CEFI & CRF Regional Highlights and a focus on the Alaska Region

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11 Sept 2024

CEFI Summit, May 7-9, 2024 (SWFSC, La Jolla, CA)

The CEFI Summit brought together NOAA builders and users of the CEFI Decision Support System. It included over 140 participants from four NOAA Line Offices (NMFS, OAR, NOS, NESDIS) and all U.S. ocean and coastal regions, and the Great Lakes. The Summit:

1. **affirmed the CEFI purpose, goals, and structure;**
2. **provided input on products, workflows and timelines for CEFI System Components;**
3. **strengthened collaborations; and,**
4. **identified key next steps, including continued engagement with target audiences/users.**

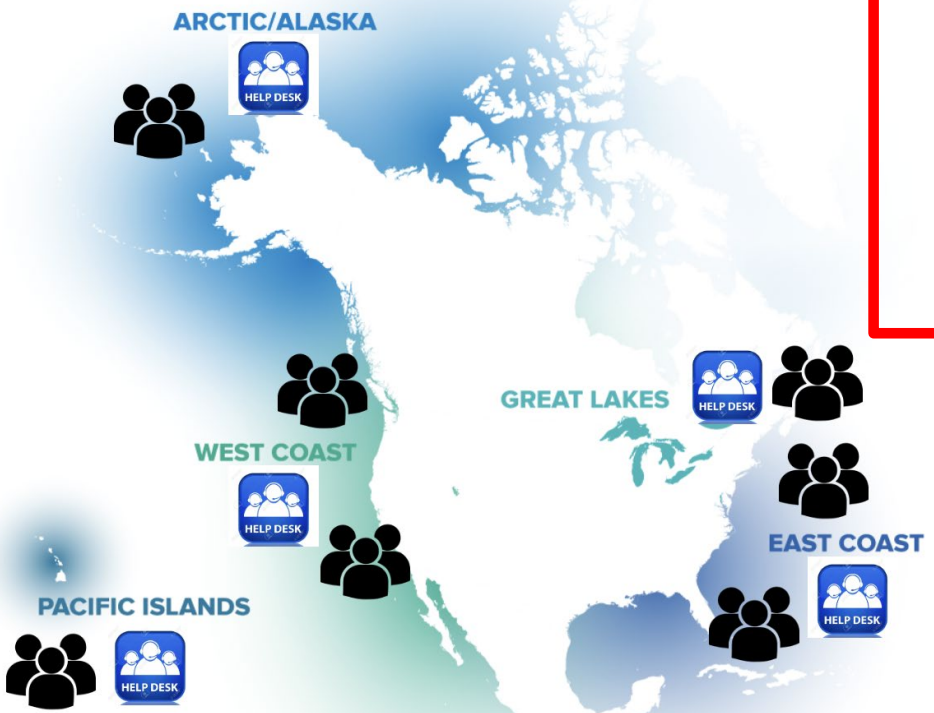
NOAA FISHERIES

CEFI Regional Teams

Regional Ocean Modeling Teams

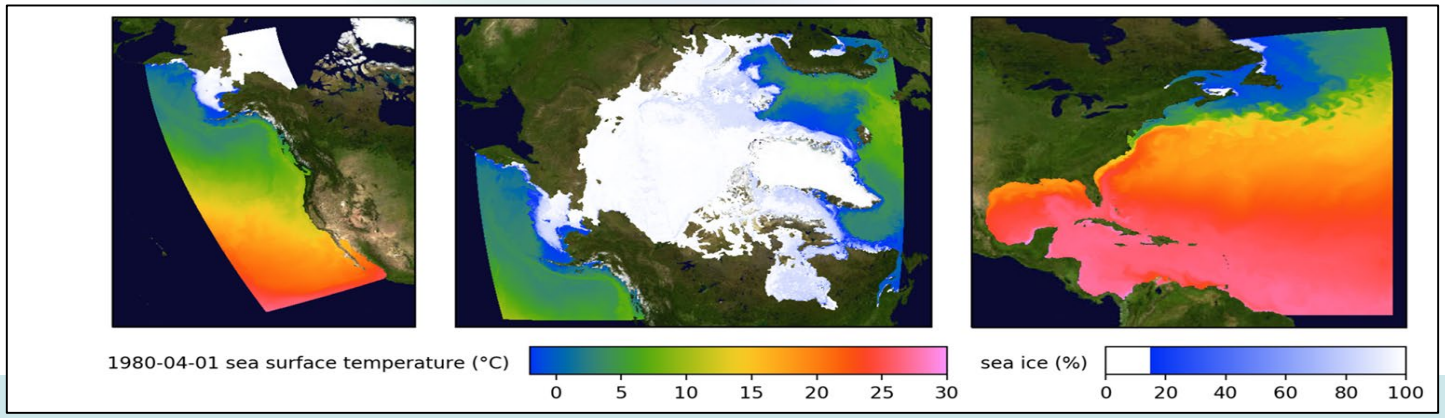
HELP DESK

Customize MOM6 regional ocean outlooks for Decision Support Teams & other users



Total 45 new (CEFI) positions nationwide:

- ***27 NMFS***
- ***11 OAR***
- ***7 NOS***



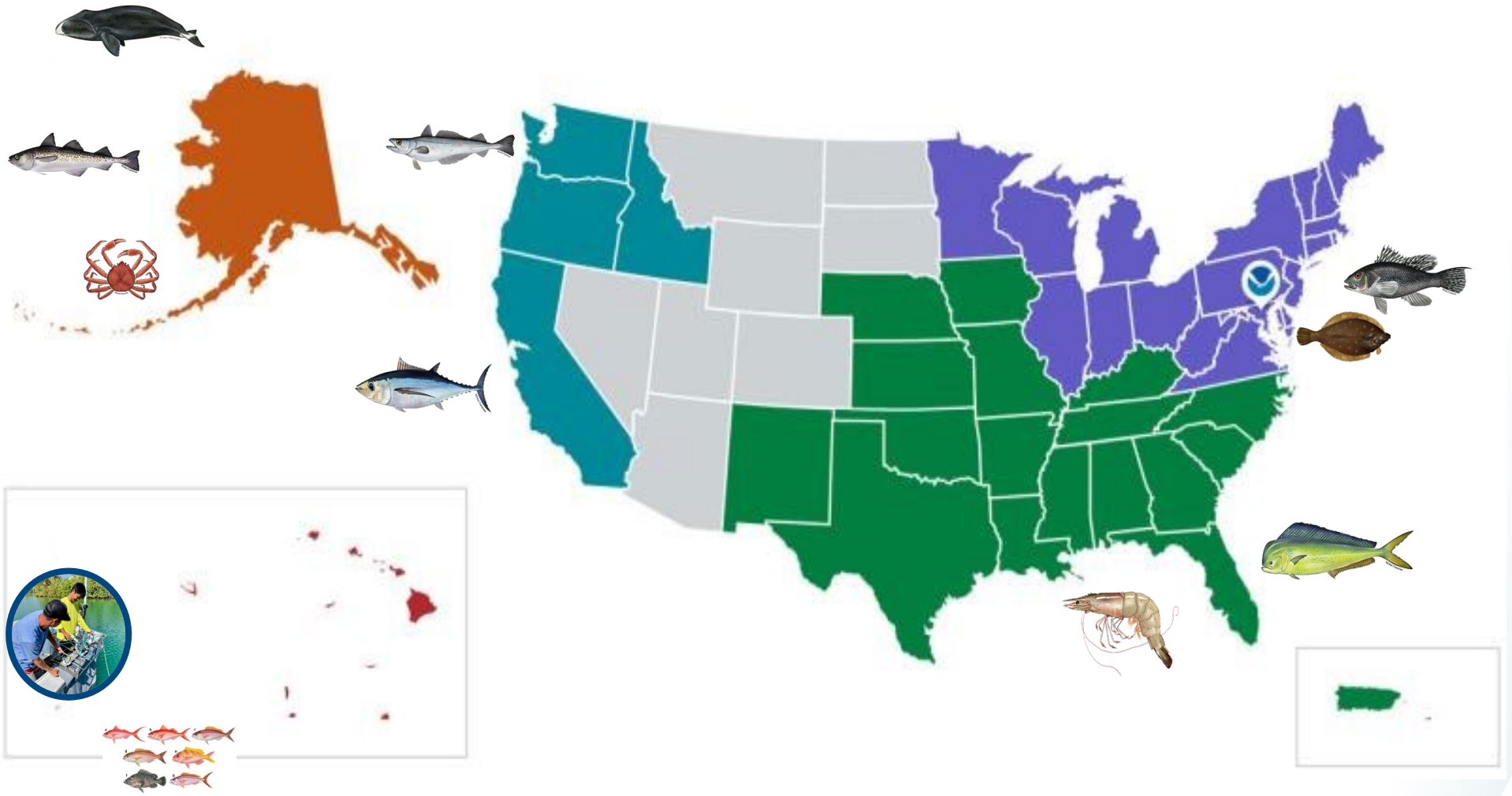
Regional Decision Support Teams

Produce socio-ecological outlooks, information & advice for decision makers

Regional Ocean Modeling Deliverables

Year	East Coast	West Coast and Arctic	Great Lakes, Pacific Islands
FY23	**Initial hindcast** ✓	Initial Configuration ✓	
FY24	Hindcast update, retrospective **seasonal predictions** ✓	**Initial hindcast** ✓	Initial configuration ✓
FY25	Hindcast update, retrospective **decadal predictions**, initial climate change projections	Hindcast update, retrospective **seasonal predictions**, initial climate change projections	**Initial hindcast**
FY26	Hindcast update, **expanded projections**, seasonal outlooks	Hindcast update, retrospective **decadal predictions,** initial climate change projections	Hindcast update, retrospective **seasonal predictions**, initial climate change projections
FY27	**All products reliably delivered**	Hindcast update, **expanded projections**, seasonal outlooks	Hindcast update, retrospective **decadal predictions,** initial climate change projections
FY28	**All products reliably delivered**	**All products reliably delivered**	Hindcast update, **expanded projections**, seasonal outlooks
FY29	**All products reliably delivered**	**All products reliably delivered**	**All products reliably delivered**

Climate Ready Fisheries Regional Pilots/Highlights



NOAA FISHERIES

Research and Management Track Assessments to Prepare Northeastern Fisheries for Climate Change

Research Track Assessments and Management Track Assessments will provide scientific information to the appropriate fishery management bodies to help them make informed decisions in the U.S. Northeast. ***Synergies: CEFI, Social Science***

Management Strategy Evaluation (MSE) for More Effective Dolphinfish Management

Dolphinfish, or mahi mahi, is an iconic species in the eastern U.S. Recent concerns over increased user conflicts, variable availability, and international harvest have sparked the need for a more flexible and adaptive management approach. ***Synergies: CEFI, Social Science***

Scenario Planning for Shrimp

Ecosystem modeling will be used for scenario planning as part of the Shrimp Futures CEFI project to understand the impacts, vulnerabilities, and risks on both shrimp and shrimp communities.***Synergies: CEFI, Social Science***

Leveraging Advanced Technologies for Pacific Hake

Pacific hake, a cornerstone of the West Coast's commercial fishing industry, faces unprecedented challenges due to climate change. ***Synergies: Active Acoustics, CEFI, Equity and Environmental Justice, 'Omics, Social Science***

Addressing Resource Availability Shifts and Community Impact for North Pacific Albacore

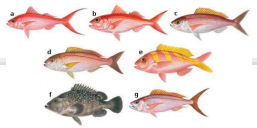
Research on potential future states of North Pacific Albacore on the West Coast will assist decision-making for domestic and international fishery managers. ***Synergies: CEFI, Future Seas, Social Science***

Cultivating Climate-Ready Fisheries with Island Communities

Three data-centered projects in Guam, in partnership with the community to improve stock assessments and fisheries management.

Synergies: Equity and Environmental Justice, Social Science

- **Centralizing Community Data in Guam**
- **Modernizing Data Collection**
- **Guam Bottomfish Fishery-Independent Survey**



NOAA FISHERIES

Alaska

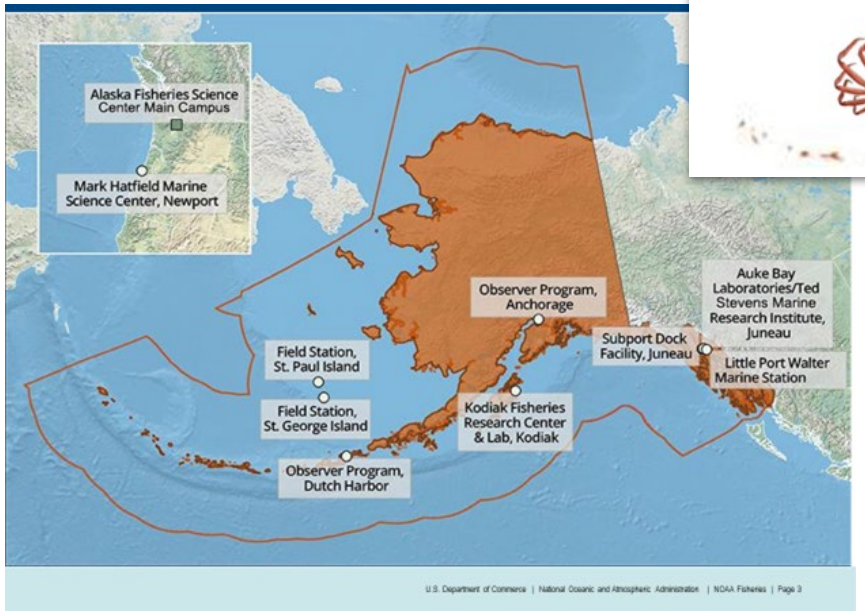
Improving Industry, Fishing Community, and Indigenous Climate Resilience in the Arctic

The AFSC is building capacity in innovative data collection, improved climate projection skill, and provision of climate service models.

Synergies: CEFI, EEJ, Social Science

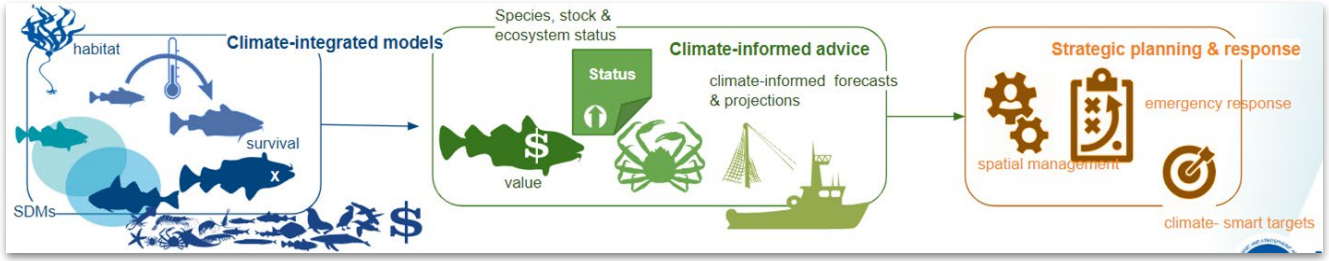
Principles of Climate Ready Fisheries

- Long-term Management Support
- Historic, Current, and Future Fishery States
- Using Best Available Science and Knowledge Base
- Climate Impacts, vulnerabilities, and risks
- Equity and Environmental Justice

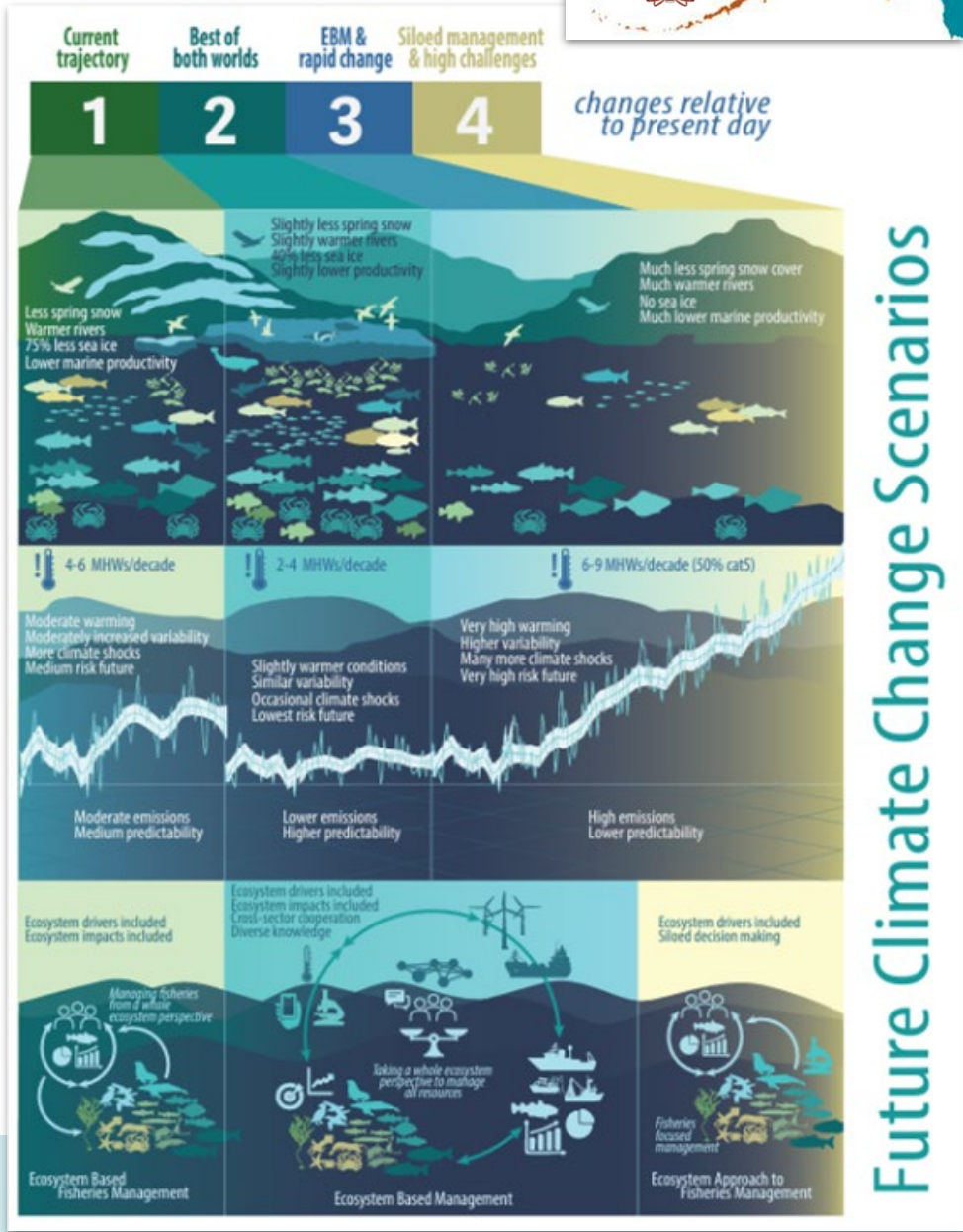


Alaska - Long-term Management Support

CEFI



- ACLIM (2017): an interdisciplinary collaboration to project and evaluate climate impacts on marine fisheries in the Bering Sea, Alaska.
- CEFI: will build the end-to-end, operational modeling, and decision support system needed to provide the information and capacity resource managers and stakeholders need to reduce impacts and increase resilience in a changing climate.
- Recent accomplishments:
  - Species distribution models linked to climate are available now
    - Forecast locations of fisheries in the future
    - Predict overlap of commercial fish species in the future
  - Collective outcome models from Climate Scenarios workshop
- Near term products:
  - Hindcasts, seasonal forecasts, and long-term projections for the Alaska region via open access indices
  - Process for evaluation and skill testing of Climate Integrated Stock Assessments and reference points
  - Delivery of Climate enhanced stock assessments for 2-3 key stocks
  - Updated climate vulnerability and risk assessments for key species
  - Climate enhanced species distribution models for key species

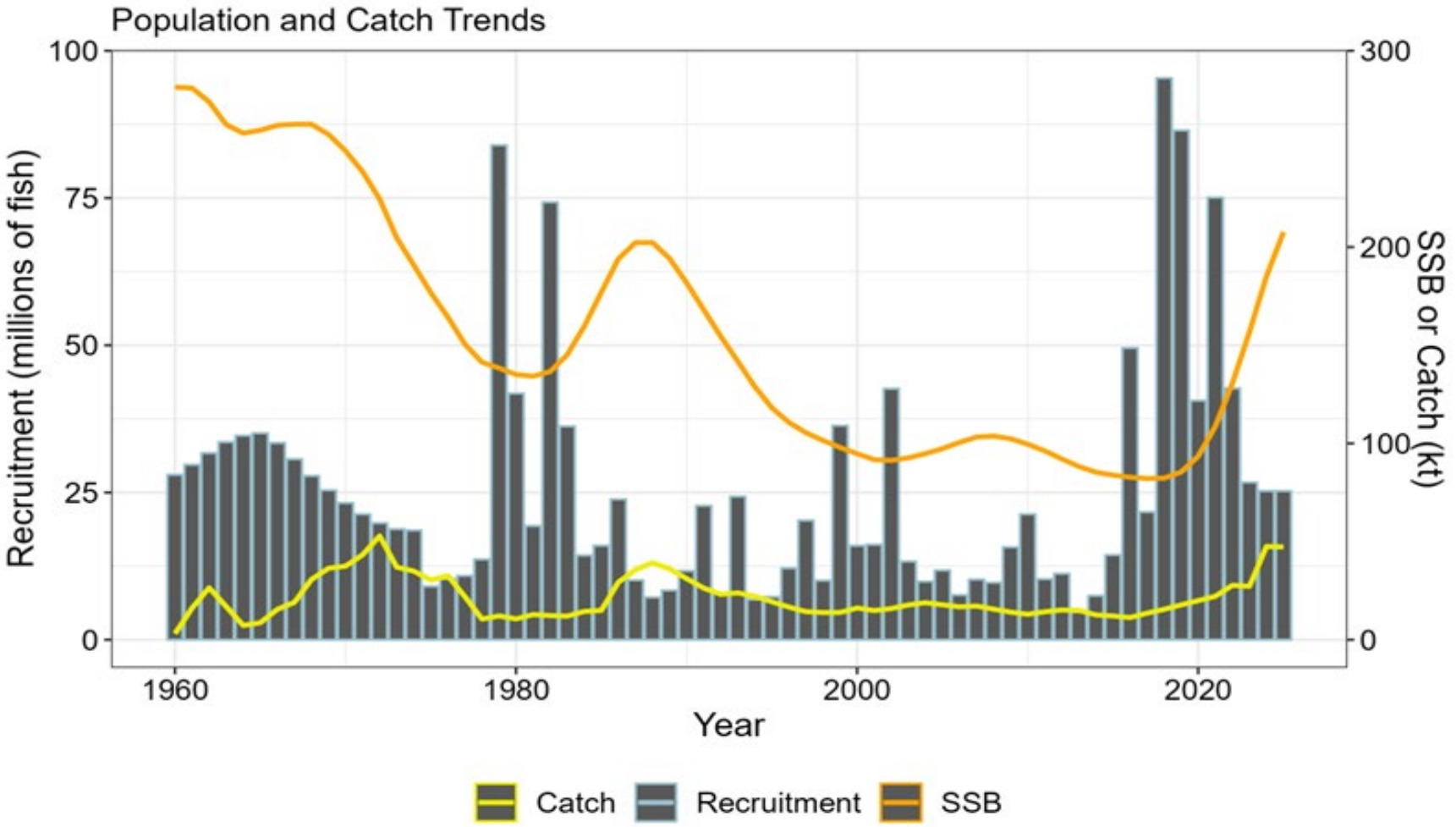


Alaska - Long-term Management Support

Create a seafood demand toolbox for managers and industry to quickly evaluate the changing conditions in Alaska fisheries impacts on seafood prices.

What about Sablefish?

- Massive population/quota shift to EBS
  - Increase in discards
  - Increase in trawl catch
- Markets
  - Price disparity increases for size grades
  - Overall decline in price even at large sizes



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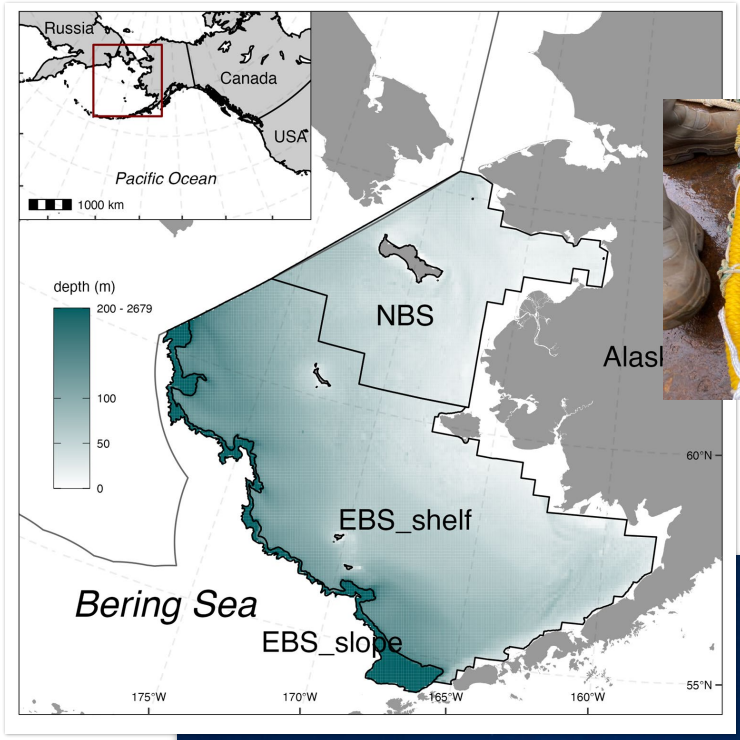
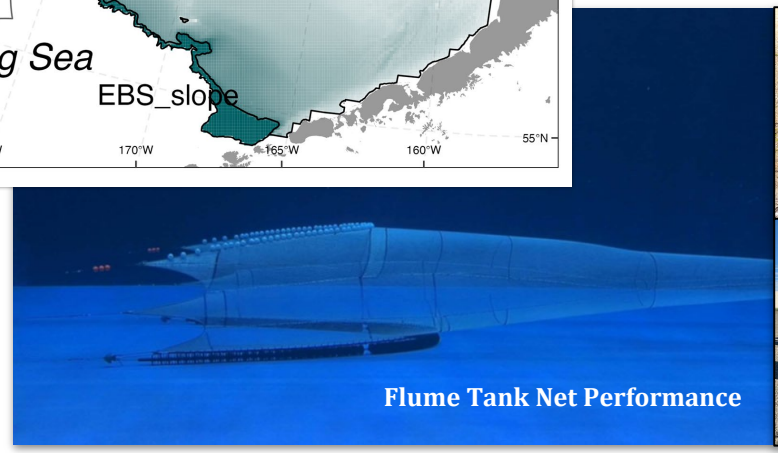
Alaska - Historic, Current, and Future Fisheries States

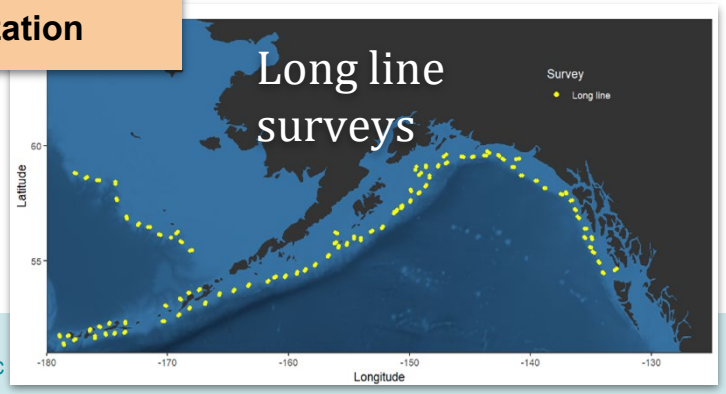
Bering Sea Survey Modernization

- **Update EBS/NBS/EBS-Slope survey Design**
  - Integrate into one cohesive survey design increasing efficiency and nimbleness to respond to a changing environment.
- **Modernize sampling net**
  - Current 83-112 eastern trawl dates from the 1970's
- **Incorporate new sampling technologies**
  - eDNA
  - Greater use of Optical systems/AI
  - Increased capacity for environmental sampling (PH, oxygen, etc)
- **Increase design capacity to accommodate multi-mission survey operations**
  - e.g. acoustics, oceanography, marine mammals, etc.





Longline survey modernization underway as well

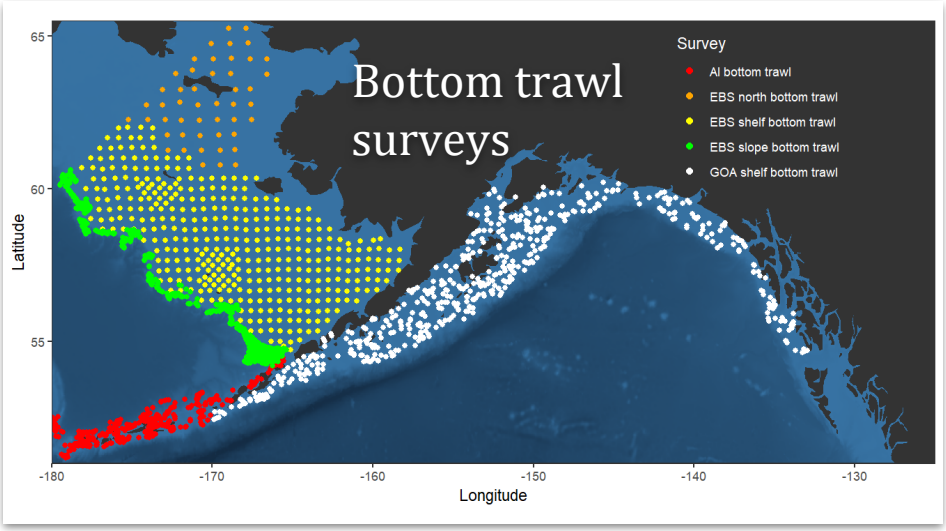


NOAA FISHERIES

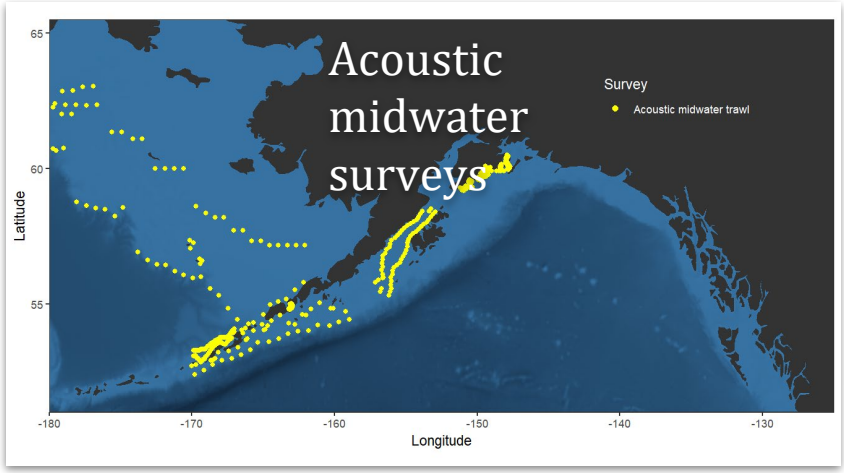
Alaska - Historic, Current, and Future Fisheries States

Bering Sea Survey Sustainment

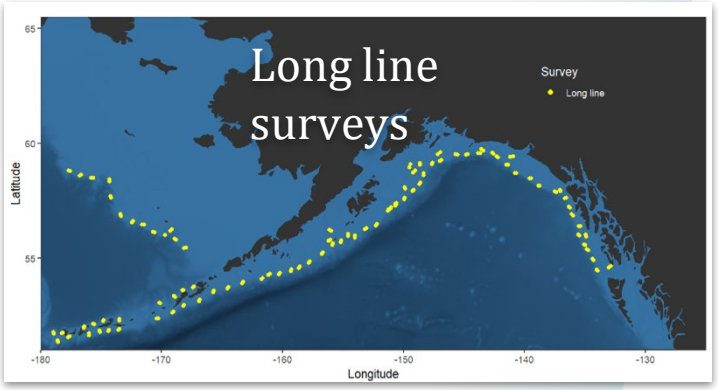
AFSC stock assessment surveys



Gulf of Alaska Continental Shelf Bottom Trawl (May-Aug, F/Vs Ocean Explorer and Sea Storm)
Eastern Bering Sea Continental Shelf Bottom Trawl Survey
(May-Aug, F/Vs Alaska Knight and Vesteraalen)
Northern Bering Sea Continental Shelf Bottom Trawl Survey
(August, F/Vs Alaska Knight and Vesteraalen)



Winter Acoustic Trawl Survey (Gulf of Alaska, March, FSV Shimada)
Summer Acoustic-Trawl Survey EBS
(Island of Four Mountains to Yakutat Bay May-Aug, FSV Oscar Dyson)
Northern Bering Sea Mid-Water Acoustic Survey
(Northern Bering Sea to Southern Chukchi Sea 60 N to 69.5 N, Aug-Sept, F/V Northern Explorer



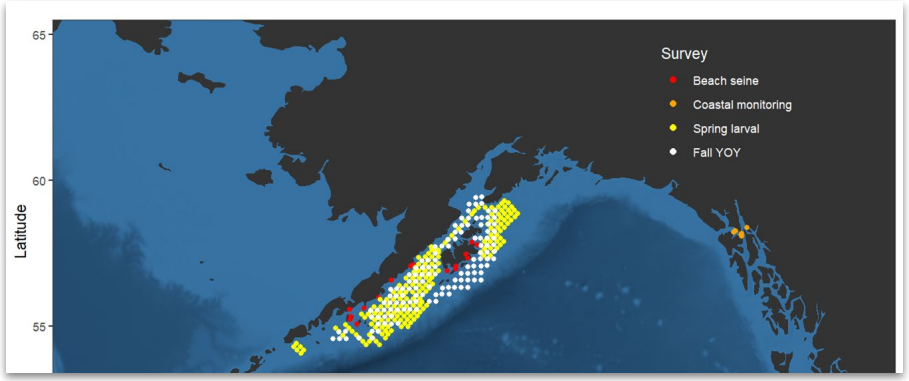
Longline Survey (Gulf of Alaska, Bering Sea, May-June)

NOAA FISHERIES

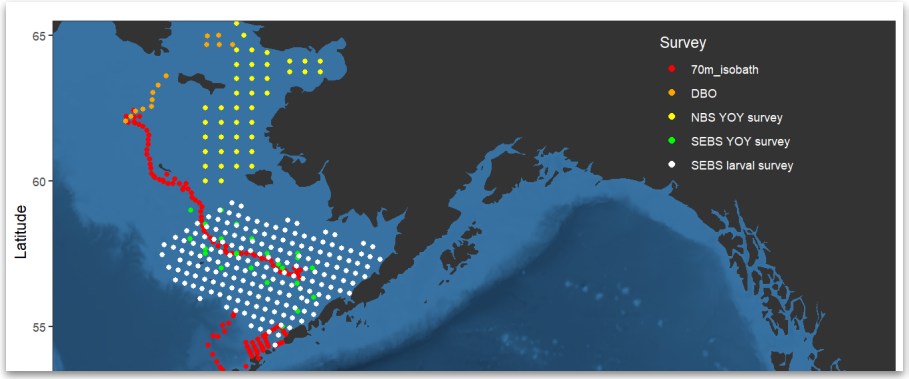
Alaska - Historic, Current, and Future Fisheries States

Bering Sea Survey Sustainment

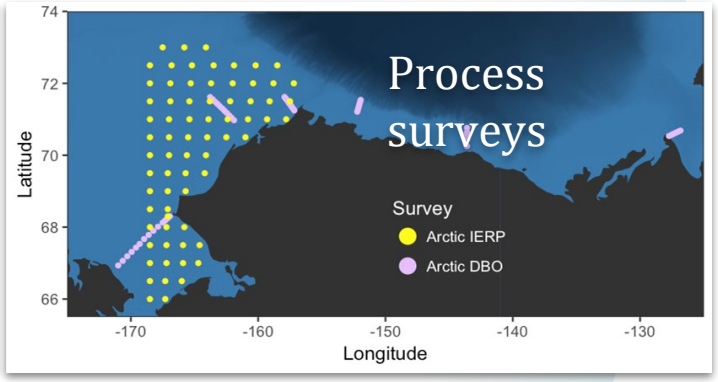
AFSC ecosystem/process surveys (and collaborations)



Spring Ichthyoplankton Surveys (Shelikof Strait, Sea Valley, Gulf of Alaska, May, FSV Oscar Dyson)
Southeast Alaska Coastal Monitoring (Gulf of Alaska and inside state waters of SE Alaska, June-Sept) (ADF&G survey we provide staff, R/V Medeia)
Fall Juvenile Fish Survey (Coastal Gulf of Alaska, odd years, Aug-Sept, FSV Oscar Dyson)



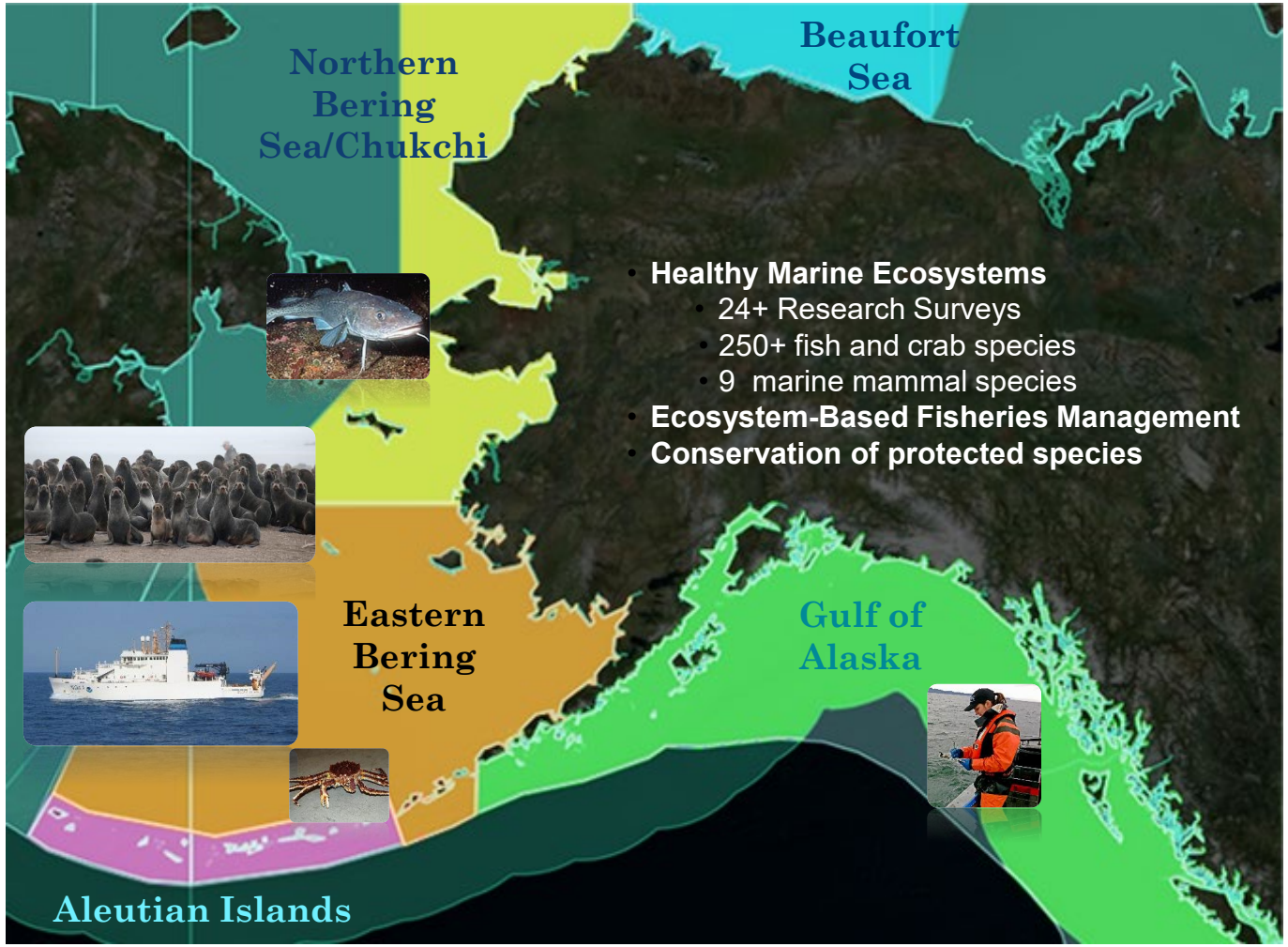
Spring/Fall Mooring and Ecosystem Observation Survey (Eastern Bering Sea, 70m isobath, Apr-May/PMEL, FSV Oscar Dyson)
RWP Moorings Project (estimating pollock flux across the U.S./Russia Border)



Arctic Ecosystem Observations -- DBO (Chukchi, August, USCGC Healy)

Arctic Integrated Ecosystem Survey (U.S. Chukchi Sea 65 N to 73 N, western Beaufort Sea Shelf & Shelf Break from 145 W to 165 W Aug-Oct, F/V Ocean Starr) (completed in 2019)

Alaska - Best Available Science and Knowledge



- Alaska EEZ = 1.5 million nm^2
- 5 Large Marine Ecosystems
- 60% U.S.-caught seafood; 31% of value*FUS 22
- $15 B economic output to U.S.*McKinley Research 22
- Top 3 volume fishing ports in U.S.
- Seafood industry supported 74,424 jobs, generated $5.1 B-sales, $2.3 B income & $2.8 B value-added impacts in AK.*FEUS 22

THE CHALLENGE

Complexity and geographic scope of the mission is vast and increasing

NOAA FISHERIES

Alaska - Best Available Science and Knowledge

Balanced Research Portfolio

Why?

- Building resilience in shifting ecosystem states
- Environmental variability & climate change
- Support dynamic management tools

NOAA FISHERIES

Alaska - Best Available Science and Knowledge

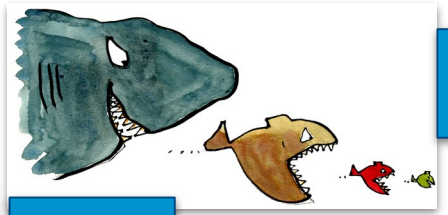
What is needed for sustainable fisheries and climate adaptation?

Ecosystem Surveys & Next Generation Assessments

Pac Cod Research Process & Tagging

New Survey Technology

Genetic Studies



Food Habits - Collection & Analysis

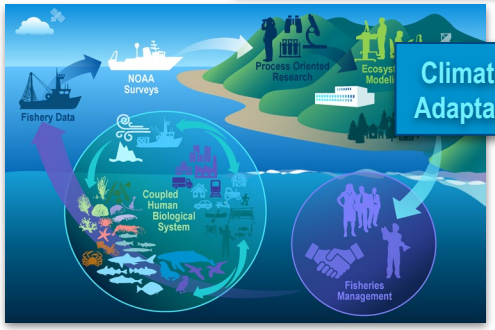
Salmon Bycatch - Aging Support

Chukchi & Beaufort Fish Surveys

Pollock Transboundary Movements

Marine Mammal Observer Program

Co-Management



Climate Modeling-Adaptation

Little Port Walter Research

Marine Mammal Surveys & Food Habit Studies

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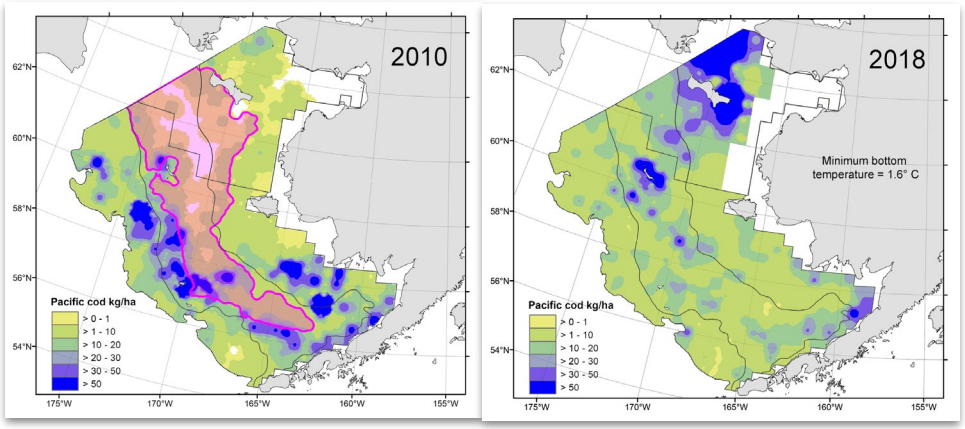
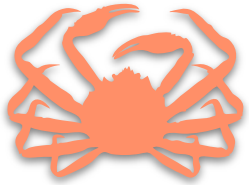
Alaska - Climate Impacts, Vulnerabilities, and Risks

Develop climate vulnerability and risk assessments through social science tools to inform adaptation strategies for fishing communities in the Arctic.

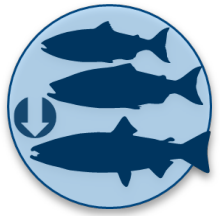
1. Fish distribution shifting north



1. Some species **in decline** while others **stable or increasing**



Bering Sea snow crab



Western Alaska salmon

Sablefish (2014 - 2019)

Pollock (2018)

Togiak herring (2016 and 2017)

Bristol Bay sockeye salmon (2015 - 2023)

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Alaska - Equity and Environmental Justice

Increase capacity for data collection, monitoring, and engagement with underserved and Indigenous communities disproportionately affected by climate change.

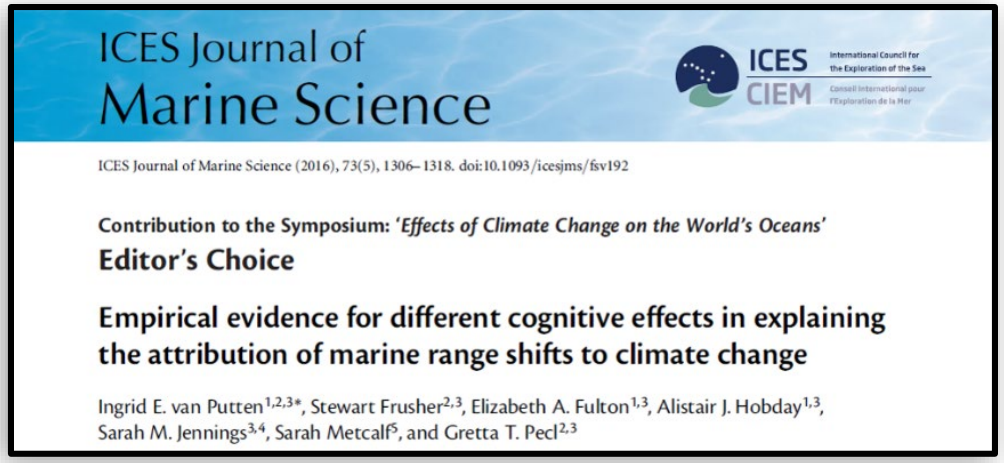
NOAA FISHERIES

Recognize, attribute, anticipate…and react

Climate-fisheries research at the Kodiak Lab

Adaptation requires stakeholders to recognize, attribute, and anticipate change

- Recognize*:* Identify the cause of fisheries volatility
- Attribute*:* To what degree are these causes one-off events vs. a human-induced trend?
- Anticipate*:* Compare historical, current, and next-decade climate risk for fisheries
- Effective information is simple information at the right time scale (this decade, next decade)



ICES Journal of Marine Science

ICES Journal of Marine Science (2016), 73(5), 1306–1318. doi:10.1093/icesjms/fsv192

Contribution to the Symposium: *'Effects of Climate Change on the World's Oceans'*

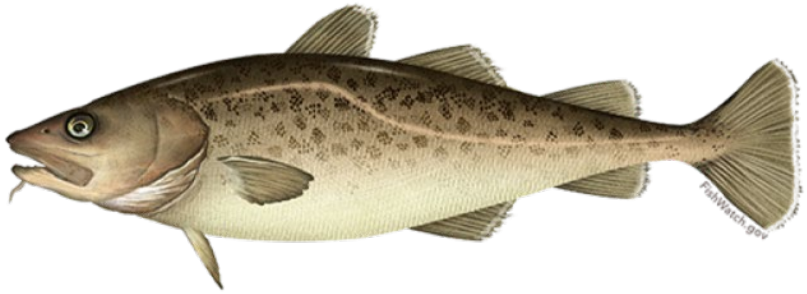
Editor's Choice

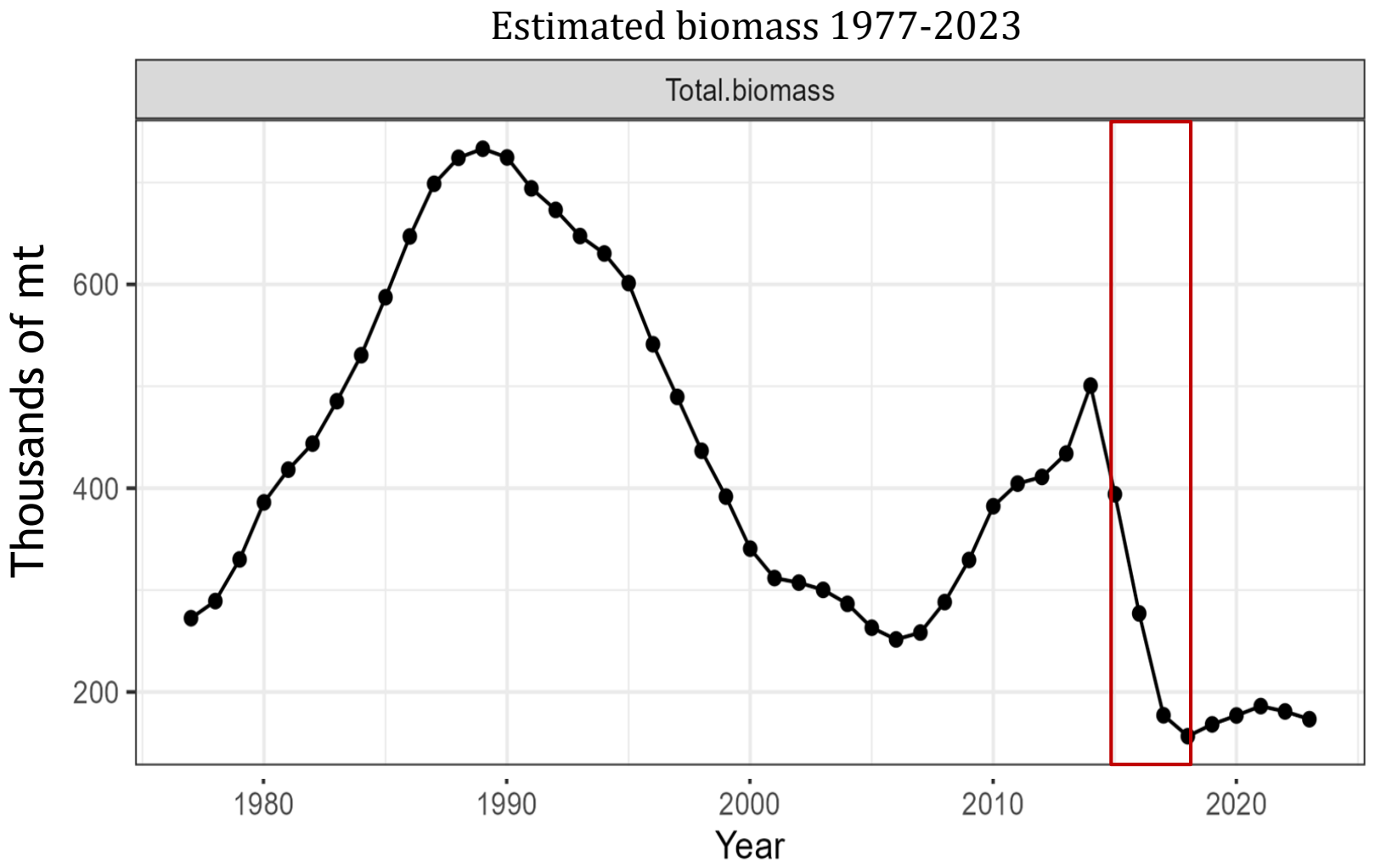
Empirical evidence for different cognitive effects in explaining the attribution of marine range shifts to climate change

Ingrid E. van Putten[1,2,3*], Stewart Frusher[2,3], Elizabeth A. Fulton[1,3], Alistair J. Hobday[1,3], Sarah M. Jennings[3,4], Sarah Metcalf[5], and Gretta T. Pecl[2,3]

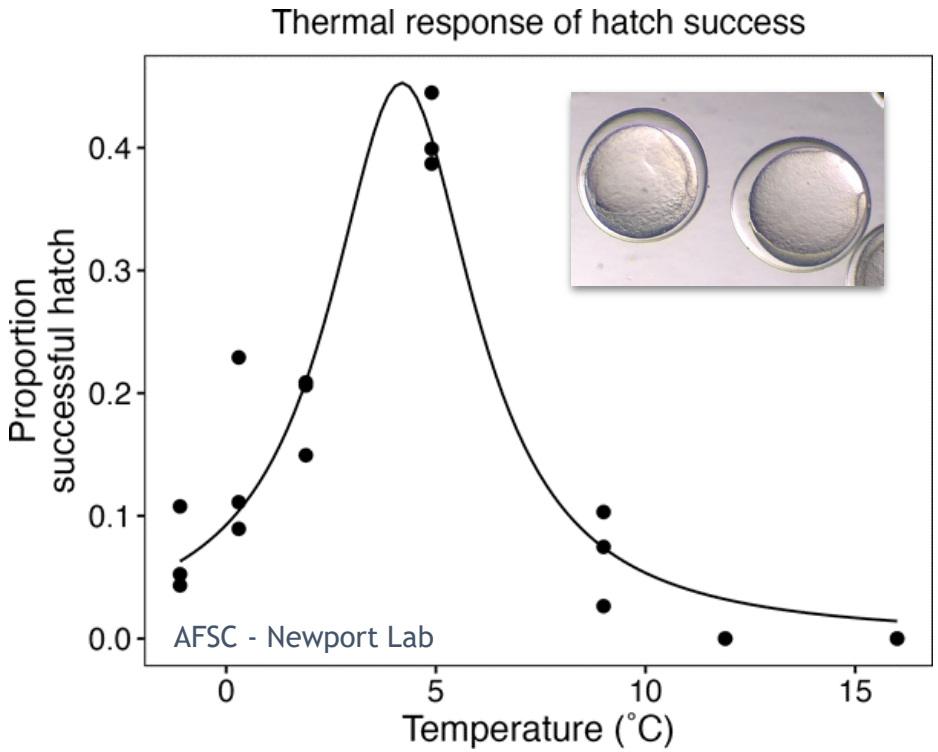
Example 1: Gulf of Alaska Pacific cod

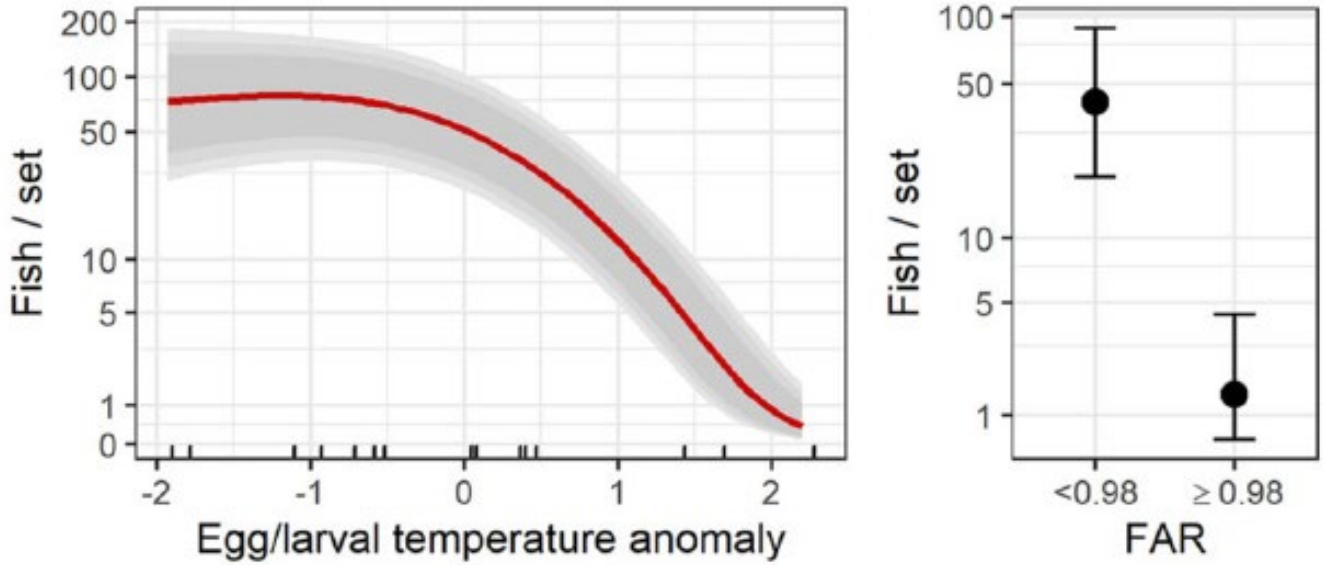
The stock has failed to recover since its collapse in 2015-17





Evidence of "system-breaking" climate effects on cod recruitment



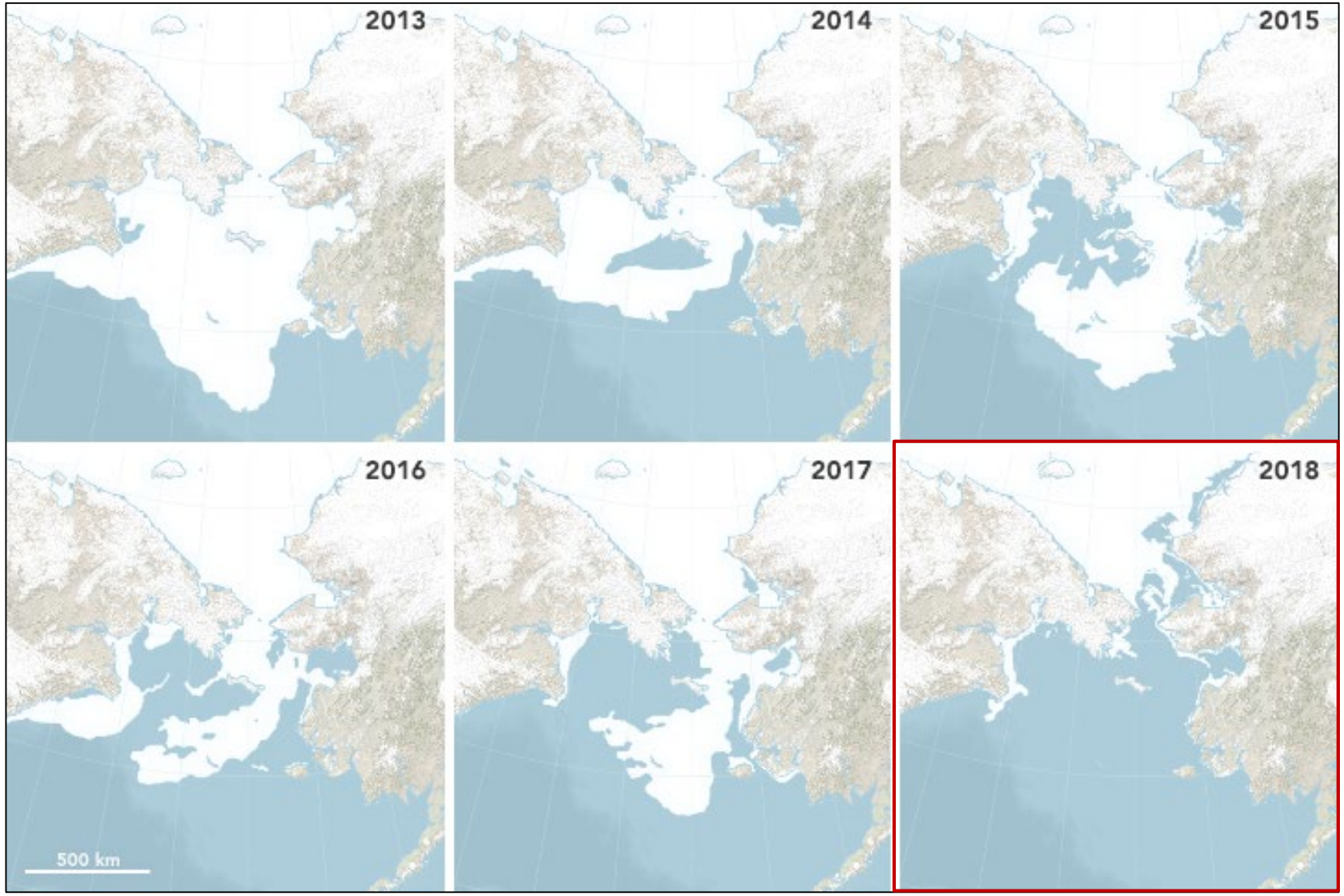


Recognize - Cod eggs can only survive in a narrow temperature range

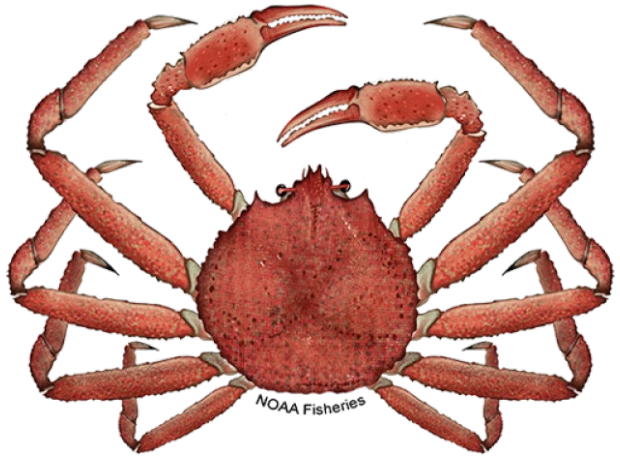
Attribute - Recruitment is very low in temperatures almost entirely due to human activities

Example 2: Bering Sea snow crab

Winter sea ice creates an Arctic/boreal (subarctic) boundary in the Bering Sea

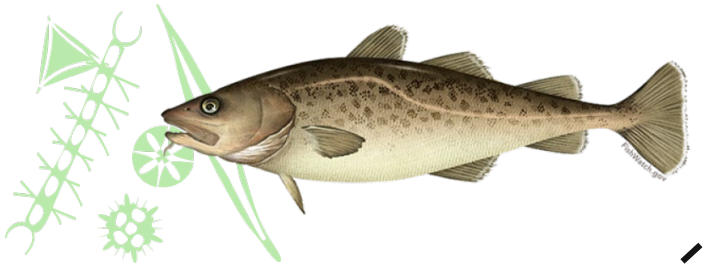


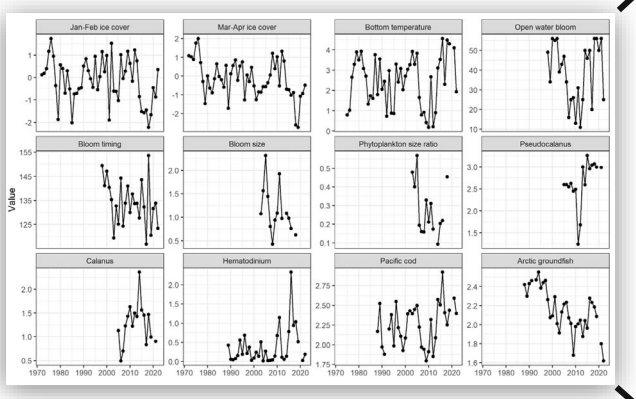
April 29 2013 - April 29 2018

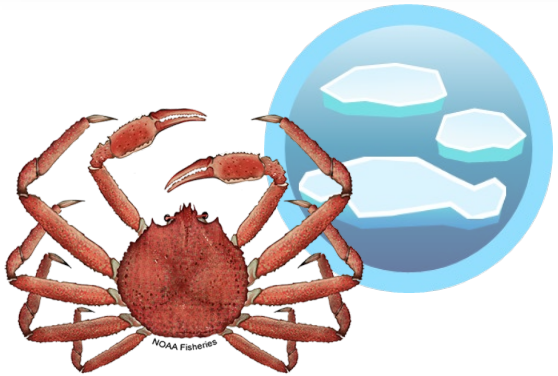


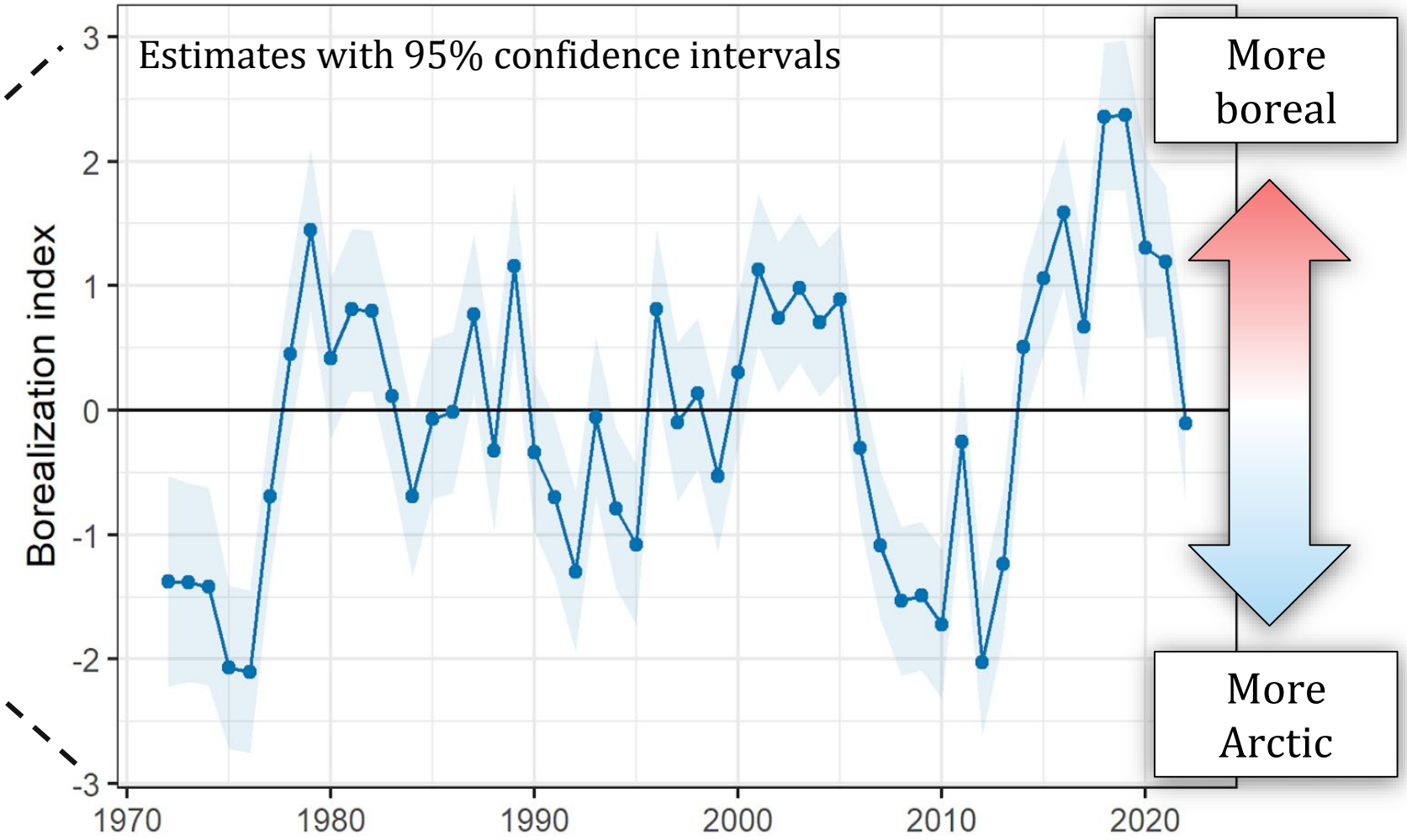
Can borealization predict the consequences of warming on snow crab, an Arctic species?

Borealization index: Dynamic Factor Analysis trend

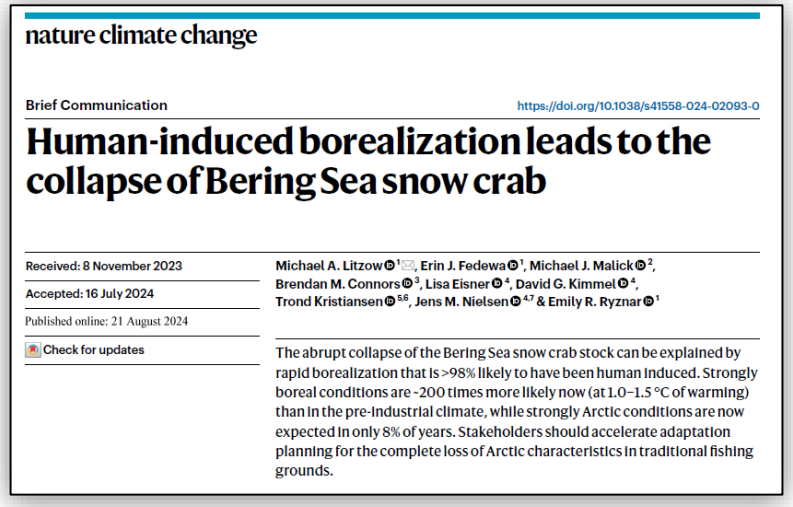








- ***Recognize*** - borealization exhibited a threshold response with abundance and is a better predictor of abundance than bottom temperature
- ***Attribute*** and ***anticipate*** - Historical conditions are increasingly irrelevant for understanding ecosystem dynamics
    - 2018-2019 collapse was human-induced
    - Arctic/boreal probability is rapidly changing
- Rapid increase in immature snow crab abundance provides hope for short-term recovery (3-4 years)
- Northern Bering Sea important for fishery's longer-term future



nature climate change

Brief Communication

https://doi.org/10.1038/s41558-024-02093-0

Human-induced borealization leads to the collapse of Bering Sea snow crab

Received: 8 November 2023

Accepted: 16 July 2024

Published online: 21 August 2024

Check for updates

Michael A. Litzow[1], Erin J. Fedewa[1], Michael J. Malick[2], Brendan M. Connors[3], Lisa Eisner[4], David G. Kimmel[4], Trond Kristiansen[5,6], Jens M. Nielsen[4,7] & Emily R. Ryznar[1]

The abrupt collapse of the Bering Sea snow crab stock can be explained by rapid borealization that is >98% likely to have been human induced. Strongly boreal conditions are ~200 times more likely now (at 1.0–1.5 °C of warming) than in the pre-industrial climate, while strongly Arctic conditions are now expected in only 8% of years. Stakeholders should accelerate adaptation planning for the complete loss of Arctic characteristics in traditional fishing grounds.

October 27, 2022

Bering Sea crabbers call for new ‘crisis response’ to fishery disasters

by Kirk Moore in Alaska, News

SHARE

Fishery Sustainability in the Spotlight with Catastrophic Loss of Snow Crab in Alaska

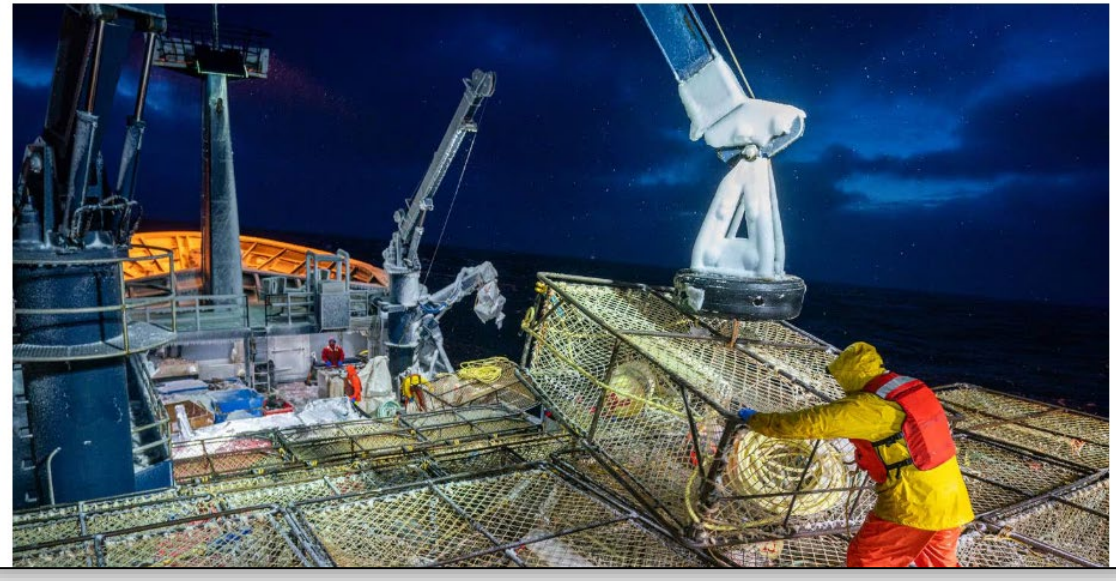
October 20, 2022 5 minute read

By Courtney Johnson-Woods

Business/Economy

Bering Sea crab collapse spurs push for stronger conservation measures

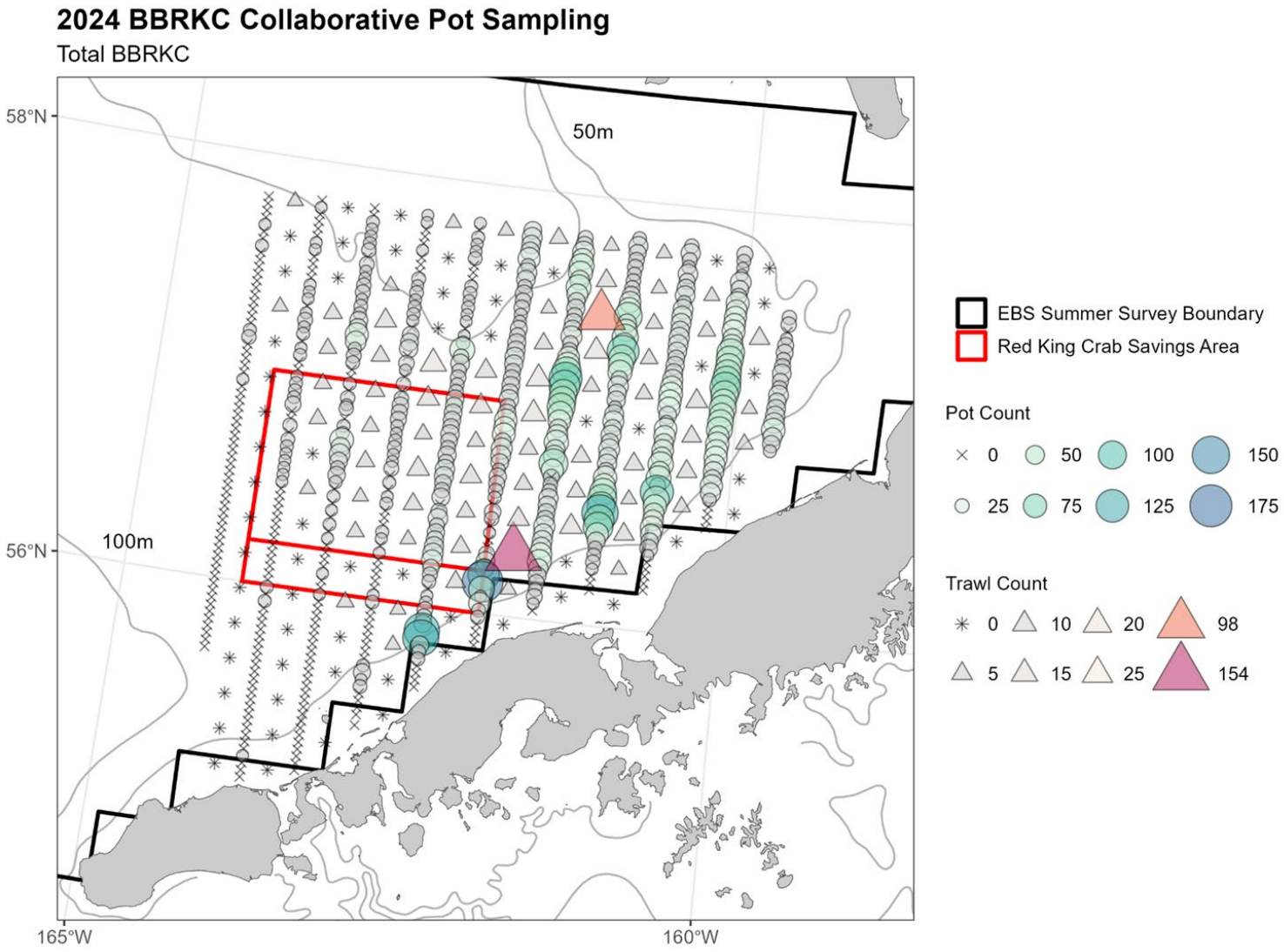
By Hal Bernton, The Seattle Times
Updated: December 8, 2022
Published: December 8, 2022



How can we be responsive to real-time stakeholder needs in a changing climate?

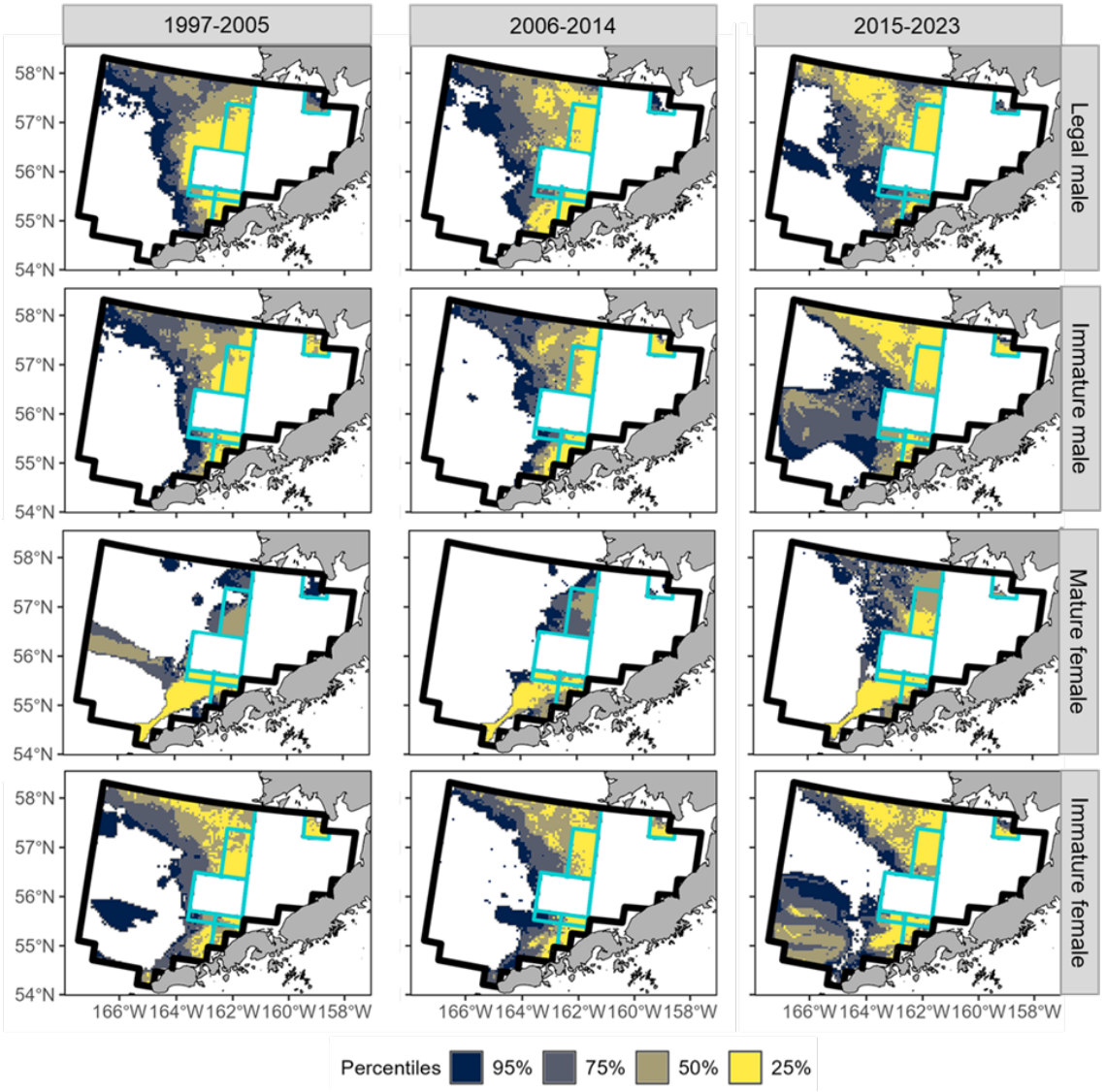
C. Lescher

Provide information on where red king crab occur in data-poor periods

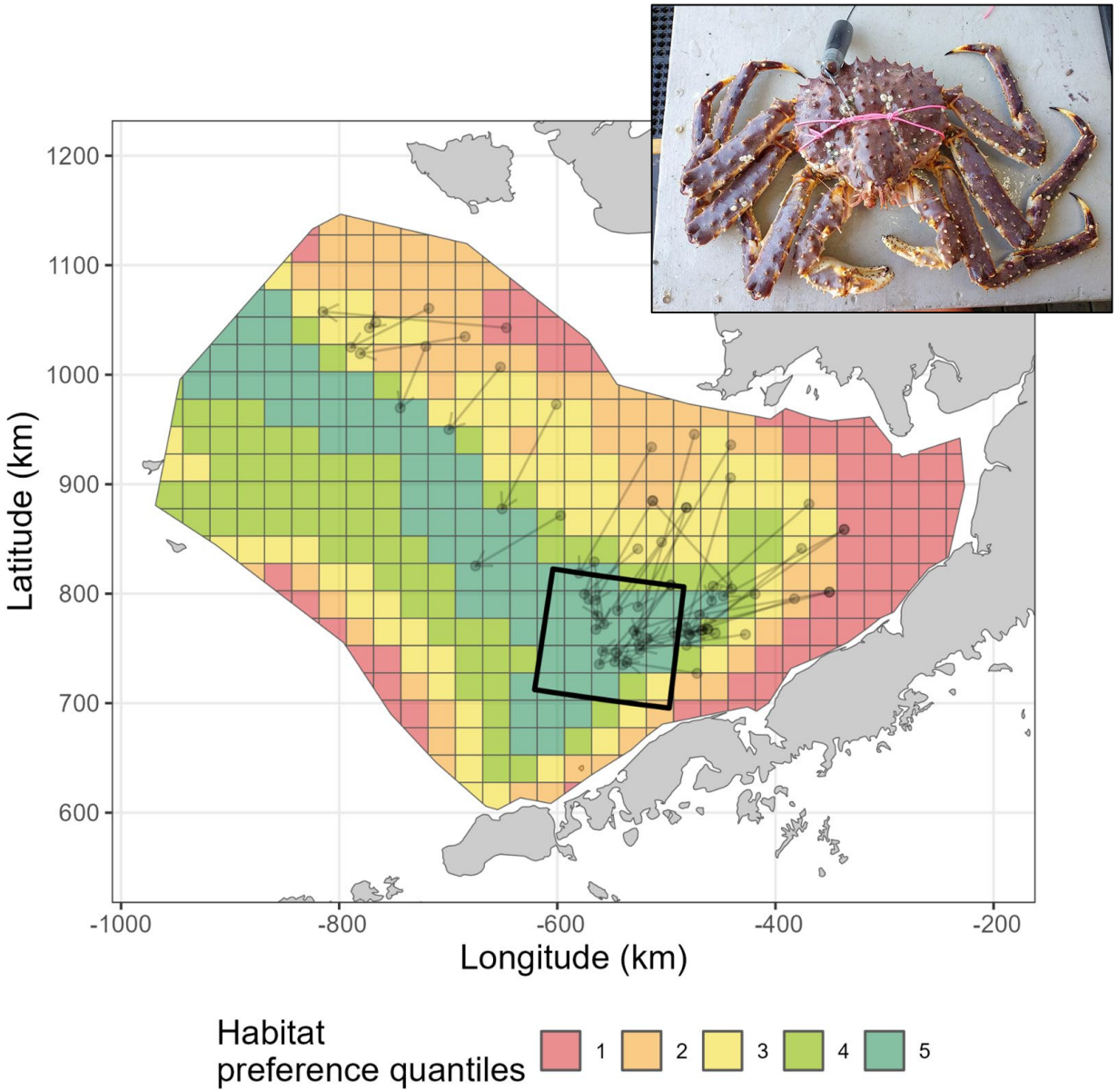


Zacher et al., in prep

Provide information on where red king crab occur in data-poor periods

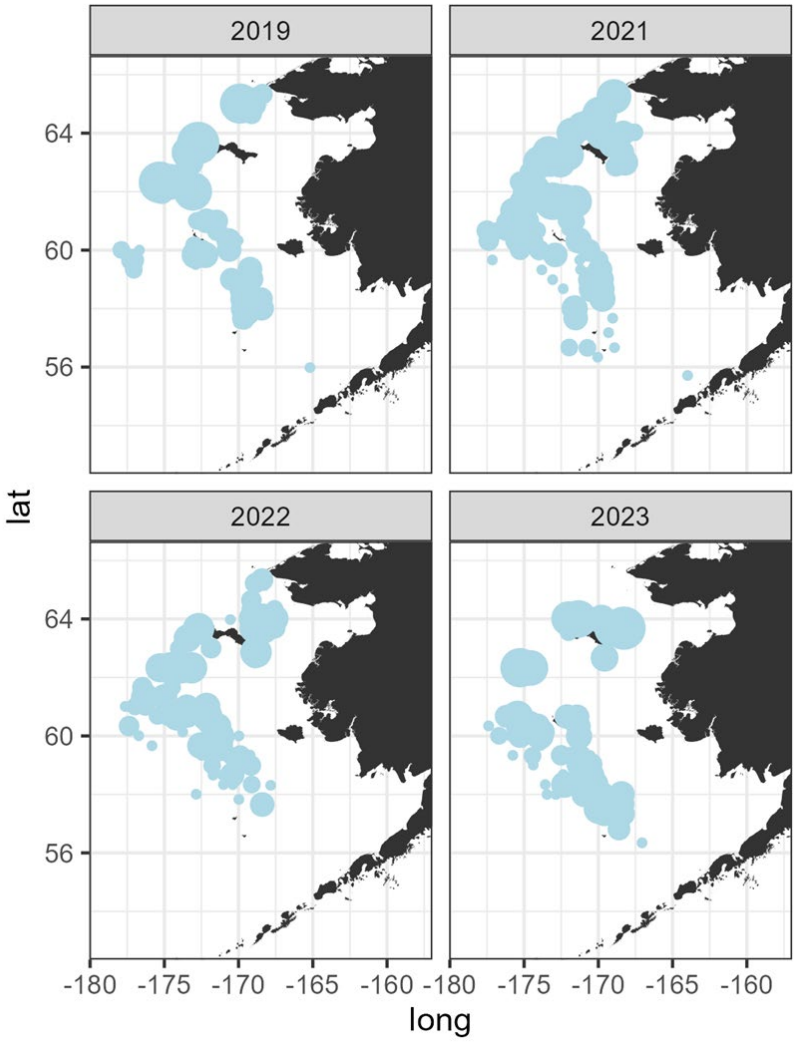


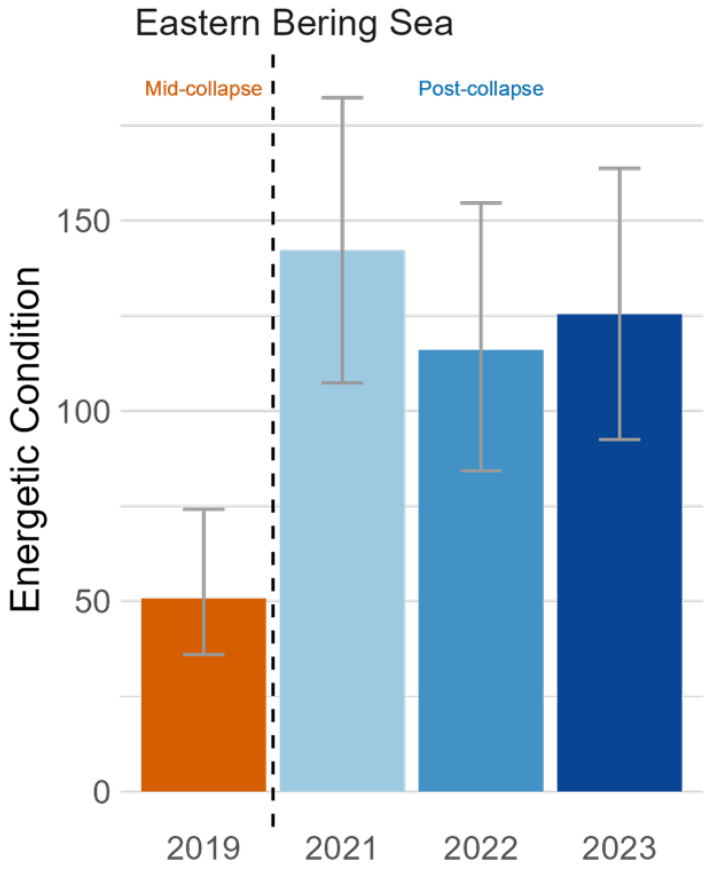
Ryznar and Litzow 2024

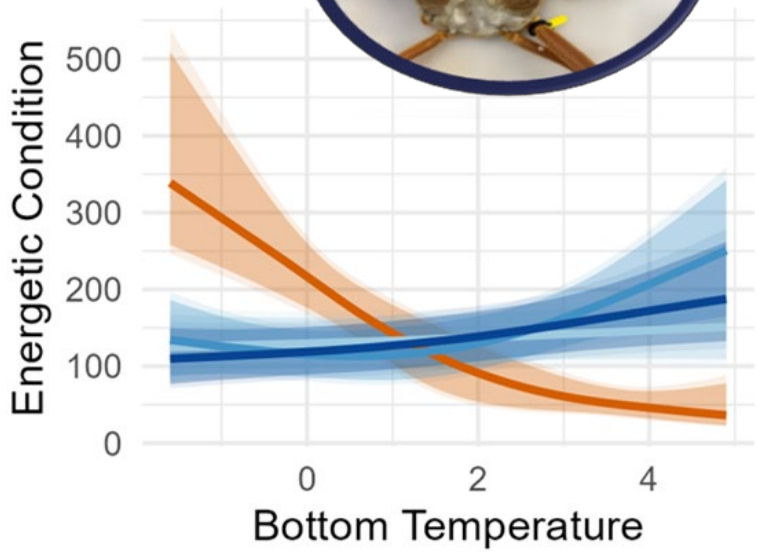


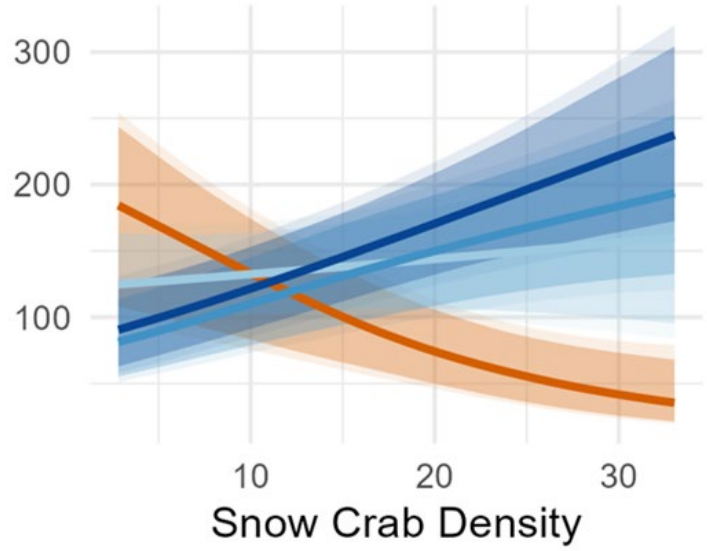
Hardison et al., in prep

Develop a condition index to assess snow crab health in real-time









Fedewa et al., in prep

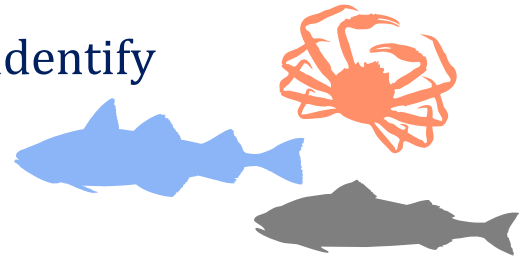
Assess recruitment bottlenecks for Bristol Bay red king crab

Weems et al., in prep

Create a standardized framework to integrate stock-specific indicators for the stock assessment process

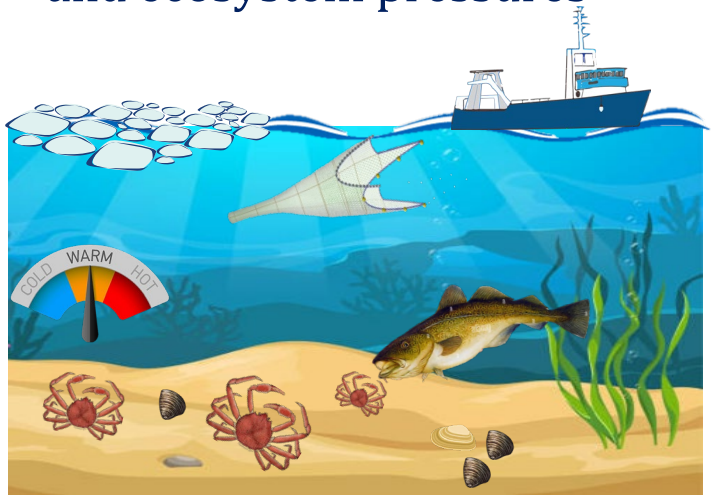
1) FOCUS

Prioritize and identify stocks for ESP



2) SYNTHESIZE

Identify stock vulnerabilities and ecosystem pressures



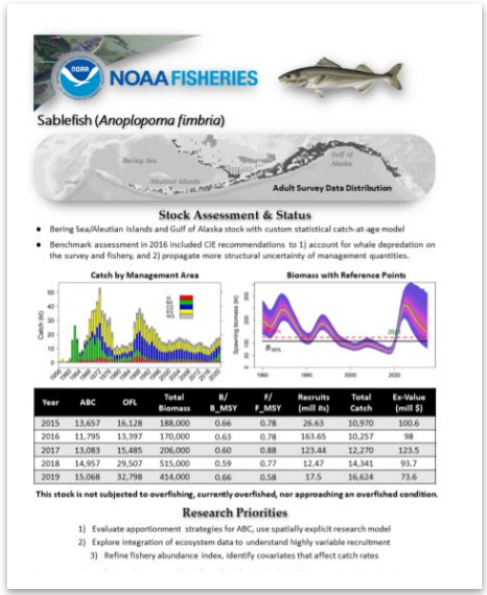
3) ANALYZE

Create and monitor a suite of stock-specific indicators

Indicator	2019 Mean
SMBKC Pre-recruit Biomass	●
Summer Bottom Temperature	+
Proportion Cold Pool	−
Benthic Predator Biomass	●

4) COMMUNICATE

Report indicator status and trends to decision makers


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

Ecosystem and Socioeconomic profiles (ESPs)

Shotwell et al., 2023

Thank you

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