



Atlantic States Marine Fisheries Commission

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MEMORANDUM

April 20, 2015

To: Atlantic Menhaden Management Board
From: Biological Ecological Reference Points Workgroup
RE: Ecological Reference Points using Pikitch et al. (2012)

At its February meeting, the Atlantic Menhaden Management Board (Board) tasked the BERP WG with developing ecological reference points for Atlantic menhaden using Pikitch et al. (2012) as described in the ERP Report. As the Workgroup noted in the ERP Report, models or ERPs presented in the ERP report required further review by the BERP WG. To complete this task, the Workgroup reviewed the methodology by Pikitch et al. (2012) to determine which “information tier” Atlantic menhaden fit into. Subsequently, the WG evaluated the applicability of the recommended management action associated with that information tier. After detailed discussions, the WG concluded:

1. The WG recognizes that the recommendations in Pikitch et al. (2012) are based on the idea that the variable stock dynamics of forage species, like Atlantic menhaden, may require additional management precautions than other non-forage species.
2. The WG acknowledges that while the ERPs referenced in Pikitch et al. (2012) may be a bet-hedging strategy, it assumes that there must be some stock-recruitment relationship that has not yet been identified for Atlantic menhaden.
3. The WG decided that menhaden fall under the “intermediate information tier” as defined by Pikitch et al. (2012), with strong caveats (please see the attached table).
4. The intermediate information tier recommends management actions in the form of applying a hockey stick harvest control rule with $B_{LIM} \geq 0.4B_0$ and $F=0.5M$. In this scenario, fishing would be prohibited when biomass levels fall below 40 percent of unfished biomass. When biomass is greater than 40 percent of unfished biomass, the fishing mortality would not exceed half the species’ natural mortality rate. The recommended fishing mortality rate from Pikitch et al. (2012) and a comparison to the 2015 Benchmark Stock Assessment single species reference points are displayed below including the terminal year F_{2013} .

Reference Points/Terminal Year F	Benchmark
$F_{26\%MSP}$ (threshold)	1.26
$F_{57\%MSP}$ (target)	0.38
$F_{64\%MSP}$ (Pikitch et al. 2012)	0.29
$F_{70\%MSP}$ (F in terminal year 2013)	0.22

5. The WG notes that many of the case studies examined in Pikitch et al. (2012) involved predators that were “highly dependent” (i.e., $\geq 50\%$ of diet) on a single forage species, with strong trophic effects caused by changes in forage abundance. However, in the case of the coast-wide stock of Atlantic menhaden, the primary predator species are more opportunistic, consuming a diverse prey base.
6. While the WG was able to identify that striped bass may meet the Pikitch et al. (2012) predator dependency definition (with menhaden as forage) at certain times of the year and in certain areas (e.g., Chesapeake Bay in winter), the WG determined that none of our predator species of interest could fit the criteria of “highly dependent” predator (with menhaden as forage) on a coast-wide scale. Therefore, the WG does not believe the reference point recommendations in Pikitch et al. (2012) are applicable to this system.
7. Ultimately, the BERP WG does not feel that the management actions recommended in Pikitch et al. (2012) are appropriate for Atlantic menhaden specific management. Furthermore, the WG cannot evaluate if the Pikitch et al. (2012) buffers will actually provide enough forage to sustain predators of interest at desired population levels. Overall, although the ERPs in Pikitch et al. (2012) are less than ideal, predator removals are a large source of mortality for this stock. As such, through the framework of the ERP Report, the WG is working to have better ERP advice that is specific to Atlantic menhaden management.

The WG recommends that the Board form a subcommittee to collaborate with the BERP WG and industry to define more concrete ecosystem management goals and objectives. This would help the WG identify which models might be the most appropriate to achieve proposed objectives. Moving forward, the WG would like to combine the recommendations of a Board subcommittee with those of the Atlantic menhaden peer reviewers to define an objective approach to developing ERPs.

References

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 Steneck, R.S. (2012). Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.

The criteria for the intermediate information tier from Pikitch et al. (2012) (pg. 90) and the associated WG review of each criterion for Atlantic menhaden.

Information Tier	Forage fish stock dynamics and fisheries	Knowledge of status, trends, and dependencies of predators	Recommended management action
Intermediate (Pikitch et al. 2012)	<ol style="list-style-type: none"> 1. Population abundance, status, and trends are monitored so that catch control rules are likely to result in population levels within specified biological limits. 2. Putative environmental drivers of forage fish productivity are identified, providing some ability to predict production dynamics and account for them in the harvest control rule. 3. There is some monitoring and enforcement of fisheries so that catches are likely to be within specified limits. 	<ol style="list-style-type: none"> 1. Dependent predators have been identified so that effects of forage fish on their abundance can be predicted on the basis of food web models or the PREP equation. 2. Population status and trends of dependent predators are monitored but with considerable uncertainty. 3. Spatial patterns of foraging are known and sufficient to support predictions about the effects of localized depletion. 	<ol style="list-style-type: none"> 1. Apply the PREP equation, or use data or models specific to the ecosystem, to assess the impacts of forage fish depletion on dependent species (using the upper 95% confidence interval). 2. Apply a hockey stick harvest control rule with $B_{LIM} \geq 0.4B_0$ and $F \leq$ the lesser of $0.5M$ and $0.5F_{MSY}$. 3. Increase B_{LIM} and decrease F when the ecosystem contains highly dependent predators or when precision of diet dependencies is low. 4. Use spatial management to protect predators likely to be adversely affected by localized depletion.
BERP WG review for Atlantic menhaden	<ol style="list-style-type: none"> 1. Applies 2. There is the ability to predict production dynamics but not many stock assessments are able to account for environmental factors. 3. Applies (Amendment 2) 	<ol style="list-style-type: none"> 1. Primary predators were identified though the development of the MSVPA model. No predators are highly dependent ($\geq 50\%$ of diet) on menhaden. 2. Predators are monitored at high certainty and at frequent intervals (exceeds this criterion). 3. Applies. Spatio-temporal diet and distribution information were assembled for predators and competing prey species through the MSVPA process. 	<ol style="list-style-type: none"> 1. ERP models are in development. 2. Recommended HCR and ERPs make little sense when there is no dependent predator or stock-recruit relationship. 3. No dependent predator and the diet data are precise (28 diet studies were reviewed, that examined a combined 40,000+ stomachs). 4. There may be concerns for localized depletion in some areas like the Chesapeake Bay, warranting spatial management (e.g., CB harvest cap). However menhaden are currently managed on a coastwide basis, and setting ERPs for the stock will have little impact on the potential for localized depletion.