

B: Scup Operational Assessment for 2019

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State of Stock:

This assessment of scup (*Stenotomus chrysops*) is an update through 2018 of commercial and recreational fishery catch data, research survey indices of abundance, and analyses of those data. The scup stock was not overfished and overfishing was not occurring in 2018 relative to the updated biological reference points (Figure B1). Spawning stock biomass (SSB) was estimated to be 186,578 mt in 2018, about 2 times the updated biomass target reference point SSB_{MSY} proxy = $SSB_{40\%}$ = 94,020 mt (Table B1, Figure B2). There is a 90% chance that SSB in 2018 was between 159,746 and 221,281 mt. Fishing mortality on the fully selected age 3 fish was 0.158 in 2018, 73% of the updated fishing mortality threshold reference point F_{MSY} proxy = $F_{40\%}$ = 0.215 (Table B1, Figure B3). There is a 90% probability that the fishing mortality rate in 2018 was between 0.123 and 0.195. The average recruitment from 1984 to 2018 is 134 million fish at age 0. The 2015 year class is estimated to be the largest in the time series at 326 million fish, while the 2016-2018 year classes are estimated to be below average. (Table B1, Figures B2, B4). 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 or projections (Figure B1). The stock has sustained catches above MSY since 2013. However, stock biomass is projected to further decrease toward the target unless more above average year classes recruit to the stock in the short term.

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 16,525 mt will be taken in 2019 and sample from the estimated recruitment for 1984-2018. The OFL projection uses $F_{2020-F2021}$ = updated F_{MSY} proxy = $F_{40\%}$ = 0.215. The OFL catches are 19,263 mt in 2020 (CV = 17%) and 16,432 mt in 2021 (CV = 15%).

OFL for 2020-2021
 Catches and SSB in metric tons

Year	Total Catch	Landings	Discards	F	SSB
2019	16,525	13,276	3,249	0.163	184,892
2020	19,263	15,472	3,755	0.215	167,439
2021	16,432	12,530	3,826	0.215	155,188

Catch:

Reported 2018 commercial landings were 6,064 mt = 13.369 million lb. Estimated 2018 recreational landings were 5,887 mt = 12.979 million lb. Total commercial and recreational landings in 2018 were 11,951 mt = 26.347 million lb. Estimated 2018 commercial discards were 3,293 mt = 7.260 million lb. Estimated 2018 recreational discards were 644 mt = 1.420 million lb. The estimated total catch in 2018 was 15,888 mt = 35.027 million lb (Catch and Status Table below; Table B2).

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 6,143 mt = 13.543 million lb, 2.5 times the Old estimate. The New MRIP estimate of 2017 recreational discards is 1,079 mt = 2.372 million lb, 2.7 times the Old estimate. The New MRIP recreational catch estimates increased the 1981-2017 total catch by an average of 18% (from 9,575 mt = 21.109 million lb to 11,310 mt = 24.934 million lb), ranging from +1% in 1986 to +51% in 2000. The increase in 2017 was +30%, from 14,608 mt = 32.205 million lb to 18,961 mt = 41.802 million lb. The 2019 updated assessment model includes the New MRIP estimates of recreational landings and discards (Catch and Status Table below; Table B2).

Catch and Status Table: Scup

Catch weights in metric tons (mt); spawning stock biomass thousands of metric tons; recruitment in millions of age 0 fish; min, max and arithmetic mean values are for 1984-2018. Commercial catches are latest reported landings and estimated discards. Recreational catches are MRIP 2018 calibrated landings and discard estimates.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Commercial landings	3,721	4,866	6,819	6,751	8,105	7,239	7,725	7,147	7,006	6,064
Commercial discards	3,189	2,638	1,234	1,029	1,279	1,004	1,774	2,772	4,733	3,293
Recreational landings	2,851	5,660	4,682	3,751	5,739	4,659	5,527	4,536	6,143	5,887
Recreational discards	552	787	516	636	568	480	581	862	1,079	644
Catch used in assessment	10,313	13,951	13,252	12,166	15,692	13,382	15,606	15,317	18,961	15,888
Spawning stock biomass	194	234	237	237	237	224	191	200	193	187
Recruitment (age 0)	128	143	199	114	106	235	326	112	93	83
Fully selected F (age 4)	0.074	0.090	0.086	0.086	0.119	0.113	0.158	0.140	0.167	0.158

Year	Min	Max	Mean
Commercial landings	1,207	8,105	4,887
Commercial discards	436	4,733	1,819
Recreational landings	824	6,430	3,893
Recreational discards	30	1,079	336
Catch used in assessment	3,485	18,961	11,430
Spawning stock biomass	3.5	237.5	93.1
Recruitment (age 0)	37.5	325.9	133.5
Fully selected F (age 4)	0.066	1.593	0.521

Stock Distribution and Identification:

The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) Joint Fishery Management Plan defines the management unit as all scup from Cape Hatteras, North Carolina northeast to the US-Canada border (MAFMC 1999).

Assessment Model:

The assessment model for scup 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 four fleets: commercial landings, recreational landings, commercial discards and recreational discards.

Indices of stock abundance from NEFSC winter, spring, and fall, Massachusetts DMF spring and fall, Rhode Island DFW spring and fall, University of Rhode Island Graduate School of Oceanography (URIGSO), RI Industry Cooperative trap, Connecticut DEEP spring and fall, New York DEC, New Jersey DFW, Virginia Institute of Marine Science (VIMS) Chesapeake Bay, VIMS juvenile fish trawl, and NEAMAP spring and fall trawl surveys were used in the 2015 SAW 60 benchmark assessment (NEFSC 2015) and the 2017 assessment update. All indices were updated for this 2019 Operational Assessment.

There is not a major retrospective pattern evident in the scup assessment model. The minor internal model retrospective error tends to overestimate F by +26% and underestimate SSB by -11% over the last 7 terminal years. The 2018 model estimates of F and SSB adjusted for internal retrospective error ($F = 0.124$; $SSB = 213,721$ 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 analysis (comparison between assessments) indicates that the general trends in spawning stock biomass, recruitment, and fishing mortality have been consistent for the last decade (Figure B5).

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 1984-2018 recruitment (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 scup are from the 2015 SAW 60 benchmark assessment (NEFSC 2015). 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 $F_{MSY} = 0.220$; the proxy estimate for $SSB_{MSY} = SSB_{40\%} = 87,302$ mt = 192.468 million lbs; the proxy estimate for the $\frac{1}{2} SSB_{MSY}$ biomass threshold = $\frac{1}{2} SSB_{40\%} = 43,651$ mt = 96.234 million lbs; and the proxy estimate for $MSY = MSY_{40\%} = 11,752$ mt = 25.909 million lbs.

The $F_{40\%}$ and corresponding $SSB_{40\%}$ proxy biological reference points for scup were updated for this 2019 Operational Assessment. The updated fishing mortality threshold $F_{40\%}$ proxy for $F_{MSY} = 0.215$. The updated biomass target proxy estimate for $SSB_{MSY} = SSB_{40\%} = 94,020$ mt = 207.279 million lbs and the updated biomass threshold proxy estimate for $\frac{1}{2} SSB_{MSY} = \frac{1}{2} SSB_{40\%} = 47,010$ mt = 103.639 million lbs. The updated proxy estimate for $MSY = MSY_{40\%} =$

12,927 mt = 28.499 million lbs.

Qualitative status description:

The age structure in current fishery and survey catches is greatly expanded compared to the truncated distribution observed in the early 1990s. Most survey aggregate biomass indices are near their time series high. Recent survey indices suggest the recruitment of several large year classes over the 15 years. These simple metrics indicate that current mortality from all sources is lower than recent recruitment inputs to the stock, which has resulted in a spawning stock biomass that is well above the management target.

Research and Data Issues:

The recent recruitment of the largest year class in the assessment time series (the 2015 year class) has contributed to recent high commercial fishery discards. The exploration of management actions to reduce discarding in the event of future high recruitment events might include modification of the commercial fishery Gear Restricted Areas and modified commercial mesh sizes.

There is evidence of a decreasing trend in mean weights at age and maturity, perhaps indicative of density dependent effects. Potential effects on reference points and projected fishery yield should continue to be closely monitored.

The stock has sustained catches above MSY since 2013. However, spawning stock biomass is projected to further decrease toward the target unless more above average year classes recruit to the stock in the short term.

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). 2009. The Northeast Data Poor Stocks Working Group Report, December 8-12, 2009 Meeting. Part A: Skate species complex, deep sea red crab, Atlantic wolffish, scup, and black sea bass. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 09-02; 496 p.

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 B1. Summary 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 (S = 1) age 3.

Year	SSB	R	F
1984	11,091	147	0.944
1985	14,688	134	1.053
1986	13,928	93	0.966
1987	11,667	70	1.017
1988	9,353	130	1.041
1989	8,809	75	0.922
1990	11,291	112	0.799
1991	9,290	99	1.321
1992	7,518	40	1.378
1993	5,713	40	1.316
1994	4,229	73	1.593
1995	3,548	43	1.248
1996	6,209	37	0.989
1997	6,505	96	0.727
1998	7,932	110	0.437
1999	16,868	231	0.279
2000	33,108	154	0.227
2001	61,166	143	0.124
2002	85,072	91	0.091
2003	106,588	92	0.125
2004	118,173	142	0.111
2005	121,024	226	0.069
2006	132,421	264	0.097
2007	145,789	262	0.093
2008	172,480	231	0.066
2009	194,081	128	0.074
2010	234,435	143	0.090
2011	236,631	199	0.086
2012	236,703	114	0.086
2013	237,483	106	0.119
2014	224,139	235	0.113
2015	191,237	326	0.158
2016	199,856	112	0.140
2017	193,258	93	0.167
2018	186,578	83	0.158

Table B2. Total catch (metric tons) of scup from Maine through North Carolina. Commercial landings include revised Massachusetts landings for 1986-1997. Commercial discards for 1981-1988 calculated from the mean ratio of discards to landings for 1989-1991. Commercial discard estimate for 1998 is the mean of 1997 and 1999 estimates. Includes the 'New' MRIP estimates of recreational catch.

Year	Commercial Landings	Commercial Discards	Recreational Landings	Recreational Discards	Total Catch
1981	9,856	4,495	5,054	108	19,514
1982	8,704	3,970	3,908	169	16,751
1983	7,794	3,555	3,911	76	15,336
1984	7,769	3,543	1,489	34	12,836
1985	6,727	3,068	5,122	72	14,989
1986	7,176	3,273	6,430	86	16,965
1987	6,276	2,862	4,722	42	13,902
1988	5,943	2,710	3,191	38	11,882
1989	3,984	1,277	4,781	54	10,096
1990	4,571	2,466	3,254	59	10,350
1991	7,081	3,388	5,857	75	16,401
1992	6,259	1,885	4,288	63	12,496
1993	4,726	1,510	2,101	31	8,367
1994	4,392	962	1,964	30	7,348
1995	3,073	974	1,030	38	5,115
1996	2,945	870	2,004	55	5,874
1997	2,188	675	1,152	38	4,053
1998	1,896	705	824	60	3,485
1999	1,505	735	2,098	51	4,390
2000	1,207	592	5,167	249	7,216
2001	1,729	1,671	4,434	417	8,251
2002	3,173	1,284	2,826	427	7,710
2003	4,405	436	7,806	462	13,109
2004	4,209	1,324	5,819	620	11,972
2005	3,711	565	1,949	413	6,637
2006	4,081	896	2,688	639	8,304
2007	4,193	1,363	3,221	407	9,183
2008	2,370	1,693	2,613	608	7,284
2009	3,721	3,189	2,851	552	10,313
2010	4,866	2,638	5,660	787	13,951
2011	6,819	1,234	4,682	516	13,252
2012	6,751	1,029	3,751	636	12,166
2013	8,105	1,279	5,739	568	15,692
2014	7,239	1,004	4,659	480	13,382
2015	7,725	1,774	5,527	581	15,606
2016	7,147	2,772	4,536	862	15,317
2017	7,006	4,733	6,143	1,079	18,961
2018	6,064	3,293	5,887	644	15,888

Figures

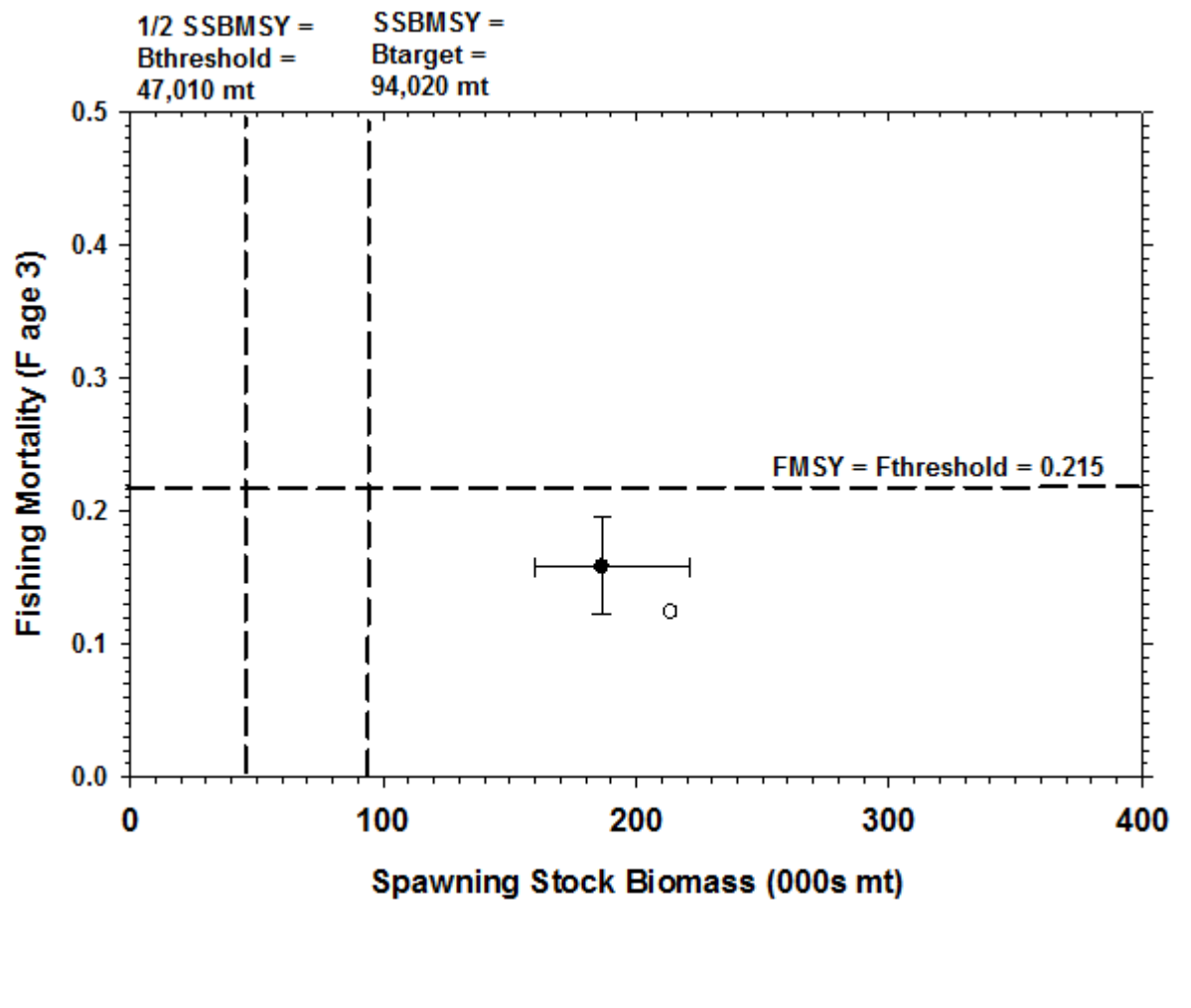


Figure B1. Estimates of scup spawning stock biomass (SSB) and fully-recruited fishing mortality (F, peak at age 3) relative to the updated 2019 biological reference points. Filled circle with 90% confidence intervals shows the assessment point estimates. The open circle shows the retrospectively adjusted estimates.

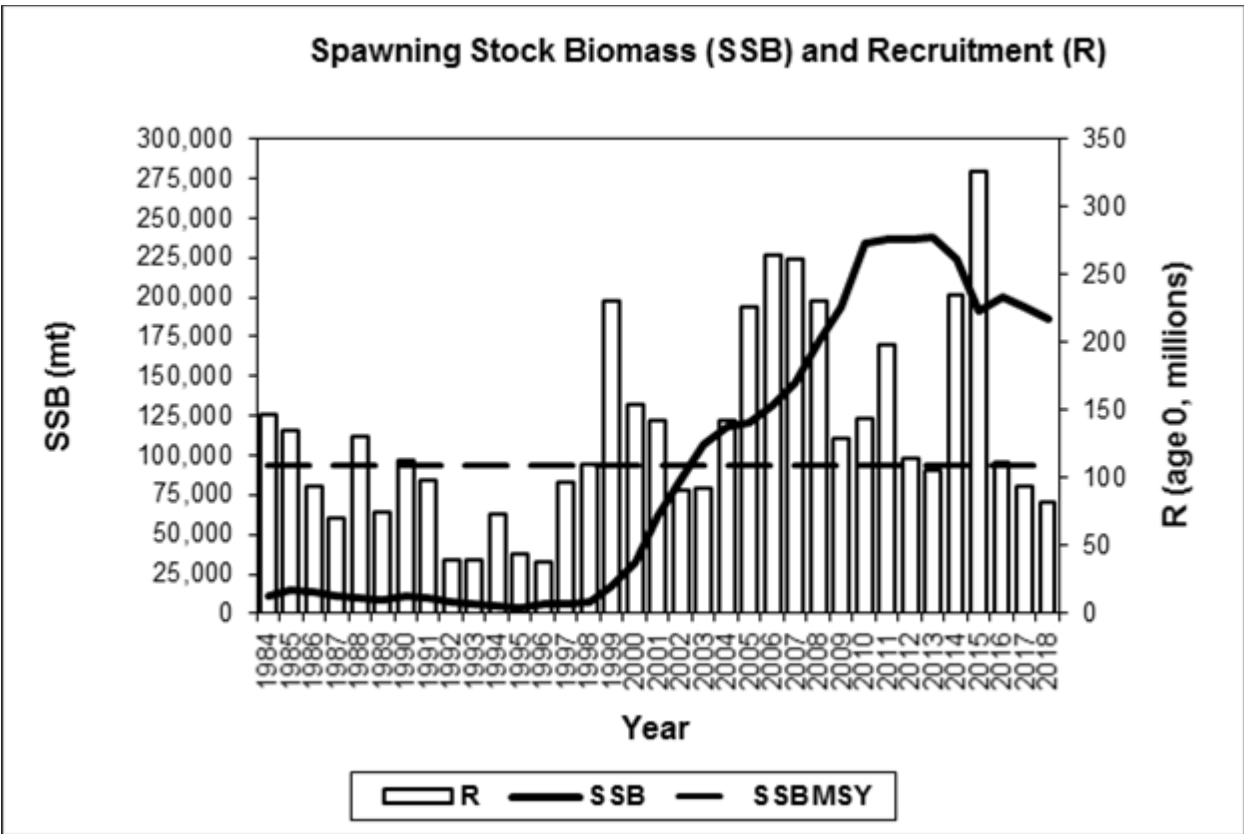


Figure B2. Scup spawning stock biomass (SSB; solid line) and recruitment at age 0 (R; vertical bars) by calendar year. The horizontal dashed line is the updated SSB_{MSY} proxy = $SSB_{40\%}$ = 94,020 mt. Note this figure only shows years when fishery age data are available in the model.

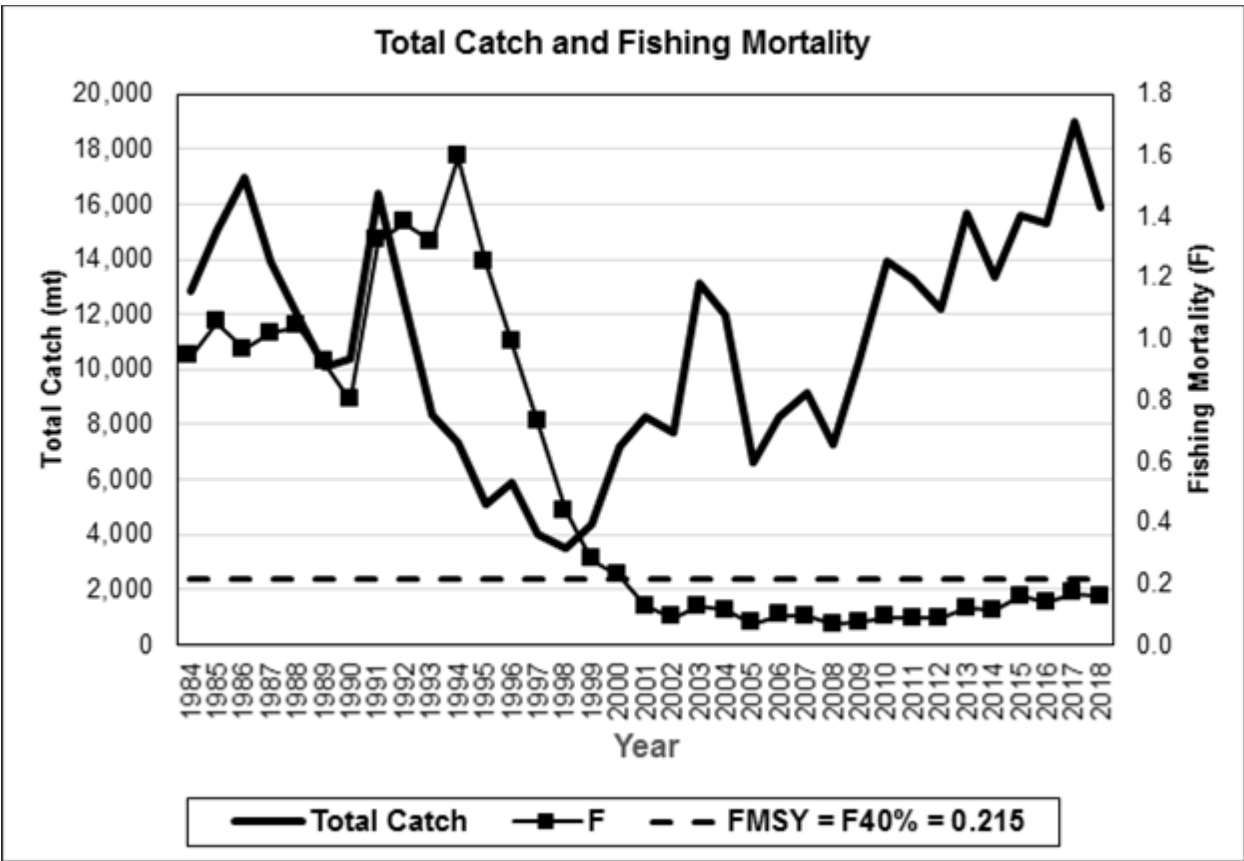


Figure B3. Total fishery catch (metric tons; mt; solid line) and fishing mortality (F, peak at age 3; squares) for scup. The horizontal dashed line is the updated F_{MSY} proxy = $F_{40\%}$ = 0.215. Note this figure only shows years when fishery age data are available in the model.

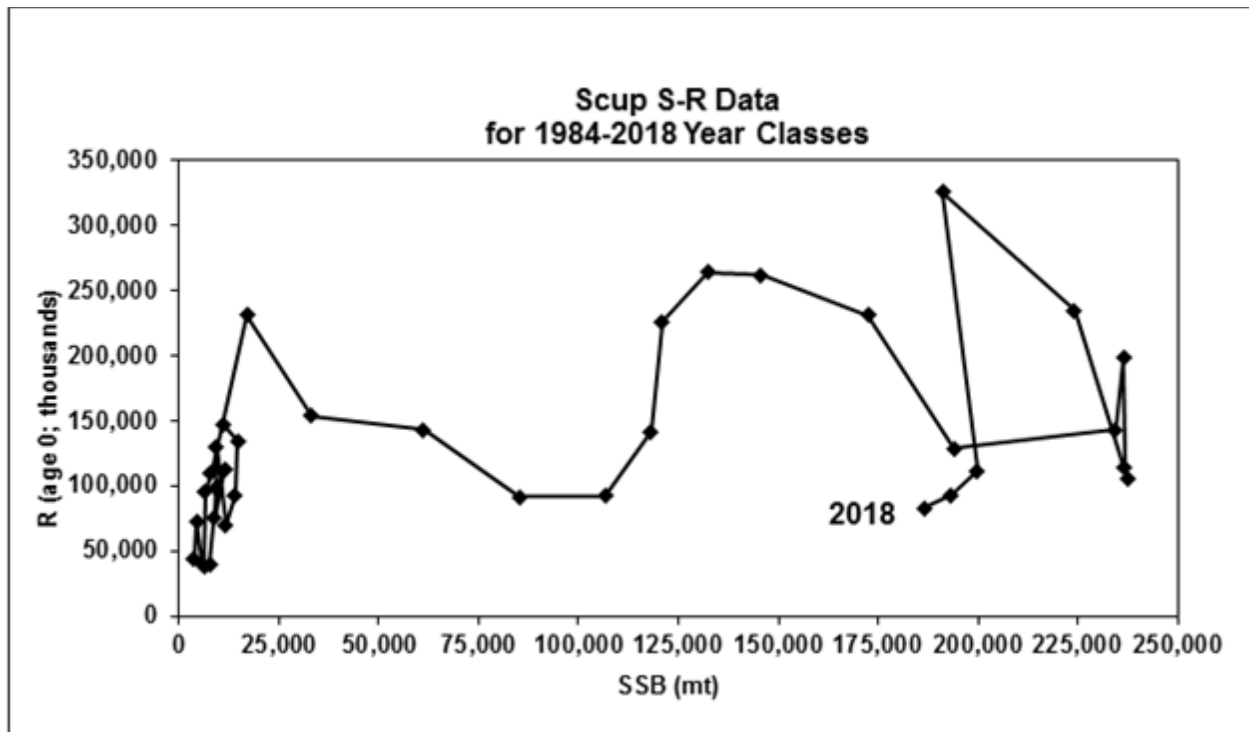


Figure B4. Spawning Stock Biomass (SSB) and Recruitment (R) scatter plot for scup. Note this figure only shows years when fishery age data are available in the model.

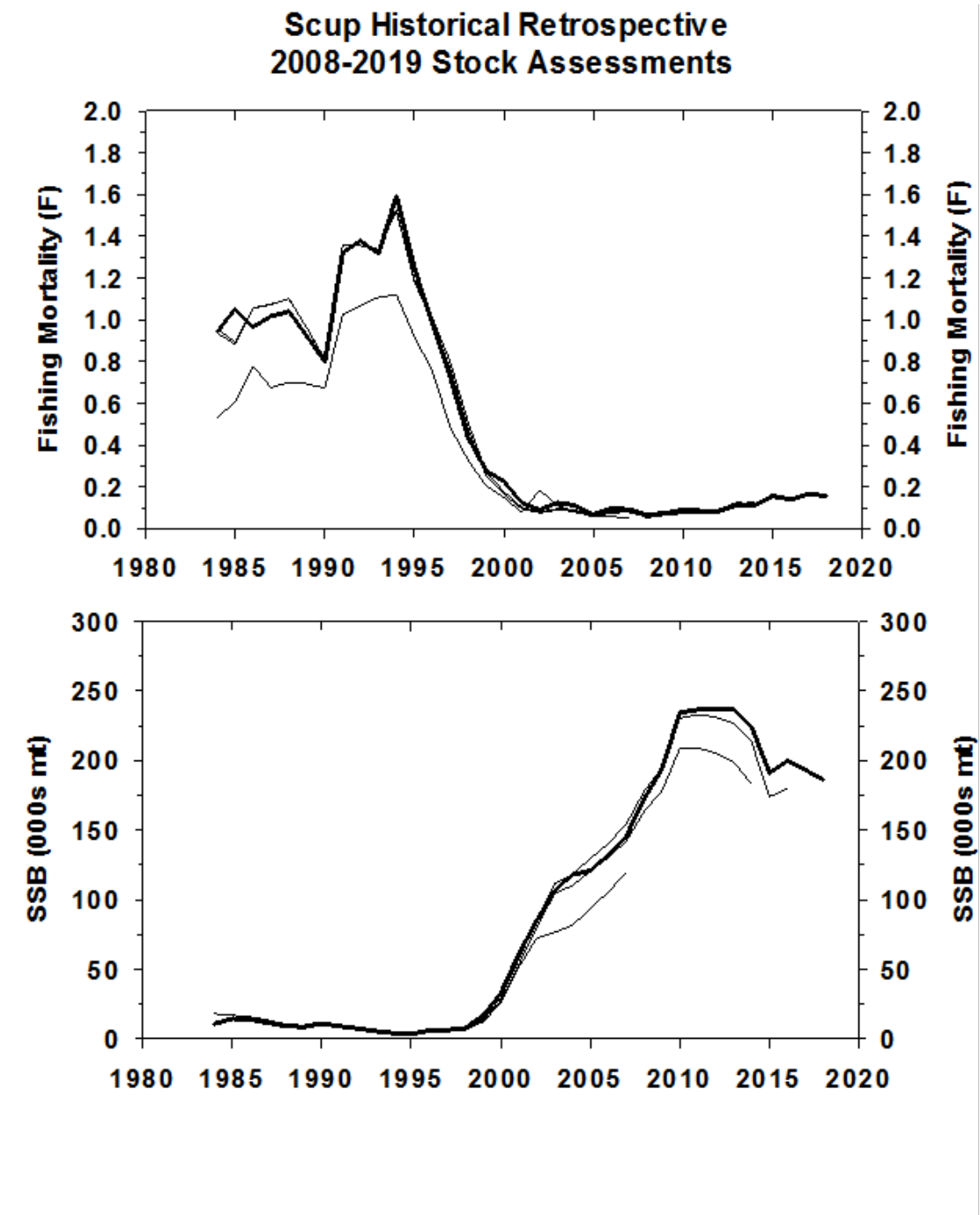


Figure B5. Historical retrospective of the 2008 (Data Poor Stocks; NEFSC 2009), 2015 (SAW 60; NEFSC 2015), 2017 (MAFMC SSC Update; unpublished) and 2019 (Operational Assessment) stock assessments of scup. The heavy solid lines are the 2019 Operational Assessment estimates that include the New MRIP recreational catch.