

NEFMC Ecosystem-based Fisheries Management prototype Management Strategy Evaluation (EBFM pMSE)

SSC Meeting
February 8, 2023



New England
Fishery Management
Council



School for Marine Science & Technology
UMass Dartmouth



Gulf of Maine
Research Institute

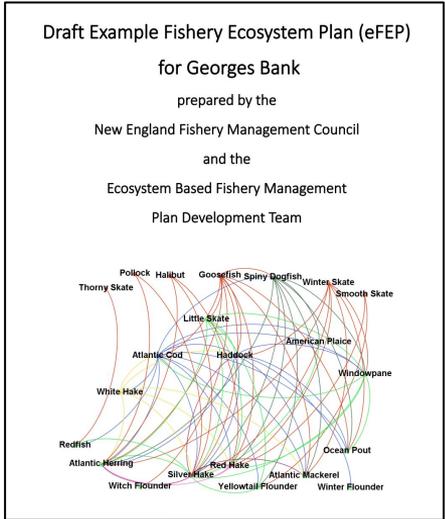
Terms of Reference

Provide comments and guidance on a proposed MSE model framework and on stakeholder input (management goals and objectives, performance metrics, and the range of management alternatives/procedures) about whether the framework is sufficient to meet the core project objectives and whether any improvements are necessary or desirable.

At a minimum the SSC should discuss:

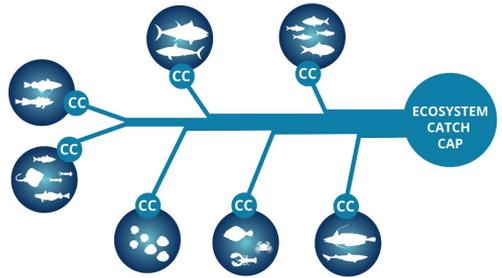
1. Whether the proposed operating model(s) scenarios are adequate to explore different states of nature considering:
 - a. Georges Bank stocks in ecosystem management
 - b. Representations of past, present, and potential future conditions
 - c. Food habits data and other information, trophic relationships among stocks including consumption of juvenile fish
 - d. Different levels of primary productivity
2. Whether the proposed objectives and performance metrics should be narrowed or expanded.
3. The decision rules for defining the ceilings and floors.
4. Proposed parameters that will be used for defining overfishing and overfished status.

Project Overview



eFEP outlines an approach for EBFM in New England via a draft worked example for Georges Bank.

Based on stock complex management and place-based productivity.



- Ecosystem Catch Cap:** Total catch from the ecosystem can not exceed a Cap related to annual productivity.
- Stock Complex Ceilings:** Assessments of the balance between **predators and prey** in the ecosystem will help determine Species Complex Ceilings (CC).
- Species Biomass Floors:** Total biomass of individual species can not decrease below threshold levels.



Project Team

- Project Lead- Dr. Gavin Fay (UMassD-SMAST)
- Project Lead- Dr. Lisa Kerr (UMaine)
- Quantitative Research Assistant- Jerelle Jesse (GMRI)
- Facilitator- Madeleine Guyant (UMassD-SMAST)
- Rapporteurs- Max Grezlik, Cristina Perez, Lucy McGinnis, Amy Martins

pMSE Overall Goal

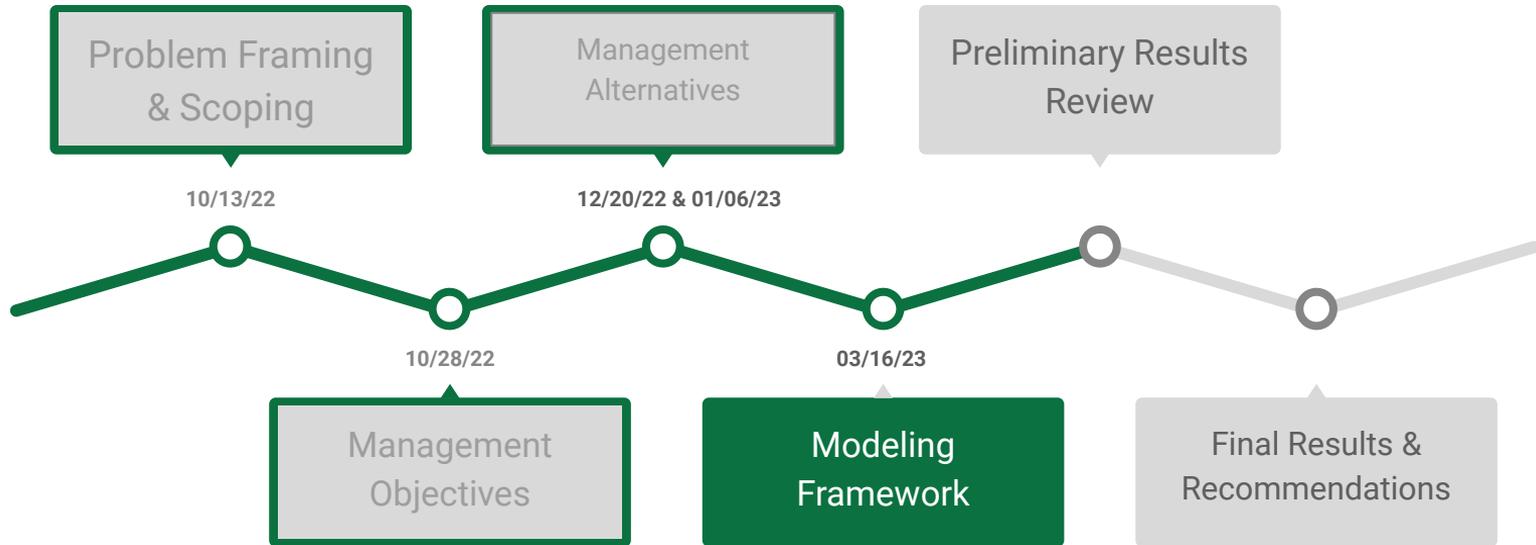
- Demonstrate how MSE can be used to evaluate EBFM management strategies for a Georges Bank Ecosystem Production Unit.

pMSE Overall Approach

- Sequence of collaborative & iterative engagement through the project with EBFM Committee and AP Chairs serving as stakeholders.
- Use and link two existing regional modeling frameworks to compare a small set of alternatives based on the eFEP management strategies.
 - MSE framework developed for Northeast US groundfish (Kerr et al. 2020, Mazur et al. 2021)
 - multispecies catch at length model Hydra (Gaichas et al. 2017, NEFMC 2019)

pMSE Stakeholder Engagement Overview

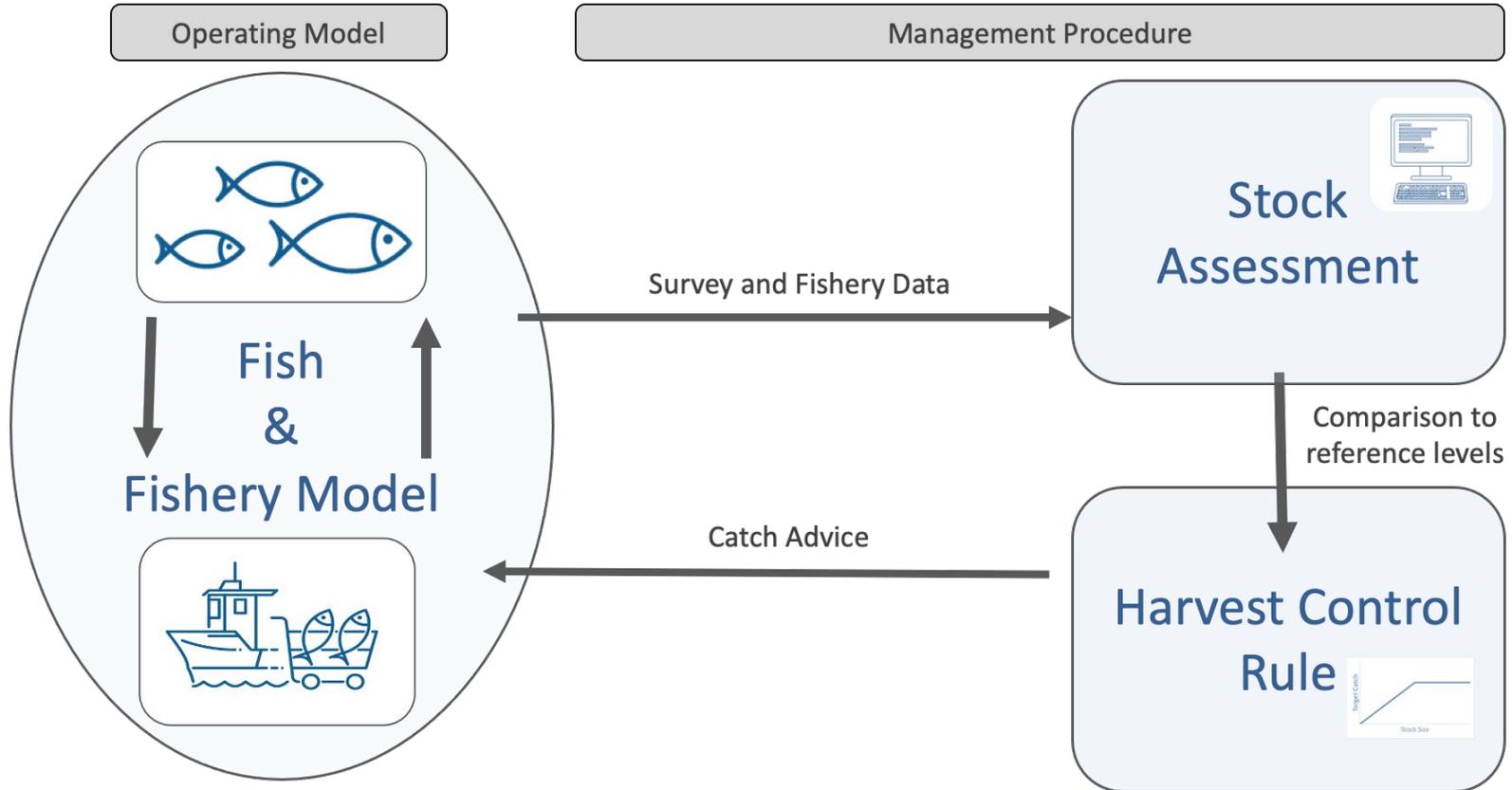
pMSE stakeholders: EBFM Committee and AP Chairs



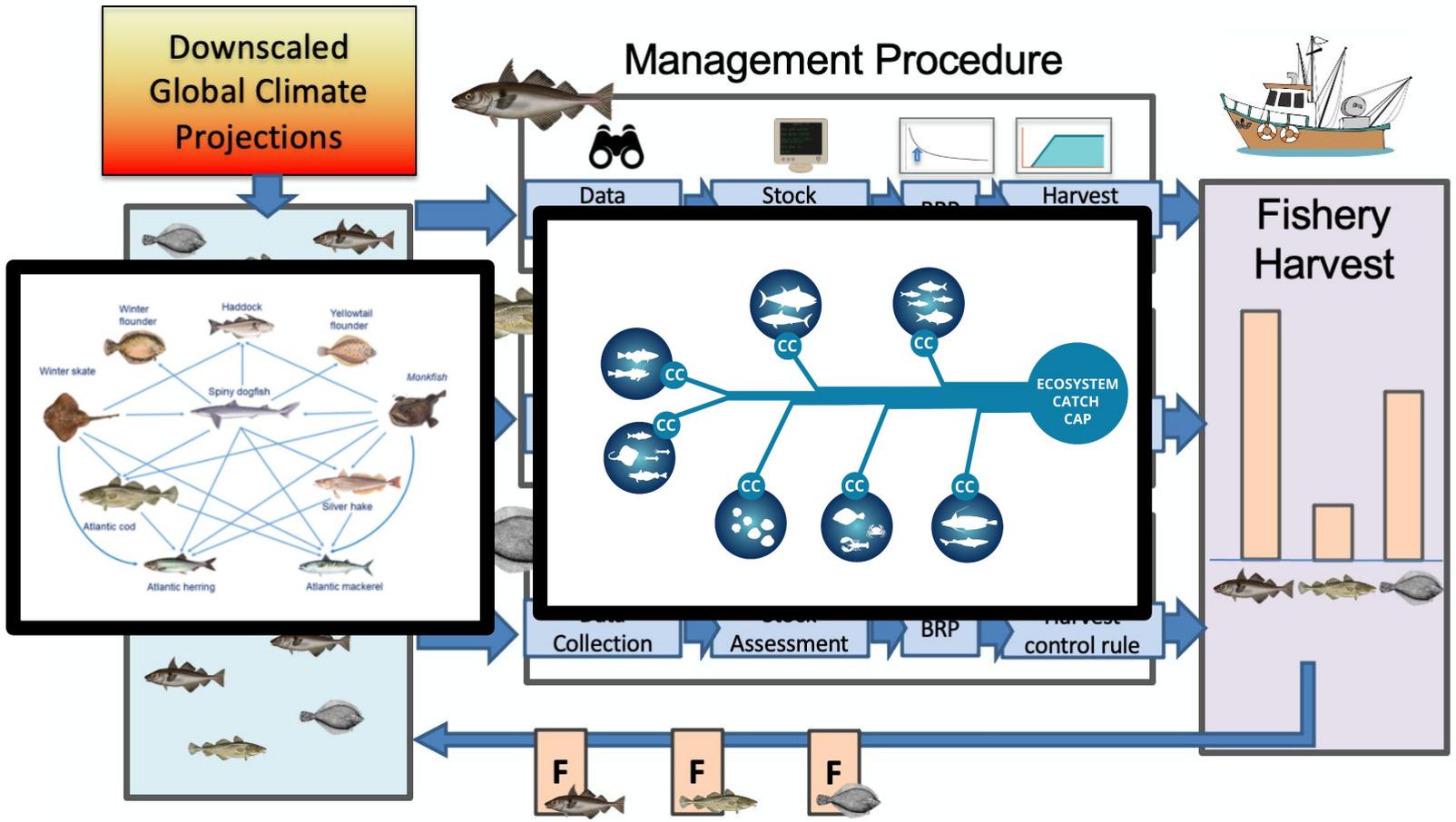
- February 1st, PDT call
- February 8th, Presentation to SSC
- Parallel sequence of engagement with the PDT
- Each workshop contains review of previous decisions

Model Framework for Prototype Management Strategy Evaluation

Management Strategy Evaluation Closed Loop Simulation framework



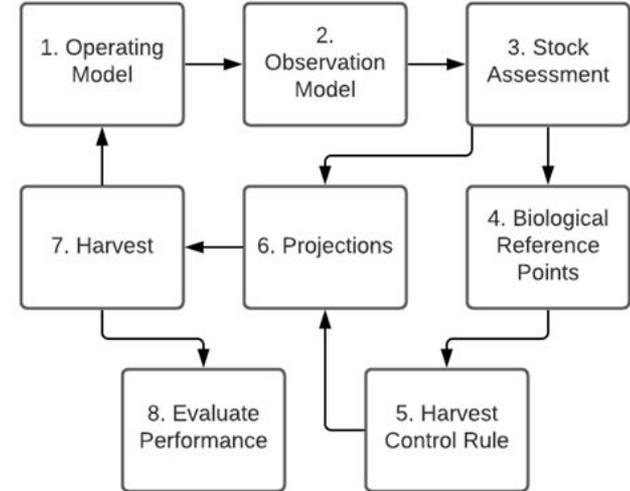
Multispecies operating model & eFEP management procedures



- Groundfish-MSE framework has been applied to address:
1) impacts of unaccounted for catch, and 2) management procedure performance in a changing ecosystem.
- Designed with general extensibility for future applications in mind.
- Communication, visuals, and tutorial education materials describing the framework, its use, and outputs are available.
- Reviewed by NEFMC Review Panel and informed by feedback from NEFMC groundfish PDT, Committee, SSC, and Council.
- Code and background materials are publicly available on GitHub repository: <https://github.com/lkerr/groundfish-MSE>

pMSE Upgrades to MSE Framework

- Including the Hydra multi-species population model as the operating model.
- Representing impact of ecosystem drivers in a version of Hydra systemic changes in productivity.
- Adding a surplus production model to allow for stock complex aggregate assessments.
- Adding decision rules for eFEP ceilings/floors approach.
- Characterize alternative fishing fleet dynamics via a set of scenarios.



Operating model: Multispecies length-structured model (Hydra)

Model is based on [Gaichas et al. \(2017\)](#), implemented in ADMB.

Multispecies length-structured model, includes trophic interactions among modeled species and size-based mortality

Already parameterized for a subset of stocks on Georges Bank

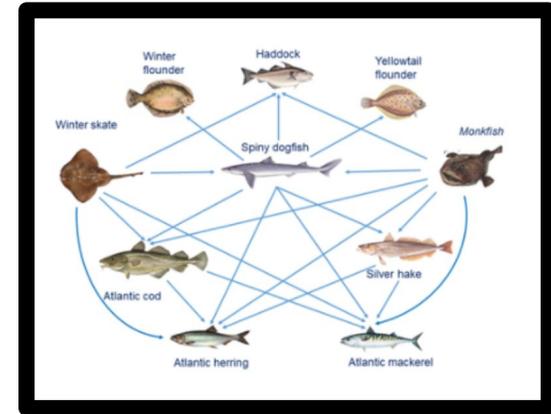
Flexible fishing fleet implementation

Ability for externally forced drivers of population productivity and growth

Reviewed as part of the 2018 Center for Independent Experts review of the NEFSC Ecosystem-Based Fishery Management Strategy

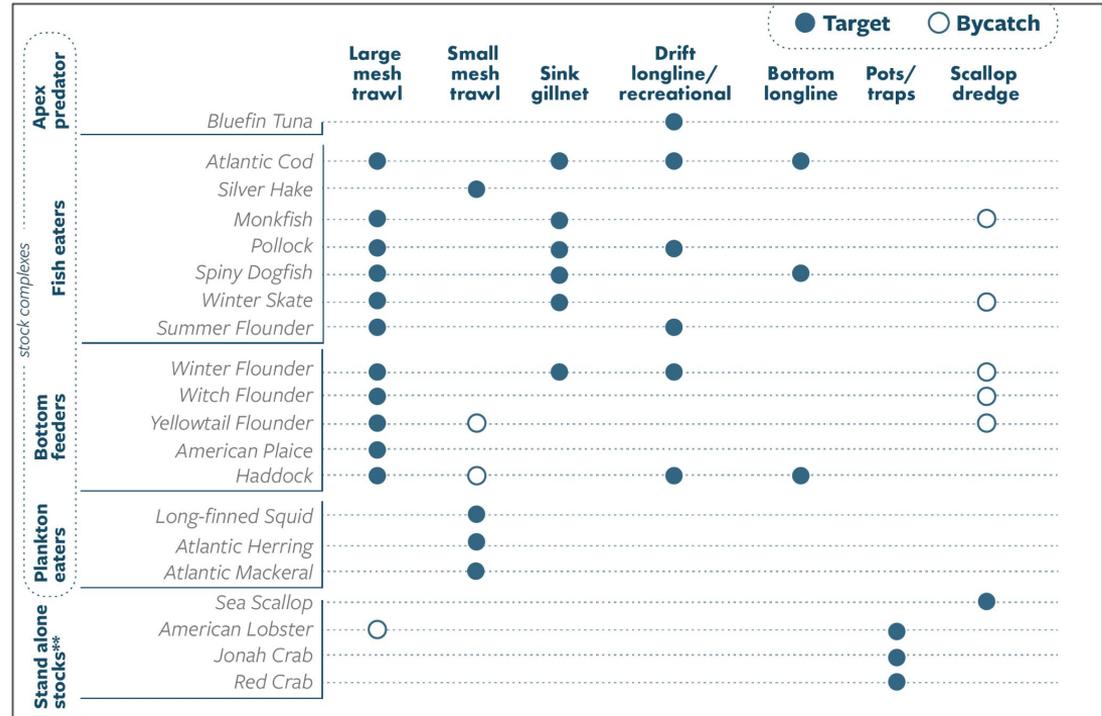
Familiarity of the model with the NEFMC EBFM committee through its use in the eFEP worked example simulations.

[Code and development](#) and [diagnostics](#) publicly available on GitHub.



Operating model species selection, stock complexes, & fishery designation

eFEP provided a map of Georges Bank stocks to fishing gears



Operating model species selection, stock complexes, & fishery designation

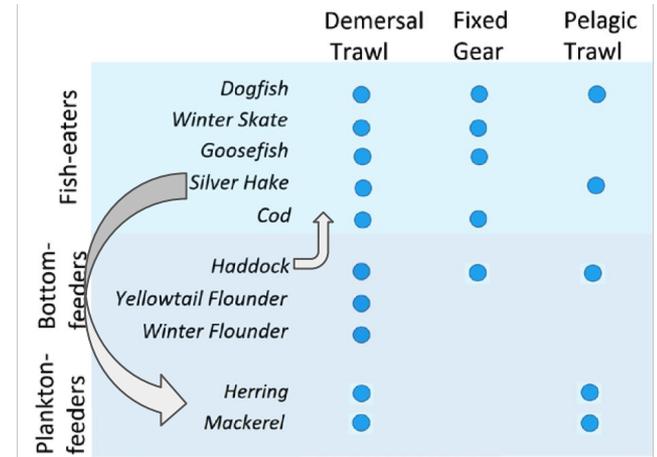
eFEP provided a map of Georges Bank stocks to fishing gears
10 modeled species in the Hydra eFEP worked example.

Continue that here, some effects of other species addressed in specific scenarios (e.g. changes in other forage abundance)

Projections from current system status

For Management alternatives with complex Management-species aggregation into complexes:

- Feeding guild and gear based
- More gear-based to reflect fishery operation



Environmental drivers of ecosystem productivity

- pMSE goals include understanding implications of changing ecosystem productivity on the performance of the eFEP approaches.
- Hydra does not include phytoplankton forcing and so goal is to emulate this desired property in the modeled ecosystem dynamics.
- Proposed approach: link deviations in annual recruitments among species to reflect systemic changes in productivity, emulating the effects of time-varying ecosystem productivity that leads to dynamic reference points (in addition to those resulting from trophic interactions).

Fishing fleet dynamics representation

Fishing modeled as size-based mortality process, with linkages among species due to size-based selectivity and relative catchabilities among stocks.

Provides the capability to include the effects of technical interactions that result in linked fishing mortality among stocks.

Fleet-based approach to modeling technical interactions with scenarios representing alternatives for flexibility in targeting:

- Recent covariation in catch among species/fleets
- Variation in complex catch allocation among fleets
- More selective targeting within fleets by value
- More selective targeting within fleets by biomass status

TOR 1

1. Whether the proposed operating model(s) scenarios are adequate to explore different states of nature considering:
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 - c. Food habits data and other information, trophic relationships among stocks including consumption of juvenile fish
 - d. Different levels of primary productivity

Management Objectives and Performance Metrics

- Fundamental and means objectives generated at Management Objectives workshop
 - Fundamental: What do you really care about?
 - Means: How do you get there?
- Organized by project team
- Stakeholder input on objectives, translation to model outputs by PDT and project team
- Performance metrics for each means objective
 - Operationalize objectives
 - Compute for each combination of OM scenario and Management Alternative
 - Assist in making choices/comparisons among alternatives

Management Objectives Stakeholder Discussion

- Emphasis on manageable number of outputs
- Some objectives assessed at ecosystem level, some at stock complex level, some at individual stock level
- Metrics allow comparison among status quo and EBFM approaches
- Stock-specific metrics to understand eFEP consistency with national standard guidelines
- Identified metrics of interest for a full MSE, opportunity for proxies in pMSE

Fundamental Objectives for pMSE

- Maintain or increase inflation adjusted total value for the fishery
- Preserve Ecosystem function and structure
- Maintain stock complex biomass around levels that optimize fishing opportunities
- Prevent overfishing
- Response of regulations to stocks at low abundance, and recovery of depleted stocks
- Reduce regulatory complexity
 - Both our stakeholders and the EBFM PDT expressed concern about the feasibility of metrics for this objective in the pMSE.

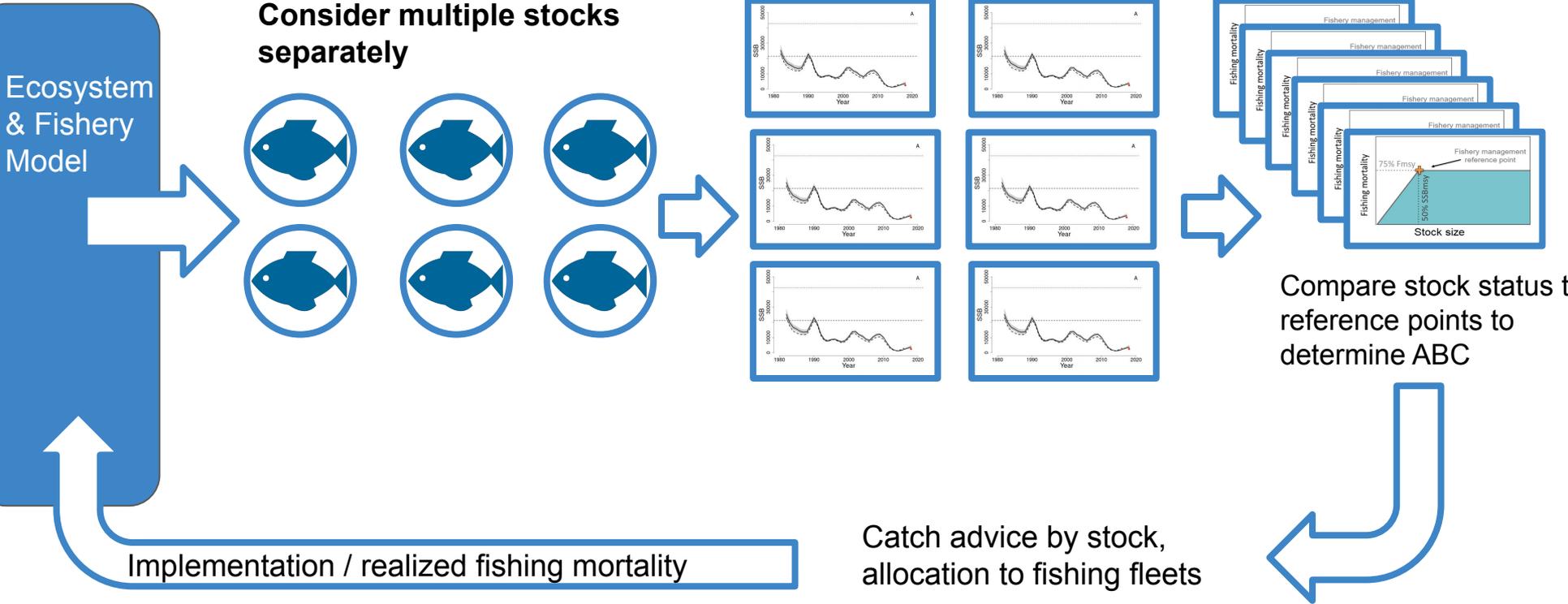
TOR 2

2. Whether the proposed objectives and performance metrics should be narrowed or expanded.

Objectives Tables provided in meeting materials.

Management Alternatives Overview

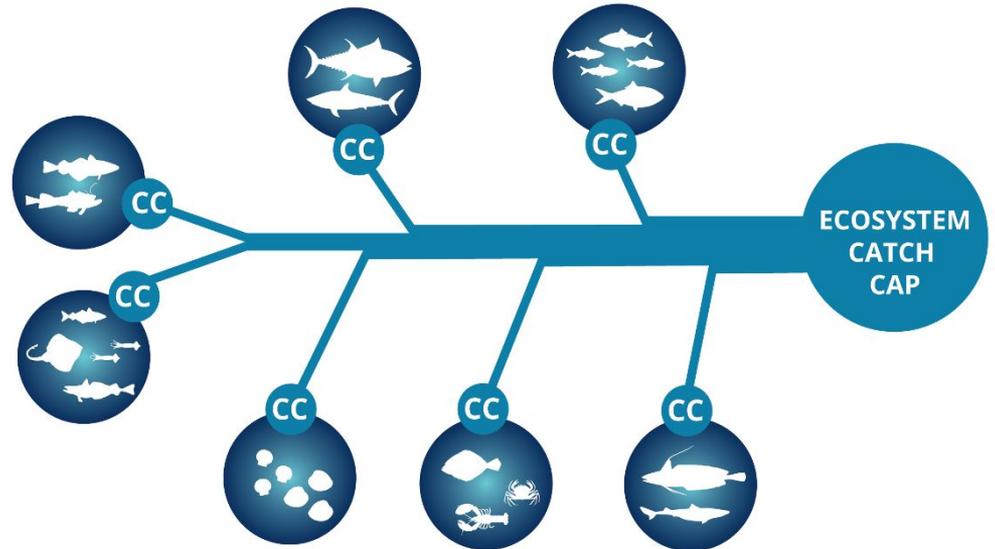
Status quo Single species management



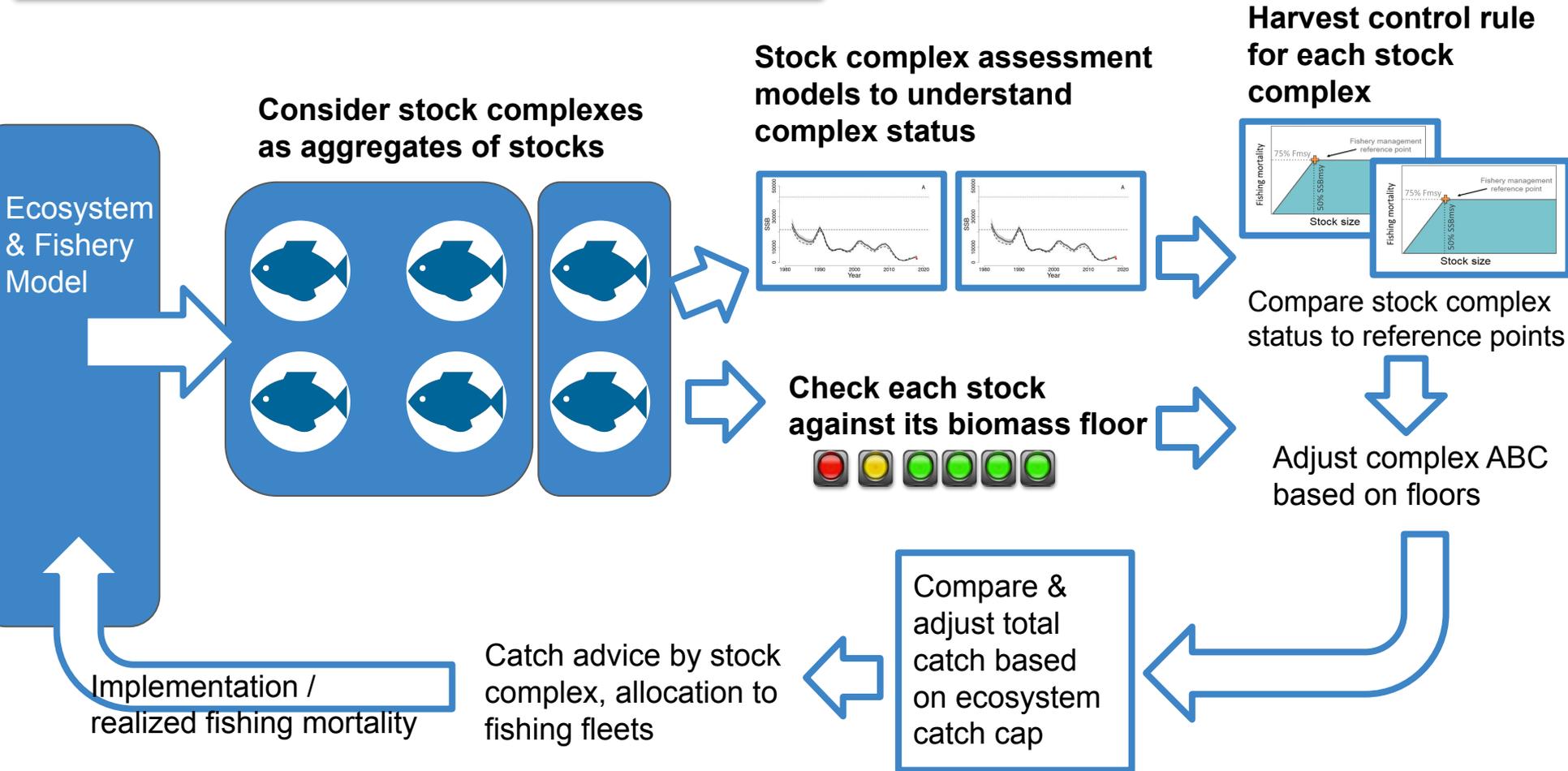
Stock Complex management from the eFEP

Based around concept of aggregating stocks into complexes and ceilings and floors

		Demersal Trawl	Fixed Gear	Pelagic Trawl
Fish-eaters	<i>Dogfish</i>	●	●	●
	<i>Winter Skate</i>	●	●	
	<i>Goosefish</i>	●	●	
	<i>Silver Hake</i>	●		●
	<i>Cod</i>	●	●	
Bottom-feeders	<i>Haddock</i>	●	●	●
	<i>Yellowtail Flounder</i>	●		●
	<i>Winter Flounder</i>	●		
Plankton-feeders	<i>Herring</i>	●		●
	<i>Mackerel</i>	●		●



Stock Complex management from the eFEP



Management Alternatives Stakeholder Discussion

- Include a range of alternatives that allows understanding of what drives changes in performance
 - Emphasis on a manageable number of management alternatives
 - Status quo, all-in, two intermediate procedures
- Interest in recognizing climate or other main drivers of change in the system in management decisions
- Investigate one alternative aggregation of stocks into complexes
- Test an alternative that includes specific rule for additional action to recover depleted stocks when management is at the stock complex level

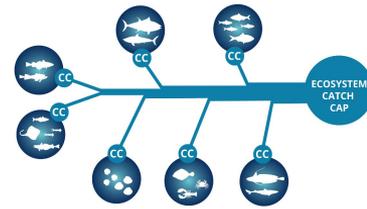
Range of Management Alternatives

General types of alternatives will include:

- Single-species assessment and management with no adjustment of reference points for underlying operating model dynamics (status quo)
- Single-species assessments and catch advice with dynamic reference points (building from the groundfish MSE work)
- Stock complex-based assessments and control rules with ceilings and floors based on abundance index thresholds
- Stock complex-based assessments and control rules with dynamic ceilings and floors

(limited exploration of alternative levels for decision points within these)

Management Alternatives



Decision points associated with a management alternative include:

- the type(s) of assessment methods,
- the aggregation (or not) of species in to species complexes,
- evaluation of individual and aggregate stocks to single-species and stock complex level reference points,
- the determination of those reference points,
- the functional forms for how catch advice is adjusted based on assessment results relative to reference points,
- functional forms and rules for how stock complex advice is modified based on ecosystem ceilings and stock biomass floors,
- rules for how advice and fishing mortality is realized given allocation to fishing fleets, stock complexes, and constraints imposed by technical interactions.

Management Alternatives Table

https://docs.google.com/spreadsheets/d/1pMVJprnZ9-H47X1c-T6IAZZ83m-F_XdMSxP6tT-PGLE/edit?usp=sharing

Management Alternatives Table Discussion

TORs

3. The decision rules for defining the ceilings and floors.
4. Proposed parameters that will be used for defining overfishing and overfished status.

Next Steps

03/16: Modeling framework workshop

Summaries of 02/01 PDT meeting & today's SSC call

Questions?

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