Mike Waine

From: Jim Price <preschesbay@verizon.net>
Sent: Friday, April 22, 2016 5:06 PM
To: LYNN FEGLEY
Cc: William Goldsborough; Bruce Vogt; David Blazer
Subject: Recommendations for Menhaden management - ASMFC Spring meeting
Attachments: Valued Customer.vcf; Official Version April 2016.docx; UPHOFF ABSTRACT oral present. US Fish&Wildlife conf. 4-4-16.docx

Lynn,

The Chesapeake Bay Ecological Foundation (CBEF) has completed a long term study of striped bass and Atlantic menhaden interactions. This study has indicated a substantial imbalance between striped bass and its prey, as evidenced by malnutrition and disease. In June 1998, MD DNR requested that I testify before the ASMFC menhaden management board on the decline of menhaden and possible effects on Chesapeake Bay striped bass. Following my testimony, the board initiated its first menhaden peer review. In July 1998, CBEF presented data compiled on striped bass lesions and the declining forage base in the Chesapeake Bay to the Living Resources Subcommittee Work Group at a workshop sponsored by the Chesapeake Bay Program. Over the next 10 years, I frequently provided the ASMFC menhaden management board with information derived from CBEF data analyses. In winter 2004-2005, CBEF initiated a study with Dr. Anthony Overton, titled "Predator/Prey Monitoring Program" (PPMP) to determine prey selection and age structure of Atlantic menhaden consumed by striped bass along the mid-Atlantic coast. Partial funding for the PPMP was provided by the U.S. Fish & Wildlife Service, MD DNR, CBEF and East Carolina University. CBEF continued to provide information to Dr. Overton through winter 2007. From 2006-2015, expanding the PPMP, CBEF collected striped bass from the mid-Atlantic coast and the Chesapeake Bay-sanctioned by MD DNR through a scientific collecting permit. CBEF has also reviewed and analyzed the data collected through the PPMP for various dissemination purposes.

I believe it is time that Maryland makes a strong case to have the ASMFC consider this Bay predator/prey imbalance in management of striped bass and Atlantic menhaden. In fact, raising the striped bass size limit and reducing fishing mortality made conditions worse by increasing prey demand. Even though the current menhaden assessment indicates high spawning stock, improvement in abundance of age 0 menhaden, a crucial prey of striped bass over 12", has not occurred. While a major imbalance has existed since mid-late 1990s, ASMFC is making slow progress in developing an ecosystem-based approach to fisheries management along the Atlantic coast. Peer-reviewed information that describes the imbalance between striped bass and its prey in Maryland's part of the Bay is accumulating. ASMFC requires that information be well documented and peer reviewed, if possible, therefore I am submitting this 25 year review and assessment of striped bass and Atlantic menhaden interactions as well as

recommendations for fisheries management. This review and assessment was presented at the U.S. Fish & Wildlife conference April 4th, 2016. CBEF has provided voluminous data to Anthony Overton and Jim Uphoff (MD DNR), enabling the publication of several scientific papers. Anthony Overton has just published a comparison of the three striped bass bioenergetics studies conducted in Maryland and Jim Uphoff is working with CBEF and others on publishing an assessment based on indicators available for Maryland (this paper is in review). These studies support my position and point out the unintended consequences of managing without considering forage supply and demand.

Jim Price
Chesapeake Bay Ecological Foundation, Inc
410-822-4400

REPORT RELEASED:
NORTHEAST FISH & WILDLIFE
ANNUAL CONFERENCE 2016

BY: JIM PRICE
JOE BOONE

CHESAPEAKE BAY ECOLOGICAL FOUNDATION, INC.

STRIPED BASS & ATLANTIC MENHADEN MANAGEMENT QUESTIONED

25 Year Review & Assessment (1990-2014) of Striped Bass & Atlantic Menhaden Fisheries Management

Analysis of 2005-2015 Striped Bass Study – Predator/Prey Monitoring Program

The Chesapeake Bay Ecological Foundation (CBEF) conducted the first long-term, year-round study of Chesapeake Bay striped bass, dissecting and examining over 15,000 from 2005-2015. At approximately 12", striped bass begin feeding on age 0 Atlantic menhaden (approx. 2"). Chesapeake Bay is primarily a production area striped bass; most females >16" become migratory ocean residents. Most striped bass harvested in Chesapeake Bay are 18"- 24" resident adult males that mainly consume 2"- 9" menhaden (ages 0&1). In 1990, Atlantic States Marine Fisheries Commission (ASMFC) increased the striped bass minimum size to 18" in the Chesapeake Bay and reduced fishing mortality. This strategy inadvertently created an unsustainable prey demand. Striped bass predation increased on bay anchovy (crucial prey for striped bass <18") as well as spot and blue crab (consuming up to 100,000,000 juvenile hard crabs in one year- MD DNR data). Predation on soft crabs is also significant; however, fast digestion precludes accurate detection during stomach content analyses. Concurrently, these populations of striped bass prey declined to historical lows (J. Uphoff- MD DNR), potentially disrupting the ecosystem. Striped bass natural mortality has increased greatly at the same time. CBEF recommends a lower striped bass minimum size to reduce natural mortality. Unfortunately, the current single-species strategy used by ASMFC to manage striped bass may be creating a bigger forage disparity for Maryland's part of the Bay by raising size limits and lowering fishing mortality further.

In the Chesapeake Bay, ages 0&1 menhaden dominate (by weight) the resident striped bass diet and are essential for nutritional health. Since the mid-1990s, MD DNR's Bay juvenile menhaden indices have remained low. In the mid-1990s, striped bass abundance rapidly increased, intensifying competition for ages 0&1 menhaden. By the late 1990's, the physical condition of resident striped bass deteriorated, growth slowed, skin lesions proliferated and natural mortality increased - indicating vulnerability to starvation and disease. Also, body fat, a nutritional indicator, is often low or absent in most striped bass during the fall, the most intense feeding period on age 0 menhaden.

In 2013, the ASMFC established a Total Allowable Catch of 170,800mT for the menhaden fishery, but failed to protect immature, ages 0&1 menhaden. Within the Chesapeake Bay during the spring, age 1 menhaden is the ONLY AGE CLASS AVAILABLE as prey for resident striped bass (approx. 16"-24"). A ban on menhaden purse seine reduction fishery harvest (processed into fish oil and meal) in the Chesapeake Bay or establishing a menhaden minimum size of 9" for the purse seine bait and reduction fisheries would prevent the large scale harvest of ages 0&1 menhaden, the crucial food source for Chesapeake Bay striped bass.

CHART PRESENTED at NORTHEAST FISH & WILDLIFE ANNUAL CONFERENCE APRIL 4-5, 2016

ECOLOGICAL INTERACTIONS OF STRIPED BASS, ATLANTIC MENHADEN & BAY ANCHOVY

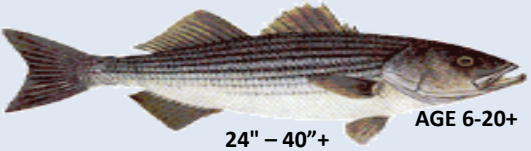
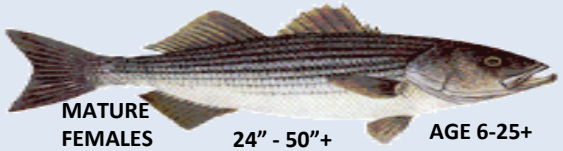
CHESAPEAKE BAY ECOLOGICAL FOUNDATION (CBEF) EXAMINED 15,000 STRIPED BASS FROM 2005-2015 IN A PREDATOR/PREY MONITORING PROGRAM, DEFINING DIET, BODY FAT, SEX RATIOS & MIGRATIONS.

STRIPED BASS: Most male striped bass reside in the Chesapeake Bay. By age 3, most immature females migrate from Chesapeake Bay to inshore coastal waters. While migrating south from northern coastal waters during the fall, adult female striped bass feed on menhaden – a vital energy source for egg development. Historical striped bass winter feeding grounds shifted, during 2005-2007, from NC coastal waters to VA coastal waters, as menhaden populations declined and distribution contracted. Migratory striped bass now overwinter in offshore coastal waters approx. 20 miles east of the Chesapeake Bay and feed primarily on aggregations of menhaden. Many adult female striped bass enter the Chesapeake Bay from fall through spring and compete with resident males for all sizes of menhaden. Both sexes accumulate body fat utilized for gonadal development. The spawning sequence is generally mid-spring for older female striped bass to early summer for young, first time spawners. After spawning in the Chesapeake Bay, female striped bass aggressively feed on menhaden in Chesapeake Bay prior to migrating north along the Atlantic coast for the summer.

ATLANTIC MENHADEN: *Ecological overfishing* (unsustainable harvest levels that disrupt the natural balance between predators and prey) of menhaden has depleted the adult striped bass food supply in the Chesapeake Bay and Atlantic coastal waters and lowered the carrying capacity of seabirds and fishes. Menhaden spawn in coastal waters and larvae are transported by wind and ocean currents into estuaries along the Atlantic coast, primarily the Chesapeake Bay. After spending most of their first year in the Bay, young age 0 menhaden migrate down the Bay and south along the Atlantic coast. During the following spring, many 1 year old menhaden return northward to the Chesapeake Bay area. In some years during this migration, (since ASMFC has not established a menhaden minimum size) over 400,000,000 age 1, CRUCIAL FORAGE SIZE MENHADEN <9" are caught by the purse seine reduction fishery (large scale harvest of menhaden for processing into fish oil and meal) in Virginia's section of the Bay and nearby coastal waters. In spring, age 1 menhaden is the ONLY AGE CLASS AVAILABLE AS PREY for resident striped bass (approx. 16"-24"). During summer, most menhaden disperse by size, with older, larger individuals migrating as far north as the Gulf of Maine and then as far south as NC by fall.

BAY ANCHOVY: Depletion of menhaden intensified striped bass predation on the bay anchovy spawning stock overwintering in coastal ocean waters. Subsequently, populations of bay anchovy (crucial prey for striped bass <18") that spawn in & inhabit Chesapeake Bay, declined to historical lows in MD's portion of the Bay.

ALL MEASUREMENTS ARE APPROX TOTAL LENGTH

CHESAPEAKE BAY STRIPED BASS:		MENHADEN AGE & SIZE CONSUMED BY STRIPED BASS:
 12" – 16"	AGE 2-3 MALES AND FEMALES MOST MALES MATURE BY AGE 2-3	 AGE 0 MOST 2" - 6"
 18" – 24"	AGE 4-6 PREDOMINANTLY ADULT RESIDENT MALES MOST FEMALES MIGRATE TO THE OCEAN BY AGE 3	 AGES 0&1 MOST LESS THAN 9"
 24" – 40"+	AGE 6-20+ PREDOMINANTLY ADULT RESIDENT MALES FEW MIGRATE TO OCEAN	 ALL AGES MOST LESS THAN 14"
 MATURE FEMALES 24" - 50"+	AGE 6-25+ MOST FEMALES MATURE BY AGE 5-7 AND LIVE IN OCEAN	 ALL AGES MOST LESS THAN 14"

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

AGES	MEAN - INCHES	MEAN WT - OZ
*0	*6.0	*1.4
1	8.6	4.0
2	10.0	7.0
3	12.2	12.0
4	12.8	13.0
5	13.5	16.0

MOST MENHADEN MATURE BY AGE 2-3
AGE 3 MENHADEN PRODUCE APPROXIMATELY 100,000 EGGS
AGE 7+ MENHADEN CAN PRODUCE OVER 1,000,000 EGGS

MENHADEN–RECORD MEASUREMENT (NMFS)

AGE	LENGTH	WEIGHT
12 YEARS	20"	54 OZ.

IN 2006, CBEF DOCUMENTED A 17" MENHADEN FOUND IN STOMACH OF 32" MALE STRIPED BASS CAUGHT IN CHESAPEAKE BAY

LARGEST DOCUMENTED STRIPED BASS (84 LB FEMALE) CAUGHT BY MD DNR-CHESAPEAKE BAY 1985

FEMALE STRIPED BASS CAN LIVE 30+ YEARS AND PRODUCE OVER 5,000,000 EGGS

BY: JIM PRICE
JOE BOONE

ABSTRACT OF ORAL PRESENTATION GIVEN AT
NORTHEAST FISH & WILDLIFE ANNUAL CONFERENCE 4/4/16:

Indicator-based Assessment of Forage Status and Well-being of Striped Bass in Upper Chesapeake Bay

Jim Uphoff, Maryland Department of Natural Resources Fisheries Service; John Jacobs, NOAA NOS; Mark Matche, Maryland Department of Natural Resources; Jim Price, Chesapeake Bay Ecological Foundation

Monitoring of striped bass health (1998-2013), relative abundance (1983-2013), natural mortality (1987-2012), and forage relative abundance in surveys (1959-2013) and fall diets of striped bass (2006-2013) provided indicators to assess forage status and striped bass well-being in Maryland's portion of Chesapeake Bay. Striped bass abundance rose rapidly during the mid-1990s and was followed by declines of Atlantic menhaden, bay anchovy, spot, and blue crab (major prey) to historical lows. Estimates of proportion without body fat indicated striped bass were typically in poor condition and vulnerable to starvation and disease during fall, 1998-2013. Condition was related to striped bass relative abundance; the relationship was described by an ascending curve with a plateau of proportion without body fat (~0.70) at high relative abundance. Striped bass were in good condition during 2008-2010 when their relative abundance was at a mid-level, proportion of stomachs without food was low, and some forage indices were higher. Age-0 Atlantic menhaden dominated biomass of fall diets even though their relative abundance was low. Correlations among survey and diet-based forage indices suggested that fall diets of striped bass less than 457 mm were more sensitive to major prey shifts than diets of larger striped bass. Instantaneous annual natural mortality estimates for striped bass in Chesapeake Bay increased from 0.26 to 0.82 shortly after forage-to-striped bass ratios fell to a nadir in the mid-1990s. Compensatory processes that intensified under regulation for highly abundant striped bass may undercut anticipated fishery and escapement outcomes from low fishing mortality.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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M E M O R A N D U M

To: **ASMFC Atlantic Menhaden PRT**

From: **Steve Heins, Chief, Bureau of Marine Fisheries**

Date: **April 26, 2016**

SUBJECT: **PLAN FOR USE OF EPISODIC EVENT QUOTA**

New York is requesting the Menhaden Board approve its inclusion in the menhaden episodic event set aside program in order to mitigate a potential massive fish kill in the Peconic River and adjacent tidal creeks, Riverhead, NY. Local baymen estimate as much as 20 million pounds of fish are in the area, which has seem several large fish kills since 2007. New York would like to remove as many fish as possible from the most confined reaches of the Peconic River and area shallow creeks, as these areas are subject to rapid loss of dissolved oxygen due to the demand by the large biomass of menhaden.

Technical Addendum I to Amendment II states to qualify for participation in the episodic events set aside program, a state must demonstrate it has implemented the mandatory provisions through submission of its implementation plan which is reviewed and verified by the Plan Review Team. This memo outlines, for PRT review, what New York will implement if the Board approves the state into the episodic event set aside program at the May 2016 ASMFC Menhaden Board Meeting.

Specifically, New York will invite up to a dozen licensed crews to harvest up to 30,000 pounds of menhaden each per trip/day. The 30K limit is seen as vital to the success of the operation as that much is needed for the efficient transport of fish to bait outlets. The license holders will be issued Letters of Authorization to allow them to exceed the current 6,000-pound limit. Four crews are now working in the area under that trip limit (6,000 pounds).

The area of the operation will be confined to the Peconic River and tidal creeks off of Flanders Bay. All by-catch will be released alive on site. The Peconic River is home to a growing run of alewife, though the 2016 run is winding down. To date, no alewives have been caught in the seining operation, while a small number of striped bass and weakfish have been released alive.

Catch will be monitored through daily VTRs.

Operations will cease once the biomass has been reduced so that there is no longer a threat of a major fish kill. This should be before the end of June.

Cc: J. Gilmore

T. Kerns

Atlantic States Marine Fisheries Commission

TECHNICAL ADDENDUM I
to

Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden

ASMFC Vision Statement:
Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

May 2013

Introduction

Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden was approved in December 2012. Amendment 2 enables the Atlantic Menhaden Management Board to set aside 1% of the overall total allowable catch (TAC) for episodic events (*Section 4.2.1.8*). Episodic events are times and areas where Atlantic menhaden are available in more abundance than they normally occur. The set aside is designed to enable increased harvest of Atlantic menhaden during episodic events.

Statement of the Problem

At its December 2012 meeting, the Board set aside 1% of the 2013 TAC for episodic events (1% of 170,800 metric tons). As part of the episodic events set aside provision the Board must develop a mechanism for state(s) to use the set aside through Board action that includes a qualifying definition of episodic events, required effort controls to scale a state's fishery to the set aside amount, and a timely reporting system to monitor the set aside. At its February 2013 meeting, the Board noted that episodic events of Atlantic menhaden historically occur in the New England region and directed a subcommittee of those states to further develop the parameters for the episodic events set aside program. This Technical Addendum details an episodic events set aside program for the 2013 fishing year that was approved by the Board at its May 22, 2013 meeting.

Episodic Events Set Aside Program

Eligibility

1. New England states (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) are eligible to participate in the episodic events set aside program.

2. To participate in the episodic events program, a state must implement the following mandatory provisions and follow the procedures outlined below:

Mandatory Provisions

1. Participating states must implement daily trip level harvest reporting. Each state must track landings and submit weekly reports to ASMFC staff.

2. Episodic event harvests and landings must be restricted to state waters of the state that declares participation in an episodic event.

3. Participating states must implement a maximum daily trip limit no greater than 120,000 pounds/vessel.

Qualification Process

1. To qualify for participation in the episodic events set aside program, a state must demonstrate it has implemented the mandatory provisions through resubmission of its implementation plan by July 1, 2013. The Plan Review Team will verify compliance with the mandatory provisions of the episodic events set aside program. The ASMFC's Executive Director (or designee) will issue a letter to the Atlantic Menhaden Management Board identifying state(s) that qualify to participate in the episodic events set aside program.

2. States that qualify for the episodic events program do not forfeit their allocated state quotas as they will use their quota to determine if an episodic event has occurred as described below.

Declaring Participation

1. A state must declare participation in the episodic events program to the ASMFC prior to September 1. Notification must be sent to ASMFC that an episodic event has been triggered as defined below:

    a. Episodic events shall be defined as any instances when a qualified state has reached its individual state quota, prior to September 1, and has information indicating the presence of unusually large amounts of menhaden in its state waters. For example, Maine has a quota of 66.58 metric tons. Should Maine landings reach 66.58 metric tons before September 1, and should Maine become aware of the presence of large amounts of menhaden in its waters, an episodic event will have been triggered specifically for that state, enabling it to begin harvesting from the set aside in accordance with the mandatory provisions herein.

2. States declaring participation in the episodic events program will not be eligible for *de minimis* status. If a qualifying state was previously granted *de minimis* status it will lose that status and will need to collect biological data and catch and effort data for an adult index as required by Amendment 2 (*Section 3.6.2.1 and 3.6.2.2*).

Procedure for Unused Set Aside

1. If an episodic event is not triggered by September 1 in any state, the unused set aside quota will immediately be rolled into the overall quota and redistributed to the states based on the historical allocation from 2009-2011.

2. If an episodic event is triggered, any unused set aside at the end of the calendar year will remain unused and will not be rolled over into the coastwide quota. The justification for this measure is that Amendment 2 does not currently allow for quota rollovers because Atlantic menhaden is experiencing overfishing.

Procedure for Set Aside Overages

1. If the episodic event set aside is exceeded, any overages will be deducted from the next year's episodic event set aside amount.

Set Aside Program Review

1. Participating states, acting through the Subcommittee, will review performance of the episodic events set aside program and report back to the Board at the fall ASMFC meeting. As part of this review, the Subcommittee will evaluate the effectiveness of timely reporting, and the appropriateness of effort controls, as implemented by states that participated in the program during 2013.

2. Upon review of the episodic events set aside program, the Board may develop additional criteria, or alter the existing program provisions through Board action or the adaptive management addendum process.

2016 REVIEW OF THE FISHERY MANAGEMENT PLAN
AND STATE COMPLIANCE
FOR THE 2015
ATLANTIC MENHADEN *(Brevoortia tyrannus)* FISHERY

Prepared by:

The Atlantic Menhaden Plan Review Team
Michael Waine, Chair Atlantic States Marine Fisheries Commission
Ellen Cosby, Potomac River Fisheries Commission
Nichola Meserve, Massachusetts Division of Marine Fisheries

April 2016

2015 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, (Pennsylvania added in 2016))
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, Plan Review Team, and Plan Development Team.
Stock Status:	Not overfished, and overfishing is not occurring (benchmark assessment; ASMFC 2015)

I. Status of the Fishery Management Plan

Atlantic menhaden management authority is vested in the states because the vast majority of landings come from state waters. All Atlantic coast states and jurisdictions except the District of Columbia have declared an interest in the Atlantic menhaden management program.

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). The goal of Amendment 1 was "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." The amendment 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 were based on fecundity instead of SSB. A new fishing mortality target and

threshold were also adopted. Stock assessments were to take place every third year; however, the Technical Committee was 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 was set at 109,020 metric tons. If harvest was greater than the cap in a given year, the cap would be reduced by the overage amount for the following year. Similarly, if harvest was less than the cap, the cap could be increased to a maximum of 122,740 metric tons for the following year. The cap established by Addendum III remained in effect through the 2010 fishing season. Addendum IV, approved in November 2009, extended 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, established a 170,800 metric ton (mt) 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%; 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.

In early 2013, the Board approved a one-year exemption from Amendment 2's bycatch allowance provision to enable two permit holders fishing aboard one vessel to harvest 12,000 pounds (one landing event per calendar day). Beginning in 2014, all states were limited to the amendment's 6,000 pound per vessel bycatch trip limit regardless of the number of permit holders on the vessel (one landing event per calendar day).

An episodic events set aside program, approved in May 2013, established 1% of the coastwide TAC as a set aside quota for the New England States (ME, NH, MA, RI, CT) to harvest Atlantic menhaden when they occur in higher abundance than normal (see Technical Addendum I to Amendment 2). An eligible state must have reached its individual quota prior to September 1

before harvesting from the set aside. For a New England state to be eligible, it must demonstrate that it meets the mandatory provisions (i.e., daily reporting, 120,000-pound trip limit, restricting harvest to state waters). At its October 2013 meeting, the Board extended the episodic event set aside program through 2015 adding a re-allocation provision, meaning any unused set aside as of October 31 of each year will be re-allocated to the coastwide states based on the same allocation percentages included in Amendment 2.

At its February 2014 meeting, the Board passed a motion to manage cast net fisheries for Atlantic menhaden under the bycatch allowance for 2014 and 2015, with the states bearing responsibility for reporting. At its November 2015 meeting, the Board approved a motion to continue the management of cast net fisheries under the bycatch allowance provision for 2016.

At its May 2015 meeting, the Board established a 414.2 million pound TAC (187,880 mt) for both 2015 and 2016 fishing years. This represents a 10% increase from the 2013 and 2014 TAC.

II. Status of the Stock

Threshold reference points are the basis for determining stock status. When the fishing mortality rate (*F*) exceeds the *F*-threshold, overfishing is occurring. When the reproductive output measure, in this case population fecundity (*FEC*), falls below its threshold, then the stock is overfished, meaning there is insufficient egg production to replenish the stock.

Amendment 2 (2013) implemented maximum spawning potential (MSP) based reference points that relate current stock conditions as a percent of unfished conditions. Considering the modeling and data input changes that occurred in the 2015 Benchmark Stock Assessment, the TC and Peer Review Panel has recommended new MSP based reference points that are applicable to the results of the assessment (ASMFC 2015).

As recommended by the Peer Review Panel, and accepted by the TC, the value of fishing mortality reference points will be the geometric mean of fishing mortality on ages-2 to -4. These ages represent the fully selected fishing mortality rates depending upon the year and fishery (i.e., bait and reduction). The fecundity (FEC) reference points match the F reference points meaning they are equal to the fecundity estimated when F reaches equilibrium at its target and threshold MSP levels, respectively.

As a result, the fishing mortality reference points are *F*-target ($F_{57\% MSP}$) = 0.38 and *F*-threshold ($F_{26\% MSP}$) = 1.26. Associated reference points for population fecundity are *FEC*-target ($FEC_{57\%MSP}$) = 189,270 (billions of eggs), and *FEC*-threshold ($FEC_{26\%MSP}$) = 86,821 (billions of eggs). Based on the 2015 stock assessment, overfishing is not occurring because fishing mortality for the terminal year (2013) is estimated to be $F = 0.22$ ($F_{70\%MSP}$), below both the target and the threshold. Additionally, the stock is not overfished because fecundity for 2013 is estimated to be *FEC* = 170,536 billion eggs, above the threshold and just below the target.

The MSP based reference points continue to be interim reference points while the ASMFC's Biological Ecological Reference Points Workgroup (BERP) develops ecological-based reference points (ERP) expected in 2019 or 2020.

The next stock assessment will be an update assessment in 2017.

III. Status of Assessment Advice

The peer review panel report contains of the 2015 Benchmark Stock Assessment contains the Panel's conclusions and recommendations for moving forward. Below is a summary of their applicable findings.

The panel reached consensus on all its recommendations and conclusions. The research, data collection, and assessment methodology recommendations of the assessment team were generally supported by the panel; overall the panel was very impressed with both the thoroughness and the clarity of the assessment reports.

- The panel recommends that the length composition data from the fishery independent surveys be down-weighted during the model fit. This change was implemented, demonstrating that the conclusions of the assessment would not be affected by this change. The panel also suggests that future analyses consider the covariance structure in the input parameters to lessen inflation of the estimated magnitude of uncertainty.
- The panel supports the development of ecological reference points (ERPs) to reflect the entire role of the species in the Atlantic coastal ecosystem, especially the inclusion of predator and prey relative abundances as a priority. However, the panel cautioned to maintain "minimum sufficient complexity" when developing ERPs.
- The panel endorses the acquisition of age composition data for the fishery independent surveys and the completion of a management strategy evaluation guided by an inclusive structured decision making process.

IV. Status of the Fishery

<u>Recreational</u>

Menhaden are important bait in many recreational fisheries; some recreational fishermen employ cast nets to capture menhaden or snag them with hook and line for use as bait, both dead and live. Recreational harvest is not well captured by the Marine Recreational Information Program (MRIP) because there is not a known identified direct harvest for menhaden, other than for bait. MRIP intercepts typically capture the landed fish from recreational trips as fishermen come to the dock or on the beach. Since menhaden caught by recreational fishermen are used as bait during their trip, they will not be a part of the catch that is typically seen by the surveyor completing the intercept.

The MRIP estimated harvest of Atlantic Menhaden in 2015 was 914,572 pounds.

Commercial

Total commercial Atlantic menhaden landings in 2015 (preliminary), including reduction, bait, bycatch, and episodic event set aside (EESA) landings, was 416.5 mil pounds. The bycatch landings[1] of 5.9 mil pounds do not count toward the coastwide commercial TAC of 414.2 mil pounds. The non-bycatch landings total was 410.6 mil pounds, representing a 1% underage of the coastwide TAC in 2015, and a 10.5% increase from the 371.7 mil pounds landed in 2014. The increase from 2014 was expected because of the 10% increase in the TAC that occurred in 2015.

Reduction Fishery

The 2015 harvest for reduction purposes was 316.2 mil pounds. This represents a 9.4% increase from the 2014 landings, and a 1.8% decrease from the previous 5-year (2010-2014) average of 321.9 mil pounds (Figure 1). Omega Protein's plant, at Reedville, Virginia, is the only active Atlantic menhaden reduction factory on the Atlantic coast. During 2015, seven purse seine steamers unloaded Atlantic menhaden for reduction at Reedville, Virginia.

Bait Fishery

The preliminary estimate of the coastwide directed bait harvest for 2015 is 92.5 mil pounds; this is a 10.6% increase from the 2014 bait harvest, and a 10.4% decrease from the average harvest of the previous five years (2010-2014) 102.1 mil pounds (Figure 1). New Jersey (51%), Virginia (35%), Maryland (6%), Massachusetts (3%), and the Potomac River Fisheries Commission (2.5%) landed the five largest shares while all other states landed less than 1% of the 2015 commercial bait harvest.

Bycatch Landings

Bycatch landings in 2015, harvested under the 6,000 pound bycatch allowance, totaled 5.9 mil pound) which represents a 10% decrease from 2014 bycatch landings. The 2015 bycatch landings accounted for approximately 1.4% of the coastwide landings, but do not count towards the coastwide TAC. From 2013 through 2015, the Chesapeake Bay jurisdictions of Maryland (41%), Virginia (25%), and PRFC (15%) comprised 81% of the average bycatch with the states of New Jersey, New York, Delaware, Florida, and Rhode Island accounting for the remaining 19% (Table 2). The predominant gears used from 2013-2015 were pound nets (61%) and gill nets (24%), which accounted for 85% of the average landings from 2013 through 2015 (Table 2).

[1] Landed under the 6,000 pound bycatch allowance

Table 1. Average landings under the bycatch allowance from 2013–2015 by gear type (stationary and mobile) and jurisdiction. Highlighted cells represent the gear type with the highest landings within a jurisdiction. (C) = confidential landings, and (-) = no landings. Total confidential landings were 209,277 pounds (i.e., the sum of all C's in the table below). Note that sum of pounds and percent of total columns do not include confidential data.

State/Jurisdiction	MD	VA	PRFC	NY	NJ**	FL	DE	RI*	Sum lbs (NonConf)	% of Total
Stationary Gears While Fishing										
Pound net	2,306,552	122,913	884,843	128,854	C	-	-	57,231	**3,500,393**	60.9%
Anchored/stake gill net	5,131	1,242,512	-	-	100,202	C	28,998	C	**1,376,843**	24.0%
Pots	10,001	-	-	C	-	C	C	-	**10,001**	0.2%
Fyke nets	C	C	-	-	C	-	-	-	**918**	0.0%
Mobile Gears While Fishing										
Cast Net	C	-	-	183,137	C	163,776	-	C	**346,913**	6.0%
Drift Gill net	16,082	57,794	-	18,175	129,620	-	66,117	-	**287,788**	5.0%
Seines Haul/Beach	C	5,119	-	206,587	-	-	-	-	**211,706**	3.7%
Trawl	-	-	-	9,733	C	-	-	C	**9,733**	0.2%
Hook & Line	C	-	-	-	-	C	-	C	**278**	0.0%
Sum lbs (NonConf)	**2,337,766**	**1,428,339**	**884,843**	**546,485**	**229,822**	**163,776**	**95,116**	**57,231**	**5,744,572**	
% of Total	40.7%	24.9%	15.4%	9.5%	4.0%	2.9%	1.7%	1.0%		

A total of 4,668 trips landed bycatch of Atlantic menhaden in 2015. A majority of the bycatch trips (68%) landed less than 1,000 pounds from 2013 through 2015 (Table 2). Maryland reported occurrences of pound net bycatch trips that were over the 6,000 pound limit because some license holders were using two vessels to legally land more than 6,000 pounds a day.

Table 2. Total number of trips by year from 2013-2015 separated into 1,000 pound landings bins.

Bins (LBS)	2013 Trips	2014 Trips	2015 Trips	Total Trips	% of total trips 2013-2015
1-1000	1,875	3,673	3,163	8,711	68%
1001-2000	252	517	582	1,351	11%
2001-3000	148	318	316	782	6%
3001-4000	110	190	139	439	3%
4001-5000	131	206	132	469	4%
5001-6000	158	265	196	619	5%
6000+	130	109	140	379	3%
Total	**2,804**	**5,278**	**4,668**	**12,750**	

Episodic Events Set Aside Program

One percent of the TAC is set aside for episodic events. Episodic events are defined as any instances when a qualified state has reached its individual state quota, prior to September 1, and has information indicating the presence of unusually large amounts of menhaden in its state waters. The states of Maine, Massachusetts and Rhode Island all qualified for the set aside program because they implemented mandatory fishery management provisions of the set aside (i.e., daily reporting, 120,000 pound trip limit, restricting harvest to state waters). In 2015, only one state—Rhode Island—declared participation in the set aside (on May 29). Rhode Island harvested 1.9 mil pounds from the set aside in 2015, and the remaining unused set aside

of 2.3 mil pounds was re-allocated to all the coastal states on November 1, 2015 using the allocation percentages from Amendment 2.

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 bio sample 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, landings by Virginia's purse-seine for-bait vessels (snapper rigs) in Chesapeake Bay are 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.

The Board has initiated Amendment 3 to the FMP which will consider ecosystem based reference points and a revisit of allocation. Amendment 3 is expected to be developed during the 2016 and 2017 fishing years for possible implementation in 2018.

VII. Implementation of FMP Compliance Requirements for 2015

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

Quota Results

The final state quotas for 2015 include an adjustment from the reallocation of unused episodic event set aside that occurred on November 1, as well as two inter-state quota transfers (Table 3). Massachusetts transferred 33,685 pounds to Rhode Island and 475,000 pounds to New York to cover quota overages that occurred within those states in 2015. Table 3 contains state specific quotas and harvest that occurred in 2015. Table 4 displays the breakdown in directed versus bycatch landings by jurisdiction.

The 2016 TAC is the same as it was in 2015 at 414.2 mil pounds (187,880 mt). State-specific quotas are displayed in Table 3. New Jersey's and Florida's 2016 quotas will be reduced by the amount of their overages in 2015 unless inter-state quota transfers are processed.

Quota Monitoring

All menhaden purse seine and bait seine vessels (or snapper rigs) are required to submit the Captain's Daily Fishing Reports (CDFRs). States that have purse seine and bait seine fisheries met the CDFR requirements in 2015.

Through Amendment 2, the Board approved timely quota monitoring programs for each state that were intended to minimize the potential for quota overages. Table 5 contains a summary of each state's approved quota monitoring system. Quota overages occurred in four states in 2015 (Table 3). The PRT recommends the Board consider requiring more timely reporting for New York because of its quota overage in 2015 (and 2014). Overages in Rhode Island and Florida are attributed to high and/or variable daily landings rates relative to their small quotas. New Jersey's overage was a result of delinquent dealer reports from the purse seine fishery. .

Biological Monitoring Requirements

Amendment 2 implemented monitoring requirements for non *de minimis* states as follows:

- One 10-fish sample (age and length) per 300 metric tons landed for bait purposes for ME, NH, MA, RI, CT, NY, NJ, and DE; and
- One 10-fish sample (age and length) per 200 metric tons landed for bait purposes for MD, PRFC, VA, and NC.

Table 6 provides the number of 10-fish samples required for 2015. These are based on the best available 2015 landings data (including bycatch) provided to the Commission by the states. Table 6 also provides the number of ages and lengths collected by the states in 2015, and an indication of the gear type sampled during collections. All states met the biological monitoring requirements of Amendment 2 in 2015.

Adult CPUE Index Requirement

Amendment 2 required that, at a minimum, each state with a pound net fishery must collect catch and effort data elements for Atlantic menhaden as follows; total pounds landed per day, number of pound nets fished per day. These are harvester trip level ACCSP data requirements. In May of 2013, the Board approved North Carolina's request to omit this information on the basis that it does not have the current reporting structure to require a quantity of gear field by harvesters or dealers. All other states with a pound net fishery met this requirement.

Chesapeake Bay Reduction Fishery Cap

Amendment 2 implemented a change to the Chesapeake Bay Cap for 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.

Reported reduction landings from the Chesapeake Bay for 2015 was less than 50,000 metric tons (110.2 mil pounds). 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). As a result, the 2016 Chesapeake Bay Cap for the reduction fishery is 98,192 metric tons. The rollover applies to the following year only, and will not be carried for multiple years.

De Minimis Status

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. If granted *de minimis* status by the Board, states are exempt from implementation of biological sampling and pound net catch and effort data reporting. The

Board also approved a *de minimis* exemption for New Hampshire, South Carolina and Georgia from implementation of timely reporting

The states of New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida requested and qualify for *de minimis* status for the 2016 fishing season. As a result, the PRT recommends that New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida be granted *de minimis* status.

VIII. Plan Review Team Recommendations

Management Recommendations

- That the Board consider the reporting timeframe of New York to minimize future quota overages.
- That the Board consider the *de minimis* requests from New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida.

IX. Literature Cited

Southeast Data, Assessment, and Review (SEDAR). 2015. SEDAR 40 – Atlantic Menhaden Stock Assessment Report. SEDAR, North Charleston SC. 643 pp.

Atlantic States Marine Fisheries Commission (ASMFC). 2012. Atlantic menhaden stock assessment update report. ASMFC, Arlington, VA, 228 p.

Atlantic States Marine Fisheries Commission. 2012. Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 114 pp.

Table 3. Results of 2015 quota accounting in pounds. Note, in this table, the 2015 landings do not include bycatch landings because they do not count towards the TAC. Some states' data are confidential, and therefore are not reported.

State	2015 Quota	Returned Set Aside	Transfer	Total 2015 Quota	2015 Landings	Overage	2016 Quota
ME	161,466	889		162,356	C		161,466
NH	123	1		124	0		123
MA	3,438,630	18,941	(508,685)	2,948,886	2,932,128		3,438,630
RI	73,457	405	33,685	107,546	107,142		73,457
CT	71,537	394		71,931	71,537		71,537
NY	227,365	1,252	475,000	703,617	698,853		227,365
NJ	45,893,335	252,794		46,146,129	47,569,115	1,422,986	44,470,349
DE	54,153	298		54,451	54,153		54,153
MD	5,628,568	31,004		5,659,572	5,601,853		5,628,568
PRFC	2,545,595	14,022		2,559,617	2,283,685		2,545,595
VA	349,873,884	1,927,211		351,801,096	348,490,296		349,873,884
NC	2,020,645	11,130		2,031,775	839637		2,020,645
SC	-	-		-	C		-
GA	-	-		-		-	-
FL	73,695	406		74,101	75766	1,665	72,030
Total	410,062,453	2,258,748		412,321,201	408,724,164.80	1,424,651	408,637,802

Table 4. Directed, bycatch, episodic and total landings (pounds) for 2015 by jurisdiction.

State	Directed	Bycatch	Episodic	Total
ME	Confidential	-		Confidential
NH	-	-		-
MA	2,932,128	-		2,932,128
RI	107,142	69,947	1,883,292	2,060,381
CT	71,537	5,466		77,003
NY	698,853	769,312		1,468,165
NJ	47,569,115	240,922		47,810,037
DE	54,153	96,389		150,542
MD	5,601,853	1,949,577		7,551,430
PRFC	2,283,685	455,350		2,739,035
VA	348,490,296	2,034,372		350,524,668
NC	839,637			839,637
SC	Confidential			Confidential
GA	-			-
FL	75,766	301,963		377,729
Total	**408,724,165**	**5,923,298**	**1,883,292**	**416,530,755**

Table 5: State quota reporting timeframes in 2015. The **bold** text indicates which reporting program (dealer or harvesters) the states use to monitor its quotas.

State	Dealer Reporting	Harvester Reporting	Notes
ME	monthly	**monthly/daily**	Harvesters landing greater than 6,000 lbs must report daily
NH	**weekly**	monthly	Exempt from timely reporting. Implemented weekly, trip level reporting for state dealers.
MA	**weekly**	monthly/daily	Harvesters landing greater than 6,000 lbs must report daily
RI	**twice weekly**	quarterly/daily	Harvesters using purse seines must report daily
CT	**weekly/monthly**	monthly	No directed fisheries for Atlantic menhaden
NY	**Weekly**	monthly	Capability to require weekly harvester reporting if needed
NJ	**weekly**	monthly	All menhaden sold or bartered must be done through a licensed dealer
DE	—	**monthly/daily**	Harvesters landing menhaden report daily using IVR
MD	monthly	**monthly/daily**	PN harvest is reported daily, while other harvest is reported monthly.
PRFC	—	**weekly**	Trip level harvester reports submitted weekly. When 70% of quota is estimated to be reached, then pound netters must call in weekly report of daily catch.
VA	—	**monthly/weekly/daily**	Purse seines submit weekly reports until 97% of quota, then daily reports. Monthly for all other gears until 90% of quota, then reporting every 10 days.
NC	**monthly (combined reports)**		Single trip ticket with dealer and harvester information submitted monthly. Larger dealers can report electronically, updated daily.
SC	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
GA	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
FL	**monthly/weekly (combined reports)**		Monthly until 50% fill of quota triggers implementation of weekly.

Table 6. Biological monitoring results in 2015. Note that total bait landings includes bycatch landings.

State	Total Bait Landings (pounds)	#10-fish samples required	#10-fish samples collected	Age samples collected	Length samples collected	Gear/Comments
MA	2,932,128	4	4	40	40	all capture via cast net south of cape cod
RI	177089	0	9	110	110	floating fish trap (8) and purse seine (1)
CT	77,003	0	2	22	22	gill nets
NY	1,468,165	2	22	190	220	gill nets, pound nets, seines
NJ	47,810,037	72	130	1300	1300	purse seine (119), and other gears (11)
DE	150,542	0	1	10	10	gill net
MD	7,551,430	17	23	277	914	pound net (12 from CBay,11 from Potomac River)
PRFC	2,739,035	6	14	140	140	pound net
VA	34,312,808	78	79	794	794	pound net (9), gill net (9), haul seine (3)
NC	839,637	2	9	120	120	gillnet, seine, trawl
	Total	**183**	**293**	**3003**	**3670**	

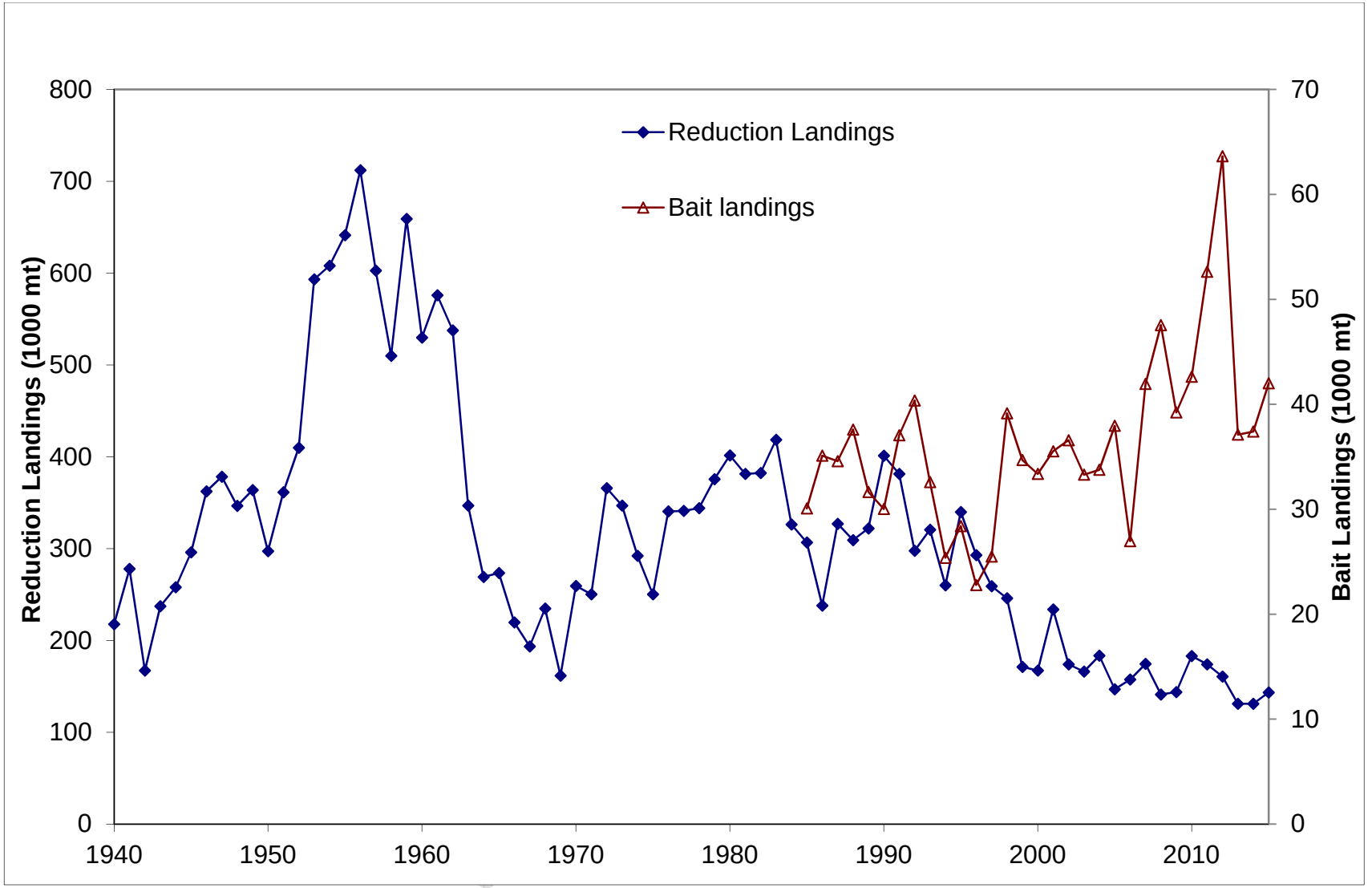

Figure 1. Landings from the reduction purse seine fishery (1940–2015) and bait fishery (1985–2015) for Atlantic menhaden.