Prototype EBFM MSE draft planning outline and timeline

1.0 Purpose

- **To showcase a simplified prototype MSE framework and demonstrate how MSE will be used to evaluate EBFM management strategies for a Georges Bank Ecosystem Production Unit, using what we learn to communicate with the public about MSE for EBFM. This product would:**
  - Act as an educational dry run from both a development and an operational perspective.
  - Provide an opportunity for Council and Committee to gain experience with MSE process
  - Identify and work through the types of decisions to be made during an MSE

- **To identify supporting data sources and develop the models and analyses that will support a full EBFM MSE when all stakeholders can participate in the next phase of the Council's EBFM development strategy.**

- **While intended to be realistic, the prototype MSE results are not intended to be actionable in a fishery ecosystem plan, but the results should be used as the basis for a full MSE. A full MSE involving all interested stakeholders in the next phase will be used to develop an actionable fishery ecosystem plan with management alternatives. As such, a prototype MSE is also NOT intended to determine the definitive management procedure or determine how much total yield will change compared to current conditions.**

2.0 Objectives for the prototype MSE

- Increase understanding of the eFEP and use the outcome to build stakeholder engagement in the Council's EBFM strategy
- Identify management decision points and potential sequences of decisions within the eFEP
- Identify critical decision points and data gaps that the prototype MSE could address
- Investigate how human behavior (i.e. targeting vulnerable stocks) can impact the ability of EBFM strategies to meet objectives (i.e. preventing overfishing and overfished conditions)
- Identify example management objectives and associated performance metrics
- Identify a limited set of realistic management procedures (harvest control rules) to be evaluated
- To show whether and how the proposed EBFM strategy (i.e. ceilings and floors approach) could be consistent with Magnuson Stevens Act National Standard 1 criteria.

- Develop scientific support for EBFM MSE; e.g. “rapid-prototyping” process with the Committee, PDT, and participating stakeholders?
- Apply a multispecies operating model that includes trophic and technical interactions and the potential effects of climate change along with estimation, management, and implementation models in closed loop simulations to address the identified set of critical decision points and data gaps
- Identify and develop summary products for effective communication and discussion of MSE results (key communication tools and visuals)

3.0 Participation and roles

Develop beta MSE demonstration with a small, effective group

- “Stakeholders”: EBFM Committee and 3 (?) selected “Advisors”. The Council should strive to include one stakeholder from each fishery functional group and one recreational fishery stakeholder.
    - Identify example objectives, associated performance metrics, and management strategies, harvest control rules, and biological reference points to be tested (to include status quo scenarios)
    - Provide feedback on results and how they are summarized and presented
- EBFM PDT
    - Technical advice and guidance
- Contractor
    - Develop the software to perform the closed-loop simulation analyses for the MSE, including refining and extending candidate operating model and implementation and application of assessment and management procedures
    - Run analyses to evaluate candidate management procedures
    - Summarize and compare results for management procedures
    - Draft a technical report on the MSE and its results

4.0 Management objectives and performance metrics To be completed during a prototype MSE

Objective	Related performance measures

5.0 Operating model
To be completed during a prototype MSE

5.1 Stocks in operating model
Bound scope

- What is the rationale and criteria for inclusion of a stock in a Georges Bank EPU MSE?
    - Catch and economic value?
    - A percent of total biomass?
    - Strong trophic relationships with managed species based on food habits data and other information?
    - Apex predator or protected species?

- At least two species per stock complex to demonstrate the notion of species complex aggregate abundance and reference points

- At least three stock complexes

- OMs should account for the energetics provided to higher trophic levels through the consumption of pre-recruit fish (juveniles, larvae, and eggs)

Stock		Role
Examples		
Georges Bank cod		Managed
Sand lance		Prey
Atlantic herring		Managed
Sharks		Predator
Grey seals		Predator
Seabirds		Predator
In Hydra Operating Model		
Atlantic cod		Predator
Yellowtail flounder		
Haddock		
Monkfish		Predator
Winter flounder		
Silver hake		Prey and predator
Atlantic mackerel		
Spiny dogfish		Predator
Winter skate		
Atlantic herring		Prey
Others required		
Squid		Predator and prey
Large pelagics (tuna and billfish)		Predators

Desirable, but not required		

5.2 Operating model scenarios or matrix
To be included in prototype MSE plan

- Equilibrium MSY (biomass at sustainable level, low M, high growth, high R/SSB) – for evaluating different EBFM management procedures
- Equilibrium depleted (current?) – for evaluating transitional management procedures. Example parameters could be high M, low growth, low R/SSB
- Historic (approximate dates?) – for evaluating how EBFM would have operated under observed past conditions
- Single model type to be chosen to prevent focusing on differences in model performance and encourage focus on the process and example harvest control rules and decision points

6.0 Example management strategies to be evaluated
To be developed during prototype MSE

- Problem framing – what is EBFM trying to solve/address? What management issues cannot be addressed by EBFM?
    - ?
- Status quo management
    - What is it? Single species catch management with periodic adjustments to reference points based on new and updated data and information about fishery selectivity and stock productivity changes that affect natural mortality and growth?
- Necessary components
    - Ecosystem Production Unit cap on removals
    - Catch limits for stock complexes
    - Minimum biomass threshold for stocks in the EPU
    - Rebuilding period and management strategy
    - Uncertainty in biological reference points
    - Uncertainty in assessing stock size
    - Science and management lags

- Others?

- Desirable characteristics
  - Single stock vs stock complex catch regulation, status determination ("apples to apples" comparison)
  - Mitigation (rebuilding) of overfished stocks in a stock complex
  - Economic effects that affect fishing on vulnerable stocks, or depeleted stocks that cannot be avoided (i.e. "choke stocks")
  - Robustness of management strategies to trophic effects that affect predator growth, reproduction, and survival, i.e. prey depletion (see herring)
  - Robustness of management strategies to climate change effects
  - Biological and economic effects
  - Others?

7.0 Presentation of results
To be discussed during design phase and developed following beta MSE

- Hierarchical decision and results table
- Analysis of tradeoffs, outcome based decisionmaking
- Tabular summary, by performance metric and estimated total value/benefits
- Radar or barchart plots, percent of best performance by metric
- Outcomes of harvest control rules and decisions discussed with Committee and stakeholders as part of the beta MSE
- A presentation of the prototype MSE process and preliminary results to public information and stakeholder workshops being held by the Council
- Final summary and results presented to the Council and used during public information workshops

8.0 Proposed Timeline for Prototype Management Strategy Evaluation Demonstration

2022	
JAN -MAR	Design phase: Develop plan for desirable objectives, characteristics, and intended results. Joint meetings with EBFM Committee and PDT
APR	MSE plan approval
APR-MAY	Issue RFP and hire contractor to conduct MSE and run analyses
JUN-JUL	Develop operating model and MSE procedures
JUL-AUG	Conduct MSE with Committee, PDT, and a limited number of chosen stakeholders
AUG-SEP	Summarize MSE outcomes and results
SEP or DEC	Present beta MSE results to the Council and use the demonstration during public information workshops

Categorized feedback and comments, in no particular order

Committee:

1. Comment on MSE purpose:

    a. The original purpose, discussed by the committee, was to "…hone the MSE process before it was used in a more inclusive setting, help to clarify potential objectives, demonstrate how an MSE would work (which could be presented during the public information deep-dive workshops, and improve methods for summarizing and explaining complex MSE results in a simplified, understandable way,"

    b. First bullet: To SHOWCASE A SIMPLIFIED PROTOTYPE MSE FRAMEWORK and demonstrate how MSE will be used to evaluate . . .

    c. Second sub-bullet: IDENTIFY AND work through THE types of decisions to be made during an MSE.

    d. Third sub-bullet: An educational MSE dry run from both a developmental and operational perspective

    e. MSE is not about developing science, especially during the phase of MSE that engages stakeholders. It is about integrating a range of plausible descriptions of the functioning of a system to support decision making under uncertainty. The reasons the herring MSE disappointed a substantial portion of stakeholders is that it tried to develop the science needed to address stakeholder concerns (about herring's role as a forage species and localized depletion), and there simply wasn't enough known about these topic and there wasn't time to learn more about them. I think it is important that scientists have a pretty good idea about what's feasible to be included in the operating model, and thus the scope of the MSE.

    f. Instead of using the Prototype MSE to primarily communicate with the Council members and select members of the public, the goal would be primarily to communicate with the Agency about the consistency of the approach with the MSA. If the conclusion is positive (i.e., the NEFMC's EBFM approach compares well with the single species approach), this will address one key impediment to progress (uncertainty about approvability) and it should reinvigorate Agency support for the science necessary to make EBFM a reality.

2. Comment on objectives:

    a. Support for first objective.

    b. The final draft objective under Section 2 is one of the most important outputs of the prototype exercise – MSE is not intuitive, and these products can promote

future success of a full MSE for EBFM, especially with input from the prototype stakeholder participants in their development.

c. Last bullet: Increase understanding of, AND INCREASE STAKEHOLDER ENGAGEMENT IN, the Council's eFEP

d. Consideration of climate change is a major expansion of the scope of the MSE. What will be the scientific basis for including it in the MSE? At some point, it is probably necessary to conduct MSE on ecosystems with additional types of non-stationarity (climate change a likely cause), but is it realistic for this contract?

3. Comment on stakeholder participation:

   a. The idea of including a few stakeholders (that might be advisors as noted under Section 3 of the document) is good. Stakeholder participation in a prototype MSE could allow for more effective communication with the public about the eventual purpose once a full MSE is executed.

   b. The "Advisors" should include at least one with experience from each of the Fishery Functional Groups that arise from whatever stocks are chosen for the operational model in section 5.1. There should also be at least one recreational Advisor familiar with the recreationally important stock complex(es) that arise from those stock choices

4. Comment on worked example and MSE steps:

   a. Dr. Fay's spreadsheet is definitely helpful in visualizing what a prototype vs. full MSE effort would look like. The spreadsheet provides an excellent roadmap in the progression from the "worked example" to an eventual full MSE.

   b. A worked example would consist of the results of an MSE that includes a realistic OM (addressing not only biological parameters, but economic ones as well) and a management procedure that we want to test. I am baffled by the comment that we need a worked example in order to create an OM? I don't know what that means, given this framework for what an MSE is. Or, by worked example, do we mean spelling out the management procedures in detail that will be modeled in the MSE? How are we going to do that?

5. Comment on stocks included in operating models/bounds and scope:

   a. It is not stated what the rationale and limitations for species selection is (maybe the strategy or intent should be indicated), but at the minimum there should be at least three species complexes and/or Fishery Functional Groups plus apex predators/protected species. However, the later may increase complexity and be challenged by lack of relevant input data while not providing a lot of information relative to the intent of the exercise (depending on the management strategies

contemplated). Each species complex should have at least two species so that the notion of species complex aggregate abundance and reference points can better be demonstrated for each complex.

b. The OMs should include or account for the energetics associated with consumption of pre-recruit fish. Fish predation on pre-recruits is probably where the most important trophic interactions occur.

c. The OMs should include squid (important predators and prey), mackerel (not necessarily abundant now, but at times probably a major predator of small fish including ichthyoplankton), and large pelagic species (e.g., tunas and billfish). These species need not be considered in management strategies, but their energetics needs to be accounted for in the OM

6. Comment on operating model scenarios:

a. The suggested options are good, especially if the equilibrium depleted option reflects current conditions. This would form a baseline to which various control rules and other stock recovery management options could be evaluated. For example, this might facilitate evaluation of management strategies (changes in control rules) to rebuild say herring, who's current low abundance poses an impediment to ecosystem energy transfer to higher trophic levels.

7. Comment on management procedures:

a. The Prototype document refers to Equilibrium MSY reference points. What are they in the context of a dynamic ecosystem? There is the concept of stochastic equilibrium, which is similar to system stationarity, but this would require a constant F on each individual species (as well a stationary environment). Maybe the intent is to include in the MSE estimation of single species equilibrium MSY reference points, which would be useful for comparison, but if so, dynamic MSY reference points also need to be calculated within the OMs.

b. The rationale and suggested application of reference points suggested by Dr. Sissenwine are the kinds of approaches we need to consider. A question for the PDT would be is this approach, or some version of it, feasible in the context of a prototype process? I'd like to explore the use of dynamic reference points given the almost certain changes we will be experiencing in species distributions, biomass, food availability, ocean uses, etc.

c. Dr. Sissenwine's paper is interesting, and I agree that a side-by-side comparison of EBFM and single species management is something a lot of people would like to see, might allay hesitations with regard to NS1, and it might mesh somewhat with some of the outline points in section 6.0. However, my other impression is that any extra analysis might put it a bit out of the scope of what is conceived for

the prototype MSE.

d. Comparison between status quo and an ecosystem strategy need to have the same circumstances and should incorporate economic effects. Choke stocks are not a problem in current management if you ignore fishermen's behavior and assume we can always achieve target mortality rates. I don't believe any of that economic modelling work has been done yet, has it?

e. An evaluation of control rules to rebuild herring might demonstrate how restoration of a lower trophic level might cascade to increases in higher trophic level abundance/biomass (assuming the chosen operational model mimics a connection between prey consumption and predator growth).

8. Comment on presentation of results:

    a. Presentation of at least preliminary MSE results might be helpful for the public information workshops.

Plan Development Team:

1. Comment on objectives:

    a. The prototype MSE should investigate how human behavior could impact the ability of EBFM management strategies to meet objectives. Specifically, can we simulate what would happen if lucrative stocks within a complex were targeted (i.e., fishermen change fishing behavior - locations, time of day, gear tweaks, etc. so that the more valuable stocks within a stock complex are a higher proportion of the catch). This could clarify how important it will be to create appropriate incentives within the EBFM framework.

2. Comment on Operating Model Scenarios:

    a. More clarity is needed to outline and describe the range or matrix of operating models (states of nature) that the Council wants to use for evaluation of EBFM management procedures.

    b. The Council should not attempt to run a historic scenario to try to tease out how EBFM would have made things different in the past. In my opinion it is better to simulate forward with some single species scenarios and compare and contrast that rather than trying to strictly recreate the past which will be much more difficult to do.