

A: Black Sea Bass Operational Assessment for 2019

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State of Stock:

This assessment of black sea bass (*Centropristis striata*) is an update through 2018 of commercial and recreational catch data, research survey and fishery-dependent indices of abundance, and the analyses of those data. The black sea bass stock was not overfished and overfishing was not occurring in 2018 relative to the updated biological reference points (Figure A1). Spawning stock biomass (retro adjusted SSB) was estimated to be 33,668 mt in 2018, about 2.4 times the updated biomass target reference point SSB_{MSY} proxy = SSB_{40%} = 14,085 mt (Table A1, Figure A2). There is a 90% chance that SSB in 2018 was between 26,187 and 42,191 mt. Fishing mortality on the fully selected ages 6-7 fish was 0.27 in 2018 after adjusting for retrospective biases, which was 57% of the updated fishing mortality threshold reference point F_{MSY} proxy = F_{40%} = 0.46 (Table A1, Figure A3). There is a 90% probability that the fishing mortality rate in 2018 was between 0.20 and 0.36. The average recruitment from 1989 to 2018 is 36 million fish at age 1. The 2011 year class was estimated to be the largest in the time series at 144.7 million fish and the 2015 year class was the second largest at 79.2 million fish. Recruitment of the 2017 year class as age 1 in 2018 was estimated at 16.0 million, well below average (Table A1, Figures A2 & A4). The 2018 model estimates of F and SSB adjusted for internal retrospective error are outside the model estimate 90% confidence intervals and so the terminal year estimates have been adjusted for stock status determination and projections (Figure A1).

OFL Projections:

Projections using the 2019 Operational Assessment ASAP model (data through 2018) were made to estimate the OFL catches for 2020-2021. The projections assume that the 2019 ABC of 4,396 mt in the north and 785 mt in the south (both adjusted for new MRIP estimates) will be taken in 2019 and sampled from the estimated recruitment for 1989-2018. The OFL projection for combined regions uses $F_{2020}-F_{2021} = \text{updated } F_{MSY} \text{ proxy} = F_{40\%} = 0.46$. The OFL catches are 9,807mt in 2020 (CV =19%) and 7,991 mt in 2021 (CV =16%).

OFL for 2020-2021			
Catches and SSB in metric tons			
Year	Total Catch	F	SSB
2019	5,181	0.20	29,652
2020	9,807	0.46	24,943
2021	7,991	0.46	21,645

Catch:

Reported 2018 commercial landings were 1,550 mt = 3.416 million lbs. Estimated 2018 recreational landings were 4,008 mt = 8.836 million lbs. Total commercial and recreational landings in 2018 were 5,558 mt = 12.252 million lbs. Estimated 2018 commercial discards were 722 mt = 1.591 million lbs. Estimated 2018 recreational discards were 1,044 mt = 2.302 million lbs. The estimated total catch in 2018 was 7,324 mt = 16.146 million lbs.

In July 2018, the Marine Recreational Information Program (MRIP) replaced the existing estimates of recreational catch ('Old' MRIP) 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 5,692 mt = 12.549 million lbs, 2.6 times the Old estimate. The New MRIP estimate of 2017 recreational discards is 1,634 mt = 3.603 million lb, 2.8 times the Old estimate. The New MRIP recreational catch estimates increased the 1981-2017 total catch by an average of 73% (from 1,687 mt = 3.719 million lb to 2,927 mt = 6.453 million lb), ranging from +9% in 1995 to +161% in 2017. The increase in 2017 was from 2,802 mt = 6.177 million lb to 7,327 mt = 16.153 million lb. The 2019 updated assessment model includes the New MRIP estimates of recreational landings and discards (Catch and Status Table below; Table A2).

Catch and Status Table: Black Sea Bass

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

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Commercial landings	523	751	765	782	1,027	1,088	1,113	1,133	1,808	1,550
Commercial discards ²	167	134	227	116	278	459	423	757	1,027	722
Recreational landings	2,525	3,502	1,421	3,162	2,685	3,510	4,448	6,131	5,692	4,008
Recreational discards ²	623	733	358	1,048	749	839	985	1,391	1,634	1,044
Catch used in assessment	3,838	5,121	2,771	5,108	4,739	5,896	6,969	9,412	10,162	7,324
Spawning stock biomass	11,127	14,062	14,130	16,730	23,656	34,706	33,231	30,710	26,103	22,518
Recruitment (age 1, millions)	34.1	34.4	39.6	144.7	47.8	26.2	34.2	79.2	47.3	10.1
F full ³	0.67	0.76	0.41	0.60	0.57	0.42	0.33	0.35	0.53	0.32

Year	Min ¹	Max ¹	Avg ¹
Commercial landings	523	1,564	1,165
Commercial discards ²	25	806	213
Recreational landings	473	2,352	2,399
Recreational discards ²	46	771	599
Catch used in assessment	1,662	4,346	4,376
Spawning stock biomass	2,485	17,158	11,507
Recruitment (age 1, millions)	11.9	68.9	36.1
F full ³	0.24	1.34	0.66

¹ Years 1989-2018² dead discards³ F on fully selected ages 6-7. Note that table values are not retro adjusted.**Stock Distribution and Identification:**

The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for black sea bass defines the management unit as all black sea bass from Cape Hatteras, North Carolina northeast to the US-Canada border (MAFMC 1999). The stock was partitioned into two sub-units to account for spatial differences in the assessment model. The sub-units are not considered to be separate stocks.

Assessment Model:

The assessment models (separate north and south models) for black sea bass is a complex statistical catch-at-age model (ASAP SCAA; Legault and Restrepo 1998; NFT 2013) incorporating a broad

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range of fishery and survey data (NEFSC 2017). The model assumes an instantaneous natural mortality rate (M) = 0.4. The fishery catch in each region is modeled as two fleets: trawl catch and non-trawl catch, which includes recreational landings, recreational discards, commercial fish pot and hand-line catch and catches from other non-trawl sources.

Indices of stock abundance for the north region used in the model were from NEFSC Albatross spring, MA DMF spring trawl, RI DFW spring trawl, CT DEEP spring Long Island trawl, New York DEC juvenile seine, NEFSC Bigelow spring, NEAMAP spring bottom trawl and MRIP catch per angler trip. The indices of abundance for the southern region were from NEFSC Albatross winter, NEFSC Albatross spring, New Jersey DEP spring trawl, DE DFW spring trawl, MD DNR spring coastal bays trawl, VIMS Chesapeake Bay juvenile trawl, NEAMAP spring trawl, NEFSC Bigelow spring trawl and MRIP catch per angler trip. Indices for both regions were comparable to those used in the 2016 benchmark assessment.

There remains a significant retrospective pattern in both the northern and southern assessment models. The retrospective pattern in the north over-estimates F by 44% over the last 5 terminal years and under-estimates SSB by 43%. In the southern region, the opposite pattern prevails where F is under-estimated by 23% and SSB is over-estimated by 22%. The 2018 regional model estimates of F and SSB were adjusted for internal retrospective error (north F (0.46) adjusted for retrospective = 0.32, north SSB (15,924 mt) adjusted for retrospective = 28,063 mt; south F (0.17) adjusted for retrospective = 0.21, south SSB (6,858 mt) adjusted for retrospective = 5,599 mt). Since the retrospective corrected values generally fell outside the 90% confidence intervals of the terminal year estimates, the retrospective adjusted values were used for status determination and OFL's. The historical retrospective analysis (comparison between assessments) indicates that the trends in spawning stock biomass, recruitment and fishing mortality have been consistent between the benchmark assessment (2016) and the 2019 update.

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 2000-2018 recruitments (equivalent to years used in 2016 benchmark assessment) was re-sampled to provide future recruitment estimates for the projections used to estimate the biomass reference point.

The existing biological reference points for black sea bass are from the 2016 SAW 62 benchmark assessment (NEFSC 2017). The reference points are $F_{40\%}$ as the proxy for F_{MSY} , and the corresponding $SSB_{40\%}$ as the proxy for the SSB_{MSY} biomass target. The $F_{40\%}$ proxy for $F_{MSY} = 0.36$; the proxy estimate for $SSB_{MSY} = SSB_{40\%} = 9,667$ mt = 21.312 million lbs; the proxy estimate for the $\frac{1}{2} SSB_{MSY}$ biomass threshold = $\frac{1}{2} SSB_{40\%} = 4,834$ mt = 10.657 million lbs; and the proxy estimate for $MSY = MSY_{40\%} = 3,097$ mt = 6.828 million lbs.

The $F_{40\%}$ and corresponding $SSB_{40\%}$ proxy biological reference points for black sea bass were updated for this 2019 Operational Assessment. The update fishing mortality threshold $F_{40\%}$ proxy for $F_{MSY} = 0.46$. The updated biomass target proxy estimate for $SSB_{MSY} = SSB_{40\%} = 14,085$ mt = 31.053 million lbs. and the updated biomass threshold proxy estimate for $\frac{1}{2} SSB_{MSY} = \frac{1}{2} SSB_{40\%} = 7,043$ mt = 15.527 million lbs. The update proxy estimate for $MSY = MSY_{40\%} = 4,771$ mt = 10.517 million lbs.

Qualitative status description:

The distribution of the fishery and catches has shifted north over the past decade. Most survey aggregate biomass indices are near their time series high. Recent survey indices suggest the recruitment of a large 2011 year class in the northern region and a strong 2015 year class in both regions. Modest catches over the past few years would indicate that current mortality from all sources is lower than recent recruitment inputs to the stock, which has resulted in a spawning biomass that is well above the management target.

Research and Data Issues:

The recent recruitment of large year classes in the assessment time series (the 2011 and 2015 year class) has contributed to increases in catch, particularly in the northern region. Additional research examining recruitment events, distribution shifts and the changing environment should be explored.

Spatial differences in recruitment and fisheries have been accounted for with independent assessment models for north and south regions. A single model which tracks the spatial differences in the population dynamics should be developed.

Allocation issues continue to be an important management issue. Development of a Management Strategy Evaluation (MSE) model could be helpful in determining the best approach.

References:

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. (MAFMC). 1999. Amendment 12 to the summer flounder, scup, and black sea bass fishery management plan. Dover, DE. 398 p + appendix.

Northeast Fisheries Science Center (NEFSC). 2017. 62th Northeast Regional Stock Assessment Workshop (62th SAW) Assessment Report. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 17-03; 822 p.

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

Tables

Table A1. Summary Black Sea Bass assessment results; Spawning Stock Biomass (SSB) in metric tons (mt); Recruitment (R) at age 0 in millions; Fishing Mortality (F) for age of peak fishery selection, ages 6-7. North-South averages, unadjusted for retrospective bias.

	SSB	R	F
1989	3,182	24,387	1.14
1990	3,045	29,782	1.09
1991	3,135	34,072	1.04
1992	3,434	29,043	0.93
1993	3,450	19,965	1.06
1994	3,477	28,660	0.87
1995	4,091	36,894	0.74
1996	4,310	26,616	0.92
1997	4,133	26,819	0.84
1998	4,638	22,881	0.60
1999	5,896	37,238	0.55
2000	7,486	46,766	0.54
2001	9,560	27,539	0.61
2002	10,085	31,600	0.66
2003	9,583	19,698	0.58
2004	8,250	15,713	0.57
2005	7,774	16,563	0.52
2006	6,446	30,813	0.55
2007	6,728	35,319	0.55
2008	9,545	45,517	0.49
2009	11,127	34,060	0.67
2010	14,062	34,417	0.76
2011	14,130	39,648	0.41
2012	16,730	144,665	0.60
2013	23,656	47,777	0.57
2014	34,706	26,202	0.42
2015	33,231	34,238	0.33
2016	30,710	79,194	0.35
2017	26,103	47,279	0.53
2018	22,518	10,051	0.32

Table A2. Total catch (metric tons) of black sea bass from Maine through North Carolina. Includes the 'New' MRIP estimates of recreational catch. Recreational discards assume 15% mortality.

	Commercial Landings	Commercial Discards	Recreational Landings	Recreational Discards	Total
1989	1,105	109	1,881	99	3,194
1990	1,402	53	1,354	231	3,040
1991	1,190	10	1,766	175	3,142
1992	1,264	141	1,344	165	2,914
1993	1,353	78	2,022	120	3,573
1994	848	37	1,347	210	2,443
1995	889	24	1,860	397	3,171
1996	1,448	285	2,755	236	4,724
1997	1,197	55	2,470	251	3,973
1998	1,152	121	681	310	2,263
1999	1,290	45	856	545	2,736
2000	1,186	44	1,836	873	3,939
2001	1,279	240	2,621	886	5,025
2002	1,564	46	2,528	1,381	5,518
2003	1,347	114	2,492	641	4,595
2004	1,405	380	1,362	374	3,521
2005	1,297	89	1,437	350	3,173
2006	1,285	33	1,243	371	2,933
2007	1,037	104	1,425	354	2,920
2008	875	66	1,606	585	3,132
2009	523	167	2,525	623	3,838
2010	751	134	3,502	733	5,121
2011	765	227	1,421	358	2,771
2012	782	116	3,162	1,048	5,108
2013	1,027	278	2,685	749	4,739
2014	1,088	459	3,510	839	5,896
2015	1,113	423	4,448	985	6,969
2016	1,133	757	6,131	1,391	9,412
2017	1,808	1,027	5,692	1,634	10,162
2018	1,550	722	4,008	1,044	7,324

Figures

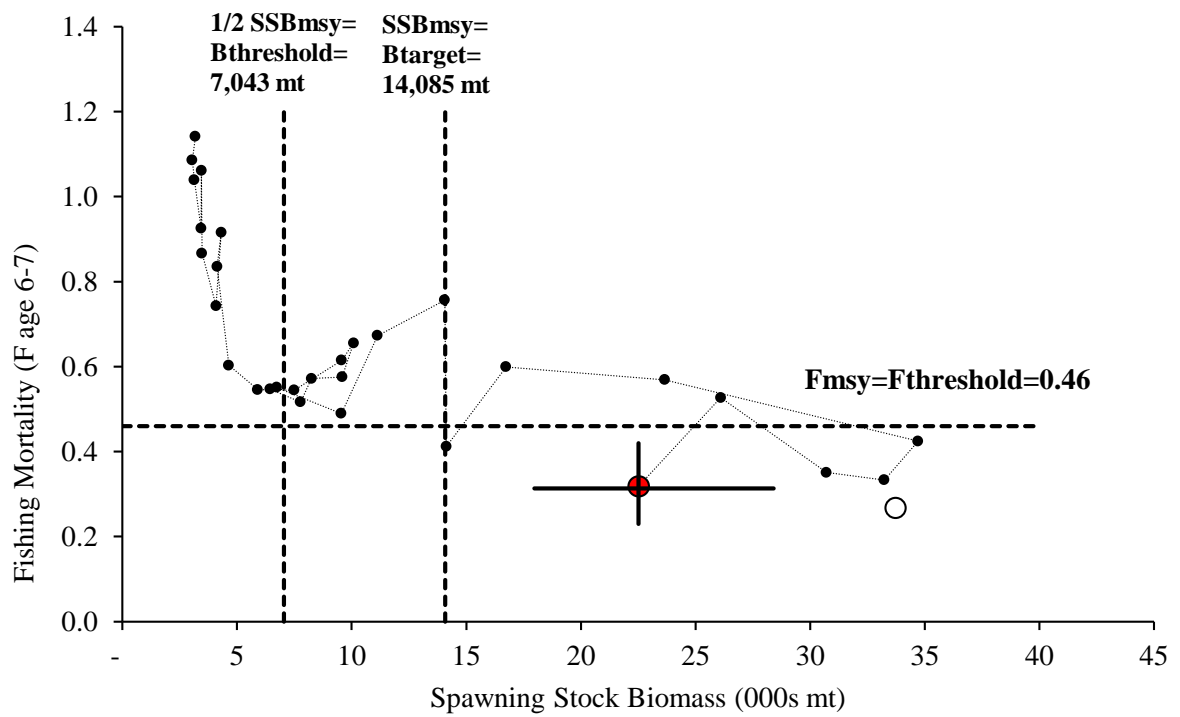


Figure A1. Estimates of black sea bass spawning stock biomass (SSB) and fully-recruited fishing mortality (F, peak at ages 6-7) relative to the updated 2019 biological reference points. Filled circle with 90% confidence intervals shows the assessment point estimates. The open circle shows the retrospectively adjusted estimates.

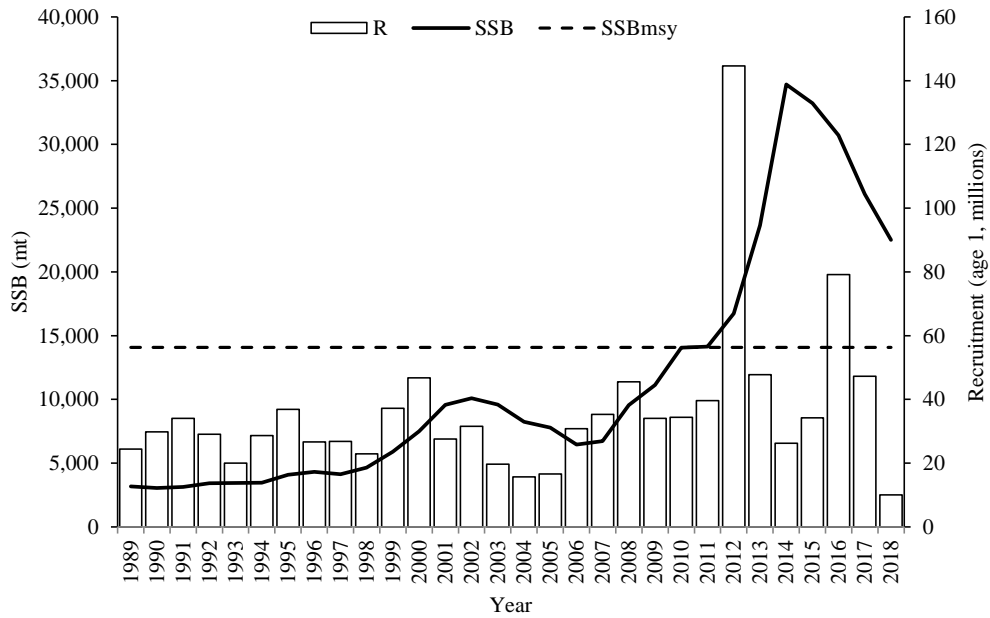


Figure A2. Black sea bass spawning stock biomass (SSB; solid line) and recruitment at age 0 (R; vertical bars) by calendar year. The horizontal dashed line is the updated SSB_{MSY} proxy = SSB_{40%} = 14,085 mt.

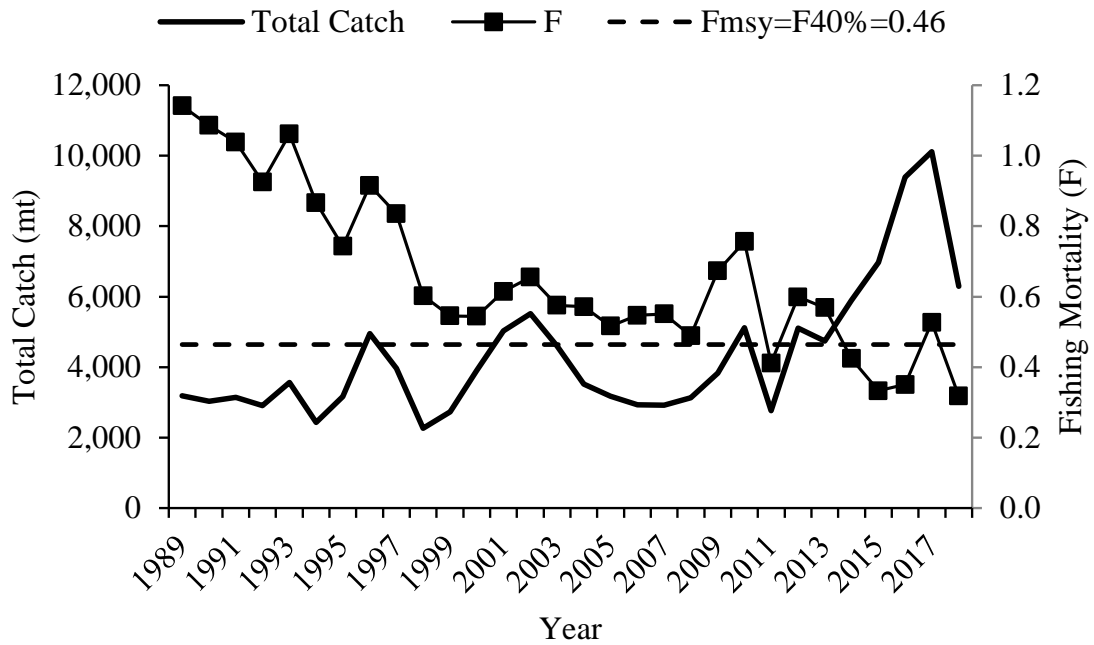


Figure A3. Total fishery catch (metric tons; mt; solid line) and fishing mortality (F, peak at age 6-7; squares) for black sea bass. The horizontal dashed line is the updated F_{MSY} proxy = F_{40%} = 0.46.

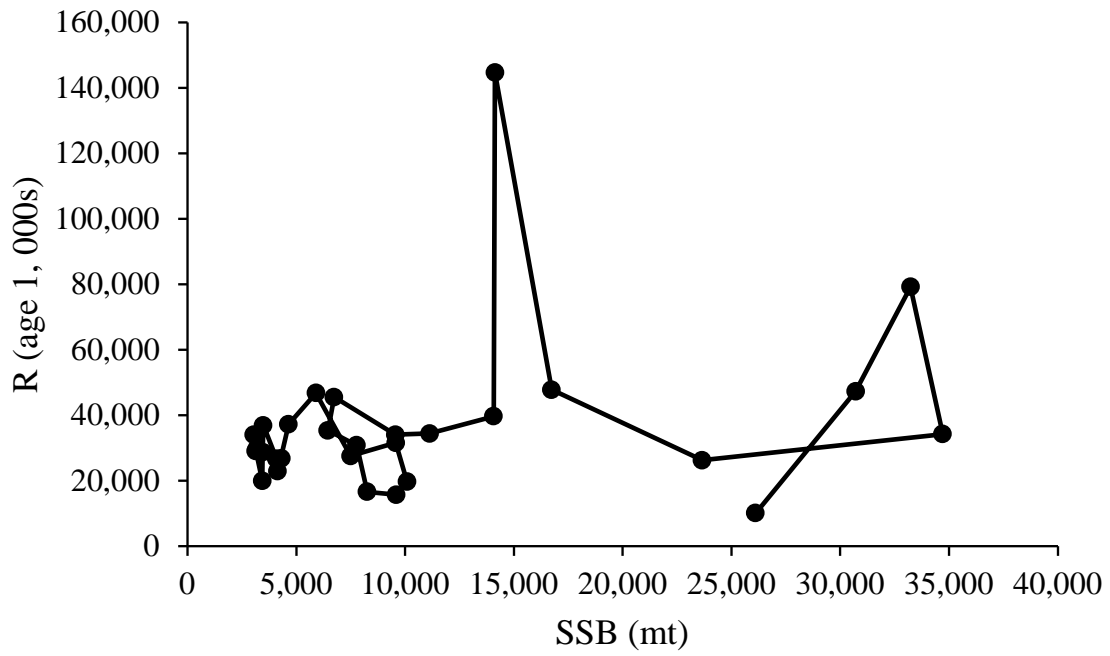


Figure A4. Spawning Stock Biomass (SSB) and Recruitment (R) scatter plot for black sea bass.

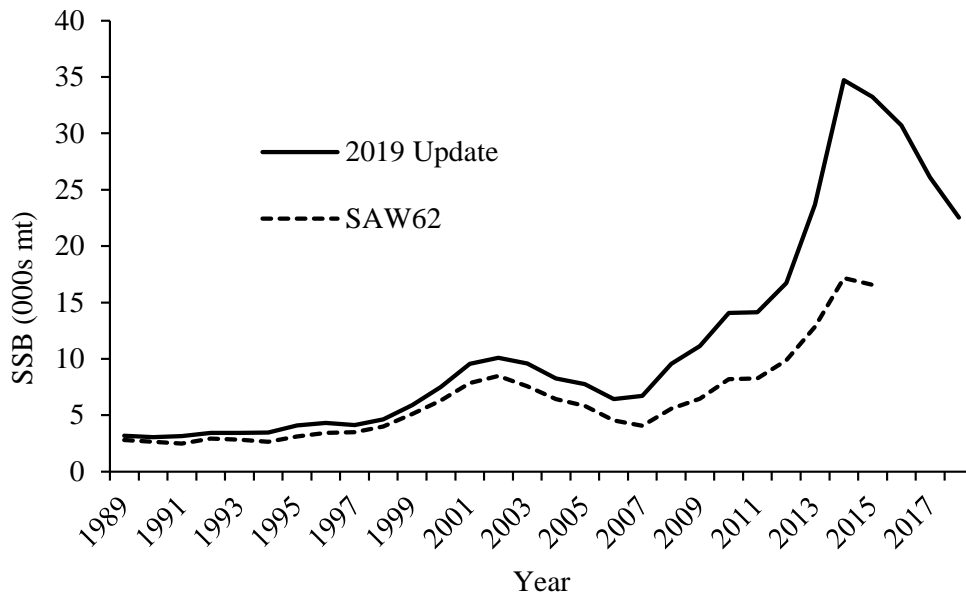


Figure A5. Historical retrospective of the 2016 (SAW 62; NEFSC 2017) and 2019 (Operational Assessment) stock assessments of black sea bass. The heavy solid lines are the 2019 Operational Assessment estimates that include the New MRIP recreational catch.