

Research Priorities and Recommendations to Support Interjurisdictional Fisheries Management

ATLANTIC MENHADEN

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**Atlantic Menhaden research recommendations are listed in chronological order: recommendations from the 2012 stock assessment update, recommendations from the 2010 benchmark stock assessment peer review panel, and recommendations from the 2008 update of this report that have not been addressed. Research recommendations from the 2012 stock assessment update are broken down into two categories: data and modeling. While all recommendations are high priority, the first recommendation is the highest priority. Each category is further broken down into recommendations that can be completed in the short term and recommendations that will require long term commitment.

2012 Stock Assessment Update Recommendations

Annual Data Collection

Long Term

- Develop a coast wide, fishery-independent index of adult abundance at age to replace or augment the existing Potomac River pound net index used in the assessment model. Possible methodologies include an air spotter survey or an industry-based survey with scientific observers on board collecting the data. In all cases, a sound statistical design is essential (involve statisticians in the development and review of the design; some trial surveys may be necessary).¹
- Work with industry to collect age structure data outside the range of the fishery.
- Validate MSVPA model parameters through the development and implementation of stomach sampling program that will cover major menhaden predators along the Atlantic coast. Validation of prey preferences, size selectivity and spatial overlap is critically important to the appropriate use of MSVPA model results.

Short Term

- Increase level of sampling from bait fisheries, particularly in the mid-Atlantic and New England.

¹ An industry funded feasibility study conducted in 2011 further supported the need for this work (Sulikowski et al. 2012). A subcommittee of the Menhaden Technical Committee began discussions for development of a coastwide aerial survey in 2008. As of July 2012, a contract has been awarded to develop the survey design, with results expected by the end of 2012. The Technical Committee is in consensus that an index of adult abundance is the highest priority research recommendations but recognizes that implementation of the survey will require significant levels of funding.

- Investigate interannual maturity variability via collection of annual samples of mature fish along the Atlantic coast.
- Recover historical tagging data from paper data sheets to characterize coastwide movements and mortality estimates for adult Atlantic menhaden.
- Increase annual sampling and processing of menhaden from the PRFC pound net fishery to better characterize age and size structure of catch.
- Compare age composition of PRFC catch with the age composition of the reduction bait fishery catch in Chesapeake Bay. Upon completion of comparative analysis develop most efficient and representative method of sampling for age structure.
- Consider developing an adult index, similar to PRFC CPUE index, using MD, VA, NJ and RI pound net information including biological data.
- Explore additional sources of information that could be used as additional indices of abundance for juvenile and adult menhaden (ichthyoplankton surveys, NEAMAP, etc.).

Assessment Methodology

Long Term

- Develop a spatially-explicit model, once sufficient age-specific data on movement rates of menhaden are available.
- Develop multispecies statistical catch-at-age model to estimate menhaden natural mortality at age.

Short Term

- Thoroughly explore causes of retrospective pattern in model results.
- Explore alternative treatments of the reduction and bait fleets (e.g., spatial split, alternative selectivity configurations) in the BAM to reflect latitudinal variability in menhaden biology (larger and older fish migrating farther north during summer).
- Review underlying data and evaluate generation of JAI and PRFC indices.
- Perform likelihood profiling analysis to guide model selection decision-making.
- Examine the variance assumptions and weighting factors of all the likelihood components in the model.
- Re-evaluate menhaden natural mortality-at-age and population response to changing predator populations by updating and augmenting the MSVPA (e.g., add additional predator, prey, and diet data when available).
- Incorporate maturity-at-age variability in the assessment model.

Future Research

- Evaluate productivity of different estuaries (e.g., replicate similar methodology to Ahrenholz et al. 1987).
- Collect age-specific data on movement rates of menhaden to develop regional abundance trends.
- Determine selectivity of PRFC pound nets.
- Update information on maturity, fecundity, spatial and temporal patterns of spawning and larval survivorship.
- Investigate the effects of global climate change on distribution, movement, and behavior of menhaden.

2010 Benchmark Stock Assessment Peer Review Panel Recommendations

Short Term (improvements for the next benchmark review)

- Cap effective sample size in future model specifications at 200, allow the gaps in the pound net index and bait fishery age composition where data are not available, modify the reduction and bait fleets to northern and southern fleets, and allow time-varying domed shaped selectivity for the southern region.
- Calculate fishing mortality as full F. The N-weighted fishing mortalities relative to the N-weighted F-reference points do not provide correct interpretation with regard to overfishing.
- Examine alternative reference points which provide more protection to SSB or fecundity than FMED. The Panel has concerns about the use of FMED and the fecundity associated with it as reference points. The concern is that there was no information on the relationship of the target and threshold fecundity in relation to virgin fecundity levels.
- Examine weighting of datasets in the model. As a starting point, some experts assert that the input variance assumptions should be consistent with the estimated variance of residuals. In the base model the effective sample sizes for catch-at-age data are far too high and consequently estimates of uncertainty are too low.
- Evaluate alternative use of the juvenile indices: combining relative abundance data from groups of adjacent states according to the similarity of trends in the state-specific time series; and cumulatively-combining these indices within the model. This allows for different regional patterns of recruitment to provide a stock-wide recruitment pattern.
- Examine the timing of fisheries and indices in the model. Many of the fisheries are seasonal and need to be timed appropriately with the abundance indices. Incorrect timing may affect model fits.

Recommendations from the 2008 Update of the Research Priorities Report

Fishery Dependent

Moderate

- Evaluate other measures of effort, including spotter pilot logbooks, trip length, etc. Spotter pilot logbooks should be evaluated for search time, GPS coordinates, and estimates of observed school size.

Low

- Conduct studies on bycatch and discard of menhaden in other fisheries.

Fishery-Independent Priorities

High

- Develop and implement fishery-independent surveys to estimate size of recruiting year classes.²

Modeling / Quantitative Priorities

Moderate

- Evaluate precision of current assessment models with Monte Carlo simulations.

² Ongoing research is being conducted to develop and test methods for estimating size of recruiting year classes of juveniles using fishery-independent survey techniques.

- Assess the feasibility of estimating year class strength using a biologically stratified sampling design. The efforts could be supported by process studies linking plankton production to abundance of young menhaden.

Low

- Conduct growth back-calculation studies to determine historical trends in growth rate. The NMFS has an extensive database on scale growth increments which should be utilized for these studies.

Life History, Biological, and Habitat Priorities

Moderate

- Determine the effects of critical estuarine habitat loss/degradation on juvenile and adult menhaden growth, survival, and abundance.
- Evaluate the effects of selected environmental factors on growth, survival, and abundance of juvenile and adult menhaden, particularly in the Chesapeake Bay and other coastal nursery areas.³
- Assess effects of fish disease (e.g., ulcerative mycosis and toxic dinoflagellates) on menhaden.⁴
- Determine the ecological role of menhaden (predator-prey relationships, nutrient enrichment, oxygen depletion, etc.) in major Atlantic coast embayments and estuaries.

Low

- Monitor fish kills along the Atlantic coast and use the NMFS Beaufort Laboratory as a repository for these reports.

Management, Law Enforcement, and Socioeconomic Priorities

Low

- Determine effects of regulations on the fishery, the participants, and the stock.
- Monitor the socioeconomic aspects of the menhaden reduction fishery.

³ Ongoing research is being conducted in the Chesapeake Bay to evaluate effects of selected environmental factors on growth, survival, and abundance of juvenile and adult menhaden.

⁴ Ongoing research is being conducted to determine the effects of fish diseases (e.g., ulcerative mycosis and toxic dinoflagellates) on menhaden.