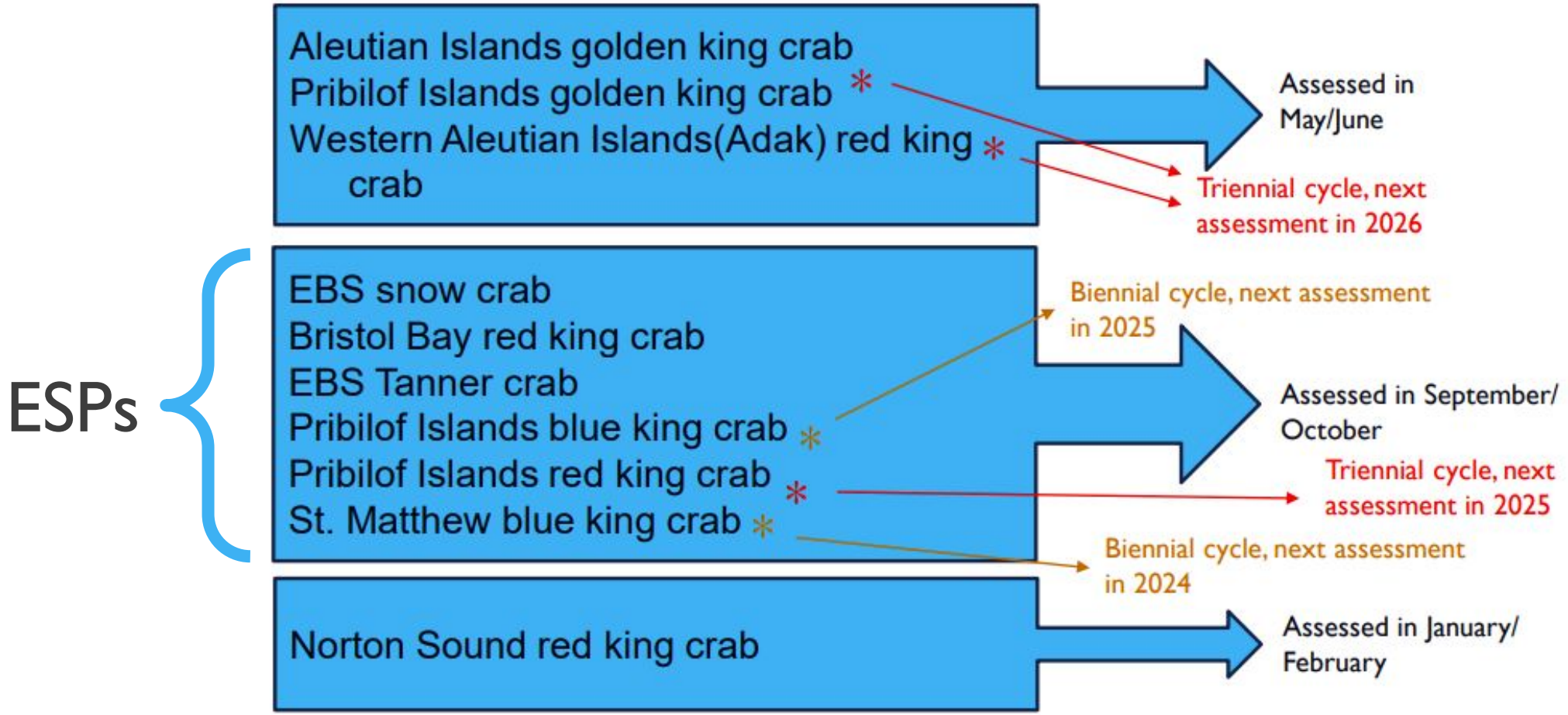
Note: only for ecosystem indicators

Risk Table Alignment

- Risk tables will soon be created for crab stocks
- ESR and ESP information feeds into these tables
  - Coordinated effort to write up the ecosystem category
  - May also inform pop dy and fisheries performance
- Proposed to meet following CPT for different schedules



Risk Table Timing



Update

Timeline	Changes to delivery of ESP statistical products, report card alignment with risk tables
National	Coordination project, climate readiness, data management and reproducibility project
Capacity	Developing socioeconomic indicators, creating general ESP report cards for all stocks

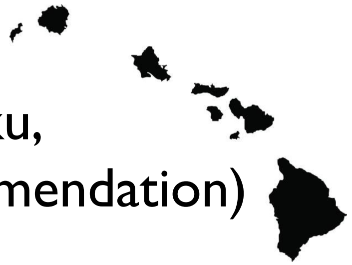
National ESP Initiative - Coordination Project

AFSC:
sablefish, pollock, Pacific cod,
king crab, snow crab
(17 total recommendations)

NWFSC:
petrale, sablefish
risk table

NEFSC:
bluefish, black sea bass, Atlantic
cod, tilefish, (flounder, mackerel,
herring scheduled)

PIFSC: uku,
(kona crab recommendation)

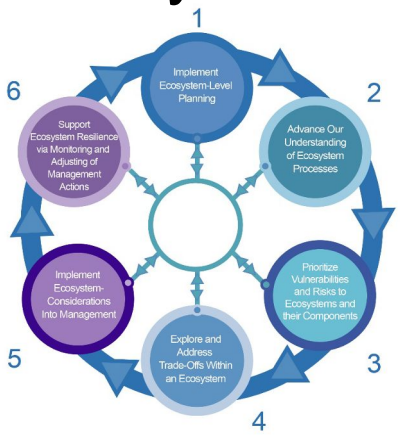


SWFSC:
ecosystem
initiative

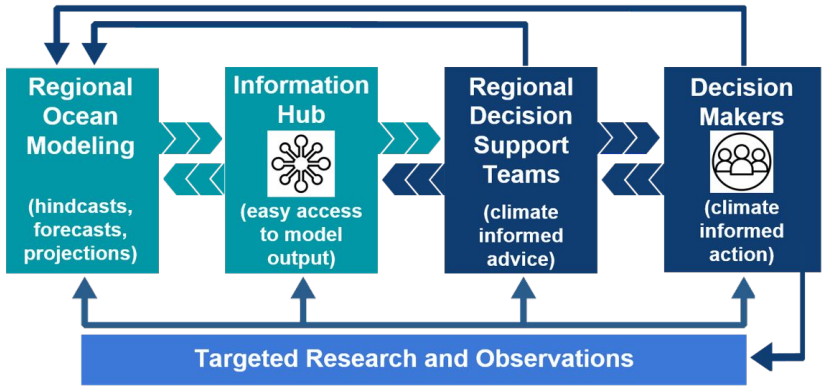
SEFSC:
~gray snapper

Using ESPs for Climate and EBFM

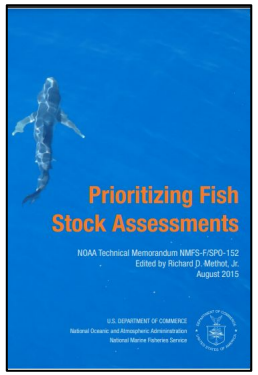
EBFM Policy and Roadmap

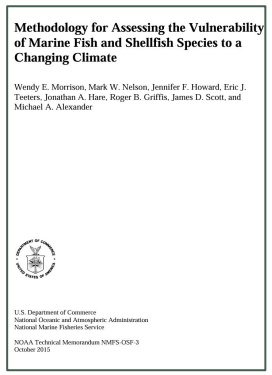


Climate, Ecosystem, Fisheries Initiative*

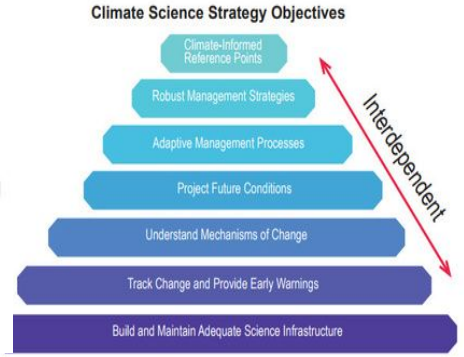


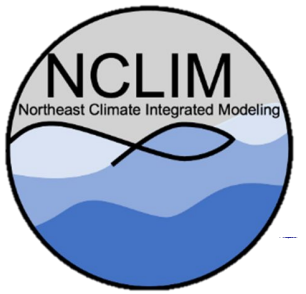
NOAA Fisheries Initiatives





Regional Action Plans & Modeling



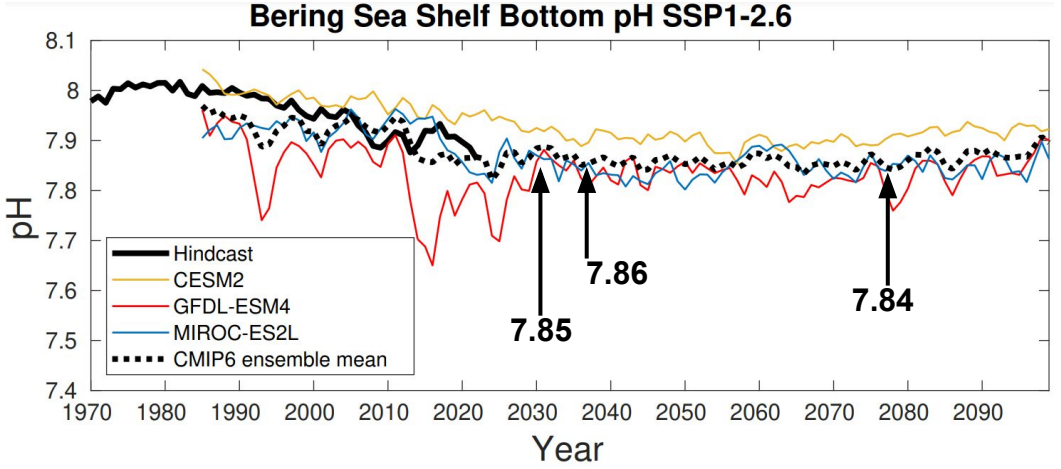


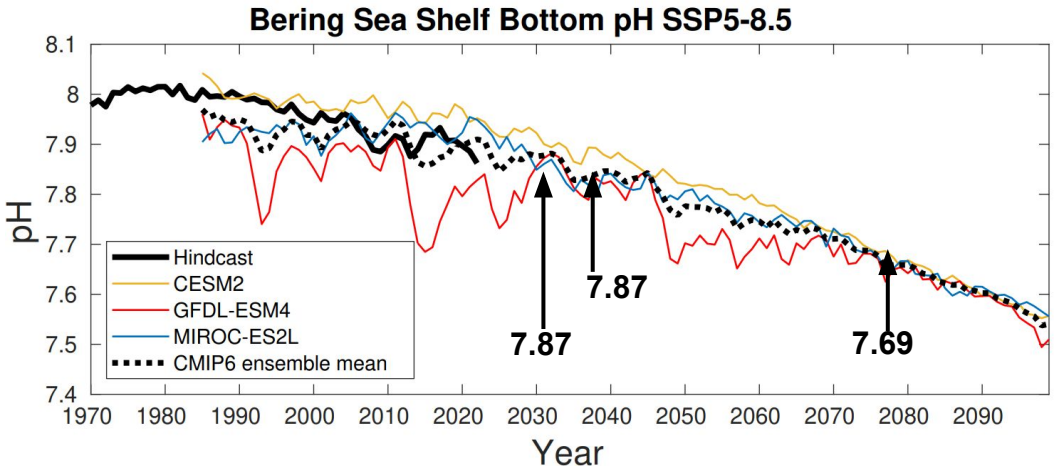
Climate Readiness

1. Focus: use climate vulnerability assessments to determine which stocks are priorities for conducting an ESP
2. Synthesize: identify thresholds and bottlenecks that may influence survival in a changing climate
3. Analyze: create projections using ocean models to make selected indicators climate informed
4. Communicate: include new graphics and measures in standard reporting template to convey climate readiness

Indicator Projections

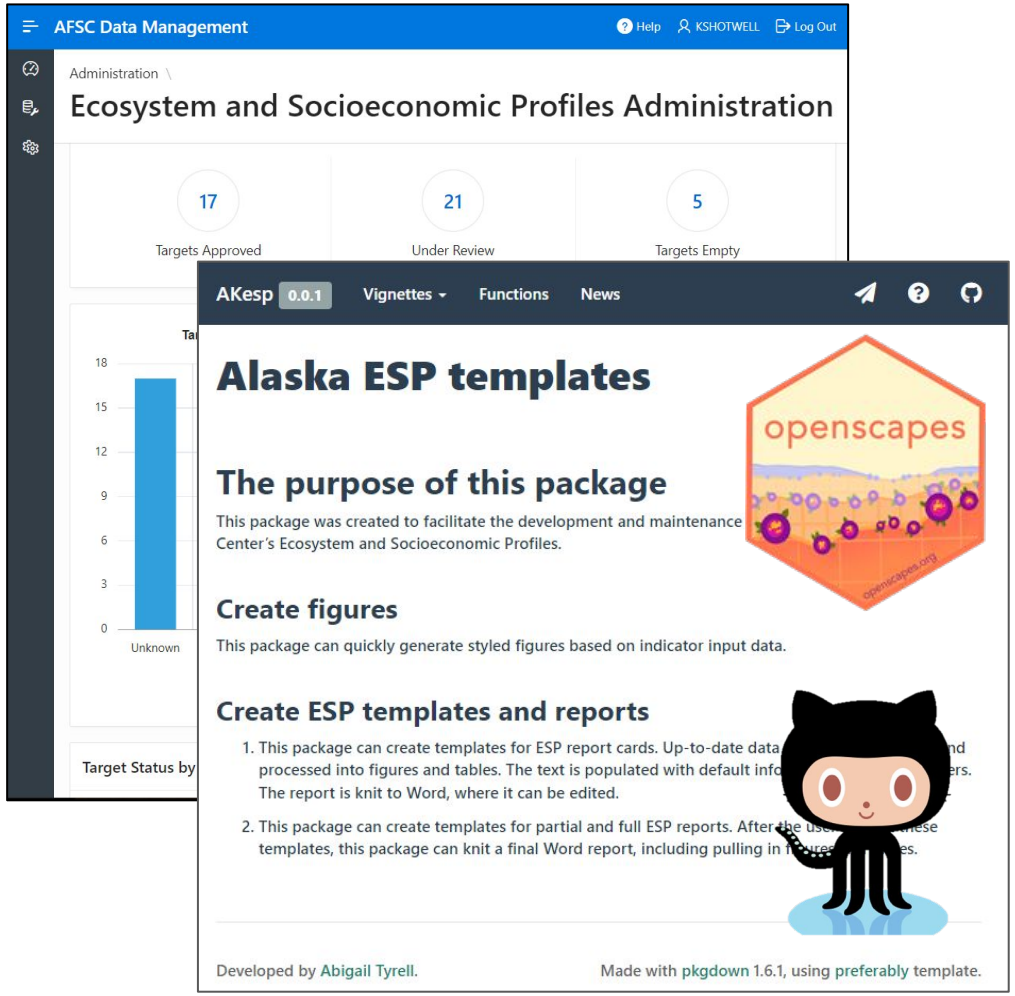
- Indicator Enhancement
  - Include different IPCC models and ensemble mean
  - Evaluate over a range of emissions scenarios
- Indicator Metrics
  - Calculate moving mean to account for interannual variability
  - Report at various future intervals (e.g., 5, 10, 50 years)





Data Management and Reproducibility

- Submission tool for ESP data
  - Provided by Alaska Fisheries Information Network (AKFIN), started in 2020
  - Metadata, feedback, tracking, auto query
  - Administrative checks & views
- AKESP R package
  - GitHub and AKFIN web service
  - Standard set of graphics available
  - Report templates in R Markdown
- Expanding both utilities to other regions with data modernization IRA/FIS project



Update

Timeline	Changes to delivery of ESP statistical products, report card alignment with risk tables
National	Coordination project, climate readiness, data management and reproducibility project
Capacity	Developing socioeconomic indicators, creating general ESP report cards for all stocks

Feedback on Socioeconomics in ESPs

- Alaska SSC Minutes (2022, 2023) and NPFMC Motion
  - SSC has consistently provided feedback on socioeconomics in ESPs particularly to coordinating multiple products, suggested workshop
  - "The Council recommends NOAA and Council staff review available data and recommend species-level socio-economic indicators appropriate for the Ecosystem and Socioeconomic Profiles (ESPs)..."
- National ESP share workshops
  - Less emphasis on socioeconomics in ESPs (little "s"), low engagement
  - Uncertainty in how to choose or use socioeconomic indicators to best support fisheries management decisions

2024 Progress

- Alaska
  - Several meetings to discuss AFSC staff capacity to produce socioeconomic indicators for ESPs and ESRs (high level overview by Brian on Thursday)
  - Plan to add a few new socioeconomic indicators for a couple groundfish ESPs this year, incorporate Council feedback, then circle back to crab
- National ESP Project
  - Review existing socioeconomic indicators in ESP/ESR and propose existing and/or develop new stock- or ecosystem-level indicators for ESP/ESR
  - Discussion session at ESP Share Workshop on resolution, temporal scale, and type of socioeconomic indicators and initiate guidance document

ESP Review Process

Step 1


An assessment for eastern Bering Sea snow crab

Cody Szuwalski

September 13, 2022

Contents

A. Summary of Major Changes

B. Comments, responses and assessment summary

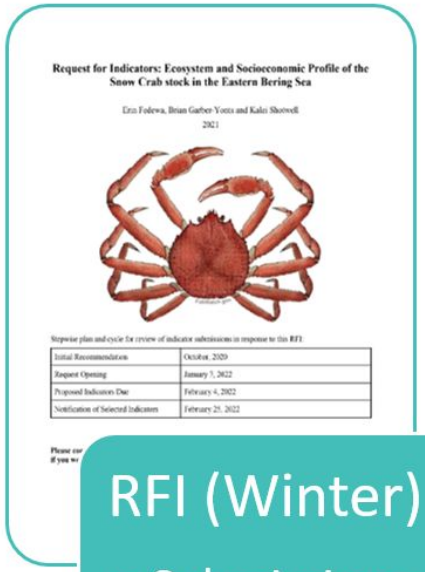
C. Introduction

D. Data

SAFE (Fall)

- Plan Team
- Priorities
- Request ESP

Step 2


Request for Indicators: Ecosystem and Socioeconomic Profile of the Snow Crab stock in the Eastern Bering Sea

Erin Fedewa, Brian Garber-Yonts and Kalei Shotwell

2021

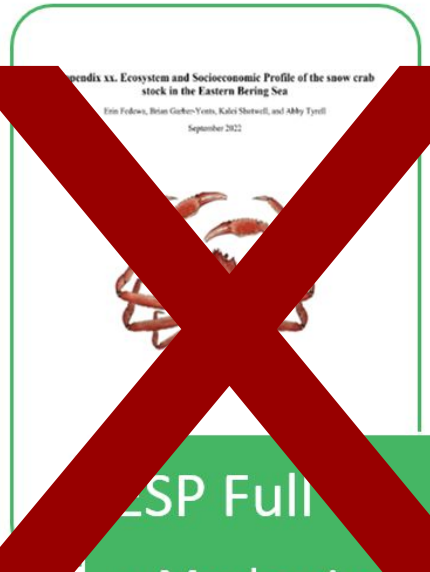
Stepwise plan and cycle for review of indicator submissions in response to this RFI:

Initial Recommendation	October, 2020
Request Opening	January 7, 2022
Proposed Indicators Due	February 4, 2022
Notification of Selected Indicators	February 25, 2022

RFI (Winter)

- Submissions
- Team Review
- Decision

Step 3


ppendix xx. Ecosystem and Socioeconomic Profile of the snow crab stock in the Eastern Bering Sea

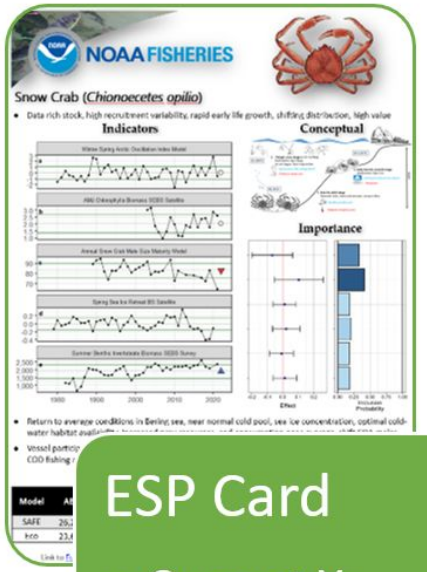
Erin Fedewa, Brian Garber-Yonts, Kalei Shotwell, and Abby Tyrell

September 2022

ESP Full

- Mechanism
- Indicators
- May Final

Step 4



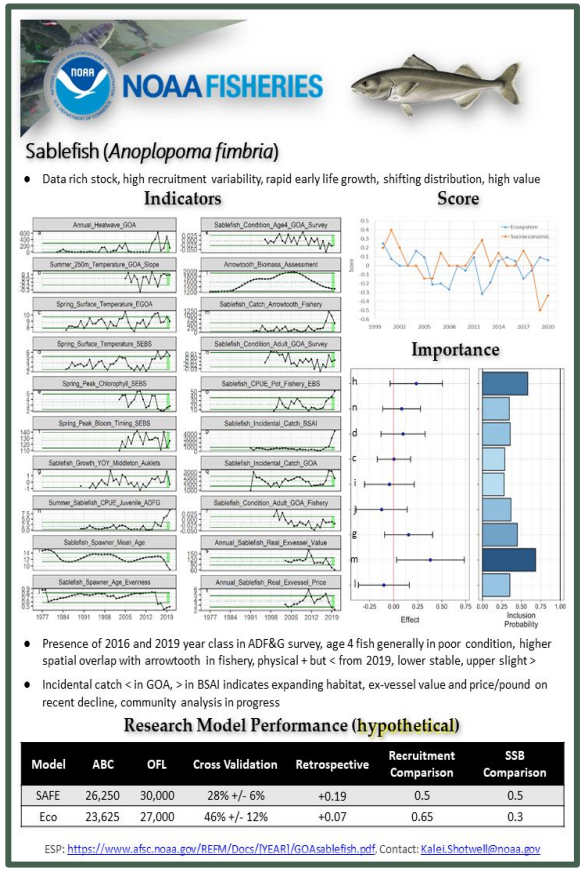
ESP Card

- Current Yr
- Sept PT
- Oct Council

General ESP Report Cards

- Indicator suite
  - Data are accessible, consistent, timely
  - Applicable to many stocks (e.g., satellite, large survey, modeled)
  - Prefer on AKFIN or database available
- Report card
  - Selection by author through dashboard
  - Simple set of tables and graphics
  - Reports automated, available Sept/Nov
- Use for risk table evaluation

Short Communication



NOAA FISHERIES

Sablefish (*Anoplopoma fimbria*)

- Data rich stock, high recruitment variability, rapid early life growth, shifting distribution, high value

Indicators

Score

Importance

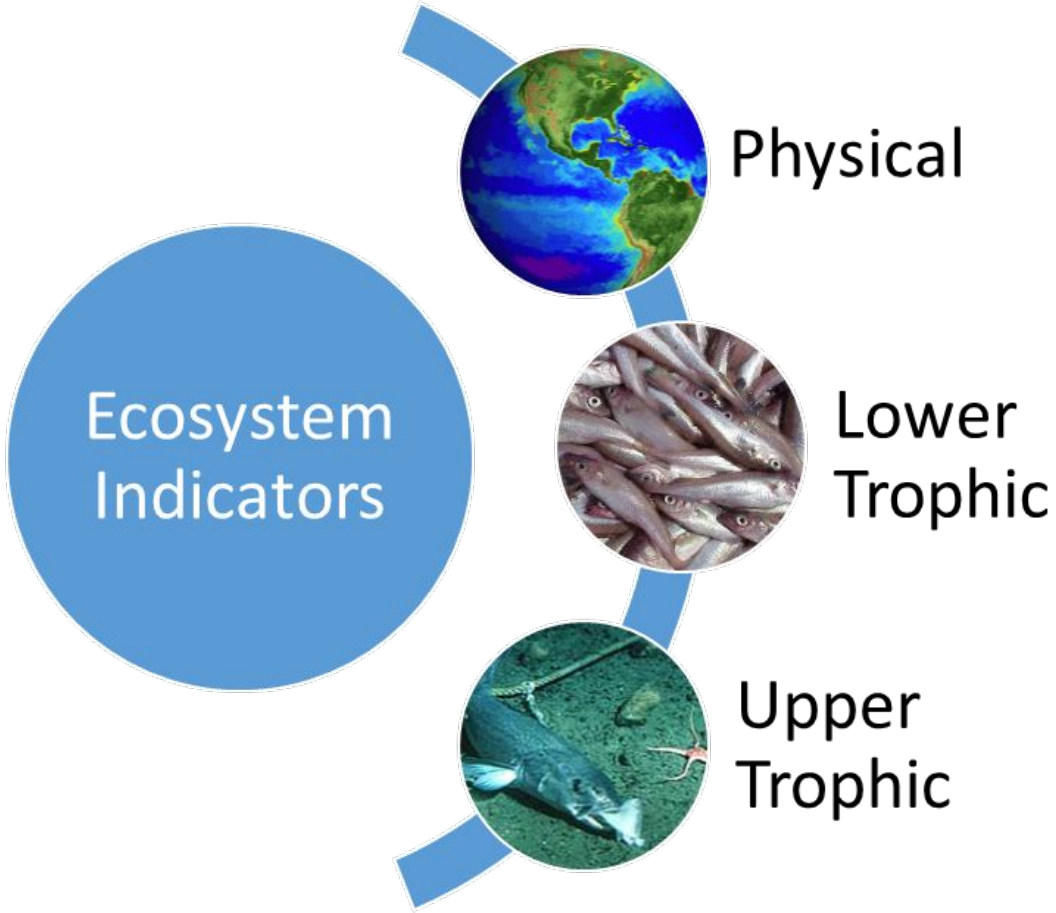
- Presence of 2016 and 2019 year class in ADF&G survey, age 4 fish generally in poor condition, higher spatial overlap with arrowtooth in fishery, physical + but < from 2019, lower stable, upper slight >
- Incidental catch < in GOA, > in BSAI indicates expanding habitat, ex-vessel value and price/pound on recent decline, community analysis in progress

Research Model Performance (hypothetical)

Model	ABC	OFL	Cross Validation	Retrospective	Recruitment Comparison	SSB Comparison
SAFE	26,250	30,000	28% +/- 6%	+0.19	0.5	0.5
Eco	23,625	27,000	46% +/- 12%	+0.07	0.65	0.3

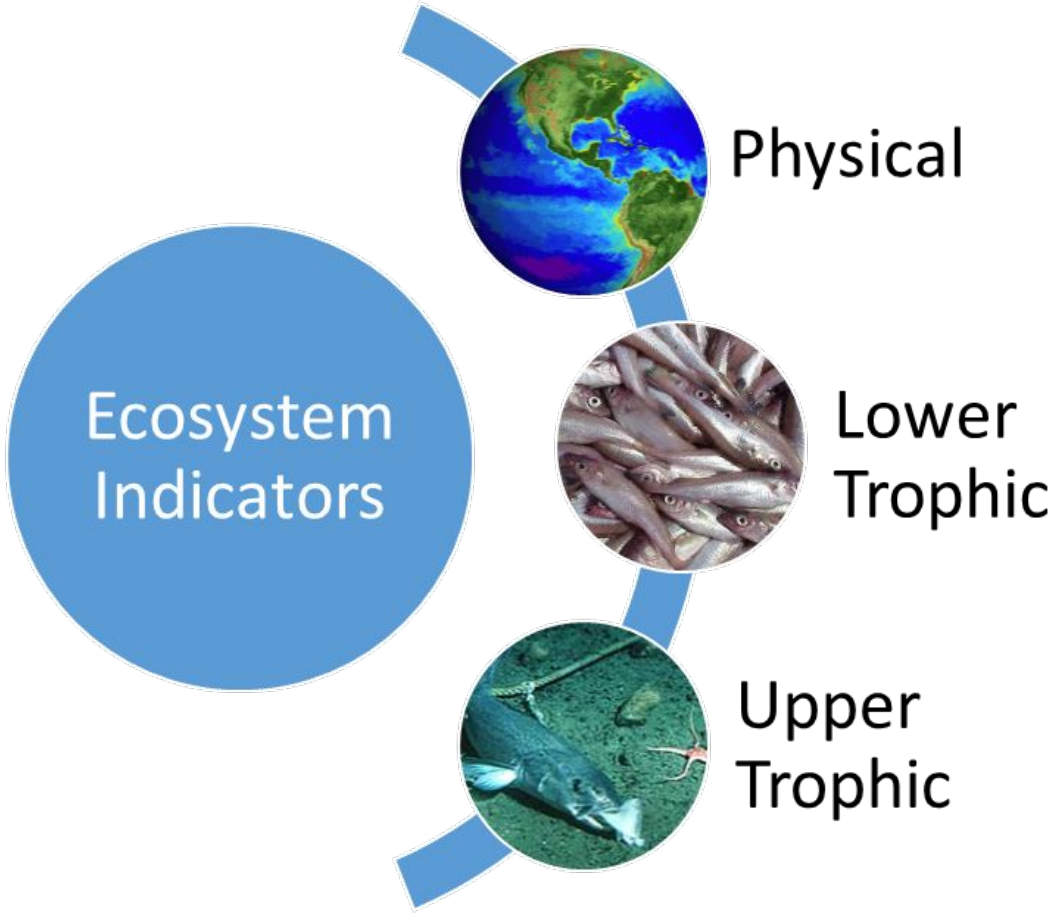
ESP: https://www.afsc.noaa.gov/REFM/Docs/[YEAR]/GOAsablefish.pdf, Contact: Kalei.Shotwell@noaa.gov

Ecosystem Indicators



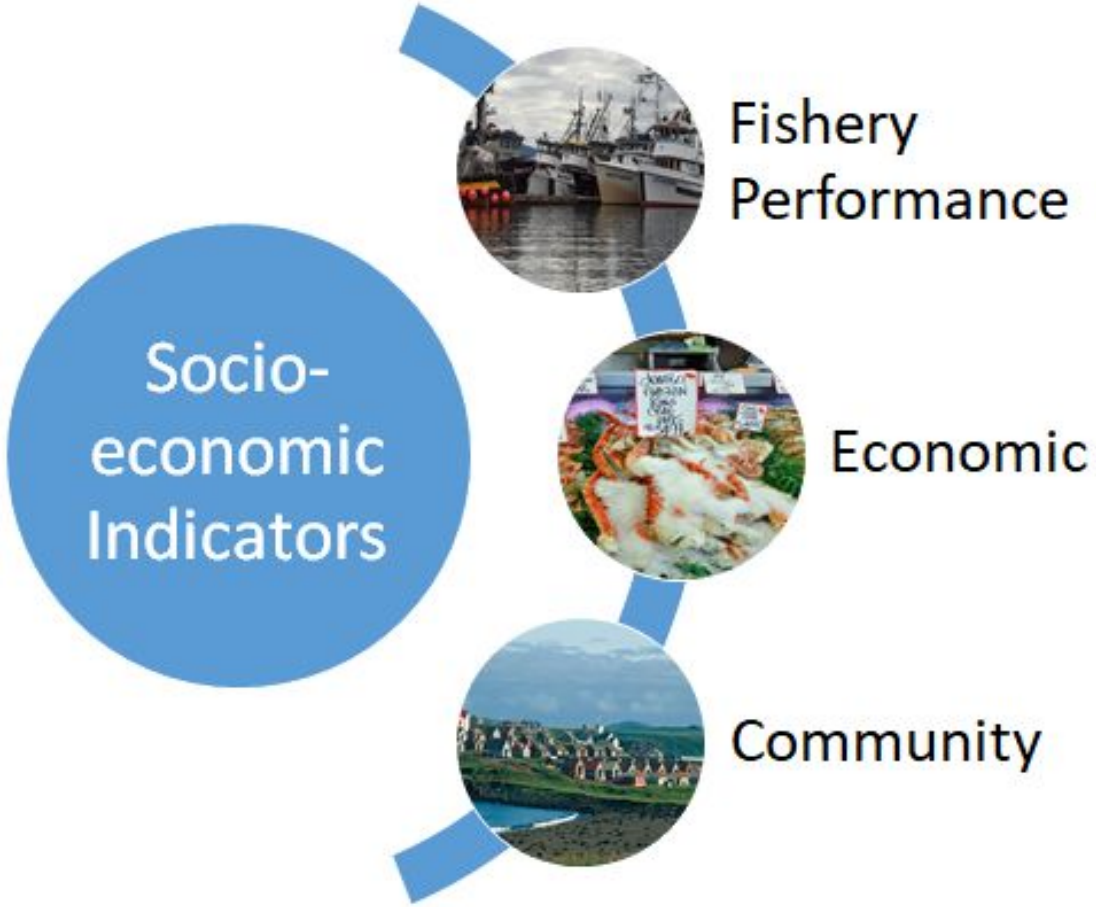
1. Marine heatwave index (model)
2. Bottom temperature (survey, **ROMS**)
3. SST, wind stress, sea-ice (satellite)
4. Corrosivity or pH index (**ROMS-NPZ**)
5. Production (chlorophyll a, satellite)
6. Small/Large copepods (survey)
7. Euphausiids (survey)
8. Seabird reproductive success (survey)
9. Larval fish abundance, condition (survey)
10. YOY biomass, growth seabird diets (survey)
11. Juvenile CPUE, condition (survey)
12. Juvenile predation mortality (model)
13. Proportion euphausiid in fish diet (survey)
14. Adult condition (survey, fishery)
15. Center of gravity, area occupied (model)
16. Predator biomass (**stock assessment**)
17. Steller sea lion non-pup estimates (survey)

Ecosystem Indicators



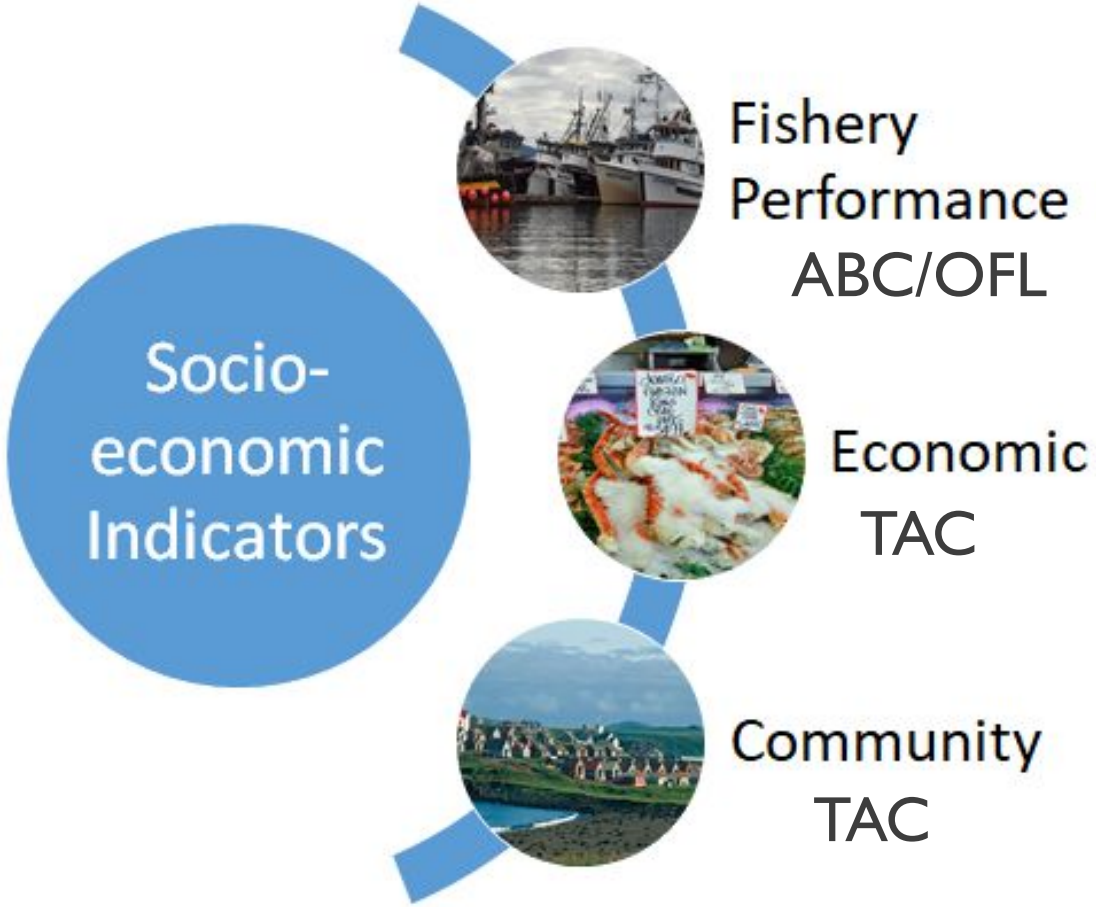
1. Marine heatwave index (model)
2. Bottom temperature (survey, **ROMS**)
3. SST, wind stress, sea-ice (satellite)
4. Corrosivity or pH index (**ROMS-NPZ**)
5. Production (chlorophyll a, satellite)
6. Small/Large copepods (survey)
7. Euphausiids (survey)
8. Seabird reproductive success (survey)
9. Larval fish abundance, condition (survey)
10. YOY biomass, growth seabird diets (survey)
11. Juvenile CPUE, condition (survey)
12. Juvenile predation mortality (model)
13. Proportion euphausiid in fish diet (survey)
14. Adult condition (survey, fishery)
15. Center of gravity, area occupied (model)
16. Predator biomass (**stock assessment**)
17. Steller sea lion non-pup estimates (survey)

Socioeconomic Indicators



1. CPUE by season, gear
2. Effort (#vessels, #processors)
3. Bycatch by gear, region
4. Centroid of the fishery
5. Ex-vessel value
6. Ex-vessel price per pound (size)
7. Ex-vessel revenue per unit effort
8. Price, price by size class
9. Roe per-unit-catch
10. Fish condition in the fishery
11. TAC utilization (percent)
12. Processors active in fishery
13. Processing employment
14. Local, regional quotient harvesting
15. Local, regional quotient processing
16. Skipper surveys

Socioeconomic Indicators



1. CPUE by season, gear
2. Effort (#vessels, #processors)
3. Bycatch by gear, region
4. Centroid of the fishery
5. Ex-vessel value
6. Ex-vessel price per pound (size)
7. Ex-vessel revenue per unit effort
8. Price, price by size class*
9. Roe per-unit-catch
10. Fish condition in the fishery
11. TAC utilization (percent)
12. Processors active in fishery
13. Processing employment
14. Local, regional quotient harvesting
15. Local, regional quotient processing
16. Skipper surveys

Proposed General Crab Indicator Suite

Ecosystem Indicators

- Bottom temperature (ROMS/survey)
- pH (ROMS)
- Primary production (chla, satellite)
- Center of gravity (survey)
- Area Occupied (survey)
- Predator Biomass (survey)

Socioeconomic Indicators

- Catch per unit effort
- Effort (#vessels, #processors)
- Bycatch by gear, region
- Centroid of the fishery

Discussion

1) What do we do with different timing of stocks?
2) Can ESPs be a vehicle for climate forecasts and projections? Other ideas than those presented?
3) Does the generalized ESP seem useful for informing risk tables? Other indicators than those presented?
4) Are there any thoughts or concerns on the plans for socioeconomic data in ESPs? (for Thursday)

Thank You!

Contact:

Erin Fedewa, AFSC
Kalei Shotwell, AFSC
Brian Garber-Yonts, AFSC

erin.fedewa@noaa.gov
kalei.shotwell@noaa.gov
brian.garber-yonts@noaa.gov

ESP Summary

Stock	Year initiated	Full ESP	Partial update	Report card*
Sablefish	2017	2017 - 2019	2020	2021, 2022, 2023
Gulf of Alaska Pollock	2019	2019	2020	2021, 2022, 2023
EBS Pacific Cod	2020	2021		2021, 2022, 2023
GOA Pacific Cod	2020	2021		2021, 2022, 2023
St Matthew Blue King Crab	2019	2019	2020	2022
Bristol Bay Red King Crab	2020	2020		2021, 2022, 2023
Bering Sea Snow Crab	2021	2022		2023