Bluefish AP Information Document - July 2014

The information in this document provides a brief overview of the management system, biology, stock conditions, and fishery performance for the Atlantic Bluefish fishery with an emphasis on the most recent complete fishing year (2013). Please review this information in preparation for the upcoming Advisory Panel meeting and in the context of your experience with the fishery.

Management System

The Bluefish Fishery Management Plan was implemented in 1990 and established the Mid-Atlantic Fishery Management Council's management authority over the fishery in federal waters. Amendment 1, implemented in 2000, addressed stock rebuilding and created the Bluefish Monitoring Committee which meets annually make management measure recommendations to the Council. Amendment 3 (effective 1/1/2012) incorporated the development of annual catch limits (ACLs) and accountability measures (AMs) into the specification process, and Amendment 4 (effective 1/21/2014) modified recreational accountability measures to accommodate uncertainty in recreational management and catch estimation.

Specifying bluefish management measures is a joint process conducted by the Council and the Atlantic States Marine Fisheries Commission's Bluefish Management Board. The Council's Scientific and Statistical Committee (SSC) reviews assessment results and the Advisory Panel's fishery performance report, and determines the allowable biological catch (ABC) for the upcoming year. The Council's Bluefish Monitoring Committee develops and recommends specific coastwide management measures (commercial quota, recreational harvest limit) that will achieve the catch target and makes further adjustments to total catch as needed based on management uncertainty. Finally, the Council and Board meet jointly to develop recommendations to be submitted to the National Marine Fisheries Service. Table 1 below illustrates how the management measures for 2014 were calculated.

Table 1. Bluefish management measures for 2014.

2014 Management Measure	Lbs	Basis
Overfishing Limit (OFL)	36,389,501	Determined by SSC
Acceptable Biological Catch (ABC)	24,431,628	Determined by SSC
Annual Catch Limit (ACL)	24,431,628	Defined in FMP as equal to ABC
Management Uncertainty	0	Determined by Monitoring Committee
Commercial Discards	0	Value used in assessment
Recreational Discards	3,351,026	2010-2012 average from MRIP
Annual Catch Target (ACT)	24,431,628	ACL - Mgmt Uncertainty
Commercial ACT	4,153,377	17% of ACT
Recreational ACT	20,278,251	83% of ACT
Commercial Total Allowable Landings (Comm TAL)	4,153,377	Comm ACT – Comm Discards
Recreational Total Allowable Landings (Rec TAL)	16,927,225	Rec ACT – Rec Discards
TAL (combined)	21,080,602	Comm TAL + Rec TAL
Expected Recreational Landings	13,179,234	2010-2012 average from MRIP
Maximum Transfer	3,340,386	Calculated so that the Adjusted RHL will equal expected Rec Landings
Initial (pre-Research Set Aside) Comm Quota	7,493,762	Comm TAL + transfer
Initial (pre-Research Set Aside) Rec Harvest Limit	13,586,839	Rec TAL - transfer
Commercial Research Set Aside Deduction (3%)	224,813	3% of Comm Quota
Recreational Research Set Aside Deduction (3%)	407,605	3% of RHL
Adjusted Commercial Quota	7,268,949	Comm Quota - RSA
Adjusted RHL	13,179,234	RHL - RSA

Bluefish Biology

Bluefish, *Pomatomus saltatrix*, are found worldwide in tropical and subtropical waters, but in the western North Atlantic range from Nova Scotia and Bermuda to Argentina. Bluefish travel in schools of like-sized individuals and undertake seasonal migrations, moving into the Middle Atlantic Bight (MAB) during spring and then south or farther offshore during fall. Within the MAB they occur in large bays and estuaries as well as across the entire continental shelf. Juvenile stages have been recorded in all estuaries within the MAB, but eggs and larvae occur in oceanic waters (Able and Fahay 1998). Growth rates are fast and they may reach a length of 3.5 ft and a weight of 27 lbs (Bigelow and Schroeder 1953). Bluefish live to age 12 and greater (Salerno et al. 2001).

Bluefish eat a wide variety of prey items. The species has been described by Bigelow and Schroeder (1953) as “perhaps the most ferocious and bloodthirsty fish in the sea, leaving in its wake a trail of dead and mangled mackerel, menhaden, herring, alewives, and other species on which it preys."

Bluefish born in a given year (young of the year) typically fall into two distinct size classes suggesting that there are two spawning events along the east coast. Studies suggest, however, that spawning is a single, continuous event, but that young are lost from the middle portion resulting in the appearance of a split season (Smith et al. 1994). As a result of the bimodal size

distribution, young are referred to as spring-spawned or summer-spawned. In the MAB, spring-spawned bluefish appear to be the dominant component of the stock.

Status of the Stock

Bluefish stock status and biological reference points are based on the maximum sustainable yield (MSY) concept and are determined from a stock assessment model called ASAP that was accepted by scientific peer-review in 2005. Overfishing is defined as occurring when the fishing mortality rate (F) is above its threshold level (defined as F_{MSY} = 0.19). The target stock size in weight (biomass or B), and B_{MSY} is currently estimated to be 324 M lb. The level below which the stock is defined as being overfished is ½ B_{MSY} which is 162 M lb.

The bluefish stock assessment is updated annually and is in the process of being updated for the 2013 fishing year, so assessment results as of this writing are from the 2012 fishing year. For 2012, the estimate of fishing mortality (F_{2012} = 0.10) was below the overfishing level (F_{MSY} = 0.19), so overfishing was not occurring. Model estimates of fishing mortality have been below the F_{MSY} threshold since 1995 (dashed line in Figure 1), consistent with catches that support growth in population biomass.

Apparent Declines in Abundance

Declines in model estimates of abundance (solid line in Figure 1) since around 2006 appear to be driven by weak year classes estimated by the model for that timeframe. A retrospective pattern is evident for model estimates of recruitment through 2012, meaning that the model had a tendency to underestimate the number of fish born in the most recent years, and model estimates of year class size increased as the model was updated over time. It is unknown whether that pattern will continue until the updated assessment is available.

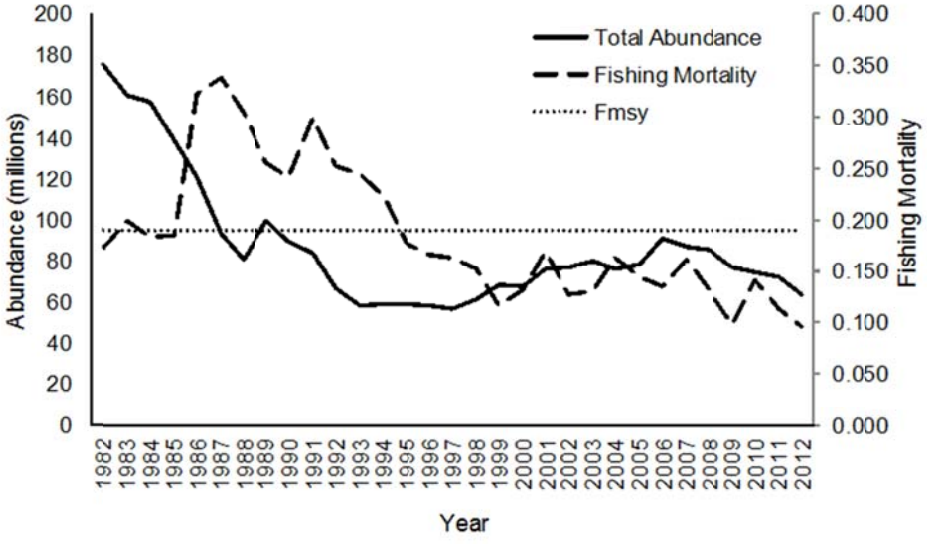


Figure 1. Total bluefish abundance and fishing mortality as estimated in ASAP model in 2012. F_{MSY} is indicated by the solid horizontal line. (Source: 2012 Assessment Update)

The time series of estimated total stock biomass and spawning stock biomass have both generally increased since a low in the nid-1990s (Figure 2). The estimate of total biomass for 2012 is below B_{MSY} but above the ½ B_{MSY} threshold. This supports the statement that for 2012 the stock was not overfished. A rebuilding plan was implemented in 2000 when the assessment model at the time indicated that biomass was below ½ B_{MSY}. Note that the current assessment shows that the biomass of bluefish never dropped below the ½ B_{MSY} threshold, although it was very close in the mid-1990s. Additionally, according to the model, biomass has not been above the B_{MSY} target since the late 1980s. A benchmark assessment, that is a complete re-examination of the appropriate population model and its configuration, will be done in 2015 and may result in a different interpretation of population trends.

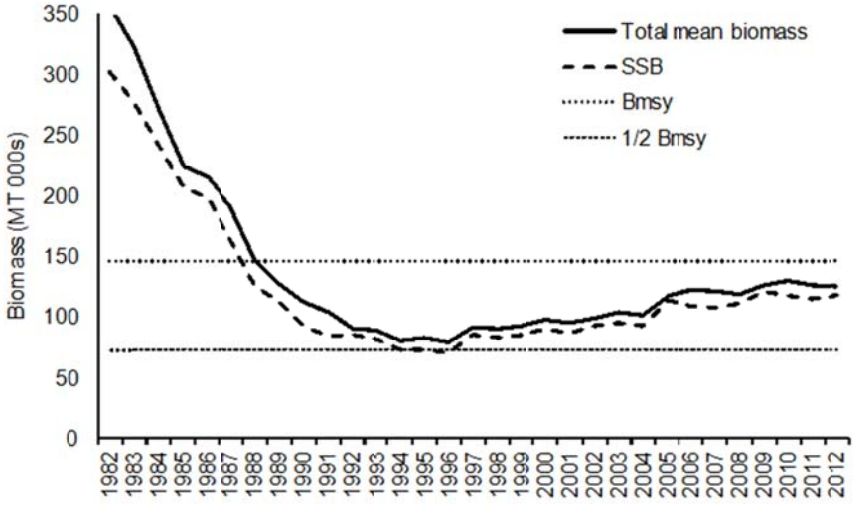


Figure 2. Time series of bluefish total mean biomass (000s mt) and spawning stock biomass (000s mt) relative to Bmsy target and threshold. (Source: 2012 Assessment Update)

Fishery Performance Relative to Management Measures

The performance of the fishery, that is, the recreational and commercial catches relative to specified management measures, is provided in Table 2. Except for 2007, the bluefish fishery has never exceeded the TAL. In 2007, the recreational fishery exceeded the recreational harvest limit by about 2 M lb, and although the commercial fishery underperformed by 1.1 M lb, the combined catches were above the specified TAL. In 2013, the combined fisheries under-harvested the combined bluefish TAL even though the recreational fishery exceeded the RHL. The recreational fishery landed 15.281 M lb compared to the 14.069 M lb RHL (a 1.2 M lb overage), and the commercial fishery landed 4.114 M lb compared to a quota of 9.076 M lb (a 5 M lb underage). Commercial fishery landings in 2014 are on the same track as in 2013 (Figure 3). Only preliminary Wave 1 (Jan-Feb) recreational landings for 2014 are available at this time.

Table 2. Summary of bluefish management measures, 2000 - 2014.

Management Measures	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
TAL (M lb)*	35.328	37.841	26.866	37.293	31.85	30.853	24.797	27.762	28.156	29.356	29.264	27.293	28.267	23.861	21.081
Comm. Quota (M lb)†	9.583	9.583	10.5	10.5	10.5	10.5	8.081	8.689	7.705	9.828	10.213	9.375	10.317	9.076	7.269
Comm. Landings (M lb)	8.041	8.688	6.863	7.401	7.994	7.045	6.955	7.499	5.968	6.99	7.069	5.082	4.93	4.114	
Rec. Harvest Limit†	25.745	28.258	16.365	26.793	21.35	20.353	16.718	19.073	20.451	19.528	18.631	17.813	17.457	14.069	13.179
Rec. Landings (M lb)	10.606	13.23	11.371	13.136	15.203	16.162	16.894	21.163	18.9	13.583	18.042	11.499	10.684	15.281	
Rec. Possession Limit	10	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Total Landings	18.647	21.918	18.234	20.537	23.197	23.207	23.849	28.662	24.868	20.573	25.111	16.581	15.614	19.395	N/A
Overage/Underage (M lb)	-16.681	-15.923	-8.632	-16.756	-8.653	-7.646	-0.948	0.9	-3.288	-8.826	-4.153	-10.712	-12.653	-4.466	N/A
Target F	N/A	N/A	N/A	N/A	N/A	0.15	0.15	0.15	0.15	0.15	0.15	0.15	N/A	0.132	0.132
ASAP F estimate	0.13	0.15	0.13	0.14	0.15	0.15	0.14	0.16	0.12	0.10	0.14	0.11	0.10	-	-

*Includes RSA
† RSA deducted

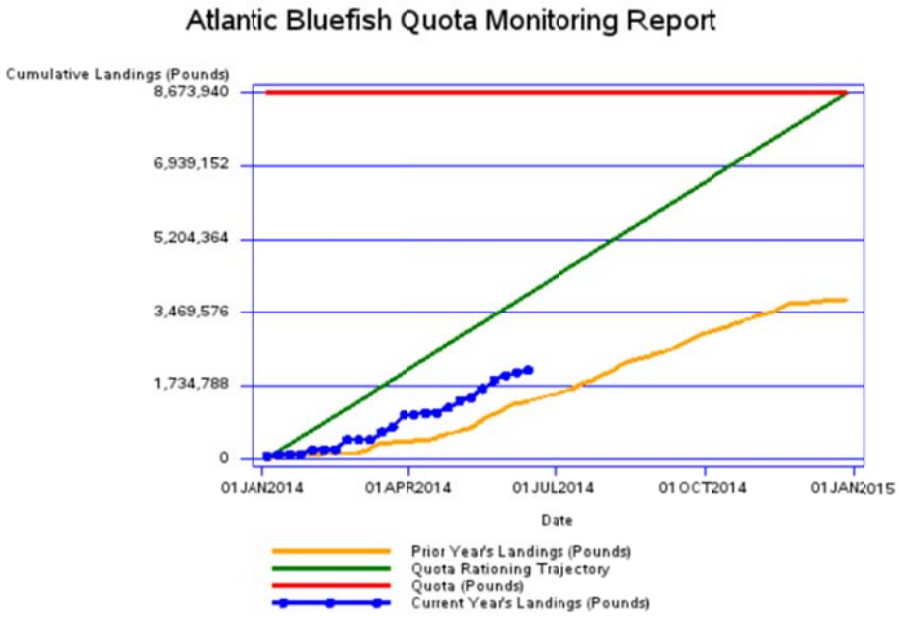


Figure 3. Comparison of 2013(yellow line) and 2014 (blue line) commercial landings from the NMFS quota monitoring website: http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm

Landings History

Given the predominance of the recreational component of the bluefish fishery, the history of bluefish catches begins with the implementation of data collection via the Marine Recreational Fisheries Statistic Survey (MRFSS) in 1981 (Figure 4). From the early 1980s to the early 1990s, recreational landings declined by factor of about 70% (avg. 1981-1983 = 89.140 M lb; avg. 1991-1993 = 25.824 M lb). Recreational landings continued to decline at a somewhat slower rate until reaching their lowest level at 8.254 M lb in 1999, but since have grown to a peak of 21 M lb in 2007. There has been an overall decline of about 10 M lb in recreational landings since 2007 to roughly 11-12 M lb in 2011 and 2012. According to MRIP, recreational landings increased to a little over 15 M lb in 2013 even though total catch in numbers was stable. Recreational discards have increased from less than 10% of the catch in the 1980s to more than 20% of the catch in the early 2000s.

Commercial landings have been relatively stable throughout the landings history (Figure 4). Commercial discards are treated as insignificant and are not estimated in the current assessment.

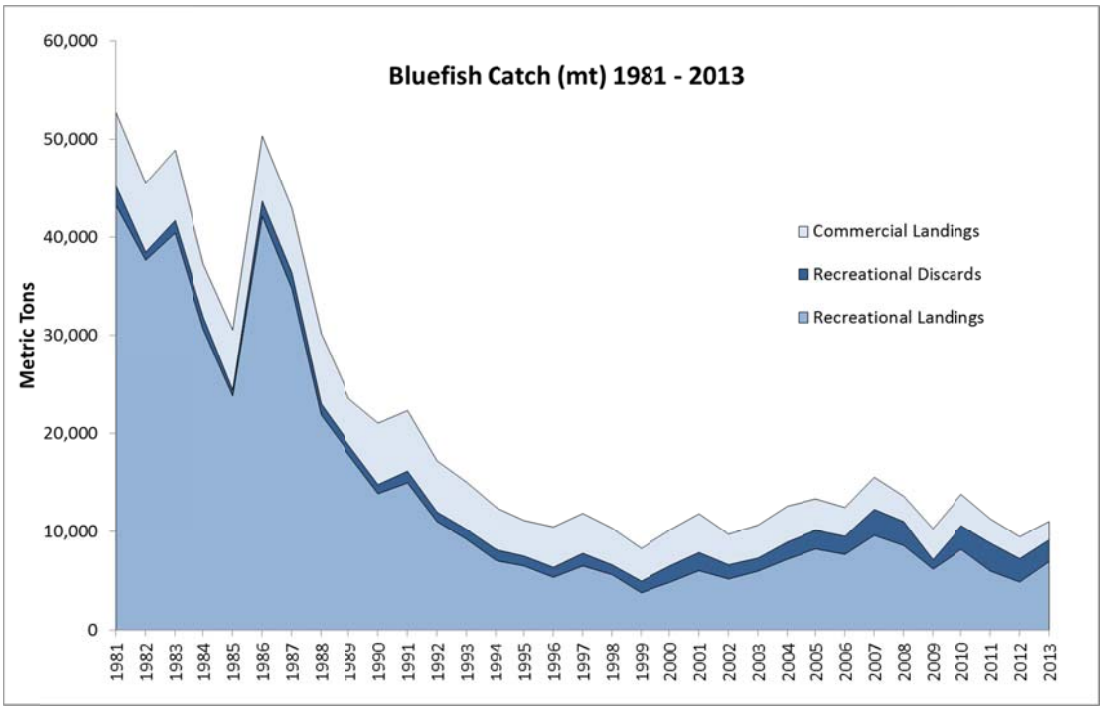


Figure 4. Time series of bluefish recreational and commercial landings and discards (Source: 2013 Assessment Update and current MRIP data).

Recreational Fishery

Trends in recreational trips associated with targeting or harvesting bluefish from 1991 to 2013 are provided in Table 3. The lowest annual estimate of bluefish trips was 1.727 million trips in 1999, but last year (2013) was also very low with 1.733 million trips. The highest annual estimate of bluefish trips in this timeframe was 5.9 million trips in 1991. Relative to total angler effort in 2013, bluefish were the primary target of recreational trips only about 4.7% of the time.

Table 31. Number of bluefish recreational fishing trips, recreational harvest limit, and recreational landings from 1991 to 2013.

Year	Number of Bluefish Trips[a]	Recreational Landings (N)	Recreational Landings per "Bluefish" Trip
1991	5,948,808	11,942,608	2.0
1992	4,549,536	7,157,754	1.6
1993	4,269,162	5,725,355	1.3
1994	3,587,131	5,767,953	1.6
1995	3,608,325	5,167,979	1.4
1996	2,820,059	4,205,103	1.5
1997	2,384,133	5,413,036	2.3
1998	2,180,471	4,202,111	1.9
1999	1,727,175	3,681,841	2.1
2000	2,041,450	4,897,008	2.4
2001	2,661,032	6,663,237	2.5
2002	2,324,253	5,300,189	2.3
2003	2,647,840	6,045,062	2.3
2004	2,898,679	7,250,407	2.5
2005	3,233,133	7,949,179	2.5
2006	2,781,357	7,035,179	2.5
2007	3,620,374	8,373,899	2.3
2008	3,024,787	6,664,150	2.2
2009	2,088,857	5,194,242	2.5
2010	2,468,273	6,090,830	2.5
2011	2,128,166	5,061,391	2.4
2012	2,394,988	5,523,282	2.3
2013	1,733,408	5,464,623	3.2

[a]Estimated number of recreational fishing trips where the primary target was bluefish or bluefish were harvested regardless of target, Maine – Florida's East Coast. Source: MRFSS (1991-2003)/MRIP (2004 fwd).

Recreational Landings by State

Recreational catch and landings by state for 2013 are provided in Table 4. The greatest overall catches (includes discards) were in North Carolina with 3 million fish and New York and Florida with about 2 million fish each. The greatest harvest (retained catch) of bluefish by weight occurred in Connecticut and New York with 3.7 and 4.2 million pounds, respectively. According to MRIP only 85 bluefish were caught in New Hampshire. Average weights, based on dividing MRIP landings in weight by landings in number for each state, suggest that bluefish size tends to increase toward the north along the Atlantic coast.

Table 4. MRIP estimates of 2013 recreational harvest and total catch for bluefish.

State	Harvest			Catch
	Pounds of Fish	Number of Fish	Average wt of fish (lbs)	Number of Fish
ME	62,654	19,542	3.2	41,726
NH	0	0	-	85
MA	2,141,185	371,734	5.8	829,473
RI	1,382,072	312,040	4.4	934,810
CT	4,192,558	875,068	4.8	1,599,615
NY	3,684,907	983,041	3.7	1,990,952
NJ	1,833,248	740,335	2.5	1,617,134
DE	26,230	24,391	1.1	94,726
MD	65,389	55,544	1.2	316,501
VA	274,713	188,367	1.5	408,435
NC	988,664	1,183,627	0.8	3,055,543
SC	109,218	298,451	0.4	607,472
GA	3,645	3,408	1.1	10,783
FL (East Coast)	516,404	409,076	1.3	1,901,087
Total	15,280,887	5,464,624	2.8	13,408,342

Figure 5 reflects MRFSS/MRIP-based estimates of catch and landings by mode (1991 through 2012) and indicates that the primary catch modes for bluefish are private boats and shore-based fishing. Less than 10 % of the catch came from for hire boats over the same time period. A remarkable increase (more than double the 2012 landings in weight) from shore-based fishing is shown in 2013.

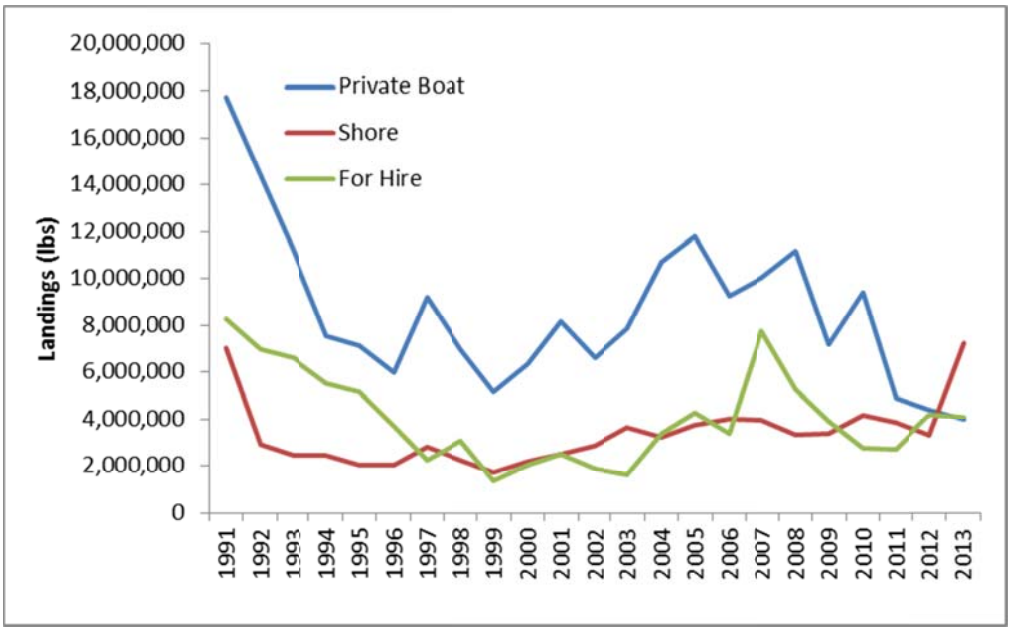


Figure 5. Bluefish landings (lbs) by recreational fishermen by mode, Atlantic Coast, 1991-2013.

Recreational Catches by Area

MRIP classifies catch into three fishing areas, inland, nearshore ocean (< 3 mi), and offshore ocean (> 3 mi). About 54% of the catch of bluefish on a coastwide basis came from inland waters, followed by nearshore ocean (39%) (Figure 4). Offshore ocean is only about 7% of the total catch. The very large increase in shore-based landings is reflected in the increase for inland waters for 2013.

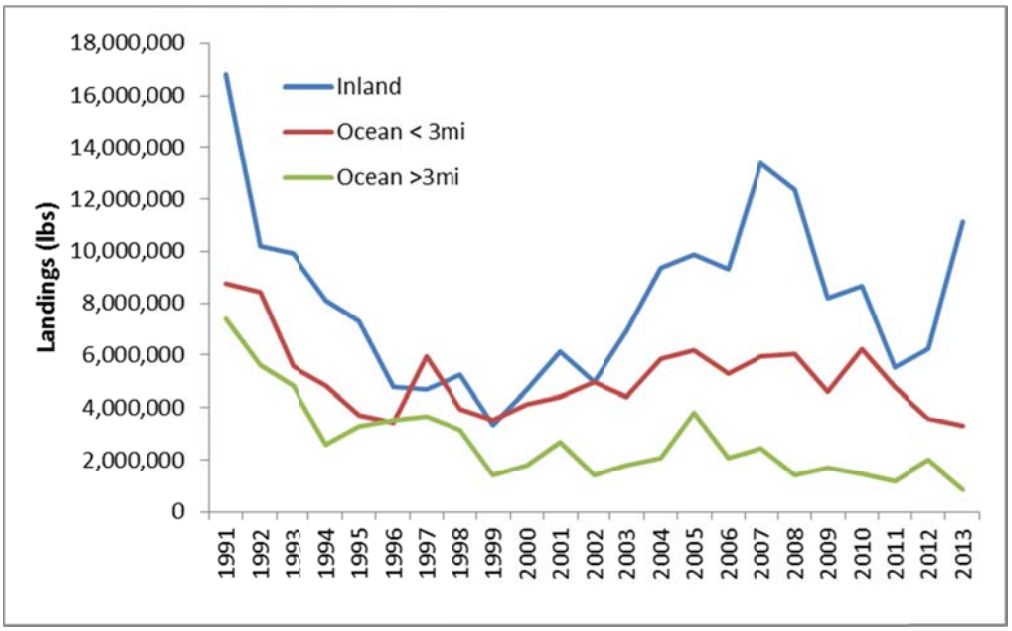


Figure 4. Bluefish recreational catch by area, Atlantic Coast, 1991-2013.

Commercial Fishery

Vessel and Dealer Activity

Federal permit data indicate that 2,954 commercial bluefish permits were issued in 2013 (Table 5). A subset of federally-permitted vessels was active in 2013 with dealer reports identifying 602 vessels with commercial bluefish permits that actually landed bluefish.

Of the 394 federally-permitted bluefish dealers, there were 167 dealers who actually bought bluefish in 2013 (Table 5).

Table 5. Permitted and active bluefish vessels and dealers by state for 2013.

STATE	PERM VESSELS	ACTIVE VESSELS	PERM DEALERS	ACTIVE DEALERS
MA	1,040	154	113	44
NJ	460	83	58	9
NY	320	124	89	45
ME	258	-	12	-
RI	212	101	41	26
NC	153	71	26	19
VA	133	33	19	11
NH	131	7	8	-
CT	66	10	4	-
MD	60	12	10	3
FL	52	-	6	5
DE	49	-	-	-
PA	13	-	3	
OTHER	7	7	5	5
TOTAL	2,954	602	394	167

Source: NMFS Permit Database and Dealer Weighout Data.

Effort/Landings by Gear

NMFS VTR data indicate that a total of 1,444 commercial trips targeted bluefish (bluefish ≥ 50 % of total catch) in 2013 (Table 6). Landings from directed trips (996 k lb) are approximately 24.2 % of coastwide commercial bluefish landings for 2013 (4.114 M lb). Gillnets accounted for 83.0 % of the directed catch while hook gear accounted for 12.0 %.

Table 6. Commercial gear types associated with bluefish harvest in 2013.

Commercial Gear Type	Trips	Landings (lbs)	Pct Total
GILL NET	716	826,502	83%
HOOK AND LINE	699	119,069	12%
OTHER	29	50,457	5%
TOTAL	1,444	996,028	100%

Effort/Landings by Area

The Northeast Region is divided into 46 statistical areas for Federal fisheries management. According to VTR data, bluefish were commercially harvest in 36 statistical areas in 2011 (Figure 5). Six statistical areas, however, collectively accounted for more than 75 % of VTR-reported landings in 2013, with individual areas contributing 6% to 18% of the total. These areas also represented 70% of the trips that landed bluefish suggesting that resource availability as expressed by catch per trip is fairly consistent through the range where harvest occurs.

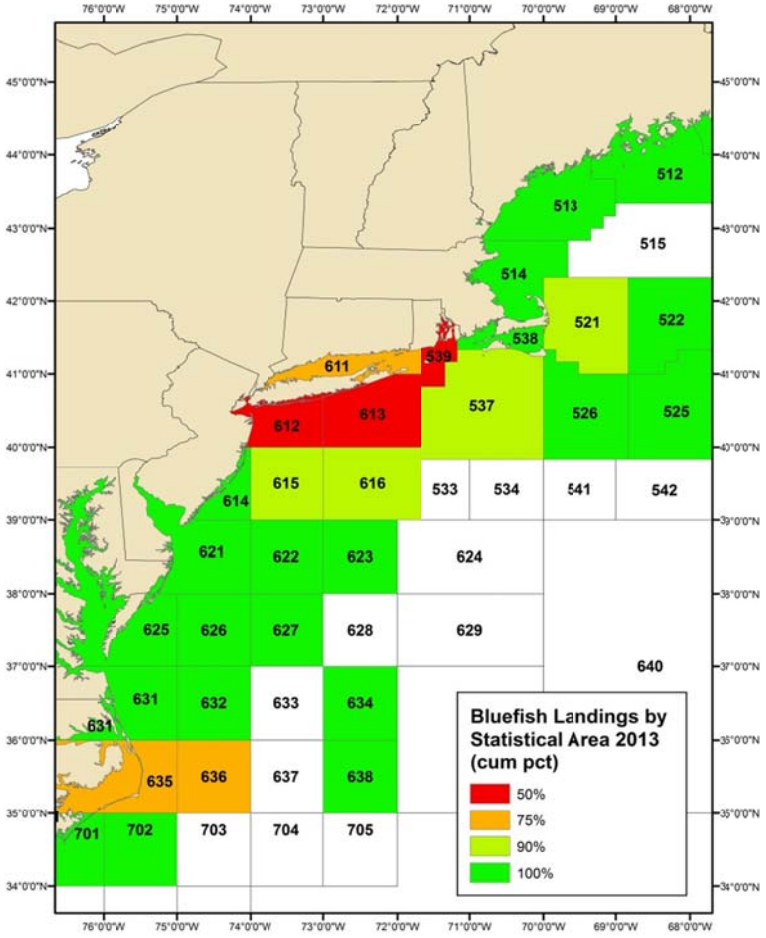


Figure 5. NMFS Statistical Areas. Shading reflects the cumulative percentage of landings with red and orange being the primary areas where the commercial landings are taken.

The top commercial landings ports for bluefish in 2013 are shown in Table 7. Ten ports qualified as "top bluefish ports", i.e., those ports where 100,000 pounds or more of bluefish were landed. Wanchese, NC was the most important commercial bluefish port with over 600,000 lb landed.

Table 7. Top ports of bluefish landings (in pounds), based on NMFS 2013 dealer data. Since this table includes only the "top ports" (ports where landings of bluefish were > 100,000 lb), it does not include all of the landings for the year.

Port[a]	Pounds	# Vessels
WANCHESE, NC	612,147	15
POINT JUDITH, RI	400,572	90
MONTAUK, NY	354,559	84
HAMPTON BAYS, NY	345,573	30
HATTERAS, NC	174,150	13
AMAGANSETT, NY	152,111	4
POINT PLEASANT, NJ	124,769	67
CHATHAM, MA	124,578	24
BELFORD, NJ	115,374	13
SHINNECOCK, NY	107,809	-

[a]Ports with less than 3 vessels not reported for confidentiality issues.
Source: Dealer Weighout Data, as of June 26, 2014.

Revenue

In 2013, commercial vessels landed about 4.114 M lb of bluefish valued at approximately $2.94 million. Average coastwide ex-vessel price of bluefish was $0.67/lb in 2013, a 6 % increase from the previous year (2011 price = $0.67/lb). The relative value of bluefish is very low among commercially landed species, approximately 0.17 % of the total value, respectively of all finfish and shellfish landed along the U.S. Atlantic coast in 2013. A timeseries of bluefish revenue and price is provided in Figure 6.

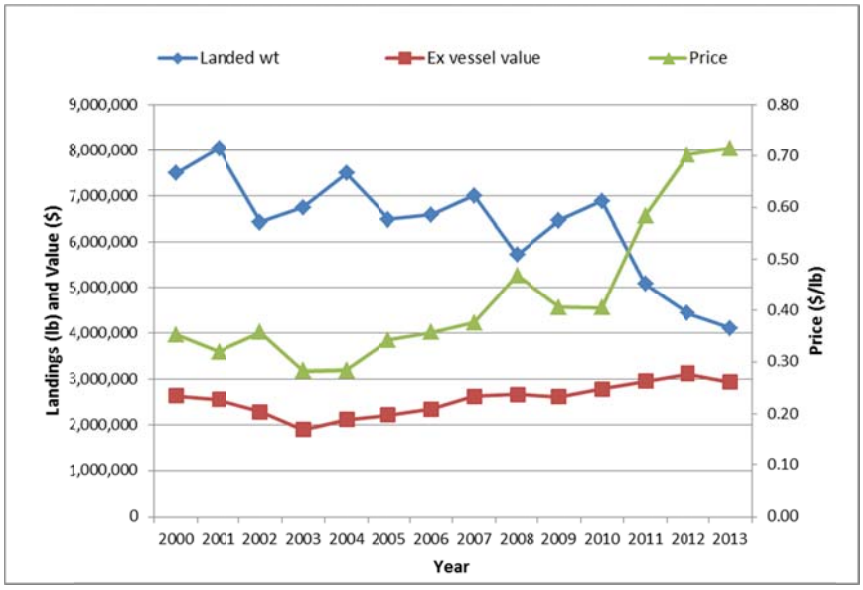


Figure 6. Landings, ex-vessel value, and price for bluefish, 2000-2013. Source: NMFS unpublished dealer data. Prices are unadjusted.

Bycatch

The commercial fishery for bluefish is primarily prosecuted with gillnets, otter trawls, and handlines. This fishery often harvests mixed species, including bonito, Atlantic croaker, weakfish, spiny dogfish, and other species. Among these species, weakfish are considered to be depleted; however, natural mortality rather than fishing mortality is implicated as constraining stock size. Atlantic croaker and spiny dogfish are not overfished, nor is overfishing occurring. Bonito are unregulated and stock status is unknown. Given the mixed-species nature of the bluefish fishery, incidental catch of non-target species is not directly attributable to the bluefish fishery.

References

Able, K.W. and M.P. Fahay. 1998. The first year in the life of estuarine fishes in the Middle Atlantic Bight. Rutgers University Press, New Brunswick, NJ. 342 p.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildl. Serv., Fish. Bull. 53. 577 p.

Essential Fish Habitat Source Document: Bluefish, *Pomatomus saltatrix*, Life History and Habitat Characteristics, 2nd Edition by Gary R. Shepherd and David B. Packer. NOAA Technical Memorandum NMFS-NE-198. 100 p.

Salerno, D.J., J.Burnett, and R.M. Ibara. 2001. Age, growth, maturity and spatial distribution of bluefish, *Pomatomus saltatrix* (Linnaeus), off the northeast coast of the United States, 1985-96. J.Northwest Atl. Fish. Sci., 29: 31-39.

Smith, W., P. Berrien, and T. Potthoff. 1994. Spawning patterns of bluefish, *Pomatomus saltatrix*, in the northeast continental shelf ecosystem. Bull. Mar. Sci. 54(1): 8-16.

2014 MAFMC Bluefish

Fishery Performance Report

The Mid-Atlantic Council's Bluefish Advisory Panel (AP) met from 9:00 AM – 10:20 AM July 11, 2014 via webinar to develop a Fishery Performance Report (FPR) for consideration during the upcoming bluefish specification cycle. After the meeting, the AP reviewed and approved the summary below as the FPR.

Attendance

MAFMC Bluefish Advisers: Fred Akers (NJ recreational), Noel Angelucci (NJ recreational), Paul Eidman (NJ recreational charter), Arnold Leo (NY commercial), Patrick Paquette (MA recreational charter) Kevin Wark (NJ commercial).
ASMFC Bluefish Advisors: George Geiger (FL recreational) and Don Swanson (NH recreational).
MAFMC SSC members: John Boreman (Chair), Brian Rothschild, Cynthia Jones, Doug Vaughan, Mike Frisk, Sunny Jardine.
Staff and Other Participants: Jim Armstrong (MAFMC staff), Kirby Rootes-Murdy (ASMFC staff), Greg DiDomenico (Garden State Seafood Association)

Because of the localized nature of AP members' observations, remarks under each heading are attributed to the states represented on the AP. Additionally, the remarks are not necessarily confined to the subject heading, but rather, reflect the affiliation of the AP members who made them. A general trend from the discussion was an increase in the abundance of bluefish in the northern part of the range and a reduction in abundance in the southern part of the range.

Recreational Fishery Issues

NH – Bluefish are being targeted much more heavily. This is likely a consequence of the reduced abundance of groundfish.
MA – Availability to the recreational fishery appeared to be down at the start of the year in 2013 but as time went on, it turned out that the fish were being encountered in different than usual places and under different patterns. The abundance was high and a very broad range of sizes was caught including very large fish.
NY – Currently bluefish appear to be very abundant across all sizes. "You can walk on them from Montauk to Riverhead". A lot of 4-5 inch school snappers have been observed in the estuaries.
NJ – Bluefish are becoming a primary target for recreational fishermen. They are currently (2014) replacing striped bass on party boats. Many large fish have been encountered on party boats. Nearshore and in the bays, the fish are mostly small. The number of schools does

appear to be reduced compared to previous years. They have been reported to be consuming grass shrimp instead of the usual finfish.
FL – Extreme cold water events occurred in 2009 and 2010 and virtually everything is reduced, presumably through the cascading effect on seagrass beds, forage fish and bluefish. Large schools of bluefish do occur, but the number of schools is much less along the coast. The fish are generally smaller, although a brief period occurred this year with large (15lb) fish being available. High levels of mercury have been reported in fish from the lagoon and in people eating fish from the lagoon.

Market / Economic Issues

MA – The price for hook caught fish was very much improved in 2013 compared to previous years ($1.00/lb compared to $0.50/lb).
NY – Prices are very low, the worst people have seen in a very long time ($0.10/lb) which is attributed to the very high abundance locally.
NJ – There are reports of large schools but they appear to be a fairly rare event making it difficult to rationalize pursuing them given the offsetting costs associated with a trip. They used to be fairly dependable to the east of Barnegat, and less so to the south around Cape May. Currently, the fish are concentrated more to the east and offshore. When you get a large catch, the payoff can be good, but a lot depends on the market which is unpredictable due to highly variable demand. In the past the fish have come in in two pulses, but the second pulse of summer fish appears to be staying offshore and going north. Barnegat Light has become what Cape May used to be like in terms of availability of bluefish.

Environmental Issues

MA – The distribution of forage may have shifted and pulled bluefish into areas where they are not typically caught.
NJ – Currently, water temperatures are a lot lower than normal offshore, but not in the bays. One commercial advisor observed that there are a lot of forage fish – menhaden and sand eels
FL – The low abundance of bluefish and many other fish is likely related to severe cold water events in 2009 and 2010.

Management Issues

NJ – High discard rates for bluefish are the norm.

ALL – The current 15 fish bag limit was considered to be excessive by all of the recreational advisors on the call.

Bluefish 2014 Stock Assessment Update

Data and Model Update Through 2013

Anthony D Wood

Coastal/Pelagic Working Group
Northeast Fisheries Science Center
National Marine Fisheries Service

Woods Hole, MA

July 2014

Executive Summary

The updated stock assessment was completed by adding catch and independent indices through 2013 to the previous 1982-2012 assessment. Catch information consisted of commercial landings and length frequencies from Maine to Virginia collected by the Northeast Fisheries Science Center, North Carolina landings and length information collected by NC Division of Marine Fisheries, Florida landings and length information collected by FL Fish and Wildlife Research Institute, and recreational landings and discards from Maine to Florida collected in the NMFS Marine Recreational Information Program (MRIP). The catch data were combined with fisheries independent survey data from the Northeast Fisheries Science Center, DE DNR, NJ DEP, CT DEEP, coast-wide recreational catch per angler, as well as juvenile indices from the SEAMAP program in the South Atlantic, in a forward projecting catch at age model (ASAP). Fishery dependent and independent information was partitioned into ages using a 2013 age-length key developed by Old Dominion University.

The result of the analysis shows that bluefish is not overfished or experiencing overfishing. Fishing mortality in 2013 was 0.118, below the biological reference point (F_{MSY}) of 0.19. Fishing mortality steadily declined from 0.32 in 1987 to 0.11 in 1999 and has remained steady since 2000 with an average F=0.133. Total stock biomass estimates peaked in 1982 at 363 thousand MT, then declined to 80.9 thousand MT by 1996 before increasing steadily to the 128 thousand MT in 2010 and slightly declining again to 123.7 thousand MT in 2013. Recruitment estimated in the ASAP model has remained relatively constant since 2002 at around 20 million age-0 bluefish, with the exception of a relatively large 2006 cohort estimated as 32.5 million fish. However, beginning in 2009 recruitment dropped to 14.3 million and the 2010 and 2011 recruitment estimates were also below average at 16.1 and 12.9 million fish, respectively. Recruitment for 2013 is 13.3 million fish, up from an all-time low in 2012 of 8.9 million fish. Low estimates of recruitment in previous years were likely due to retrospective bias resulting in the model underestimating recruitment near the end of the time series. This bias has minimized and flipped with the 2013 model update. A projection of the abundance through 2016, under five different fishing scenarios between F=0.10 and F=0.19, suggest that biomass will continue to decline due to poor incoming year classes. Changes in the NMFS survey (no

longer sampling inshore strata, timing off in 2013), limited age information, discard size data and model configuration all contribute to the uncertainty in the assessment.

Introduction

The Atlantic coast stock of bluefish (*Pomatomus saltatrix*), distributed from Maine through eastern Florida, is jointly managed by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council (MAFMC). A total annual quota is established and allocations given to commercial and recreational fisheries. The management plan requires a distribution of 80% to recreational and 20% to commercial, with provisions to shift unused recreational quota to commercial fisheries.

A bluefish stock assessment was presented for peer-review at the Northeast Fisheries Science Center Stock Assessment Review Committee meeting in 2005 (NEFSC SARC 41). The reviewers accepted the assessment for use in management decisions although there were some reservations about the modeling approach. Since the review, the bluefish stock assessment sub-committee (SASC) has produced annual updates while maintaining the basic model settings from the approved assessment. The current assessment is a continuation of the model update with the addition of 2013 catch at age and indices at age information.

Life History

Bluefish, *Pomatomus saltatrix*, is a coastal, pelagic species found in temperate and tropical marine waters throughout the world (Goodbred and Graves 1996; Juanes et al. 1996). Bluefish spawn in offshore waters (Kendall and Walford 1979; Kendall and Naplin 1981). Larvae develop into juveniles in continental shelf waters and eventually move to estuarine and nearshore shelf habitats (Marks and Conover 1993; Hare and Cowen 1994; Able and Fahay 1998; Able et al. 2003). Bluefish are highly migratory along the U.S. Atlantic coast and seasonally move between the U.S. South Atlantic and Middle-Atlantic, traveling as far north as Maine (Shepherd et al., 2006).

Several studies show bluefish to be a moderately long-lived fish with a maximum age of 14 years (Hamer 1959; Lassiter 1962; Richards 1976; Barger 1990; Chiarella and Conover 1990; Terceiro and Ross 1993; Austin et al. 1999; Salerno et al. 2001; Sipe and

Chittenden 2002). Bluefish up to 88 centimeter (cm) fork length (FL) have been aged (Chiarella and Conover 1990; Salerno et al. 2001), although Terceiro and Ross (1993) noted considerable variation in mean bluefish size-at-age. Scale ages have been used to estimate von Bertalanffy growth parameters (Lassiter 1962; Barger 1990; Terceiro and Ross 1993; Salerno et al. 2001). The values for L_∞ from these studies (87-128 cm FL) match closely to the largest individuals in catch data and growth rates do not differ between sexes (Hamer 1959; Salerno et al. 2001).

Bluefish grow nearly one-third of their maximum length in their first year (Richards 1976, Wilk 1977). Variation in growth rates or sizes-at-age among young bluefish is evident from the appearance of intra-annual cohorts. Lassiter (1962) identified a spring-spawned cohort and a summer-spawned cohort from the bimodal appearance of size at Annulus I for fish aged from North Carolina and the seasonal cohorts can differ in age by two to three months. Summer-spawned larvae and juveniles grow faster than spring-spawned larvae and juveniles (McBride and Conover 1991) although size differences at annual age diminish greatly after three to four years (Lassiter 1962).

Spawning occurs offshore in the western North Atlantic Ocean, from approximately Massachusetts to Florida (Norcross et al. 1974; Kendall and Walford 1979; Kendall and Naplin 1981; Collins and Stender 1987). Bluefish are characterized as iteroparous spawners with indeterminate fecundity and spawn continuously during their spring migration (Robillard et al. 2008). In addition to distinctive spring and summer cohorts, Collins and Stender (1987) identified a fall-spawned cohort, demonstrating the potential of an extended bluefish spawning season.

Bluefish in the western North Atlantic are managed as a single stock (NEFSC 1997; Shepherd and Packer 2006). Genetic data support a unit stock hypothesis (Graves et al. 1992; Goodbred and Graves 1996; Davidson 2002). For management purposes, the ASMFC and MAFMC define the management unit as the portion of the stock occurring along the Atlantic Coast from Maine to the east coast of Florida.

Fisheries Dependent Data

Annual catch information was developed for five components of the commercial fishery. Commercial landings from Maine to Virginia, North Carolina commercial

landings, Florida commercial landings, coast-wide recreational landings and coast-wide recreational discards.

Commercial fisheries from Maine to Virginia were sampled as part of the NEFSC data collection program. Lengths were sampled from a variety of gears and market categories. Expansion of length data was completed by market category and quarter of the year, with the results merged into half year periods. In 2013 a total of 5,379 measurements were collected across all market categories from total landings of 1,381 MT (70% of all commercial landings; Table 1). Market category/quarter with inadequate length samples were filled with length information from adjacent quarters within the same market category.

North Carolina commercial landings were expanded using length samples collected by NC Division of Marine Fisheries. A total of 795 measurements were collected from landings of 515 MT (Table 1). Expansion of landings at length were done by quarter, market category and gear type and then combined into half year totals.

Length samples from Florida 2013 commercial landings were also available. A total of 182 lengths were used to expand commercial landings of 65 MT (Table 1). No landings were reported for South Carolina or Georgia. Total coast-wide commercial landings in 2013 were 1,961 MT, a decrease of 275 MT from 2012 (Figure 1).

Length frequencies from commercial fisheries are characterized by a skewed distribution, lacking the multi-modal distribution seen in previous years. In 2013 the distribution had a strong peak at 36 cm and lacked the definitive second peak at around 70 cm seen in previous years (Figure 2).

Recreational landings are sampled for length as part of the MRIP program. The 2013 recreational landings were 6,980 MT, an increase from 4,846 MT in 2012 (Table 2, Figure 3). The MRIP 2012 length samples were used to expand recreational landings per half year. Recreational discards in 2013 were estimated at 15,207 MT and after adjusting for a 15% mortality rate the resulting discard loss was 2,281 MT. A recent publication (Fabrizio et al 2008) shows that mortality may be higher and the 15% should be reevaluated in the next benchmark assessment. Length sampling of bluefish tagged and released in the American Littoral Society tagging program (by definition B2 catches) were included in the length distribution (n=730). Length frequencies from the

recreational catch and discards show a similar trend to the commercial length frequency. While previous years were characterized by a bimodal distribution, the 2013 length frequency is a skewed distribution, with a main peak around 28 cm and a flat/slightly-decreasing distribution out to 90 cm (Figure 4). Total combined (commercial and recreational) length frequencies are presented in Figure 5.

Recreational landings are also used to develop a recreational catch per angler trip index. In 2013 this CPA index showed a small decrease to 0.34 fish per angler trip from 0.37 in 2012 (Table 3). The recreational catch per angler was modeled in a generalized linear model using a negative binomial error structure. The year coefficient partitioned into ages (assuming the same proportion as the recreational catch) was used in the ASAP model as a relative index of abundance.

Age data were provided by Virginia Marine Resources Commission and Old Dominion University ageing lab (n = 466). It should be noted that other age data from multiple states along the Atlantic coast is available for bluefish. For consistency with previous years (adhering to the definition of an update assessment) only ODU data were used. Various sources of new age data will be considered and peer reviewed at the upcoming benchmark assessment (2015).

The length frequencies by age were converted to weight for calculation of annual weights at age (Table 4, Figure 6). Length-weight equations from the spring and fall NEFSC bottom trawl survey were used for calculating weights at age. Due to low sample size in spring surveys, all years beginning with 1992 were used in the equation (n=290, a = -11.377, b = 3.009). Fall equations were estimated from combined 2004-2013 length-weight data (n = 3867, a = -11.604, b = 3.092).

The 2013 catch at age (includes commercial landings, recreational landings and recreational discards) is presented in table 5. As in previous bluefish assessments the ages are summarized in a plus category for ages 6 and above to reduce the effect of aging error.

Fisheries Independent Data

Survey indices as used in the previous bluefish assessment were updated for 2013. These indices include SEAMAP juvenile (age 0) indices, Northeast Fisheries Science

Center (NEFSC) bottom trawl survey indices for ages 0 to 6+, CT DEEP bottom trawl survey for ages 0-6+, NJ bottom trawl survey indices of ages 0 to 2, and DE bottom trawl survey indices for ages 0 to 2. The CT DEEP bottom trawl survey in 2008 and 2010 were not conducted during the month of September, therefore these indices were treated as missing data. The NEFSC survey in 2009 was modified by the replacement of the FV Albatross IV with the FSV Henry B. Bigelow. The consequence of the replacement was a change in the areas surveyed and the efficiency of the survey due to a change in net size and towing speed (as well as other intangibles associated with a different vessel). Beginning in 2009 only the outer third of the inshore strata set was sampled by the Bigelow. In addition, a conversion coefficient of 1.16 was used to convert Bigelow mean number per tow into equivalent Albatross units (Miller et al., 2010).

Among these survey indices, there were no consistent trends in total abundance. The total NEFSC index (log re-transformed stratified mean number per tow) declined from 38.05 in 2006 to 6.66 in 2010, increased to 7.45 in 2011, and dropped to 5.27 in 2012 (Table 6). The value of the index for 2013 is 0.99, the lowest in the time series. This low value is likely a result of the later timing of the survey in 2013 due to a 2+ week government shutdown. The 2013 Delaware survey index of ages 0 to 2 was 0.17 fish per tow, and below the time series average (0.48 per tow; Table 7). New Jersey trawl survey indices of ages 0 to 2 for 2013 (4.2 fish/tow) was also below the time series average of 6.7 per tow (Table 7). The Connecticut DEP survey index for 2012 was 17.12, lower than the mean of 32.3, and a drop from the 2012 estimate of 25.19 (Table 8).

ASAP Model

The ASAP model was run as an update of previous 1982-2012 input file, updated for 2013 total catch, catch at age, weight at age, and indices at age. The fishery was modeled as a single fleet with selectivity fixed as a bimodal pattern with full recruitment at age 1 (coded age 2). Model weighting factors remained the same as previous assessments with the model weighted towards the fishery total catch more than the survey indices. Input CVs around the NMFS fall survey indices were relaxed in 2013 to provide the model more flexibility and to mitigate the effects of the survey timing. Natural mortality was fixed at 0.2 and maturity at age was held constant with full maturity at age

3. The updated model was run using the same parameter settings while substituting the updated catch and weight at age matrices.

The results of the updated ASAP model showed a decrease in total abundance since 2006, declining from 90.4 million to 59.5 million fish (Table 9, Figure 7). Poor recruitment began in 2009 with a below average estimate of 13.5 million fish compared to the series average of 21.4 million. Low recruitment persisted for 2010 and 2011, and estimated recruitment in 2012 was the lowest in the time series at 8.9 million fish. Recruitment for 2013 increased to an estimate of 13.3 million (Table 9, Figure 8). The estimate of age 6-plus bluefish for 2013 continued to be large at 14.3 million. Total mean biomass in 2013 equaled 123,716 MT, a slight increase from the 2012 estimate of 121,998 MT (Table 10, Figure 9). Corresponding spawning stock biomass (SSB) in 2012 was 114,382 MT, a slight decrease from the 2012 estimate of 117,417 MT (Figure 9, Table 11).

Fishing mortality estimates in ASAP are based on a separability assumption with F at age the product of F_{MULT} and selectivity. Full selectivity is fixed at age 1. The 2013 F_{MULT} value equals 0.118 (Figure 7, Table 11). Fishing mortality steadily declined from 0.32 in 1987 to 0.11 in 1999 and has remained relatively steady since 2000, with a slight declining trend in recent years.

Retrospective bias for the final model was examined for F, total abundance, recruitment (age 0) and total biomass. The analysis shows little evidence of bias in the estimates of SSB, F, and total abundance. A small retrospective bias has been present in the recruitment estimates going back to the early 2000's (Figure 10). This bias has been increasing in recent years, however, for 2013 the direction of the bias flipped and the magnitude decreased. The variation in the final model results for F and SSB was determined using a Monte Carlo Markov chain with 1000 iterations and a thinning factor of 100. The MCMC results of variation around F ranged from 0.098 to 0.145, with the 80% CI between 0.111 and 0.126. Estimates for SSB ranged from 93,500 to 138,700 MT, with an 80% CI between 108,000 MT and 124,200 MT. (Figure 11).

Projections

Bluefish abundance and biomass through 2016 were examined for a range of fishing scenarios with a stochastic projection in AGEPRO software. Weight at age in 2014-2016 was assumed equal to 2013, recruitment was derived from a random draw of 32 empirical estimates of age 0 abundance since 1982 and initial population size was drawn from the output of the MCMC run. Fishing quota for 2014 was set equal to the ACL of 11,082 MT. Five standard projection scenarios were examined: F =0.10, F=status quo (0.118), F_{target} (0.17) which equals 90% of F_{MSY} as defined in FMP, $F_{0.1}$ (0.16) from the yield per recruit, and F_{MSY} (0.19).

Results of the projections show a decrease in mean biomass and SSB for each scenario (Table 12). Abundance increased slightly in all cases except for projections at F_{MSY}. Yield through 2016 would be projected as lower for F scenarios of F_{low} or F_{sq} or less. Under status quo F (0.118), projected 2015 yield would decrease to 9,920 MT, which includes commercial and recreational landings as well as recreational discards losses.

Biological Reference Points

The current biological reference points for bluefish were determined in SARC 41 and are F_{MSY} (0.19) and B_{MSY} (147,052 MT). The basis for the reference points was the Sissenwine-Shepherd method using the Beverton-Holt stock recruitment parameters and SSB per recruit results generated by the SARC 41 ASAP model results. B_{MSY} was calculated using mean weights at age and is therefore comparable to mean biomass in year *t*. The 2013 estimate of mean total biomass is 123,716 MT, which is below B_{MSY} but well above ½ B_{MSY} of 73,526 MT. The 2013 estimate of fishing mortality (0.118) remains well below F_{MSY}.

Model Uncertainty

Model uncertainty can be characterized using the MCMC simulations to produce a distribution of possible outcomes given the model input parameters. However, these results do not capture the uncertainty from variations in the model input parameters. Forward projecting catch at age models are extremely flexible in applying weighting

factors to emphasize either catch data or survey data. It should be noted that the current model is weighted toward the catch. Sensitivity analyses exploring changes in effective sample size and changes to index lambdas and CVs will be explored in the upcoming benchmark (2015).

Conclusion

The conclusion of the updated assessment is that the Atlantic coast bluefish stock continues below B_{MSY} while remaining below F_{MSY} and is not considered overfished or experiencing overfishing. The estimates of the model show little variation, and a retrospective bias that was present in the recruitment estimates has flipped and reduced in magnitude. The overall lack of variation is due in part to the fixed parameters for selectivity. Nevertheless, uncertainty remains in several aspects of the assessment input data. Age data continues to be limited to one age key built from a limited set of samples. The assumption that this age information is applicable to all areas remains untested but will be explored during the benchmark assessment in 2015. Length samples from recreational discards are limited and contribute to the uncertainty as does the lack of commercial discard estimates. Changes in the NEFSC inshore survey series, from both vessel changes and sample area adjustments, significantly alter indices. Strata inshore of 15 fathoms are currently sampled as part of the NEMAP survey, but the time series is not yet adequate to provide a tuning index. For 2013, the delayed timing of the NMFS fall survey likely resulted in an unrepresentative index.

The highly migratory nature of bluefish populations and the recruitment dynamics of the species create a unique modeling situation. Migration creates seasonal fisheries with unique selectivity patterns resulting in a bimodal partial recruitment pattern. This pattern has been identified in previous assessments as a source of uncertainty in the results and has been held constant in the model. The migratory pattern in bluefish also results in several recruitment events. A spring cohort, originating south of Cape Hatteras, NC during spring migrations, and a summer cohort originating in the offshore Mid-Atlantic Bight result in a bimodal age-0 size distribution. It has been hypothesized that the success of the spring cohort controls the abundance of adult bluefish.

It is anticipated that specific modeling and data uncertainties will be explored extensively during the benchmark assessment in 2015.

Acknowledgments

Thanks to the Coastal Pelagic Working Group members who contributed advice and expertise during the assessment process. Also, thank you to the age and growth laboratories of Old Dominion University, and the numerous state biologists who supplied the necessary data to complete this update.

Literature Cited

Able, K.W. and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. New Brunswick, NJ.

Able, K.W., P. Rowe, M. Burlas, and D. Byrne. 2003. Use of ocean and estuarine habitats by young of the year bluefish (*Pomatomus saltatrix*) in the New York Bight. Fishery Bulletin 101:201-214.

Austin, H.M., D. Scoles, and A.J. Abell. 1999. Morphometric separation of annual cohorts within Mid-Atlantic bluefish, *Pomatomus saltatrix*, using discriminant function analysis. Fishery Bulletin 97:411-420.

Barger, L.E. 1990. Age and growth of bluefish *Pomatomus saltatrix* from the northern Gulf of Mexico and U.S. South Atlantic coast. Fishery Bulletin 88:805-809.

Beaumariage, D.S. 1969. Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. Florida Dept. of Natural Resources, Marine Research Lab Technical Series No. 59:1-38.

Chiarella, L.A. and D.O. Conover. 1990. Spawning season and first year growth of adult bluefish from the New York Bight. Transactions of the American Fisheries Society 119:455-462.

Chittenden Jr., M.E., L.R. Barbieri, C.M. Jones, and S.J. Bobko. 1990. Initial information on the Atlantic croaker, annual report on the development of age determination methods, life history - population dynamics information and evaluation of growth

overfishing potential for important recreational fishes. April. Submitted to the Virginia Marine Resources Commission. 88 p.

Collins, M.R. and B.W. Stender. 1987. Larval king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), and bluefish (*Pomatomus saltatrix*) off the southeast coast of the United States, 1973-1980. Bulletin of Marine Science 41:822-834.

Davidson, W.R. 2002. Population structure of western Atlantic bluefish (*Pomatomus saltatrix*). Master's Thesis. Thesis. University of Delaware., Wilmington, DE.

Fabrizio, M.C., F.S. Scharf, G.R. Shepherd, and J.E. Rosendale. 2008. Factors affecting catch-and-release mortality of bluefish. North Am. J. of Fisheries Management 28:533-546.

Goodbred, C.O. and J.E. Graves. 1996. Genetic relationships among geographically isolated populations of bluefish (*Pomatomus saltatrix*). Marine and Freshwater Research 47:347-355.

Graves, J.E., J.R. McDowell, A.M. Beardsley, and D.R. Scoles. 1992. Stock structure of the bluefish *Pomatomus saltatrix* along the Mid-Atlantic coast. Fishery Bulletin 90:703-710.

Hamer, P.E. 1959. Age and growth studies of the bluefish (*Pomatomus saltatrix* Linnaeus) of the New York Bight. Master's Thesis. Rutgers University, New Brunswick, NJ.

Hare, J.A. and R.K. Cowen. 1995. Effect of age, growth rate, and ontogeny on the otolith size -- fish size relationship in bluefish *Pomatomus saltatrix,* and the implications for back-calculation of size in fish early life history stages. Canadian Journal of Fisheries and Aquatic Science 52:1909-1922.

Juanes, F., J.A. Hare, and A.G. Miskiewicz. 1996. Comparing early life history strategies of *Pomatomus saltatrix*: a global approach. Marine and Freshwater Research 47:365-379.

Kendall, A.W.J. and L.A. Walford. 1979. Sources and distribution of bluefish, *Pomatomus saltatrix*, larvae and juveniles off the east coast of the United States. Fishery Bulletin 77:213-227.

Kendall, A.W.J. and N.A. Naplin.1981. Diel-depth distribution of summer ichthyoplankton in the Middle Atlantic Bight. Fishery Bulletin 79:705-726.

Lassiter, R.R. 1962. Life history aspects of the bluefish, *Pomatomus saltatrix*, larvae and juveniles off the east coast of the United States. Fishery Bulletin 77: 213-227.

Lund, W.A. and G.C. Maltezos. 1970. Movements and migrations of the bluefish, *Pomatomus saltatrix*, tagged in waters of New York and Southern New England. Transactions of the American Fisheries Society 99:719-725.

Marks, R.E. and D.O. Conover. 1993. Ontogenetic shift in the diet of young-of-the-year bluefish *Pomatomus saltatrix* during the oceanic phase of the early life history. Fishery Bulletin 91:97-106.

McBride, R.S. and D.O. Conover. 1991. Recruitment of young-of-the-year bluefish *Pomatomus saltatrix* to the New York Bight: variation in abundance and growth of spring- and summer-spawned cohorts. Marine Ecology Progress Series 78:205-216.

Miller, T.J., C. Das, P.J. Politis, A.S. Miller, S.M. Lucey, C.M. Legault, R.W. Brown, and P.J. Rago. 2010. Estimation of Albatross IV to Henry B. Bigelow calibration factors. NEFSC Ref. Doc. CRD 10-05.

Norcross, J.J., S.L. Richardson, W. H. Massmann, and E.B. Joseph. 1974. Development of young bluefish (*Pomatomus saltatrix*) and distribution of eggs and young in Virginian coastal waters. Transactions of the American Fisheries Society 103:477-497.

Northeast Fisheries Science Center. 1997. Report of the 23rd Northeast Regional Stock Assessment Workshop (23rd SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. NEFSC Reference Document 97-05.

Northeast Fisheries Science Center. 2005. Report of the 41st Northeast Regional Stock Assessment Workshop (41st SAW): 41st SAW Assessment Report NEFSC CRD 05-14. September, 2005. 237 pp. 97-05.

Richards, S.W. 1976. Age, growth, and food of bluefish *(Pomatomus saltatrix*) from East-Central Long Island Sound from July through November 1975. Transactions of the American Fisheries Society 105:523-525.

Robillard, E., C.S. Reiss, C.M. Jones. 2008. Reproductive biology of bluefish

(*Pomatomus saltatrix*) along the East Coast of the United States. Fisheries Research 90 (2008): 198-208.

Salerno, D.J., J. Burnett and R.M. Ibara. 2001. Age, growth, maturity, and spatial distribution of bluefish, *Pomatomus saltatrix*, off the northeast coast of the United States, 1985 – 96. Journal of Northwest Atlantic Fishery Science 29:31-39.

Sipe, A.M. and M.E. Chittenden Jr. 2002. A comparison of calcified structures for ageing bluefish in the Chesapeake Bay region. Transactions of the American Fisheries Society 131:783-790.

Shepherd, G.R., J. Moser, D. Deuel, P. Carlson. 2006. The migration patterns of bluefish (*Pomatomus saltatrix*) along the Atlantic coast determined from tag recoveries. Fish. Bull. 104:559-570.

Shepherd, G.R. and D. B. Packer. 2006. Essential Fish Habitat Source Document: Bluefish, *Pomatomus saltatrix*, Life History and Habitat Characteristics 2nd edition. NOAA Technical Memorandum, NMFS-NE-198:100.

Terceiro, M. and J.L. Ross. 1993. A comparison of alternative methods for the estimation of age from length data for Atlantic coast bluefish. Fishery Bulletin 91:534-549.

Wilk, S.J. 1977. Biological and fisheries data on bluefish, *Pomatomus saltatrix* (Linnaeus). NOAA, NMFS, NEFC, Sandy Hook Lab. Technical Series Report. No. 11.

Table 1. Commercial landings (mt) by state groupings used in length expansions.

Year	State			**Total**
	ME - VA	NC	SC-FL	
1982	4137	1946	914	**6997**
1983	3421	3061	685	**7166**
1984	3046	1615	720	**5380**
1985	4199	1634	289	**6122**
1986	4559	1562	531	**6651**
1987	3805	2069	705	**6578**
1988	4277	2286	599	**7161**
1989	2793	1493	455	**4740**
1990	3684	2076	489	**6250**
1991	3709	1778	673	**6160**
1992	3423	1288	495	**5205**
1993	3039	1226	543	**4808**
1994	3071	809	424	**4304**
1995	2034	1365	229	**3628**
1996	2654	1496	62	**4212**
1997	2165	1815	129	**4109**
1998	2257	1327	155	**3739**
1999	1921	1252	157	**3330**
2000	2057	1525	64	**3647**
2001	2038	1844	63	**3945**
2002	2025	1054	37	**3116**
2003	1739	1574	45	**3358**
2004	1885	1707	56	**3647**
2005	1844	1122	71	**3037**
2006	1851	1146	45	**3042**
2007	2282	909	76	**3267**
2008	1766	762	57	**2585**
2009	1959	1096	97	**3151**
2010	1601	1463	143	**3206**
2011	1482	862	111	**2455**
2012	1809	347	81	**2236**
2013	1381	515	65	**1961**

Table 2. Commercial landings, recreational landings, recreational discard loss, and total catch for bluefish from Maine to Florida, 1974 to 2013.

Year	Commercial Landings (mt)	Commercial Landings (000 lbs)	Recreational Landings (mt)	Recreational Discard (mt): 0.15 * B2	Recreational Catch (mt)	Total Landings (mt)	Total Catch (mt) (w/o comm. discards)
1974	4538	10005					
1975	4402	9705		**assumes same**			
1976	4546	10022		**mean wt**			
1977	4802	10587		**as landings**			
1978	4986	10992					
1979	5693	12551					
1980	6857	15117					
1981	7465	16457	43222	*2001*	*45223*		52688
1982	6997	15426	37651	*832*	*38483*	44648	45480
1983	7166	15798	40425	*1280*	*41705*	47591	48871
1984	5380	11861	30597	*1260*	*31857*	35977	37237
1985	6122	13497	23821	*599*	*24420*	29943	30542
1986	6651	14663	42133	*1544*	*43677*	48784	50328
1987	6578	14502	34769	*1615*	*36384*	41347	42962
1988	7161	15787	21873	*1146*	*23019*	29034	30180
1989	4740	10450	17808	*989*	*18797*	22548	23537
1990	6250	13778	13860	*929*	*14789*	20110	21039
1991	6160	13580	14967	*1194*	*16161*	21127	22320
1992	5205	11475	11011	*979*	*11990*	16216	17195
1993	4808	10600	9204	*1013*	*10217*	14012	15025
1994	4304	9488	7049	*1128*	*8177*	11353	12481
1995	3628	7998	6489	*1003*	*7492*	10117	11120
1996	4113	9066	5328	*1010*	*6338*	9441	10451
1997	4064	8960	6487	*1287*	*7774*	10551	11838
1998	3739	8242	5595	*999*	*6594*	9334	10333
1999	3330	7341	3744	*1191*	*4935*	7074	8264
2000	3647	8040	4811	*1675*	*6486*	8458	10132
2001	3945	8697	6001	*1857*	*7858*	9946	11803
2002	3116	6869	5158	*1448*	*6606*	8274	9721
2003	3358	7403	5958	*1331*	*7289*	9316	10647
2004	3647	8041	7179	*1761*	*8940*	10826	12587
2005	3187	7026	8225	*1915*	*10140*	11412	13327
2006	2926	6450	7663	*1860*	*9523*	10589	12449
2007	3267	7182	9608	*2653*	*12261*	12874	15527
2008	2585	5655	8573	*2443*	*11016*	11158	13601
2009	3151	6990	6161	*960*	*7121*	9312	10273
2010	3206	7069	8184	*2409*	*10593*	11390	13799
2011	2455	5413	5965	*2856*	*8821*	8420	11276
2012	2236	4930	4846	*2383*	*7229*	7082	9465
2013	1961	4323	6980	*2281*	*9261*	8941	11222

Table 3. Recreational catch per angler trip by age for bluefish from Maine to Florida, 1982 to 2013. Index was predicted from a Generalized Linear Model with a negative binomial transformation.

Year	Age							**Total**
	0	1	2	3	4	5	6+	
1982	0.110	0.100	0.027	0.022	0.010	0.016	0.048	**0.332**
1983	0.040	0.058	0.063	0.025	0.008	0.011	0.042	**0.246**
1984	0.087	0.069	0.056	0.025	0.011	0.008	0.041	**0.297**
1985	0.080	0.097	0.097	0.050	0.018	0.008	0.040	**0.390**
1986	0.055	0.068	0.084	0.035	0.013	0.019	0.054	**0.327**
1987	0.036	0.067	0.065	0.068	0.024	0.015	0.054	**0.329**
1988	0.022	0.027	0.031	0.023	0.028	0.022	0.042	**0.195**
1989	0.059	0.090	0.046	0.017	0.005	0.015	0.040	**0.271**
1990	0.038	0.114	0.033	0.012	0.006	0.005	0.029	**0.236**
1991	0.044	0.056	0.057	0.027	0.005	0.003	0.027	**0.217**
1992	0.016	0.049	0.033	0.054	0.013	0.004	0.024	**0.193**
1993	0.021	0.047	0.023	0.012	0.024	0.016	0.015	**0.158**
1994	0.042	0.063	0.029	0.010	0.006	0.012	0.018	**0.180**
1995	0.026	0.081	0.015	0.004	0.006	0.015	0.013	**0.158**
1996	0.055	0.062	0.017	0.007	0.007	0.008	0.023	**0.179**
1997	0.050	0.101	0.035	0.011	0.004	0.002	0.029	**0.231**
1998	0.031	0.077	0.066	0.029	0.010	0.007	0.018	**0.237**
1999	0.106	0.090	0.065	0.026	0.007	0.008	0.015	**0.318**
2000	0.034	0.180	0.088	0.028	0.003	0.011	0.007	**0.352**
2001	0.060	0.157	0.094	0.035	0.006	0.012	0.008	**0.373**
2002	0.029	0.210	0.064	0.019	0.005	0.006	0.015	**0.348**
2003	0.034	0.092	0.129	0.024	0.007	0.010	0.019	**0.316**
2004	0.018	0.157	0.088	0.051	0.013	0.016	0.024	**0.368**
2005	0.101	0.071	0.106	0.036	0.009	0.014	0.012	**0.349**
2006	0.194	0.151	0.146	0.031	0.012	0.006	0.027	**0.568**
2007	0.022	0.086	0.148	0.042	0.024	0.018	0.038	**0.377**
2008	0.036	0.147	0.137	0.014	0.016	0.006	0.012	**0.367**
2009	0.008	0.133	0.119	0.019	0.014	0.006	0.020	**0.319**
2010	0.012	0.120	0.143	0.022	0.021	0.013	0.029	**0.361**
2011	0.017	0.170	0.097	0.030	0.016	0.026	0.045	**0.401**
2012	0.063	0.130	0.089	0.037	0.023	0.008	0.022	**0.372**
2013	0.041	0.097	0.083	0.060	0.024	0.021	0.017	**0.343**

Table 4. Bluefish mean catch weight at age (kg) from 1982 to 2013

Year	Age						
	0	1	2	3	4	5	6+
1982	0.140	0.490	1.520	2.050	3.200	4.232	4.958
1983	0.100	0.420	0.990	2.150	3.160	4.417	5.577
1984	0.100	0.410	0.930	1.830	2.910	4.483	5.650
1985	0.100	0.400	0.970	1.930	2.820	3.991	5.053
1986	0.120	0.490	1.200	2.320	3.150	4.303	4.848
1987	0.120	0.300	1.180	2.020	2.960	3.927	4.984
1988	0.170	0.400	1.000	2.050	2.840	3.564	4.623
1989	0.130	0.300	1.060	2.120	3.640	4.106	4.720
1990	0.210	0.500	0.880	1.730	3.240	4.177	4.474
1991	0.140	0.330	0.700	1.730	2.810	3.963	4.965
1992	0.160	0.390	1.040	1.890	2.800	3.303	5.107
1993	0.180	0.590	0.950	2.460	2.730	3.237	4.880
1994	0.120	0.400	0.900	1.880	3.040	3.757	4.093
1995	0.170	0.440	0.980	1.730	2.850	4.058	4.696
1996	0.170	0.440	0.980	1.730	2.850	4.058	4.696
1997	0.113	0.483	1.048	2.360	3.301	4.411	6.005
1998	0.173	0.570	0.891	2.314	3.387	4.079	5.906
1999	0.133	0.511	0.890	2.111	3.577	4.168	5.960
2000	0.160	0.430	0.959	2.692	3.508	3.659	5.851
2001	0.134	0.383	0.830	2.339	3.608	3.846	4.926
2002	0.143	0.495	1.119	2.284	2.922	3.872	5.158
2003	0.101	0.556	1.007	2.308	2.774	4.170	5.011
2004	0.069	0.371	1.049	1.949	2.779	3.639	4.488
2005	0.135	0.564	0.980	2.316	3.434	4.310	5.529
2006	0.160	0.525	1.125	2.081	3.379	3.664	5.317
2007	0.066	0.421	1.168	2.408	3.018	3.476	5.006
2008	0.151	0.407	1.263	2.359	3.169	3.747	4.756
2009	0.081	0.450	1.270	2.394	3.444	3.690	4.880
2010	0.098	0.384	0.975	1.580	3.470	4.017	4.979
2011	0.086	0.342	0.833	1.416	2.609	4.377	5.397
2012	0.084	0.366	0.844	1.396	3.148	3.896	5.541
2013	0.084	0.378	1.050	1.654	2.511	3.773	5.793

Table 5. Bluefish catch at age (000s) from Maine to Florida, 1982 to 2013.

Year	Age							Total
	0	1	2	3	4	5	6+	
1982	11164.1	9747.9	2850.8	2439.3	795.3	1213.5	3736.3	**31947.2**
1983	4778.4	7666.7	8686.1	3022.0	970.6	1325.3	4778.4	**31227.5**
1984	7121.3	6807.3	6718.5	2039.9	895.1	744.7	3176.7	**27503.5**
1985	4676.7	6468.8	5773.3	2925.5	1328.5	520.0	2377.1	**24069.9**
1986	5169.3	8070.7	8728.0	2801.7	1056.4	1703.1	4465.0	**31994.2**
1987	3127.1	5419.5	5177.8	5757.4	2009.3	1083.0	3948.2	**26522.3**
1988	1709.8	2083.6	2524.0	1588.6	1984.1	1598.6	2740.4	**14229.1**
1989	3473.6	5672.6	3221.1	992.1	395.9	1168.5	2409.8	**17333.6**
1990	2726.7	7185.8	1840.7	687.2	381.8	431.6	2478.6	**15732.4**
1991	3694.6	5292.6	7391.9	1590.7	310.9	224.7	2136.5	**20641.9**
1992	2131.3	9633.3	1709.8	2352.9	583.4	479.2	967.2	**17857.1**
1993	1194.1	2081.6	1566.9	593.0	1040.8	669.0	1178.9	**8324.3**
1994	1970.8	3144.3	1313.3	368.1	296.7	849.5	1073.1	**9015.8**
1995	1822.8	3371.4	735.7	137.7	214.1	695.7	1057.8	**8035.2**
1996	1701.5	2145.1	631.5	202.2	207.2	545.0	1411.8	**6844.3**
1997	1634.1	4299.3	1496.2	510.5	196.6	93.4	1212.3	**9442.4**
1998	683.5	2754.1	2786.1	861.3	261.0	308.0	458.8	**8112.8**
1999	1638.5	1946.1	2096.7	572.8	174.7	352.5	482.8	**7264.1**
2000	667.4	4396.5	2693.3	717.7	96.9	536.0	155.9	**9263.7**
2001	1414.3	4466.7	3466.2	1151.9	198.3	608.0	243.5	**11548.9**
2002	587.1	5145.6	1661.6	542.6	340.3	236.8	415.9	**8929.9**
2003	819.3	2646.0	3975.0	774.6	377.9	319.8	644.0	**9556.6**
2004	420.9	4445.2	2683.8	1276.9	429.5	507.0	816.4	**10579.8**
2005	2756.1	2139.9	3953.0	1907.3	563.0	629.7	576.5	**12525.4**
2006	1291.6	3212.1	2554.9	1844.1	1392.2	419.2	845.7	**11559.8**
2007	639.0	5181.4	4255.6	1529.3	927.1	300.3	679.1	**13511.7**
2008	839.8	4242.2	3327.5	878.9	762.1	424.3	523.0	**10997.9**
2009	94.5	2858.7	2783.3	682.3	490.3	320.1	633.2	**7862.4**
2010	254.5	2925.0	3924.7	631.5	640.5	377.9	836.2	**9590.2**
2011	342.0	3282.2	2207.8	782.1	296.6	500.6	902.5	**8313.7**
2012	1145.9	2746.2	2357.4	919.5	493.0	188.1	507.1	**8357.2**
2013	858.3	2438.3	2252.2	1436.6	542.9	495.9	388.7	**8412.8**

Table 6. NEFSC bluefish indices by age using fall inshore strata and re-transformed $\log_e$ stratified mean number per tow, 1982 to 2013.

Year	Age							Total
	0	1	2	3	4	5	6+	
1982	18.768	10.788	0.064	0.053	0.011		0.023	**29.71**
1983	8.189	16.695	0.845	0.034	0.004	0.017	0.068	**25.85**
1984	81.356	40.869	1.257	0.201	0.120	0.052	0.147	**124.00**
1985	17.473	9.703	0.925	0.428	0.096	0.036	0.088	**28.75**
1986	21.055	0.923	0.042	0.060	0.024	0.028	0.033	**22.17**
1987	7.589	1.768	0.167	0.238	0.098	0.049	0.158	**10.07**
1988	9.493	0.067	0.009	0.010	0.028	0.006	0.023	**9.64**
1989	237.573	1.254	0.113	0.130		0.014	0.119	**239.20**
1990	6.186	3.637	0.006	0.016	0.016		0.084	**9.95**
1991	7.878	0.154	0.050	0.026	0.001		0.001	**8.11**
1992	6.625	0.637	0.016	0.022	0.002	0.002	0.008	**7.31**
1993	1.109	0.123	0.044	0.003	0.034	0.023		**1.34**
1994	6.580	0.760	0.010	0.019	0.030	0.021	0.006	**7.43**
1995	9.222	4.122	0.115	0.015	0.015	0.025	0.062	**13.58**
1996	9.643	1.638	0.211	0.144	0.027	0.021	0.019	**11.70**
1997	4.179	0.482	0.217	0.107	0.002	0.007	0.013	**5.01**
1998	4.793	0.387	0.074	0.045	0.017			**5.32**
1999	15.266	1.528	0.061	0.051	0.018	0.002	0.008	**16.93**
2000	2.485	1.517	0.157	0.017	0.015	0.006		**4.20**
2001	8.819	0.754	0.148	0.020	0.002	0.001	0.003	**9.75**
2002	7.815	1.210	0.042	0.037				**9.10**
2003	48.332	3.085	0.277	0.019	0.006	0.022	0.043	**51.78**
2004	7.048	5.307	0.372	0.079	0.008	0.012	0.031	**12.86**
2005	24.086	0.705	0.107	0.098	0.031	0.030	0.012	**25.07**
2006	36.300	1.017	0.714	0.016				**38.05**
2007	8.837	7.064	0.583	0.082	0.012	0.004	0.009	**16.59**
2008	7.444	4.543	0.797	0.012	0.010	0.009	0.026	**12.84**
2009*	1.050	5.385	0.503	0.013	0.011	0.000	0.037	**7.00**
2010*	2.559	3.352	0.527	0.029	0.069	0.028	0.093	**6.66**
2011*	2.641	4.357	0.299	0.036	0.045	0.030	0.039	**7.45**
2012*	1.746	2.763	0.587	0.123	0.043	0.004	0.008	**5.27**
2013*†	0.786	0.195	0.001	0.003	0.003	0.006		**0.99**

*indices adjusted with conversion factor = 1.16 (Miller et al., 2010)

† Timing of survey off. 2-3 weeks late because of government shutdown.

Table 7. Bluefish survey indices by age from the Delaware (stratified geometric mean number per tow) and New Jersey (stratified mean number per tow) trawl surveys.

	Delaware				New Jersey			
Year	Age			**Total**	Age			**Total**
	0	1	2		0	1	2	
1982	0.025							
1983	0.024							
1984	0.039							
1985	0.022							
1986	0.081							
1987	0.073							
1988	0.114				26.066	0.411	0.002	**26.48**
1989	0.267				7.041	0.544	0.026	**7.61**
1990	0.082	0.683	0.015	**0.780**	5.947	0.299	0.005	**6.25**
1991	0.132	0.209	0.004	**0.345**	3.652	0.009	0.020	**3.68**
1992	0.071	0.211	0.003	**0.285**	3.747	0.582	0.040	**4.37**
1993	0.063	0.220	0.013	**0.296**	2.483	0.085	0.109	**2.68**
1994	0.103	0.295	0.004	**0.401**	11.179	0.231	0.017	**11.43**
1995	0.093	0.376	0.031	**0.500**	5.055	0.238	0.050	**5.34**
1996	0.081	0.426	0.017	**0.524**	2.483	0.096	0.015	**2.59**
1997	0.147	0.317	0.023	**0.486**	3.930	0.075	0.034	**4.04**
1998	0.080	0.581	0.107	**0.768**	1.719	0.243	0.154	**2.12**
1999	0.097	0.439	0.034	**0.570**	1.710	0.350	0.035	**2.10**
2000	0.113	0.365	0.047	**0.525**	1.410	0.395	0.102	**1.91**
2001	0.290	0.555	0.107	**0.952**	0.400	0.068	0.090	**0.56**
2002	0.159	1.210	0.047	**1.416**	7.924	3.469	0.077	**11.47**
2003	0.038	0.224	0.012	**0.274**	6.793	0.196	0.077	**7.06**
2004	0.074	0.836	0.030	**0.940**	2.019	0.684	0.318	**3.02**
2005	0.060	0.127	0.009	**0.195**	6.141	0.235	0.168	**6.54**
2006	0.039	0.070	0.020	**0.129**	6.573	0.126	0.061	**6.76**
2007	0.093	0.321	0.021	**0.436**	6.136	6.718	0.342	**13.20**
2008	0.087	0.172	0.016	**0.275**	9.041	0.843	0.028	**9.91**
2009	0.031	0.282	0.029	**0.342**	3.013	0.187	0.010	**3.21**
2010	0.031	0.383	0.066	**0.481**	1.934	0.136	0.020	**2.09**
2011	0.054	0.214	0.022	**0.290**	7.364	6.989	0.017	**14.37**
2012	0.024	0.162	0.016	**0.202**	7.959	2.535	0.081	**10.57**
2013	0.041	0.125	0.000	**0.166**	3.846	0.350	0.000	**4.20**

Table 8. Bluefish survey indices by age (stratifed geometric mean number per tow) from the Conneticut DEP trawl survey.

Year	Age							Total
	0	1	2	3	4	5	6+	
1984	52.101	0.800	0.760	0.298	0.054	0.014	0.041	**54.068**
1985	36.368	1.573	1.075	0.498	0.244	0.044	0.131	**39.933**
1986	8.727	0.547	0.352	0.083	0.053	0.028	0.018	**9.808**
1987	14.357	2.229	0.951	0.279	0.213	0.131	0.070	**18.230**
1988	13.122	0.851	0.567	0.358	0.234	0.173	0.106	**15.411**
1989	47.873	1.900	0.732	0.205	0.347	0.282	0.072	**51.411**
1990	28.027	3.499	0.742	0.106	0.141	0.200	0.024	**32.739**
1991	36.482	5.233	2.078	0.194	0.135	0.164	0.075	**44.361**
1992	24.585	3.359	1.750	0.172	0.152	0.283	0.005	**30.306**
1993	25.810	1.241	2.161	0.877	0.385	0.107		**30.581**
1994	30.018	1.410	0.752	0.512	0.386	0.251	0.010	**33.339**
1995	26.588	6.967	1.313	0.303	0.168	0.202	0.034	**35.575**
1996	42.334	0.491	1.031	0.360	0.060	0.036	0.159	**44.471**
1997	40.413	0.586	0.536	0.140	0.051	0.022	0.058	**41.806**
1998	34.831	1.453	0.512	0.130	0.058	0.011	0.025	**37.020**
1999	44.950	5.617	0.287	0.188	0.046	0.049	0.079	**51.216**
2000	22.593	3.652	1.408	0.178	0.021	0.016	0.029	**27.897**
2001	34.050	2.294	2.180	0.283	0.026	0.021	0.042	**38.896**
2002	12.419	4.926	0.578	0.135	0.045	0.048	0.063	**18.214**
2003	27.307	0.357	0.655	0.104	0.024	0.034	0.044	**28.525**
2004	20.134	3.944	3.315	1.336	0.071	0.160	0.171	**29.131**
2005	29.687	0.047	0.243	0.099	0.037	0.021	0.007	**30.141**
2006	14.353	0.719	0.558	0.030				**15.660**
2007	25.680	16.460	0.940	0.260	0.040	0.010	0.040	**43.430**
2008	no september sampling							
2009	30.217	1.702	0.733	0.107	0.067	0.006	0.029	**32.860**
2010	mechanical failure							
2011	12.237	0.306	0.190	0.081	0.014	0.034	0.069	**12.930**
2012	22.346	2.563	0.165	0.066	0.024	0.008	0.017	**25.190**
2013	16.432	0.144	0.406	0.106	0.026	0.007		**17.120**

Table 9. Abundance at age (000s) for bluefish from the ASAP model updated through 2013.

Year	Age							Total
	0	1	2	3	4	5	6+	
1982	44069	42328	13007	6950	6716	11662	51532	**176263**
1983	34084	34109	29347	9105	5257	5194	44750	**161847**
1984	44537	26138	23009	20020	6798	4028	34411	**158940**
1985	24594	34323	17892	15915	15052	5234	26834	**139843**
1986	20885	18932	23416	12336	11947	11576	22372	**121465**
1987	14439	15354	11272	14201	8679	8769	21288	**94002**
1988	20409	10558	8997	6735	9916	6336	18531	**81482**
1989	45480	15091	6395	5546	4777	7321	15727	**100337**
1990	18834	34184	9594	4125	4025	3586	15246	**89594**
1991	23242	14221	22030	6269	3014	3036	12516	**84328**
1992	11440	17213	8654	13638	4457	2229	9836	**67467**
1993	12566	8606	10971	5596	9911	3348	7939	**58938**
1994	18356	9474	5521	7139	4080	7464	7516	**59551**
1995	16609	13945	6216	3669	5260	3096	10267	**59062**
1996	15923	12802	9551	4302	2760	4051	9380	**58769**
1997	14520	12316	8857	6673	3251	2133	9535	**57284**
1998	19716	11249	8562	6216	5054	2516	8282	**61595**
1999	23050	15331	7906	6071	4733	3927	7751	**68769**
2000	15409	18135	11156	5793	4700	3721	8660	**67574**
2001	26177	12055	12977	8046	4448	3674	9044	**76421**
2002	20422	20223	8312	9037	6070	3434	8999	**76496**
2003	22731	16006	14552	6026	6958	4755	9118	**80145**
2004	16002	17785	11459	10499	4628	5441	10150	**75963**
2005	22477	12374	12300	8003	7932	3576	11084	**77746**
2006	32573	17496	8725	8748	6102	6170	10555	**90369**
2007	18618	25428	12442	6255	6697	4760	12179	**86380**
2008	20768	14378	17513	8656	4717	5168	11970	**83169**
2009	13516	16179	10160	12482	6607	3672	12387	**75002**
2010	16461	10658	11853	7492	9693	5207	11945	**73310**
2011	14904	12771	7441	8353	5686	7514	12273	**68943**
2012	8939	11699	9230	5417	6444	4461	14607	**60797**
2013	13284	7074	8665	6876	4228	5098	14319	**59543**

Table 10. Biomass at age (mt) for bluefish as estimated from the ASAP model updated through 2013.

Year	Age							Total
	0	1	2	3	4	5	6+	
1982	3561	14590	16623	11476	18293	42915	255494	**362951**
1983	1684	8271	20440	16461	13381	19527	249570	**329333**
1984	2227	5293	14381	26947	17004	15159	194424	**275434**
1985	1112	6865	11283	21321	34194	17838	135590	**228202**
1986	1585	4192	16223	18506	29456	40326	108461	**218749**
1987	949	2913	8571	22110	22744	30840	106098	**194224**
1988	2612	2313	4928	10474	23751	20579	85667	**150324**
1989	3015	3408	4164	8074	13049	25000	74230	**130941**
1990	3155	8717	4929	5587	10549	13982	68211	**115131**
1991	1950	3743	13033	7735	6645	10878	62144	**106129**
1992	953	4023	5070	15687	9809	6790	50234	**92564**
1993	1517	2644	6678	8951	22514	10081	38744	**91128**
1994	1151	2542	4023	9540	11157	23903	30765	**83082**
1995	1756	3205	3892	4579	12176	10874	48212	**84693**
1996	1607	3501	6272	5602	6128	13776	44049	**80935**
1997	730	3528	6015	10148	7769	7561	57259	**93010**
1998	1985	2855	5617	9681	14289	9234	48911	**92571**
1999	1706	4558	5631	8327	13616	14755	46195	**94788**
2000	1593	4336	7809	8967	12789	13463	50671	**99629**
2001	1825	2984	7753	12050	13863	13495	44553	**96522**
2002	1481	5207	5442	12443	15869	12834	46417	**99692**
2003	1198	4514	10273	9684	17514	16597	45690	**105470**
2004	386	3443	8751	14708	11721	17286	45553	**101849**
2005	1540	2441	7417	12474	20522	12377	61283	**118052**
2006	3212	4658	6950	12492	17071	21885	56123	**122390**
2007	495	6599	9743	10296	16784	16314	60967	**121198**
2008	1817	2357	12770	14367	13030	17377	56929	**118648**
2009	503	4218	7305	21705	18832	12556	60447	**125565**
2010	864	1880	7852	10613	27937	19368	59476	**127989**
2011	602	2338	4209	9815	11545	29284	66235	**124028**
2012	356	2075	4959	5842	13606	14221	80938	**121998**
2013	526	1261	5371	8124	7917	17570	82948	**123716**

Table 11. Annual SSB (MT), recruitment (000s), total abundance (000s), and F from the ASAP model updated through 2013.

Year	SSB	Recruitment	Total Abundance	F
1982	314095	44069	176263	0.161
1983	288344	34084	161847	0.187
1984	251449	44537	158940	0.173
1985	216116	24594	139843	0.176
1986	207229	20885	121465	0.307
1987	171621	14439	94002	0.320
1988	133802	20409	81482	0.288
1989	120439	45480	100337	0.241
1990	98483	18834	89594	0.229
1991	89876	23242	84328	0.282
1992	90617	11440	67467	0.238
1993	87018	12566	58938	0.232
1994	78365	18356	59551	0.211
1995	78308	16609	59062	0.170
1996	74793	15923	58769	0.161
1997	90404	14520	57284	0.156
1998	87666	19716	61595	0.146
1999	89952	23050	68769	0.113
2000	95106	15409	67574	0.130
2001	90547	26177	76421	0.166
2002	96099	20422	76496	0.125
2003	99486	22731	80145	0.130
2004	95937	16002	75963	0.164
2005	117524	22477	77746	0.145
2006	112286	32573	90369	0.137
2007	109798	18618	86380	0.169
2008	113381	20768	83169	0.144
2009	122346	13516	75002	0.109
2010	117913	16461	73310	0.156
2011	115466	14904	68943	0.123
2012	117417	8939	60797	0.099
2013	114382	13284	59543	0.118

Table 12. Projection results for bluefish through 2016 under various fishing scenarios.

		Quota (000s mt)	F	Jan 1 Abundance (000s)	Mean Biomass (000s mt)	SSB (000s mt)	Yield (000s mt)
F status quo	**2014**	11.08		64930.90	110.38	104.77	11.08
	2015		0.118	68624.50	105.94	98.48	9.92
	2016		0.118	70609.40	104.38	95.82	10.02
F low	**2014**	11.08		64930.90	110.38	104.77	11.08
	2015		0.10	68624.50	106.66	99.18	8.47
	2016		0.10	71251.80	106.54	97.87	8.68
F0.1	**2014**	11.08		64930.90	110.38	104.77	11.08
	2015		0.16	68624.50	104.28	96.86	13.23
	2016		0.16	69147.00	99.54	91.20	12.93
Ftarget	**2014**	11.08		64930.90	110.38	104.77	11.08
	2015		0.17	68624.50	103.89	96.48	14.00
	2016		0.17	68806.00	98.42	90.14	13.57
Fmsy	**2014**	11.08		64930.90	110.38	104.77	11.08
	2015		0.19	68624.50	103.12	95.72	15.52
	2016		0.19	68132.50	96.23	88.05	14.82

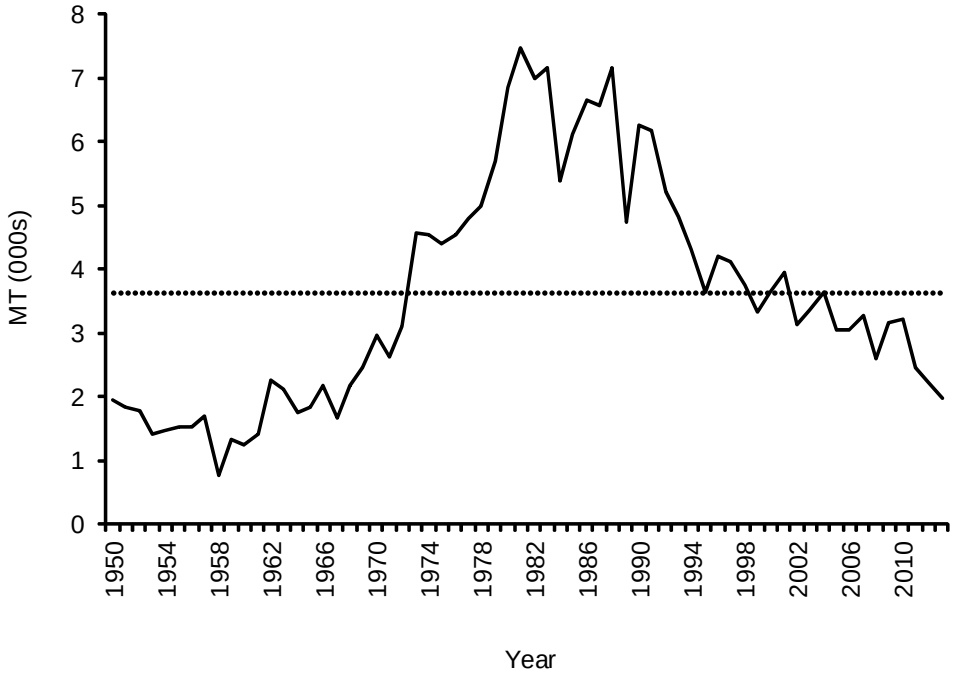


Figure 1. Times series of bluefish commercial landings (mt) along the Atlantic coast from 1950 to 2013.

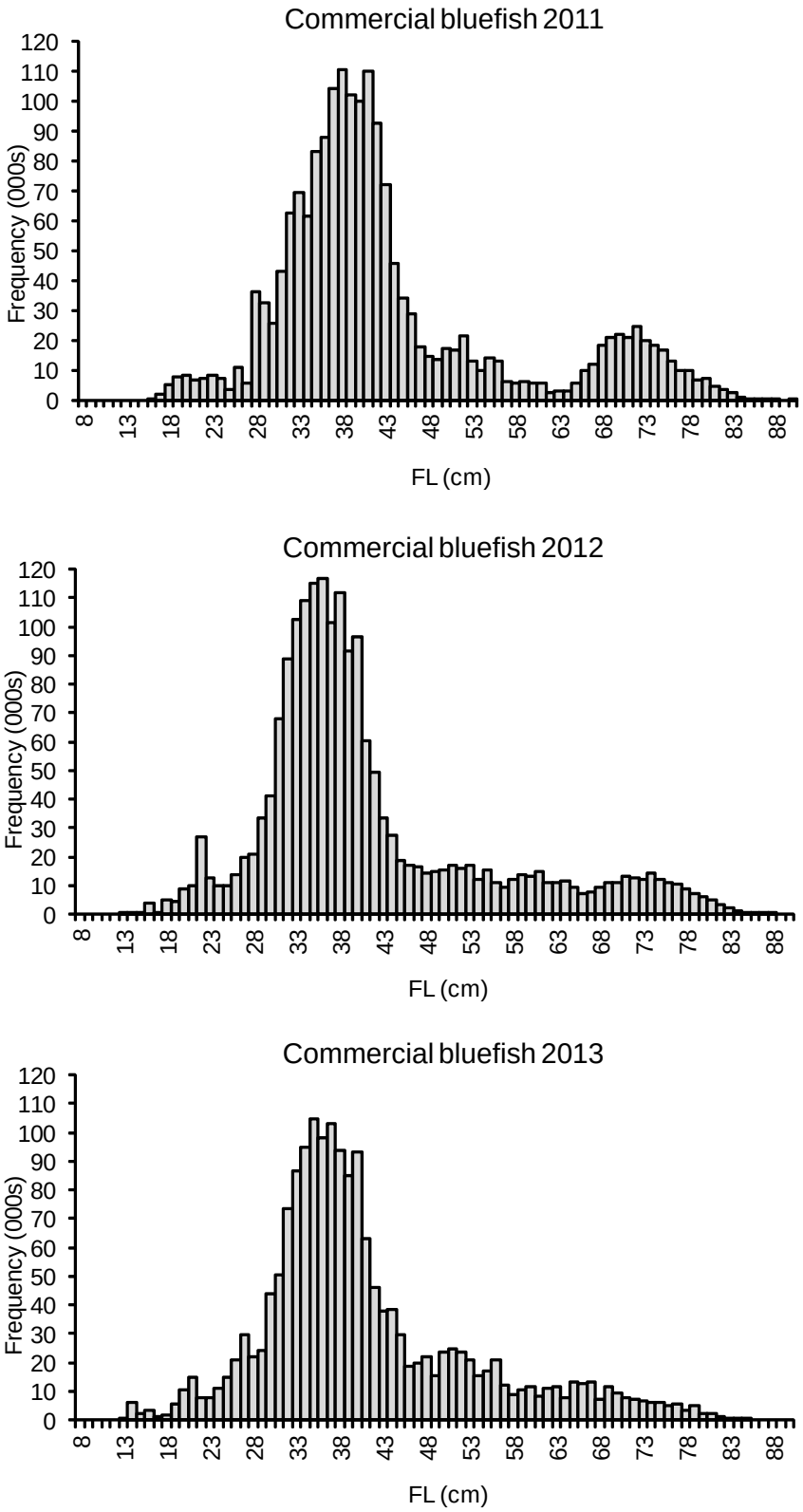


Figure 2. Length frequency distribution of commercial bluefish landings from Maine to Florida, 2011 to 2013.

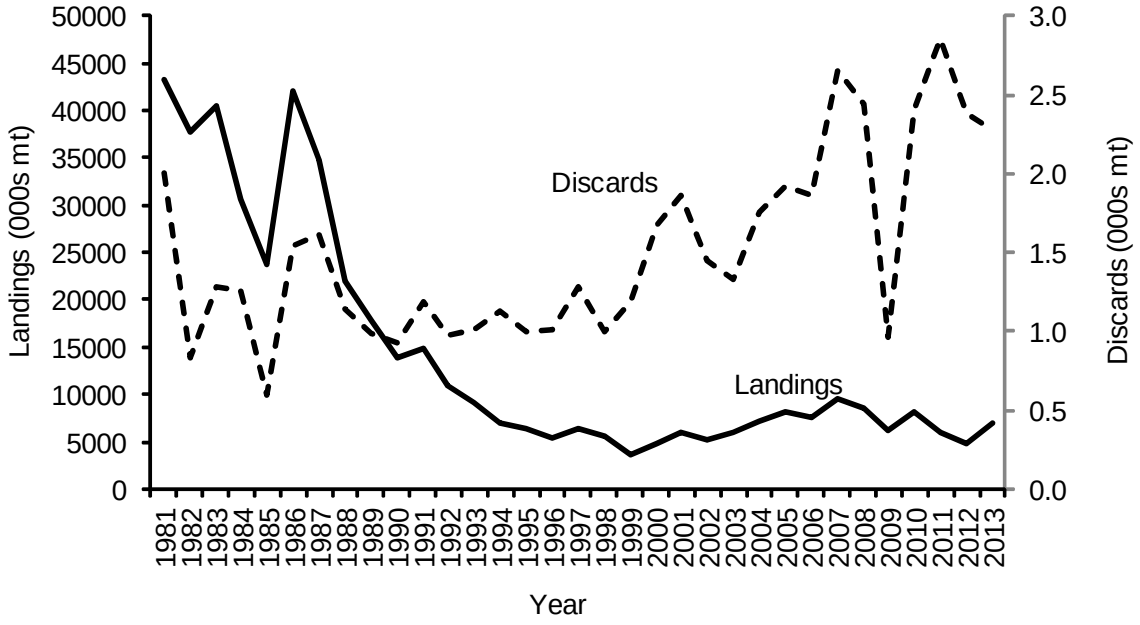


Figure 3. Recreational landings (mt) and recreational discard losses (MRIP B2 estimates*0.15) from Maine to Florida, 1981 to 2013.

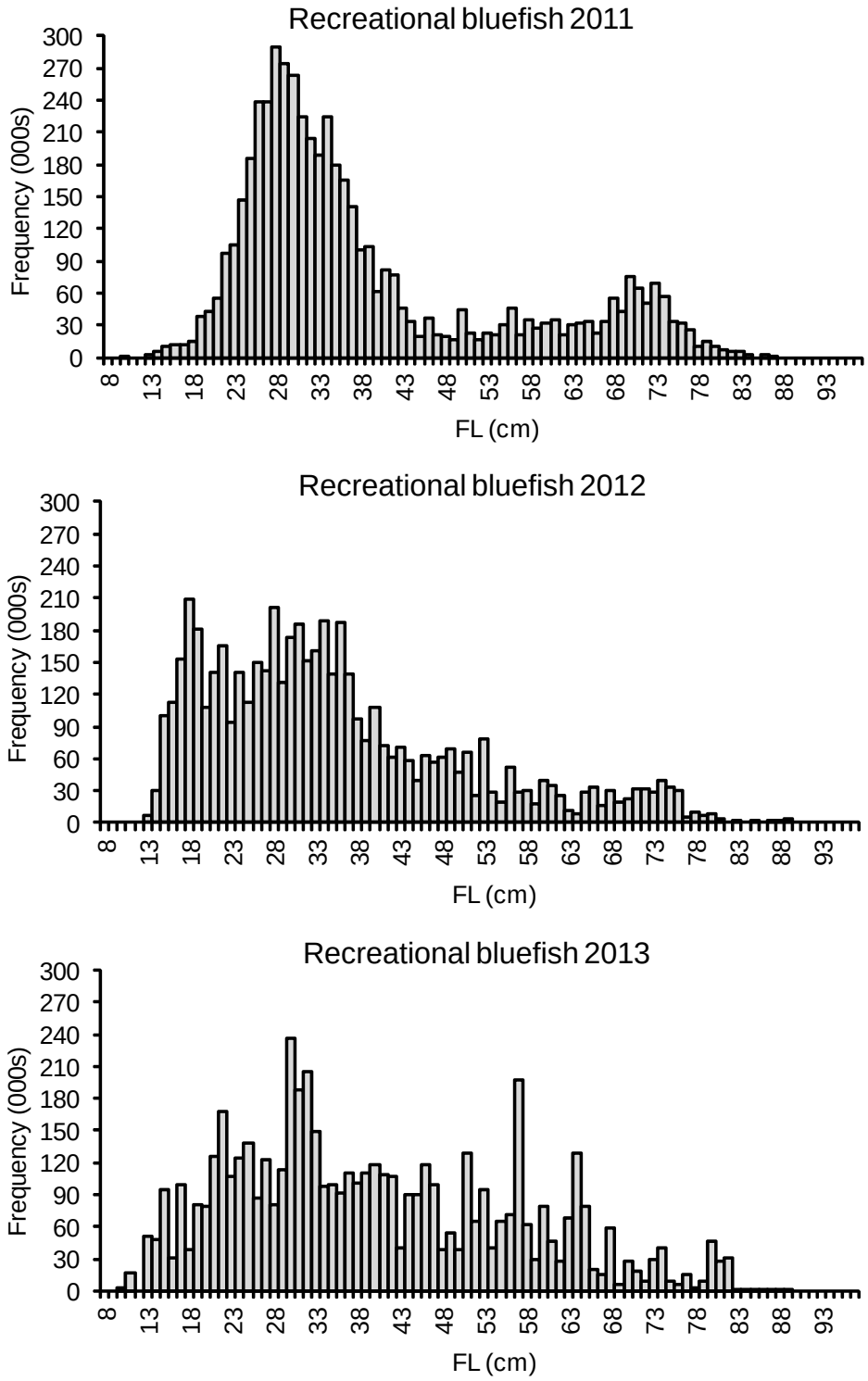


Figure 4. Length frequency distribution of recreational bluefish landings from Maine to Florida, 2011 to 2013.

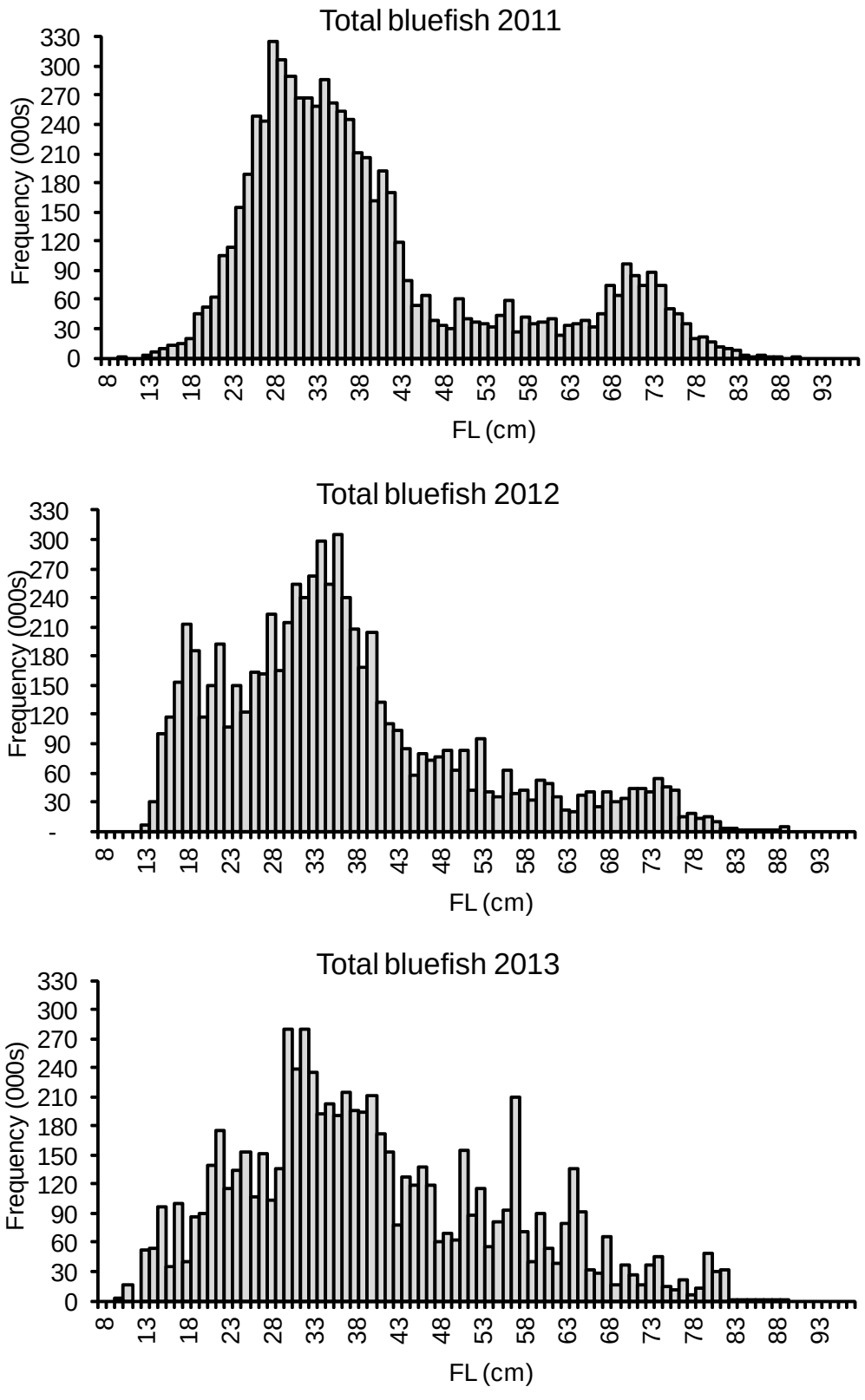


Figure 5. Length frequency distribution of total bluefish landings from Maine to Florida, 2011 to 2013.

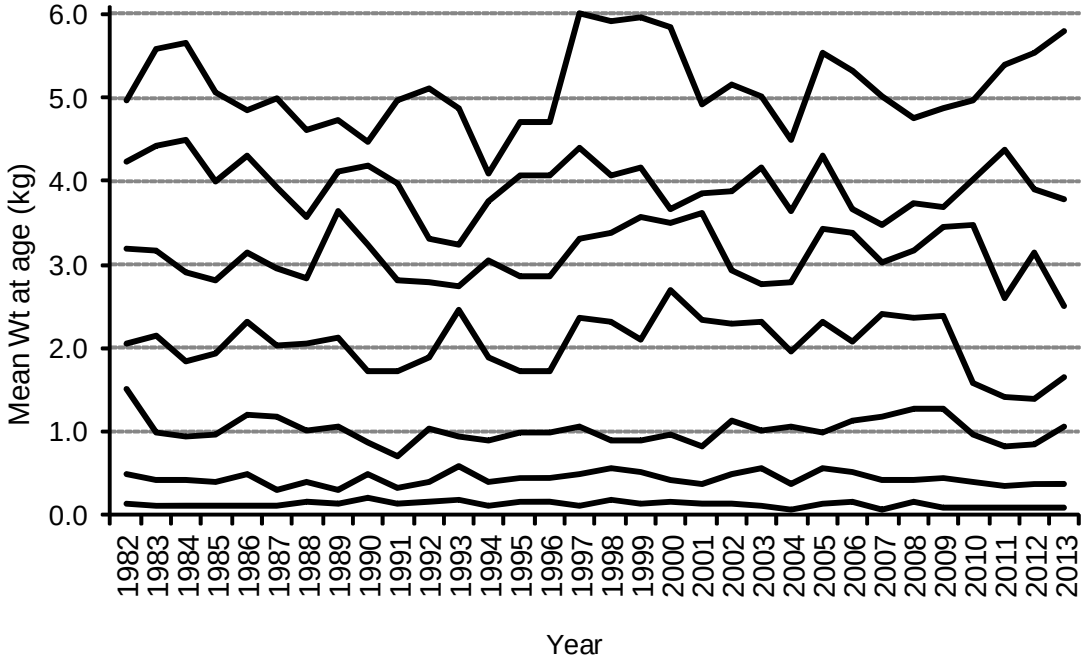


Figure 6. Bluefish mean weights (kg) at ages 0 to 6+ from 1982 to 2013.

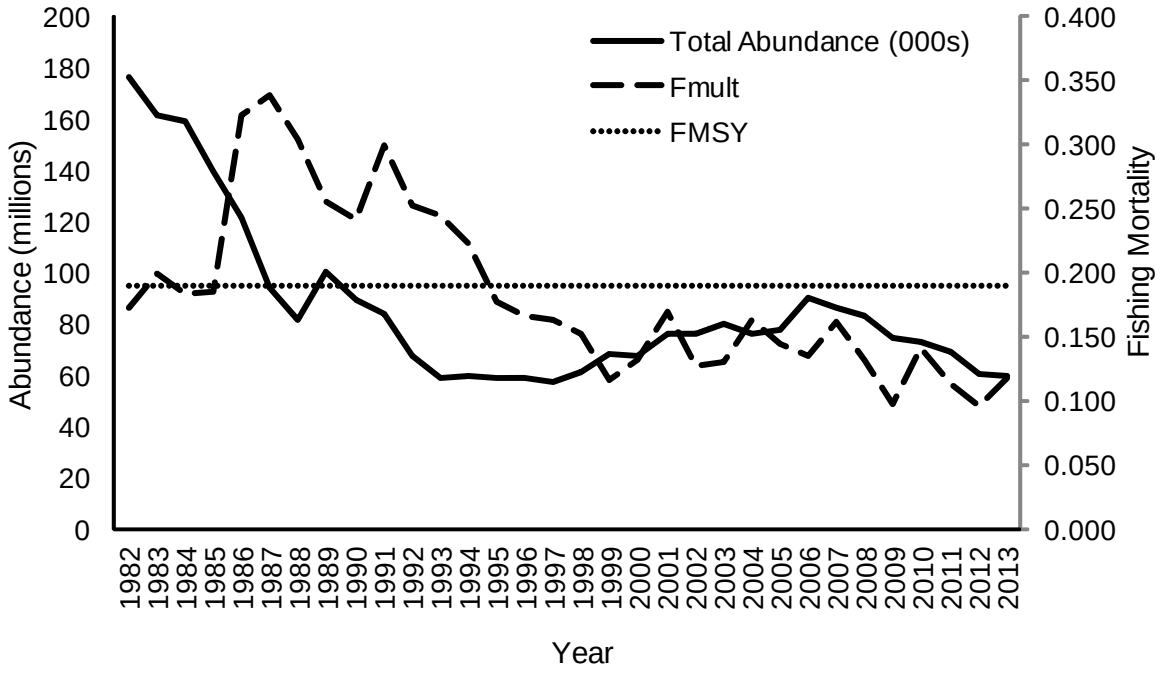


Figure 7. Total bluefish abundance and fishing mortality as estimated in ASAP model updated through 2013. F_{MSY} indicated by dotted horizontal line.

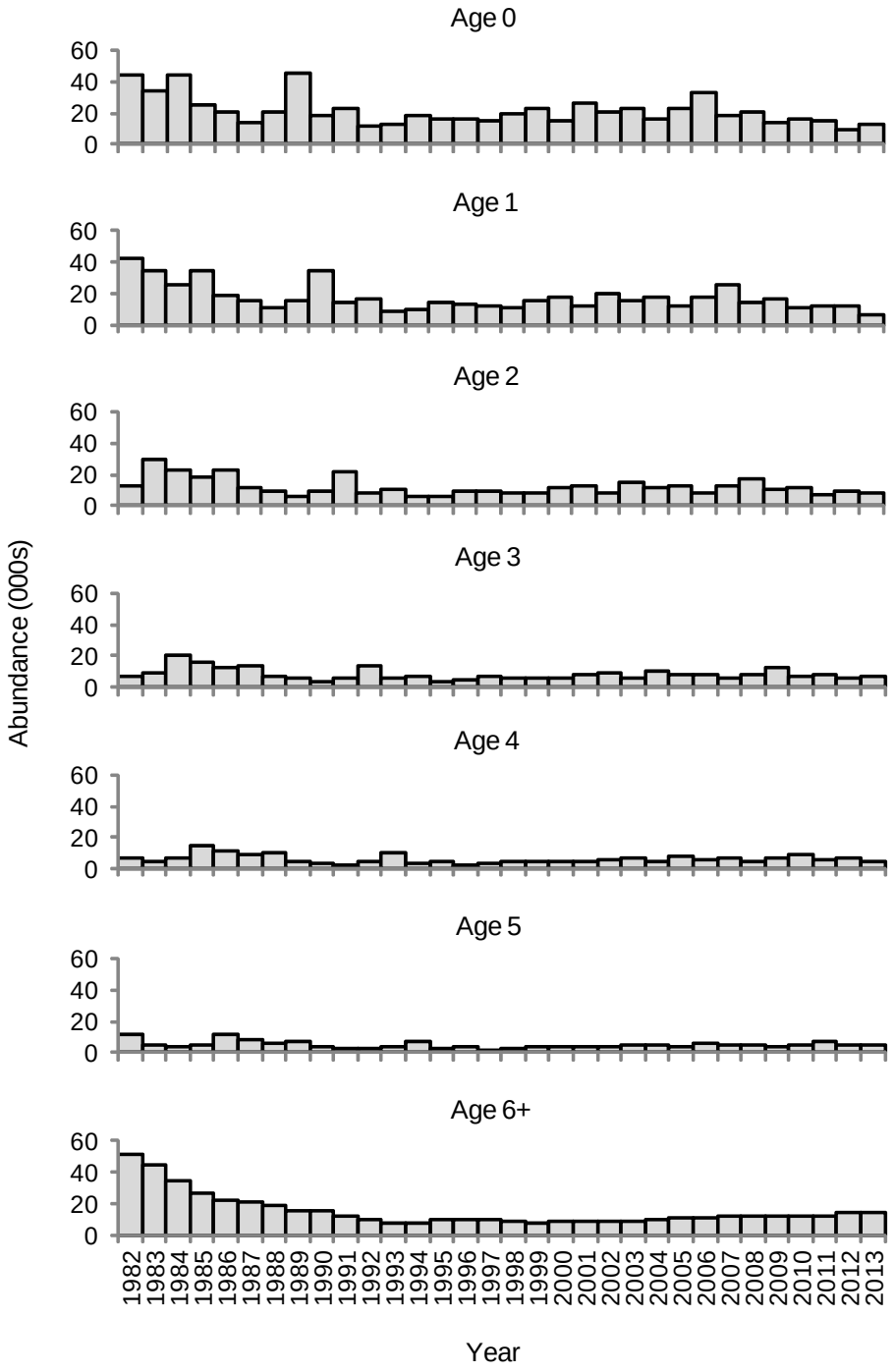


Figure 8. Total bluefish abundance (000s) at age from ASAP model results.

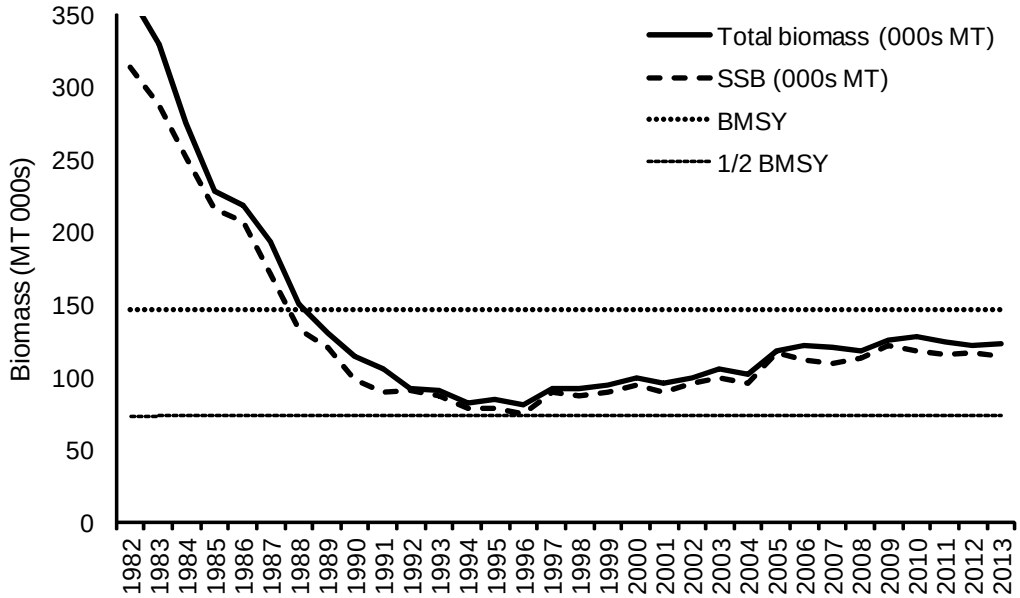


Figure 9. Time series of bluefish total mean biomass (000s mt) and spawning stock biomass (000s mt).

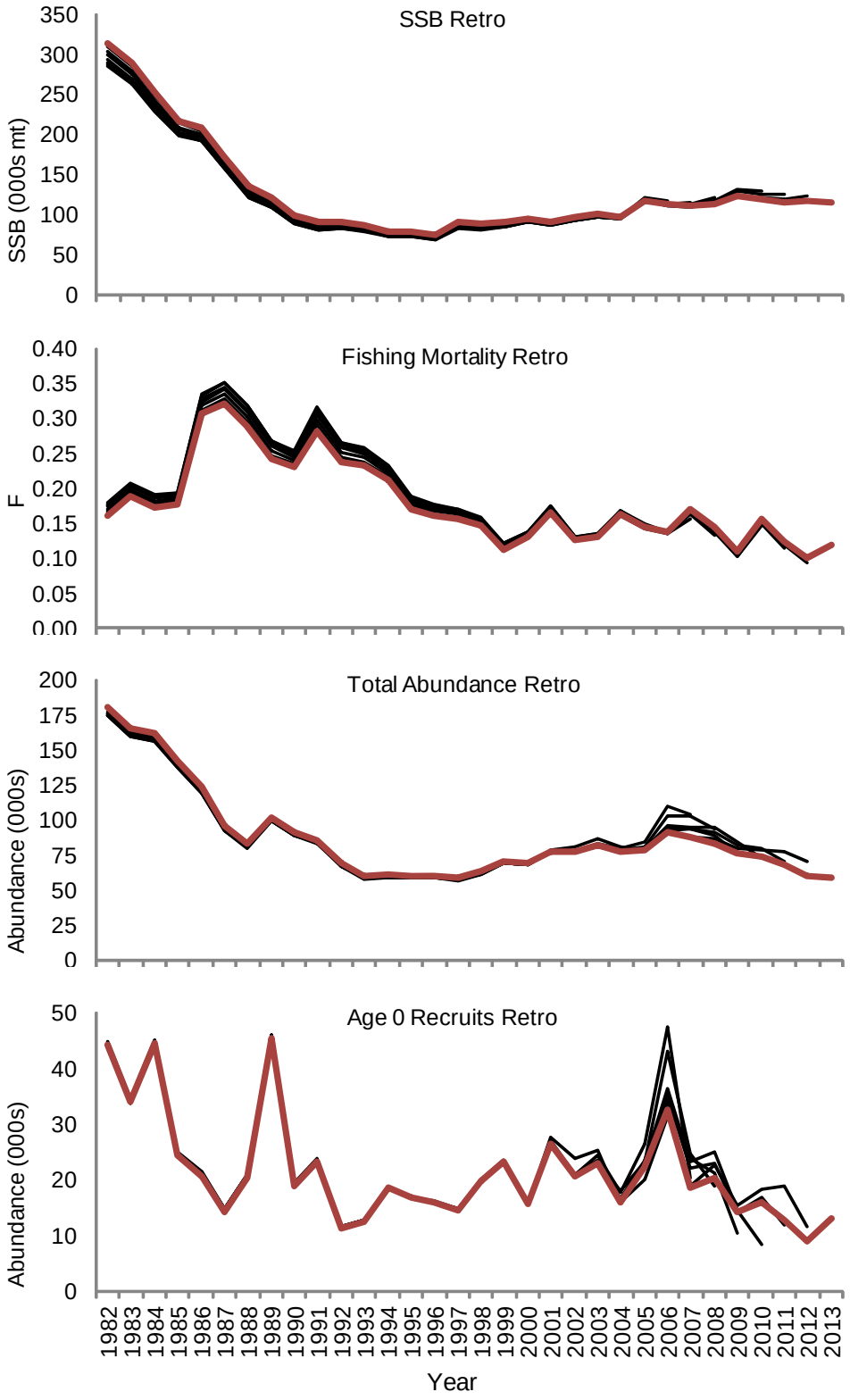
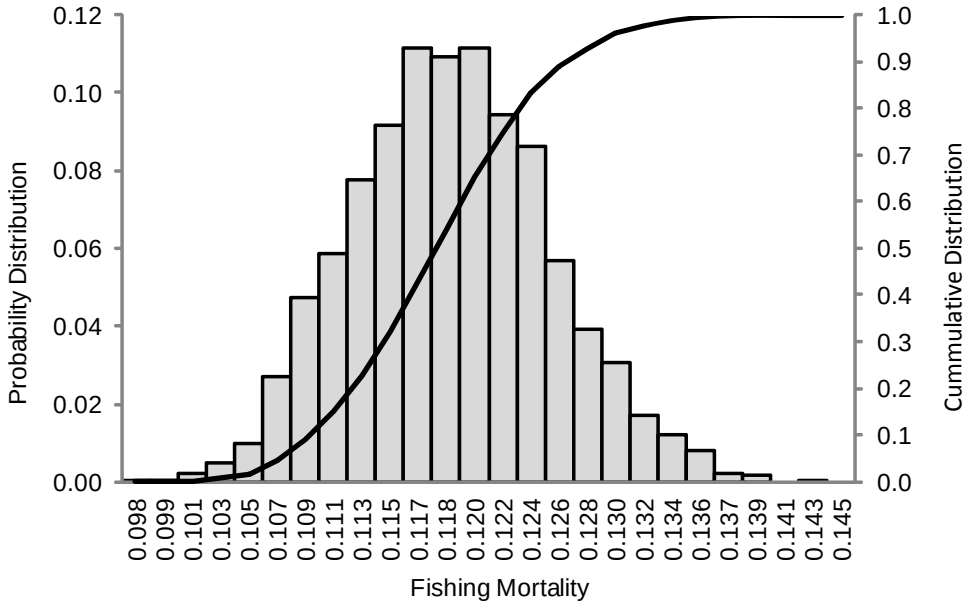


Figure 10. Retrospective bias in bluefish estimates from ASAP model.



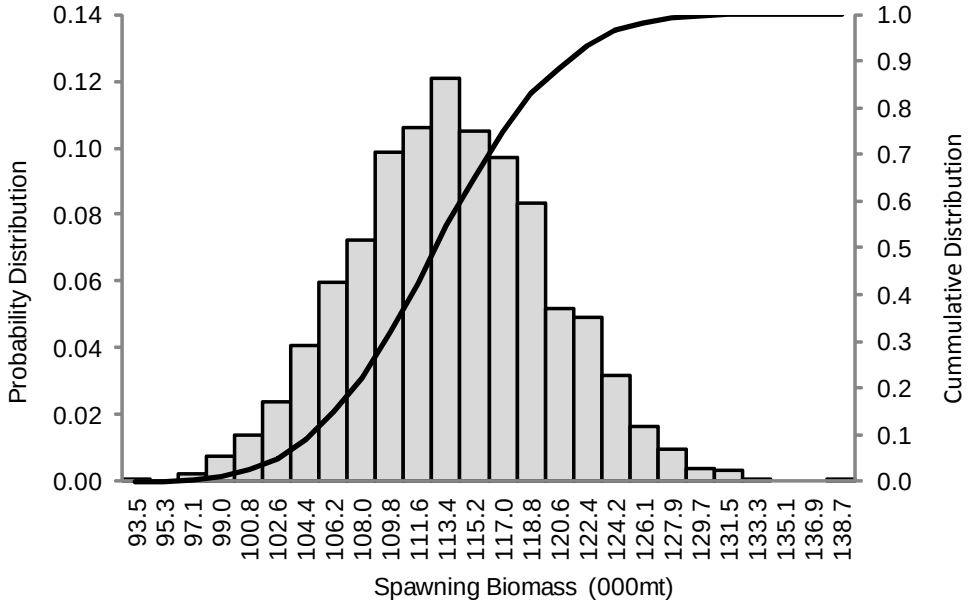


Figure 11. Distribution of bluefish fishing mortality and spawning stock biomass resulting from 1000 MCMC iterations in ASAP model.

Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201, Dover, DE 19901-3910
Phone: 302-674-2331 | Toll Free: 877-446-2362 | FAX: 302-674-5399 | www.mafmc.org
Richard B. Robins, Jr., Chairman | Lee G. Anderson, Vice Chairman
Christopher M. Moore, Ph.D., Executive Director

MEMORANDUM

DATE: July 17, 2014

TO: Chris Moore, Executive Director

FROM: Jim Armstrong, Staff Lead, Bluefish FMP

SUBJECT: Bluefish ABC and Management Measures for 2015

Executive Summary

The 2014 bluefish assessment update indicates that the bluefish stock is not overfished and overfishing is not occurring. The estimate of stock biomass (123,716 mt) for 2013 is 84.1 % of B_{MSY} (147,052 mt) and realized F for 2013 (0.118) is below F_{MSY} (0.19). Staff has identified acceptable biological catch (ABC) = 9,772 mt for 2015, consistent with Council risk policy for a tier 3 assessment and a species with a typical life history, a B/B_{MSY} ratio of 0.7506, and OFL = 15,522 mt. According to the FMP, ACL is set equal to ABC. It is recommended that the commercial and recreational Annual Catch Targets (ACTs) sum to ACL and ABC (no buffer for management uncertainty). After adjusting the ACTs for discards (1,520 mt), the commercial and recreational total allowable landings (TALs) sum to (8,252 mt). The maximum allowable transfer of landings to the commercial fishery would result in a recreational harvest limit (RHL) of 6,113 mt and a commercial quota of 2,139 mt before adjusting for RSA. Staff recommends that up to 3% of the TALs (248 mt) be made available to the Research Set-Aside (RSA) Program. Staff also recommends reducing the current recreational bag limit to 10 fish.

Introduction

Specification of bluefish management measures is a joint process conducted annually by the Mid-Atlantic Fishery Management Council (Council) and the Atlantic States Marine Fisheries Commission's Bluefish Management Board (Board) with information and recommendations coming from their associated committees. The Commission's Bluefish Stock Assessment Sub-Committee (SASC) updates the bluefish assessment and conducts short term projections. The Council's Scientific and Statistical Committee (SSC) reviews assessment results and determines the acceptable biological catch (ABC) for the upcoming year. ABC is a reduction from the overfishing limit (OFL) based on the SSC's consideration of scientific uncertainty and serves as an upper limit on the catch target that management measures attempt to achieve. The Council's Bluefish Monitoring Committee (MC) develops and recommends specific coastwide (Maine – E. Coast Florida) management measures and allocations that will achieve target catch and make further adjustments to total catch as needed based on management uncertainty. Finally, the Council and Board meet jointly to develop recommendations to be submitted to the National Marine Fisheries Service.

In this memorandum, information is presented to assist the SSC and MC in their roles in the specification process. Assessment update results are presented briefly, and a more detailed summary prepared by the SASC is distributed under separate cover.

Catch and Landings

As shown in Figure 1, from the early 1980s to the early 1990s, recreational landings estimates declined dramatically (avg. 1981-1983 = 40,433 mt; avg. 1991-1993 = 11,727 mt). Recreational landings estimates continued to decline at a somewhat slower rate until reaching a low of 3,744 mt in 1999. A rebuilding plan was implemented in 2000 and the stock was declared rebuilt in 2009. Since 2000, recreational landings estimates grew to a peak of 9,608 mt in 2007, and then declined to an all-time low of 4,846 mt in 2012. In 2013, recreational landings increased to 6,980 mt. Estimated recreational discards increased from less than 10% of the rec catch in the 1980s to an average of 22% of the rec catch in the 2000s. Commercial landings have declined at a slower rate over the landings history, from around 7,000 mt in the early 1980s to around 3,000 mt in the 2000s. The 2013 commercial landings at 1,961 mt is the lowest on record. Commercial discards are treated as insignificant and are not estimated in the current assessment.

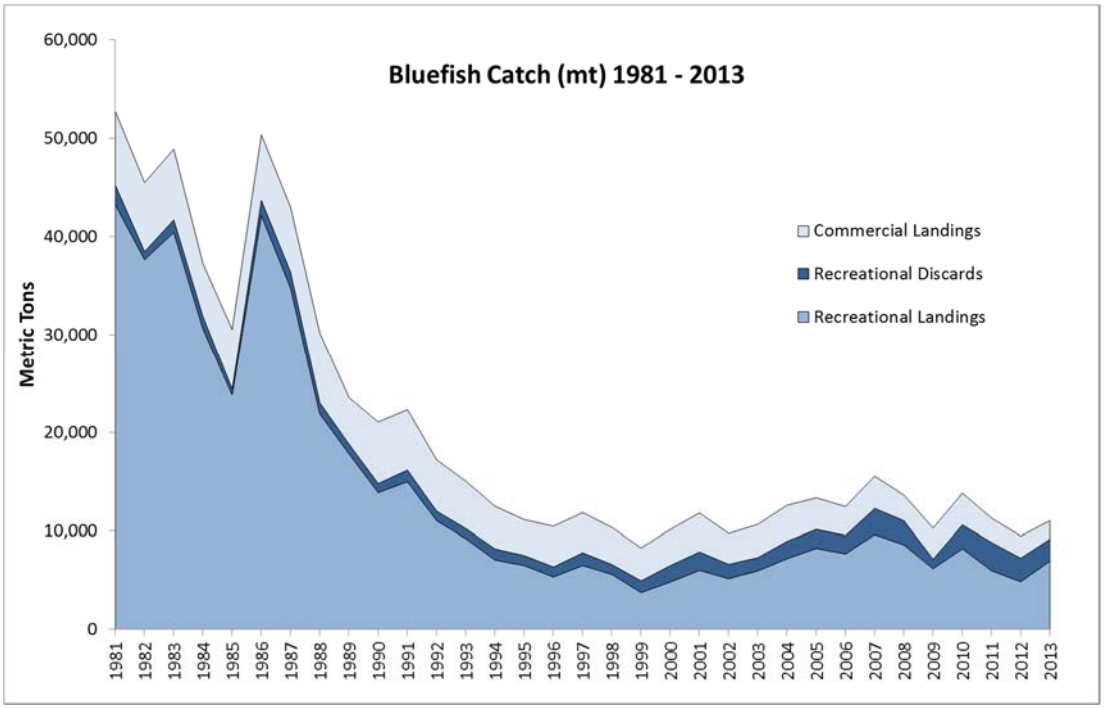


Figure 1. Time series of bluefish recreational and commercial landings and discards (Data Source: 2014 Assessment Update).

Regulatory Review (Current Management Measures)

For the current 2014 fishing year, bluefish ABC (12,461 mt) was based on P* = 0.341 which was calculated using OFL_{2014} = 16,506 mt, B_{2013}/B_{MSY} =0.8113, CV for OFL = 100%, and life history = "typical".

Specific sources of uncertainty in the assessment that have been noted by the SSC include:

- Missing data in the age-length keys (ALKs)
- Calibration of Albatross vs. Bigelow trawl catches
- Previously sampled near shore areas unavailable to the BIGELOW.

- Commercial discards assumed insignificant
- Significant population biomass (~40%) aggregated in the 6+ age group
- Uncertainty in the MRFSS estimates, in general

According to the FMP, ACL is set equivalent to ABC and, given the historic underharvest of landings allowances by the fishery the Monitoring Committee concluded that no deduction to accommodate management uncertainty was needed, so ABC = ACL = ACT. Specifically, the recreational ACT (83%) is 9,198 mt and the commercial ACT (17%) is 1,884 mt. Estimated discards for the 2014 fishery are the average observed discards for the past three years and were 1,520 mt for the recreational fishery and zero for the commercial fishery. The resulting recreational TAL for 2014 is 7,678 mt and the commercial TAL is 1,884 mt. The FMP stipulates that if 17% of the TAL is less than 4,763 mt (10.5 M lb), then a transfer of landings could be made to increase the commercial quota to a limit of 4,763 mt as long as the combined commercial and recreational landings would not exceed the TAL.

In the specification of management measures for 2014, an estimate of recreational harvest for 2014 (5,978 mt) was reported. Accordingly, a transfer of 1,515 mt to the commercial fishery was made resulting in an initial commercial quota of 3,399 mt and an initial RHL of 6,163 mt. An adjustment for research set aside resulted in a final commercial quota of 3,297 mt and a final RHL of 5,978 mt.

Biological Reference Points

Bluefish biological reference points were established in the most recent benchmark assessment (41st SARC; NEFSC 2005). The reference points are based on output from the ASAP model, a forward projecting statistical catch-at-age model that is used to estimate current and historic population size and fishing mortality (Legault and Restrepo 1998).

Overfishing is defined as occurring above F_{MSY} is 0.19, which was determined internally to the ASAP model. Overfishing is prevented by setting management measures based on ABC which is calculated using the Council's risk policy for a Tier 3 assessment (P* method).

The estimate of B_{MSY} is 147,051 mt, and the level at which the stock is determined to be overfished (½ B_{MSY}) is 73,525.5 mt. B_{MSY} was estimated in the 2005 assessment using SSB and recruit estimates from ASAP, fit externally to a Beverton-Holt stock-recruit model and subsequently using Thompson-Bell Yield and SSB/R.

Stock Status and Projections

The current update uses MRIP instead of MRFSS data as recreational inputs for 2004 forward. The effect is that of minor shifts, but no significant change in recreational estimates.

The ASAP estimate of fishing mortality for 2013 is 0.118, below the F threshold (F_{MSY} = 0.19). This outcome supports the statement that for 2012 *overfishing was not occurring*. Model estimates of annual F have been below threshold levels since 1995 (see Figure 2), consistent with catches that support growth in population biomass.

Within the past 20 years, estimated population abundance peaked in 2006 at 90.369 million fish, but has declined since to 59.543 million fish in 2013 (Table 9 in the Assessment Update). The current low is due largely to model estimates of weak year class strength rather than high fishing mortality. The 2012 year class is the lowest in the time series. Retrospective analysis of recruitment estimates showed underestimation of terminal year classes in the previous assessment update, but in the current update, the

retrospective pattern is less evident (Figure 10 in the Assessment Update). Recreational catches of age zero fish have been lower in recent years (about 3% of the rec catch in 2009-2011) than the long term average (around 18% in 1982-2008).

The time series of estimated stock biomass has increased by about 158% since 1996 (See Figure 3 below and Table 10 in the Assessment Update). The estimate of total biomass for 2013 is 123,716 mt which is 84% of B_{MSY} (147,052 mt) and 168% of the ½ B_{MSY} threshold (73,526). As such, *the stock is not overfished*.

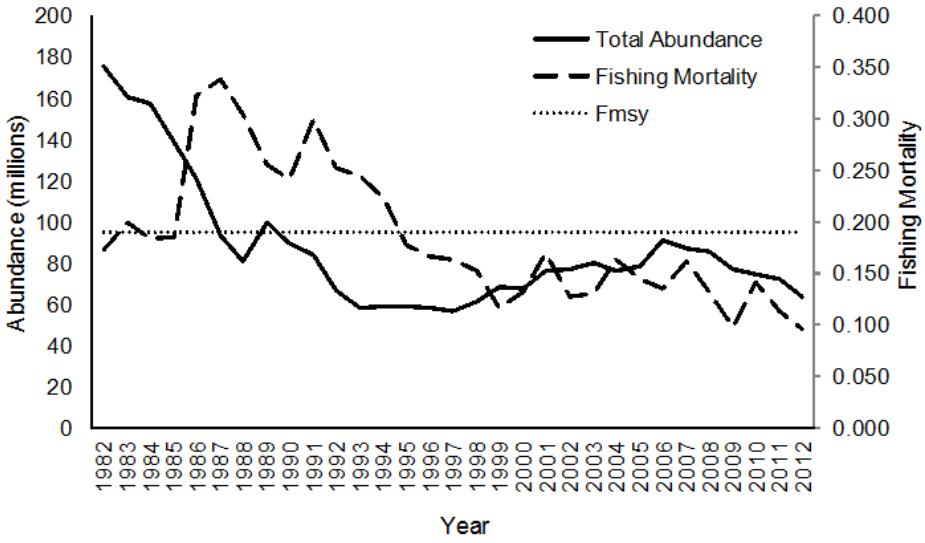


Figure 2. Total bluefish abundance and fishing mortality as estimated in ASAP model. FMSY is indicated by the solid horizontal line. (Source: 2014 Assessment Update)

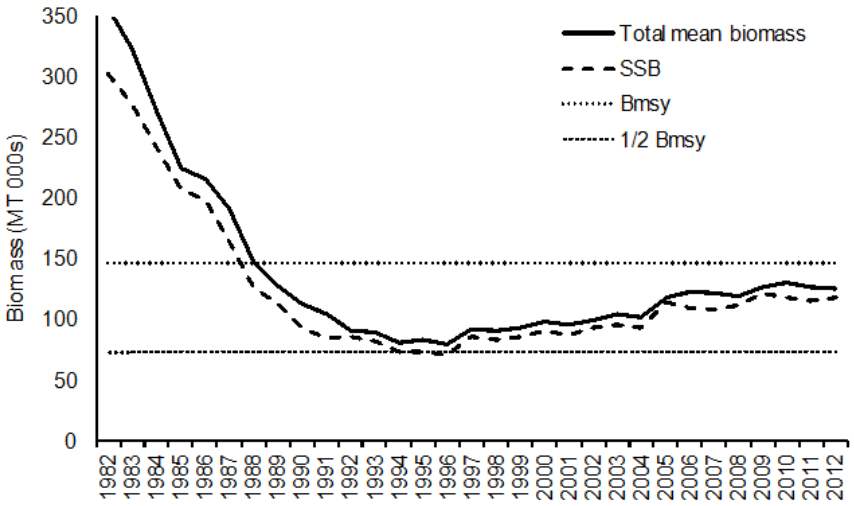


Figure 3. Time series of bluefish total mean biomass (000s mt) and spawning stock biomass (000s mt) relative to Bmsy target and threshold. (Source: 2014 Assessment Update)

ABC Recommendation

Since the implementation of the Omnibus ACL/AM Amendment (Bluefish Amendment 3) in 2012, ABC for bluefish has been calculated using the Council's Risk Policy for a tier-3 assessment and a species with a typical life history. Consistent with that approach, the needed inputs include OFL (projected catch at F_{MSY}) and $B_{CURRENT}/B_{MSY}$. For 2015, OFL is projected to be 15,520 mt and B_{2014}/B_{MSY} is 0.7506 which results in ABC = 9,772 mt. This corresponds to an estimated probability of overfishing (P*) = 0.289 and ABC = 62.95% of OFL.

It may be noted that if the above ABC is adopted it continues a decline in ABC of approximately 12% annually (33% total) since the 2012 specification year even though catches have not achieved specified limits and biomass appears to be stable (i.e., Figure 3). The driver for the annual declines in ABC is serial reductions in terminal year estimates of biomass (retrospective pattern) which has resulted in declining B/B_{MSY}. Figure 4 provides the biomass time series for the last four assessment updates.

Table 1. Changes in OFL, ABC, B/B_{MSY} for 2012-2015 specification years. (Metric Tons)

Specif. Year	OFL	ABC	Change	Mean Biomass		$B_{Proj}/Bmsy$
				Term Year	Proj Year	
2012	18,572	14,535		145,455	141,833	96.50%
2013	17,521	12,461	-14.3%	132,890	127,577	86.80%
2014	16,506	11,082	-11.1%	125,808	119,311	81.10%
2015	15,522	9,772	-11.8%	123,716	110,378	75.10%

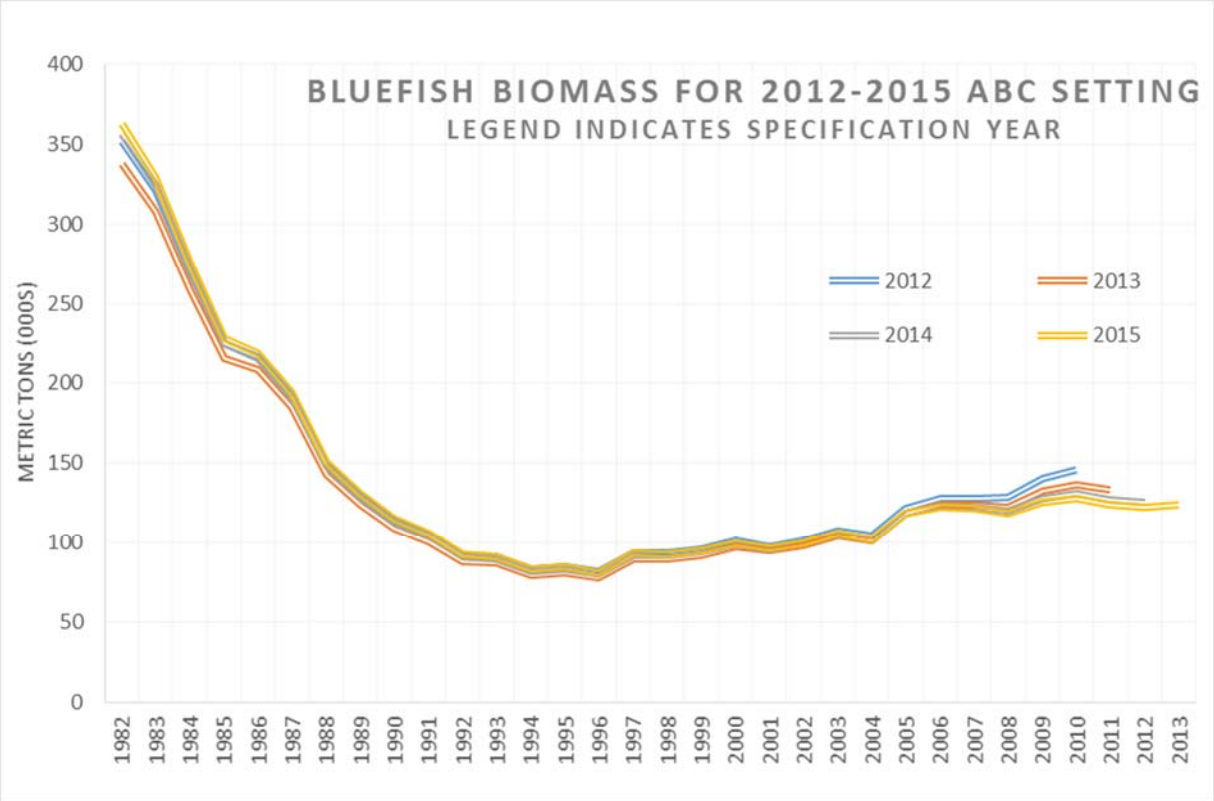


Figure 4. Time series of bluefish total biomass (000s mt) from the assessment updates used for the 2012-2015 specification years. (Source: 2011-2014 Assessment Updates)

Other Management Measures

Derivation of the management measures discussed in this section is provided in Table1.

Annual Catch Limit

Under the Omnibus Amendment, an annual catch limit (ACL) is set equal to ABC. Accordingly, the recommended ACL for bluefish for 2015 is 9,772 mt.

Table 2. Bluefish management measures for 2015 based on ABC = 9,772 mt.

2014 Management Measure	Basis	mt	M lb
OFL		15,520	34,215,743
ABC	Constant F (0.132)	9,772	21,543,572
ACL	= ABC	9,772	21,543,572
Mgmt Uncertainty	per MC	0	0
Comm Discards	from assessment	0	0
Rec Discards	Three Year Average	1,520	3,351,026
Comm ACT	(ACL - Mgmt Uncert) * 17%	1,661	3,662,407
Rec ACT	(ACL - Mgmt Uncert) * 83%	8,111	17,881,165
Comm TAL	Comm ACT - Disc	1,661	3,662,407
Rec TAL	Rec ACT - Disc	6,591	14,530,139
TAL (combined)	Comm + Rec TAL	8,252	18,192,546
Expected Recreational Landings	Three Year Average	5,930	13,073,412
Maximum Transfer	Calculated	477	1,052,394
pre-RSA Comm Quota	Comm TAL + transfer	2,139	4,714,802
pre-RSA RHL	Rec TAL - transfer	6,113	13,477,744
Comm RSA Deduction (3%)	3% of Comm Quota	64	141,444
Rec RSA Deduction (3%)	3% of RHL	183	404,332
Adjusted Comm Quota	Comm Quota - RSA	2,074	4,573,358
Adjusted RHL	RHL - RSA	5,930	13,073,412

ACT and TAL

The FMP prescribes an initial allocation of 17% of the ACL to the commercial ACT and 83% to the recreational ACT (Table 2) which is based on the historic proportion of commercial and recreational landings for the period 1981-1989. Prior to this initial split, however, a reduction from ACL can be made in order to accommodate management uncertainty. As an initial proposal and in order to avoid impinging further on the commercial fishery given the reductions in ABC (Tables 1 and 2), staff recommend no reduction from ACL for management uncertainty.

A reduction of the commercial and recreational ACTs to their respective TALs is mandatory and is calculated as ACT – discards for each fishery. No adjustment is made in calculating the commercial TAL since commercial discards are not currently estimated in the assessment and are assumed to be negligible. The adjustment to the Rec ACT for discards accommodates the updated discard estimate of

1,520 mt (average of the last three years). The combined TAL is 8,252 mt; Table 2).

Quota Transfer and Initial RHL and Commercial Quota

The FMP stipulates that if 17% of the combined TAL is less than 10.5 M lb (4,763 mt) then the commercial quota could be increased to as much as 10.5 M lb as long as the recreational fishery is projected to land less than 83% of the TAL in the specification year. The recreational fishery is expected to land 5,930 mt (72% of the TAL) and as such a transfer of 477 mt to the commercial fishery is possible which results in an initial commercial quota of 2,139 mt and an initial recreational harvest limit of 6,113 mt (Table 2).

RSA deduction and Adjusted RHL and Commercial Quota

An adjustment allowing for research projects to utilize up to 3% of bluefish TAL may be specified for 2015. The reduction from the TALs (total = 247 mt) for RSA results in an adjusted commercial quota of 2,074 mt and an adjusted recreational harvest limit of 5,930 mt. Note the marked reduction in the commercial quota for 2015 compared to previous years (Table 3a and 3b). This quota is the maximum that can be achieved given continued reductions in B/BMSY.

Gear Regulations and Minimum Fish Size

There was unanimous support among Advisors who participated in the July 11, 2014 Bluefish Advisory Panel meeting for reduction of the current 15 fish recreational bag limit. Catch and landings frequencies (Figure 5) suggest minimal impact on anglers if the recreational bag limit were to be reduced to 10 fish and a reduced bag limit would be more in keeping with state-specified bag limits. Staff recommends a 10 fish recreational bag limit for 2015.

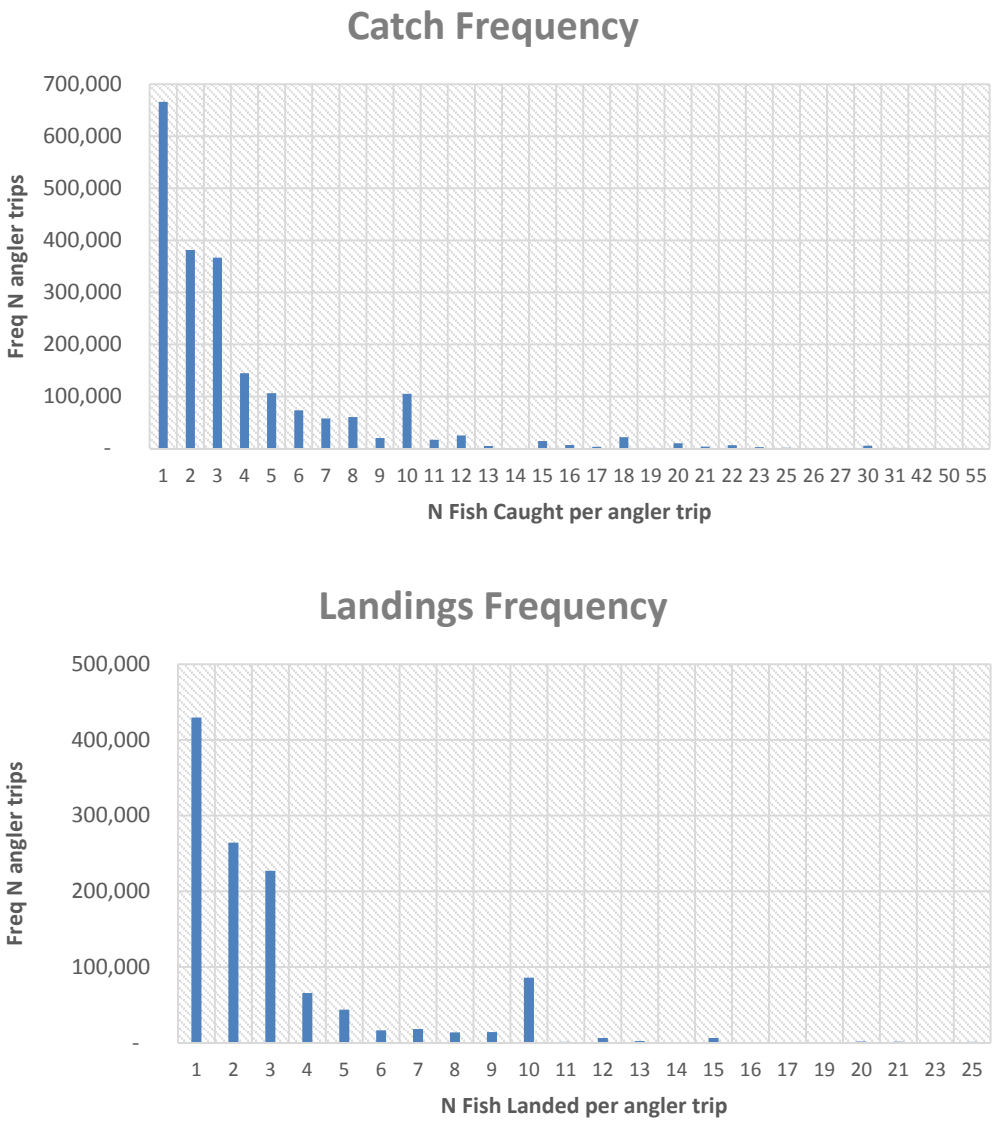


Figure 5. Catch (top) and landings (bottom) frequencies for recreationally caught bluefish in 2013. (Source: Scott Steinback NEFSC; MRIP)

Table 3a. Summary of bluefish management measures, 2000 – 2014 and proposed 2015. (Values are in mt)

Management Measures	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TAC[1]/ **ABC**[2] (M lb)	n/a	n/a	13,200	17,917	15,520	15,520	13,222	14,530	14,464	15,459	15,593	14,399	14,535	12,461	11,082	9,772
TAL (M lb)[3]	16,025	17,164	12,186	16,916	14,447	13,995	11,248	12,593	12,771	13,316	13,274	12,380	12,822	10,823	9,562	8,252
Comm. Quota (M lb)[4]	4,347	4,347	4,763	4,763	4,763	4,763	3,665	3,941	3,495	4,458	4,633	4,252	4,680	4,117	3,297	2,074
Comm. Landings (M lb)	3,647	3,945	3,116	3,358	3,647	3,187	2,926	3,267	2,585	3,151	3,206	2,455	2,236	1,961	-	-
Rec. Harvest Limit[4]	11,678	12,818	7,423	12,153	9,684	9,232	7,583	8,651	9,276	8,858	8,451	8,080	7,918	6,382	5,978	5,930
Rec. Landings (M lb)	4,811	6,001	5,158	5,958	7,179	8,225	7,663	9,608	8,573	6,161	8,184	5,965	4,846	6,980	-	
Rec. Possession Limit	10	15	15	15	15	15	15	15	15	15	15	15	15	15	15	*10*
Total Landings	8,458	9,946	8,274	9,316	10,826	11,412	10,589	12,874	11,158	9,312	11,390	8,420	7,082	8,941	-	-
Overage/Underage (M lb)	-7,567	-7,218	-3,912	-7,600	-3,621	-2,583	-659	282	-1,613	-4,003	-1,884	-3,960	-5,739	-1,882	-	-
Total Catch (M lb)	10,132	11,803	9,721	10,647	12,587	13,327	12,449	15,527	13,601	10,273	13,799	11,276	9,465	11,222	-	-
Overage/Underage (M lb)			-3,478	-7,270	-2,933	-2,192	-773	997	-863	-5,186	-1,793	-3,123	-5,070	-1,239	-	-
ASAP F estimate	0.133	0.17	0.127	0.131	0.164	0.145	0.136	0.163	0.132	0.097	0.141	0.114	0.097	0.118	-	-

[1] through 2011
[2] 2012 fwd.
[3] not adjusted for RSA
[4] adjusted downward for RSA

Table 3b. Summary of bluefish management measures, 2000 – 2014 and proposed 2015. (Values are in M lb)

Management Measures	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TAC[1]/ **ABC**[2] (M lb)	n/a	n/a	29.1	39.5	34.215	34.215	29.15	32.033	31.887	34.081	34.376	31.744	**32.044**	**27.472**	**24.432**	***21.543***
TAL (M lb)[3]	35.328	37.841	26.866	37.293	31.85	30.853	24.797	27.762	28.156	29.356	29.264	27.293	28.267	23.861	21.081	*18.193*
Comm. Quota (M lb)[4]	9.583	9.583	10.5	10.5	10.5	10.5	8.081	8.689	7.705	9.828	10.213	9.375	10.317	9.076	7.269	*4.573*
Comm. Landings (M lb)	8.041	8.688	6.863	7.401	7.994	7.045	6.955	7.499	5.968	6.99	7.069	5.082	4.93	4.114	-	-
Rec. Harvest Limit (M lb)[4]	25.745	28.258	16.365	26.793	21.35	20.353	16.718	19.073	20.451	19.528	18.631	17.813	17.457	14.069	13.179	*13.073*
Rec. Landings (M lb)	10.606	13.23	11.371	13.136	15.203	16.162	16.894	21.163	18.9	13.583	18.042	11.499	10.684	15.281	-	
Rec. Possession Limit (N)	10	15	15	15	15	15	15	15	15	15	15	15	15	15	15	*10*
Total Landings (M lb)	18.647	21.918	18.234	20.537	23.197	23.207	23.849	28.662	24.868	20.573	25.111	16.581	15.614	19.395	-	-
Overage/Underage (M lb)	-16.681	-15.923	-8.632	-16.756	-8.653	-7.646	-0.948	0.9	-3.288	-8.826	-4.153	-10.712	-12.653	-4.466	-	-
Total Catch (M lb)	22.338	26.022	21.432	23.473	27.749	29.382	27.445	34.232	29.985	22.647	30.422	24.859	20.868	24.74	-	-
Overage/Underage (M lb)			-7.668	-16.027	-6.466	-4.833	-1.705	2.199	-1.902	-11.434	-3.954	-6.885	-11.176	-2.732	-	-
ASAP F estimate	0.133	0.170	0.127	0.131	0.164	0.145	0.136	0.163	0.132	0.097	0.141	0.114	0.097	0.118	-	-

[1] through 2011
[2] 2012 fwd.
[3] not adjusted for RSA
[4] adjusted downward for RSA