C: Atlantic Bluefish Operational Assessment for 2019

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State of Stock:

This assessment of Atlantic bluefish (*Pomatomus saltatrix*) is an update through 2018 of commercial and recreational catch data, research survey indices of abundance, and the analyses of those data. The bluefish stock was overfished and overfishing was not occurring in 2018 relative to the updated biological reference points (Figure 1). Spawning stock biomass (SSB) was estimated to be 91,041 MT in 2018, about 46% of the updated biomass target reference point SSB_{MSY} proxy = $SSB_{35\%}$ = 198,717 MT, and 92% of the $SSB_{threshold}$ = 99,359 MT (Table 1, Figure 2). There is a 90% chance that SSB in 2018 was between 66,840 and 99,299 MT. Fishing mortality on the fully selected age 2 fish was 0.146 in 2018, 80% of the updated fishing mortality threshold reference point F_{MSY} proxy = $F_{35\%}$ = 0.183 (Table 1, Figure 3). There is a 90% probability that the fishing mortality rate in 2018 was between 0.119 and 0.205. The average recruitment from 1985 to 2018 was 46 million fish at age 0. The largest recruitment in the time series occurred in 1989 at 99 million fish, and the lowest recruitment was in 2016 at 29 million fish. Recruitment over the last decade has been below the time series average, except for 2013 where recruitment was 48 million fish (Table 1, Figures 2 & 4). Recruitment in 2018 was 42 million fish. The 2018 model estimates of F and SSB adjusted for internal retrospective error are within the model estimate 90% confidence intervals and so no adjustment of the terminal year estimates has been made for stock status determination of projections (Figure 1).

OFL Projections:

Projections using the 2019 bluefish Operational Assessment ASAP model (data through 2018) were made to estimate the OFL catches for 2020-2021. Projections assumed that the 2019 ABC of 9,893 MT was harvested and sample from the estimated recruitment for 1985-2018. The OFL projection uses F_{2020}-F_{2021} = updated F_{MSY} proxy = F35% = 0.183. The OFL catches are 17,166 MT in 2020 (CV = 10%) and 18,115 MT in 2021 (CV = 9%).

Atlantic bluefish OFL for 2020-2021
Catches and SSB in metric tons

Year	Total Catch	F	SSB
2019	9,893	0.115	98,998
2020	17,166	0.183	112,911
2021	18,115	0.183	117,285

Catch:

Reported 2018 commercial landings were 1,105 MT = 2.435 million lb. Estimated 2018 recreational landings were 5,695 MT = 12.556 million lb. Total commercial and recreational landings in 2018 were 6,800 MT = 14.991 million lb. Estimated 2018 recreational discards were 4,489 MT = 9.896 million lb. Commercial discards are not considered significant and not included in the assessment. The estimated total catch in 2018 was 11,288 MT = 24.887million lb.

In July 2018, the Marine Recreational Information Program (MRIP) replaced the existing estimates of recreational catch with a calibrated 1981-2017 time series ('New' MRIP) that corresponds to new survey methods that were fully implemented in 2018. For comparison with the existing estimates noted above, the 'New' MRIP estimate of 2017 recreational landings is 15,421 MT = 33.997 million lb, 3.3 times the 'Old' estimate. The 'New' MRIP estimate of 2017 recreational discards is 10,111 MT = 22.291 million lb, 5.4 times the 'Old' estimate. The 'New' MRIP recreational catch estimates increased the 1985-2017 total catch by an average of 116% (from 13,578 MT = 29.935 million lb to 29,291 MT = 64.576 million lb), ranging from +63% in 1986 to +291% in 2017. The increase in 2017 was 291%, from 6,532 MT = 14.400 million lb to 25,532 MT = 56.288 million lb. The 2019 updated assessment model includes the 'New' MRIP estimates of recreational landings and discards (Catch and Status Table; Table 2).

Catch and Status Table: Atlantic bluefish

(Weights in mt, recruitment in thousands, arithmetic means, includes New MRIP estimates)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Commercial landings	3,119	3,304	2,453	2,212	1,974	2,236	1,902	1,929	1,873	1,105
Recreational landings	18,040	21,013	15,430	15,051	15,526	12,050	13,524	10,433	15,421	5,695
Recreational discards[2]	10,071	11,965	14,606	11,039	9,537	9,848	6,953	8,008	10,111	4,489
Catch used in assessment	31,231	36,281	32,489	28,303	27,037	24,135	22,379	20,370	27,404	11,288
Spawning stock biomass	121,382	118,142	115,427	112,703	110,627	94,203	85,924	96,805	92,794	91,041
Recruitment (age 0, thousands)	36,453	40,079	35,654	31,643	48,315	41,454	44,071	28,904	45,171	41,890
F full[3]	0.27	0.32	0.32	0.32	0.35	0.38	0.37	0.26	0.40	0.15

	Min[1]	Max[1]	Avg[1]
Commercial landings	1,105	7,162	3,807
Recreational landings	5,695	74,988	21,012
Recreational discards[2]	1,440	14,850	7,717
Catch used in assessment	11,288	84,201	32,536
Spawning stock biomass	75,510	185,654	105,254
Recruitment (age 0, thousands)	28,461	98,997	46,159
F full[3]	0.15	0.58	0.35

[1] Years 1985-2018

[2] dead discards

[3] F on fully selected age 2. Note that table values are not retro adjusted.

Stock Distribution and Identification:
The Atlantic States Marine Fisheries Commission (ASMFC) and Mid-Atlantic Fishery Management Council (MAFMC) jointly developed the Fishery Management Plan (FMP) for the bluefish fishery and adopted the plan in 1989 (ASMFC 1989, MAFMC 1990). The Secretary of Commerce approved the FMP in March 1990. The FMP defines the management unit as bluefish (*Pomatomus saltatrix*) in U.S. waters of the western Atlantic Ocean.

Assessment Model:
The assessment model for Atlantic bluefish is a complex statistical catch-at-age model (ASAP SCAA; Legault and Restrepo 1998; NFT 2013) incorporating a broad range of fishery and survey data (NEFSC 2015). The model assumes an instantaneous natural mortality rate (M) = 0.2. The fishery catch is modeled as two fleets: 1. Commercial landings, and 2. Combined recreational landings and recreational discards.

Indices of stock abundance included a recreational catch-per-unit-effort index developed from the MRIP intercept data. In addition, eight fishery-independent indices were included in the model. Age-0+ fishery-independent indices included the NEFSC fall Bigelow trawl survey, the New Jersey ocean trawl survey, the Connecticut Long Island Sound trawl survey, the NEAMAP fall inshore trawl survey, and the North Carolina Pamlico Sound independent gillnet survey. Young-of-year indices included the SEAMAP fall trawl survey and a composite index developed from state seine indices from New Hampshire to Virginia. In 2018, all indices except the composite seine juvenile survey showed a decrease from 2017 values.

There is not a major retrospective pattern evident in the bluefish assessment model. The minor internal model retrospective error tends to underestimate F by 18% and overestimate SSB by 19% over the last 7 terminal years. The 2018 model estimates of F and SSB adjusted for internal retrospective error (F = 0.179; SSB = 76,312 MT) are within the model estimate 90% confidence intervals and so no adjustment of the terminal year estimates has been made for stock status determination or projections. The 'historical' retrospective comparison between the SARC60 benchmark, a 2017 continuity run using old MRIP data, and this update, indicates similar trends for SSB, F, and recruitment for most of the time-series (Figure 5). The addition of the new calibrated MRIP data in 2019 resulted in the model scaling estimates of SSB, F, and recruitment higher compared to the using the old data. Near the end of the time-series low catch in 2016 and 2018 leads to large drops in F.

Biological Reference Points (BRPs):
Reference points were calculated using the non-parametric yield and SSB per recruit long-term projection approach. The cumulative distribution function of the 1985-2018 recruitments (corresponding to the period of input fishery catches-at-age) was re-sampled to provide future recruitment estimates for the projections used to estimate the biomass reference point.

The existing biological reference points for bluefish are from the SSC review of the SAW 60 benchmark assessment (NEFSC 2015). The reference points are F35% as the proxy for FMSY, and the corresponding SSB35% as the proxy for the SSBMSY biomass target. The F35% proxy for FMSY = 0.19; the proxy estimate for SSBMSY = SSB35% = 101,343 MT = 223 million lbs; the proxy estimate for the ½ SSBMSY biomass threshold = ½ SSB35% = 50,672 MT = 112 million lbs; and the proxy estimate for MSY = MSY35% = 14,443 MT = 32 million lbs.

The F35% and corresponding SSB35% proxy biological reference points for bluefish were updated for this 2019 Operational Assessment. The updated fishing mortality threshold F35% proxy for FMSY = 0.183; the updated biomass target proxy estimate for SSBMSY = SSB35% = 198,717 MT = 438 million lbs; the updated biomass threshold proxy estimate for ½ SSBMSY = ½ SSB35% = 99,359 MT = 219 million lbs; and the updated proxy estimate for MSY = MSY35% = 29,571 MT = 65 million lbs.

Qualitative status description:

The bluefish stock has experienced a decline in SSB over the past decade, coinciding with an increasing trend in F. Recruitment has remained fairly steady, fluctuating just below the time-series mean of 46 million fish. Both commercial and recreational fisheries had poor catch in 2016 (20,370 MT), and 2018 (11,288 MT), resulting in the second lowest and lowest catches on record, respectively. As a result of the very low catch in 2018, fishing mortality was estimated below the reference point for the first time in the time-series. These lower catches are possibly a result of availability. Anecdotal evidence suggests larger bluefish stayed offshore and inaccessible to most of the recreational fishery during these two years.

Research and Data Issues:

The large increase in recreational landings and discards from the new MRIP calibration has further increased the importance of the recreational data to this assessment. Accurately characterizing the recreational discard lengths is an important component of the assessment and research that improves the methodology used to collect these data is recommended.

References:

Atlantic States Marine Fisheries Commission (ASMFC).1989. Fishery Management Plan for Bluefish. 81 pp. + append.

Legault CM, Restrepo VR. 1998. A flexible forward age-structured assessment program. ICCAT. Col. Vol. Sci. Pap. 49:246-253.

Mid-Atlantic Fishery Management Council. 1990. Fishery management plan for the bluefish fishery. Dover, DE. 81 p. + append.

Northeast Fisheries Science Center (NEFSC). 2015. 60th Northeast Regional Stock Assessment

Workshop (60th SAW) Assessment Report. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 15-08; 870 p.

NOAA Fisheries Toolbox (NFT). 2013. Age Structured Assessment Program (ASAP) version 3.0.11. (Internet address: http://nft.nefsc.noaa.gov).

Tables

Table C1. Summary assessment results for Atlantic Bluefish; Spawning Stock Biomass (SSB) in metric tons (MT); Recruitment (R) at age 0 in thousands; Fishing Mortality (F) for age of peak fishery selection (S = 1) age 2.

Year	SSB	R	F
1985	185,654	66,750	0.322
1986	165,351	52,276	0.491
1987	138,473	38,531	0.581
1988	102,815	47,993	0.547
1989	96,055	98,997	0.493
1990	85,487	48,818	0.534
1991	78,506	55,975	0.506
1992	75,510	28,461	0.447
1993	75,901	30,001	0.417
1994	77,018	42,217	0.350
1995	77,789	32,381	0.302
1996	76,446	42,664	0.304
1997	80,924	42,066	0.328
1998	94,032	40,385	0.299
1999	97,647	63,230	0.295
2000	107,896	35,554	0.297
2001	118,111	55,720	0.351
2002	101,029	44,238	0.288
2003	105,989	59,680	0.268
2004	117,967	31,811	0.267
2005	132,223	59,630	0.260
2006	107,584	67,106	0.303
2007	109,312	46,148	0.297
2008	131,873	44,782	0.229
2009	121,382	36,453	0.267
2010	118,142	40,079	0.324
2011	115,427	35,654	0.318
2012	112,703	31,643	0.324
2013	110,627	48,315	0.351
2014	94,204	41,454	0.381
2015	85,924	44,071	0.374
2016	96,805	28,904	0.257
2017	92,794	45,171	0.404
2018	91,041	41,890	0.146

Table C2. Total catch (metric tons) of Atlantic bluefish from Maine through Florida from 1985-2018. Does not include commercial discards as they are not considered significant for this stock. Includes the 'New' MRIP estimates of recreational catch.

Year	Commercial Landings	Recreational Landings	Recreational Discards	Total Catch
1985	6,124	47,376	1,655	55,154
1986	6,657	74,988	2,556	84,201
1987	6,579	63,834	3,198	73,610
1988	7,162	36,337	1,440	44,938
1989	4,740	36,250	2,029	43,019
1990	6,250	31,268	4,999	42,516
1991	6,138	26,485	6,137	38,760
1992	5,208	22,262	4,351	31,820
1993	4,819	16,170	5,955	26,943
1994	4,306	14,085	6,126	24,517
1995	3,629	13,228	4,400	21,257
1996	4,213	10,623	6,477	21,313
1997	4,109	12,516	7,829	24,455
1998	3,741	15,243	5,693	24,676
1999	3,325	10,501	11,809	25,634
2000	3,660	10,950	12,431	27,041
2001	3,953	14,888	14,850	33,691
2002	3,116	13,612	8,241	24,970
2003	3,359	14,758	7,281	25,398
2004	3,661	17,264	9,050	29,975
2005	3,211	17,661	9,571	30,443
2006	3,252	16,653	10,379	30,284
2007	3,390	18,077	10,136	31,603
2008	2,730	17,185	9,173	29,088
2009	3,119	18,040	10,071	31,231
2010	3,304	21,013	11,965	36,281
2011	2,453	15,430	14,606	32,489
2012	2,212	15,051	11,039	28,303
2013	1,974	15,526	9,537	27,037
2014	2,236	12,050	9,848	24,135
2015	1,902	13,524	6,953	22,379
2016	1,929	10,433	8,008	20,370
2017	1,873	15,421	10,111	27,404
2018	1,105	5,695	4,489	11,288

Figures

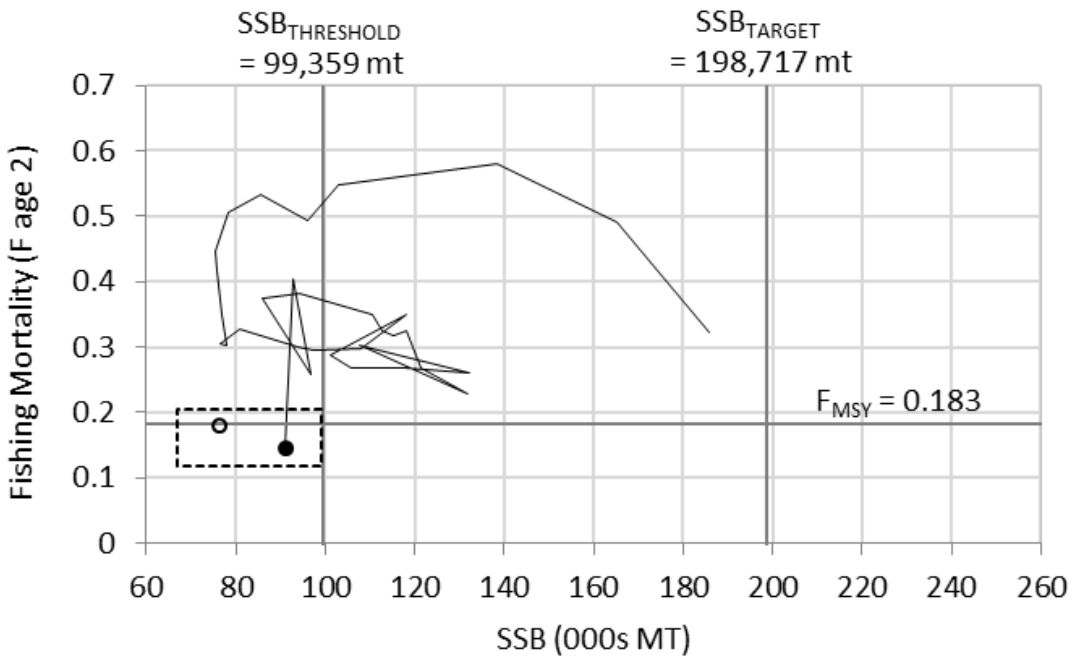

Figure C1. Estimates of Atlantic bluefish spawning stock biomass (SSB) and fully-recruited fishing mortality (F, peak at age 2) relative to the updated 2019 biological reference points. Filled circle with 90% confidence intervals (dotted box) shows the assessment point estimates. The open circle shows the retrospectively adjusted estimates.

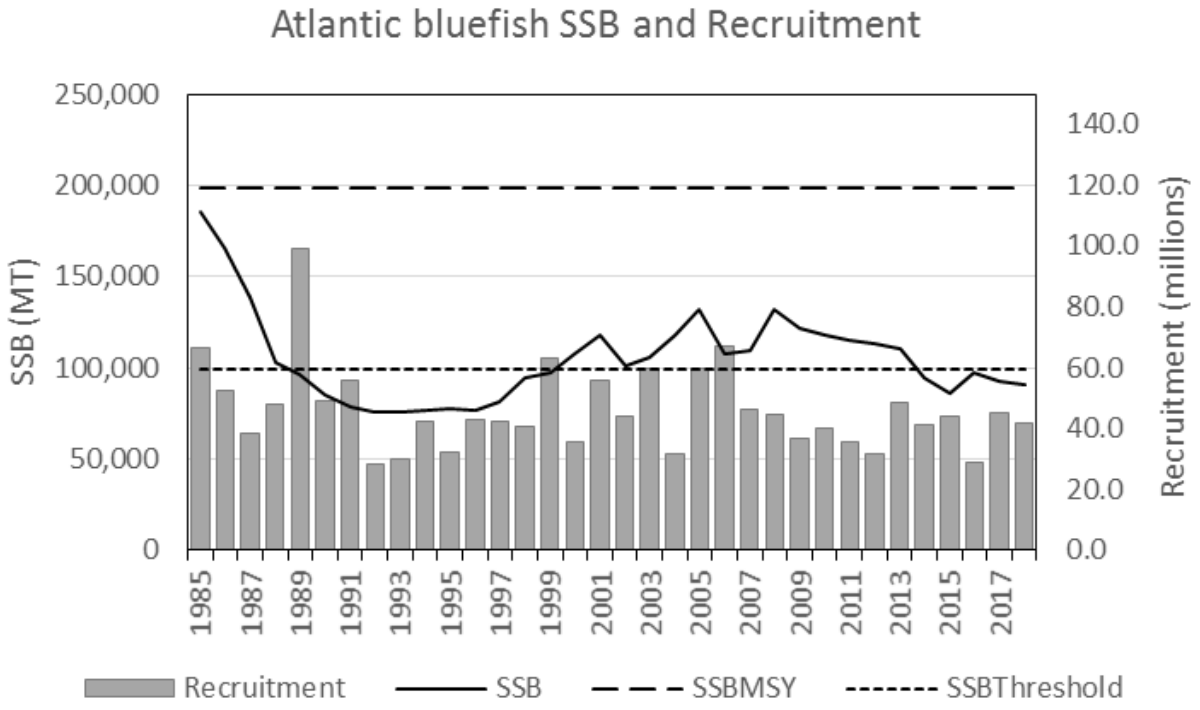

Figure C2. Atlantic bluefish spawning stock biomass (SSB; solid black line) and recruitment at age 0 (R; gray vertical bars) by calendar year. The horizontal dashed line is the updated SSB_{MSY} proxy = $SSB_{40\%}$ = 198,717 MT, and the dotted black line is the SSBThreshold = 99,359 MT.

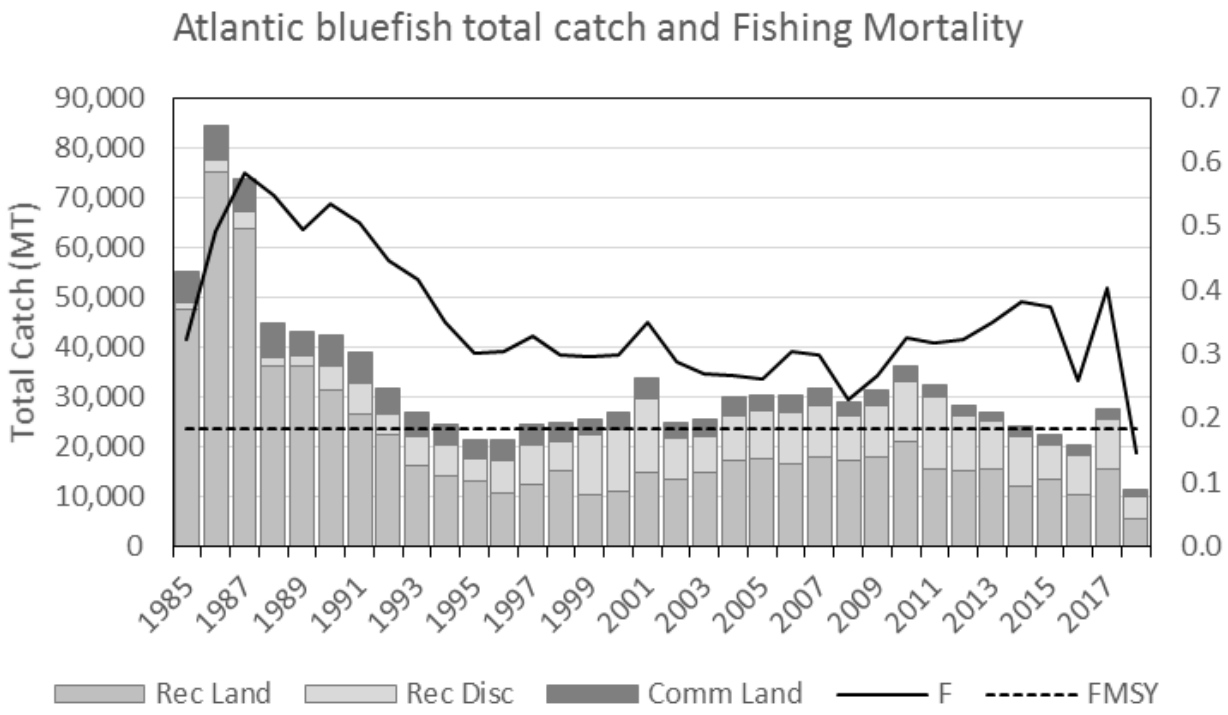

Figure C3. Total fishery catch (metric tons; MT; solid line) and fishing mortality (F, peak at age 3; squares) for Atlantic bluefish. The horizontal dashed line is the updated F_{MSY} proxy = $F_{35\%}$ = 0.183.

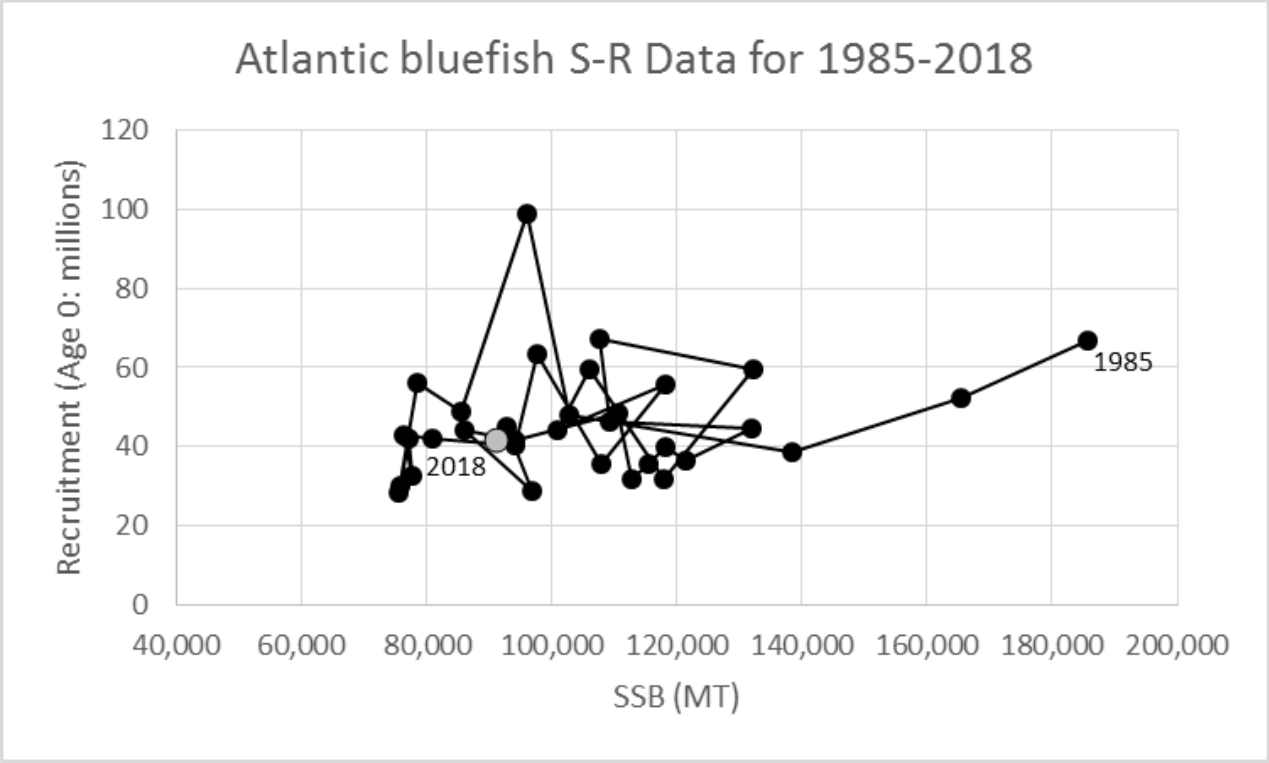

Figure C4. Spawning Stock Biomass (SSB) and Recruitment (R) scatter plot for Atlantic bluefish.

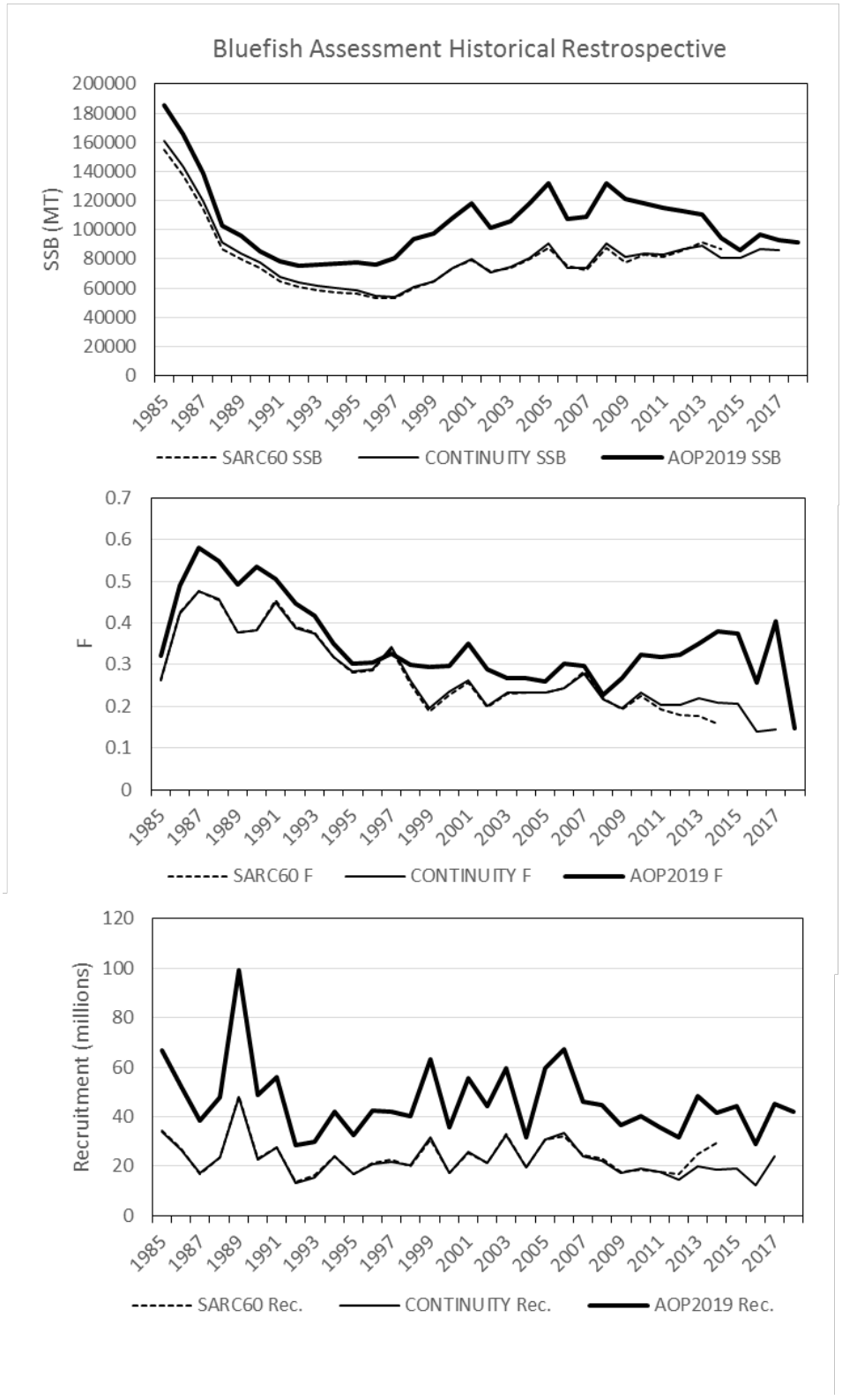

Figure C5. Historical retrospective analysis of the 2015 (dotted), 2017 (continuity run: slim black line), and 2019 (bold black line) stock assessments of Atlantic bluefish.