



New England Fishery Management Council

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MEMORANDUM

DATE: January 20, 2017
TO: Ecosystem Based Fishery Management (EBFM) Committee
FROM: Andrew Applegate, EBFM Plan Development Team (PDT) chair
SUBJECT: **Example Fishery Ecosystem Plan (eFEP) documents**

In response to the request and issues raised by the EBFM Committee when it reviewed the “Operational Framework” document (<http://s3.amazonaws.com/nefmc.org/1c.-Draft-Operational-Frameowrk-and-Operational-Models-to-Support-Fishery-Ecoysstem-Plan-Development.pdf>), the PDT provides two additional documents to help illustrate core features of the developing eFEP. I hope that these documents satisfy the committee’s understanding of the ecosystem model and assessment capabilities as well as how the pieces can fit together to evaluate management strategies and provide ecosystem catch advice.

Simulated operating models are necessarily technical and the documents provided by the PDT include a considerable amount of technical detail. For the committee meeting, I will give a presentation that summarizes the work of the PDT in a bit less detail and plain terminology.

The first document (Document 2) explains how a tiered approach for providing catch advice could be structured. At the highest level, satellite-based measurements of primary productivity would be utilized to set a limit exploitation rate defined as the ratio of new to total primary production. This ratio is approximately 0.3 based on the average values observed from 1992-2015. Target exploitation rates would then be defined as a fraction of this ratio. Example simulations have been conducted setting this fraction between 0.5 and 0.667, giving target exploitation rates of 0.15 to 0.2. A corresponding catch limit for the ecosystem production unit (EPU) would then be derived by multiplying the target exploitation rate and an estimate of biomass for the system determined by research surveys and/or multispecies assessments. This overall catch limit for a Georges Bank EPU would serve as a ceiling to ensure that catches of individual components or stock complexes do not exceed system limits.

Last month, I circulated to the committee a pair of informative presentations by Drs. Kim Hyde and Heidi Sosik, which were originally presented at a QuantFish Workshop sponsored by Dr. Gavin Fay at the University of Massachusetts, Dartmouth. These presentations illustrated the quantitative basis for measuring primary productivity in the NW Atlantic.

At the next tier, multispecies models and assessments would provide catch advice for stock complexes (previously referred to as ‘functional groups) and where necessary for

individual species. Georges Bank EPU species would be assigned to stock complexes, accounting for their trophic level and interactions, as well as the selectivity by the Georges Bank fisheries. The table of species in the “Operational Framework” document indicates how these species would be grouped. Allocation of catch amongst these stock complexes would be established to 1) prevent overfishing and reduce the risk that the stock complex and individual species become overfished and 2) achieve an optimal balance of tradeoffs between management objectives.

The second document (Document 3) provides a demonstration and illustration of how operating models can be used to evaluate management strategies. Although we are not yet ready to start a management strategy evaluation to establish objectives and performance metrics, the illustration applies a 10-species multispecies model (Hydra operating model; <https://icesjms.oxfordjournals.org/content/early/2016/07/12/icesjms.fsw119>) with trophic interactions to show how various forms of stock complex harvest control rules (HCRs) could affect outcomes. These 10 species represent a large fraction of Georges Bank commercial catches and have relatively good information about predation rates. Other species can be included by either inferring trophic interactions from what is known about a related species, or by applying a candidate HCR to the additional species without factoring in trophic interactions or by making assumptions for scenario testing.

The model includes a stochastic recruitment process, various recruitment function types, fleet selectivity, and effects on predation and growth caused by changes in temperature. Presently, the models do not include any predatory feedback, e.g. high availability of prey enhancement of predator growth and survival.

Fixed or variable (function of stock biomass) catch limits were applied in a simulation mode to show how they would affect 1) biomass of stock complexes, 2) catches derived from stock complexes, and 3) risk of stock complexes and individual species to fall below an ‘overfished’ threshold. Adding a price function or setting fishing cost as a function of fleet effort could allow comparisons of management strategies based on gross revenue, net revenue, and possibly employment. Several types of HCRs were applied for demonstration, including fixed mortality at three levels and a ‘hockey-stick’ approach with alternative minimum biomass thresholds below which mortality is reduced.

Another demonstration using a different model is also provided, applying portfolio analysis. This model (named ‘Kraken’) uses a different type of approach, but includes a similar set of Georges Bank species that are analyzed in the ‘Hydra’ model. Instead of evaluating the effect of HCRs on biomass and catch, the performance metric is interannual variability in revenue, i.e. stability. This could be another important metric to evaluate performance of ecosystem HCRs, one that is consistent with the Council’s Risk Policy. An intuitive outcome of this type of model is that favorable HCRs raise the catch rate of high-value species with low recruitment variability, and conversely lower the catch rate of lower valued species with high recruitment variability.

Both (and other types of) operating models could be used to evaluate the effects of similar HCRs using different performance metrics. The ‘Operational Framework’ document discusses other types of operating models, including Ecosym/Ecopath and Atlantis. Both models are relatively more complex than Hydra and Kraken, but include a wider range of species. They are however more difficult to parametrize and run.

With your feedback, these two documents (ecosystem catch advice framework and using operating models in a management strategy evaluation) could become key components of an eFEP, along with other issues that an example or prototype FEP would address: candidate goals and strategic objectives, a description of a Georges Bank EPU and boundaries (draft PDT discussion document 2), jurisdictional coordination, limiting fishing access (draft PDT discussion document 8), forage fish management (draft PDT discussion document 10), protections for overfished stocks (considering ecosystem risk and rebuilding; draft PDT discussion document 4), spatial conservation measures (including spawning, habitat quality, and/or juvenile fish survival; draft PDT discussion document 9), and potential monitoring and research priorities (draft PDT discussion document 5).

When a draft eFEP has been finished, the Council will be in a good position to focus debate and conduct a management strategy evaluation (Phase III), leading to either an implementable Georges Bank Fishery Ecosystem Plan or a set of ecosystem management policies and procedures for setting catch limits or consideration of ecosystem management effects within existing FMPs.