



Context and tools for Ecosystem-Based Fisheries Management in Alaska



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*NPFMC Ecosystem
Research Workshop
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Timeline of ecosystem-based fisheries management science

1980s: Proactive ecosystem measures in Alaska

Ecosystem models, 2M MT cap, forage fish ban

1990s: What is ecosystem-based management?

Academic panel reports (nationwide), development of Alaska Ecosystem Status Report (*"Ecosystem Considerations"*)

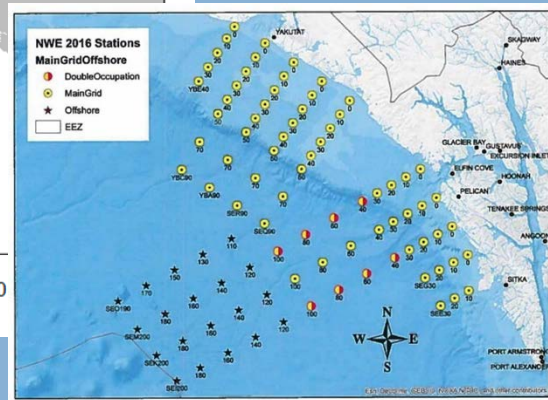
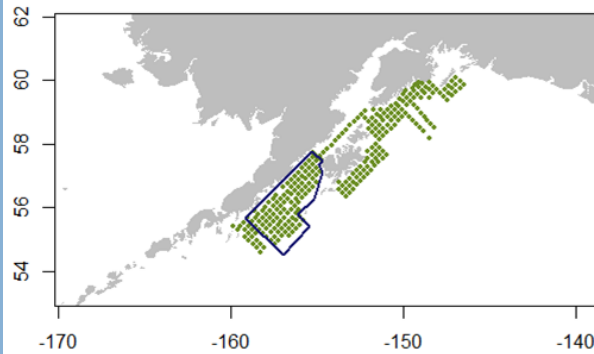
2000s: Product and tool development

Models, analysis tools, observations (IERPs), conceptual models

2010s: Development of formalized programs

National and Local Roadmaps, Integrated Ecosystem Assessments

Increased integration of fieldwork and management advice



Alaska Marine Ecosystem Considerations

Home Report Assessments Report Cards Hot Topics Links

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Eastern Bering Sea

- Assessment
- Report Card
- Hot Topics
 - Chum Salmon
 - Bird Sightings

Aleutian Islands

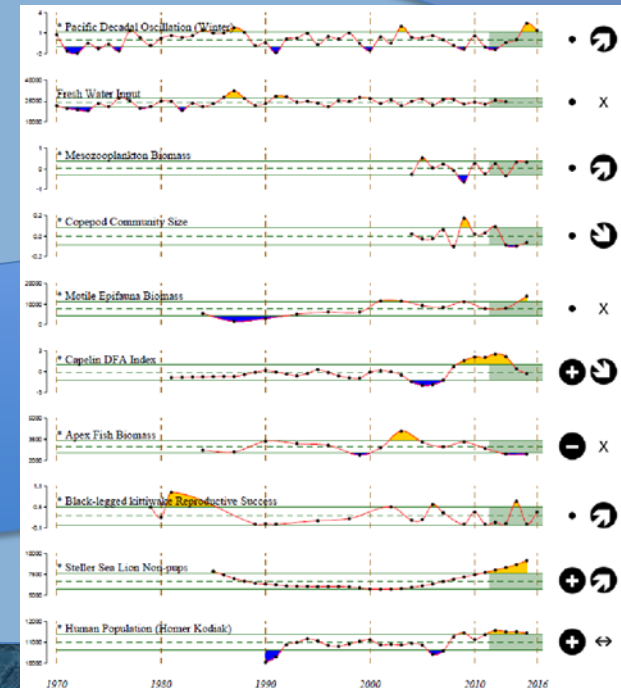
- Assessment
- Report Card

Gulf of Alaska

- Assessment
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- Hot Topics
 - Too Warm?
 - Age-0 Pollock
 - Marine Mammals

Arctic

- Assessment
- Hot Topics
 - Polar Bears





Development of national policy documents and programs

Levels	Scientific Advice	Management Framework
EBM Ecosystem Based Management	Fisheries Development Energy Eco Tourism Oil & Gas Conservation Marine Sanctuaries Aquaculture Etc	Regional Ocean Plans
EBFM Ecosystem Based Fisheries Management	Fisheries Climate Habitat Predator	Fisheries Ecosystem Plan
EAFM Ecosystem Approach to Fisheries Management	Fisheries Climate Habitat Predator	Fishery Management Plan
SS Single Species	Fish	Fishery Management Plan

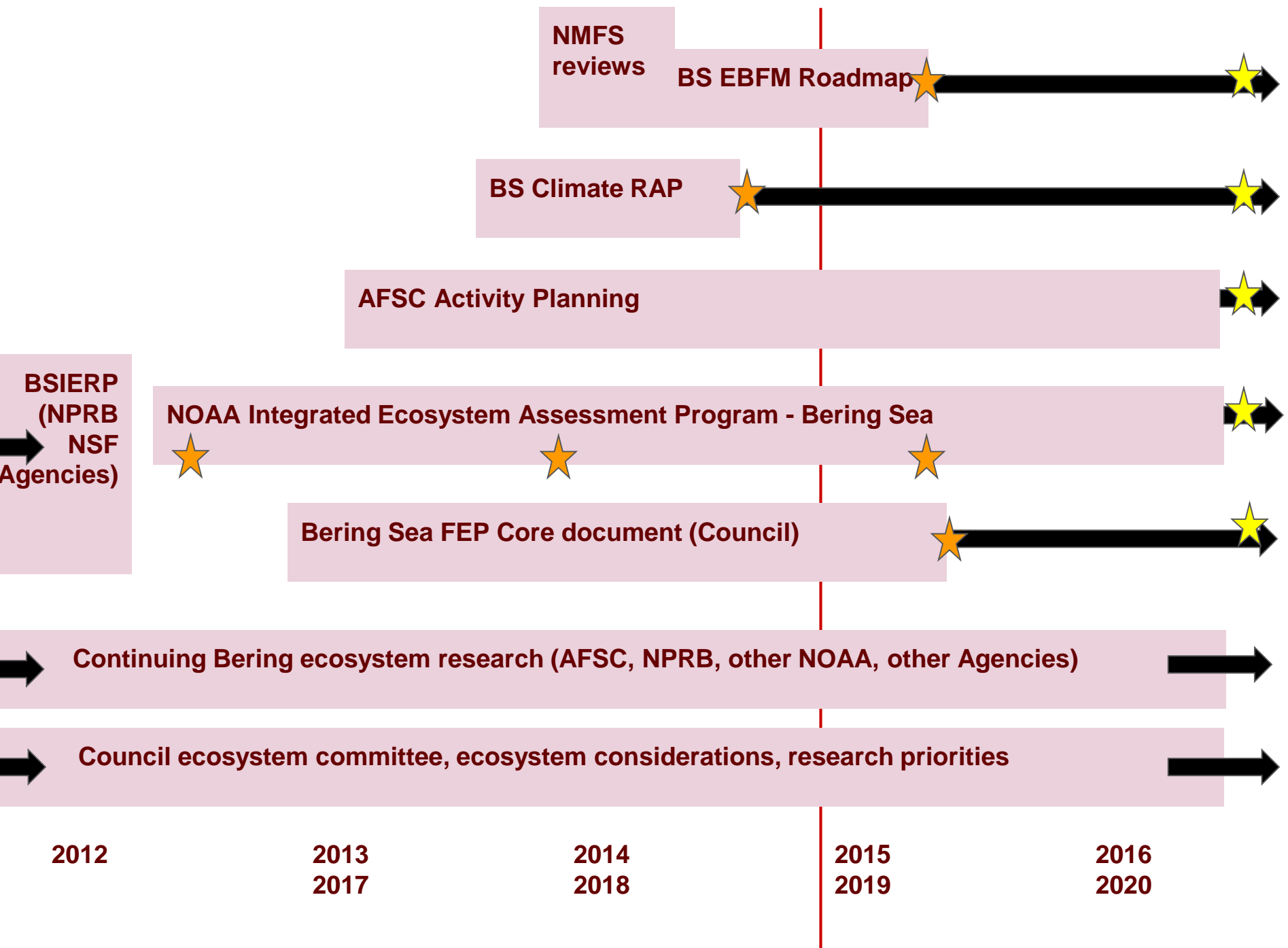


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NMFS EBFM Roadmap



NOAA Integrated Ecosystem Assessment (IEA) Program





What is an Integrated Ecosystem Assessment?



- A. It's a set of **best practices** and principles for EBM.
 - B. It's a **process** for delivering advice to management.
 - C. It's a **product**: “we have conducted an Integrated Ecosystem Assessment for the Bering Sea.”
 - D. It's a NOAA **program** with a budget and deliverables.
- A. All of the above.*



PLACE-BASED

FOUR Large Marine Ecosystems -
FOUR Integrated Ecosystem Assessment Programs

Eastern Bering
Sea (EBS)



High Arctic



Aleutian Islands
(AI)



Gulf of Alaska
(GOA)





B: It's a Process

The NOAA IEA Process

Management Strategy Evaluation

MSE is useful to help resource managers consider the system trade-offs and potential for success in reaching a target which helps make informed decisions. It uses simulation through ecosystem modelling to evaluate the potential of different management strategies to influence the status of natural and human system indicators and to achieve our stated ecosystem objectives.

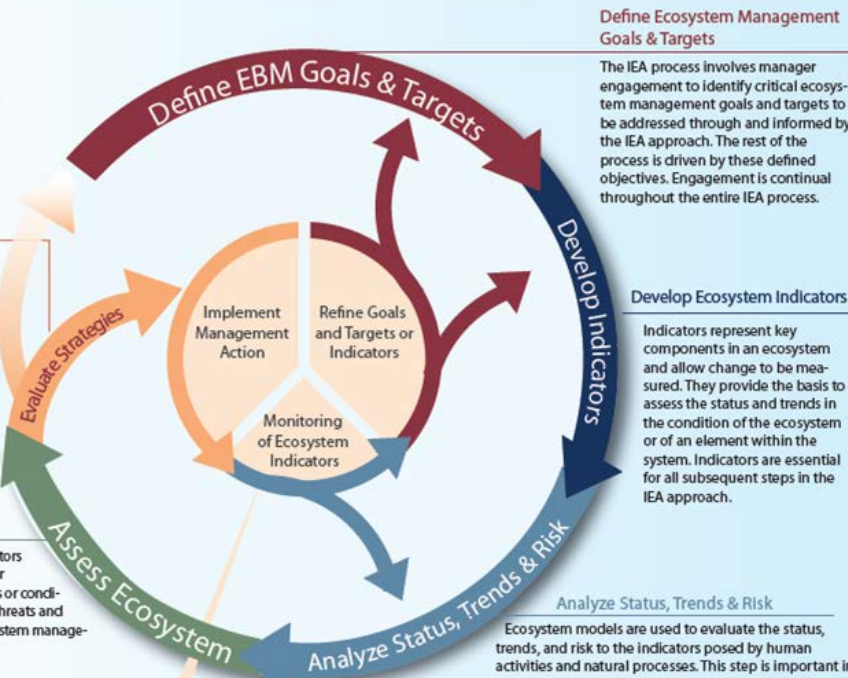
Assess Ecosystem

During this step, individual indicators are considered together to further evaluate the overall current status or condition of the ecosystem relative to threats and risks, historical state, and to ecosystem management goals and targets.



Taking, Monitoring, and Refining Action

Based on the MSE, an action is selected and implemented (on occasion the goal and/or target may need to be refined rather than take an action). Monitoring of indicators is important to determine if the action is successful; if yes, the status, trends, and risk to the indicators continue to be analyzed for incremental change; if not, either goals and targets or indicators need to be refined as part of adaptive management.



Define Ecosystem Management Goals & Targets

The IEA process involves manager engagement to identify critical ecosystem management goals and targets to be addressed through and informed by the IEA approach. The rest of the process is driven by these defined objectives. Engagement is continual throughout the entire IEA process.

Develop Ecosystem Indicators

Indicators represent key components in an ecosystem and allow change to be measured. They provide the basis to assess the status and trends in the condition of the ecosystem or of an element within the system. Indicators are essential for all subsequent steps in the IEA approach.

Analyze Status, Trends & Risk

Ecosystem models are used to evaluate the status, trends, and risk to the indicators posed by human activities and natural processes. This step is important in determining incremental improvements or declines in ecosystem indicators in response to changes in drivers and pressures and to predict the potential that an indicator will reach or remain in an undesirable state.

For more information visit: www.noaa.gov/iea

Stock assessment

Goal: Max.
sustainable yield

Indicators: Stock
biomass

Status: Surveys,
reference points

Assess: Stock
assessment

Evaluate: Adaptive
management

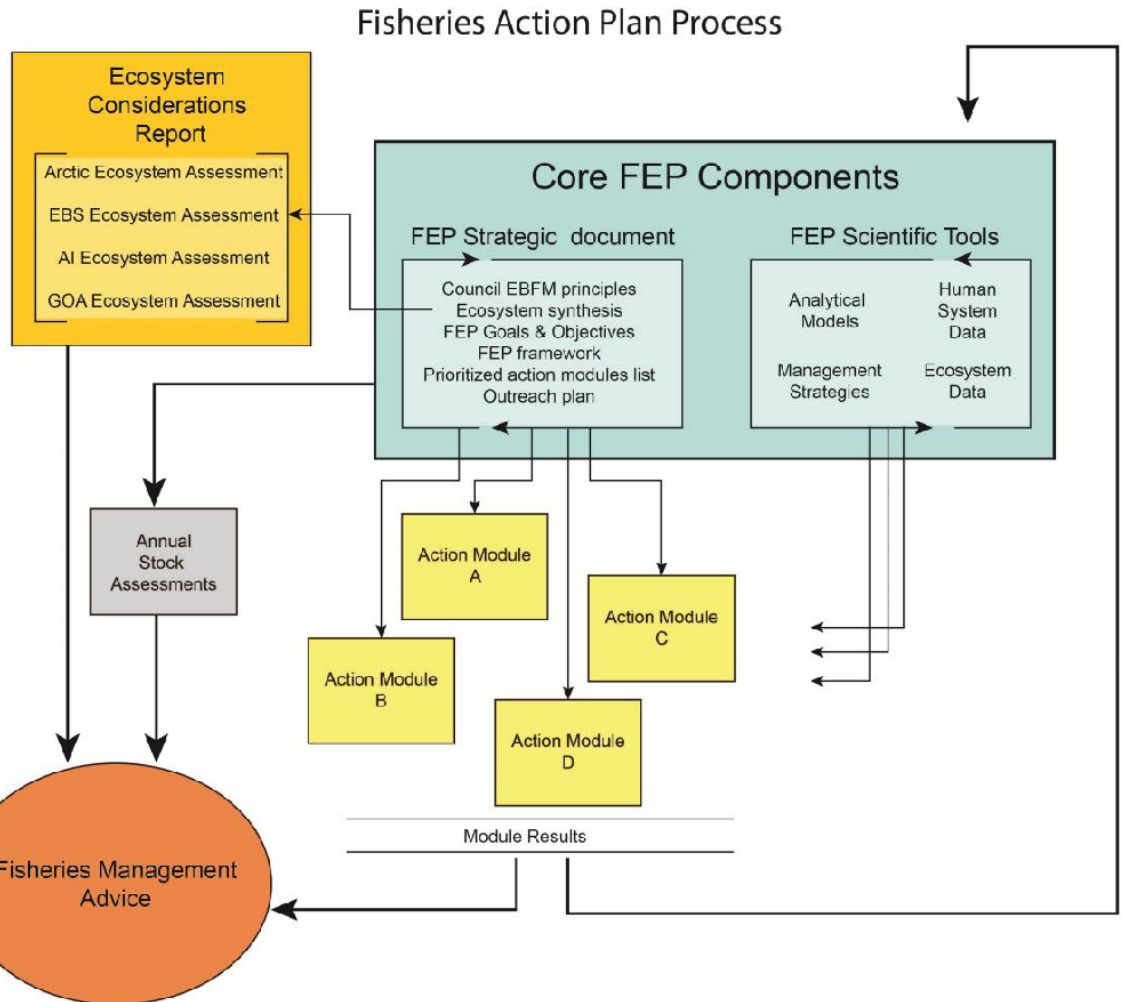


C: Products

- **Fisheries Ecosystem Plans (FEPs)**
- Conceptual Models
- Ecosystem Models
- Ecosystem Indicators
- Ecosystem Assessment
- Risk Assessments
- Management Strategy Evaluations

Eastern Bering Sea

Fisheries Ecosystem Plan
(completion ~Summer 2018)



- Developed by multi-agency team
- Transparent council processes for including ecosystem information in management
- Outreach
- Action modules integrate climate, EFH, human sectors, local/traditional knowledge
- Ecological framework of conceptual models
- Research and success tracking (“did we get there?”)



Example FEP task: Formalize ecosystem warnings (while maintaining flexibility)

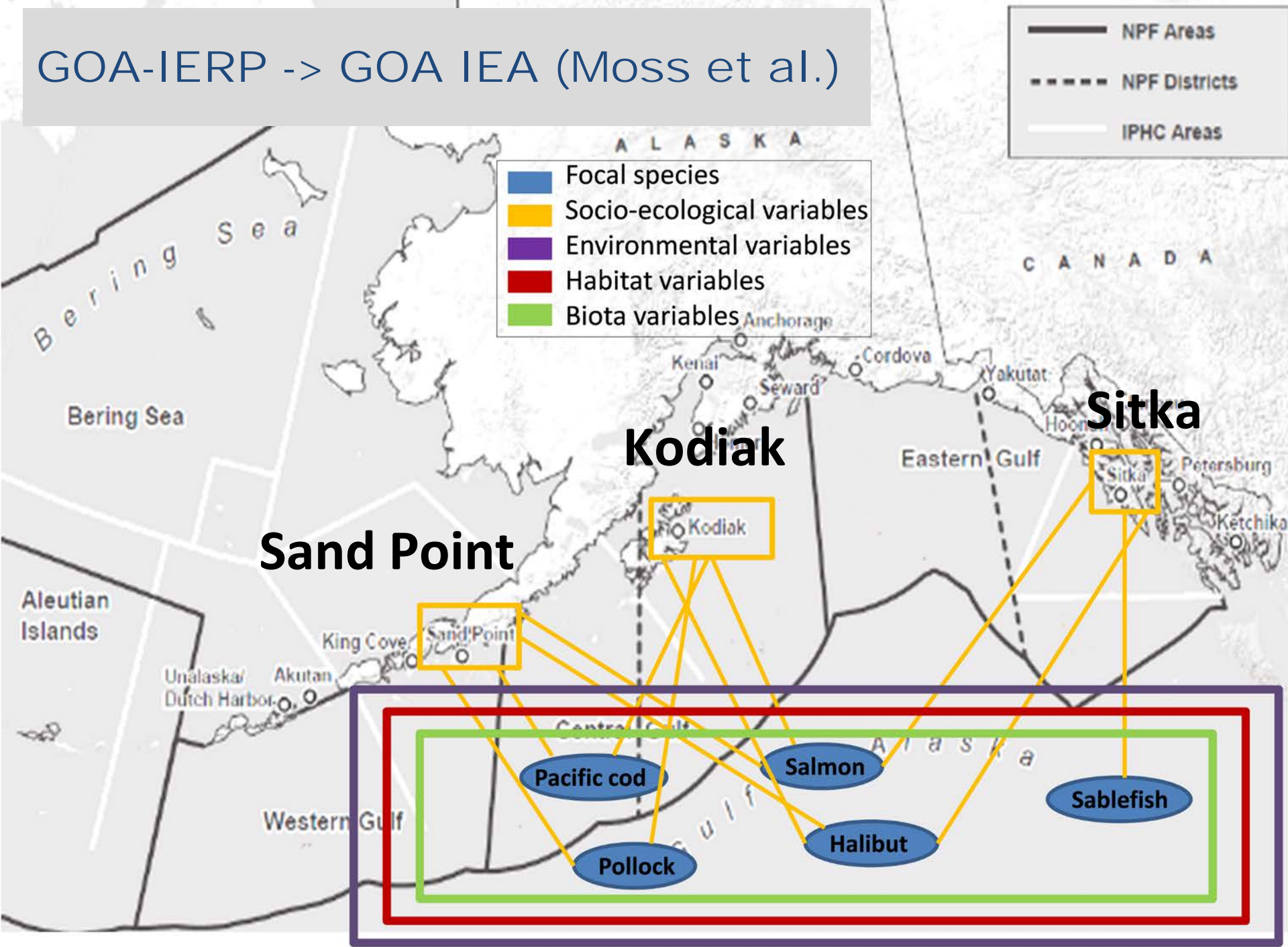
		Stock Assessment information	
		Not okay	Okay
Ecosystem Status Report information	Not Okay	2006 EBS pollock 2017 GOA cod	2016 EBS Pollock
	Okay	"No red flags were indicated."	EBS Yellowfin sole



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GOA-IERP -> GOA IEA (Moss et al.)





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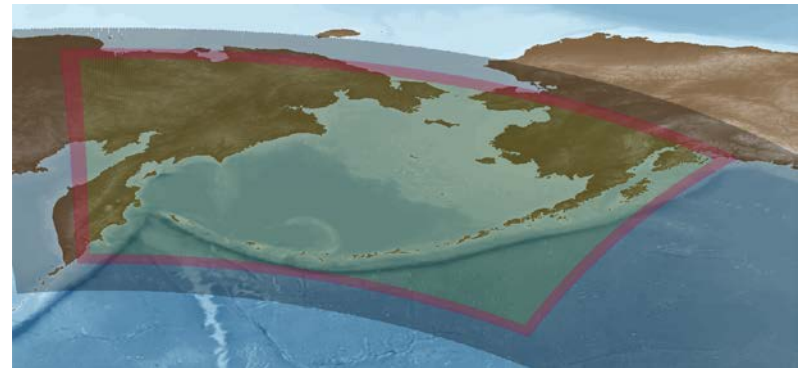
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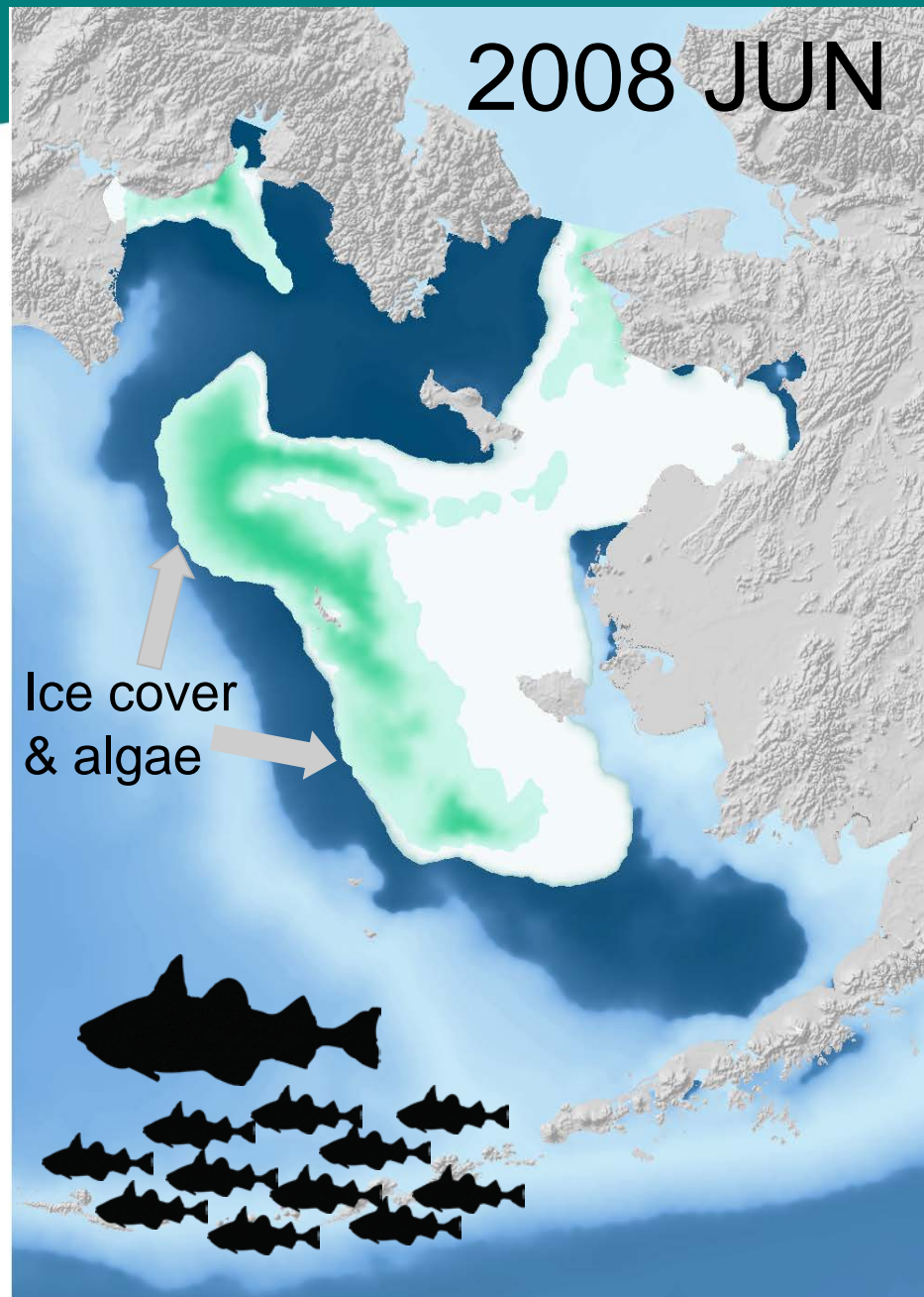
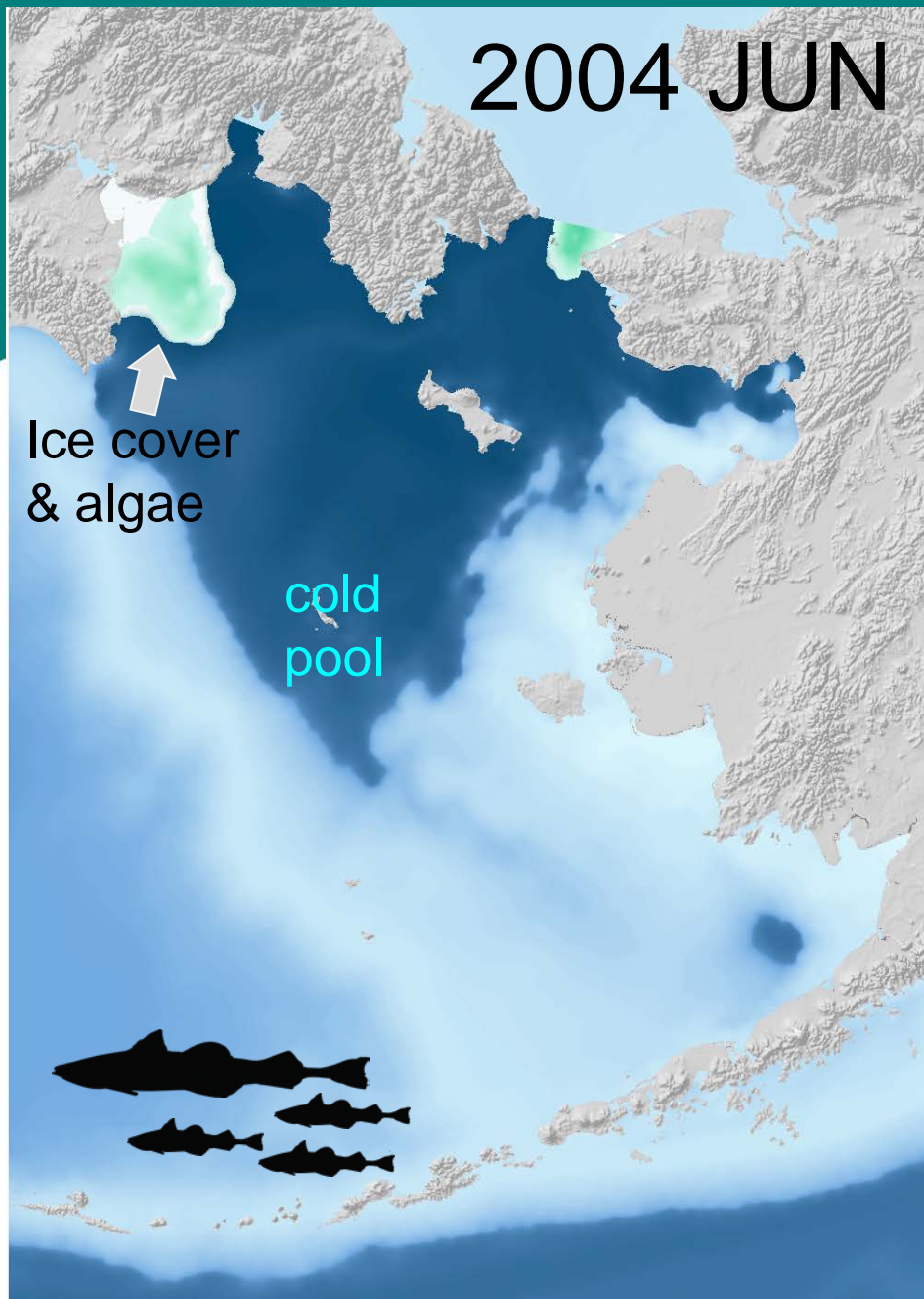


Bering ROMS/NPZ

(Regional Oceanographic model with nutrients and plankton dynamics)

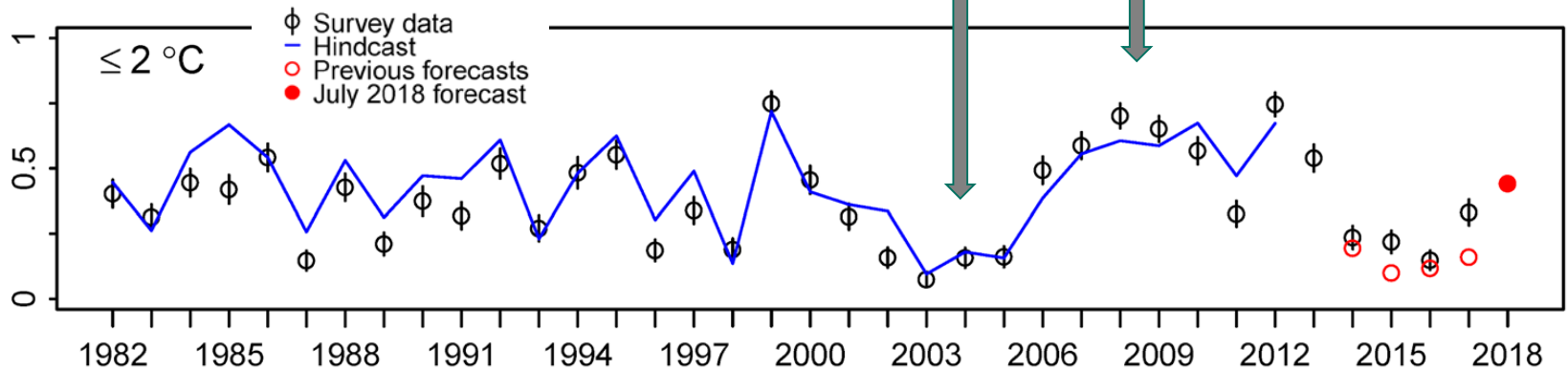
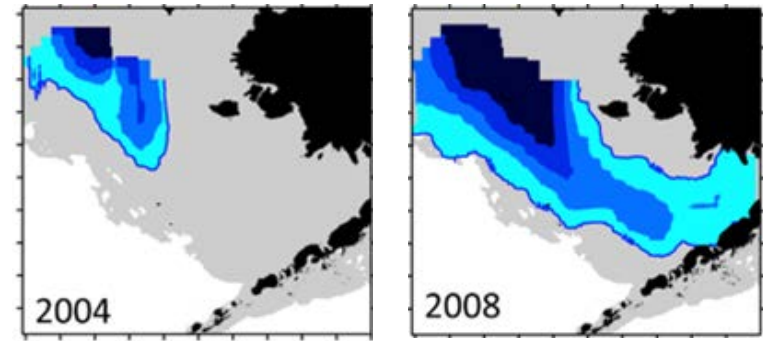
- Developed with NSF/North Pacific Research Board
- Ongoing IEA partnership (AFSC/PMEL)
- Significant advances in ice modeling, ice plankton
- Products
 - 46-year hindcast (1971-2017)
 - Nowcasts (annual)
 - 9-month forecast (annual)
 - Forecasts to 2100 with IPCC outputs
 - Rapid Climate Assessment
 - EFH predictive maps







9-month (seasonal) forecast - cold pool



- Included in annual Bering Sea ecosystem status report (November prediction for following summer)
- Validation funded under NOAA MAPP Program - focus on ice prediction



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Ecosystem Considerations Reports

<http://access.afsc.noaa.gov/reem/ecoweb/>

Contact: Stephani.Zador@noaa.gov

Alaska Marine Ecosystem Considerations 

[Home](#) [Report](#) [Assessments](#) [Report Cards](#) [Hot Topics](#) [Links](#)

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Arctic

- [Assessment](#)
- [Report Card](#)

- LME-scale assessments
- Targeted for managers
- Linked with stock assessments
- Provides context for EBFM

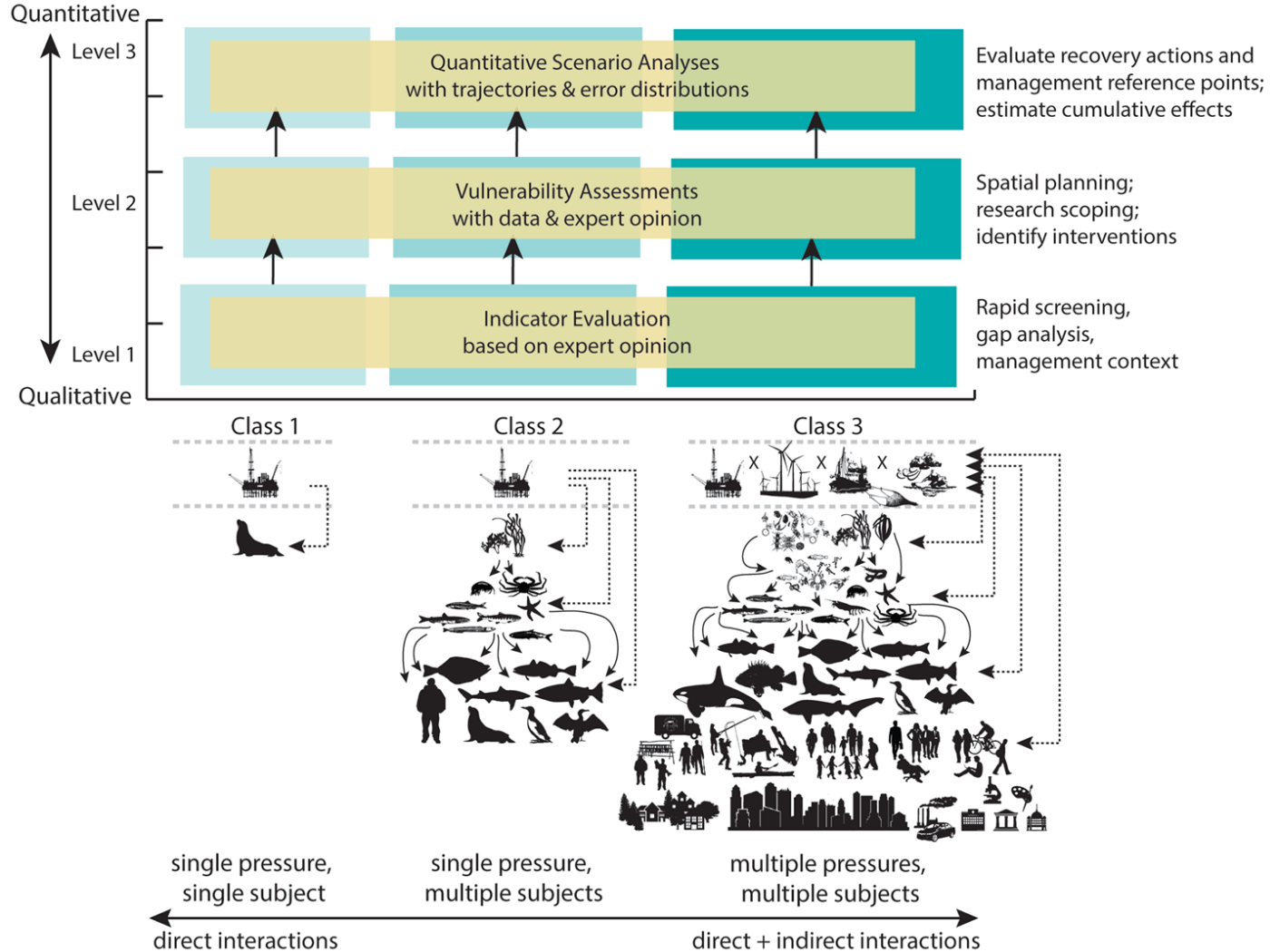




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- Management Strategy Evaluations

Ecosystem Risk Assessment



Holsman et al. 2017



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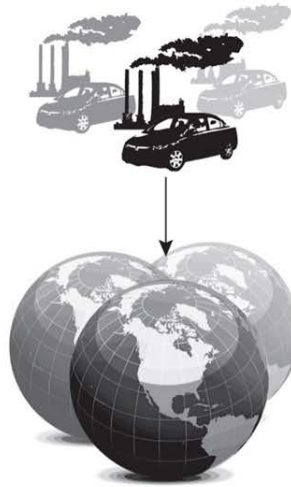
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- **Management Strategy Evaluations**

Alaska CLIMate Project

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Trond Kristiansen (IMR, Norway)
Al Hermann (UW JISAO/PMEL)
Wei Cheng (UW JISAO/PMEL)
André Punt (UW SAFS)

FATE: Fisheries & the Environment
SAAM: Stock Assessment Analytical Methods
S&T: Climate Regimes & Ecosystem Productivity



IPCC Scenarios (x3)

AR4 A1B
AR5 RCP6.0
AR5 RCP8.5

Global Climate Models (x 11)

ECHO-G (AR4 A1B)
MIROC3.2 med res. (AR4 A1B)
CGCM3-t47 (AR4 A1B)
CCSM4-NCAR- PO (AR5 RCP 6.0 & 8.5)
MIROCESM-C- PO (AR5 RCP 6.0 & 8.5)
GFDL-ESM2M*- PO (AR5 RCP 6.0 & 8.5)
GFDL-ESM2M*- PON (AR5 RCP 6.0 & 8.5)

Future Climate Scenarios



Climate-enhanced Biological Models



Fishing Scenarios



Bering Sea Models

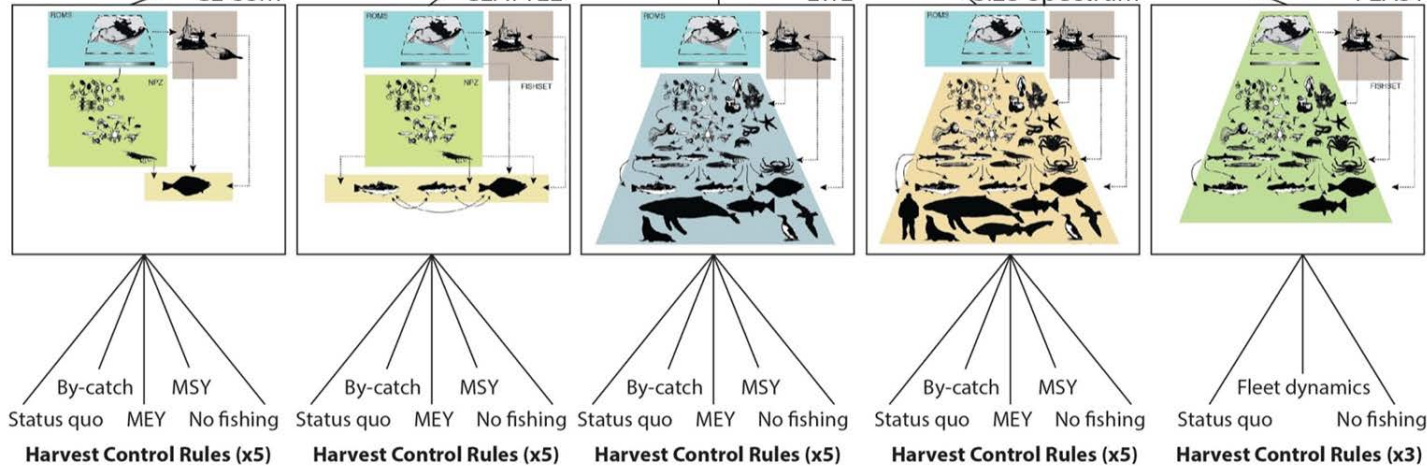
CE-SSM

CEATTLE

EwE

Size-Spectrum

FEAST



multiple non-linear pressures

multiple non-linear interacting pressures