Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

MEMORANDUM

July 31, 2013

TO: **Atlantic Menhaden Management Board**

FROM: **Atlantic Menhaden Technical Committee**

RE: **TC Review of Sulikowski et al. Aerial Survey Design for Atlantic Menhaden**

The Atlantic Menhaden Technical Committee was tasked by the Management Board (M-13-057) with reviewing a survey proposal titled *A comprehensive aerial survey design: comparing biomass estimates of Atlantic menhaden captured within and outside the normal fishery range and the implications for improved management of this resource* and authored by Dr. James Sulikowski, Dr. Alexia Morgan, and Ms. Amy Carlson from the University of New England. A brief summary of the TC's review and detailed responses to each Term of Reference are provided below.

SUMMARY

Based on the information provided, this study is unlikely to produce biomass estimates with a high degree of confidence or to provide data that will be highly applicable to the 2014 assessment. The TC concluded that adequate statistical justification for the proposed survey methodology was not presented in the proposal. Also, the spatial area covered by this survey would focus on sampling the mid- and northern portions of the stock; therefore, the use of these data alone to help characterize selectivity of the reduction fishery would produce biomass estimates that would be biased high and characterization of the stock's age structure would be biased towards older ages.

This study may offer a slight benefit to the 2014 assessment by providing a small data set for use in age-structure comparisons, sensitivity analyses, or development of statistical priors for parameter estimates. However, it is unlikely these data would be used in the base run of the 2014 assessment given the pilot nature of this study and its limited temporal and spatial coverage. Even if these data proved useful for the assessment, the TC is concerned that they may not be available until after the January 2014 Data Workshop.

If the survey design is adequately developed and successfully implemented over a longer time series, these data would be useful for future benchmark assessments. The TC recommends the authors conduct further simulation and power analysis work prior to implementation of any large scale aerial survey. Additional consultation on development of this proposed survey may require more time than the TC can afford at present if it is to meet the deadlines for the upcoming benchmark stock assessment in 2014.

M13-068

TERMS OF REFERENCE REPORT

TOR1. Are the goals and objectives of this study clearly stated?

Although the goals and objectives of the study were not clearly stated, the TC interpreted them as:

Goal: To obtain new fishery-independent data to inform management of Atlantic menhaden

Objectives:

1) To determine and compare estimates of stock abundance and age structure between the region north of the reduction fishery's range and the region within which the reduction fishery operates, and

2) To improve reduction fishery selectivity estimates for the stock assessment.

The TC recognizes the importance of obtaining new fishery-independent information and would welcome the successful implementation of a statistically robust aerial survey designed to quantify the latitudinal gradient in biomass and age structure of the Atlantic menhaden stock. The TC also made a minor clarifying note that the proposed study would focus on estimating availability of menhaden-at-age to the reduction fishery from Virginia northward, but would not estimate gear selectivity of the purse-seine fishery.

TOR 2. Evaluate the merits of this survey design given the goals of the study.

a. Is the survey technique and design appropriate for estimating the biomass and age of menhaden during the summer and fall months?

The TC recommends more careful analyses be performed to determine the appropriate number of transects and samples required for estimation of menhaden biomass at desired levels of precision. Estimating biomass and age structure of the Atlantic menhaden stock across such a wide area should involve the use of simulations and/or power analysis that incorporate measured variability from the 2011 pilot survey and other studies to determine the adequate number of transects and biological samples to collect. There was no information regarding data simulations in the reviewed proposal.

The TC noted that this proposal focuses on sampling a subset of the Atlantic menhaden's range from Virginia northward. However, Atlantic menhaden range from Maine to Florida and a third of the historical annual landings came from regions south of Virginia where younger, smaller fish predominate; therefore, the use of these data alone to help characterize selectivity of the reduction fishery would produce biomass estimates that would be biased high and characterization of the stock's age structure would be biased towards older ages.

Regarding biological sampling, the TC noted that a goal of 50 fish per set may be too high given the proven homogeneity of fish within a set. For comparison, the commercial sampling program has been selecting a subset of 10 fish since the 1970s. Given the greatest variability is found between sets, the goal for the collection of biological samples should be to collect samples from a wide range of sets. Note that NMFS Beaufort staff volunteered to age all samples collected, but requested that the authors budget for and dedicate staff time to mounting scales before delivery to the Beaufort lab.

If the TC's concerns with sampling design could be addressed, these data could be useful for comparing size and age structure between samples collected from the bait fishery and those available farther offshore. To make this comparison, an assumption would be made that 2013 is a typical, representative year for demonstrating age and size structure of the Atlantic menhaden stock.

b. Is the survey design appropriate for comparing menhaden in southern fishing grounds with regions to the north at a time corresponding to peak fishing activities?

The TC noted that the spatial strata proposed in this study are based on the extent of the reduction fishery and do not necessarily reflect strata that are biologically meaningful. Focusing sampling efforts in areas from Virginia northward will not yield data that will be fully representative of the entire stock. The TC also noted that incorporation of this type of data may require development of a spatially-explicit assessment model and restructuring of the annual time step in the current model.

The TC voiced concern about the need to avoid double counting fish throughout the sampling time frame. The proposed sampling window is late summer through mid-November. However, by the beginning of October, northern fish begin to appear in the southern region. The TC suggests limited sampling beyond the end of September. Ending the survey earlier in the season might also make it possible for the data to be considered at the January 2014 Data Workshop.

c. Evaluate the technical merits of the proposed methods for estimating biomass from this survey.

In addition to the concerns mentioned above in TOR 2a, the TC noted that schools can form or disappear quickly. Although the TC recognizes there are serious practical limitations involved in deploying aerial and purse seine survey crews, it should be noted that the methods as described in the proposal (conducting aerial surveys to obtain counts on one day and collection of biological samples on different days) would not allow for direct comparison of transect counts and school size. However, if additional spotter pilot estimates are obtained on sampling days, ground verification of school size and composition could be conducted. The TC also noted that many schools will be too large to fully encircle and expressed concern that eliminating those schools from sampling might bias results.

The TC was also concerned that the options to space transects 2 nautical miles apart was too close relative to the inherent variability in school area and size. Also, given there are not enough days in the month to collect that many samples even under good weather conditions and double counting could become a problem (tagging papers have documented schools moving 10-15km/day), the TC suggests the authors explore the more widely spaced transect options in their proposal or create more substrata.

Finally, the TC noted that a linear relationship between surface area and biomass of menhaden schools is highly unlikely. The PIs may wish to consider adding an analysis of the data that used a nonlinear relationship (e.g., 3-parameter Michaelis-Menton) similar to that developed for Pacific sardine.

d. Do the data collected by this study have the potential to inform the reduction fishery selectivity curve in the current stock assessment model? Could it be used in a different type of stock assessment model?

The objective of estimating selectivity within the scope of this study alone does not seem feasible. Selectivity is a function of two components: 1) the probability of capture, and 2) the temporal and spatial availability of the fish to the fishery. This study appears to focus on quantifying the availability of fish to the reduction fishery from Virginia northward. These data would need to be paired with additional fishery-independent data from the southern portion of the range and fishery-dependent data, most likely in an assessment framework, in order to provide a complete analysis of fishery selectivity.

The TC would need to conduct extensive discussions to determine how best to incorporate this type of data into the current or alternative assessments (either explicitly in the model or in data preparations outside the model). The TC is currently considering a wide range of modeling approaches for the 2014 benchmark stock assessment and has not concluded discussions on how the 2014 assessment modeling framework will be different from previous assessments. Therefore, it is too soon for the TC to say how these data would be incorporated into this or other models that will be considered.

2. At minimum, how many years of data would need to be collected before this survey would be considered for use in the following manner in a benchmark stock assessment for Atlantic menhaden? Comment on any additional uses not listed below.

The TC noted that it is impossible to say exactly how many years of data would be needed without examining the exact implementation of the study design and precision of the resulting estimates. However, the TC can comment in general on the anticipated usefulness of these data in the short-term (1-2 year implementation) versus long-term monitoring program development.

a. As biological samples

i. to help characterize length/age structure of the population

This study has the potential to provide new information on the age structure of a portion of the stock (Virginia northward), if the precision is reasonable for one year's worth of data. However, the desired level of precision achieved by this sampling design was not provided by the authors, so the TC could not provide comment on its appropriateness.

ii. to help characterize purse seine reduction fleet selectivity

See 1d above.

b. To provide absolute estimates of abundance or biomass

As mentioned in 2a above, this study has the potential to estimate summer/fall 2013 biomass of Atlantic menhaden for the portion of the stock from Virginia northward if the number of samples is adequate given the desired level of precision. However, the desired level of precision achieved by this sampling design was not provided by the authors, so the TC could not determine if the sampling scheme proposed was adequate.

c. To provide priors on abundance/biomass or selectivity parameters in a Bayesian framework

This study may offer a slight benefit to the 2014 assessment by providing a small data set for use in sensitivity analyses or developing statistical priors for parameter estimates.

d. **To develop an index of abundance.**

Development of an index of abundance was not a stated goal of this study. The proposal is limited at present to collecting one year of data which would not be useful for development of an index of abundance. An abundance index would require more work on sampling design, implementation of a pilot study, evaluation of data collected, and a minimum of 5-6 years of full survey implementation (not including pilot data years) before consideration in the stock assessment.

4. Would this study provide information to address a TC research recommendation or recommendations?

If properly designed and implemented, this study could provide data to address the TC's short-term research recommendation to "Work with industry to collect age structure data outside the range of the fishery'' as identified in the 2012 assessment update.

5. Summarize the overall utility of this study for:

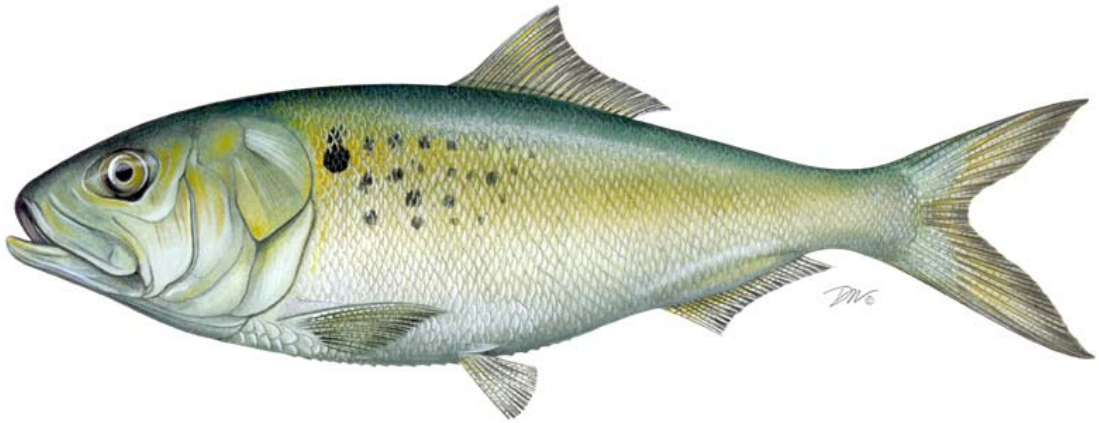
a. The 2014 benchmark stock assessment

This study may offer a slight benefit to the 2014 assessment by providing a small data set for use in age-structure comparisons, sensitivity analyses, or development of statistical priors for parameter estimates. However, it is unlikely these data would be used in the base run of the assessment given the pilot nature of this study and its limited temporal coverage. Even if these data proved adequate for use in the assessment, the TC is concerned that they may not be available until after the January 2014 Data Workshop.

- **b. Future benchmark stock assessments (2016+)**

If properly designed, implemented, and continued over a series of years, this study has the potential to provide useful data for the stock assessment. However, given the short time period allowed for this study, it may prove more fruitful to concentrate on conducting the proper simulation and survey design preparatory work needed to improve the precision and accuracy of such a large-scale undertaking as an aerial survey.

2013 REVIEW OF THE FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR THE 2012 ATLANTIC MENHADEN *(Brevoortia tyrannus)* FISHERY



Prepared by:

The Atlantic Menhaden Plan Review Team
Ellen Cosby, Potomac River Fisheries Commission
Steve Meyers, National Marine Fisheries Service
Trish Murphey, North Carolina Division of Marine Fisheries
Nichola Meserve, Massachusetts Division of Marine Fisheries
Michael Waine, Chair Atlantic States Marine Fisheries Commission

July, 2013

2013 REVIEW OF THE FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR ATLANTIC MENHADEN *(Brevoortia tyrannus)*

Management Summary

Date of FMP:	Original FMP: August 1981
Amendments:	Plan Revision: September 1992 Amendment 1: July 2001 Amendment 2: December 2012
Management Unit:	Maine through Florida
States With Declared Interest:	Maine – Florida, excluding Pennsylvania
Additional Jurisdictions:	Potomac River Fisheries Commission, National Marine Fisheries Service, United States Fish and Wildlife Service
Active Boards/Committees:	Atlantic Menhaden Management Board, Advisory Panel, Technical Committee, Stock Assessment Subcommittee, and Plan Review Team
Stock Status:	Overfished status is unknown, but overfishing is occurring (revised assessment; ASMFC 2011)

I. Status of the Fishery Management Plan

Amendment 1 to the Interstate Fisheries Management Plan (FMP) for Atlantic Menhaden was approved at the 2001 Spring Meeting of the Atlantic States Marine Fisheries Commission (Commission). Management authority is vested in the states because the vast majority of landings come from state waters. All Atlantic coast states and jurisdictions except Pennsylvania and the District of Columbia have declared an interest in the Atlantic menhaden management program. The goal of Amendment 1 is "to manage the Atlantic menhaden fishery in a manner that is biologically, economically, socially and ecologically sound while protecting the resource and those who benefit from it."

Amendment 1, developed during 1999-2000, established new overfishing/overfished definitions based on fishing mortality and Spawning Stock Biomass (SSB). Addendum I to Amendment 1, approved in August 2004, revised the biological reference points, changed the frequency of stock assessments, and updated the habitat section. The biomass target and threshold are based on fecundity instead of SSB. A new fishing mortality target and threshold were also adopted. Stock assessments take place every third year, however the Technical Committee is required to meet annually to review the previous year's landings and indices.

Addendum II, approved in October 2005, initiated a research program to examine the possibility of localized depletion of menhaden in Chesapeake Bay. Read more about the research in Section V of this report. Addendum III, approved in Fall 2006, established a harvest cap for the reduction fishery in the Chesapeake Bay. The annual total allowable harvest from the Chesapeake Bay by the reduction fishery is set at 109,020 metric tons. If harvest is greater than the cap in a given year, the cap will be reduced by the overage amount for the following year. Similarly, if harvest is less than the cap, the cap can be increased to a maximum of 122,740 metric tons for the following year. The cap established by Addendum III remains in effect through the 2010 fishing season. Addendum IV, approved in November 2009, extends the provisions of Addendum III and the Chesapeake bay reduction fishery harvest cap through 2013.

Addendum V, approved in November 2011 established a new F threshold and target rate based on maximum spawning potential (MSP) with the goal of increasing abundance, spawning stock biomass, and Atlantic menhaden availability as a forage species.

Amendment 2, approved in December 2012, establishes a 170,800 metric ton total allowable catch (TAC) for the commercial fishery beginning in 2013 and continuing until completion of, and Board action on, the next benchmark stock assessment, scheduled for 2014. The TAC is allocated by state based on landings history of each state's fishery from 2009-2011; allocation will be revisited three years after implementation. States are accountable for their respective quotas and must pay back any overages the following year. The amendment includes provisions to allow for the transfer of quota between states and a bycatch allowance of 6,000 pounds for non-directed fisheries that are operating after a state's quota has been landed. Further, it reduces the Chesapeake Bay reduction fishery harvest cap by 20% (this is an adjustment of the original cap which was in place since 2006); and establishes requirements for timely reporting and improved biological monitoring. Lastly, new SSB reference points were implemented that match the MSP based fishing mortality reference points approved through Addendum V.

Technical Addendum I to Amendment 2, approved in May 2013, establishes a pilot program for New England states to use the episodic events set aside if such an event occurs.

II. Status of the Stock

Threshold reference points are the basis for determining stock status (i.e., whether overfishing is occurring or a stock is overfished). When the fishing mortality rate (F) exceeds the F-threshold, then overfishing is occurring. When the reproductive output (measured as spawning stock biomass or population fecundity) falls below the spawning stock biomass-threshold, then the stock is overfished, meaning there is insufficient mature female biomass (SSB) or egg production (population fecundity) to replenish the stock.

Based on the 2012 stock assessment update, overfishing is occurring because Full $F/F_{15\%}$ for the terminal year was greater than 1, meaning the terminal year estimate of F(2011) is greater than the F threshold. Additionally, the sensitivity runs conducted in the 2012 update, excluding the retrospective analysis, all suggest overfishing is occurring in the terminal year (2011), and all of the bootstrap runs completed for the uncertainty analysis result in an overfishing stock status.

Thus, the stock status in regards to overfishing seems stable for the model changes explored and the uncertainty specified during the update assessment.

The new biomass reference points, based on the 2012 stock assessment update, are SSB_{target} = $SSB_{30\%}$ = 61,100 and $SSB_{threshold}$ = $SSB_{15\%}$ = 30,551 (units are billions of ova). The terminal year estimate of SSB from the 2012 stock assessment is approximately 44% of the SSB threshold. In addition, four sensitivity runs estimated terminal year SSB as 41 to 48% of the threshold value. However, one sensitivity run indicated that terminal year SSB was 120% of the threshold value. In other words, the base run and four sensitivity runs indicate the stock is overfished, while one sensitivity run indicates that the stock is not overfished. The Technical Committee concluded that there was not sufficient evidence to determine overfished status. There was discussion that five of six runs indicated the stock was overfished, which might provide support for this status determination. However, these five runs all employed a flat-top fishery selectivity curve, while the final run employed dome-shaped selectivity. There has been a great deal of attention surrounding the appropriate selectivity pattern recently, and without conclusive evidence regarding the shape of selectivity, the Technical Committee reached consensus that the number of runs in favor of a given status was not an indicator of its validity. The Technical Committee will investigate the effects of the selectivity curve shape during the 2014 benchmark stock assessment, but until then, the overfished status of the Atlantic menhaden stock remains uncertain. The Technical Committee previously determined that overfishing is occurring relative to the MSP-based fishing mortality reference points.

The next stock assessment is a benchmark planned for late 2014.

III. Status of Assessment Advice

The peer review panel drafted a report including its conclusions of the assessment and recommendations for moving forward. Below is a summary of their applicable findings.

- The Panel was also concerned about the use of F_{med} and the fecundity associated with it as reference points. The concern is that there is no information on the relationship of the target and threshold fecundity in relation to virgin fecundity levels. Projections were run to examine this, and the estimated annual fecundity since 1998 was only 5 to 10% of the virgin fecundity.
    - Through Addendum V and Amendment 2, the Board implemented new fishing mortality and SSB reference points based on maximum spawning potential (MSP) in 2011 and 2012, respectively.
- The Panel recommends that a model specification similar to the Panel's reference run be considered for future assessments. This includes capped effective sample size at 200, allow the gaps in the pound net index and bait fishery age composition where data are not available, modification of the reduction and bait fleets to northern and southern fleets, and time-varying domed selectivity for the southern region.

  This model specification combines information of the bait and reduction fisheries occurring together regionally because they are essentially using the same gear but fishing

on different age components of the stock in the two areas. Removing the estimated age composition and indices for years where it is absent is desirable because the data from years where it is available is providing the correct amount of information, from a statistical perspective, to the assessment model. Allowing domed selectivity of the fisheries in the southern region allows for the lack of availability of older fish in that region when the fishery is occurring. The reduction of effective sample sizes is intended to better reflect the actual information content of the age composition data (the residuals in the base model were inconsistent with the large assumed effective sample sizes). Also, the time-varying selectivity in the southern region had the best AIC of comparable runs and reduced the undesirable pattern of residuals in the southern fishery.

IV. Status of the Fishery

The 2012 coastwide harvest of Atlantic menhaden (reduction and bait [preliminary]) was 224,200 metric tons; this is a 2% decrease from the 228,800 metric tons landed in 2011.

Reduction Fishery
The 2012 harvest for reduction purposes only was 160,627 metric tons. This represents an 8% decrease from the 2011 landings of 174,021 metric tons, and a 2% decrease from the previous 5-year (2007-2011) average of 163,289 metric tons (Figure 1). Omega Protein's plant at Reedville, Virginia, is the only active Atlantic menhaden reduction factory on the Atlantic coast. During 2012, thirteen purse seine vessels (eight regular steamers and five snapper boats) unloaded Atlantic menhaden for reduction at Reedville, Virginia.

Bait Fishery
The preliminary estimate of the coastwide bait harvest for 2012 is 63,566 metric tons; this is an increase of 17% from the 2011 bait harvest of 52,720 metric tons, and an increase of 30% from the average harvest of the previous five years (2007-2011) of 44,802 metric tons. Moreover, bait landings in 2012 were the highest in time series that began in 1985 (Figure 1).

The Mid-Atlantic and Chesapeake Bay regions harvested 98% of total bait landings coast wide in 2012. New Jersey (61%), Virginia (23%), Maryland (10%), Potomac River Fisheries Commission (4%), and Massachusetts (1%) landed the five largest shares while all other states landed less than 1% of the 2012 commercial bait landings.

V. Status of Research and Monitoring

Commercial fisheries monitoring
Reduction fishery The NMFS Southeast Fisheries Science Center Beaufort Laboratory in Beaufort, North Carolina, continues to monitor and process landings and biosamples data collected on the Atlantic menhaden purse-seine reduction fishery. The Beaufort Laboratory processes and ages all reduction samples collected on the East Coast. In addition, the purse-seine reduction fishery continues to provide Captains Daily Fishing Reports (CDFRs) to the Beaufort Laboratory where NMFS personnel enter data into a database for storage and analysis.

Bait fishery The SAFIS daily electronic dealer reporting system allows near real time data acquisition for federally permitted bait dealers in the Mid-Atlantic and Northeast. However through 2012, landings by Virginia's purse-seine for-bait vessels (snapper rigs) in Chesapeake Bay have been tabulated (at season's end) using CDFRs maintained on each vessel during the fishing season. A bait-fishery sampling program for size and age composition (of mostly the purse-seine catch) has been conducted since 1994. In New Jersey and New England, state fisheries personnel collect and process the bait samples and forward the data to the NMFS Beaufort Laboratory. Maryland has been collecting age and length samples since 2005. In 2010, the Potomac River Fisheries Commission began collecting samples for size and age composition from their pound net fishery; Beaufort Laboratory personnel process the fish. The Beaufort Laboratory ages all bait samples collected.

Atlantic menhaden research

The following research projects relevant to menhaden assessment and management have been recently completed:

- Publication: *Lynch, P. , Brush, Mark J., and Latour, Robert J. 2011. Simulated short term impacts of the Atlantic Menhaden reduction fishery on Chesapeake Bay water quality. North American Journal of Fisheries Management 31(1): 70 78.*
    - A simulation study was performed to estimate the monthly and annual water quality impacts caused by the reduction fishery harvesting its current total allowable catch in Chesapeake Bay of Atlantic menhaden, a filter feeding fish that consume phytoplankton. The study concluded that average feeding rates are relatively low and that the probable impact of the fishery on water quality is negligible.
- Publication: *Lozano, C. & Houde, E. D. 2013. Factors contributing to variability in larval ingress of Atlantic menhaden,* Brevoortia tyrannus*. Estuarine, Coastal and Shelf Science 118:1 10.*
    - A larval ingress study was conducted at the Chesapeake Bay mouth during 2005 2008. Two peaks in larval menhaden spawning activity were identified – one in November/December and a second in January/February – with stronger recruitment resulting from the later pulse. Environmental variables were not correlated consistently with temporal and spatial variability in abundance of larvae at ingress. Larval abundance was not correlated with juvenile survey abundance in the three study years.
- Report (Not peer reviewed, funded by Omega Protein): *Sulikowski, J., Morgan, A., Carlson, A., and Butterworth, D. 2012. Inferences from aerial surveys on the abundance of Atlantic menhaden from outside the normal fishery range: implications for improved management of this resource.*
    - A pilot study was initiated to test the feasibility of an aerial survey for menhaden in New England to estimate the abundance of ages 3+ that may reside outside the area fished. The ratio of estimated biomass for the northern vs. southern region was estimated through the use of commercial spotter plane data from the fishery. Results suggest that biomass estimates of menhaden in absolute terms for the New England survey was negatively biased, possibly due to deep swimming schools

not observed. The relative biomass ratio suggested that New England biomass may be more than twice that of southern region biomass.

The following research projects relevant to menhaden assessment and management are ongoing:

- Dr. Robert Latour of the Virginia Institute of Marine Science is developing a statistical design for an aerial survey of adult Atlantic menhaden along the Eastern Seaboard of the United States. An aerial survey could be used to develop a coastwide adult index of abundance which is currently lacking in the stock assessment. Funding for implementation of the aerial survey has not been identified.
- Dr. Cynthia Jones and Mr. Jason Schaffler of Old Dominion University are using stable isotope and trace element analyses to assess Atlantic menhaden population structure and connectivity, and to identify essential areas. Signatures of juvenile menhaden from Massachusetts to Florida are being determined and adults collected from the fishery are being assigned back to region of origin. To date, age□1 trace element analysis is complete, and juvenile signature analysis from 2009□2011 is nearly complete.
- Drs. Edward Houde and David Secor at the University of Maryland Center for Environmental Science Chesapeake Biological Laboratory are comparing the precision of relative abundance estimates of YOY menhaden sampled by seining and mid□water trawling gears in principal sub□estuaries of the Chesapeake Bay. Hydrographic and environmental correlates associated with YOY menhaden catches will be investigated. Size, age, and spatial variability of YOY caught will be compared with Maryland DNR juvenile index surveys. The first field season was completed in 2012; however, funding for future research is uncertain.

VI. Status of Management Measures and Issues

Amendment 2 was adopted in December of 2012, and was implemented on July 1, 2013 (see Section I for FMP details).

The Board placed a high priority on continuing work on developing ecosystem reference points using a multispecies modeling approach (MSVPA). Ecosystem reference points would explicitly address the forage needs of menhaden's predator species such as striped bass, weakfish, and bluefish. This work is anticipated to take some time because of its complexity.

VII. Implementation of FMP Compliance Requirements for 2012

All states are required to submit annual compliance reports by April 1.

Amendment 1 to the Interstate FMP for Atlantic Menhaden requires all states to implement the reporting requirement contained in *Section 4.2.5.1*. All menhaden purse seine and bait seine vessels (or snapper rigs) are required to submit the Captain's Daily Fishing Reports (CDFRs). Existing reporting requirements may serve as an alternative to implementing this measure. Table 1 shows state compliance with this requirement and current regulations and reporting.

The cap for reduction landings from the Chesapeake Bay was set at 122,740 metric tons for 2012. Reported reduction landings from Chesapeake Bay for 2012 were approximately 85,000 metric tons.

Amendment 2, implemented a change to the Chesapeake Bay Cap by the reduction fishery, starting in 2013 and continuing indefinitely. More specifically, the new cap is 87,216 metric tons (a 20% reduction from 109,020 which was the average landings from 2001-2005). Harvest for reduction purposes shall be prohibited within the Chesapeake Bay when 100% of the 87,216 cap is harvested from the Chesapeake Bay.

The maximum rollover of unlanded fish is 10,976 metric tons (a 20% reduction from the prior maximum rollover amount of 13,720 metric tons). The rollover applies to the following year only, and will not be carried for multiple years.

VIII. Research Needs/ PRT Recommendations

Compliance Recommendation

New Hampshire, South Carolina, Georgia, and Florida requested *de minimis* status for the 2013 fishing season through their Amendment 2 implementation plans. To be eligible for *de minimis* status, a state's bait landings must be less than 1% of the total coastwide bait landings for the most recent two years. State(s) with a reduction fishery are not eligible for *de minimis* consideration. Based on 2011-2012 bait landings data, NH, SC, GA, and FL are eligible for *de minimis* status in 2013.

If granted *de minimis* status by the Board, states are exempt from implementation of biological sampling and pound net catch and effort data reporting, but must still submit a plan to implement all other compliance criteria as detailed in Amendment 2. The Board also approved a *de minimis* exemption for NH, SC and GA from implementation of timely reporting

Annual compliance reports are required from all states, including those granted *de minimis* status. The PRT recommends that New Hampshire, South Carolina, Georgia, and Florida be granted *de minimis* status.

The Board unanimously approved *de minimis* status for New Hampshire, South Carolina, Georgia, and Florida on May 22, 2013 during review of state's implementation plans for Amendment 2.

Reporting Recommendations

The PRT requests that:

- all menhaden bait landings are updated every year over the entire time series to ensure preliminary landings are final.

- New York investigates whether the state gill net landings are included in the NMFS Commercial Database or ACCSP Data Warehouse figures.

- New York includes in its annual compliance reports a summary table of menhaden landings by major gear type for each year. Landings by minor gear types can be grouped into one column.

IX. Literature Cited

Atlantic States Marine Fisheries Commission (ASMFC). Updated 2011. Atlantic Menhaden Stock Assessment and Review Panel Reports. SAR No. 10-02. 325 pp.

Table 1. Atlantic Menhaden Plan Review Team compliance review summary for 2012

State	Met Reporting Requirement of Amendment 1	Summary of Regulations
ME	Yes	Commercial license and endorsement if gillnetting. Unlawful to fish more than 2000 feet of bait gillnet in territorial waters. Bait gillnet shall have less than 3.5 inches diamond or square stretch mesh throughout the entire net. Area pilot program with daily catch limits and vessel restrictions.
NH	Yes	State law prohibits the use of mobile gear in state waters.
MA	Yes	No specific menhaden regulations. Purse seining prohibited in some areas (mostly nearshore), and no purse seines larger than 100 fathoms may be used.
RI	Yes	Menhaden harvest by purse seine for reduction (fish meal) purposes is outlawed. No purse seines larger than 100 fathoms in length or 15 fathoms in depth may be used. Commercial gear and vessels need to be inspected and may not have a useable fish storage capacity greater than that that can hold 120,000 pounds of menhaden. Daily catch limit of 120,000 pounds per vessel when standing stock estimate reaches 3,000,000 pounds. When 50% of estimated weekly standing stock is harvested, or estimated weekly standing stock drops below a 1,500,000 pound threshold, the fishery closes until further notice. Permanent closures in specific areas.
CT	Yes	Purse seines prohibited in state waters. Menhaden can be caught by other gear and sold as bait. Personal gillnet restricted to mesh greater than 3 inches and net shall not exceed 60 feet in length.
NY	Yes	Purse seines limited to certain times/areas. Purse seine season commences on the Monday following the fourth day of July and ending on the third Friday in October.
NJ	Yes	Prohibited purse seining for reduction purposes in state waters. Mandatory reporting for purse seine (bait) fishery. Bait fishery subject to gear restrictions and closed seasons. In 2011, implemented a limited entry program for purse seine fishery. To purchase a license applicant must have purchased a license at least one year during 2002-2009 and a license in 2010. Length of vessel under permit is allowed to increase by 10% (not to exceed 90 feet) and up to 20% greater horsepower.
DE	Yes	Purse-seine fishery prohibited since 1992. No specific regulation of gillnetting for menhaden.
MD	Yes	Purse-seine fishing prohibited; menhaden harvested by pound net primarily.
PRFC	Yes	All trawling and purse nets are prohibited. In 2011, Pound net fishery which is limited entry must use at least six PRFC approved fish cull panels properly installed in each pound net to help release undersized fish.

VA	Yes	The annual menhaden harvest cap for the purse seine fishery for Atlantic menhaden shall be no more than 109,020 metric tons, subject to annual adjustment for underages or overages, and shall not exceed 122,740 metric tons in any one year. It is unlawful for any person to take or catch with a purse net in the waters of the Commonwealth menhaden between the Saturday following the third Friday in November and the Sunday proceeding the first Monday in May. In waters east of the Chesapeake Bay Bridge Tunnel within the three-mile limit such prohibition shall be between the Friday before Christmas and the Sunday preceding the first Monday in May. It is also unlawful for any person to use any purse net or other net having a stretched mesh of less than 1 ¾ inches. Any purse seine vessel or bait seine vessel (snapper rig) licensed to take menhaden by purse net is required to submit the Captain's Daily Fishing Reports to the National Marine Fisheries Service, in accordance with the provision of Amendment 1, effective July 1, 2001.
NC	Yes	Combination of gear restrictions and seasonal and area closures (e.g., no purse seine fishing within 3 miles of coast of Brunswick Co. from May – October).
SC	Yes	Purse seines prohibited in state waters
GA	Yes	State waters closed to purse seine fishing
FL	Yes	Purse seines prohibited in state waters; primarily a cast net fishery

Table 2. Menhaden Bait Landings by Region (2008 – 2012) [in 1,000s of metric tons]

Year	New England (ME - CT)	Mid-Atlantic (NY - MD Coast)	Chesapeake Bay (MD Bay, VA, PRFC)	South Atlantic (NC - FL)	**Total (ME-FL)**
2008	8.53	17.54	21.16	0.32	**47.55**
2009	3.25	15.29	19.70	0.99	**39.23**
2010	2.33	23.09	16.59	0.62	**42.63**
2011	0.13	33.86	17.07	1.67	**52.72**
2012	0.81	38.92	23.53	0.29	**63.57**

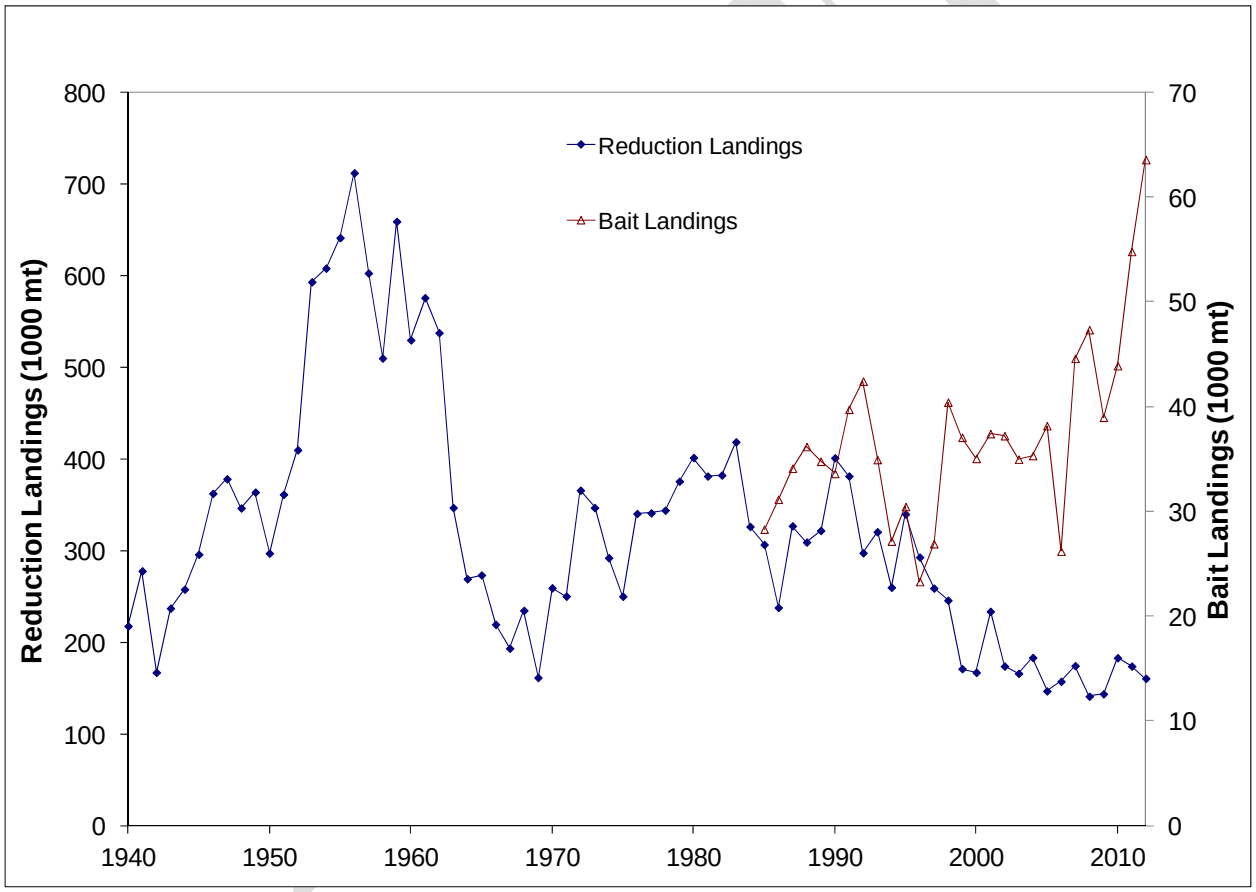


Figure 1. Landings from the reduction purse seine fishery (1940–2012) and bait fishery (1985–2012) for Atlantic menhaden.

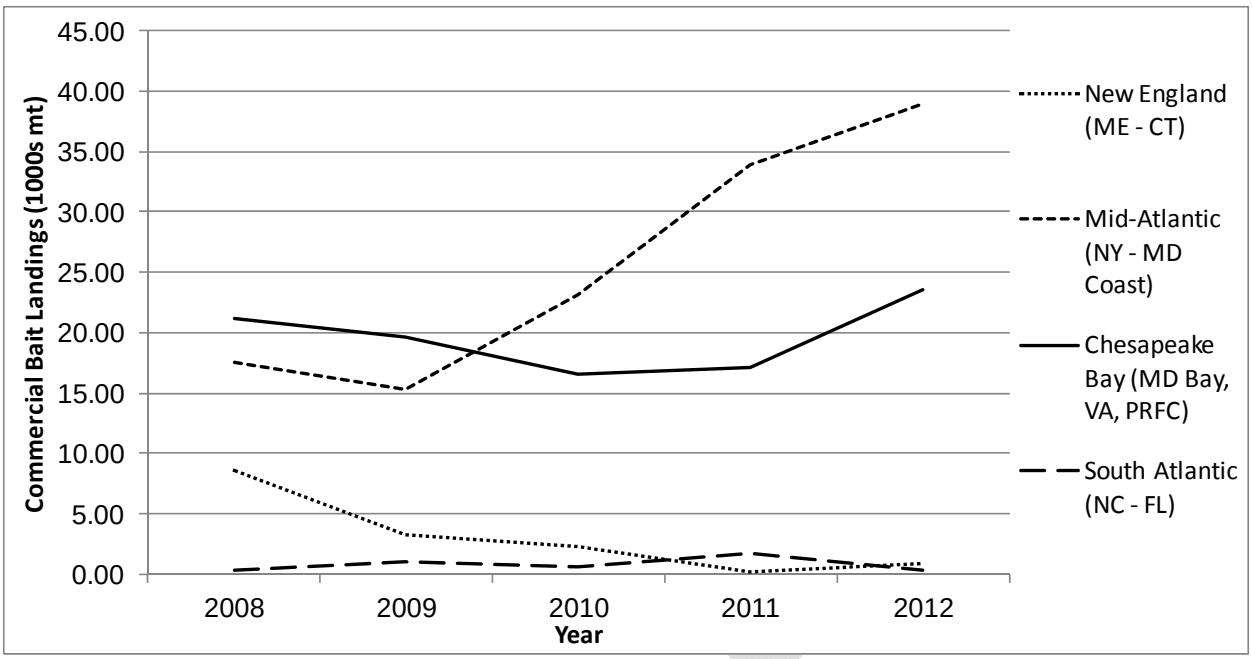


Figure 2. Annual commercial landings by region from the Atlantic menhaden bait fishery, 2008–2012.

ATLANTIC MENHADEN TOTAL ALLOWABLE CATCH WILL NOT PREVENT ECOLOGICAL OVERFISHING

STRIPED BASS HEALTH AND PRODUCTIVITY LINKED TO MENHADEN DEPLETION

Responding to historically low levels of Atlantic menhaden, the Atlantic States Marine Fisheries Commission (ASMFC) approved Amendment 2 of the Interstate Fishery Management Plan for Atlantic Menhaden in an attempt to end "overfishing". Beginning in 2013, Amendment 2 establishes a **total allowable catch** (TAC) of 170,800 metric tons for the menhaden fishery, only 20% less than average landings from 2009 to 2011. Menhaden are the most important food source for many Atlantic coast fishes, birds and mammals and are essential to striped bass health. Chesapeake Bay and U.S. Atlantic coast ecosystems would be considerably more productive if ASMFC classified and managed Atlantic menhaden as a crucial forage fish and not as an industrial commodity. The TAC needs to be reduced until menhaden recruitment increases to a level that restores the nutritional health of Chesapeake Bay striped bass and other menhaden predators. ASMFC needs to establish nutritional reference points and periodically monitor the nutritional health (body fat) of striped bass to determine if the menhaden population is ecologically sound - a primary goal of Amendment 2.

Since 2006, Chesapeake Bay Ecological Foundation (CBEF) has conducted a year-round Predator/Prey Monitoring Program (partially funded by the U.S. Fish and Wildlife Service and MD DNR), studying interactions of striped bass and menhaden and monitoring diet, body fat, sex ratios and bacterial infections of more than 10,000 striped bass in Chesapeake Bay and mid-Atlantic coastal waters. CBEF data and other diet studies show menhaden are ***ecologically depleted*** (insufficient numbers to provide adequate prey for dependent predators) in the Chesapeake Bay and along the mid-Atlantic coast. The Chesapeake Bay Program is considering the application of nutritional reference points for use in ecosystem based and multispecies fish management.

The ASMFC has not resolved the problem of ***ecological overfishing*** (unsustainable harvest levels that disrupt the natural balance between predators and prey). Over the past two decades, chronic overfishing by the menhaden purse seine reduction fishery has resulted in few menhaden surviving past age 3 even though the maximum lifespan is 10-12 years. Menhaden over age 7 can produce ten times more eggs than 3 year olds. Since the early 1990's, recruitment by these young spawners has not supplied adequate prey for Chesapeake Bay striped bass. Consequently, Chesapeake Bay striped bass accumulate less body fat, growth rates slowed, internal mycobacterial infections and external lesions proliferated, natural mortality rates increased, migration patterns changed and the recreational fishery declined. Most striped bass caught in the Chesapeake Bay are less than 24" and primarily consume ages 0&1 menhaden less than 10". Since the ASMFC has established no minimum size, from 2006 thru 2011 an average of 400,000,000 age 1 menhaden (43% by number) have been harvested annually in the Chesapeake Bay area by the purse seine reduction fishery.

The tragic collapse of the Chesapeake Bay and mid-Atlantic coast striped bass **forage base** (primarily menhaden and bay anchovy) is an ecological catastrophe and a classic example of what occurs when a keystone species is overfished and an ecosystem disrupted. The depletion of young menhaden has resulted in striped bass increasing consumption of valuable recreational and commercial species, e.g., white perch and blue crab. In the Chesapeake Bay, striped bass are now preying heavily on the low blue crab population. During recent years the winter feeding grounds of large migratory striped bass have shifted from N. Carolina to Virginia and Maryland waters. In mid-Atlantic coastal waters, striped bass that fed primarily on menhaden increased predation on over-wintering adult bay anchovies which spawn in the Chesapeake Bay. Subsequently, the bay anchovy population (essential small prey) declined to historical lows. CBEF studies, MD DNR data and peer reviewed papers support the conclusion that year-round, Atlantic menhaden are the crucial forage fish for maintaining a large, nutritionally healthy population of striped bass in Chesapeake Bay and mid-Atlantic coastal waters. The goal of implementing ecosystem-based fish management in the Chesapeake Bay necessitates cooperation and open communication between fishery managers, scientists and stake holders. **Atlantic menhaden should be listed as a "Species of Concern" by NOAA's National Marine Fisheries Service.**

7/29/13

CHESAPEAKE BAY ECOLOGICAL FOUNDATION, INC
www.chesbay.org

STRIPED BASS HEALTH AND PRODUCTIVITY LINKED TO ATLANTIC MENHADEN DEPLETION

CHESAPEAKE BAY ECOLOGICAL FOUNDATION (CBEF) CONDUCTS FIRST LONG TERM YEAR-ROUND STUDY ON CHESAPEAKE BAY STRIPED BASS

CBEF HAS EXAMINED OVER 10,000 STRIPED BASS SINCE 2006, STUDYING DIET, BODY FAT, SEX RATIOS, BACTERIAL INFECTIONS, REPRODUCTIVE STAGES AND MIGRATIONS. IN 2013, ATTEMPTING TO END OVERFISHING, THE ATLANTIC STATES MARINE FISHERIES COMMISSION ESTABLISHED A *TOTAL ALLOWABLE CATCH* (TAC) OF 170,800 METRIC TONS FOR MENHADEN.

CHESAPEAKE BAY: Since the early 1990's ***ecological overfishing*** (unsustainable harvest levels that disrupt the natural balance between predators and prey) of Atlantic menhaden has depleted the food supply in the Chesapeake Bay and lowered the carrying capacity of seabirds and fishes, including striped bass (major menhaden predator). Most resident striped bass less than 24" primarily consume ages 0&1 menhaden less than 10". Due to chronic overfishing of the spawning stock, age 0 menhaden became ***ecologically depleted*** (insufficient numbers to provide adequate prey for dependent predators) in the Chesapeake Bay. After spending most of their first year in the Chesapeake Bay, young menhaden (age 0) migrate down the Bay and south along the Atlantic coast. During the following spring thru fall, many 1 year old menhaden return to the Chesapeake Bay area. In some years during their return migration, over 400,000,000 1 year olds less than 10" are caught in Virginia's section of the Chesapeake Bay and nearby coastal waters by the menhaden purse seine reduction fishery (large scale harvest of menhaden for processing into fish oil and meal). Consequently, Chesapeake Bay striped bass accumulate less body fat, growth rates slowed, mycobacterial infections and external lesions proliferated, natural mortality rates increased, migration patterns changed (females migrate to the ocean) and their diet shifted to more bay anchovy, blue crab and white perch.

ALL MEASUREMENTS IN TOTAL LENGTH

AGE AT MATURITY: MOST MALE STRIPED BASS AGE 2 - 3 / MOST FEMALE STRIPED BASS AGE 5 - 7 / MOST MENHADEN AGE 3

STRIPED BASS SIZE AND AGE VERSUS SIZE AND AGE OF MENHADEN CONSUMED

12" – 16"

Striped Bass - - -
Age 2-3 (Approx. 50% Males)

Menhaden - Age 0
approx. 99% consumed by striped bass are less than 7"

16" – 24"

Striped Bass - - -
Age 4-6 (Predominantly Males)

Menhaden - Ages 0&1
approx. 96% consumed by striped bass are less than 10"

24" - 45"

Striped Bass - - -
Age 7+ (Predominantly Males)

Menhaden - All Ages
approx. 99% consumed by striped bass are less than 15"

MENHADEN - CHESAPEAKE BAY AREA
2007 DATA - NMFS BEAUFORT, NC / 2009 DATA – CBEF*

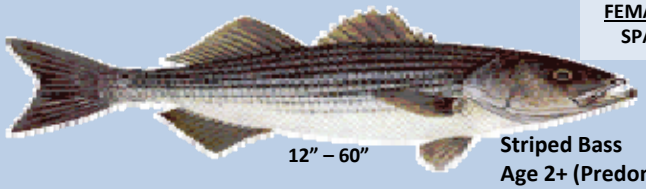
AGE	MEAN - INCHES	MEAN WT. – OZ.
*0	*5.0	*0.7
1	8.6	4.3
2	10.0	6.7
3	12.2	11.9
4	12.8	13.2
5	13.5	16.1

ASMFC has not established a minimum size on menhaden. Since the intensive menhaden fishery targets juveniles (ages 1&2), few menhaden survive to spawning age (3+). Menhaden can constitute over 75% of the striped bass diet (by weight) and are essential for nutritional health.

LARGEST DOCUMENTED STRIPED BASS (84 LBS.) CAUGHT BY MD DNR IN CHESAPEAKE BAY 1985 / LARGEST DOCUMENTED MENHADEN (17") FOUND BY CBEF IN MALE STRIPED BASS (32") FROM CHESAPEAKE BAY 2006

ATLANTIC OCEAN: From 1988 to 1993 overfishing in the Gulf of Maine depleted the older, most prolific component of the menhaden spawning stock. Concurrently, pre-spawning menhaden were being intensively fished in the Chesapeake Bay and in Virginia and North Carolina coastal waters. This overfishing lowered the carrying capacity for fishes, birds and mammals that prey on menhaden. Winter feeding grounds of large migratory striped bass shifted from N.C. to VA and MD waters. Striped bass that historically fed on menhaden increased predation in ocean waters on over-wintering adult bay anchovy which spawn in the Chesapeake Bay. Subsequently, the bay anchovy population (crucial prey for small striped bass) declined to historical lows. Now, during fall through winter, many migratory striped bass enter Chesapeake Bay and compete with resident striped bass for the depleted food supply.

FEMALE STRIPED BASS: MIGRATE TO THE OCEAN / CAN LIVE 30+ YEARS
SPAWN IN CHESAPEAKE BAY / CAN PRODUCE OVER 5,000,000 EGGS



12" – 60"

Striped Bass - - -
Age 2+ (Predominantly Migratory Females)

Menhaden - All Ages
approx. 99% consumed by striped bass are less than 15"

MENHADEN – RECORD MEASUREMENTS
SOURCE – NMFS

AGE	LENGTH	WEIGHT
12 YEARS	20"	54 OZ.

AGE 3 MENHADEN PRODUCE APPROXIMATELY 100,000 EGGS
AND AGE 7+ MENHADEN CAN PRODUCE OVER 1,000,000 EGGS

COLLAPSE OF THE CHESAPEAKE BAY AND MID-ATLANTIC COAST STRIPED BASS FORAGE BASE (PRIMARILY MENHADEN AND BAY ANCHOVY) IS AN ECOLOGICAL CATASTROPHE. THE TAC NEEDS TO BE REDUCED UNTIL MENHADEN RECRUITMENT INCREASES TO A LEVEL THAT RESTORES THE NUTRITIONAL HEALTH (BODY FAT) OF STRIPED BASS AND OTHER MENHADEN PREDATORS. THE ASMFC NEEDS TO ESTABLISH NUTRITIONAL REFERENCE POINTS FOR STRIPED BASS AND MONITOR THE NUTRITIONAL HEALTH OF PREDATOR SPECIES THEY MANAGE IN ORDER TO DETERMINE IF THE MENHADEN POPULATION IS ECOLOGICALLY SOUND. ATLANTIC MENHADEN SHOULD BE LISTED AS A "SPECIES OF CONCERN" BY NOAA'S NATIONAL MARINE FISHERIES SERVICE.