

Ecosystem Based Management Overview



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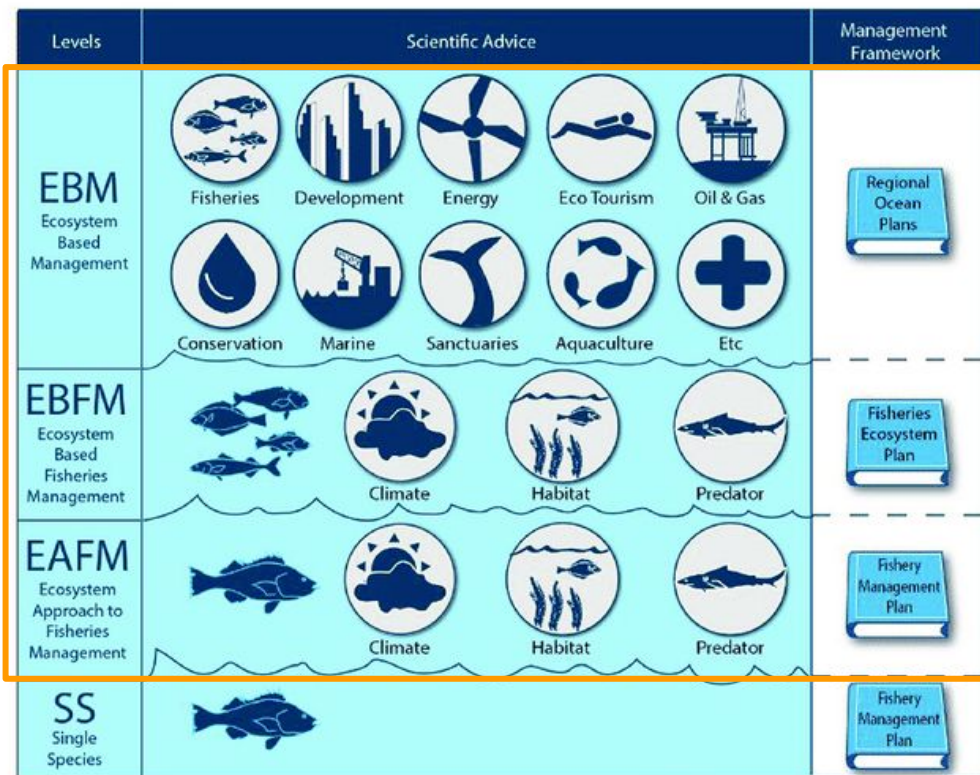


Challenge: Need to implement coordinated and collaborative adaptation & mitigation planning to prepare for and respond to climate change impacts

Opportunity: Climate-informed and inclusive EBM/EBFM has potential to effectively address climate change challenges (*most often if coupled with climate mitigation)



Ecosystem Based Management Continuum



Single species management

Fisheries focused management



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

Ecosystem Approach to Fisheries Management

Fisheries focused management



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- Consider ecological & climate effects on focal species

Ecosystem Based Fisheries Management

Managing fisheries from a whole ecosystem perspective

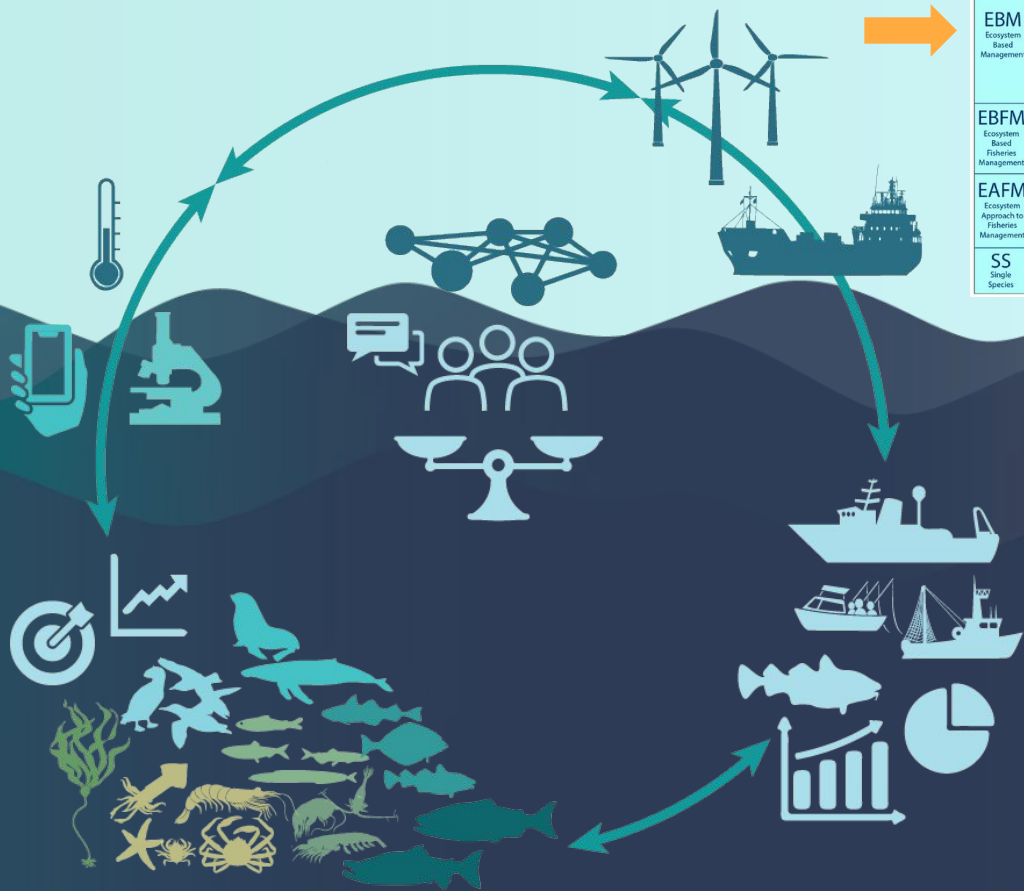


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EBM Ecosystem Based Management	Fisheries	Development	Energy	Eco Tourism	Oil & Gas	Regional Ocean Plan
	Conservation	Marine	Sanctuaries	Aquaculture	Etc	
EBFM Ecosystem Based Fisheries Management	Climate	Habitat	Predator		Fisheries Ecosystem Plan	
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SS Single Species	Single Species				Fishery Management Plan	

- Consider ecological & climate effects on focal species
- Consider (& manage for) ecological impacts of harvest on other parts of the ecosystem

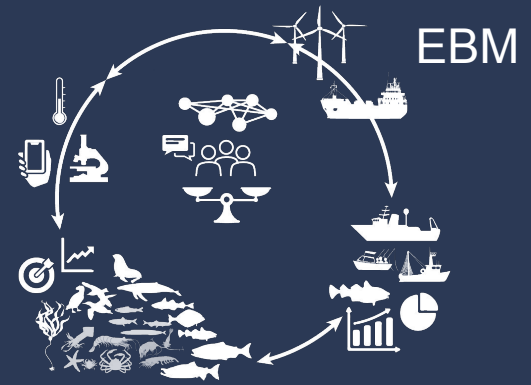
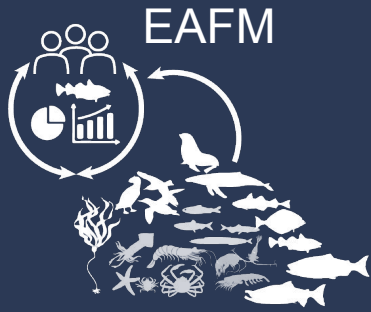
Ecosystem Based Management

Taking a whole ecosystem perspective to manage all resources



Levels	Scientific Advice					Management Framework
EBM Ecosystem Based Management						
EBFM Ecosystem Based Fisheries Management						
EAFM Ecosystem Approach to Fisheries Management						
SS Single Species						

Balance multiple interacting pressures, benefits, & interconnected responses across the system & sectors



- Fishery impacts on target spp
- Changes in habitat
- Surveys of size and abundance
- Fishery information
- Information from harvesters

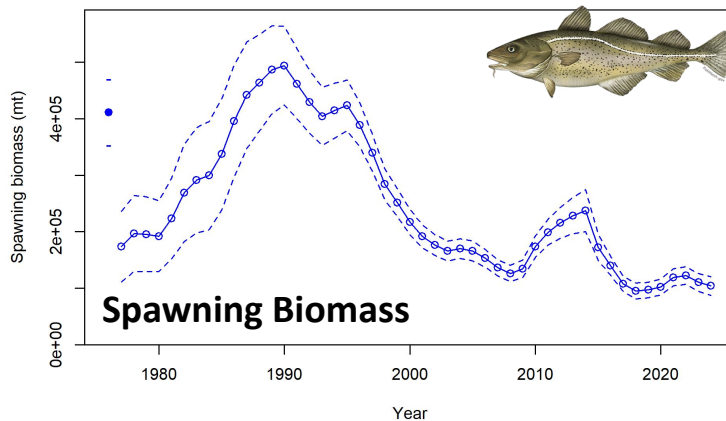
- Multiple fishery effects on system interactions & connections
- Eval, risk, trends & tipping points in ecosystem indicators as a function of harvest levels (e.g., diets)
- Account for ecosystem targets & limits (as prey, bycatch, or predators) in harvest control rules

- Multiple fishery & non-fishery effects on system interactions, connections, and services (often spatial)
- Cumulative effects of multiple activities on habitats and ecosystem function
- Accounting for plurality of perspectives and needs in tradeoff analyses, activities, & agreements across multiple sectors.





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Barbeaux et al. (2020) doi: 10.3389/fmars.2020.00703

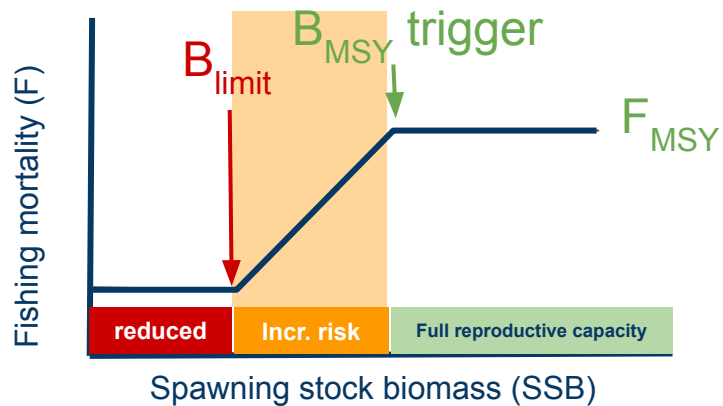
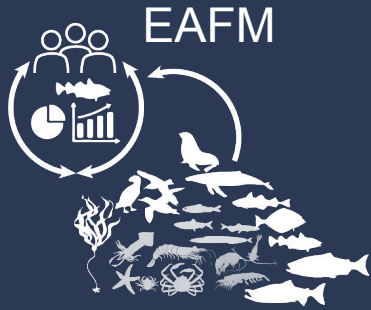


Figure modified from Geir Huse



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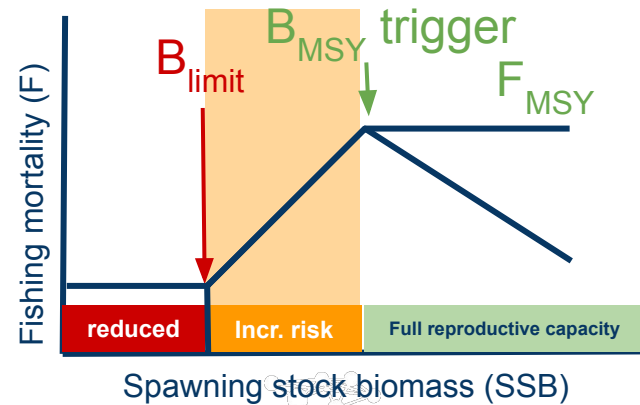


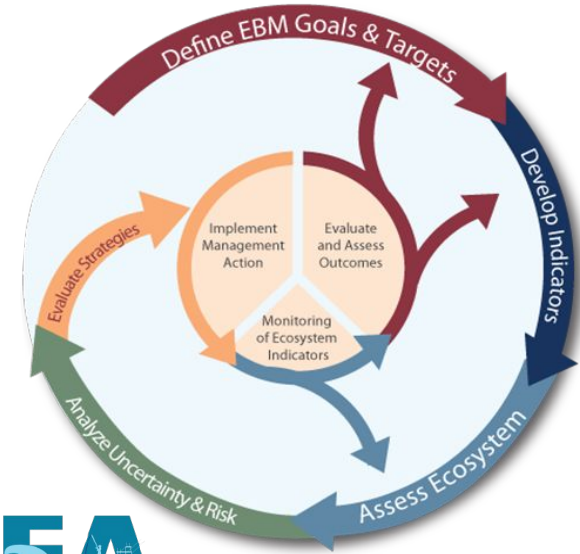
Figure modified from Geir Huse

Bering Sea Fishery Ecosystem Plan

North Pacific
Fishery Management Council
January 2019

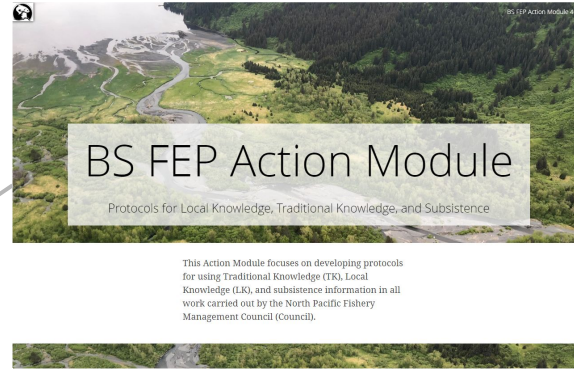
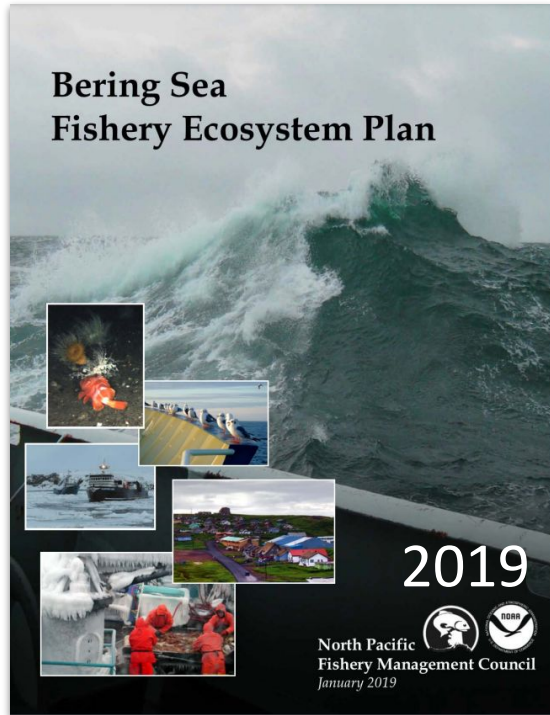


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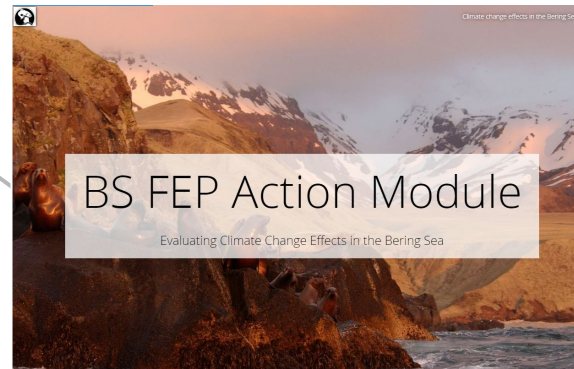
<https://www.npfmc.org/bering-sea-fishery-ecosystem-p>

Eastern Bering Sea Fisheries Ecosystem Plan (FEP)



2020

Local Knowledge,
Traditional Knowledge &
Subsistence Information
Task Force



2020

Climate Change
Task Force

Local Knowledge, Traditional Knowledge, and Subsistence Task Force

D2 LKTKS Protocol
APRIL 2023

Protocol for Identifying, Analyzing, and Incorporating Local Knowledge, Traditional Knowledge, and Subsistence Information into the North Pacific Fishery Management Council's Decision-making Process

March 17, 2023

For further information contact: Kate Haapala, North Pacific Fishery Management Council
1007 W. 3rd Ave, Suite 400, Anchorage, AK 99501
(907) 271-2809

Abstract:

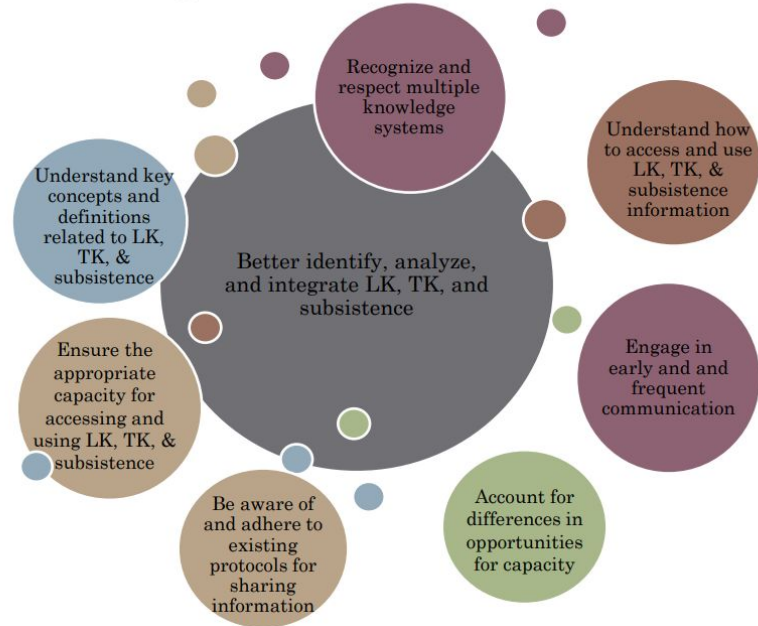
This Protocol provides guidance for identifying, analyzing, and incorporating Local Knowledge, Traditional Knowledge, and subsistence information into the Council's decision-making process.^{1, 2} The Protocol is the result of a collaborative, multi-year effort from the Council's Local Knowledge, Traditional Knowledge, and Subsistence Taskforce, which is a nominated body formed under Action Module 2 in the Bering Sea Fishery Ecosystem Plan. This Protocol is specific to the Bering Sea region, though it could be used more widely as the information within is relevant to Council and agency staff, Council advisory bodies, and the public. The full Protocol provides the Council foundational information for working with Local Knowledge, Traditional Knowledge, and subsistence information. However, the primary content for how to best identify, analyze, and incorporate Local Knowledge, Traditional Knowledge, the social science of Local Knowledge and Traditional Knowledge, and subsistence information within the context of the Council's decision-making process is housed in the eight guidelines in Section 4 of the Protocol which provide the reader with best practices for engaging and working with these knowledge systems and expertise. Each guideline is followed by some ideas illustrating different ways to move forward related work to help the Council consider what it might look like to put the guidelines into practice.

¹ The Taskforce chose to work with the term 'Traditional Knowledge' because it resonates with knowledge holders and existing work on Indigenous knowledge systems in the Bering Sea region.

² The Council's motion adopting the goals and objectives for this Taskforce can be found here: <https://meetings.npfmc.org/CommentReview/DownloadFile?p=cc213a15-6672-4d0b-9fad-6b071938804.pdf&fileName=D3%20MOTION%20.pdf>

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Protocol guidelines



Climate information “on ramps” for EBFM

Climate informed annual* stock and ecosystem assessments & EBFM advice

Climate information in near-term ecosystem based management targets

Climate-ready Ecosystem Based Fisheries Management planning, information & design

KEY: Matching climate information & projections to scale of decision making & advice

On-ramp 1



Tactical Near-term Advice (<2 yr)

Climate change information incorporated into stock assessment models, stock-specific indicators (ESPs), stock-specific risk tables (as appropriate).

E.g., ABC based on climate forecasts



On-ramp 2



Strategic Near-term Advice (<2 yr)

Climate change context for observed changes in social, ecological, & oceanographic conditions relevant for harvest advice and targets.

E.g., Forecasts of climate-driven distributions, tipping points, & thresholds



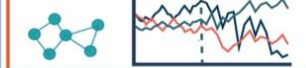
On-ramp 3 (new)



Strategic & Long-term Advice (>2 yr)

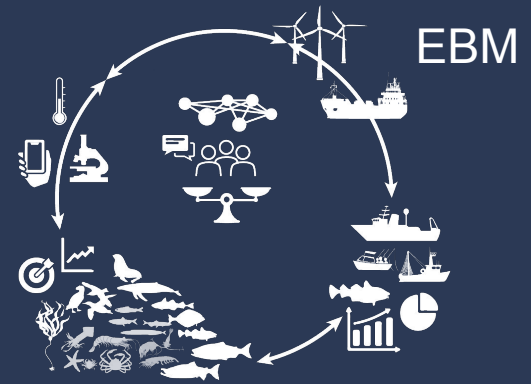
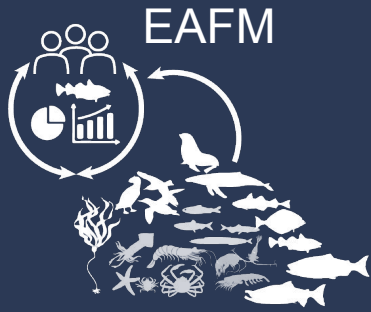
Climate - informed long-term strategic decision making & planning informed by IK, LK, and climate & management scenario evaluations, risk assessments, & adaptation efficacy & feasibility evaluations.

E.g., Targets based on climate projections



Legend

—	Existing tools or process
- - -	Help ID climate change gaps
—	New tools or process



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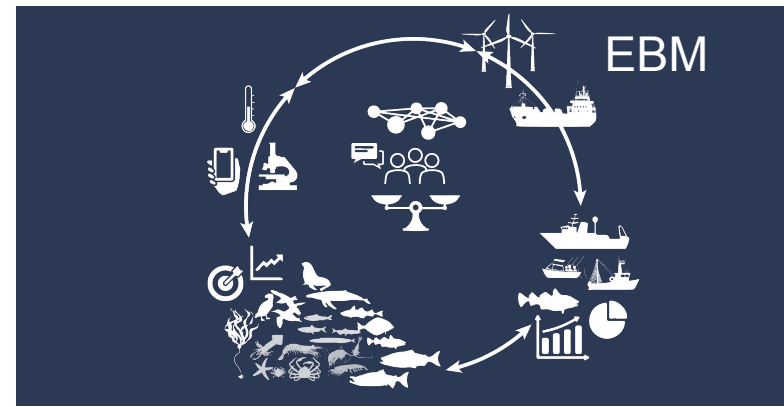


Why might we need cross-sector decision making?

Because social-ecological systems are complex networks, climate change impacts multiple parts of the system at the same time, and a response in one area can impact adaptation effectiveness in another.

If we don't account for that we might:

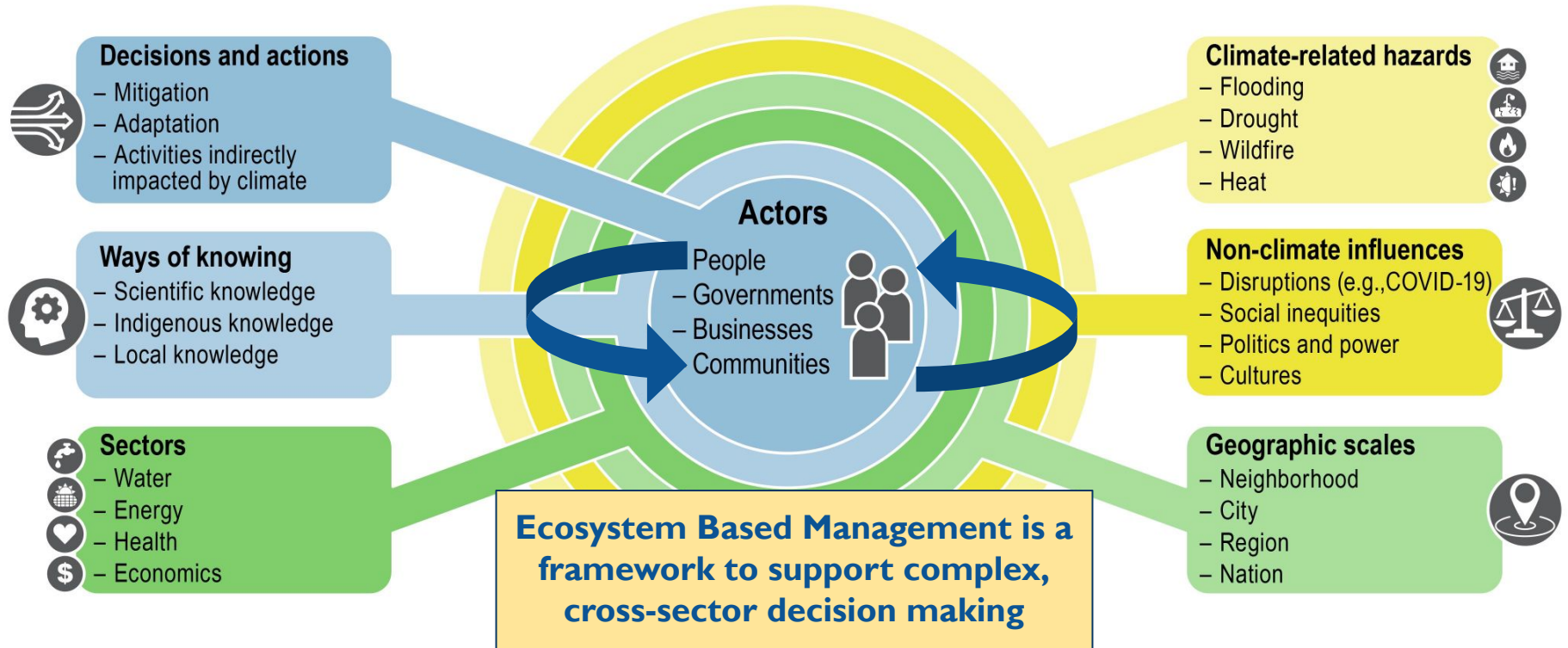
- Inadvertently amplify climate impacts
- Expand inequities in the system
- May not see the whole picture and miss impacts that are lagged
- Might react too slowly...
or too strongly...



- Multiple fishery & non-fishery effects on system interactions, connections, and services (often spatial)
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Interacting and Overlapping Features of Human–Natural Systems



Climate change & EBM

- Ecosystem Based Management (EBM) is a framework that considers complex social & ecological interdependencies
- Often supports interdisciplinary collaborations in order to understand social-ecological connections
- Recent advancements include bringing climate change impacts & response – both ecological and social – into EBM planning & advice to support resilience
- Broader more complex EBM is needed for climate advice & places an increased emphasis on transdisciplinary approaches & bridging multiple knowledge systems



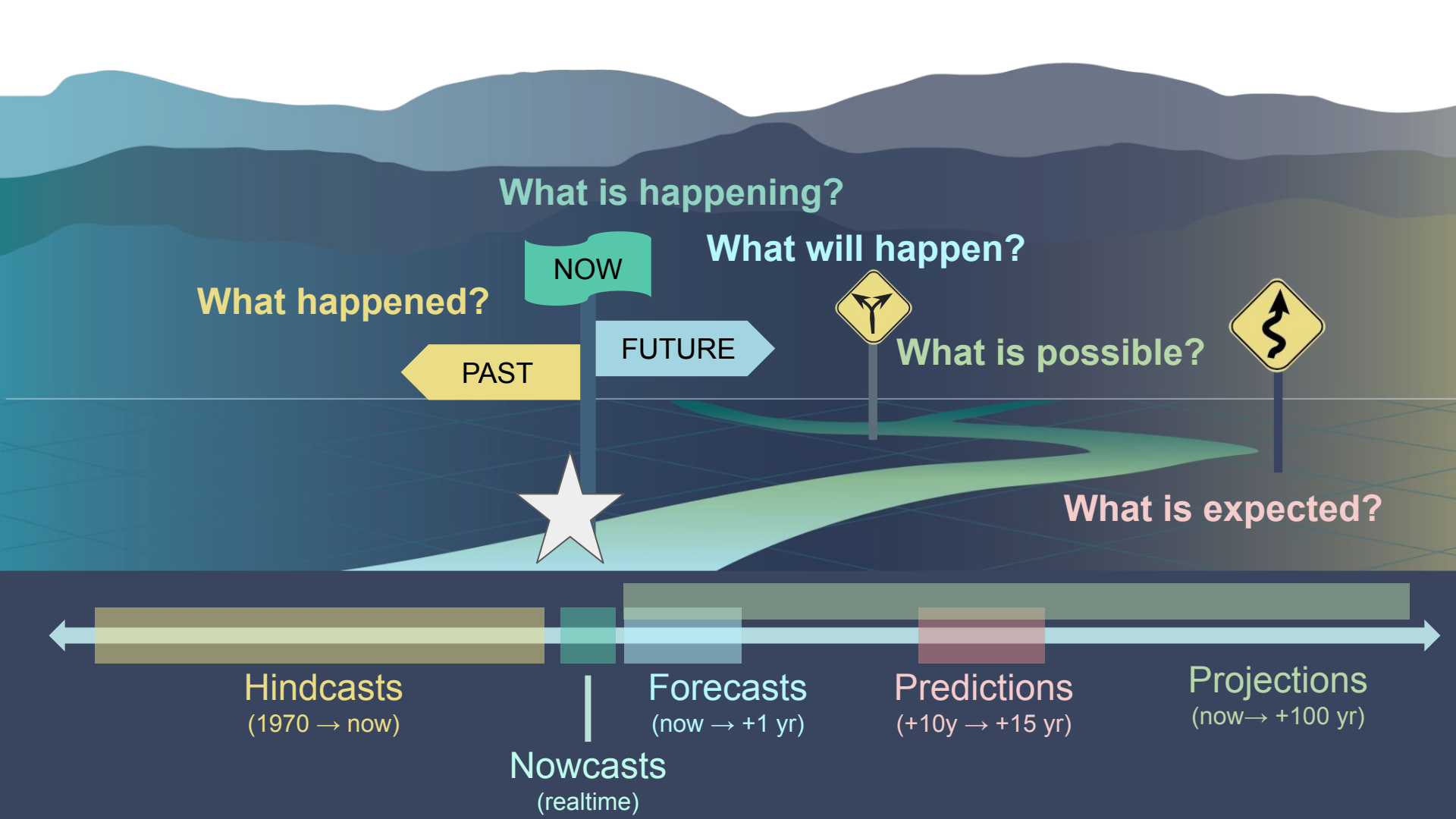
<https://learnz.org.nz/seaweedaquaculture211/discover/ecosystem-based-management>

from
NPFMC
Ecosystem
Policy and
Vision
Statement
Adopted 2014

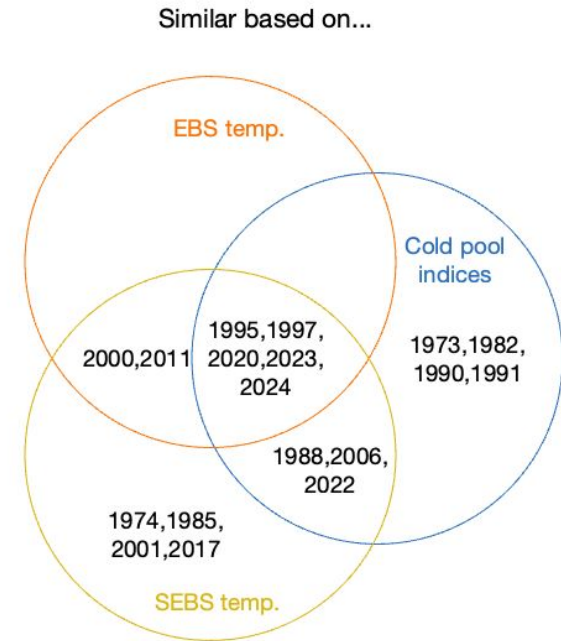
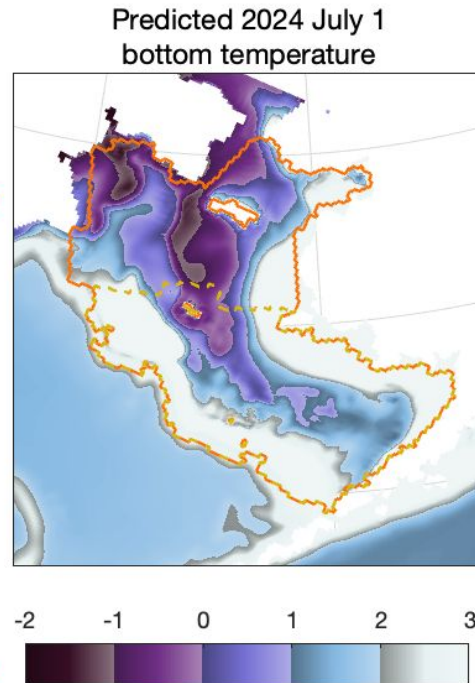
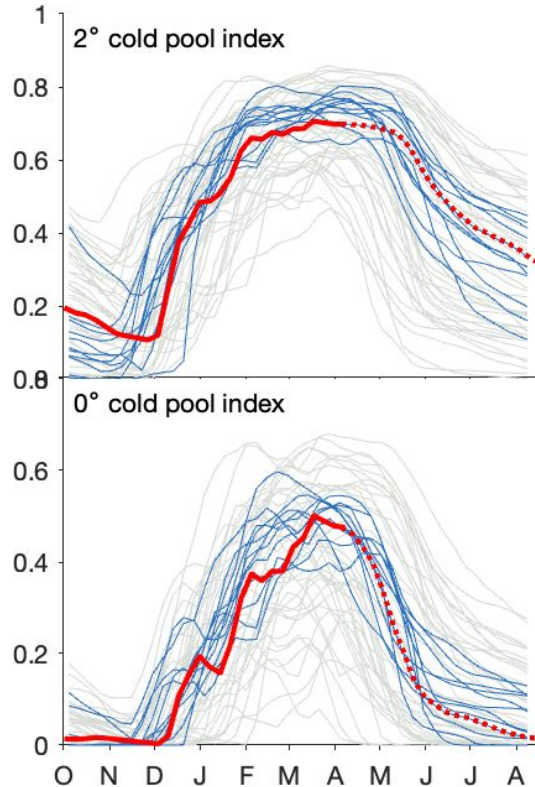
- ▶ The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which:
 - ▶ (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services;
 - ▶ (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and
 - ▶ (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.
- ▶ The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species, and associated ecosystem components..., and relationships between marine species.

predictive tools to reduce uncertainty

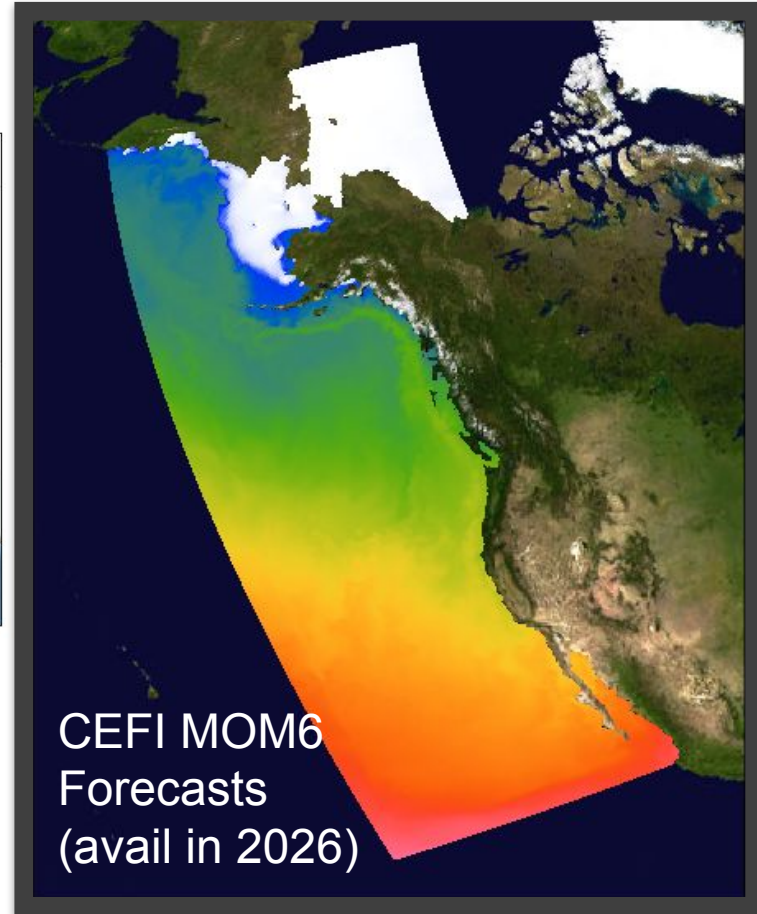
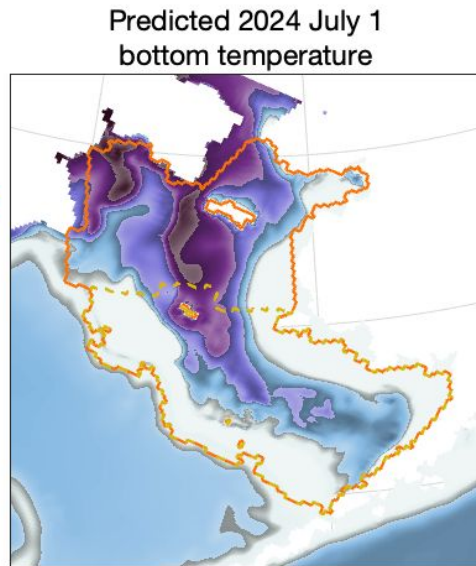
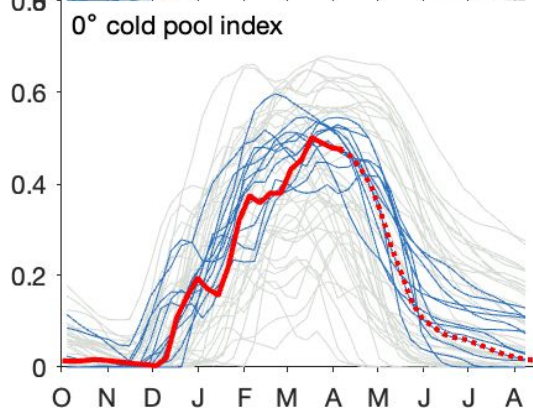
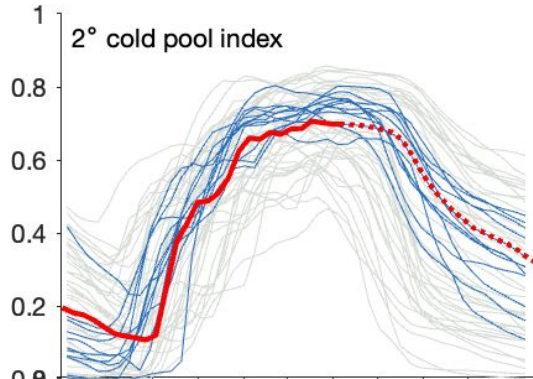




Current Bering10K high resolution oceanographic seasonal forecasts



Current Bering10K high resolution oceanographic seasonal forecasts



Open Science: interactive species distribution tools



ACLIM2 SDMs: Species range and overlap forecasts

Species 1: arrowtooth flounder
Species 2: walleye pollock
Species 1 size bin: adult
Species 2 size bin: juvenile

Compute overlap indices using:
Estimated biomass | Probability of occurrence

Climate scenarios:
SPPS-2.0 (CMRPA) | RCP4.5 (CMRPA) | SPPS-4.0 (CMRPA)

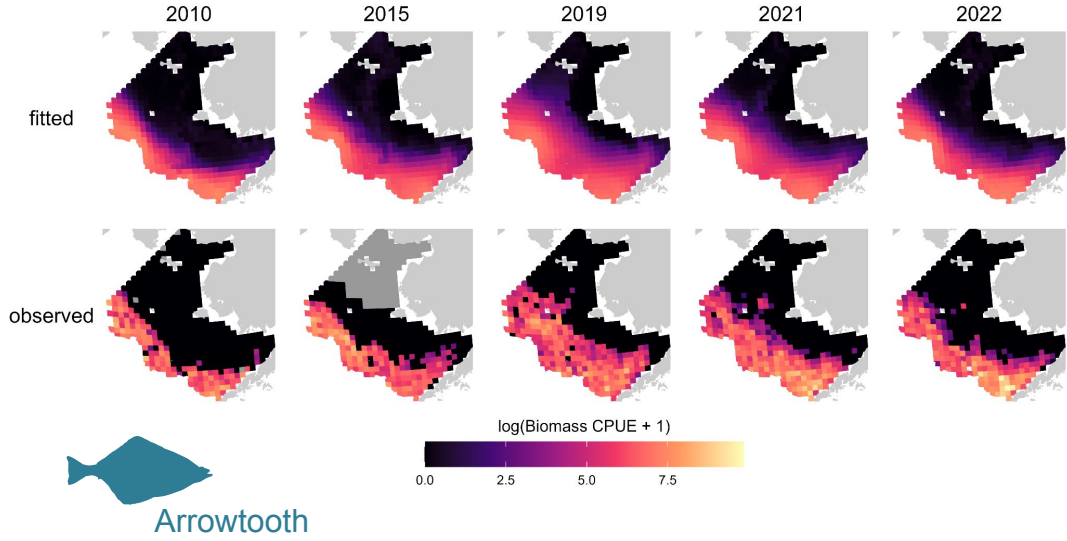
Climate models:
Note: Ensemble combines estimates from selected models only.
ensemble | CESM | GFDL | MIROC

Download output:
Contact Heather Goodman (hgoodman3@noaa.gov) for other outputs.
Overlay | Species 1 | Species 2

Background
This interface displays fitted means and confidence intervals from SDMs built for a suite of eastern Bering Sea groundfish and crab species. As part of the ACLIM2 project, Generalized additive models (GAMs) were built for each species with environmental covariates selected using time-series cross-validation (i.e., by optimizing year-ahead predictive performance). Terms considered in the models include temperature, depth, oxygen, pH, and spatially-varying effects of the cold pool. We were fit separately for juveniles and adults for most species, but not for snow crabs, and not for king crab. When plotting these species, choose "all" for the size bin. We use a delta-GAM, with a binomial component for estimating probability of occurrence, and lognormal component for estimating positive (non-zero) biomass. Only projections are plotted below, with model summaries and range projections for individual species available in tabs to the right.

Spatial overlap
Each of the below overlap metrics varies between 0 and 1, with 0 indicating no overlap and 1 indicating complete overlap, and each is lowest under linear transect motion, i.e., impacted only by the relative biomass distributions of each species, not by the aggregate sum biomass in a given year. The years containing groundfish survey data (1970-2019) are shaded.

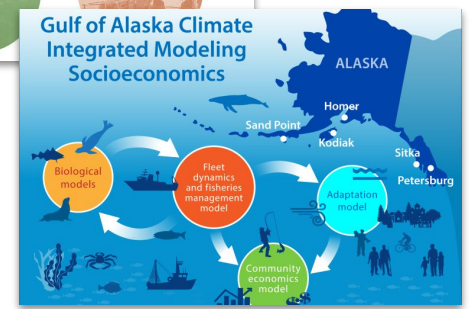
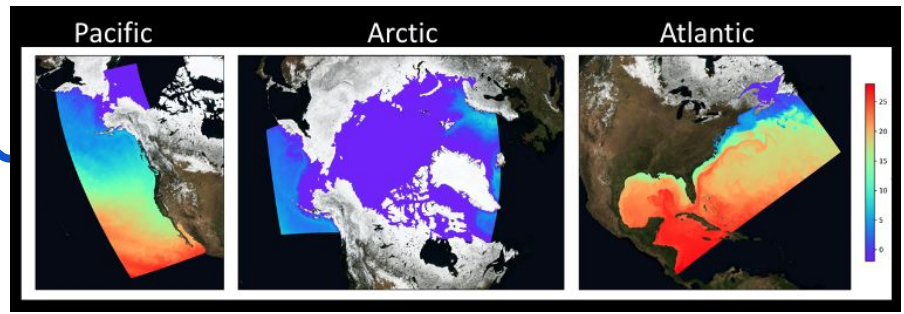
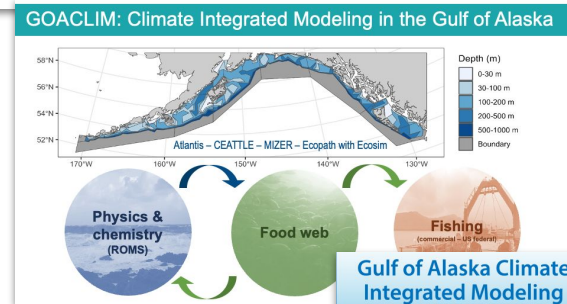
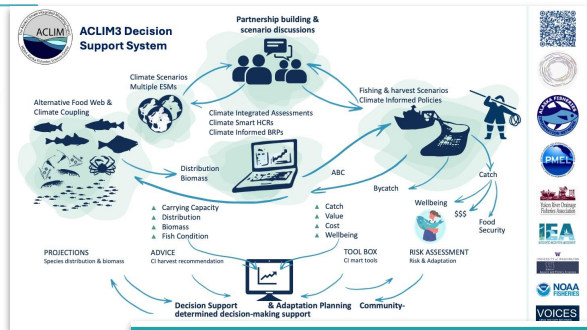
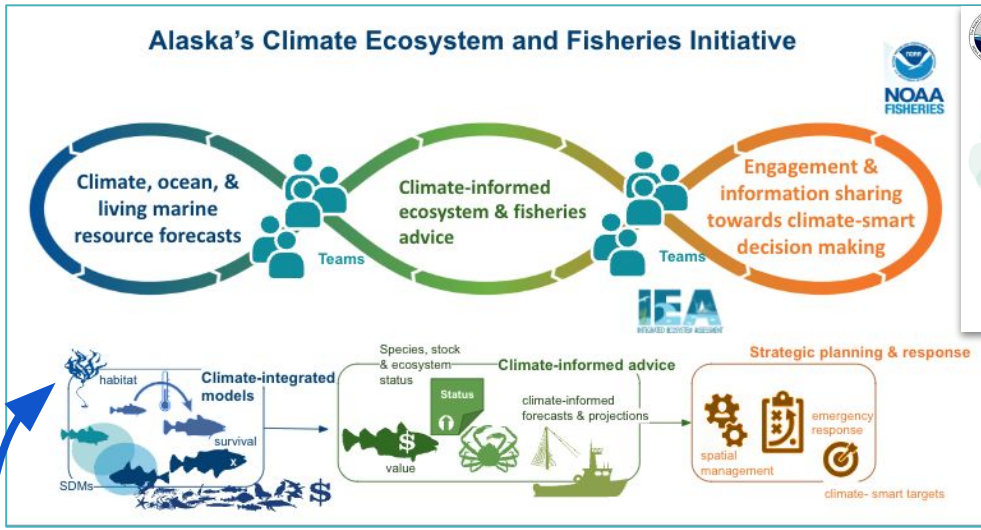
Local index of collocation
The local index of collocation (or locally a relative metric of interspecies encounters, which measures co-occurrence as a non-centered correlation among estimated species biomass:



Interactive tools to explore spatial distribution changes

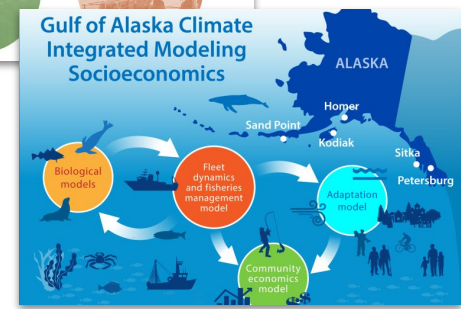
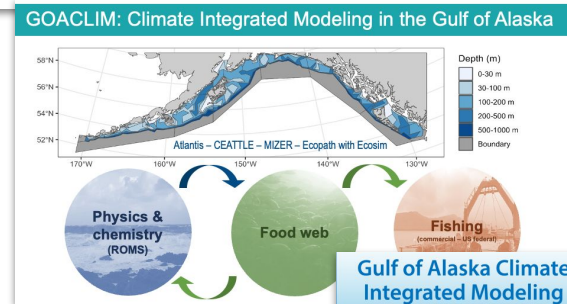
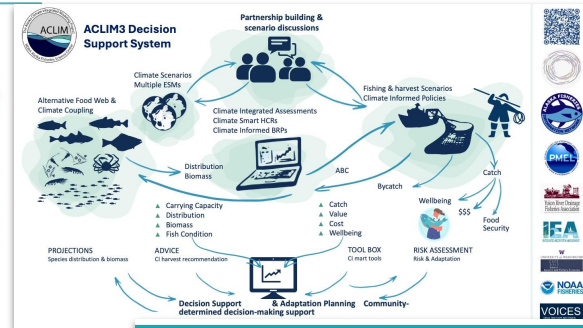
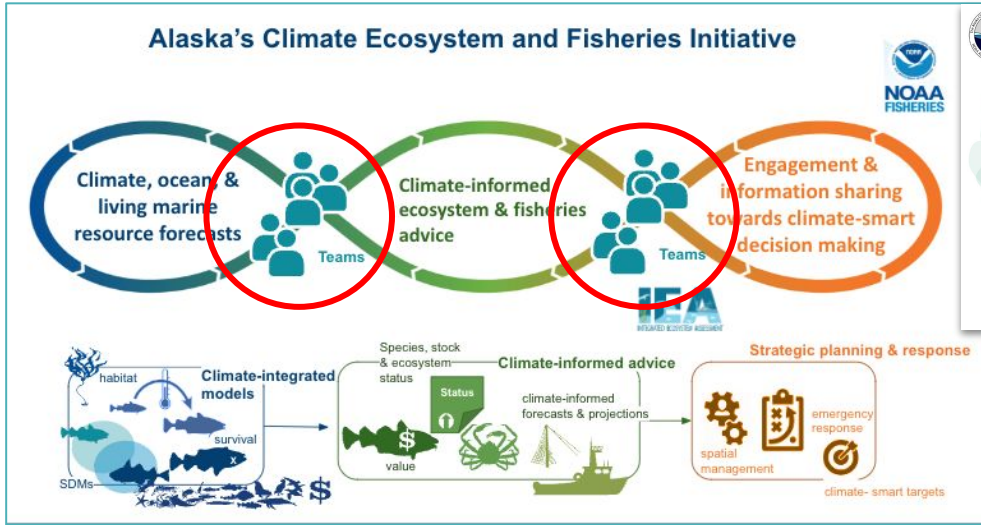
https://mgoodman.shinyapps.io/aclim2_sdms_explorer/

Build on progress from Integrated Modeling Projects



High resolution climate forecast, hindcasts, decadal predictions & projections

Build on progress from Integrated Modeling Projects



Recognizing that building meaningful advice requires a sustained multidisciplinary approach (from information and data sharing to advice)

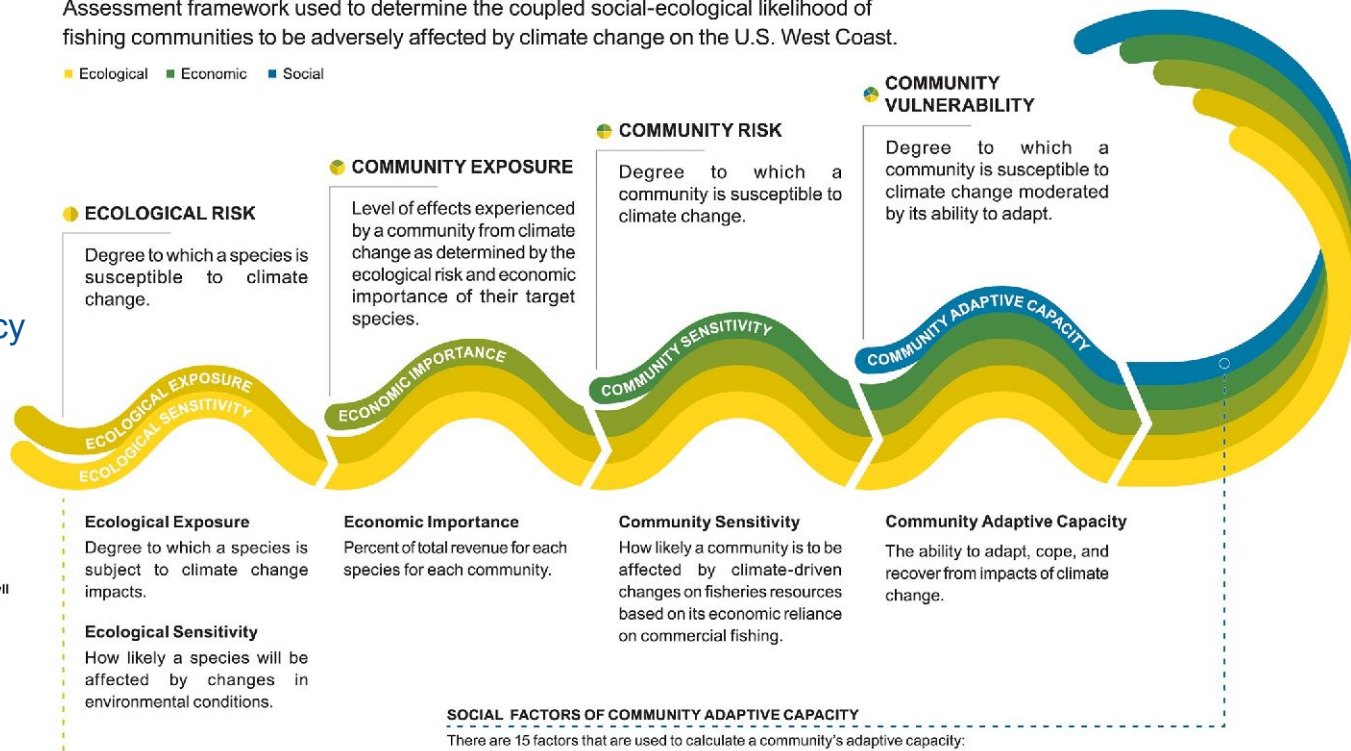
**Inclusive processes to assess impacts,
trade-offs, and solutions**



Socioecological Vulnerability of Climate Change on Fishing Communities

Assessment framework used to determine the coupled social-ecological likelihood of fishing communities to be adversely affected by climate change on the U.S. West Coast.

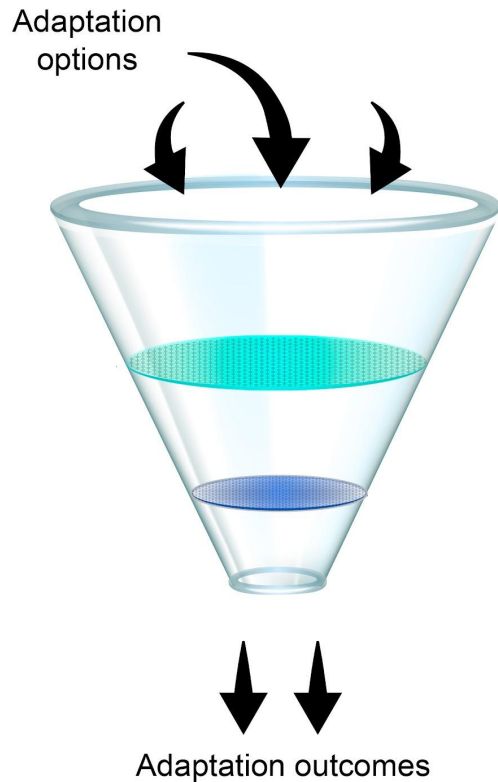
■ Ecological ■ Economic ■ Social



Collectively understand:

- Climate drivers
- Climate impacts
- Value & importance
- Sensitivity & dependency
- Adaptive capacity

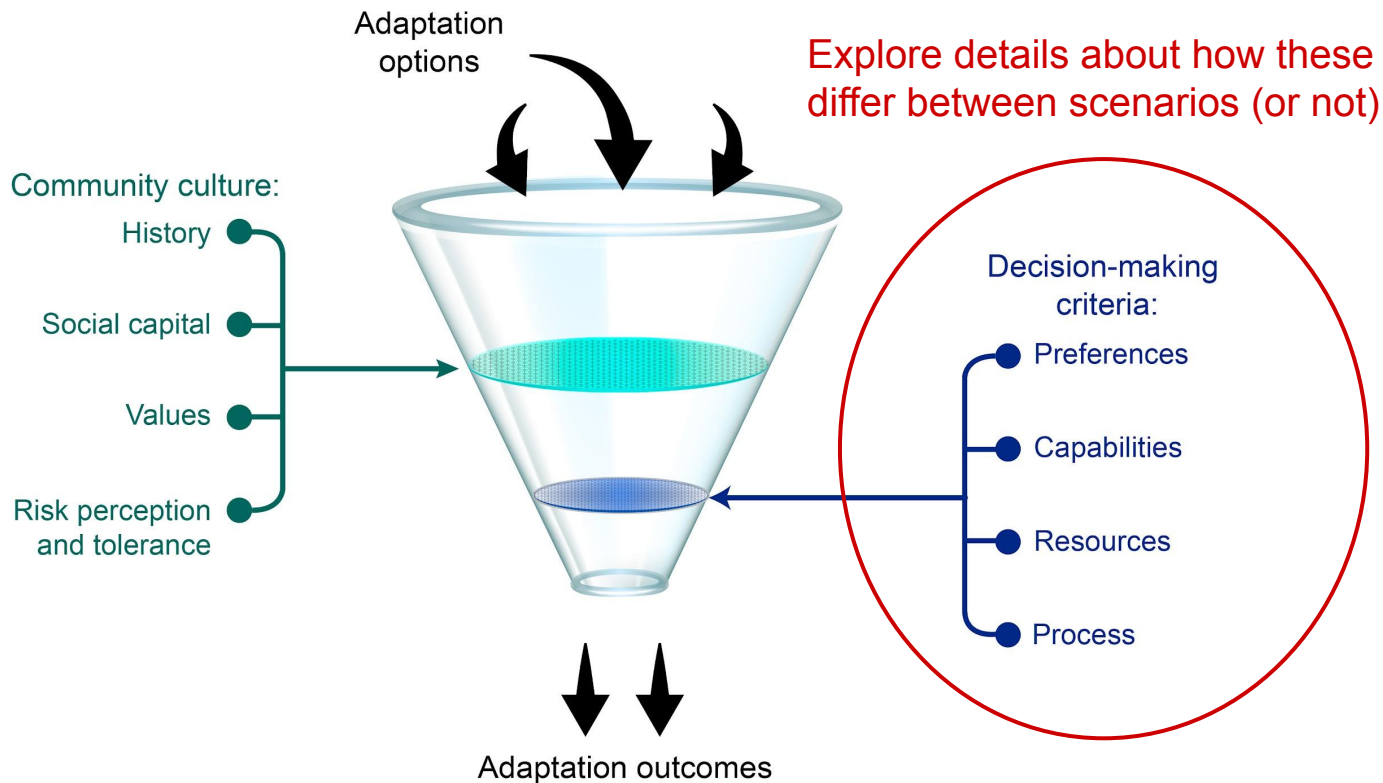
Adaptation Actions Defined by Multiple Factors



NCA5 31.2: Adaptation Actions Defined by Multiple Factors

Adaptation outcomes are the result of individual and group values and decision-making processes and constraints.

Adaptation Actions Defined by Multiple Factors



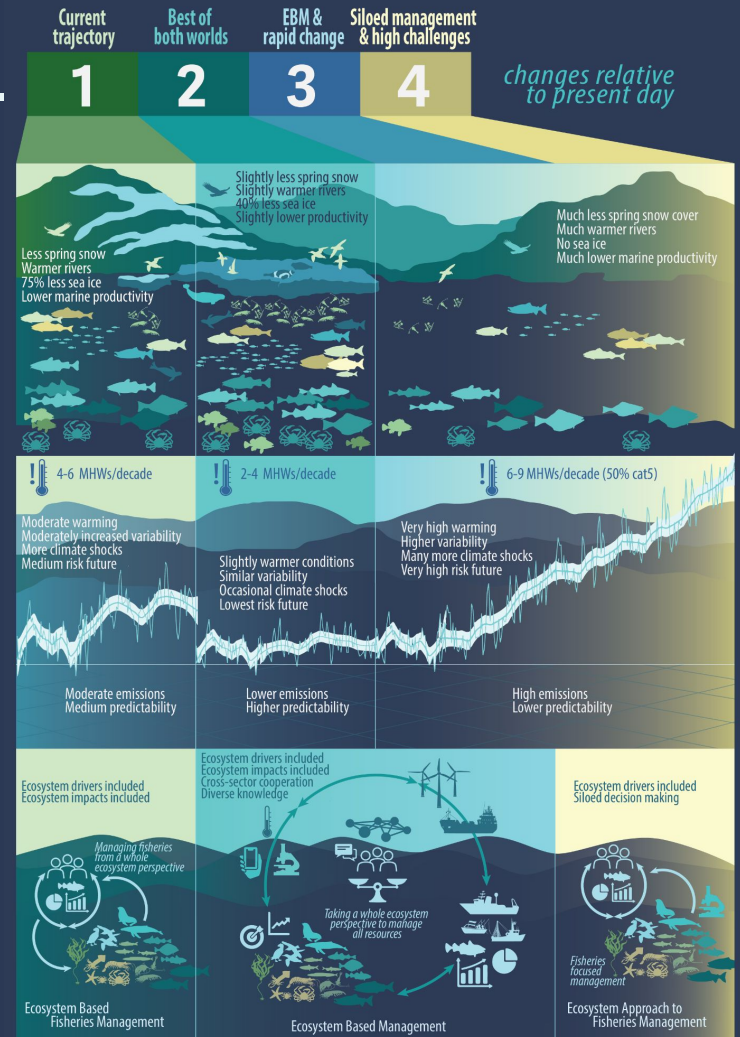
NCA5 31.2: Adaptation Actions Defined by Multiple Factors

Adaptation outcomes are the result of individual and group values and decision-making processes and constraints.

Does climate readiness need inclusive and cross-sector EBM? Why or why not?

If so how, who, and why? Specifics...

- Sectors
- Timelines (how far ahead is it needed)
- Timeframes (when ? soon, next decade +..)
- Data & information specifics
- Management tools (specific strengths, weaknesses of each approach)

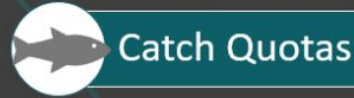


Future Climate Change Scenarios

How might these change across scenarios?

Types of Management Actions

Catch Quotas: Specify overfishing limits (OFL), allowable biological catch levels (ABC), and total allowable catch (TAC)



Catch Quotas

Gear Types and Seasons: identification of legal gear types, and seasons to distribute harvest in time to avoid gear conflicts, reduce bycatch and marine mammal interactions



Gear Types and Seasons

Bycatch and PSC: Bycatch and prohibited species catch limits, time/area/ gear type closures



Bycatch and PSC Limits

Protected Resources: Time and area closures to protect critical areas, prey species limitations



Protected Resources

Habitat: Description and identification of essential fish habitat for all managed species, gear/area closures to protect key areas



Habitat

Community Protections: Harvest quota set asides for communities, regional delivery restrictions



Community Protections

Limited Access Privileges: Create limited access programs, sector allocations, rationalization privileges



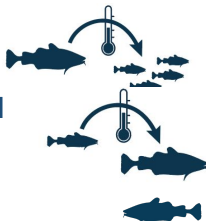
Limited Access Privileges

Types of Management Actions

Climate impacts ecosystems & food webs



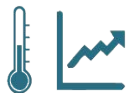
Climate impacts on growth, survival & biomass



Changes to fish distributions (& fishing grounds)



Climate change (oceanography)



Climate Informed EBM advice



Catch Quotas

Gear Types and Seasons

Bycatch and PSC Limits

Protected Resources

Habitat

Community Protections

Limited Access Privileges

QUESTIONS?

