Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Atlantic Menhaden Management Board

FROM: Megan Ware, FMP Coordinator

DATE: July 24, 2017

SUBJECT: Staff Memo Regarding Draft Amendment 3

At the August meeting, the Atlantic Menhaden Management Board (Board) will consider approving Draft Amendment 3 for public comment. Presently, the document contains a large number of management alternatives, particularly in regard to the allocation method. Staff is concerned this volume of options may be overwhelming at public hearings and hinder the ability to receive effective public comment. As a result, staff has put together a series of questions for the Board to answer at the upcoming meeting. Following each question, pros and cons of the various management alternatives are discussed. For some options, staff has provided recommendations for the Board to consider. The comments and recommendations presented in this document were developed with a coastwide perspective in mind.

In addition to the questions posed to the Board in this memo, staff encourages the Board to consider streamlining other portions of the document, including options for the allocation timeframes (Tier 4 in Section 4.3.2) indecision clause (Section 4.3.2.1), quota transfers (section 4.3.3), quota rollovers (Section 4.3.4), and incidental catch (Section 4.3.5).

At the end of the memo, staff has prepared tables that show the various allocation percentages translated into pounds, based on the current TAC of 200,000 mt. The intent of these tables is to provide additional information to the Board regarding the allocation options, using the current TAC as an example. It is important to note the pounds in these tables are subject to change depending on the combination of allocation methods chosen and the TAC selected for 2018.

1. Does the Board want to keep all three fixed minimum options: 2% fixed minimum, 1% fixed minimum, and 0.5% fixed minimum?

The fixed minimum allocation method provides a management alternative under which each jurisdiction has the ability, to some degree, to participate in the menhaden fishery; however, it may not be necessary for the document to include all three fixed minimum sub-options (i.e. 0.5%, 1%, 2%). The benefit of the 2% fixed minimum option is it provides each jurisdiction with the greatest minimum level of quota, resulting in growth opportunities for many states. However, this growth opportunity (2% of the current TAC is roughly 8.8 million pounds) is well in excess of what some states have annually landed over the last decade, including New Hampshire, Rhode Island, Connecticut, New York, Delaware, PRFC, South Carolina, Georgia, and Florida. Furthermore, this large growth opportunity would be compensated by significant

reductions in allocation levels for New Jersey and Virginia relative to recent landings. For example, under the 2009-2011 timeframe, Virginia's allocation would be reduced by 25.47%.

The 0.5% and 1% fixed minimum options provide a more moderate base amount of quota to each state. For many states, these percentages are still greater than their current allocation, and may sufficiently allow for a more appropriate growth in their fishery. For reference, 0.5% of the current TAC is roughly 2.2 million pounds and 1% of the current TAC is approximately 4.4 million pounds. In addition, smaller levels of fixed minimum quota result in smaller decreases in allocation for New Jersey and Virginia.

Staff recommends the 2% fixed minimum option be removed from Draft Amendment 3. This recommendation is endorsed by the PDT. Removing this option would eliminate Tables 9a-c in Draft Amendment 3.

2. Does the Board want to keep both fleet-capacity options, including a two-fleet and a three-fleet option?

Draft Amendment 3 includes a fleet-capacity allocation method that divides quota based on historic landings by gear type. An advantage of this method is it can secure quota for various gear types, addressing one of the concerns of the current allocation method. Presently, there are two options under the fleet capacity option: a two-fleet split and a three-fleet split. In addition, there is a sub-option that allows for the small-capacity fleet to be managed under a soft cap. Advantages of a soft cap include relieving the administrative burden on states to implement timely quota monitoring for a small (<6% of total landings) portion of the fishery, minimizing economic impacts on small-scale community fisheries, and providing a method to streamline management of the resource. Draft Amendment 3 includes harvest control measures for gears subject to a soft cap, including a trip limit, a requirement that landings be reported in annual compliance reports, and the ability for the Board to reduce a trip limit or remove a specific gear from the soft cap.

Under the three-fleet option, small-scale gears (i.e. cast nets, pots, hand lines) are separated from the medium-capacity gears (i.e. pound nets, gill nets, fish traps). The benefit of this option is it secures quota for these two distinct categories of gear types. However, given the medium-capacity gears are not subject to a soft cap, it may limit the flexibility provided to these gear types. This is an important fact given the medium-capacity fleet includes many passive gears whose landings are dependent on the abundance and movement of menhaden. In addition, it maintains an administrative burden on states to implement timely quota monitoring on the medium fleet which, between 2012 and 2016, harvested just 5.5% of total landings in the fishery.

The two-fleet option provides a simpler management alternative while still achieving the goals of this allocation method. Specifically, the two-fleet method ensures small scale gears and stationary gears have access to quota, in addition to the large mobile gears. This option would reduce the administrative burden on states with lower menhaden landings by allowing a greater portion of gears to be subject to a soft cap.

Staff recommends the three-fleet option be removed from Draft Amendment 3. Removing this option would eliminate Tables 6a-c and portions of Tables 11c-d.

3. Does the Board want to keep both regional allocation methods, including a three-region and four-region split?

The purpose of a regional allocation approach is to secure quota for different menhaden fisheries along the coast given menhaden migrate seasonally. From a coastwide perspective, regional quotas are most advantageous when combined with the dispositional and/or fleet-capacity allocation methods because they secure quota by gear type and region. Currently, there are options for a three-region and four-region split. An advantage of the four-region split is it separates the South Atlantic fishery from the Chesapeake Bay fishery, which are different in terms of timing and gears used. However, due to confidentiality rules, there are limitations in what allocation percentages can be shown in the draft Amendment for the four-region approach, particularly if a fleet capacity quota is further divided by four regions. Some percentages that result from combining the fleet-capacity quota with a three region approach can be shown but others have to be redacted.

Staff notes that there are large swings in the quota given to regions under this allocation method depending on the timeframe chosen. For example, under the 2012-2016 time period, the Mid-Atlantic region (NY-DE) would be allocated up to 12.90% of the TAC while the New England region (ME-CT) would only be allocated 0.97% of the TAC. In contrast, under the 1985-1995 time period, the Mid-Atlantic region would be allocated only 2.22% (for perspective, NJ alone currently receives 11.19%) of the TAC while the New England region would be allocated 3.82% of the TAC. These large swings in allocation may hinder the ability of the Board to identify a viable outcome, based solely on a regional approach.

Staff recommends that a regional approach only be used in combination with another allocation method (i.e. dispositional quota, fleet-capacity quota) and that a regional approach not be used as the sole method to allocate the menhaden TAC. Pairing down the regional allocation options would remove Tables 11a-b and 12a-b.

4. Does the Board want to include all historic reduction landings in the allocation percentages, or only those of Virginia?

For the timeframes that contain landings prior to 2006, there are sub-options that include all historic reduction landings in the allocation percentages, and sub-options that only include Virginia's reduction landing. The Board needs to make a decision regarding which landings are included in the allocation percentages. Staff does not have a recommendation for this question, but offers the following pros and cons associated with each option. One advantage of including all reduction landings is it accurately reflects historic fisheries in each state. However, including these landings significantly increases a state's allocation, sometimes to a level well-above the state's recent landings history. This is particularly true for the 1985-1995 time period, in which some states, with recent landings of about 1 million pounds annually, would be allocated almost 10% of the TAC (44 million pounds). One advantage of only including VA reduction

landings is it may provide a more accurate reflection of recent fishery performance; however, it may affect future growth opportunities in states that historically had a reduction fishery.

Due to confidentiality rules, there are limitations on the bait and reduction allocation percentages that can be shown when only Virginia's reduction landings are included. This primarily impacts the longer and older timeframes. Given dispositional bait quota can be combined with other allocation methods, this may limit the timeframes available to the Board in these combinations. Importantly, these older and longer time periods result in significantly lower bait allocations relative to current landings, and may not meet the goals and objectives of the Amendment. All timeframes in the dispositional quota allocation are available to the Board if all historic reduction landings are included or if the Board chooses a 30/70 split between the bait and reduction sectors.

5. Does the Board want to accept New York's proposal to re-calibrate their landings given in-sufficient or non-existent reporting prior to Amendment 2?

New York has submitted a proposal to re-calibrate the state's menhaden landings due to a lack of historic reporting. This proposal was reviewed by the PDT and the report is included in briefing materials. Overall, the PDT supports the re-calibration method used by New York; however, the PDT notes that, in addition to an increase in reporting, an increase in the abundance of menhaden in the Mid-Atlantic could contribute to the higher landings reported by New York. The PDT also notes the proposal sets a precedent and may invite other states with inconsistent reporting to recalibrate their landings. The current timeframe for Amendment 3 does not provide an opportunity for the Board to react to other proposals. Please refer to the PDT memo for further details and information.

Allocation Scenario Examples

Below are a series of tables that show the pounds resulting from each allocation method, assuming a TAC of 200,000 mt. These tables are presented as reference to the Board to help facilitate discussion at the August Board meeting. It is important to note the pounds in these tables are subject to change depending on the combination of allocation methods chosen and the 2018 TAC. Furthermore, a portion of the TAC is not set aside for episodic events or incidental catch. The table numbers match those in Draft Amendment 3.

2a. Dispositional allocation. This table includes all reduction landings.

	Bait Quota	Reduction Quota
2009-2011	93,359,797	347,564,727
2012-2016	109,451,334	331,473,190
1985-2016	59,718,466	381,206,058
1985-1995	36,690,513	404,234,011
Weighted	62,166,280	378,758,244
30/70 Split	132,277,357	308,647,167

2b. Dispositional allocation. This table only includes VA reduction landings. Three time periods are not shown due to confidentiality rules.

	Bait Quota	Reduction Quota
2009-2011	93,359,797	347,564,727
2012-2016	109,451,334	331,473,190
1985-2016		
1985-1995		
Weighted		
30/70 Split	132,277,357	308,647,167

3/4. Allocation Based on TAC Level.

Given the TAC is 200,000 mt (below the baseline of 212,500 mt), allocations are based on jurisdiction landings from 2009-2011. See Table 10.

5a. Two-fleet allocation method. This table includes all historic reduction landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Quota	424,238,499	415,274,422	424,033,826	423,479,810	420,514,968
Small Capacity Quota	16,686,025	25,650,102	16,890,698	17,444,714	20,409,556

5b. Two-fleet allocation method. This table only includes VA reduction landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Quota	424,238,499	415,274,422	422,553,244	421,201,392	418,889,218
Small Capacity Quota	16,686,025	25,650,102	18,371,280	19,723,132	22,035,306

5c. Bait landings divided into two fleets. These landings represent a combination of the dispositional quota with the fleet-capacity quota. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This bait quota is applied to all timeframes but the allocation differs based on historic fleet landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Bait Quota	76,673,772	83,801,240	43,145,092	19,896,982	42,307,281
Small Capacity Bait Quota	16,686,025	25,650,094	16,573,374	16,793,531	19,858,999

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Bait Quota	108,635,669	101,277,948	95,567,069	71,732,990	90,021,397
Small Capacity Bait Quota	23,641,688	30,999,409	36,710,288	60,544,367	42,255,960

6a. Three-fleet allocation method. This table includes all historic reduction landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Quota	424,238,499	415,274,422	424,033,826	423,479,810	420,514,968
Medium Capacity Quota	16,283,469	24,502,856	16,323,739	17,039,606	19,736,292
Small Capacity Quota	402,555	1,147,246	566,959	405,109	673,264

6b. Three-fleet allocation method. This table only includes VA historic reduction landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Quota	424,238,499	415,274,422	422,553,244	421,201,392	418,889,218
Medium Capacity Quota	16,283,469	24,502,856	17,754,623	19,265,113	21,308,413
Small Capacity Quota	402,555	1,147,246	616,657	458,019	726,894

6c. Bait landings divided into three fleets. These landings represent a combination of the dispositional quota with the fleet-capacity quota. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic fleet landings.

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Bait Quota	76,673,772	83,801,240	43,145,092	19,896,982	42,307,281
Medium Capacity Quota	16,283,469	24,502,849	16,017,066	16,403,544	19,203,896
Small Capacity Quota	402,555	1,147,245	556,308	389,987	655,102

	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
Large Capacity Bait Quota	108,635,669	101,277,948	95,567,069	71,732,990	90,021,397
Medium Capacity Quota	23,071,326	29,612,906	35,478,058	59,138,380	40,862,034
Small Capacity Quota	570,363	1,386,503	1,232,231	1,405,987	1,393,926

7a. Allocations with a 0.5% fixed minimum quota. This table includes all historic reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	2,280,187	3,101,682	5,805,521	9,827,301	7,397,142
NH	2,204,745	2,204,696	2,216,101	2,230,300	2,221,049
MA	5,624,327	4,601,512	4,443,588	4,714,945	4,673,958
RI	2,282,693	2,811,135	4,628,390	7,442,268	5,768,907
CT	2,274,217	2,254,735	2,319,162	2,290,733	2,277,726
NY	2,495,413	3,222,741	2,666,344	2,608,646	2,830,536
NJ	48,002,477	53,391,517	23,742,752	10,743,199	26,153,259
PA	2,204,623	2,204,623	2,204,623	2,204,623	2,204,623
DE	2,260,146	2,333,117	2,276,606	2,273,973	2,295,344
MD	8,333,763	10,267,735	6,244,195	4,487,352	6,575,970
PRFC	4,736,226	5,666,175	6,311,300	7,207,563	6,650,615
VA	347,313,601	339,176,026	337,867,507	334,101,324	335,934,960
NC	4,218,335	2,834,714	32,760,463	42,513,841	28,176,634
SC	2,204,623	2,204,678	2,205,165	2,205,817	2,205,405
GA	2,204,623	2,204,623	2,204,623	2,204,623	2,204,623
FL	2,284,526	2,444,817	3,028,185	3,868,018	3,353,775

7b. Allocations with a 0.5% fixed minimum quota. This table includes only VA reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	2,280,187	3,101,682	2,467,680	2,296,478	2,610,393
NH	2,204,745	2,204,696	2,217,101	2,233,623	2,222,345
MA	5,624,327	4,601,512	4,638,738	5,039,797	4,868,928
RI	2,282,693	2,811,135	4,839,648	8,120,054	6,050,330
CT	2,274,217	2,254,735	2,329,146	2,301,876	2,283,498
NY	2,495,413	3,222,741	2,706,588	2,660,930	2,879,956
NJ	48,002,477	53,391,517	25,620,041	11,848,148	28,044,158
PA	2,204,623	2,204,623	2,204,623	2,204,623	2,204,623
DE	2,260,146	2,333,117	2,282,880	2,282,948	2,302,507
MD	8,333,763	10,267,735	6,596,289	4,782,752	6,921,116
PRFC	4,736,226	5,666,175	6,669,243	7,854,977	7,001,655
VA	347,313,601	339,176,026	367,124,285	377,050,981	362,285,130
NC	4,218,335	2,834,714	4,096,833	4,635,993	3,933,750
SC	2,204,623	2,204,678	2,205,212	2,205,972	2,205,467
GA	2,204,623	2,204,623	2,204,623	2,204,623	2,204,623
FL	2,284,526	2,444,817	2,721,594	3,200,753	2,906,045

7c. Bait landings divided by jurisdiction with a 0.5% fixed minimum quota. These landings represent a combination of the dispositional quota with 0.5% fixed minimum quota. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic state bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	542,363	1,444,316	535,295	260,904	675,253
NH	466,921	547,330	309,821	207,905	326,748
MA	3,886,504	2,944,146	2,488,847	2,574,057	2,703,637
RI	544,869	1,153,769	2,669,629	5,171,314	3,764,650
CT	536,393	597,369	410,640	265,456	381,669
NY	757,589	1,565,375	750,269	568,208	917,346
NJ	46,264,653	51,734,150	21,368,146	8,314,824	23,517,245
PA	466,799	547,257	298,592	183,453	310,831
DE	522,322	675,751	369,010	249,496	398,741
MD	6,595,939	8,610,369	4,250,281	2,357,318	4,546,701
PRFC	2,998,402	4,008,809	4,315,927	4,947,803	4,619,033
VA	25,816,228	32,563,326	18,589,292	7,964,775	16,577,473
NC	2,480,511	1,177,348	2,001,232	2,233,572	1,863,756
SC	466,799	547,312	299,123	184,590	311,590
GA	466,799	547,257	298,592	183,453	310,831
FL	546,703	787,451	763,771	1,023,384	940,777

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	768,451	1,745,528	1,185,687	940,617	1,436,802
NH	661,560	661,476	686,258	749,544	695,255
MA	5,506,615	3,558,146	5,512,836	9,280,042	5,752,796
RI	772,001	1,394,387	5,913,271	18,643,724	8,010,419
CT	759,992	721,950	909,575	957,027	812,114
NY	1,073,395	1,891,833	1,661,857	2,048,516	1,951,929
NJ	65,550,336	62,523,283	47,330,784	29,976,767	50,039,974
PA	661,387	661,387	661,387	661,387	661,387
DE	740,055	816,678	817,362	899,488	848,440
MD	9,345,493	10,406,057	9,414,441	8,498,650	9,674,466
PRFC	4,248,303	4,844,845	9,559,846	17,837,915	9,828,374
VA	36,577,869	39,354,392	41,175,579	28,714,763	35,273,532
NC	3,514,527	1,422,883	4,432,761	8,052,517	3,965,698
SC	661,387	661,454	662,561	665,487	663,001
GA	661,387	661,387	661,387	661,387	661,387
FL	774,599	951,673	1,691,766	3,689,525	2,001,784

8a. Allocations with a 1% fixed minimum quota. This table includes all historic reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	4,478,239	5,228,300	7,697,022	11,369,082	9,150,242
NH	4,409,357	4,409,313	4,419,725	4,432,690	4,424,243
MA	7,531,584	6,597,710	6,453,518	6,701,278	6,663,856
RI	4,480,527	4,963,017	6,622,250	9,191,443	7,663,591
CT	4,472,788	4,455,000	4,513,825	4,487,867	4,475,991
NY	4,674,750	5,338,831	4,830,817	4,778,136	4,980,732
NJ	46,224,677	51,145,105	24,074,494	12,205,336	26,275,391
PA	4,409,245	4,409,245	4,409,245	4,409,245	4,409,245
DE	4,459,940	4,526,566	4,474,969	4,472,565	4,492,077
MD	10,005,416	11,771,217	8,097,550	6,493,476	8,400,475
PRFC	6,720,709	7,569,793	8,158,821	8,977,147	8,468,630
VA	319,508,747	312,078,788	310,884,053	307,445,364	309,119,553
NC	6,247,852	4,984,546	32,308,056	41,213,314	28,122,821
SC	4,409,245	4,409,296	4,409,740	4,410,336	4,409,960
GA	4,409,245	4,409,245	4,409,245	4,409,245	4,409,245
FL	4,482,201	4,628,553	5,161,193	5,927,998	5,458,471

8b. Allocations with a 1% fixed minimum quota. This table includes only VA reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	4,478,239	5,228,300	4,649,428	4,493,113	4,779,731
NH	4,409,357	4,409,313	4,420,639	4,435,723	4,425,427
MA	7,531,584	6,597,710	6,631,699	6,997,883	6,841,872
RI	4,480,527	4,963,017	6,815,138	9,810,291	7,920,543
CT	4,472,788	4,455,000	4,522,940	4,498,042	4,481,261
NY	4,674,750	5,338,831	4,867,561	4,825,873	5,025,854
NJ	46,224,677	51,145,105	25,788,540	13,214,203	28,001,865
PA	4,409,245	4,409,245	4,409,245	4,409,245	4,409,245
DE	4,459,940	4,526,566	4,480,698	4,480,760	4,498,617
MD	10,005,416	11,771,217	8,419,027	6,763,189	8,715,609
PRFC	6,720,709	7,569,793	8,485,638	9,568,264	8,789,145
VA	319,508,747	312,078,788	337,596,763	346,660,268	333,178,404
NC	6,247,852	4,984,546	6,136,915	6,629,192	5,988,014
SC	4,409,245	4,409,296	4,409,783	4,410,477	4,410,016
GA	4,409,245	4,409,245	4,409,245	4,409,245	4,409,245
FL	4,482,201	4,628,553	4,881,263	5,318,755	5,049,674

8c. Bait landings divided by jurisdiction with a 1% fixed minimum quota. These landings represent a combination of the dispositional quota with 1% fixed minimum quota. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic state bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	1,002,592	1,913,568	813,304	437,622	954,395
NH	933,710	1,094,581	607,437	389,231	636,196
MA	4,055,937	3,282,978	2,596,982	2,549,631	2,806,398
RI	1,004,880	1,648,285	2,762,044	4,921,040	3,775,149
CT	997,140	1,140,268	699,489	441,778	686,340
NY	1,199,102	2,024,099	1,009,585	718,204	1,175,437
NJ	42,749,030	47,830,373	19,834,603	7,791,201	21,810,128
PA	933,598	1,094,513	597,185	366,905	621,663
DE	984,293	1,211,834	661,479	427,206	701,928
MD	6,529,769	8,456,485	4,205,248	2,351,739	4,489,195
PRFC	3,245,062	4,255,061	4,265,185	4,716,964	4,555,238
VA	24,078,729	30,326,576	17,297,389	7,471,591	15,473,813
NC	2,772,205	1,669,814	2,151,769	2,238,753	2,039,550
SC	933,598	1,094,564	597,669	367,944	622,355
GA	933,598	1,094,513	597,185	366,905	621,663
FL	1,006,554	1,313,821	1,021,913	1,133,799	1,196,830

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	1,420,528	2,312,641	1,801,482	1,577,723	2,030,761
NH	1,322,932	1,322,855	1,345,482	1,403,265	1,353,696
MA	5,746,677	3,967,641	5,752,358	9,191,981	5,971,451
RI	1,423,770	1,992,034	6,117,972	17,741,430	8,032,760
CT	1,412,804	1,378,071	1,549,380	1,592,706	1,460,394
NY	1,698,955	2,446,224	2,236,246	2,589,283	2,501,095
NJ	60,569,206	57,805,374	43,933,963	28,088,991	46,407,571
PA	1,322,774	1,322,774	1,322,774	1,322,774	1,322,774
DE	1,394,601	1,464,561	1,465,186	1,540,170	1,493,561
MD	9,251,740	10,220,081	9,314,692	8,478,536	9,552,106
PRFC	4,597,784	5,142,452	9,447,454	17,005,691	9,692,631
VA	34,116,084	36,651,169	38,313,993	26,936,726	32,925,167
NC	3,927,814	2,018,053	4,766,202	8,071,197	4,339,753
SC	1,322,774	1,322,835	1,323,846	1,326,518	1,324,247
GA	1,322,774	1,322,774	1,322,774	1,322,774	1,322,774
FL	1,426,141	1,587,818	2,263,554	4,087,596	2,546,615

9a. Allocations with a 2% fixed minimum quota. This table includes all historic reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	8,874,342	9,481,535	11,480,024	14,452,644	12,656,440
NH	8,818,581	8,818,545	8,826,974	8,837,469	8,830,631
MA	11,346,098	10,590,104	10,473,378	10,673,946	10,643,652
RI	8,876,195	9,266,782	10,609,971	12,689,793	11,452,961
CT	8,869,930	8,855,530	8,903,150	8,882,137	8,872,523
NY	9,033,423	9,571,013	9,159,763	9,117,117	9,281,122
NJ	42,669,078	46,652,282	24,737,977	15,129,612	26,519,656
PA	8,818,490	8,818,490	8,818,490	8,818,490	8,818,490
DE	8,859,529	8,913,464	8,871,696	8,869,750	8,885,545
MD	13,348,724	14,778,182	11,804,261	10,505,725	12,049,486
PRFC	10,689,676	11,377,029	11,853,861	12,516,316	12,104,659
VA	263,899,040	257,884,310	256,917,144	254,133,444	255,488,740
NC	10,306,887	9,284,210	31,403,242	38,612,260	28,015,195
SC	8,818,490	8,818,531	8,818,891	8,819,373	8,819,069
GA	8,818,490	8,818,490	8,818,490	8,818,490	8,818,490
FL	8,877,550	8,996,025	9,427,210	10,047,957	9,667,864

9b. Allocations with a 2% fixed minimum quota. This table includes only VA reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	8,874,342	9,481,535	9,012,924	8,886,383	9,118,408
NH	8,818,581	8,818,545	8,827,714	8,839,925	8,831,590
MA	11,346,098	10,590,104	10,617,620	10,914,054	10,787,760
RI	8,876,195	9,266,782	10,766,118	13,190,766	11,660,970
CT	8,869,930	8,855,530	8,910,529	8,890,373	8,876,789
NY	9,033,423	9,571,013	9,189,508	9,155,761	9,317,650
NJ	42,669,078	46,652,282	26,125,539	15,946,313	27,917,278
PA	8,818,490	8,818,490	8,818,490	8,818,490	8,818,490
DE	8,859,529	8,913,464	8,876,333	8,876,383	8,890,839
MD	13,348,724	14,778,182	12,064,505	10,724,064	12,304,594
PRFC	10,689,676	11,377,029	12,118,427	12,994,839	12,364,123
VA	263,899,040	257,884,311	278,541,719	285,878,842	274,964,953
NC	10,306,887	9,284,210	10,217,080	10,615,590	10,096,541
SC	8,818,490	8,818,531	8,818,926	8,819,488	8,819,115
GA	8,818,490	8,818,490	8,818,490	8,818,490	8,818,490
FL	8,877,550	8,996,025	9,200,600	9,554,760	9,336,933

9c. Bait landings divided by jurisdiction with a 2% fixed minimum quota. These landings represent a combination of the dispositional quota with 2% fixed minimum quota. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic state bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	1,923,048	2,852,071	1,369,323	791,057	1,512,680
NH	1,867,286	2,189,081	1,202,669	751,884	1,255,090
MA	4,394,804	3,960,641	2,813,253	2,500,779	3,011,921
RI	1,924,900	2,637,318	2,946,875	4,420,491	3,796,148
CT	1,918,635	2,226,066	1,277,187	794,421	1,295,684
NY	2,082,128	2,941,549	1,528,217	1,018,195	1,691,619
NJ	35,717,784	40,022,818	16,767,517	6,743,955	18,395,892
PA	1,867,196	2,189,027	1,194,369	733,810	1,243,326
DE	1,908,235	2,284,001	1,246,417	782,625	1,308,302
MD	6,397,430	8,148,718	4,115,183	2,340,581	4,374,185
PRFC	3,738,381	4,747,566	4,163,703	4,255,286	4,427,648
VA	20,603,731	25,853,078	14,713,582	6,485,222	13,266,495
NC	3,355,592	2,654,746	2,452,842	2,249,116	2,391,139
SC	1,867,196	2,189,068	1,194,761	734,651	1,243,886
GA	1,867,196	2,189,027	1,194,369	733,810	1,243,326
FL	1,926,255	2,366,562	1,538,197	1,354,629	1,708,937

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	2,724,681	3,446,869	3,033,073	2,851,934	3,218,680
NH	2,645,675	2,645,613	2,663,930	2,710,707	2,670,580
MA	6,226,803	4,786,630	6,231,401	9,015,858	6,408,763
RI	2,727,306	3,187,330	6,527,375	15,936,840	8,077,441
CT	2,718,429	2,690,311	2,828,990	2,864,064	2,756,955
NY	2,950,075	3,555,007	3,385,025	3,670,816	3,599,426
NJ	50,606,945	48,369,557	37,140,319	24,313,437	39,142,764
PA	2,645,547	2,645,547	2,645,547	2,645,547	2,645,547
DE	2,703,693	2,760,328	2,760,833	2,821,535	2,783,804
MD	9,064,235	9,848,129	9,115,196	8,438,307	9,307,388
PRFC	5,296,746	5,737,668	9,222,669	15,341,242	9,421,146
VA	29,192,513	31,244,725	32,590,820	23,380,651	28,228,437
NC	4,754,390	3,208,392	5,433,084	8,108,557	5,087,864
SC	2,645,547	2,645,596	2,646,415	2,648,578	2,646,740
GA	2,645,547	2,645,547	2,645,547	2,645,547	2,645,547
FL	2,729,226	2,860,107	3,407,131	4,883,736	3,636,276

10a. Jurisdictional allocation. This table includes all historic reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	82,135	975,065	3,914,020	8,285,520	5,644,043
NH	133	80	12,476	27,910	17,854
MA	3,717,070	2,605,315	2,433,658	2,728,611	2,684,060
RI	84,859	659,252	2,634,530	5,693,092	3,874,222
CT	75,646	54,470	124,500	93,598	79,460
NY	316,077	1,106,650	501,871	439,156	680,341
NJ	49,780,276	55,637,928	23,411,010	9,281,061	26,031,126
PA	-	-	-	-	-
DE	60,351	139,667	78,243	75,381	98,610
MD	6,662,109	8,764,252	4,390,839	2,481,227	4,751,464
PRFC	2,751,743	3,762,557	4,463,780	5,437,978	4,832,601
VA	375,118,455	366,273,265	364,850,961	360,757,284	362,750,366
NC	2,188,818	684,881	33,212,870	43,814,367	28,230,448
SC	-	60	589	1,298	851
GA	-	-	-	-	-
FL	86,852	261,081	895,176	1,808,039	1,249,079

10b. Jurisdictional allocation. This table only includes VA reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	82,135	975,065	285,931	99,842	441,055
NH	133	80	13,564	31,522	19,264
MA	3,717,070	2,605,315	2,645,778	3,081,711	2,895,984
RI	84,859	659,252	2,864,158	6,429,817	4,180,117
CT	75,646	54,470	135,351	105,710	85,734
NY	316,077	1,106,650	545,615	495,986	734,058
NJ	49,780,276	55,637,928	25,451,542	10,482,092	28,086,452
PA	-	-	-	-	-
DE	60,351	139,667	85,062	85,136	106,396
MD	6,662,109	8,764,252	4,773,550	2,802,315	5,126,623
PRFC	2,751,743	3,762,557	4,852,849	6,141,689	5,214,166
VA	375,118,455	366,273,265	396,651,807	407,441,694	391,391,856
NC	2,188,818	684,881	2,056,750	2,642,794	1,879,486
SC	-	60	641	1,466	918
GA	-	-	-	-	-
FL	86,852	261,081	561,926	1,082,750	762,416

10c. Bait landings divided by jurisdiction. These landings represent a combination of the dispositional and jurisdictional allocation methods. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic state bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	82,135	975,065	257,285	84,186	396,110
NH	133	80	12,205	26,579	17,301
MA	3,717,070	2,605,315	2,380,712	2,598,484	2,600,875
RI	84,859	659,252	2,577,214	5,421,589	3,754,151
CT	75,646	54,470	121,791	89,134	76,997
NY	316,077	1,106,650	490,952	418,213	659,256
NJ	49,780,277	55,637,928	22,901,688	8,838,447	25,224,363
PA	-	-	-	-	-
DE	60,351	139,667	76,541	71,786	95,554
MD	6,662,109	8,764,252	4,295,314	2,362,897	4,604,206
PRFC	2,751,743	3,762,557	4,366,668	5,178,641	4,682,828
VA	27,553,728	34,800,075	19,881,195	8,457,959	17,681,132
NC	2,188,818	684,881	1,850,695	2,228,391	1,687,961
SC	-	60	576	1,236	824
GA	-	-	-	-	-
FL	86,852	261,081	505,629	912,969	684,723

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME	116,374	1,178,414	569,891	303,511	842,842
NH	188	97	27,034	95,823	36,813
MA	5,266,552	3,148,652	5,273,314	9,368,104	5,534,140
RI	120,233	796,739	5,708,570	19,546,019	7,988,079
CT	107,179	65,830	269,770	321,348	163,834
NY	447,835	1,337,441	1,087,467	1,507,749	1,402,763
NJ	70,531,467	67,241,191	50,727,606	31,864,544	53,672,377
PA	-	-	-	-	-
DE	85,509	168,795	169,538	258,805	203,319
MD	9,439,246	10,592,033	9,514,189	8,518,764	9,796,825
PRFC	3,898,822	4,547,237	9,672,239	18,670,140	9,964,116
VA	39,039,655	42,057,614	44,037,166	30,492,800	37,621,897
NC	3,101,239	827,713	4,099,319	8,033,838	3,591,643
SC	-	73	1,277	4,457	1,754
GA	-	-	-	-	-
FL	123,057	315,529	1,119,977	3,291,455	1,456,954

11a. Three region allocations, including all historical reduction landings

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	9,119,183	16,828,731	12,299,639
NY, NJ, PA, DE	50,156,704	56,884,246	23,991,124	9,795,598	26,810,077
MD, PRFC, VA, NC, SC, GA, FL	386,807,976	379,746,097	407,814,217	414,300,194	401,814,808

11b. Three region allocations, only include VA reduction landings

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	5,944,783	9,748,602	7,622,153
NY, NJ, PA, DE	50,156,704	56,884,246	26,082,219	11,063,214	28,926,906
MD, PRFC, VA, NC, SC, GA, FL	386,807,976	379,746,097	408,897,522	420,112,708	404,375,465

11c. Bait landings divided by three regions. These landings represent a combination of the dispositional and regional allocation methods. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic regional bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	5,349,207	8,219,972	6,845,434
NY, NJ, PA, DE	50,156,705	56,884,245	23,469,181	9,328,447	25,979,172
MD, PRFC, VA, NC, SC, GA, FL	39,243,249	48,272,907	30,900,078	19,142,094	29,341,674

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	5,610,527	5,189,731	11,848,579	29,634,805	14,565,709
NY, NJ, PA, DE	71,064,811	68,747,428	51,984,612	33,631,098	55,278,460
MD, PRFC, VA, NC, SC, GA, FL	55,602,019	58,340,198	68,444,166	69,011,454	62,433,189

11d. Fleet landings divided by three regions. These landings represent a combination of the fleet capacity and regional allocation methods. Percentages presented in the top table are based off of a fleet capacity quotas outlined in Tables 5a, 5b, 6a, and 6b. For example, the large fleet-all reduction landings quota for the 1985-2016 timeframe is 423,479,810 pounds.

Large Fleet - All Historic Reduction Landings (2 or 3 Fleet Options)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT			8,806,111		
NY, NJ, PA, DE			22,257,209		
MD, PRFC, VA, NC, SC, GA, FL			392,970,506		
Large Fleet - VA Only Reduction Landings (2 or 3 Fleet Options)					
	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
ME, NH, MA, RI, CT			5,406,035		
NY, NJ, PA, DE			24,208,201		
MD, PRFC, VA, NC, SC, GA, FL			392,939,007		
Small Fleet (2 Fleet Option-All Red)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	226,368	365,299	313,072	371,775	369,435
NY, NJ, PA, DE	898,229	5,042,066	1,733,917	1,435,836	2,738,874
MD, PRFC, VA, NC, SC, GA, FL	15,561,428	20,242,737	14,843,709	15,637,102	17,301,247
Small Fleet (2 Fleet Option-VA Red)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	226,368	365,299	340,515	420,332	398,863
NY, NJ, PA, DE	898,229	5,042,066	1,885,906	1,623,368	2,957,043
MD, PRFC, VA, NC, SC, GA, FL	15,561,428	20,242,737	16,144,859	17,679,432	18,679,401
Medium Fleet (3 Fleet Option-All Red)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	140,513	322,132	215,214	292,334	303,101
NY, NJ, PA, DE	825,359	4,349,992	1,555,415	1,345,864	2,431,344
MD, PRFC, VA, NC, SC, GA, FL	15,317,598	19,830,732	14,553,110	15,401,408	17,001,847
Medium Fleet (3 Fleet Option-VA Red)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	140,513	322,132	234,079	330,515	327,245
NY, NJ, PA, DE	825,359	4,349,992	1,691,757	1,521,644	2,625,016
MD, PRFC, VA, NC, SC, GA, FL	15,317,598	19,830,732	15,828,787	17,412,953	18,356,152
Small Fleet (3 Fleet Option-All Red)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	85,855	43,167	97,858	79,440	66,334
NY, NJ, PA, DE	72,869	692,074	178,502	89,972	307,529
MD, PRFC, VA, NC, SC, GA, FL	243,830	412,004	290,599	235,696	299,401
Small Fleet (3 Fleet Option-VARed)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	85,855	43,167	106,436	89,816	71,618
NY, NJ, PA, DE	72,869	692,074	194,148	101,723	332,026
MD, PRFC, VA, NC, SC, GA, FL	243,830	412,004	316,072	266,480	323,250

11e. Bait landings by fleet and three regions. These landings represent a combination of the dispositional, fleet capacity, and regional allocation methods. Percentages in the top table are based off of the bait by fleet quotas in the upper Tables of 5c and 6c. For example, the large fleet bait quota in 1985-2016 is 43,145,127. The bottom table is based off of the bait by fleet quotas in the bottom Tables of 5c and 6c, where there is a 30/70 split between the bait and reduction fisheries. Here the large fleet bait quota in 1985-2016 is 95,567,145.

Large Fleet Bait (2 or 3 Fleet Options)					
	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
ME, NH, MA, RI, CT			4,876,973		
NY, NJ, PA, DE			21,839,065		
MD, PRFC, VA, NC, SC, GA, FL			16,429,054		
Small Fleet Bait (2 Fleet Option)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	226,368	365,299	307,191	357,897	359,469
NY, NJ, PA, DE	898,229	5,042,064	1,701,342	1,382,239	2,664,992
MD, PRFC, VA, NC, SC, GA, FL	15,561,428	20,242,731	14,564,842	15,053,395	16,834,538
Medium Fleet Bait (3 Fleet Option)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	140,513	322,132	211,171	281,422	294,925
NY, NJ, PA, DE	825,359	4,349,991	1,526,193	1,295,625	2,365,758
MD, PRFC, VA, NC, SC, GA, FL	15,317,598	19,830,726	14,279,702	14,826,497	16,543,214
Small Fleet Bait (3 Fleet Option)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	85,855	43,167	96,020	76,475	64,545
NY, NJ, PA, DE	72,869	692,074	175,148	86,614	299,233
MD, PRFC, VA, NC, SC, GA, FL	243,830	412,004	285,140	226,898	291,325

Large Fleet Bait (2 or 3 Fleet Options, 30/70 Split Between Bait and Reduction)					
	2009-2011	2012-2016	1985-2016	1985-1995	Weighted
ME, NH, MA, RI, CT			10,802,574		
NY, NJ, PA, DE			48,373,878		
MD, PRFC, VA, NC, SC, GA, FL			36,390,617		
Small Fleet Bait (2 Fleet Option, 30/70 Split Between Bait and Reduction)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	320,731	441,482	680,432	1,290,299	764,878
NY, NJ, PA, DE	1,272,660	6,093,584	3,768,499	4,983,275	5,670,567
MD, PRFC, VA, NC, SC, GA, FL	22,048,297	24,464,342	32,261,356	54,270,793	35,820,515
Medium Fleet Bait (3 Fleet Option, 30/70 Split Between Bait and Reduction)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	199,086	389,312	467,746	1,014,588	627,540
NY, NJ, PA, DE	1,169,415	5,257,179	3,380,543	4,671,012	5,033,857
MD, PRFC, VA, NC, SC, GA, FL	21,702,825	23,966,415	31,629,768	53,452,780	35,200,637
Small Fleet Bait (3 Fleet Option, 30/70 Split Between Bait and Reduction)					
	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	121,645	52,170	212,685	275,709	137,338
NY, NJ, PA, DE	103,245	836,405	387,956	312,262	636,708
MD, PRFC, VA, NC, SC, GA, FL	345,472	497,928	631,590	818,016	619,880

12a. Four region allocations. This table includes all historical reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	9,119,183	16,828,731	12,299,639
NY, NJ, PA, DE	50,156,704	56,884,246	23,991,124	9,795,598	26,810,077
MD, PRFC, VA	384,532,306	378,800,074	373,705,581	368,676,490	372,334,431
NC, SC, GA, FL	2,275,670	946,022	34,108,636	45,623,704	29,480,377

12b. Four region allocations. This table only includes VA reduction landings.

	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	5,944,783	9,748,602	7,622,153
NY, NJ, PA, DE	50,156,704	56,884,246	26,082,219	11,063,214	28,926,906
MD, PRFC, VA	384,532,306	378,800,074	406,278,206	416,385,698	401,732,645
NC, SC, GA, FL	2,275,670	946,022	2,619,316	3,727,010	2,642,820

12c. Bait landings divided by four regions. These landings represent a combination of the dispositional and regional allocation methods. Percentages presented in the top table are based off of a bait quota allocated to the timeframe in Table 2a. For example, the 2009-2011 bait quota is 93,359,797 while the 2012-2016 bait quota is 109,451,334. The bottom table is based off a bait quota of 132,277,357 pounds, which results from the 30/70 split between the bait and reduction fisheries. This quota is applied to all timeframes but the allocation differs based on historic regional bait landings.

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	3,959,844	4,294,182	5,349,207	8,219,972	6,845,434
NY, NJ, PA, DE	50,156,705	56,884,245	23,469,181	9,328,447	25,979,172
MD, PRFC, VA	36,967,579	47,326,884	28,543,177	15,999,498	26,968,165
NC, SC, GA, FL	2,275,670	946,022	2,356,901	3,142,596	2,373,509

BAIT	2009-2011 TAC %	2012-2016 TAC %	1985-2016 TAC %	1985-1995 TAC %	Weighted
ME, NH, MA, RI, CT	5,610,527	5,189,731	11,848,579	29,634,805	14,565,709
NY, NJ, PA, DE	71,064,811	68,747,428	51,984,612	33,631,098	55,278,460
MD, PRFC, VA	52,377,724	57,196,884	63,223,593	57,681,704	57,382,838
NC, SC, GA, FL	3,224,296	1,143,315	5,220,573	11,329,750	5,050,351

ASMFC Stock Assessment Overview: Atlantic Menhaden


Image courtesy of Brian Gratwicke

Introduction

This document presents a summary of the 2017 Stock Assessment Update for Atlantic menhaden. The assessment is an update to the 2015 Benchmark Stock Assessment that was peer-reviewed by an independent panel of scientific experts through the 40th SouthEast, Data, Assessment, and Review (SEDAR) workshop. This assessment is the latest and best information available on the status of the coast-wide Atlantic menhaden stock for use in fisheries management.

Management Overview

The Atlantic menhaden stock is currently managed under Amendment 2 (2012) to the Fishery Management Plan. Amendment 2 instituted a 170,800 metric ton (mt) total allowable catch (TAC) beginning in 2013 and established state-by-state allocations based on landings history from 2009-2011. States are required to close their fisheries when their portion of the TAC has been reached and any overages must be paid back the following year. Under Amendment 2, the Atlantic Menhaden Management Board (Board) also sets aside 1% of the overall TAC for episodic events and allows a 6,000 pound bycatch limit per trip for non-directed fisheries that operate after a jurisdiction's quota has been landed.

In 2015, the Board established an 187,880 mt TAC for the 2015 and 2016 fishing years. This represented a 10% increase from the 2013 and 2014 TAC. In October 2016, the Board approved a TAC of 200,000 mt for the 2017 fishing year, representing a 6.45% increase from the 2015 and 2016 fishing years. Both increases stemmed from results of the 2015 Stock Assessment as well as projection analysis.

Amendment 3 to the Atlantic Menhaden FMP was initiated in 2015 to consider the development of ecological reference points (ERPs) and revisit allocation methods. Given the role of menhaden as forage fish, ERPs are intended to account for changes in the abundance of prey and predator species when setting overfished/overfishing thresholds and targets for menhaden. The Board is also investigating various allocation scenarios given concern that the current method does not provide equitable access to all gear types, jurisdictions, and regions. Draft Amendment 3 is slated for public hearings this fall, and the Board is scheduled to take final action on the Amendment in November 2017. In additional, the Board will be selecting a TAC for 2018.

What Data Were Used?

The Atlantic menhaden assessment used both fishery-dependent and -independent data as well as information about Atlantic menhaden biology and life history. Fishery-dependent data come from the commercial reduction and bait fisheries, while fishery-independent data are collected through scientific research and surveys.

Life History

Atlantic menhaden undergo extensive north-south migratory movements and are believed to consist of a single population. Adults move inshore and northward in the spring, grouping by age and size along the Atlantic coast. During the summer, older and larger menhaden are

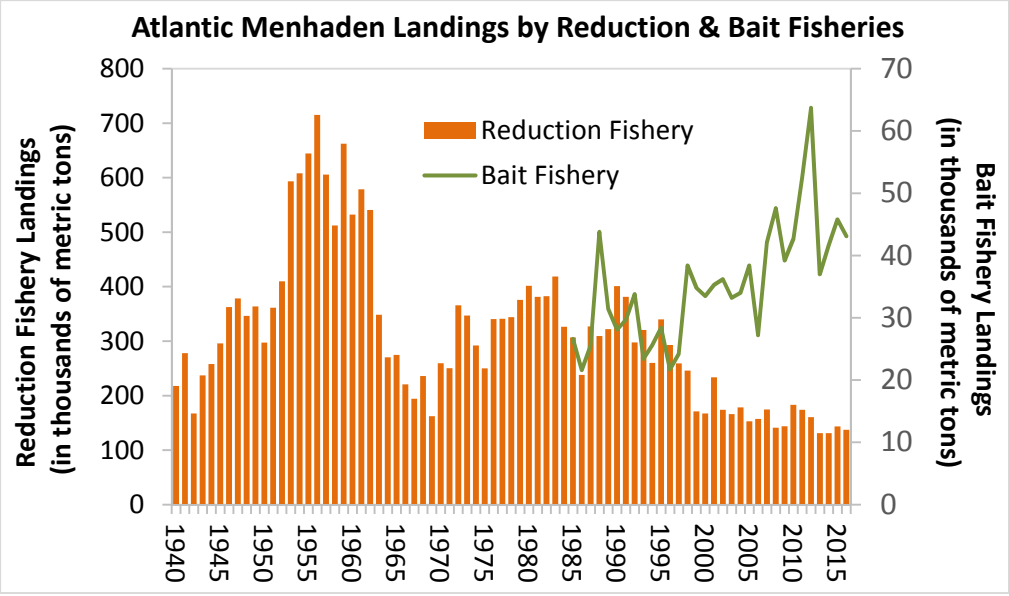
typically found in northerly habitats whereas immature menhaden are typically found in estuarine and inshore areas from the Chesapeake Bay southward. The population extends as far north as the Gulf of Maine though menhaden abundance in the northern extent of its range can significantly fluctuate from year to year. Spawning occurs along the continental shelf as well as in sounds and bays. Eggs hatch at sea and larvae are carried by inshore currents to estuaries where they grow to the juvenile stage. Adults typically overwinter off the coast of North Carolina. Menhaden start reaching sexual maturity at age-1 and can live up to 10 years; however, fish older than age-6 have been uncommon in the fishery-dependent data since the mid-1960s. Natural mortality is modeled as age-varying with the highest mortality on the youngest fish.

Commercial Data

The Reduction Fishery

Atlantic menhaden are harvested primarily for reduction to fish meal, oil, and solubles. The reduction fishery grew with the advent of purse seine gear in the mid-1800s. Purse seine landings peaked in 1956 at 712,500 mt. At the time, over 20 menhaden reduction factories were in operation from southern Maine to northern Florida. In the 1960s, the Atlantic menhaden stock contracted geographically, and many of the fish factories north of the Chesapeake Bay closed because of a scarcity of fish. Reduction landings dropped to a low of 162,300 mt in 1969.

In the 1970s and 1980s, the menhaden population began to expand (primarily because of a series of large year classes entering the fishery), and reduction landings rose to around 300,000-400,000 mt. Adult menhaden were again abundant in the northern half of their range and as a result reduction factories in New England and Canada began processing menhaden again. However, by 1989 all shore-side reduction plants in New England had closed, mainly because of odor abatement regulations.



During the 1990s, the Atlantic menhaden stock contracted again, mostly due to a series of poor year classes. Over the next decade, several reduction plants consolidated or closed, resulting in a significant decrease in fleet size and fishing capacity. Since 2005, there has been one operational reduction factory processing Atlantic menhaden on the Atlantic coast. From 2010-2012, landings averaged 172,600 mt. Following the implementation of the coastwide TAC, landings in 2013 were 131,000 mt. In 2016, reduction landings were 137,400 mt and accounted for approximately 76% of coastwide landings. Numerous portside samples are taken to obtain information about the weight, length, and age distribution of the fished population.

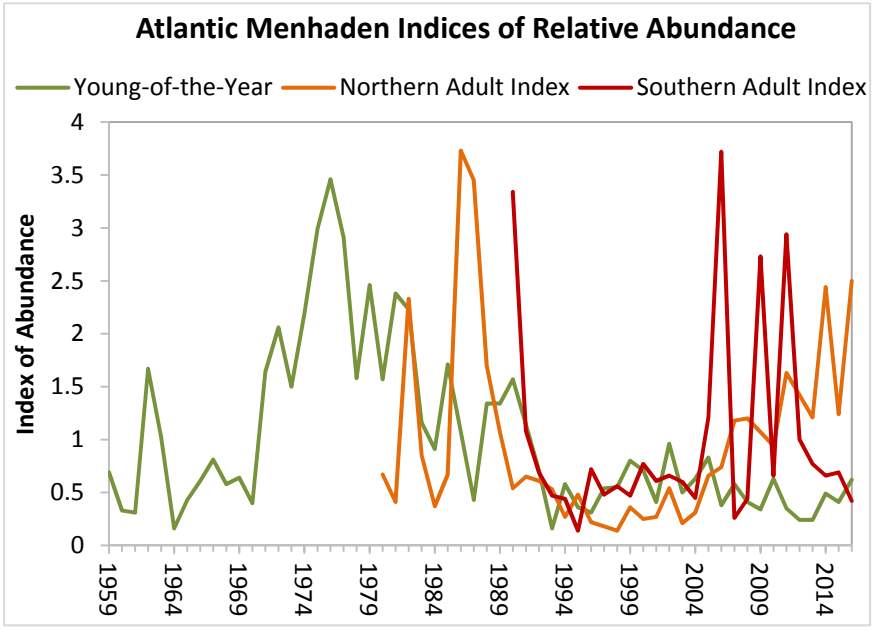
The Bait Fishery

While reduction landings have declined since the mid-2000s, menhaden landings for bait have become increasingly important to the total coastwide landings of menhaden. Commercial bait landings occur in almost every Atlantic coast state. A majority of the menhaden-for-bait landings are used commercially in crab, lobster, and hook-and-line fisheries. Recreational fishermen also catch Atlantic menhaden as bait for various game fish.

Total landings of menhaden for bait along the Atlantic Coast averaged 53,000 mt annually in 2010-2012. Following the implementation of the coastwide TAC, landings in 2013 were 37,000 mt. In 2016, bait landings were 43,100 mtons and comprised 24% of coastwide landings. Since the mid-1980s, portside samples have been taken to obtain information about the weight, length, and age distribution of the fished population.

Fishery-Independent Surveys

Data collected from several different surveys were used in the 2015 stock assessment and 2017 update. These data were used to inform both juvenile and adult abundance within the model. Data used to develop an index of relative abundance for juvenile menhaden (young-of-the-year) were collected from seine surveys conducted in Connecticut, New York, New Jersey, Virginia, and Maryland; from trawl surveys in Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and Georgia; and from an electrofishing survey in South Carolina. Data from these 16 surveys were statistically combined into one coastwide index. The index increased from historic lows in the 1960s to highs in the 1970s and 1980s, with a decline through the mid-1990s. Young-of-year abundance has since been lower with notable year classes in 2005, 2010, and 2016.

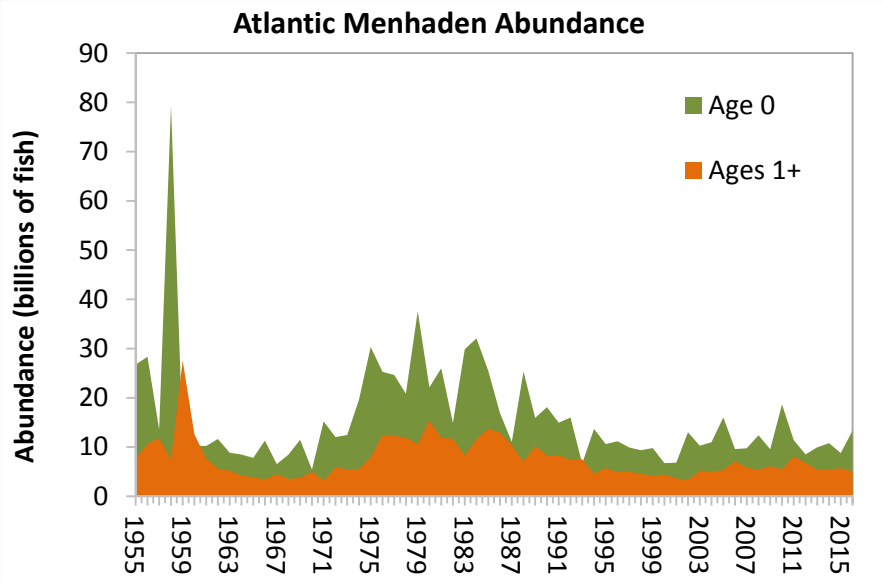


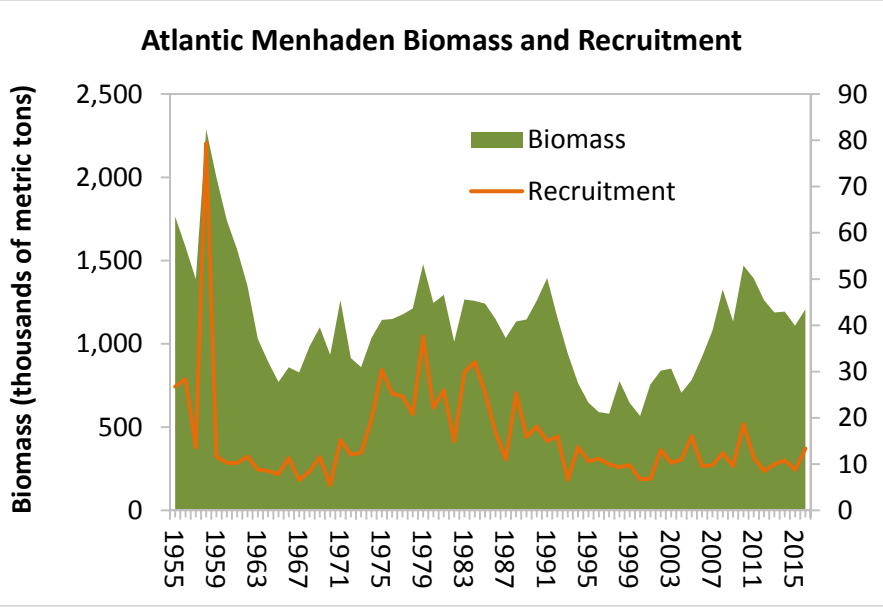
Two adult abundance indices were developed using state survey data. The first was the southern adult index (SAD), which included trawl survey data from Georgia and the Southeast Area Monitoring and Assessment Program. The second was the northern adult index (NAD), which included trawl survey data from Connecticut, New Jersey, Delaware, Virginia, Chesapeake Bay Multispecies Monitoring and Assessment Program, and Chesapeake Bay Fishery-independent Multispecies Survey. Data from each of the surveys were statistically combined into the two coastwide indices of adult abundance.

The SAD index was low through the 1990s and early 2000s. Throughout the mid-2000s and early-2010s it was highly variable and has been on a decline since 2012. The NAD index was high during the 1980s, declined to a low around 2000, and has been increasing since then. 2014 and 2016 represented two of the largest values in the NAD index, second only to 1987 and 1988. In the most recent years, the NAD index indicated an increase in abundance for ages-2+, while the SAD index indicated a slightly decreasing abundance for age-1.

What Models Were Used?

The Beaufort Assessment Model (BAM), which was used for providing management advice during the 2015 benchmark stock assessment. Using the same model, additional years of data (2013-2016) were incorporated into the 2017 update. BAM is a statistical catch-at-age model that estimates population size-at-age and recruitment, using 1955 as the based year, and then projects the population forward in time. The model estimates trends in the population, including abundance-at-age, recruitment, spawning stock biomass, egg production, and fishing mortality rates. BAM was configured to be a fleets-as-areas model with each of the fleets broken into areas to reflect differences along the coast. This means that both reduction and bait fleets were split into north and south regions because the fisheries operated differently along the coast and through time.



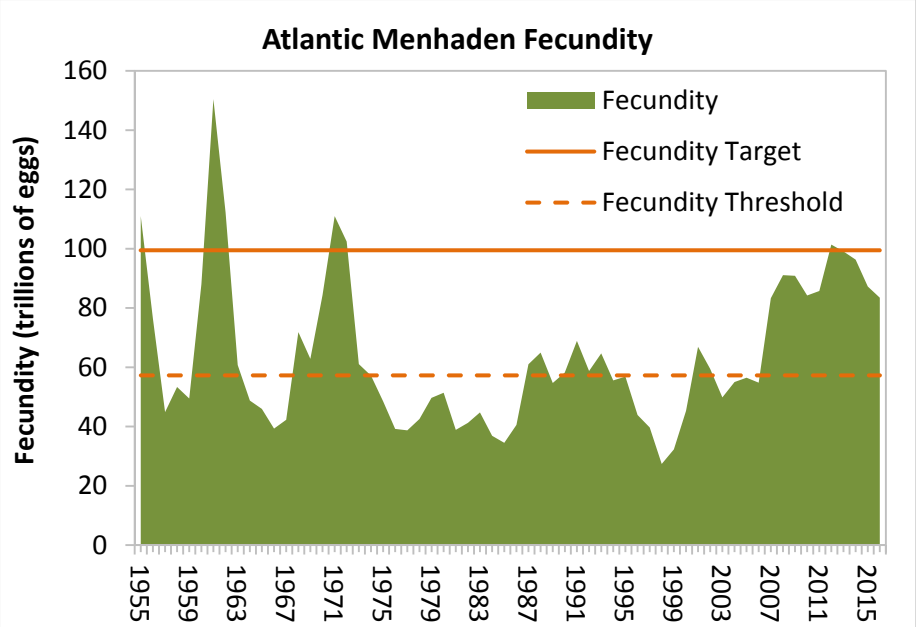


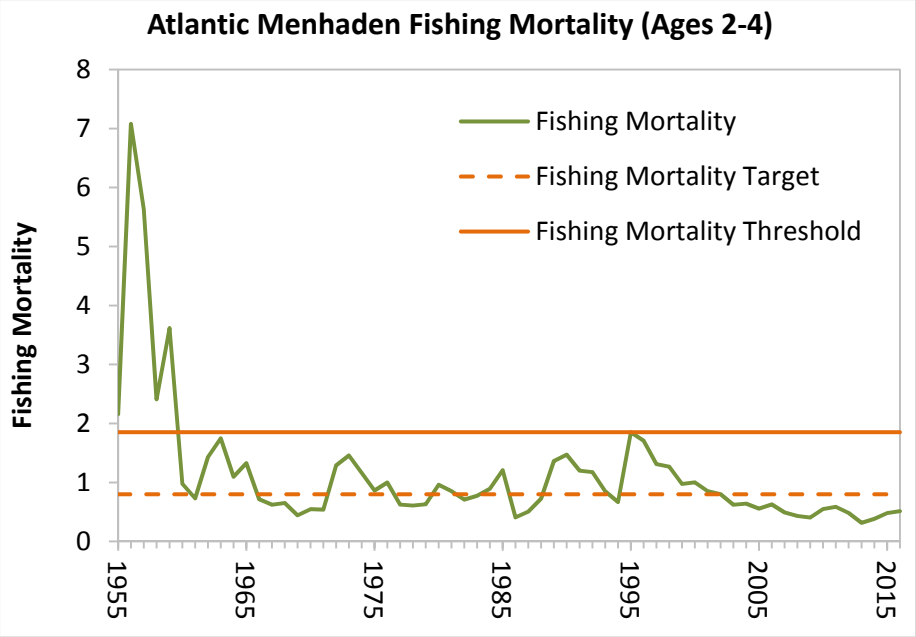
Model results indicate the population has undergone several periods of both high and low abundance. Following a peak in the late 1950s, abundance was high in the 1970s and 1980s, with a decline in the 1990s and a subsequent increase in the 2000s. Juvenile abundance follows a similar pattern with highs in the 1970s and 1980s, a decline in the 1990s, and a slight increase during the 2000s. Population fecundity (measured as number of maturing ova, or eggs) is variable in the beginning of the time series, with many highs and lows. After a period of low fecundity in the 1990s, fecundity has been increasing since the mid-2000s.

Fishing mortality rates were highly variable throughout the entire time series, with a decline in fishing mortality from the 1950s to the 1960s. Since the early 2000s, fishing mortality rates have declined to some of the lowest values in the entire time series. The model suggests a high degree of variability, but in general the reduction fishery has experienced declining fishing mortality rates since the 1950s in the north and since 2000 in the south. The bait fishery has expanded since the 1980s causing some increase in fishing mortality in the north and south.

What is the Status of the Stock?

Based on the assessment update, Atlantic menhaden are neither overfished nor experiencing overfishing. Stock status was evaluated against the assessment's reference points, which used historical performance of the population during the 1960-2012 time frame, a period during which the Technical Committee considers the population to have been sustainably fished. Fishing mortality rates have remained below the overfishing threshold (1.85) since the 1960s, and hovered around the overfishing target (0.8) through the 1990s. In 2003, fishing mortality dropped below the target and was estimated to be 0.51 in 2016 (the latest year in the assessment update). Generally, fishing mortality has been decreasing throughout the history of the fishery, has been below the threshold since the early 1960s, and has been below the target since the early 2000s.





The biological reference point used to determine the fecundity target is defined as the mature egg production one would expect when the population is being fished at the threshold fishing mortality rate. Population fecundity, a measure of reproductive capacity, has been well above the threshold (57,295 billion eggs) and at or near the target (99,467 billion eggs) in recent years. In 2016, fecundity is estimated to be 83,486 billion eggs, still well above the threshold but below the target.

Why are the Reference Points for the Update Different from the 2015 Benchmark Assessment?

The stock status stemming from the 2017 update assessment is assessed in the same way as the status from the 2015 benchmark assessment, although the reference point values have changed. The threshold and target are calculated as the maximum and median geometric mean fishing mortality rate for ages-2 to -4 during 1960-2012 using the same methods as the benchmark assessment. Adding the additional years (2013-2016) of data results in generally higher fishing mortality values throughout the time series. This is primarily an effect of the NAD which shows significant increases in menhaden abundance in the Mid-Atlantic and New England states, thus affecting the scaling of the reference points. This trend supports the higher landings values reported by the northern states in recent years. Since the estimated maximum and median fishing morality

values associated with the update are higher than the 2015 benchmark, the resulting reference points are $F_{36\%MSP}$, $F_{21\%MSP}$, $FEC_{36\%MSP}$, and $FEC_{21\%MSP}$ which differ from the 2015 reference points of $F_{57\%MSP}$, $F_{38\%MSP}$, $FEC_{57\%MSP}$, and $FEC_{38\%MSP}$. While the scale is different and the trend differs in some years, the stock status for both fishing mortality rate (F) and fecundity (FEC) has been similar over the past decade. For reference, MSP is the estimated egg production from the female reproductive population that would occur if there was no fishing. %MSP can be used to measure the health of a stock, with a higher %MSP indicating that egg production is closer to that of an unfished stock. The use of MSP was adopted in 2012 under Amendment 2 as an interim reference point with the goal of increasing abundance, spawning stock biomass, and menhaden availability as a forage species while the Commission's develops ecological-based reference points for the resource.

Reference Points	*Update Values*
$F_{21\%MSP\ (THRESHOLD)} = 1.85$ $F_{36\%MSP\ (TARGET)} = 0.80$	$F_{48\%MSP}$ (F in 2016) = 0.51
$FEC_{21\%MSP\ (THRESHOLD)} = 57{,}295$ billion eggs $FEC_{36\%MSP\ (TARGET)} = 99{,}467$ billion eggs	FEC_{2016} = 83,486 billion eggs

Research Needs & Next Steps

Both the 2015 benchmark assessment and the 2017 update identified a number of data and research needs for future Atlantic menhaden stock assessments. In particular, the Atlantic menhaden stock assessment would be substantially improved by the development of a coastwide fishery-independent survey to replace or supplement the existing indices. Also, development of a spatially-explicit (e.g., regional) stock assessment model would be beneficial once sufficient age-specific data on movement rates of menhaden are available.

Currently, the Biological Ecological Reference Point Workgroup is developing menhaden-specific ERPs based on multi-species models. The purpose of this analysis is to consider the ecological role of menhaden as prey when determining an overfished and overfishing status. This work was noted as a high priority by the 2015 Peer Review Panel and is expected to be complete in 2019 in conjunction with the 2019 benchmark stock assessment.

Glossary

Age class – All of the individuals in a stock that were spawned or hatched in the same year. This is also known as the year class or cohort.

Biological reference point (BRP) – A particular value of stock size, catch, fishing effort, or fishing mortality that may be used as a measure of stock status or management plan effectiveness. BRPs can be categorized as limits, targets, or thresholds depending on their intended use.

Fecundity (FEC) – The number of eggs produced per female per unit time (e.g., per spawning season).

Fishing mortality (F) – The instantaneous (not annual) rate at which fish are killed by fishing

Maximum spawning potential (MSP) – The estimated egg production from female spawning stock biomass that would occur in the absence of fishing. A percentage of this value (%MSP) can be used as a measure of the health of a fish stock.

Recruitment – A measure of the weight or number of fish that enter a defined portion of the stock, such as the spawning stock or fishable stock.

Overfishing – A condition in which the rate of removal of fish by the fishery exceeds to the ability of the stock to replenish itself.

Overfished – A condition in which there is insufficient mature female biomass or egg production to replenish the stock.

Statistical catch-at-age (SCAA) model – An age-structured stock assessment model that works forward in time to estimate population size and fishing mortality in each year. It assumes some the catch-at-age data have a known level of error.

Young-of-the-year (YOY) – An individual fish in its first year of life; for most species, YOY are juveniles.

References

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SEDAR. 2015. SEDAR 40 – Atlantic Menhaden Stock Assessment Report. SEDAR, North Charleston SC. 643 pp. http://www.asmfc.org/uploads/file/55089931S40_AtlMenhadenSAR_CombinedFINAL_1.15.2015-reduced.pdf

Memorandum

Subject: Update on ecosystem modeling to support Atlantic menhaden fisheries management

To: Biological Ecological Reference Points (BERP) Committee

From: Andre Buchheister (Humboldt State University), Thomas J. Miller (Chesapeake Biological Lab), and Edward D. Houde (Chesapeake Biological Lab)

CC: Robert E. Beal (ASMFC Executive Director), Patrick A. Campfield (ASMFC Fisheries Science Program Director), Toni Kearns (ASMFC Interstate Fisheries Management Program Director)

Date: 7/24/17

Here, we provide an update on the status of our ecosystem modeling research in support of ecological reference point (ERP) development and evaluation. As you know, we developed an Ecopath with Ecosim (EwE) model of the Northwest Atlantic Continental Shelf (NWACS) region to support ecosystem approaches to Atlantic menhaden management. Our research manuscript on this issue was recently accepted for publication in the journal *Marine and Coastal Fisheries.* We will be providing the paper to the BERP and are arranging to present the results in the September 2017 BERP meeting. Below, we provide a synopsis of the major benefits and findings of the research, we briefly address some methodological concerns raised by Dr. Ray Hilborn, and we provide some thoughts on how the model could be integrated into addressing the BERP's charge.

Our NWACS model is currently the only tool now available to explore consequences and tradeoffs of alternative reference points and other menhaden harvest policy choices for Atlantic menhaden within a broad ecosystem context. We offer to communicate or collaborate in any way that may be helpful to the BERP's important work to develop reference points in an ecosystem approach to managing Atlantic menhaden fisheries.

Major benefits of the NWACS model:

- The model is comprehensive and was developed based on long time series of fisheries and ecosystem data, extending from 1982 to 2013.
- It was developed specifically for Atlantic menhaden and accounts for diverse menhaden predators such as fishes, birds, and marine mammals.
- It represents menhaden and its important fish predators as age-structured populations rather than as unstructured populations.
- It incorporates predator-prey feedbacks (e.g., the effects of menhaden on predators and vice versa), which most modeling methods being considered by the BERP do not address.
- It allows for the quantification and evaluation of potential ecosystem tradeoffs associated with different management decisions in a common currency – that is, we can simulate proposed management approaches within the same management tool to enable comparisons of the performance of different options.
- Its particular strength lies in its ability to provide strategic, long-term management advice, but it does not provide short-term, tactical advice (e.g., annual catch limits).

- It can be a modeling foundation for adding complexity, addressing other research questions, or comparing with other models.

Major findings

- Simulations of the ecosystem under different menhaden fishing mortality rates resulted in a range of responses by the 61 trophic groups modeled within the system.
- Striped bass was among the most sensitive species that was negatively-affected by menhaden fishing, along with other higher trophic-level groups (birds, highly migratory species, sharks, and marine mammals).
- Bluefish and weakfish had modest to negligible responses at the highest menhaden F rates.
- We quantified tradeoffs associated with a range of alternative ecosystem-based reference points, including F for maximum sustainable yield (F_{MSY}), $0.5F_{MSY}$, proxies for current single-species F reference points, 75% unfished B (B_0), and $40\%B_0$.
- The alternative reference points considered resulted in 1) variable menhaden biomasses (40-75% of B_0) and yields (54-100% MSY), 2) up to a 60% decline in striped bass biomass and yield, 3) negative impacts on the biomass of 13% of modeled groups, and 4) positive impacts on the biomass of 6% of groups.
- There were some discrepancies between the NWACS model and the 2015 stock assessment model results related to scale of biomass, catch, and the level of menhaden depletion, and there were challenges in translating existing single species reference points into the EwE framework. These differences between the modeling frameworks should be investigated in future research.

Brief response to Hilborn et al. comments

Our research addresses several limitations noted by Dr. Ray Hilborn at the June 30 2017 BERP meeting and in his recent paper (Hilborn et al. 2017). For example, our model is case-specific, developed specifically for Atlantic menhaden. Also, our model accounts for size-selectivity in predator-prey relationships that are important for menhaden. Our model can be used as a platform or foundation to evaluate additional questions related to effects of environmental regime shifts on biological productivity, prey spatial distributions, and predator production.

Next steps

- When our paper is published, we will make the model and its documentation available to the BERP and other interested parties. We stand ready to facilitate technical reviews or additional evaluation of the model.
- We would welcome an opportunity to collaborate with ASMFC and the BERP to apply, update, or modify the model to address specific management questions or perceived weaknesses to better meet the needs of managers.

References

Hilborn, R., R. O. Amoroso, E. Bogazzi, O. P. Jensen, A. M. Parma, C. Szuwalski, and C. J. Walters. 2017. When does fishing forage species affect their predators? Fisheries Research (2017). http://dx.doi.org/10.1016/j.fishres.2017.01.008.