Atlantic States Marine Fisheries Commission

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MEMORANDUM

October 27, 2015

To: Atlantic Menhaden Management Board

From: Biological Ecological Reference Points Workgroup

RE: Ecological Reference Point Recommendations for Draft Amendment 3 Development

The Biological Ecological Reference Points Workgroup (BERP WG) has been tasked to develop ecological reference points (ERPs) that will be considered with changes to the Atlantic menhaden management program in Draft Amendment 3. In the *Ecological Reference Points for Atlantic Menhaden* report, the BERP WG presented a suite of preliminary ERP models and ecosystem monitoring approaches for feedback as part of the 2015 Benchmark Stock Assessment for Atlantic Menhaden (Appendix E, SEDAR 40 Stock Assessment Report). In August, ASMFC conducted a facilitated workshop with managers and stakeholders to develop specific ecosystem and fisheries objectives to drive further development of ERPs.

At its October meeting, the BERP WG used the outcome of this Ecosystem Management Objectives Workshop (EMOW) and the SEDAR 40 peer review recommendations to assess the ability of each ERP model or tool to address management objectives and performance measures. The BERP WG identified fundamental objectives and performance measures from the EMOW that can be addressed using ecological models and approaches. Objectives such as "Sustain Atlantic menhaden to provide for historical and cultural values" or "Achieve broad public support for management" would require additional data (e.g., socioeconomic) or identification of relationships that are outside the purview of the BERP WG.

Based on committee deliberations, the BERP WG recommends using a surplus production (Steele-Henderson) and a multispecies statistical catch-at-age model to formulate potential reference points. Table 1 summarizes the recommended models and the fundamental objectives each model can address as well as the associated performance measures. Models were selected based on: (1) the ability to address multiple management objectives; (2) the ability to predict and monitor performance measures in response to management action; (3) technical merits; and (4) adherence to the advice from the SEDAR 40 Peer Review. Additionally, a majority of the BERP WG was in favor of using ecosystem indicators (e.g., forage indices or predator prey ratios) as a monitoring tool, which would give an empirical indication on performance of some management measures and indicate when to use modeling tools to assess the system. A minority of the BERP WG suggested that the ecosystem indicators be considered to develop harvest control rules as standalone alternatives to the other modeling approaches. At the next meeting of the BERP WG, the minority members will provide examples for committee consideration, and a final recommendation will be made. Currently, the BERP WG recommends their use only in an ecological context in conjunction with the other approaches rather than as standalone indicators.

The BERP WG also discussed models that are in development outside of the committee. External models such as a coastwide Ecopath with Ecosim and another surplus production model will be explored and compared to BERP WG modeling efforts as appropriate during the BERP

WG process. Because these efforts are not a draw on committee time, the BERP WG agreed that the findings from these models would be useful to compare to BERP WG modeling outputs to check for convergence.

The BERP WG notes that the timeline for model development and subsequent review will exceed the current tentative timeline for Draft Amendment 3. Creating ERPs from these models will take three to four years before being ready for management use. Three to four years is on the order of a new stock assessment with the added complications associated with modeling multiple species using a suite of models in order to address management objectives. The multispecies models will require six months to a year to complete development of the code. Because these are complex, brand-new models, the BERP WG and the menhaden TC will require a year or two to review and test the models, to ensure that the code is correct and the models are robust and performing well. During this time, the BERP WG and the TC will also have to gather, vet, and update all inputs for a standard single-species assessment for menhaden, as well as the same data for all the predators included in the model. During this process, the BERP WG will periodically present updates to the Board and request feedback where applicable. Once the BERP WG and TC are satisfied with the performance of the models and the final model runs are completed, the models and inputs will have to be peer-reviewed, then presented to the Board, which will require three to six months. When the Board has accepted the multispecies assessment framework, the BERP WG will conduct a Management Strategy Evaluation (MSE) to quantify the effects of different levels of fishing mortality on the objectives identified by the Board. This will allow the Board to examine the tradeoffs between different objectives and select ERPs that achieve the desired balance between all objectives. The MSE will require six months to a year, depending on the range of options the Board wants to consider.

In the interim, the BERP WG recommends that the Board continue the use of the BAM single-species biological reference points as accepted for management use from the 2015 Benchmark Stock Assessment for Atlantic menhaden. The Board may also consider an *ad hoc* ecological control rule such as those found in the Lenfest Forage Fish Report[1], E=F/Z =0.4[2], SPR = 30 or 50%[3] as well as others outlined in Department of Fisheries and Oceans Canada review[4]. Although these *ad hoc* reference points are easily calculated, they are generalized rules of thumb based on meta-analyses of multiple species. The BERP WG previously reviewed the Lenfest Forage Fish Report and did not feel that the management actions recommended in that report are appropriate for Atlantic menhaden management (see Memo M15-30). The BERP WG met with the Lenfest Forage Fish Task Force in August and maintains its original position. Additionally, none of the *ad hoc* approaches will allow for an evaluation of the tradeoffs between management objectives for menhaden and predators without the development of a multispecies MSE framework and forward projections of a multispecies model.

The BERP WG will present these recommendations for approval and tasking from the Atlantic Menhaden Management Board at its November 3rd meeting. Once approved, the BERP WG will move forward with the assessment process.

For more detailed information, please see the Ecosystem Management Objectives Workshop Report, the October meeting summary of the BERP Workgroup, and the April BERP WG memo on the ASMFC website: http://www.asmfc.org/species/atlantic-menhaden.

Table 1: BERP WG recommended modeling approaches to develop ERPs for Atlantic menhaden and the fundamental objectives they address.

	FUNDAMENTAL OBJECTIVES										
	Sustain menhaden to provide for fisheries				Sustain menhaden to provide for predators				Provide stability for all types of fisheries		
	PERFORMANCE MEASURES										
	Abundance/ biomass of menhaden	Menhaden yield objectives	Age Composition	Historical distribution (Age comp as proxy)	Abundance/ biomass of predators	Predator yield objectives	Predator nutrition	Prey availability relative to predator distribution	Stability in yield for directed menhaden fisheries	Stability in yield for non-menhaden fisheries	**Timeline for Management Use**
Single-Species Models											
BAM Statistical Catch-at-Age Model (current model)	X	X	X	X					X		Ready now
Multi-Species Models											
Surplus Production											
Steele-Henderson	X	X					X (proxy)		X		6 months-1 year, 2-3 years for committee review, peer review
Catch-at-Age											
Multi-species Catch-at-Age (MSSCA)	X	X	X	X	X	X	X (proxy)	*	X	X	1 year to finalize model, 2-3 years for committee review, peer review

*: Possible to develop a spatially-explicit version of the model that would meet that performance objective, but would require extensive additional work (10+ yrs)

The WG also recommends that ecosystem indicators such as forage indices and predator nutrition be monitored as part of a comprehensive ecosystem approach.
Progress on additional ecosystem models being developed by outside groups (e.g., time-varying r, Ecopath with Ecosim) should also be monitored.

References:

[1.] Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D., Plagányi, É., Sainsbury, K., and R.S. Steneck. (2012). Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.

[2.] Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Rev. Fish Biol. Fish., 2:321-338

[3.] Walters, C. J., and Martell, S. J. D.. 2004. Fisheries ecology and management. Princeton University Press, Princeton and Oxford. 399 pp.

[4.] Guénette, S., Melvin, G., and Bundy, A. 2014. A review of the ecological role of forage fish and management strategies. Can. Tech. Rep. Fish. Aquat. Sci. 3065