

Scup Stock Assessment Update for 2017

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State of Stock: This assessment of scup (*Stenotomus chrysops*) is an update through 2016 of commercial and recreational catch data, research survey indices of abundance, and the analyses of those data. The scup stock was not overfished and overfishing was not occurring in 2016 relative to the biological reference points from the 2015 SAW 60 assessment (NEFSC 2015; Figure 1). Spawning stock biomass (SSB) was estimated to be 179,898 mt in 2016, about 2.1 times biomass reference point SSB_{MSY} proxy = $SSB_{40\%}$ = 87,302 mt (Table 1, Figure 2). There is a 90% chance that SSB in 2016 was between 152,000 and 207,000 mt. Fishing mortality on the fully selected age 3 fish was 0.139 in 2016, 63% of the reference point F_{MSY} proxy = $F_{40\%}$ = 0.220 (Table 1, Figure 3). There is a 90% probability that the fishing mortality rate in 2016 was between 0.110 and 0.172. The average recruitment from 1984 to 2016 is 121 million fish at age 0. The 2015 year class is currently estimated to be large at 252 million fish, while the 2016 year class is currently estimated to be below average at 65 million fish (Table 1, Figures 2 & 4).

Catch: Reported 2016 commercial fishery landings were 7,147 mt = 15.756 million lbs, about 77% of the commercial quota (9,284 mt = 20.468 million lbs). Estimated 2016 commercial fishery dead discards were 2,772 mt = 6.111 million lbs. Estimated 2016 recreational fishery landings were 1,932 mt = 4.259 million lbs, about 70% of the recreational harvest limit (2,763 mt = 6.091 million lbs). Estimated 2016 recreational fishery dead discards were 354 mt = 0.780 million lbs. Total 2016 catch was 12,205 mt = 26.907 million lbs, about 87% of the 2016 ABC = 14,110 mt = 31.107 million lbs (Table 2, Figure 3).

Catch and Status Table: Scup
 (weights in 000s mt, recruitment in millions, arithmetic means)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Max ¹	Min ¹	Mean ¹
Commercial landings	4.2	2.4	3.7	4.9	6.8	6.8	8.1	7.2	7.7	7.1	8.1	1.2	4.8
Commercial discards ²	1.4	1.7	3.2	2.6	1.2	1.0	1.3	1.0	1.8	2.8	3.5	0.4	1.7
Recreational landings	2.1	1.7	1.5	2.7	1.6	1.8	2.5	2.1	2.3	1.9	6.2	0.5	2.2
Recreational discards ²	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.0	0.4	0.1
Total Catch	8.0	6.1	8.6	10.5	9.9	9.9	12.1	10.6	12.0	12.2	16.8	3.1	8.8
Commercial quota	4.2	2.5	3.9	5.0	8.0	5.8	10.7	10.0	9.6	9.3	10.7	1.1	5.2
Recreational harvest limit	1.3	0.9	1.2	1.4	2.0	3.9	3.4	3.2	3.3	2.8	3.9	0.6	1.8
Spawning Stock Biomass ^{1,3}	154	178	195	230	233	231	227	213	174	180	233	4	86
Recruitment (age 0) ¹	239	207	112	124	166	87	80	175	252	65	252	31	121
F (age 3) ¹	0.079	0.056	0.065	0.073	0.071	0.076	0.105	0.104	0.148	0.139	1.523	0.056	0.535

1: Over the period 1984-2016

2: Dead discards

3: On June 1

Stock Distribution and Identification: The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) 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 the NEAMAP spring and fall bottom trawl survey data were used in the 2015 SAW 60 benchmark assessment and in this update (NEFSC 2015).

There is not a major retrospective pattern evident in the scup assessment model; the minor pattern that exists tends to overestimate F and underestimate SSB . 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 (Figures 5-7).

Biological Reference Points (BRPs): The biological reference points for scup are from the 2015 SARC 60 ASAP model (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 (9,445 mt = 20.823 million lbs of landings and 2,307 mt = 5.086 million lbs of discards).

Reference points were calculated using the non-parametric yield and SSB per recruit/long-term projection approach. The cumulative distribution function of the 1984-2015 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.

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). 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>).

Table 1. 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	11,467	134	0.958
1985	15,207	128	0.893
1986	14,499	83	1.058
1987	11,407	64	1.075
1988	8,656	118	1.102
1989	7,510	68	0.961
1990	10,432	100	0.810
1991	8,469	90	1.359
1992	6,996	37	1.355
1993	5,590	38	1.337
1994	4,241	62	1.523
1995	3,679	36	1.183
1996	5,535	31	0.992
1997	5,663	82	0.769
1998	7,003	103	0.479
1999	14,266	233	0.254
2000	29,777	153	0.165
2001	57,127	145	0.096
2002	85,742	89	0.076
2003	111,574	90	0.090
2004	118,294	138	0.084
2005	129,788	218	0.057
2006	140,476	246	0.079
2007	154,377	239	0.079
2008	177,819	207	0.056
2009	194,964	112	0.065
2010	230,434	124	0.073
2011	233,060	166	0.071
2012	231,263	87	0.076
2013	226,992	80	0.105
2014	213,279	175	0.104
2015	174,017	252	0.148
2016	179,898	65	0.139

Table 2. 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.

Year	Commercial Landings	Commercial Discards	Recreational Landings	Recreational Discards	Total Catch
1981	9,856	4,495	3,116	59	17,526
1982	8,704	3,970	2,791	53	15,518
1983	7,794	3,555	3,353	63	14,765
1984	7,769	3,543	1,296	33	12,641
1985	6,727	3,068	3,268	60	13,123
1986	7,176	3,273	6,223	97	16,769
1987	6,276	2,862	3,323	42	12,503
1988	5,943	2,710	2,289	35	10,977
1989	3,984	1,277	2,980	43	8,285
1990	4,571	2,466	2,220	42	9,299
1991	7,081	3,388	4,336	87	14,892
1992	6,259	1,885	2,366	52	10,562
1993	4,726	1,510	1,714	31	7,981
1994	4,392	962	1,409	41	6,804
1995	3,073	974	720	14	4,781
1996	2,945	870	1,156	22	4,993
1997	2,188	675	642	9	3,514
1998	1,896	705	469	16	3,086
1999	1,505	735	1,012	7	3,259
2000	1,207	592	2,919	61	4,779
2001	1,729	1,671	2,285	184	5,869
2002	3,173	1,284	1,944	152	6,553
2003	4,405	436	4,549	176	9,566
2004	4,209	1324	3,278	182	8,993
2005	3,711	565	1,215	270	5,761
2006	4,081	896	1,681	426	7,084
2007	4,193	1,363	2,085	346	7,987
2008	2,370	2,254	1,713	287	6,624
2009	3,721	3,189	1,462	211	8,583
2010	4,866	2,638	2,715	318	10,537
2011	6,819	1,234	1,632	173	9,858
2012	6,751	1,029	1,842	231	9,853
2013	8,105	1,279	2,464	224	12,072
2014	7,239	1,004	2,124	229	10,596
2015	7,725	1,774	2,295	226	12,020
2016	7,147	2,772	1,932	354	12,205

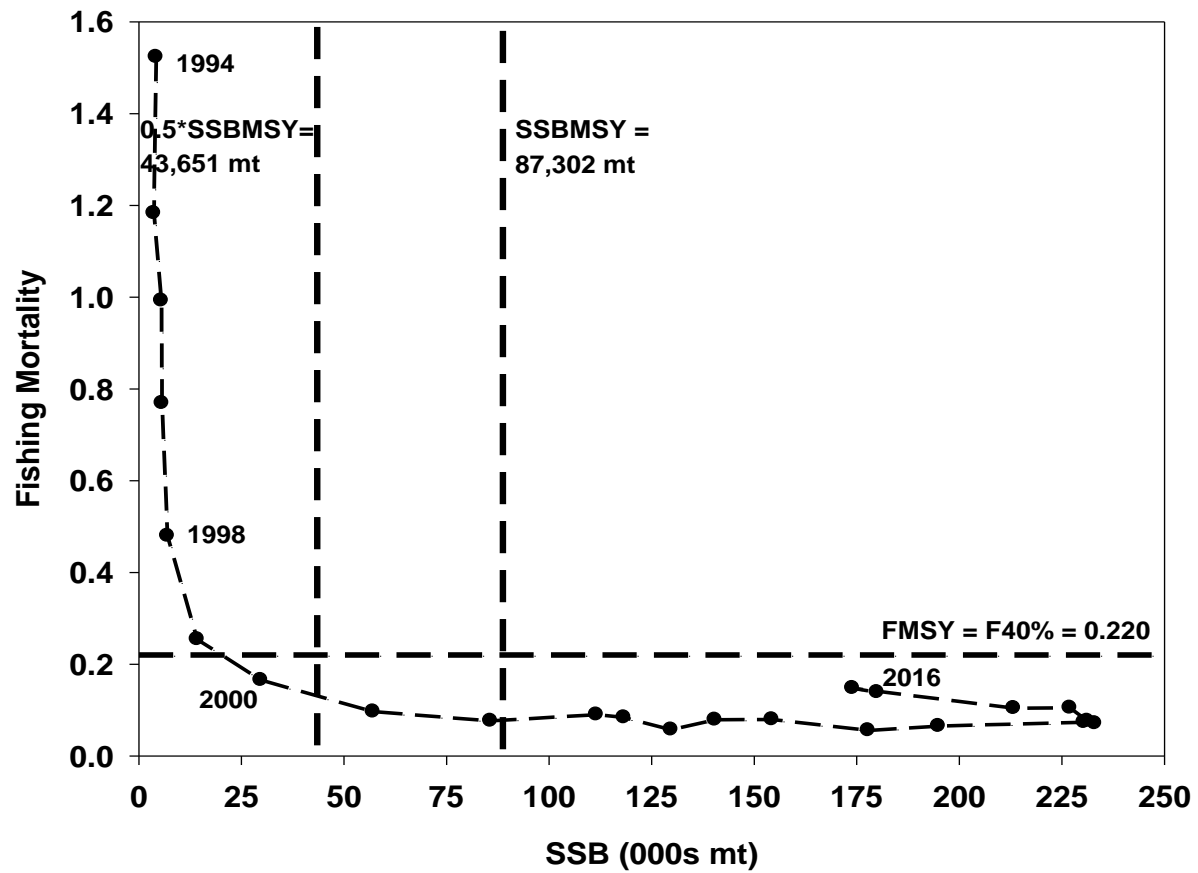


Figure 1. Status determination plot for scup: spawning stock biomass (SSB) and fully-recruited fishing mortality relative to the biological reference points (NEFSC 2015).

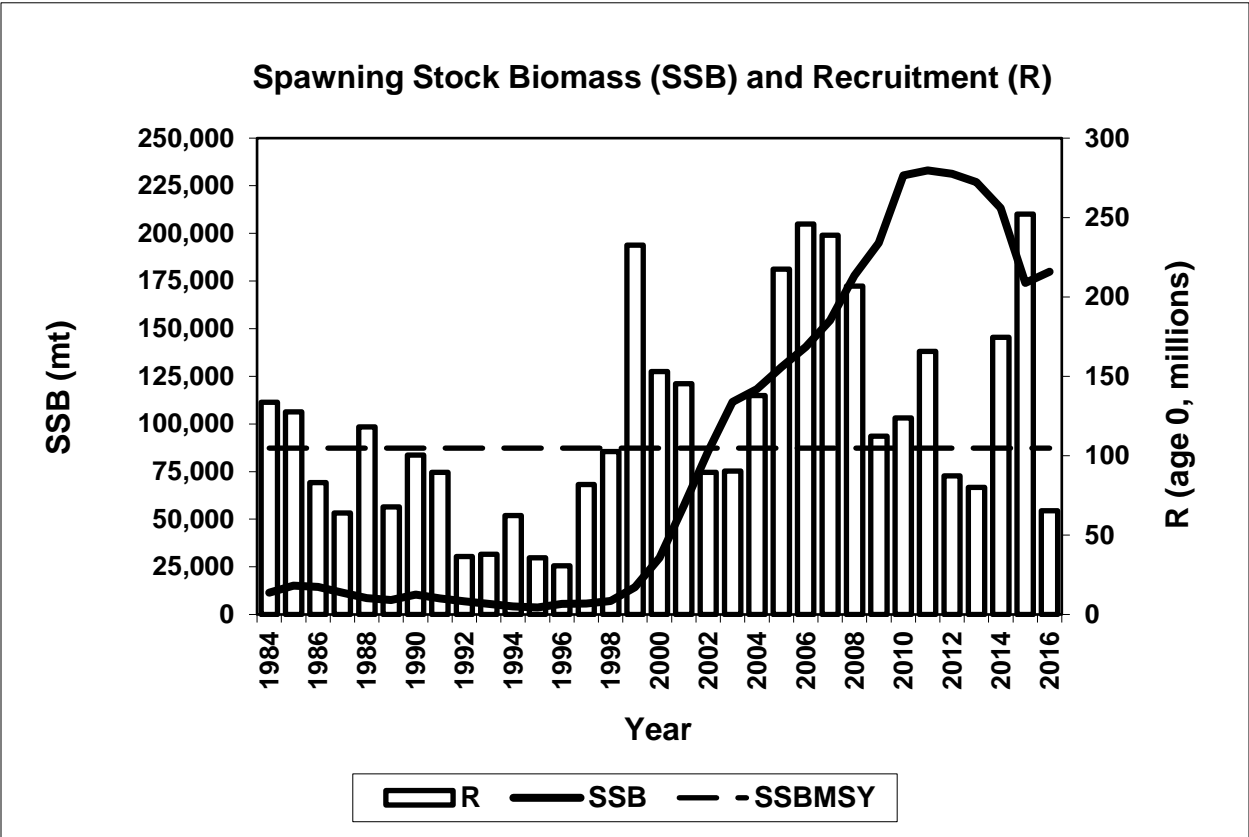


Figure 2. Spawning Stock Biomass (SSB; solid line) and Recruitment (R at age 0; vertical bars) for scup. The horizontal dashed line is the SSB_{MSY} proxy = $SSB_{40\%}$ = 87,302 mt (NEFSC 2015). Note this figure only shows years where fishery age data are available in the model.

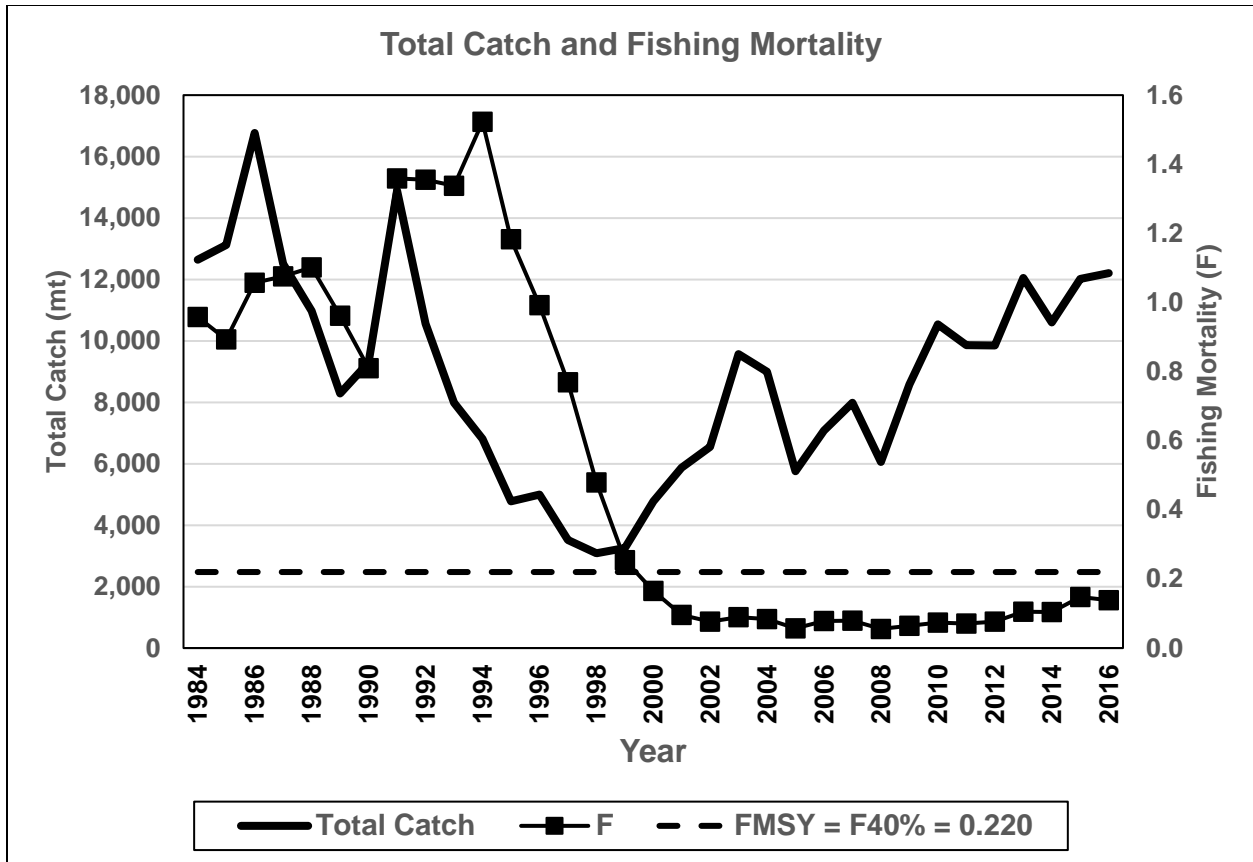


Figure 3. Total fishery catch and fishing mortality (F at age 3) for scup. The horizontal dashed line is the F_{MSY} proxy = $F_{40\%} = 0.220$ (NEFSC 2015). Note this figure only shows years where fishery age data are available in the model.

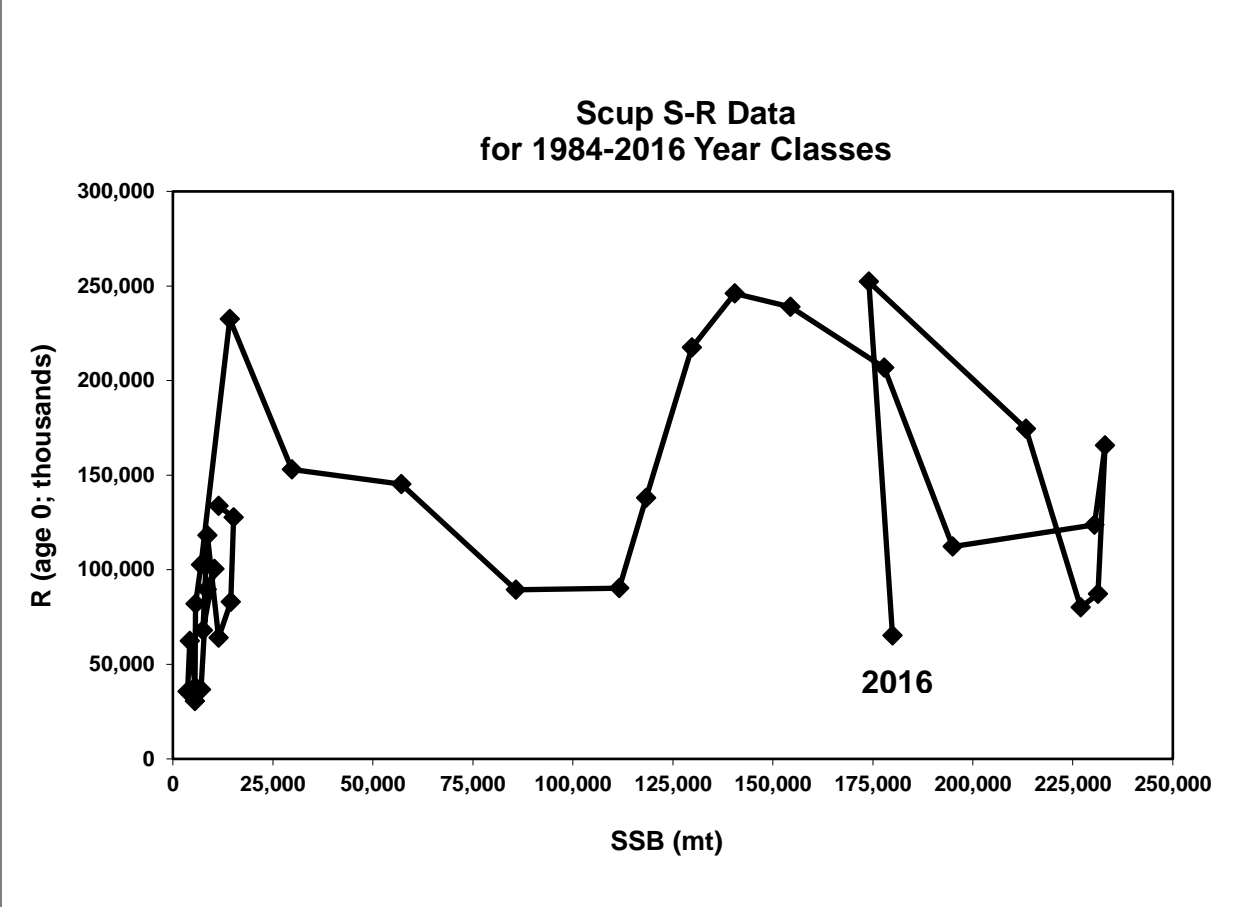


Figure 4. Spawning Stock Biomass (SSB) and Recruitment (R) scatter plot for scup. Note this figure only shows years where fishery age data are available in the model.

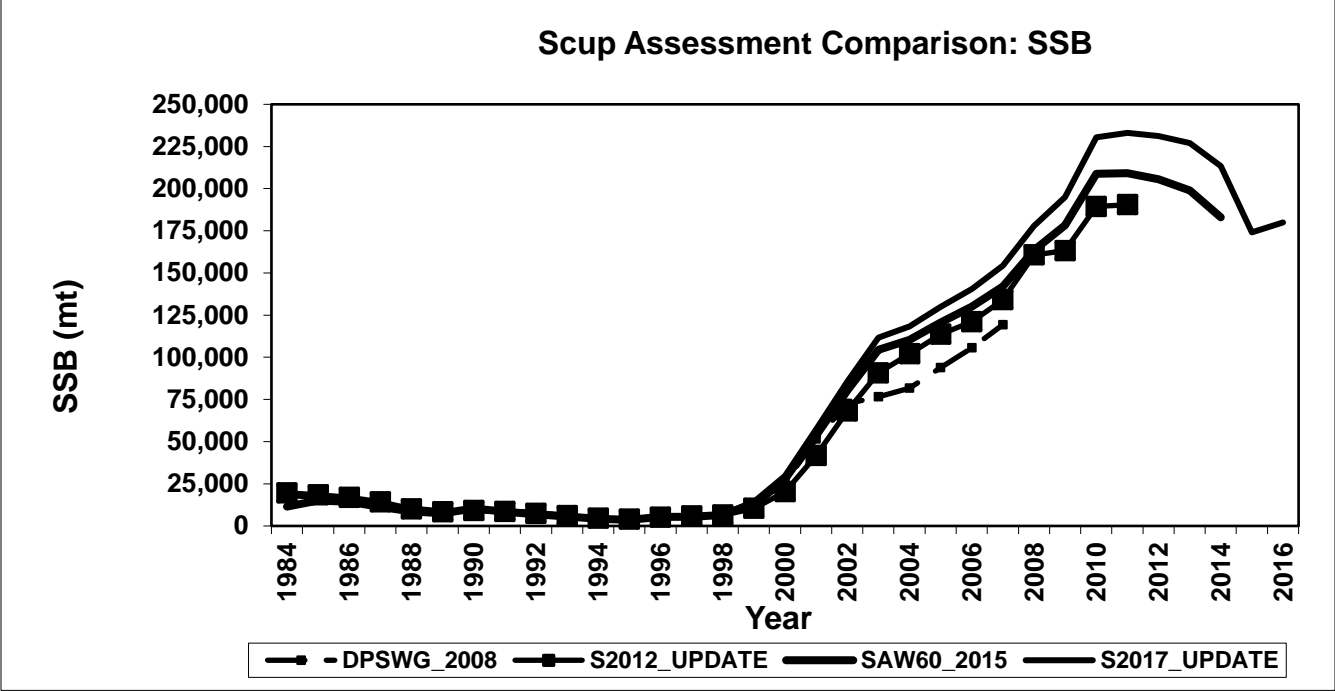


Figure 5. Comparison of estimates of Spawning Stock Biomass (SSB) from the 2008 benchmark, 2012 update, 2015 benchmark, and 2017 update assessments.

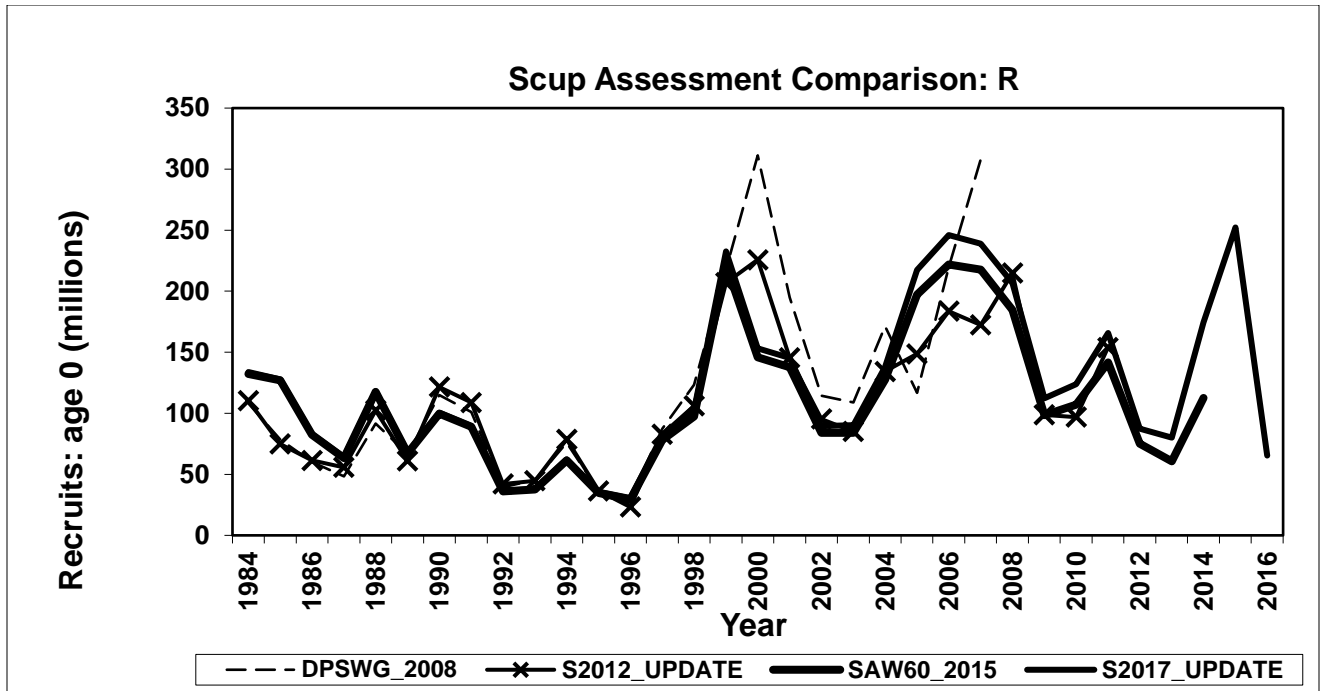


Figure 6. Comparison of estimates of recruitment at age 0 (R) from the 2008 benchmark, 2012 update, 2015 benchmark, and 2017 update assessments.

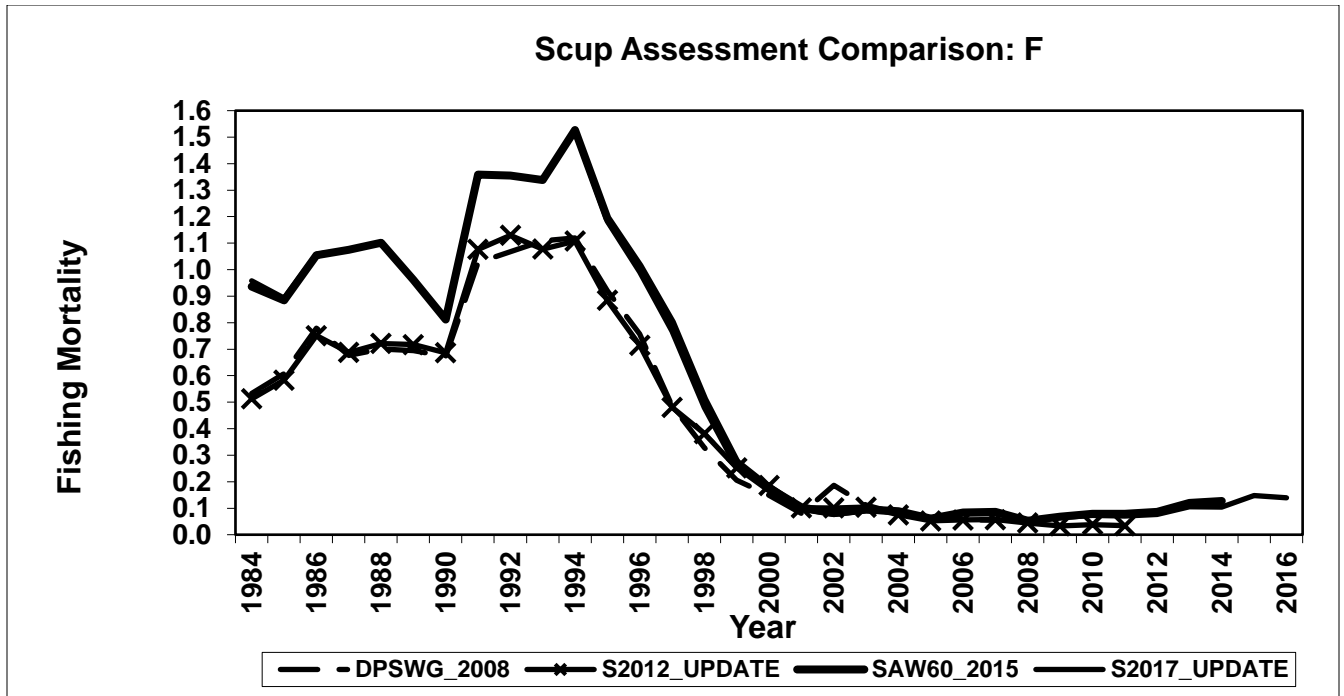


Figure 7. Comparison of estimates of fully recruited fishing mortality at age 3 (F) from the 2008 benchmark, 2012 update, 2015 benchmark, and 2017 update assessments.