Atlantic States Marine Fisheries Commission

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A Synthesis of Scientific Findings on Menhaden's Role in the Chesapeake Bay Ecosystem and Their Relevance to the Chesapeake Bay Reduction Fishery Cap

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Introduction

The Atlantic States Marine Fisheries Commission (ASMFC) requested a synthesis of existing scientific evidence on the importance of Atlantic menhaden in the Chesapeake ecosystem to help inform management decisions about harvest levels in the Chesapeake Bay. This review was conducted by ASMFC staff and is not a product of ASMFC's Menhaden Technical Committee (TC) or Ecological Reference Point Working Group (ERP WG).

This synthesis reviews the literature that informed the 2015 Atlantic menhaden benchmark stock assessment (SEDAR 2015) and Amendment 3 (ASMFC 2017) to the Atlantic Menhaden Fishery Management Plan (FMP). It does not reflect the most recent and ongoing work of the Stock Assessment Subcommittee (SAS) or the ERP WG, which will be completed as part of the 2019 single-species and ecological-based benchmark assessments.

History of the Chesapeake Bay Cap

In the years leading up to Amendment I (2001) to the Atlantic Menhaden FMP, the number of reduction plants and vessels in the reduction fleet had declined along the coast, with effort concentrating in Virginia and North Carolina. As a result, total landings along the coast and from Chesapeake Bay (Bay) also declined, but the proportion of removals from the Bay increased (ASMFC 2005a). The higher proportion of effort in the Chesapeake Bay and the lower levels of recruitment to the Bay raised concerns about the possibility of localized depletion, defined as a reduction in menhaden population size/density below the level of abundance that is sufficient to maintain its basic ecological (e.g. forage base, grazer of plankton), economic, and social/cultural functions, as a result of fishing pressure, environmental conditions, and predation pressures that occur on a small spatial or temporal scale.

In response to these concerns, ASMFC implemented a harvest cap on the reduction fishery in Chesapeake Bay through Addendum II (ASMFC 2005), limiting removals of Atlantic menhaden from the Bay for reduction purposes to the average of 2000-2004 landings to be implemented in the 2006 fishing year. Before its first year of use, the cap was revised through Addendum III (ASMFC 2006) to be the average landings from 2001-2005, or 109,020 mt. The cap was reduced by 20% in 2013 to 87,216 mt with the concurrent implementation of a coastwide quota which also represented a 20% reduction from recent average landings (ASMFC 2012). Amendment 3 further reduced the Bay cap to 51,000 metric tons, approximately equal to the five-year average of reduction harvest from the Chesapeake Bay between 2012 and 2016 (ASMFC 2017). Reduction landings from Chesapeake Bay have not exceeded 51,000 mt since 2012, even under the higher historical caps.

In response to the concerns raised in Addendum II, the NOAA Chesapeake Bay Office coordinated funding for a series of research projects to address the question of whether localized depletion was occurring in Chesapeake Bay. These projects were reviewed in 2009 by a panel appointed by the Center for Independent Experts. The panel determined that the individual research projects were relevant and well-designed, and the results of many of them informed this synthesis. However, the panel noted that without an operational definition of depletion, it could not be determined whether localized depletion was occurring or how well the ongoing research could address that question (Maguire 2009).

Atlantic Menhaden Life History

Genetic studies indicate Atlantic menhaden are a single stock on the Atlantic coast (Anderson 2007; Lynch et al. 2010). Juvenile and adult menhaden make seasonal migrations along the Atlantic coast, moving inshore and north in the spring and offshore and south in fall (Nicholson 1978). Larger, older individuals migrate further north. This results in different size and age classes being available to the fishery in different regions; fisheries operating in the Chesapeake Bay and further south harvest a higher proportion of age-1 and age-2 fish compared to fisheries operating further north (SEDAR 2015).

Adults spawn on the continental shelf throughout the year as they migrate, with the peak of spawning generally occurring from December through March (Nicholson 1978; Lewis et al. 1987). Larvae are then carried into bays and estuaries where they settle as age-0 recruits. The Chesapeake Bay is one of the important nursery grounds for Atlantic menhaden. Otolith microchemistry analysis showed that from 2010 – 2012, individuals from Chesapeake Bay made up about 30% of the exploitable Atlantic menhaden (ages 2-4) on the coast (Anstead et al. 2017).

The abundance of age-0 menhaden within Chesapeake Bay in any given year is influenced by a combination of offshore and inshore factors. This includes things such as large scale climatic regimes like the Atlantic Multidecadal Oscillation (Bucheister et al. 2016) and annual variability in the abundance of phytoplankton and zooplankton within the Bay (Houde et al. 2016). Total spawning stock biomass (SSB) along the coast may also play a role, although the relationship between coastwide SSB and recruitment stock-wide is weak (SEDAR 2015). The TC was unable to detect a relationship between abundance of age-2 and age-3 menhaden in the Bay and recruitment to the Bay the following year (ASMFC 2005b).

Atlantic Menhaden's Role in the Ecosystem

As larvae, Atlantic menhaden feed on zooplankton, but as juveniles and adults, they consume primarily phytoplankton by filtering seawater through specialized gill rakers (June and Carlson 1971, Friedland 1985, Friedland et al. 2006). Modeling work suggests that Atlantic menhaden may have a dampening effect on large algal blooms in Chesapeake Bay through their feeding (Dalyander and Cerco 2010), but are likely not reducing the total nitrogen load in the Bay (Lynch et al. 2010, Friedland et al 2011).

Atlantic menhaden are also an important forage species. Numerous studies have been conducted on the food habits of fish species within the Chesapeake Bay; however, it is difficult to compare the results directly because studies often occurred in different seasons, sampled different size ranges of predators, and use different methods of calculating the species composition in a diet. In addition, the proportion of Atlantic menhaden in species' diets can change across years, depending on the relative abundance of Atlantic menhaden and other prey species. For example, Overton (2015) found that striped bass in the Chesapeake Bay had a higher proportion of Atlantic menhaden in their diet in the 1950s, when menhaden abundance along the coast and recruitment of menhaden to Chesapeake Bay were high, than during the mid-1990s to early 2000s when menhaden abundance along the coast and recruitment of menhaden to Chesapeake Bay were both low.

During the 2010 and 2015 benchmark stock assessment for Atlantic menhaden, the ASMFC Multispecies Technical Committee did a thorough review of published studies and food habits databases from fishery independent sources such as the NEFSC Food Habits Database, NEAMAP, ChesMMAP, and CHESFIMS in order to parameterize the MSVPA-X model (SEDAR 2015). They synthesized average diet composition information by season and size class for several important predator species (Table 1). The prevalence of menhaden in predators' diets varied across seasons and size or age classes. For example, the percent by weight of Atlantic menhaden in striped bass stomach contents ranged from over 90% for age 8+ striped bass in the winter to less than 10% of age 1-2 striped bass in the spring. Similarly, the percent by weight of Atlantic menhaden in bluefish stomachs ranged from 3.5% to 50.4%, depending on the season and size class of bluefish.

Atlantic menhaden are also consumed by other predators such as piscivorous birds. The prevalence of Atlantic menhaden in bald eagles' diets in the Bay also showed seasonal patterns. Mersmann (1989) found that bald eagles consumed fish almost exclusively during the summer, the majority of which were gizzard shad and Atlantic menhaden; during the winter, bald eagles' diets were predominantly comprised of carrion from birds and mammals. McLean and Byrd (1991a) found that Atlantic menhaden made up 75% of the diet by number of nesting ospreys in the Chesapeake Bay in 1985. Glass and Watts (2009) found that the proportion of Atlantic menhaden in osprey diets depended on the location of the osprey nests: ospreys nesting in higher salinity regions of the Bay consumed a higher proportion of Atlantic menhaden (24% by number) than ospreys nesting in lower salinity regions (1.5% by number). However, overall, the diets of non-fish predators within the Chesapeake Bay are not well studied. For example, cormorant and heron abundance within the Bay has increased over time and both species are known to consume tidal freshwater fish like menhaden from studies in other regions, but there are no studies of their diet in Chesapeake Bay (Viverette 2007).

The body of diet work shows that Atlantic menhaden can make up a significant proportion of many predators diets' for specific seasons, size/age classes, and locations within the Bay, and that the prevalence of Atlantic menhaden in predators' diets changes with changing menhaden abundance. However, understanding the impact of reduced menhaden abundance on predator population health is much more difficult, and the evidence is less clear.

Some work has been done to estimate the predatory demand of individual species within the Bay (e.g., Hartman and Brandt 1995, Uphoff 2003), but whether there is enough menhaden biomass in the Bay to support this demand cannot be determined from the current coastwide stock assessment.

Lower levels of Atlantic menhaden abundance along the coast and lower levels of menhaden recruitment in Chesapeake Bay have been correlated with negative population metrics for some species. For example, striped bass reached coastwide highs in abundance during the late 1990s to early 2000s during a period of low menhaden abundance. However, within the Chesapeake Bay, the prevalence of mycobacteriosis in striped bass increased sharply (Uphoff 2003, Overton et al. 2003) while migratory striped bass outside the Bay had lower levels of infection (Matsche et al. 2010). Jacobs et al (2009) found that poor diet worsened the progression and severity of mycobacteriosis in striped bass in the lab. The weakfish population has continued to decline, even with greatly reduced fishing pressure, and an increase in natural mortality has been implicated (ASMFC 2014). As the population declined, recruitment indices remained relatively stable for weakfish, and the mortality bottleneck appears to be at around age 1-2, when weakfish switch over to consuming fish; one hypothesis is that the increase in natural mortality is linked to reduced prey availability including menhaden (NEFSC 2009). Osprey population growth rates in Chesapeake Bay were higher during the late 1970s and early 1980s, a period of high menhaden abundance and high recruitment to the Bay, than they were during the late 1980s and in 2006 (Watts 2007); McLean and Byrd (1991b) observed behavioral signs of food limitations such as sibling aggression in osprey in Chesapeake Bay in 1985 and noted that a similar study in 1975-1976 had not observed any sibling aggression.

However, all of these correlations come with many caveats. The increased prevalence of mycobacteriosis in striped bass in Chesapeake Bay has also been linked to environmental factors such as increased eutrophication and warming water temperatures in the Bay (Gauthier and Rhodes 2009). Cycles in weakfish landings are correlated with the Atlantic Multidecadal Oscillation, and age-0 weakfish are a major component of shrimp trawl bycatch (ASMFC 2014). Osprey showed higher population growth rates in low salinity areas where menhaden made up a lower proportion of their diet (Glass and Watts 2009). All of these populations are driven by many factors, including environmental conditions, habitat availability, overall forage abundance, and anthropogenic impacts, and parsing out the importance of menhaden abundance alone is difficult.

Conclusions

- There is currently no estimate of Atlantic menhaden abundance specifically within Chesapeake Bay and there is no quantitative determination of an appropriate depletion threshold, therefore there is no quantitative determination of whether localized depletion is or is not occurring.
- Recruitment to Chesapeake Bay does not appear to be correlated with abundance of age-2 and age-3 Atlantic menhaden within the Bay; as long as environmental conditions and total coastwide fecundity are favorable, recruitment to the Bay can occur.

- From a single-species perspective, the projections used to set the coastwide quota were conducted with the assumption that selectivity in the future would be equal to the selectivity of the most recent year of the model. The Bay fishery harvests a higher proportion of age-1 and age-2 fish than the more northern fisheries. Therefore, if the proportion of removals from the Bay changes, the impact of those removals on the total population will change even if the coastwide quota is not exceeded, because the overall selectivity pattern will be different.
- Demand for forage in Chesapeake Bay from fish and bird predators has increased since the early to mid-1980s, the last period of strong recruitment to Chesapeake Bay (Uphoff 2003, Viverette 2007).
- Atlantic menhaden can make up a significant proportion of many predators diets' for specific seasons, age classes, and locations within the Bay, particularly when menhaden are abundant.
- Lower levels of Atlantic menhaden abundance and recruitment have been linked to negative population metrics for several species within the Bay, but the overall complexity of the Chesapeake Bay food web, changing environment, and population dynamics makes it difficult to prove causation.

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Table 1. Average percent of menhaden by weight in the stomachs of key predators within the Chesapeake Bay by season and age or size class. (-- indicates no samples available.) Data from published studies and fishery independent surveys synthesized by the ASMFC Multispecies TC (SEDAR 2015).

Striped Bass														
	Age													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Jan-Mar	--	0.0	10.0	33.3	54.2	63.4	75.4	82.9	89.3	93.7	91.6	94.0	94.3	93.0
Apr - Jun	0.0	0.2	7.8	15.4	16.8	17.6	22.5	30.2	24.6	29.3	46.0	34.3	36.3	36.3
Jul - Sep	0.0	16.2	14.2	23.8	27.4	29.2	24.7	13.7	28.7	43.8	30.6	43.4	76.5	36.4
Oct - Dec	0.0	7.8	66.1	71.1	73.0	73.1	74.2	74.3	75.0	74.9	75.0	75.0	75.0	75.0

Weakfish							
	Age						
	0	1	2	3	4	5	6+
Jan-Mar	--	0.0	0.0	0.0	0.0	0.0	--
Apr - Jun	0.0	0.0	0.0	0.0	6.9	--	--
Jul - Sep	1.7	2.4	5.7	3.3	3.4	--	--
Oct - Dec	0.9	6.7	22.8	16.8	39.2	69.4	61.2

Bluefish			
	Size Class		
	<34 cm	34-55 cm	>55 cm
Jan-Mar	--	--	--
Apr - Jun	3.5	20.4	16.7
Jul - Sep	8.7	50.8	40.8
Oct - Dec	4.4	32.9	32.9

Spiny Dogfish			
	Size Class		
	<34 cm	34-55 cm	>55 cm
Jan-Mar	0.0	37.3	19.1
Apr - Jun	--	0.0	--
Jul - Sep	--	--	--
Oct - Dec	--	25.6	--

Public Comment

From: Stephen Oksienik [mailto:stephenoksienik@gmail.com]
Sent: Tuesday, September 11, 2018 12:36 PM
To: Comments <comments@asmfc.org>
Subject: menhaden

As an avid bay fisherman I would like to see limits set on the industrial harvesting of menhaden for their oil. The rest of the food chain needs the forage for their very lives, while we use the oil as a supplement to our diets. If the menhaden were not so heavily harvested, there would be many more, and larger stripers in the bay for anglers to catch and to consume.

That way we still get the oils for our diets and the bass get to have rich lives in the bay.

Thank you.

Stephen Oksienik
Crofton, Md.

Tina Berger

From: info
Sent: Monday, January 14, 2019 1:39 PM
To: Comments
Subject: FW: Menhaden management

From: Walter Zadan [mailto:walterzadan@cox.net]
Sent: Sunday, January 13, 2019 4:46 PM
To: info <info@asmfc.org>
Subject: Menhaden management

Reject Omega's menhaden certification on fishery sustainability until it comes into compliance with ASMFC's plan.

Walter Zadan
221 Wingate Dr.
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The following public comment has been submitted by 940 individuals.

Tina Berger

From:	Frank Walsh <squidder329@gmail.com>
Sent:	Tuesday, January 29, 2019 4:26 PM
To:	Comments; hq@omegaprotein.com
Subject:	Request to refrain from fishing in the waters of the Western New York Bight

Dear Owners and Directors of Omega Protein And Commissioners of ASMFC

While we recognize that the Omega Fleet is operating under the current Total Allowable Catch and in waters beyond the NY or NJ State jurisdictions, we would like to request certain restraints on the fishing activity that would conflict with the whales we have been documenting feeding in this area.

The Atlantic States Marine Fisheries Commission is often cited as determining that there is no local impact on this conflict. A timely survey has yet to be done in this area and we are totally opposed to finding out, by learning after the fact, that there are no more whales in the area.

We therefore request, representing the undersigned, that the Omega Fleet maintain a 20 mile “no fish zone” from the entrance to NY harbor. This would allow a reasonable fishing area while protecting the specific local area where we have been documenting humpback feeding increasingly since 2011. A voluntary exclusion would be, we think, a demonstration of the company’s willingness to respect other interests.

Please consider this message and let the management know that there is an opportunity to work with groups like ours in a cooperative rather than an adversarial manner. We believe, and hope the company agrees, that positive public relations have a beneficial effect on the bottom line.

Thank you for the consideration and hope that whales, menhaden, and our common interest of a sustainable fishery can be ensured.

--
Mr Frank Walsh
squidder329@gmail.com