Proposed Ecosystem & Socioeconomic Profile (ESP) for BSAI Atka mackerel

Presentation by Jane Sullivan and Rusty Dame

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September 2025, Presentation to the Groundfish Plan Team

Motivation

- Recruitment bottleneck
- Regional productivity & spatial structure
- Socioeconomic factors: Am 80, market dynamics, SSL species, spatial management & CPUE, fishery selectivity

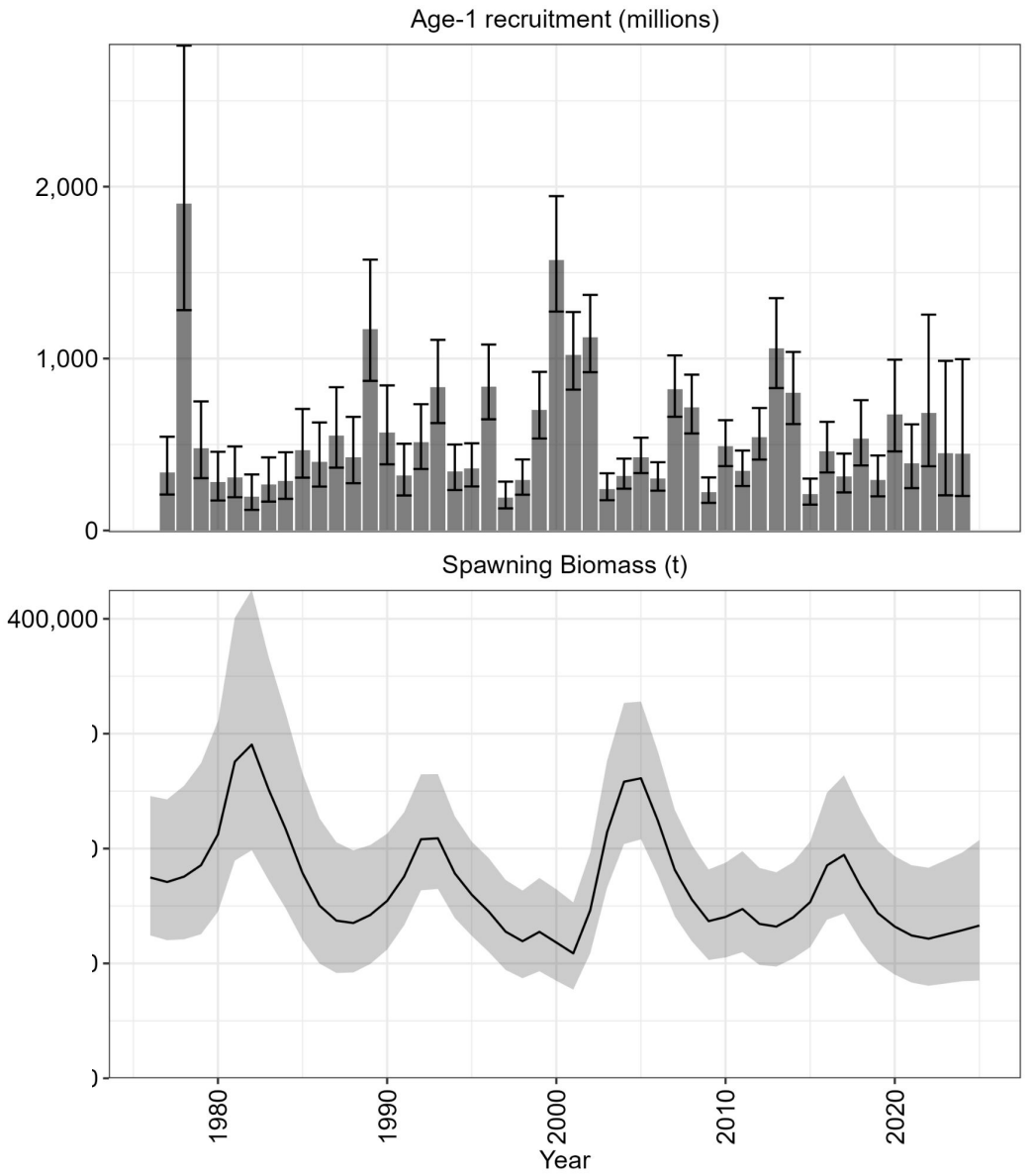

Image source: Oiso Co., Ltd. via https://www.shimanebuyers.com/product/cat05/184/

Timeline and Proposal Structure

BSAI PT Nov 2019, 2024, SSC Dec 2019, 2024	Plan Team and SSC recommends ESP development for Atka
Sep/Oct 2025	Propose indicators, Feedback from BSAI GPT and SSC
Nov 2026	First full ESP presented with Atka assessment

2025 proposal includes: Proposed socioeconomic and ecosystem indicators. Description of data, proposed hypotheses/linkages, indicator caveats, and knowledge gaps.

This proposal does not include: Status and trends, indicator synthesis, and management implications.

Socioeconomic Indicators

Economic Performance Report (EPR) tables

- Contains historical first-wholesale market and global market data
- First-wholesale market table contains Amendment 80-specific data

Snippet of First-Wholesale Market EPR Table

Sector	Species Group		2015-2019 Average	2020	2021	2022	2023	2024
Fishery Totals	AMCK	First-wholesale production (K mt)	37.22	34.19	35.63	33.91	38.74	43.15
		First-wholesale value (M US$)	$98.84	$79.07	$71.55	$75.29	$90.34	$94.05
Amendment 80 Vessels with Atka Mackerel Landings	AMCK	First-wholesale production (K mt)	22.74	28.17	29.61	27.88	32.58	35.51
		First-wholesale value (M US$)	$57.04	$64.68	$58.59	$61.19	$75.97	$77.77
	PCOD	First-wholesale production (K mt)	4.18	5.71	3.94	4.50	6.08	6.65
		First-wholesale price (USD/lb.)	$1.34	$1.15	$1.25	$2.02	$1.49	$1.70

Socioeconomic Indicators

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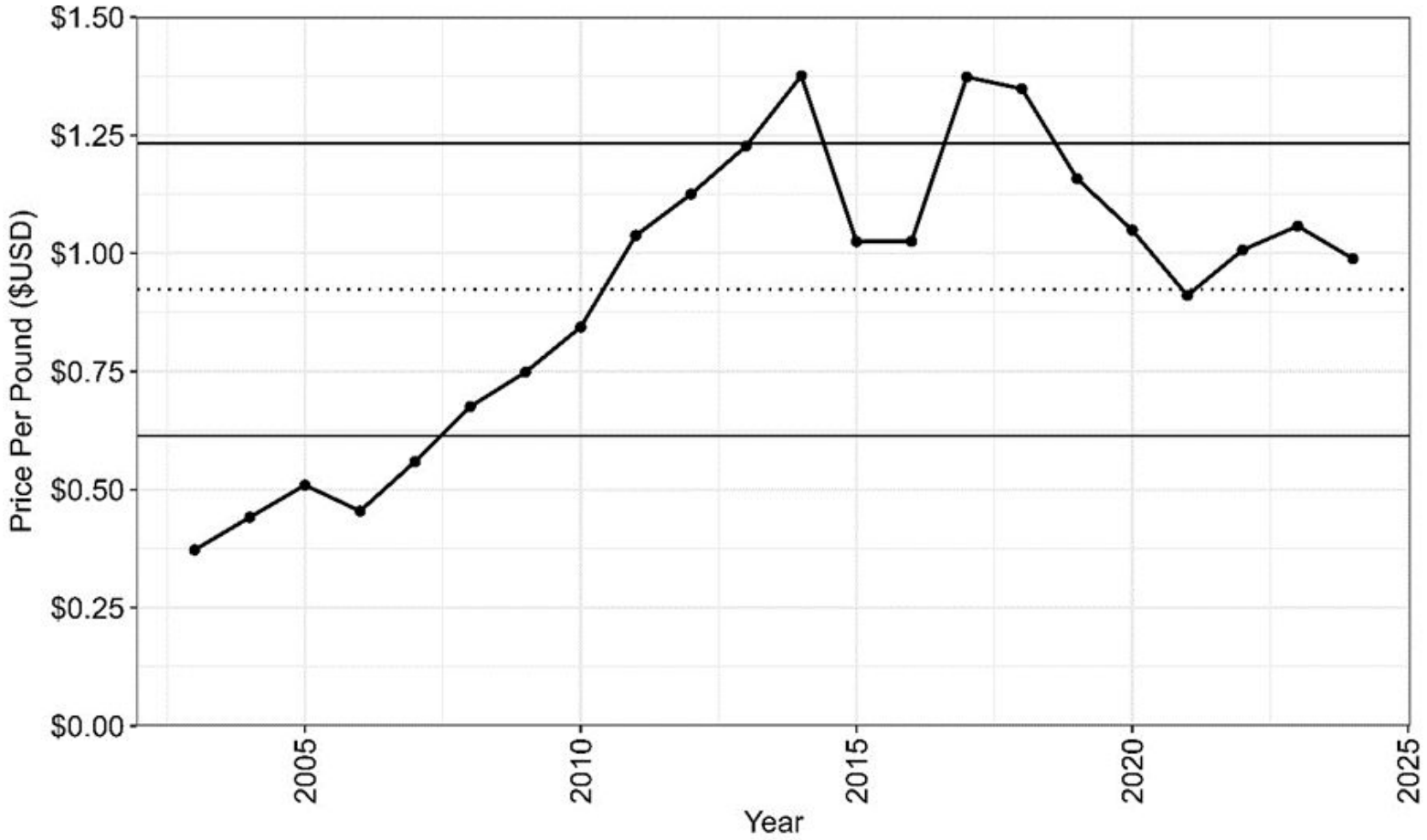
Socioeconomic indicators

1. First-wholesale market price per-pound
2. First-wholesale market value
3. Alaska-wide TAC utilization

First-wholesale market price per-pound (2003-2024)



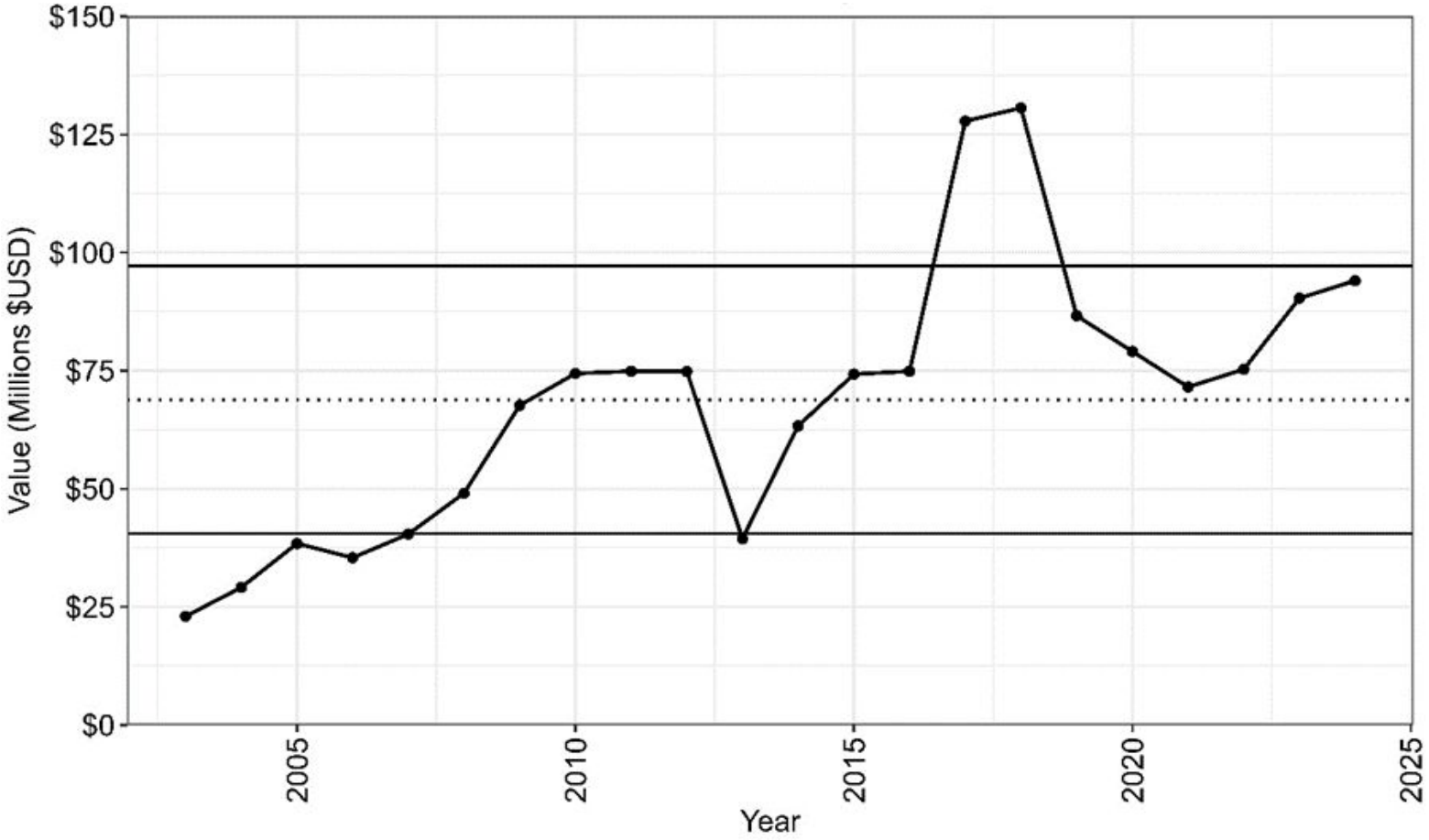
Data:

- Commercial Operators Annual Report (COAR)
- Considers fishery totals

Use:

- Track annual first-wholesale market prices over time

First-wholesale market value (2003-2024)



Data:

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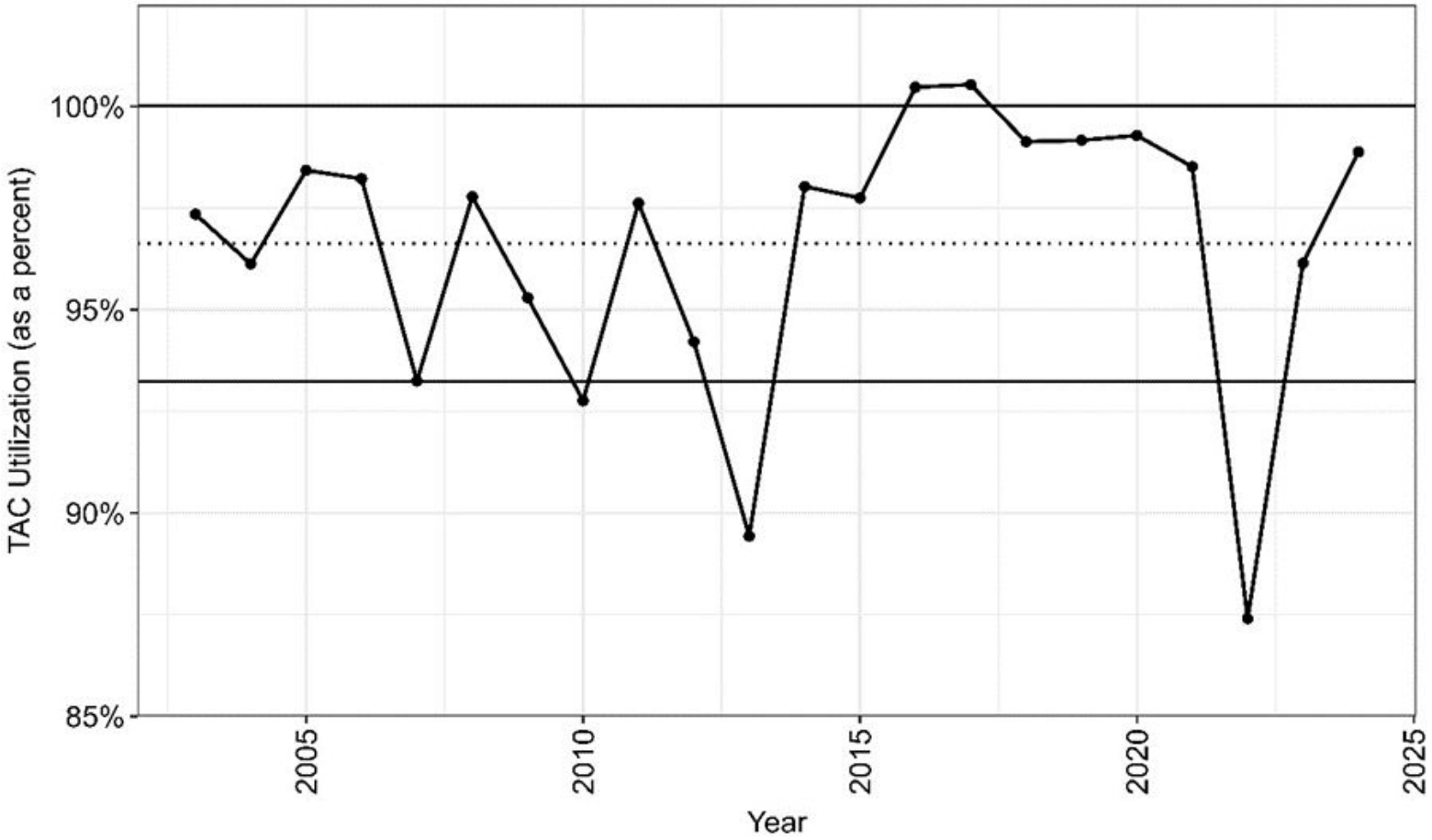
Use:

- Track annual first-wholesale market value over time

Alaskan TAC utilization of Atka mackerel (2003-2024)



Data:

- NMFS AKRO Catch Accounting System (CAS)
- Considers end-of-year fishery totals

Use:

- Track end-of-year TAC utilization of Atka mackerel
- Determine how sensitive the fishery may be to changes in TAC

Socioeconomic Indicators

Economic Performance Report (EPR) tables

- Contains historical first-wholesale market and global market data
- First-wholesale market table contains Amendment 80-specific data

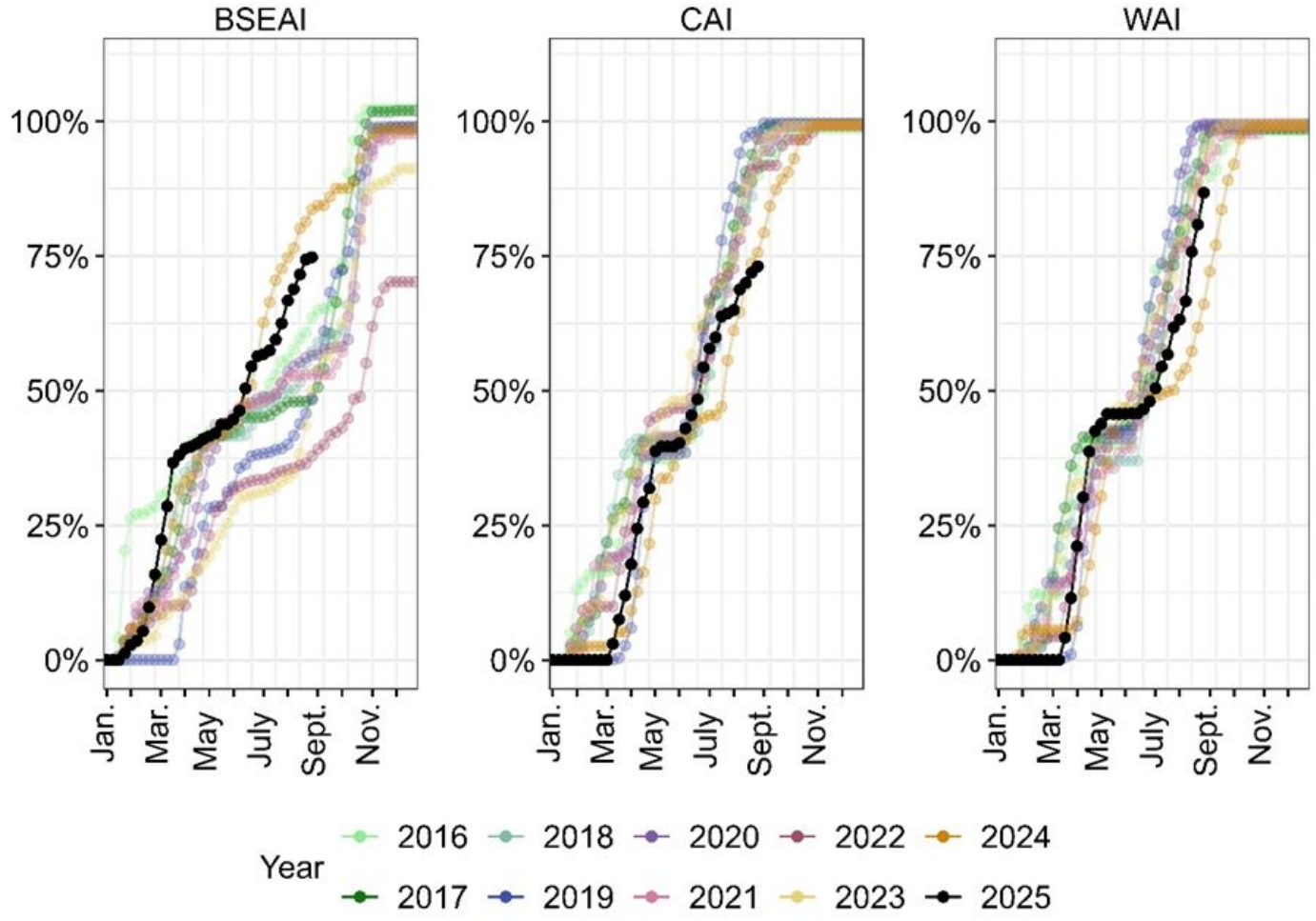
Socioeconomic indicators

1. First-wholesale market price per-pound
2. First-wholesale market value
3. Alaska-wide TAC utilization

Value-added socioeconomic indicators

1. Weekly TAC utilization by area
2. Share of export value by country
3. Employee count and share of employees by community

Weekly TAC utilization by area



Data:

- NMFS AKRO CAS
- Considers TAC allocated by area (sector totals)

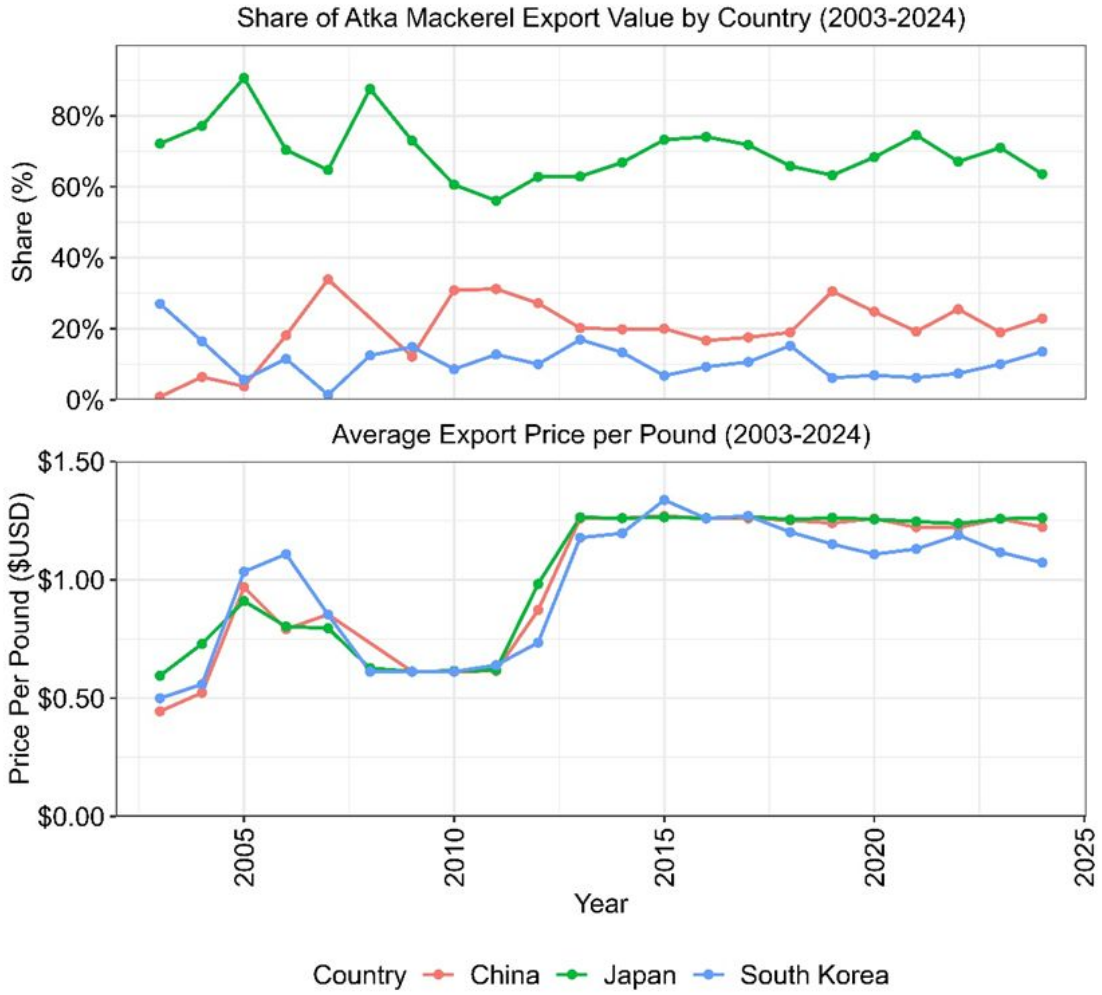
Use:

- Determine which area may be most sensitive to changes in TAC regulations

Notes:

- Accounts for in-season reallocations

Share of Atka mackerel export value and average price per-pound by country



Data:

- Foreign Trade Division of the U.S. Census Bureau

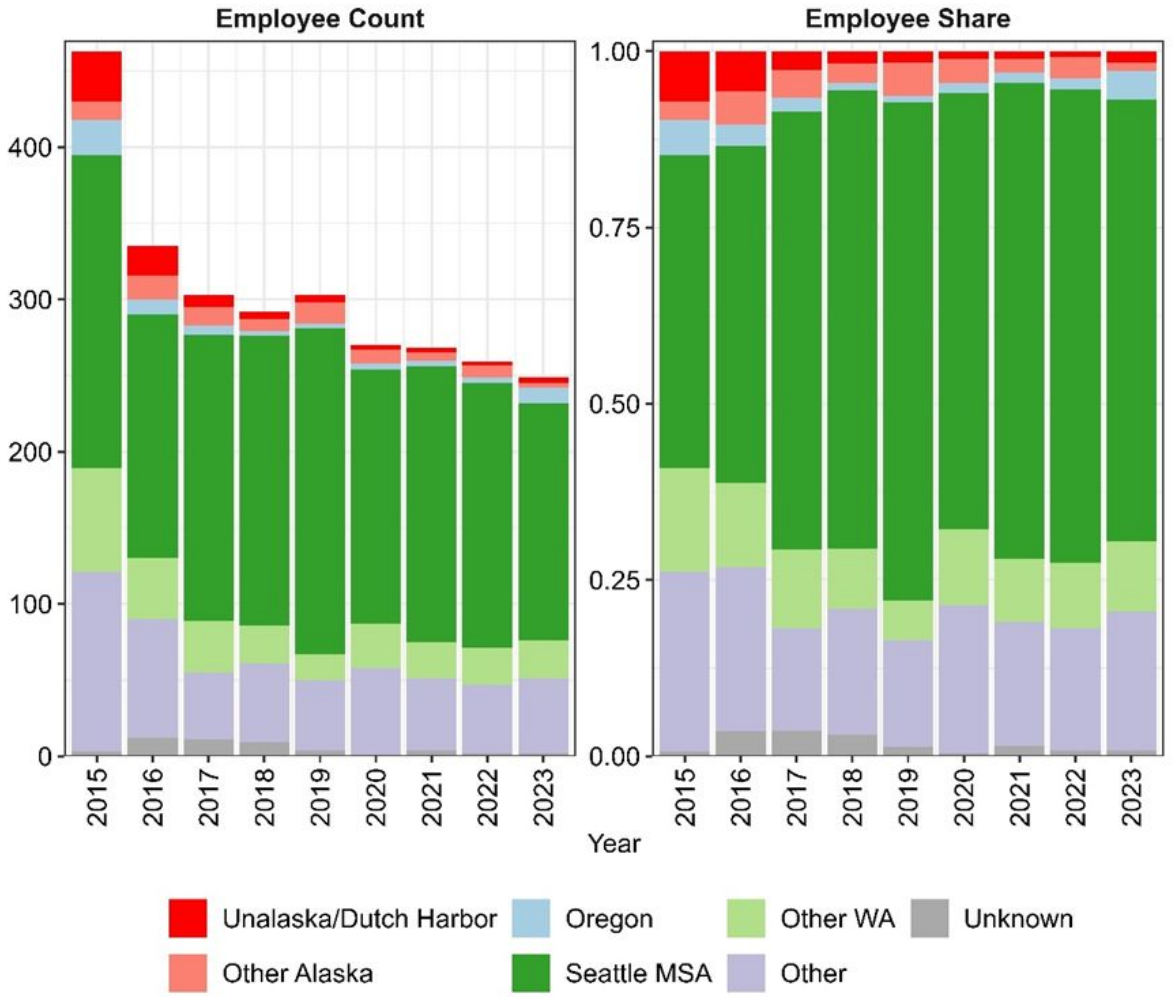
Use:

- Provides important export market information of Atka mackerel and potential impacts from changes in the global market

Note:

- Trade data contains a ~3-month lag; looking into in-season export shares

Employee count and share of employees by community for the Amendment 80 fleet with Atka mackerel landings



Data:

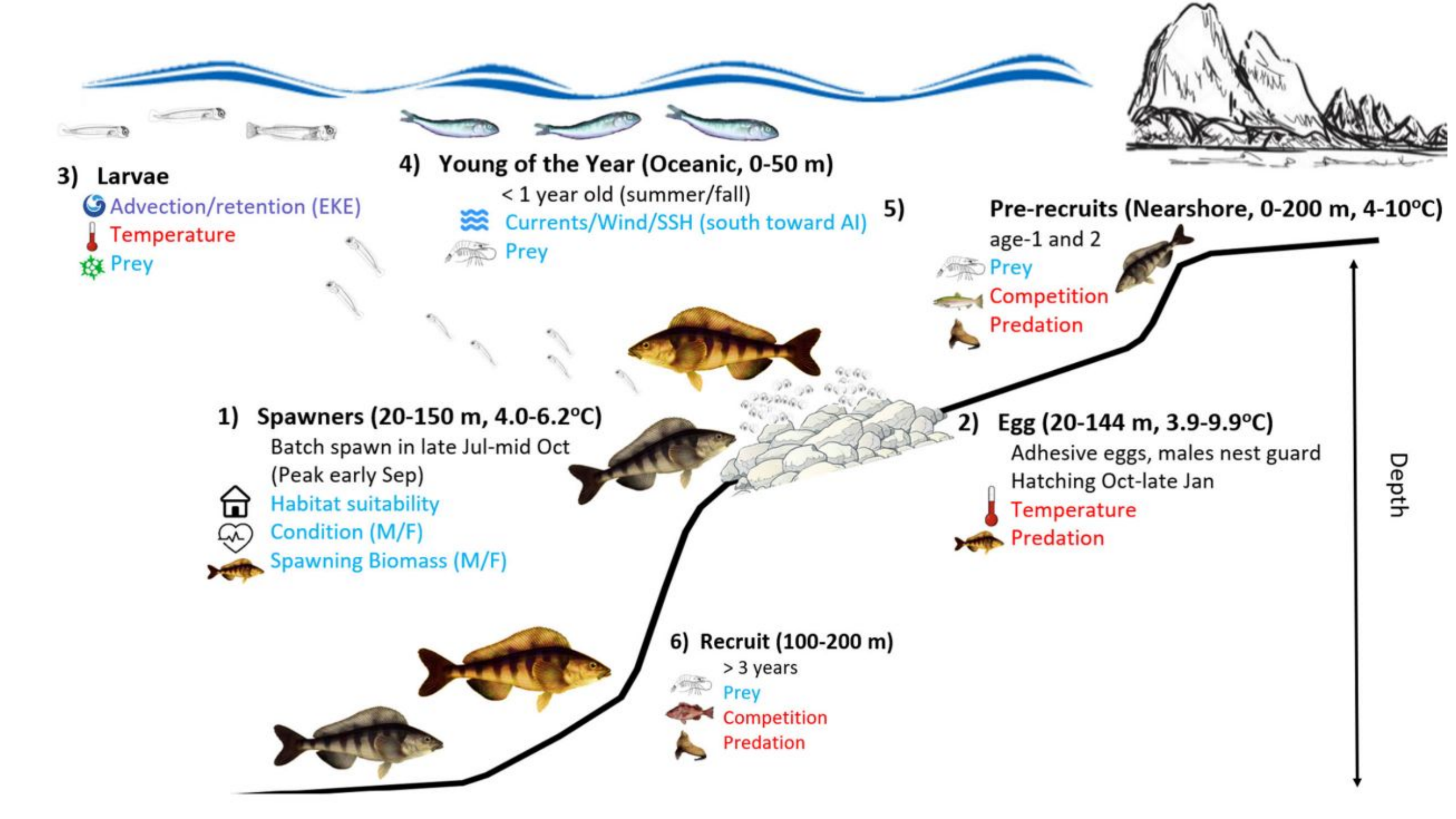
- Economic Data Report (EDR) program

Use:

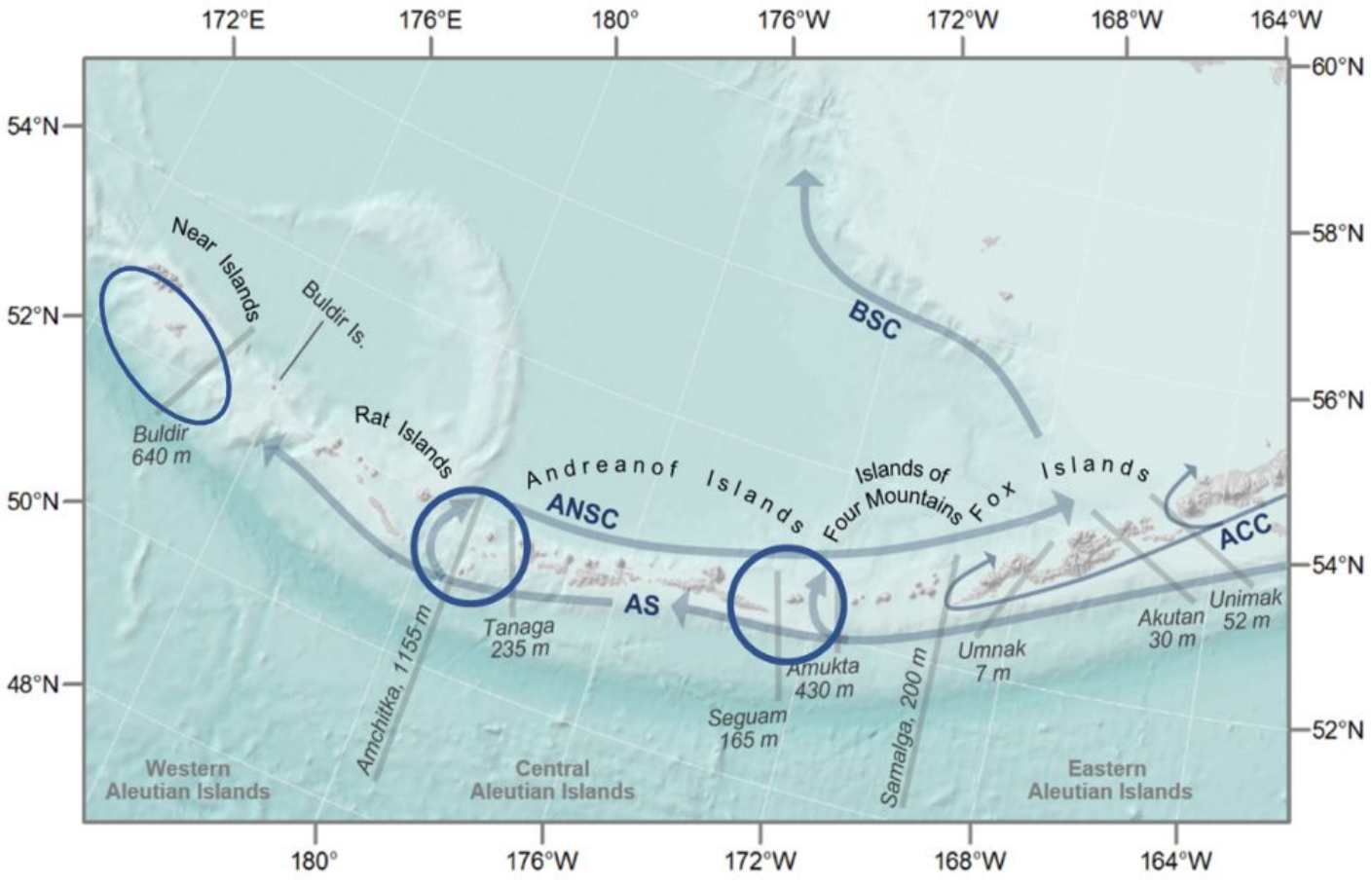
- Provides information on potential community-level impacts from changes in TAC

Note:

- Considers data from only Amendment 80 vessels that landed Atka mackerel (primary difference from Figure 9.13 in GF Econ. SAFE)


3) Larvae
Advection/retention (EKE)
Temperature
Prey
4) Young of the Year (Oceanic, 0-50 m)
< 1 year old (summer/fall)
Currents/Wind/SSH (south toward AI)
Prey
5) Pre-recruits (Nearshore, 0-200 m, 4-10°C)
age-1 and 2
Prey
Competition
Predation
1) Spawners (20-150 m, 4.0-6.2°C)
Batch spawn in late Jul-mid Oct
(Peak early Sep)
Habitat suitability
Condition (M/F)
Spawning Biomass (M/F)
2) Egg (20-144 m, 3.9-9.9°C)
Adhesive eggs, males nest guard
Hatching Oct-late Jan
Temperature
Predation
6) Recruit (100-200 m)
> 3 years
Prey
Competition
Predation
Depth

Life History and Aleutian Biogeography

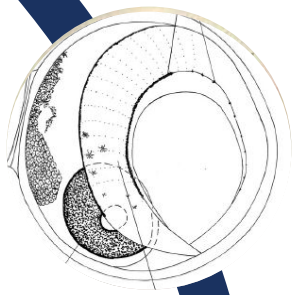


EAI: influenced by Alaska Coastal Current (ACC), warmer, lower salinity waters, which can support higher primary and secondary productivity, offering more abundant food resources for Atka mackerel. Atka in the EAI (including Seguam Pass) and the Southern Bering Sea) exhibit higher size-at-age and realized fecundity.

CAI: influenced by Alaska Stream (AS) and deep tidal mixing; characterized by cooler, higher salinity waters. Lower realized fecundity.

WAI: Lower productivity, food availability, and recent warming trends. Atka mackerel in this region exhibit the lowest size-at-age and realized fecundity.

Ecosystem Indicators



Eggs to Larvae

YOY to Pre-recruits

Recruits to Adults

1.Fall sea surface temperature

2.Spring eddy kinetic energy

3.Spring Sea surface temperature

4.Copepods community (CPR)

5. Euphausiid/copepod prevalence in diets (trawl survey)

6.Zooplankton availability (auklet reproductive success)

7.YOY condition (puffin diets)

8.Competition with Kamchatka pink salmon

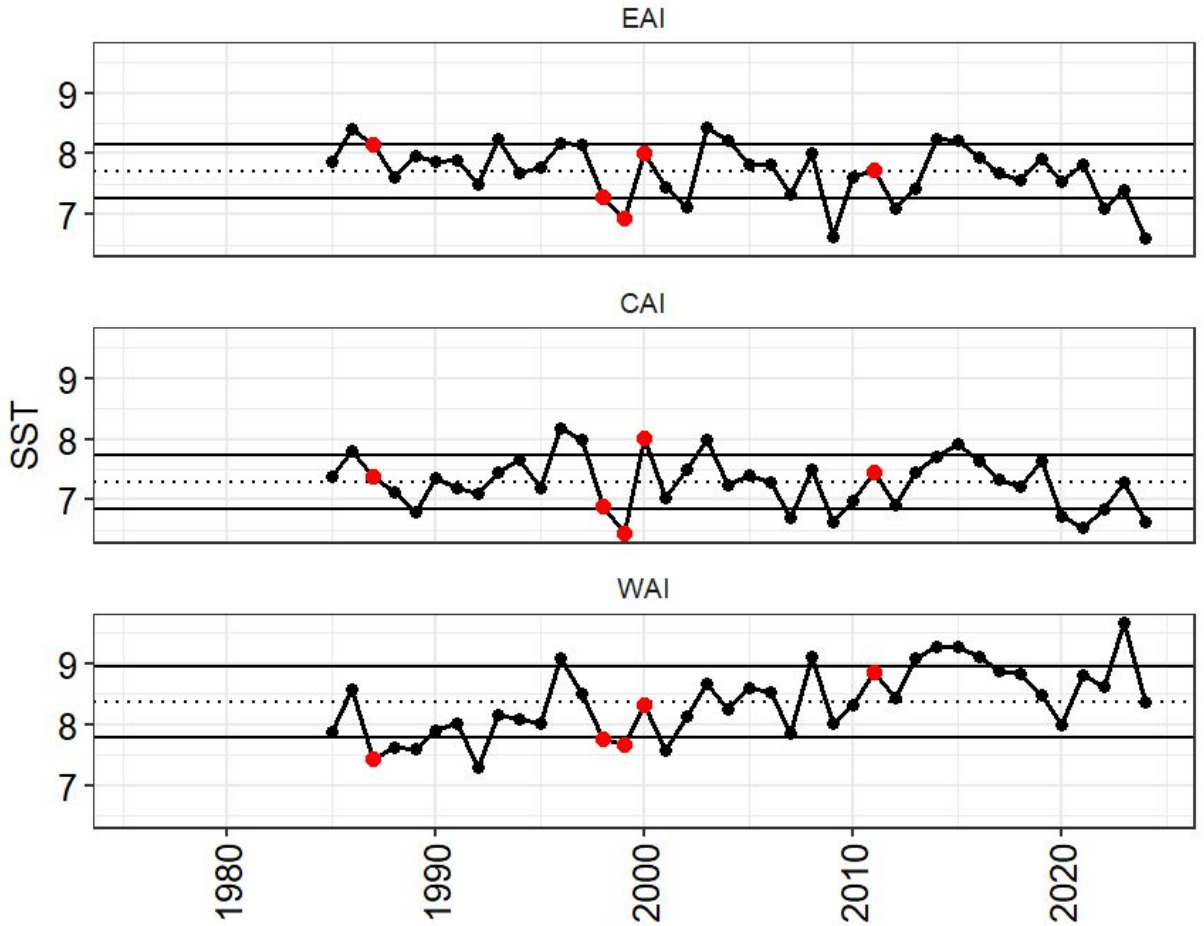
9.Competition with POP/northern rockfish

10. Predation by Pacific cod

11.Predation by SSL

12.Adult/spawner condition (AI survey, fishery)

Fall Sea Surface Temperature (Aug 15-Nov 15)



● Above avg recruitment at appropriate lag (>+1 SD above mean)

Data:

- Satellite (Matt Callahan), site specific in island passes

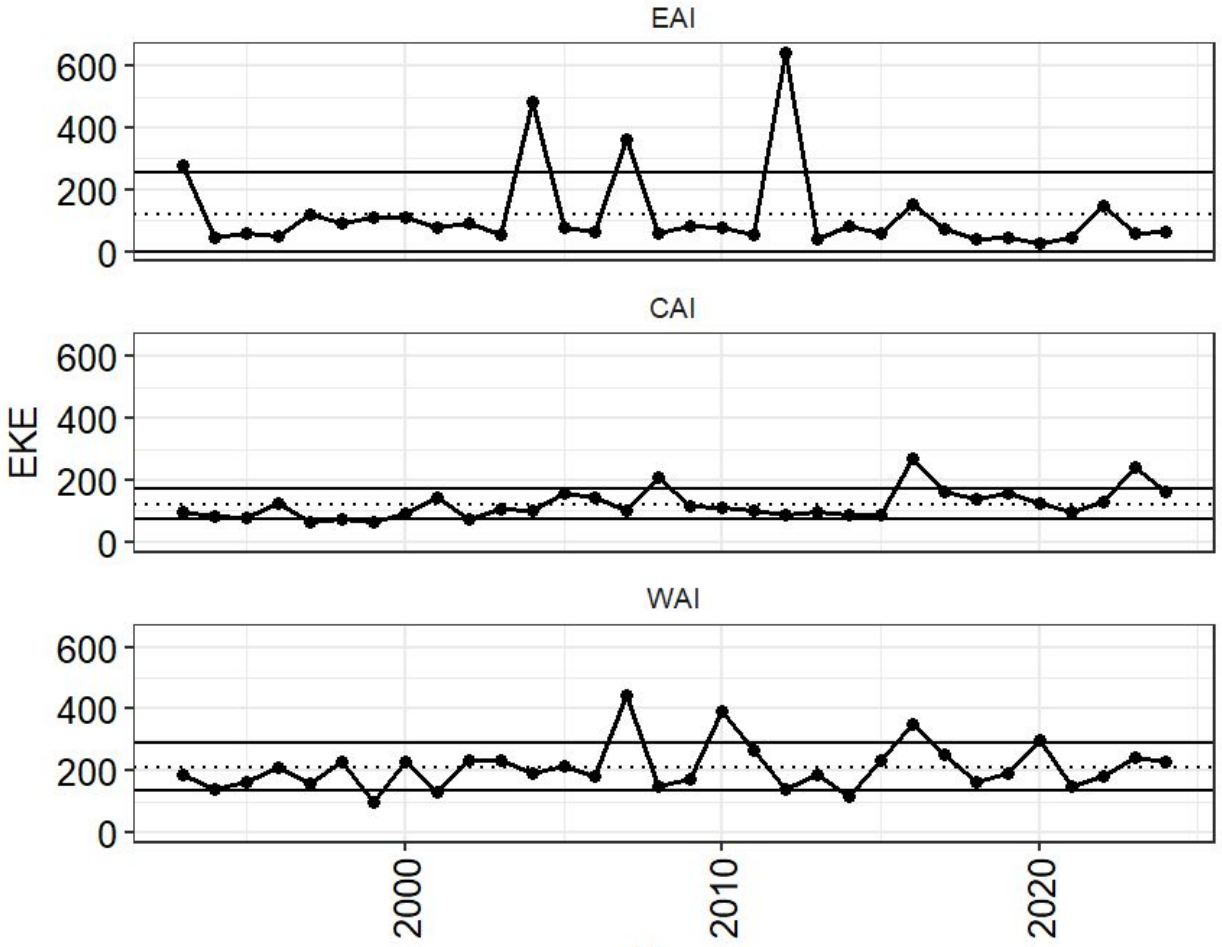
Use:

- Thermal experience for eggs, brooding males

Caveats/knowledge gaps:

- Average SST may not reflect intensity, duration → considering MHW

Eddy Kinetic Energy (Apr-Jun)



Data:

- Same source data and spatial extent as AI ESR (Wei Cheng)

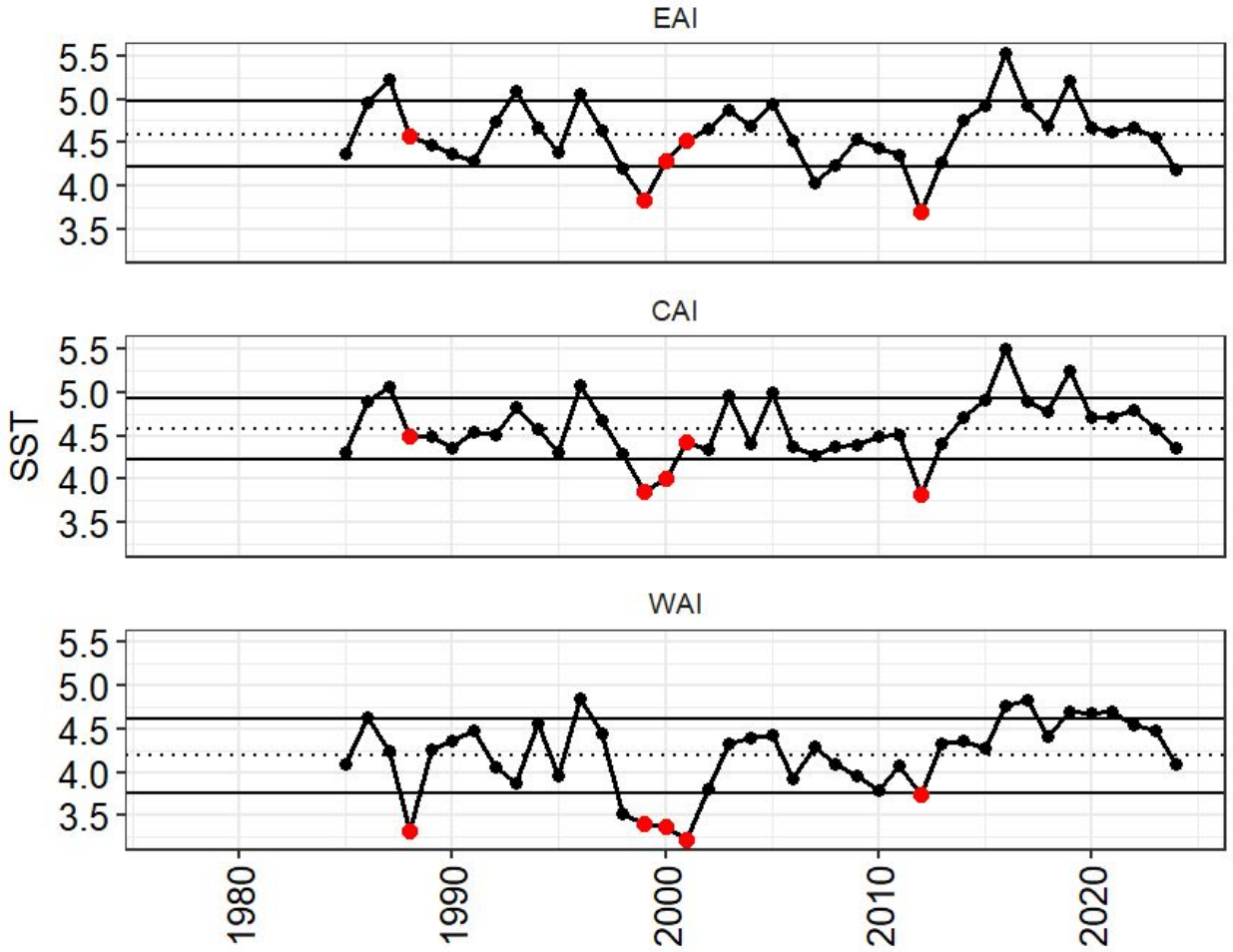
Use:

- Indicator of spring temperatures with site-specific effects, influences YOY thermal experience

Caveats/knowledge gaps:

- Should improve characterization of region-specific vertical and horizontal exchange processes, and potential linkages to larval dispersal/retention and productivity

Spring Sea Surface Temperature (Apr-Jun)



● Above avg recruitment at appropriate lag (>+1 SD above mean)

Data:

- Satellite (Matt Callahan), site specific in island passes

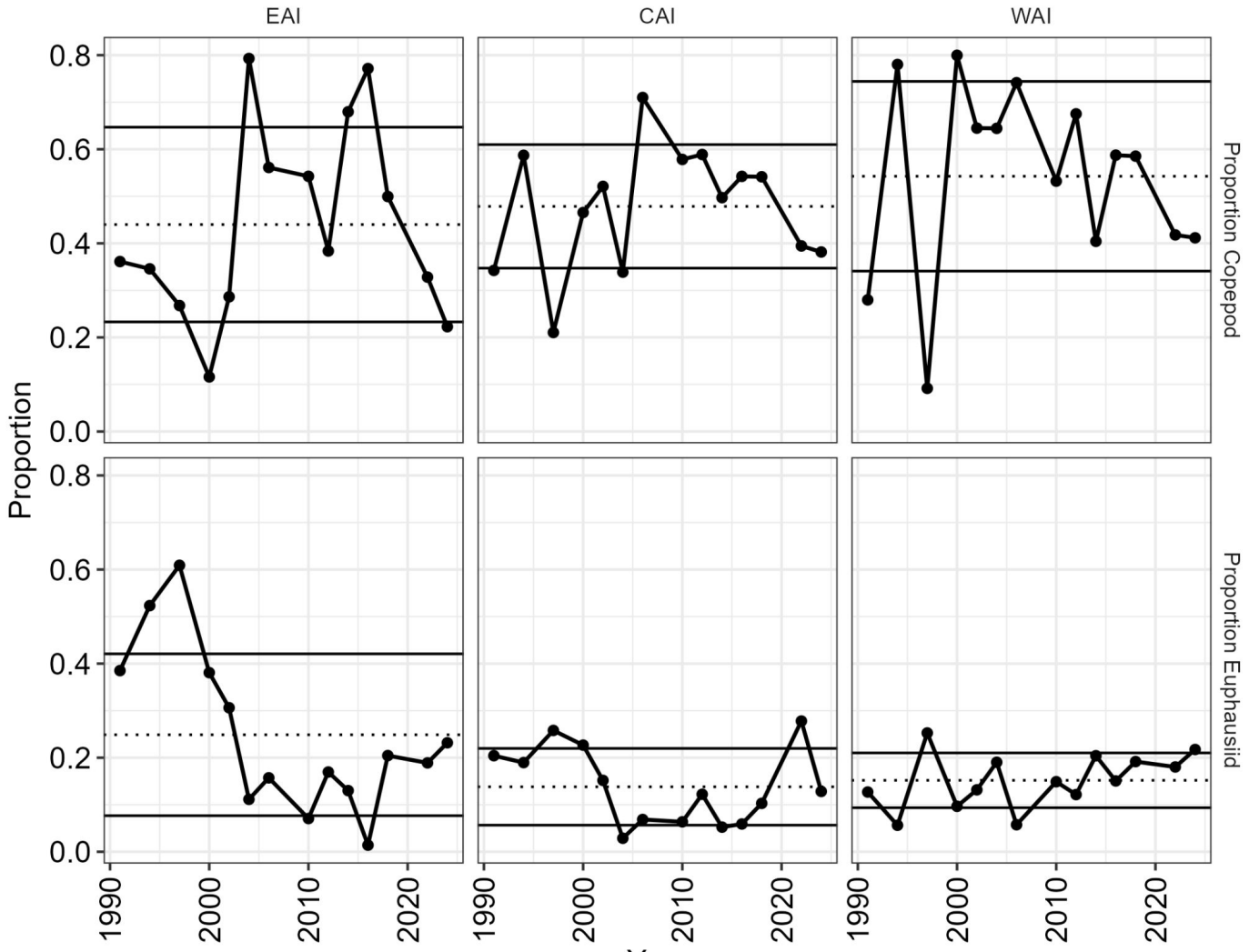
Use:

- Bottom up effects on productivity, availability of prey for YOY

Caveats/knowledge gaps:

- Currently not linked to chlorophyll-a or zooplankton data, should evaluate spatial overlap with target life history stage

Prevalence of Euphausiids and Copepods



Data:

- Trawl Survey/Food Habits (Kerim Aydin)

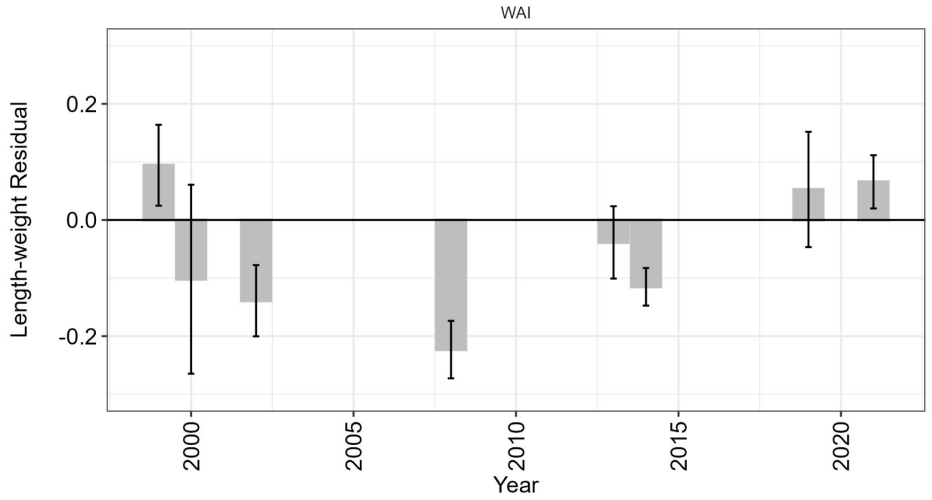
Use:

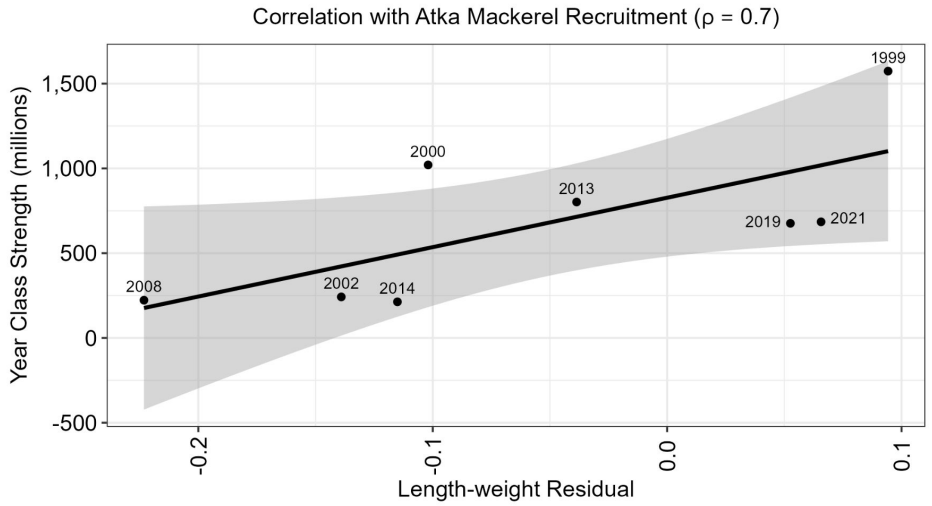
- Large copepods & euphausiids associated with faster Atka growth in EAI

Caveats/knowledge gaps:

- Future improvements could include standardizing for sampling effort & population distribution, incorporating stomach fullness, & developing indices that integrate zooplankton intake across multiple planktivorous taxa.

Age-0 Atka Condition from Buld Is. Puffin Diets





Data:

- Alaska Maritime National Wildlife Refuge (Nora Rojek)

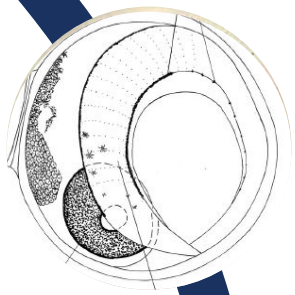
Use:

- YOY growth, survival, prey availability

Caveats/knowledge gaps:

- Limited time series and sample sizes but without larval/juvenile surveys in the Aleutians, these are the only direct observations of YOY Atka mackerel

Ecosystem Indicators



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Current Development: Causal Workflow in ESPs

Structural Causal Enhanced Assessment Model (SCEAM) / DSEM framework (Champagnat et al., accepted, Thorson et al., 2024)

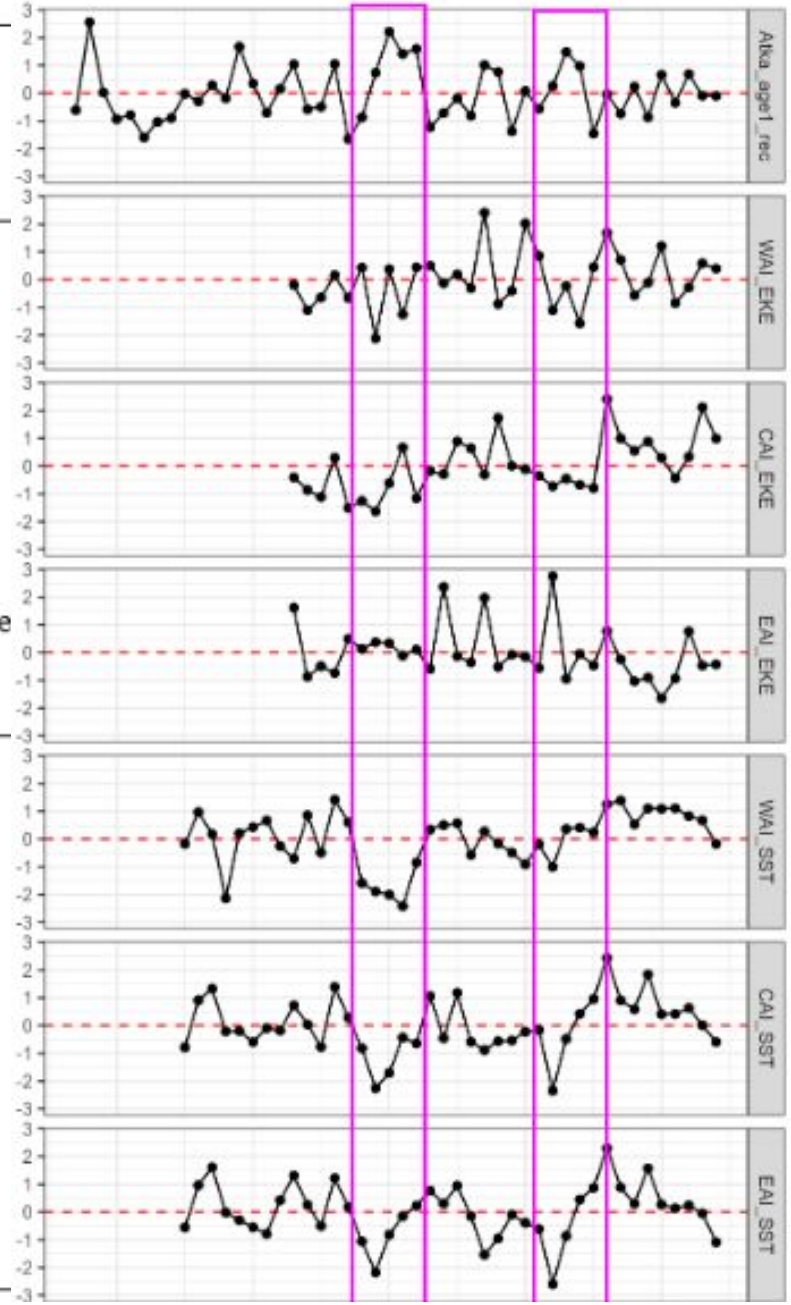
- Mechanism table and Directed Acyclic Graphs (DAG)
  - Use synthesis and any established relationships from ESP to develop mechanism table
- Use Dynamic Structural Equation Model (DSEM,) for estimation
  - Test multiple models, evaluate relationships, model selection
- Use new Rceattle, expanded to link recruitment to environmental variables via DSEM (Adams et al., 2022; Holsman et al., 2016)

How could this work for Atka?

- Uses EKE, spring SSTs
- Hypotheses
- DAGs & candidate models
- SCEAM: Fit integrated DSEM in Atka Rceattle model

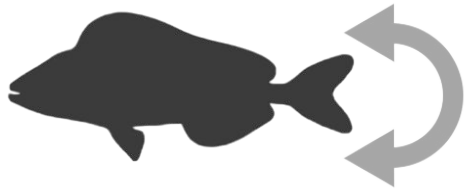
Collaboration w/ Grant Adams, Cole Monnahan, Kalei Shotwell

Driver	Causal Hypothesis	Lag to Age-1 Recruitment	Effect direction	Site-specific notes
Spring EKE (Apr-Jun) Wei Cheng Coye 2005; Zimmerman and Prescott, 2020; Saito et al., 2013; Saito et al. 2016; Stabeno et al., 2009	Direct effects on spring temperatures. Indirect effects on YOY Atka mackerel by promoting favorable thermal and feeding conditions	1 yr	EAI = negative CAI = positive WAI = positive	EAI = associated with increased flow between GOA and EBS via Alaska Stream and Aleutian North Slope Current EAI = narrower passes = more upwelling CAI=associated with Bering Slope Current, influences zooplankton community in Amchitka CAI/WAI = wider passes = more lateral exchange of warm water masses
Spring SST Matt Callahan Rand at al., 2010 (food quality & bioenergetics)	Temperature has direct effects on Atka mackerel metabolic rates and larval development. Indirect effects on larval growth and survival through ecosystem processes like plankton phenology.	1 yr	EAI = negative CAI = negative WAI = negative	Temperatures are highly correlated among sites.

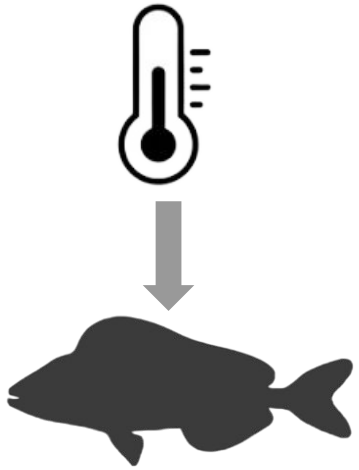


Alternative Models

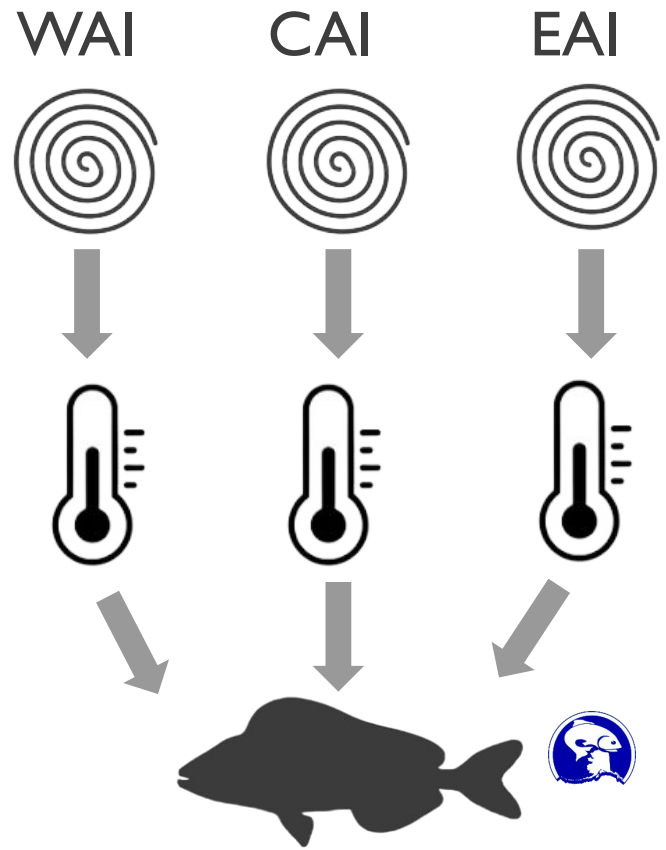
Base Model
(iid recruitment)



SST Regression Model



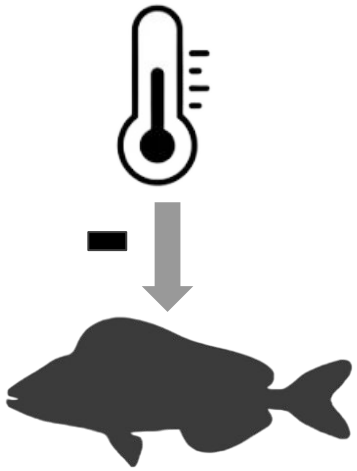
DSEM Model



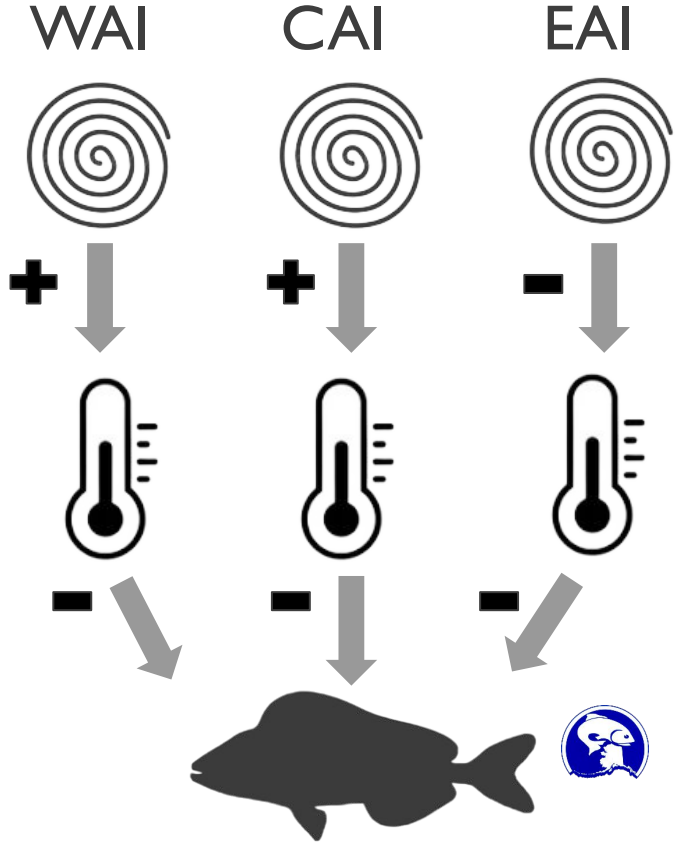
Alternative Models

Driver	Lag to Age-1 Recruitment	Effect direction
Spring EKE	1 yr	EAI = negative CAI = positive WAI = positive
Spring SST	1 yr	EAI = negative CAI = negative WAI = negative

SST Regression Model



DSEM Model



Alternative Models

Driver	Lag to Age-1 Recruitment	Effect direction
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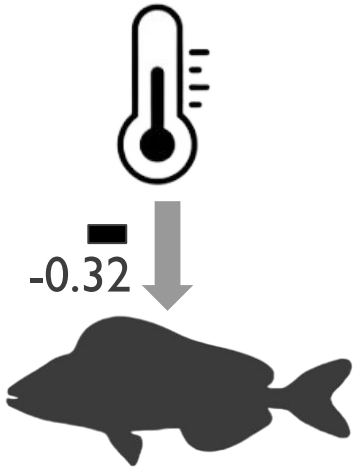
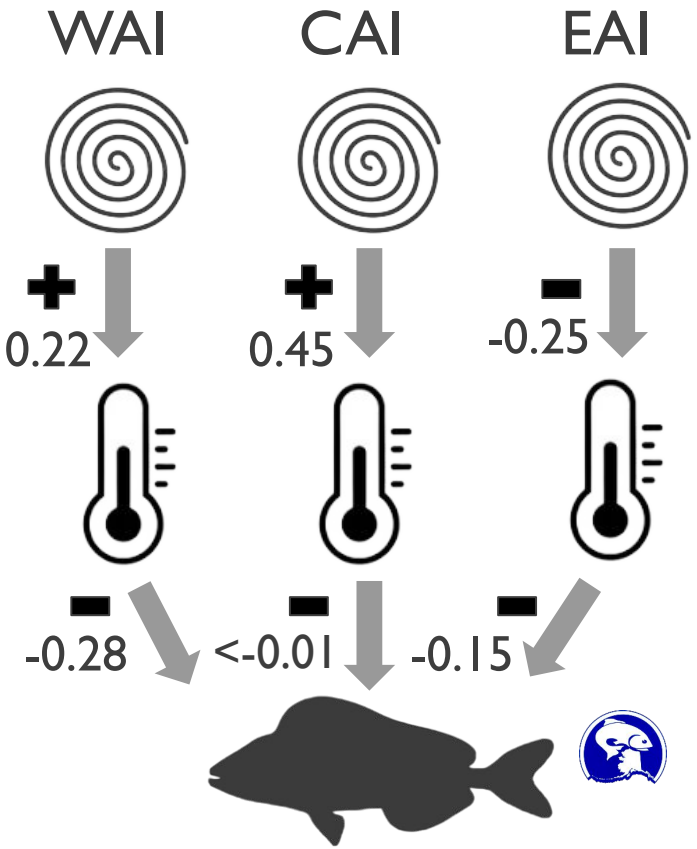
SST Regression Model



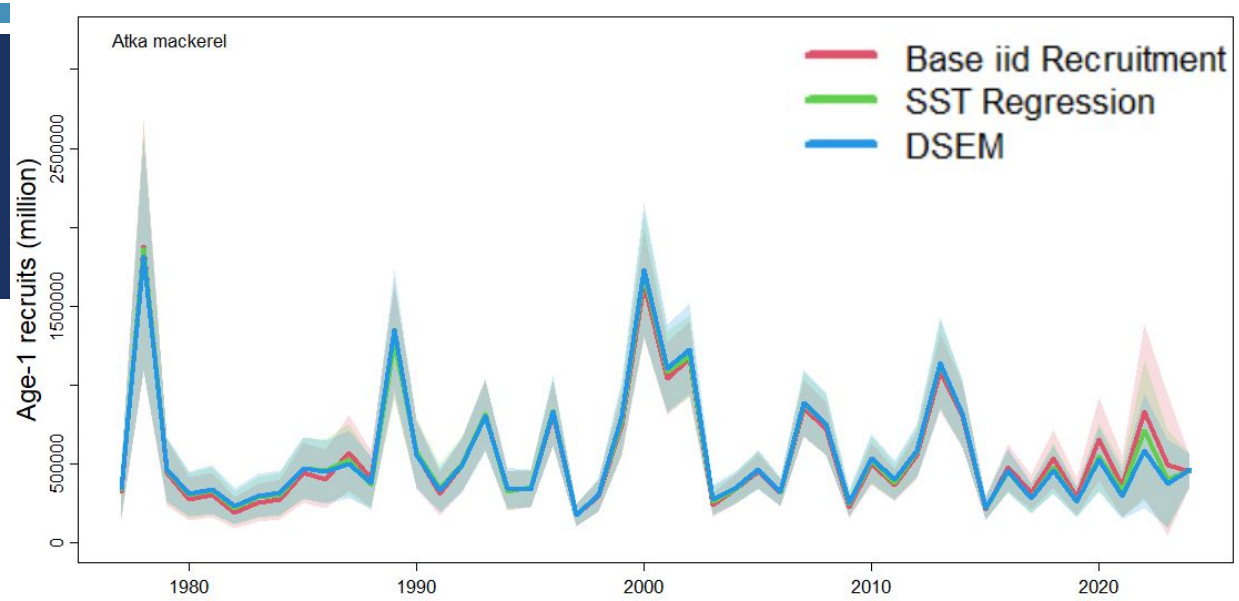
DSEM Model

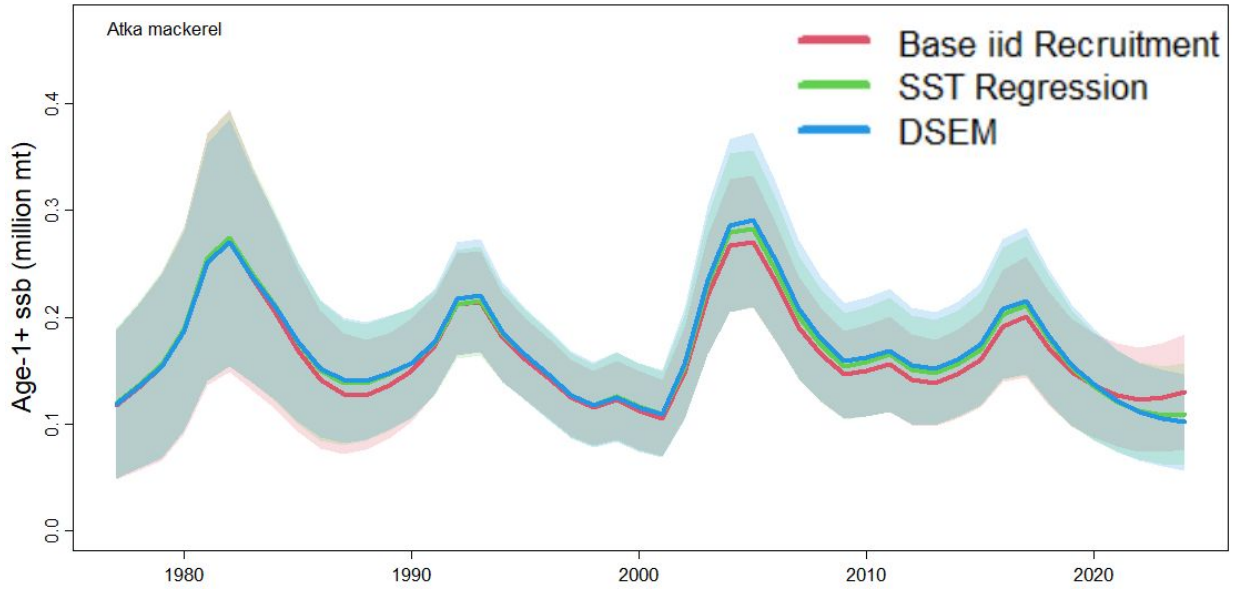


Model Results

Downgrade in recent recruitment/SSB estimates attributed to warm temperatures in the Aleutians

~20% reduction in recruitment variance





Next Steps

- Incorporate review feedback, ESP team coordination
- Indicator evaluation
  - New predictive/contextual organization, Traffic light, Bayesian adaptive sampling, SCEAM/DSEM work in Rceattle
- Investigating economic value through a natural value capital accounting modelling framework

Discussion

1) Is Sep/Oct 2025 → Nov 2026 timeline reasonable?
2) Feedback on current indicator suite: interpretation, caveats, missing indicators
3) Feedback on SCEAM/DSEM causal workflow

Thank You!

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Thank you, data contributors!