Supplemental documentation to the SEDAR 70 Stock Assessment Report

December 22, 2020
SEFSC – Sustainable Fisheries Division

SEFSC staff met with GMFMC (Council) staff to discuss the SEDAR 70 Stock Assessment Report (SAR) on November 3rd, 2020. Council staff at the meeting requested a number of clarifications to the SAR and some additional projections, incorporating the most recent landings data (2019). This supplement conveys the clarifications and the additional projections as requested.

ASPIC supplemental description

Term of Reference 4 for SEDAR 70 states, "Develop a sensitivity run using a secondary model, such as a surplus production model (e.g., Just Another Bayesian Biomass Assessment model [Winker et al. 2018], ASPIC) to compare with the proposed base model from Stock Synthesis." The assessment team chose ASPIC, as it had been developed thoroughly as an alternate model for SEDAR 33, the last Benchmark assessment for Greater Amberjack. As the TOR specified, a sensitivity run using ASPIC was carried out, similarly to other sensitivity runs. No diagnostics were done, and the model was not considered as an alternative to the base model in SS. We have produced additional plots to help compare the benchmarks from the base model in SS to the sensitivity run in ASPIC. One issue with comparing the two models is that different benchmarks are produced in each, MSY-based benchmarks in ASPIC, and SPR30% in SS. In Figure 1, the B/B_{MSY} and the $B/B_{SPR30\%}$ from each model is shown, though they are not directly comparable. Also noteworthy is the fact that current management is based on spawning stock biomass based references rather than total biomass.

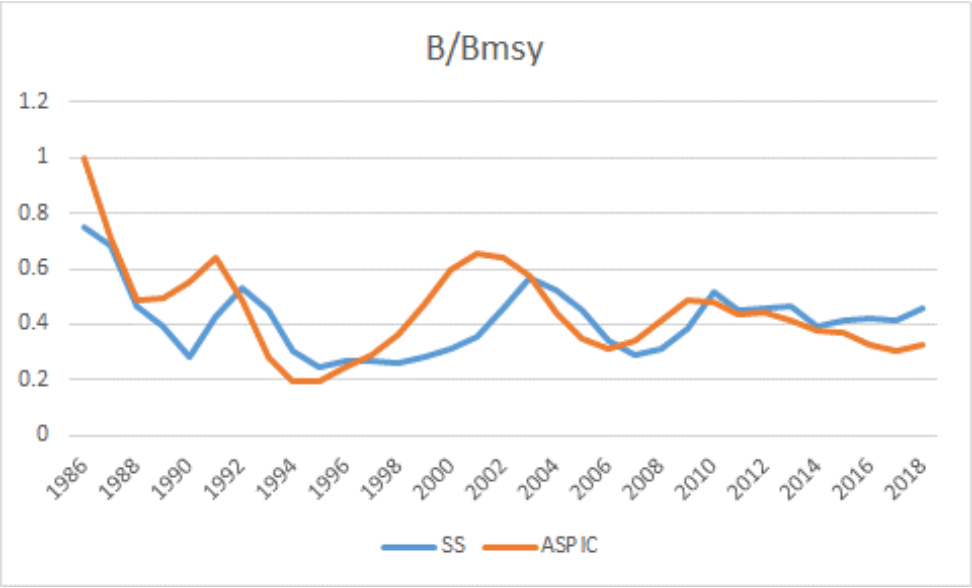

Figure 1. Biomass benchmarks through time for both the SS model and the ASPIC model. Though the ASPIC model does output Bmsy, the stock is managed using SSBspr30%. The SS time series shown is B/Bspr30%. Therefore the relative time series are not directly comparable.

Similarly, in Figure 2, the F/F_{MSY} and the $F/F_{SPR30\%}$ from each model is shown, though they are also not directly comparable. In addition to the disparate reference levels (i.e. Fspr30% and Fmsy), in surplus biomass models such as ASPIC, fishing mortality estimates (F) are not conditioned on selectivity as they are in age and size structured models such as SS. Current management is based on the $F/F_{SPR30\%}$ benchmark.

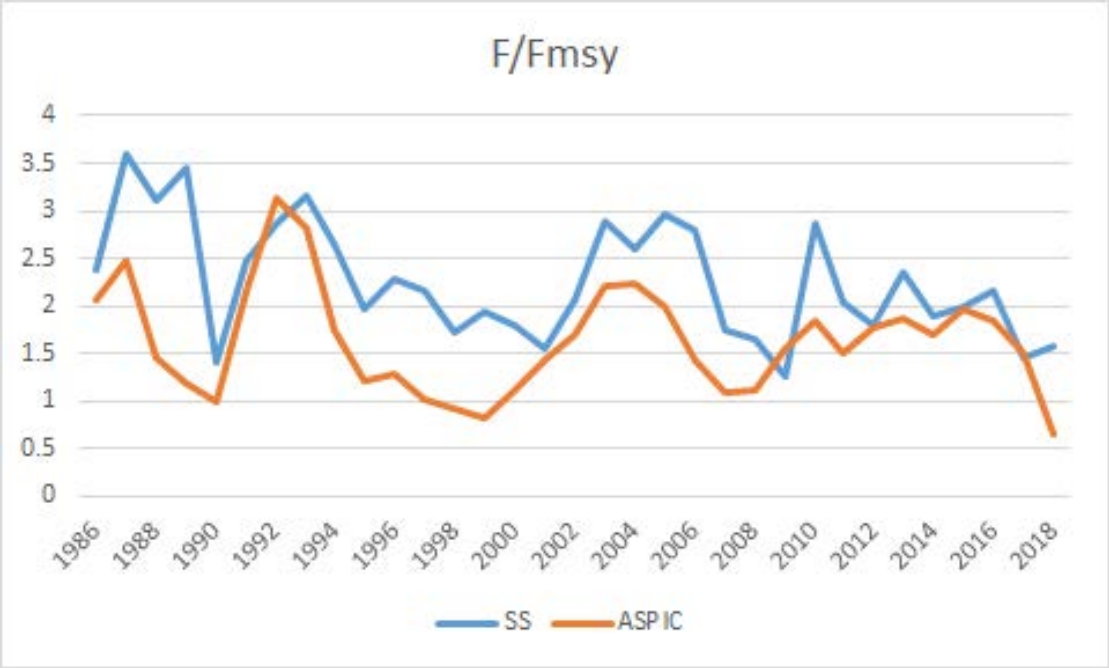

Figure 2. Fishing benchmarks through time for both the SS model and the ASPIC model. Though the ASPIC model does output F_{MSY}, the stock is managed using $F_{SPR30\%}$. The SS time series shown is $F/F_{SPR30\%}$. Therefore the relative time series are not directly comparable.

While the TORs did request a sensitivity run using a surplus production model (e.g. JABBA, ASPIC), it is important to note that previous attempts to assess greater amberjack using productions models were not used to produce OFL and ABC advice (SEDAR 9) or were rejected for base model consideration by reviewers (SEDAR 33 Benchmark). The Center does not support the development of management advice for greater amberjack using a surplus production model (e.g. ASPIC, JABBA). We have summarized key points from the SEDAR 33 Benchmark Review Panel report below.

From the RW Panel report:

1. Regarding data:
    a. ASPIC model cannot deal with currently available information on size structure of catches with which to evaluate temporal changes over the time series. Thus, the ASPIC model does not incorporate all of the relevant information with which to evaluate stock status (and changes thereof),

b. The ASPIC model, cannot account for changes in fishery-dependent indices of abundance following changes in fishery selectivity or retention.

2. Regarding ASPIC application results:
   a. "The current implementation gives a different result (more optimistic) than the previous update assessment. According to the assessment team, this is mainly due to changing the recreational fishery abundance indices from numbers to weights."
   b. While support for varying selectivity between fleets was evident for greater amberjack, the ASPIC model cannot accommodate this process. As an example: "the size range of catches associated with the MRFSS index suggests a broad selection pattern, while the narrow and small range of catches associated with the headboat survey suggests a dome shaped pattern".
3. Regarding status determination and uncertainties addressed.
   a. The change in status results between SEDAR 9 (2006) and SEDAR 33 (2012), overfishing to not-overfishing status, could be due to changing in units of indices from numbers to weight.
   b. Further, regarding selectivity temporal changes were clear for the MRFSS index providing support for breaking the index into two (2) periods; however, this decision produced indices reduced to smaller segments that no longer show any significant trend. As management change is a common feature for the amberjack indices, an assessment that can deal with those changes in more appropriate manner is preferred
   c. Regarding determination of recruitment overfishing- the ASPIC model cannot partition mortality by life history stanza.
   d. Relating to status determinant and uncertainty of- the SEDAR 33 ASPIC application was highly sensitive to changes in data as relates model inputs: B1/K input ratio, discard mortality, and index weighting.
4. Regarding RW Panel "guidance on key improvements in data or modelling approaches"**,** the Panel "considers that for greater amberjack, the Stock Synthesis modelling framework still remains appropriate for the type of data available, and allows flexibility to account for changes in size limits or IFQs that affect patterns of discarding in commercial and recreational fisheries".

Converting metric tons to pounds

Council staff also requested that we provide landings in pounds rather than metric tons. We have converted the metric tons to pounds, where requested, and added Tables 13-16_supplemental, using the same numbers of the original tables in the stock assessment report. We added the "_supplemental" suffix in order to reduce confusion with the original tables provided.

Table 13_supplemental Observed (Obs) and predicted (Exp) landings by fleet for the commercial fisheries in weight (ww, pounds) and number (1000s of fish) for Gulf of Mexico Greater Amberjack. Note that the standard errors were as follows: Commercial Vertical Line (0.05) and Commercial Longline (0.05).

Year	Vertical Line (Obs, ww)	Vertical Line (Exp, ww)	Vertical Line (Exp, Number)	Longline (Obs, ww)	Longline (Exp, ww)	Longline (Exp, Number)
1963	8,431	8,431	0.281	0	0	0
1964	6,294	6,294	0.211	4	4	0.000
1965	5,187	5,187	0.175	0	0	0
1966	7,317	7,317	0.248	0	0	0
1967	28,903	28,903	0.983	0	0	0
1968	11,394	11,394	0.389	0	0	0
1969	72,162	72,162	2.476	0	0	0
1970	13,508	13,508	0.465	15	15	0.000
1971	38,072	38,072	1.318	0	0	0
1972	39,344	39,344	1.369	1878	1878	0.042
1973	27,975	27,975	0.979	2	2	0.000
1974	41,313	41,313	1.453	0	0	0
1975	77,347	77,347	2.736	0	0	0
1976	85,568	85,566	3.040	26	26	0.001
1977	118,071	118,069	4.211	589	589	0.013
1978	149,134	149,134	5.336	13	13	0.000
1979	147,163	147,163	5.288	2769	2769	0.064
1980	171,672	171,672	6.251	4910	4910	0.113
1981	210,436	210,434	7.956	22302	22302	0.519
1982	182,739	182,739	7.080	38945	38945	0.921
1983	230,950	230,966	9.593	45127	45127	1.094
1984	462,577	462,593	21.701	61068	61070	1.568
1985	647,202	647,180	29.767	114447	114447	3.170
1986	919,853	920,208	42.410	209629	209636	5.995
1987	1,297,858	1,298,764	61.183	263528	263541	7.570
1988	1,730,596	1,730,845	81.019	346766	346731	10.394
1989	1,648,879	1,645,656	86.948	319878	319715	9.851
1990	1,111,415	1,104,881	44.316	153253	153125	4.494
1991	1,746,743	1,733,722	68.940	36198	36189	1.169
1992	1,005,097	1,000,738	36.641	57675	57655	1.766
1993	1,526,401	1,498,334	51.641	97546	86671	2.405
1994	1,206,770	1,179,968	41.383	80634	78031	2.095
1995	1,158,215	1,145,904	41.419	85039	81591	2.248
1996	1,183,883	1,185,202	43.042	62561	61608	1.752

Table 13_supplemental (continued)

Year	Vertical Line (Obs, ww)	Vertical Line (Exp, ww)	Vertical Line (Exp, Number)	Longline (Obs, ww)	Longline (Exp, ww)	Longline (Exp, Number)
1997	1,012,008	1,021,188	36.721	57,455	57,450	1.622
1998	603,881	609,893	21.9	51,926	52,550	1.442
1999	663,093	669,114	24.39	65,350	66,128	1.836
2000	778,785	771,133	29.179	71,754	72,590	2.075
2001	657,967	655,370	25.134	48,440	48,945	1.406
2002	688,702	683,847	26.394	80,242	80,423	2.402
2003	842,369	845,797	31.55	118,184	118,541	3.570
2004	868,714	875,738	31.351	82,336	83,297	2.390
2005	644,263	649,806	22.747	72,909	73,740	2.022
2006	515,054	518,048	18.532	76,895	77,742	2.132
2007	528,293	526,966	19.265	59,576	60,034	1.654
2008	377,510	381,463	15.14	91,351	91,338	2.562
2009	545,121	550,703	21.91	49,714	50,133	1.449
2010	530,249	522,107	20.099	24,264	24,504	0.703
2011	507,783	506,293	17.958	11,782	11,894	0.337
2012	304,276	306,856	10.636	10,889	11,023	0.302
2013	454,337	452,068	15.479	16,965	17,161	0.454
2014	507,056	502,819	17.577	24,976	25,272	0.674
2015	469,804	459,259	16.281	30,810	31,178	0.849
2016	454,520	456,627	15.952	24,026	24,291	0.665
2017	457,112	459,575	15.843	26,914	27,232	0.743
2018	298,734	300,819	10.015	26,810	27,124	0.712

Table 14_supplemental Observed (Obs) and predicted (Exp) landings by fleet for the recreational fisheries in weight (ww, pounds) and number (1000s of fish) for Gulf of Mexico Greater Amberjack. Note that the standard errors were as follows: Recreational Charter Private (0.25) and Recreational Headboat (0.21).

Year	Charter Private (Obs, Number)	Charter Private (Exp, Number)	Charter Private (Exp, ww)	Headboat (Obs, Number)	Headboat (Exp, Number)	Headboat (Exp, ww)
1950	102.889	102.888	1,711,744	0.45	0.45	8,433
1951	123.467	123.465	2,052,355	0.54	0.54	10,110
1952	144.044	144.042	2,388,296	0.63	0.63	11,768
1953	164.622	164.618	2,715,397	0.72	0.72	13,398
1954	185.2	185.194	3,033,084	0.81	0.81	14,989
1955	205.778	205.768	3,341,644	0.9	0.9	16,550
1956	218.831	218.818	3,520,373	1.2	1.2	21,916
1957	231.884	231.866	3,694,208	1.49	1.49	27,027
1958	244.937	244.914	3,864,141	1.79	1.79	32,247
1959	257.99	257.959	4,030,458	2.09	2.09	37,397
1960	271.043	271.003	4,193,094	2.39	2.39	42,477
1961	271.749	271.702	4,163,243	2.69	2.69	47,485
1962	272.455	272.4	4,136,964	2.99	2.99	52,459
1963	273.161	273.097	4,115,447	3.29	3.29	57,422
1964	273.867	273.792	4,098,361	3.59	3.59	62,378
1965	274.573	274.486	4,085,111	3.89	3.89	67,336
1966	281.185	281.078	4,161,942	4.25	4.25	73,319
1967	287.796	287.668	4,237,892	4.6	4.6	79,082
1968	294.407	294.255	4,312,056	4.96	4.96	84,951
1969	301.019	300.836	4,383,728	5.32	5.32	90,743
1970	307.63	307.41	4,453,394	5.68	5.68	96,450
1971	318.449	318.172	4,577,691	5.68	5.68	95,956
1972	329.269	328.907	4,694,713	5.98	5.98	100,419
1973	340.088	339.61	4,810,676	6.28	6.28	104,839
1974	350.907	350.275	4,925,802	6.28	6.28	104,277
1975	361.727	360.942	5,043,463	8.67	8.67	143,312
1976	382.304	381.451	5,306,034	8.37	8.37	137,919
1977	402.881	402.263	5,574,316	7.77	7.77	127,725
1978	423.457	423.825	5,850,401	7.47	7.47	122,425
1979	444.034	447.23	6,125,451	8.37	8.37	136,052
1980	464.611	472.948	6,288,704	8.37	8.372	132,148
1981	327.881	333.911	4,136,369	7.77	7.975	119,544
1982	896.104	829.923	10,101,675	7.77	7.781	113,269
1983	482.745	626.561	6,913,958	7.77	7.778	102,405

Table 14_supplemental (continued)

Year	Charter Private (Obs, Number)	Charter Private (Exp, Number)	Charter Private (Exp, ww)	Headboat (Obs, Number)	Headboat (Exp, Number)	Headboat (Exp, ww)
1984	155.049	187.578	1,818,030	7.77	7.581	90,873
1985	570.517	467.026	5,104,002	7.77	7.577	98,620
1986	489.706	638.349	6,858,292	86.02	87.277	1,163,195
1987	1306.6	1068.7	11,007,579	52.89	53.594	690,353
1988	329.389	485.852	5,436,967	29.66	30.245	396,218
1989	473.968	596.005	5,339,677	52.52	52.282	587,633
1990	89.132	86.328	1,434,049	24.26	24.562	394,823
1991	333.375	291.632	4,927,544	9.85	10.177	177,292
1992	379.227	309.321	5,852,055	19.75	19.33	383,006
1993	196.448	214.973	4,226,780	14.05	14.709	297,096
1994	134.192	121.939	2,309,613	13.12	12.642	241,224
1995	55.301	66.634	1,207,925	8.67	7.915	144,981
1996	137.635	89.399	1,626,932	10.51	9.955	186,174
1997	70.126	85.305	1,624,527	7.54	6.827	132,580
1998	68.11	72.431	1,596,453	5.11	5.34	107,421
1999	123.246	103.017	2,169,167	5.29	5.417	104,790
2000	99.061	105.308	2,260,737	6	5.119	101,468
2001	113.744	129.998	2,815,135	6.01	6.177	116,861
2002	234.766	255.525	5,201,711	10.69	10.335	192,237
2003	315.708	371.951	7,618,249	11.98	11.613	229,936
2004	246.435	253.604	5,471,183	6.24	4.831	100,399
2005	217.248	257.845	5,597,134	3.99	3.859	78,566
2006	134.064	192.354	4,102,748	4.73	3.693	74,441
2007	68.677	95.772	2,096,333	4.46	4.159	83,040
2008	142.14	85.977	2,567,070	4.82	4.016	90,884
2009	112.171	74.227	2,139,363	5.24	4.845	109,696
2010	149.766	245.864	7,070,223	2.57	2.507	57,836
2011	112.563	138.489	3,947,763	2.99	2.904	67,642
2012	149.101	116.86	3,387,346	3.84	3.701	88,611
2013	131.738	152.342	4,561,575	3.13	3.166	75,654
2014	138.357	108.573	3,194,088	1.99	2.098	48,616
2015	121.194	123.089	3,577,694	2.87	3.03	70,619
2016	109.607	86.489	3,929,751	1.1	1.159	38,173
2017	39.83	50.774	2,164,249	0.92	0.965	31,407
2018	86.479	61.077	2,521,588	2.46	2.008	65,978

Table 15_supplemental Observed (Obs) and predicted (Exp) discards by fleet for the commercial fisheries in weight (ww, pounds) and number (1000s of fish) for Gulf of Mexico Greater Amberjack. The standard errors were as follows: Commercial Vertical Line (0.25) and Commercial Longline (0.25).

Year	Vertical Line (Obs, Number)	Vertical Line (Exp, Number)	Vertical Line (Exp, ww)	Longline (Obs, Number)	Longline (Exp, Number)	Longline (Exp, ww)
1993	30.18	37.209	43,253	0.62	1.318	3,510
1994	30.63	39.859	40,700	0.8	1.167	2,998
1995	37.45	43.881	45,885	0.88	1.362	3,327
1996	38.85	40.301	46,657	0.87	1.091	2,665
1997	38.21	33.767	36,072	0.96	0.966	2,434
1998	32.71	23.823	22,536	1.94	0.843	2,108
1999	42.35	27.151	28,177	2.25	1.142	2,738
2000	33.29	37.267	33,391	2.88	1.334	3,166
2001	36.4	37.392	31,628	1.4	0.938	2,147
2002	31.65	34.265	35,717	1.82	1.707	3,823
2003	35.69	29.625	35,671	2.62	2.391	5,690
2004	36.32	26.352	29,904	2.75	1.428	3,624
2005	27.02	19.71	22,051	2.78	1.152	2,948
2006	22.09	17.909	19,222	2.07	1.254	3,135
2007	21.74	22.617	20,704	1.26	0.995	2,441
2008	19.548	14.743	13,477	1.63	1.639	3,854
2009	23.1	18.847	18,832	1.21	0.95	2,240
2010	11.23	14.539	16,010	0.61	0.44	1,076
2011	15.29	16.912	21,142	0.78	0.203	509
2012	11.35	9.415	11,200	0.35	0.169	441
2013	13.32	15.047	16,451	0.65	0.244	642
2014	16.36	18.802	21,147	0.94	0.385	970
2015	12.92	17.345	19,425	1.07	0.496	1,246
2016	17.09	15.217	18,563	1.1	0.386	977
2017	14.8	12.865	17,152	0.99	0.417	1,087
2018	8.56	7.02	9,178	0.6	0.362	999

Table 16_supplemental. Observed (Obs) and predicted (Exp) discards by fleet for the recreational fisheries in weight (ww, pounds) and number (1000s of fish) for Gulf of Mexico Greater Amberjack. The standard errors were as follows: Recreational Charter Private (0.25) and Recreational Headboat (0.5).

Year	Charter Private (Obs, Number)	Charter Private (Exp, Number)	Charter Private (Exp, ww)	Headboat (Obs, Number)	Headboat (Exp, Number)	Headboat (Exp, ww)
1981	38.13	37.659	9,612	0.005	0.001	2
1982	87.957	94.271	20,128	0.154	0.001	2
1983	162.086	111.801	23,920	0.421	0.001	0
1984	33.864	25.992	7,344	0	0.001	0
1985	43.587	49.387	8,510	0.001	0.001	2
1986	110.919	95.956	25,816	14.212	0.009	11
1987	72.778	93.856	26,059	0.301	0.004	4
1988	119.888	69.272	10,296	0.074	0.006	4
1989	172.696	128.518	34,701	1.85	0.007	4
1990	185.604	181.393	193,615	26.612	22.358	28,005
1991	348.563	297.446	369,584	6.839	5.095	7,972
1992	322.31	270.526	293,480	7.638	7.737	11,572
1993	321.673	255.245	263,585	13.173	7.412	9,901
1994	182.616	183.03	179,448	7.137	8.024	9,980
1995	119.484	95.05	101,382	3.744	4.937	6,572
1996	79.563	104.139	112,809	4.279	5.274	7,335
1997	130.064	121.351	112,690	3.006	4.098	4,956
1998	196.222	184.992	193,319	7.296	5.155	6,843
1999	223.08	235.654	262,653	5.904	5	7,000
2000	340.347	294.331	268,910	3.72	5.511	6,565
2001	1492.92	431.3	448,047	8.991	7.424	9,412
2002	748.64	562.095	688,770	8.224	9.244	14,101
2003	664.76	565.064	696,023	6.91	7.791	12,738
2004	386.374	424.11	474,745	1.98	3.344	5,066
2005	543.235	478.222	568,904	2.552	2.909	4,445
2006	507.998	377.028	402,631	1.79	2.994	4,226
2007	328.476	260.827	257,811	3.369	4.282	5,404
2008	369.371	512.787	705,479	4.637	7.206	11,543
2009	267.774	363.301	533,544	5.619	7.351	12,692
2010	1063.26	1024.83	1,605,035	2.981	3.336	6,118
2011	690.032	505.669	816,660	3.107	3.486	6,614
2012	370.876	428.347	634,514	3.834	4.399	7,877
2013	703.34	673.826	960,446	4.665	4.416	7,489
2014	422.74	491.141	731,055	5.75	3.014	5,258

Table 16_supplemental (continued)

Year	Charter Private (Obs, Number)	Charter Private (Exp, Number)	Charter Private (Exp, ww)	Headboat (Obs, Number)	Headboat (Exp, Number)	Headboat (Exp, ww)
2015	515.972	529.273	780,813	8.235	4.121	7,242
2016	673.16	772.986	1,404,613	7.5	4.204	9,914
2017	542.797	349.806	680,344	4.484	2.932	7,489
2018	305.405	367.947	674,524	3.499	5.533	13,999

Updated Projections

Council staff requested updated projections, using the 2019 estimate of landings. Because the 2019 landings were not finalized before the assessment delivery deadline, the mean of 2017-2019 model predicted landings were used as defined in Table 22_supplemental. The mean values in Table 22_supplemental are lower than those assumed in the base model projections (284.01 mt for commercial vertical line, 11.90 mt for commercial longline, 65.43 thousands for charter/private, and 1.38 thousands of fish for headboat). All other projections specifications were the same as used for the base model projections (final stock assessment report can be found here: http://sedarweb.org/sedar-70-gulf-mexico-greater-amberjack-final-stock-assessment-report). The tables and figure shown below are numbered the same as in the stock assessment report with the "_supplemental" suffix to reduce confusion with the original tables and figures.

Table 22_supplemental. Settings used for Gulf of Mexico Greater Amberjack projections.

Parameter	Value	Comment
Relative F	Average from 2016 – 2018	Average relative fishing mortality over terminal three years (2016-2018) of model
Selectivity	Average from 2016 – 2018	Average fleet specific selectivity estimated over terminal three years (2016-2018) of model
Retention	Average from 2016 – 2018	Average fleet specific retention estimated over terminal three years (2016-2018) of model
Recruitment	Average from 2009 – 2018	Average recruitment over last 10 years
2019 and 2020 Landings	158.11 mt (Commercial Vertical Line), 12.4635 mt (Commercial Longline), 44.9437 thousands of fish (Charter/Private), 1.3209 thousands of fish (Headboat)	2019 landings
Allocation Ratio	27:73	commercial:recreational

Table 23_supplemental. Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for the SEDAR70 Gulf of Mexico Greater Amberjack assessment. Spawning Stock Biomass (SSB) is in metric tons, whereas F is a harvest rate (total biomass killed / total biomass).

Variable	Definition	Value
Base M	Fully selected ages of Lorenzen Natural Mortality (M)	0.28
Steepness	Fixed Stock-Recruit (SR) parameter (not used in projections)	0.777
Virgin Recruitment	Estimated SR parameter (not used in projections)	3,698
Generation Time	Fecundity-weighted mean age	7.59
SSB Unfished	Estimated virgin spawning stock biomass	23,733
	Mortality Rate Criteria	
F_{MSY}proxy	Equilibrium F that achieves SPR30%	0.175
MFMT	Equilibrium F that achieves SPR30%	0.175
$F_{Rebuild}$	F that rebuilds the stock to SSBSPR30% by 2027	0.107
FOY	0.75 * Directed F at FSPR30%	
$F_{current}$	Geometric Mean (F2016-2018)=Fcurrent	0.302
$F_{current}/F_{MSYproxy}$	Current stock status based on FMSYproxy	1.729
$F_{current}$/MFMT	Current stock status based on MFMT	1.729
	Biomass Criteria	
$SSB_{MSYproxy}$	Equilibrium SSB at FSPR30%	7,118
MSST	0.5*SSBSPR30%	3,559
SSB at Optimum Yield	Equilibrium SSB when Directed F = 0.75 * Directed F at FSPR30%	
SSB_{2018}	SSB2018	2,433
$SSB_{2018}/SSB_{FMSYproxy}$	Current stock status based on SSBSPR30% (Equil)	0.34
SSB_{2018}/MSST	Current stock status based on MSSTSPR30%	0.68
$SSB_{2018}/SSB_{unfished}$	2018 SPR	0.1

Table 25_supplemental. Results of projections that achieve an SPR of 30% in equilibrium for Gulf of Mexico Greater Amberjack. Recruitment is in 1000s of age-0 fish, SSB is in metric tons, F is a harvest rate (total biomass killed / total biomass), and OFL is the overfishing limit in millions of pounds whole weight. Reference points include $F_{SPR30\%} = 0.175$, $SSB_{FSPR30\%} = 7{,}118$ metric tons, and $MSST_{FSPR30\%} = 3{,}559$ metric tons which was calculated as (0.5) * $SSB_{FSPR30\%}$. SSBratio was calculated as annual SSB divided by SSB_0 where $SSB_0 = 23{,}733$ metric tons.

Year	R	F	F/F_{SPR30}	SSB	SSB/SSB_{SPR30}	SSB/MSST	SSB/SSB_0	OFL
2021	2,805	0.206	1.180	2,535	0.356	0.712	0.107	1.915
2022	2,805	0.211	1.208	2,991	0.420	0.840	0.126	2.333
2023	2,805	0.221	1.265	3,649	0.513	1.025	0.154	2.925
2024	2,805	0.228	1.306	4,273	0.600	1.201	0.180	3.424
2025	2,805	0.232	1.328	4,733	0.665	1.330	0.199	3.752
2026	2,805	0.233	1.334	5,042	0.708	1.417	0.212	3.947
2027	2,805	0.233	1.334	5,240	0.736	1.472	0.221	4.059
2028	2,805	0.233	1.334	5,365	0.754	1.507	0.226	4.123
2029	2,805	0.233	1.334	5,446	0.765	1.530	0.229	4.160
2030	2,805	0.233	1.334	5,492	0.772	1.543	0.231	4.181

Table 26_supplemental. Results of projections at Frebuild for Gulf of Mexico Greater Amberjack, which will rebuild the stock to SSB_{SPR30} (7,118 metric tons) by 2027. Recruitment is in 1000s of age-0 fish, SSB is in metric tons, F is a harvest rate (total biomass killed / total biomass), and retained yield (Yield) in millions of pounds whole weight. Reference points include $SSB_{FSPR30\%} = 7{,}118$ metric tons and $MSST_{FSPR30\%} = 3{,}559$ metric tons (0.5 * $SSB_{FSPR30\%}$). SSBratio was calculated as annual SSB divided by SSB_0 where $SSB_0 = 23{,}733$ metric tons.

Year	R	F	SSB	SSB/SSB_{SPR30}	SSB/MSST	SSB/SSB_0	Yield
2021	2,805	0.107	2,535	0.356	0.712	0.107	1.026
2022	2,805	0.111	3,336	0.469	0.937	0.141	1.383
2023	2,805	0.118	4,403	0.619	1.237	0.186	1.865
2024	2,805	0.123	5,498	0.772	1.545	0.232	2.317
2025	2,805	0.126	6,428	0.903	1.806	0.271	2.665
2026	2,805	0.127	7,161	1.006	2.012	0.302	2.910
2027	2,805	0.127	7,713	1.084	2.167	0.325	3.076
2028	2,805	0.127	8,121	1.141	2.282	0.342	3.187
2029	2,805	0.126	8,425	1.184	2.367	0.355	3.261
2030	2,805	0.126	8,628	1.212	2.424	0.364	3.310

Table 27_supplemental. Summary of projected retained yields in millions of pounds whole weight (mp ww) over the short-term for each projection scenario along with rebuilding time for Gulf of Mexico Greater Amberjack. Reference points include $F_{SPR30\%}$ = 0.175, $SSB_{FSPR30\%}$ = 7,118 metric tons, and $MSST_{FSPR30\%}$ = 3,559 metric tons which was calculated as (0.5) * $SSB_{FSPR30\%}$.

Criteria	Definitions	Yield	Year SSB>MSST	Year SSB>SSB_{SPR30}
OFL	Annual yield (mp ww) at MFMT=$F_{SPR30\%}$		2023	2036
	2021	1.915		
	2022	2.333		
	2023	2.925		
	2024	3.424		
	2025	3.752		
	2026	3.947		
ABC	Annual yield (mp, ww) at Frebuild		2023	2026
	2021	1.026		
	2022	1.383		
	2023	1.865		
	2024	2.317		
	2025	2.665		
	2026	2.910		

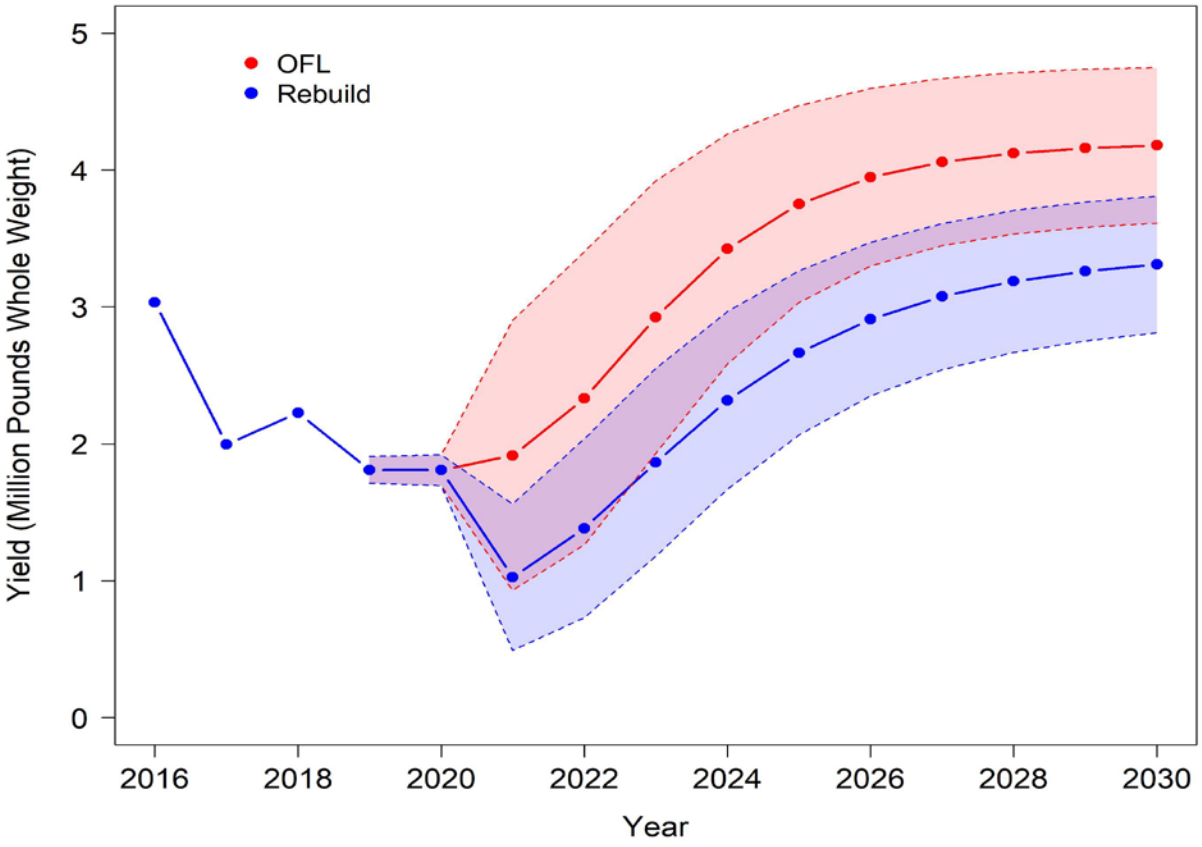

Figure 69_supplemental. Historic (2016 – 2019) and forecasted yields with 95% uncertainty bands for the OFL projections (red) and Frebuild projections (blue).

Did the catch exceed the ABC?

The final issue discussed with the Council staff was whether there were recent overages for GAJ. We pulled the following tables from https://www.fisheries.noaa.gov/southeast/recreational-fishing-data/gulf-mexico-historical-recreational-landings-and-annual-catch and https://gulfcouncil.org/wp-content/uploads/GreaterAmberjackFramework20170906FINAL.pdf respectively in order to answer that question. Though the catch exceeded the ACT or ACL in010, 2013, and 2015-7, it has not exceeded the ABC.

Greater Amberjack

Year	Fishing Year	Total Reported*	Units	ACT	ACT %	ACL	ACL %	Closure Date	Data Source
2018/2019	Aug 1 - July 30	946,642		902,185	104.9	1,086,970	87.1	5/1/19	MRIP
2017*/2018		622,011		716,173	86.9	862,860	72.1		MRIP
2017	Jan 1 - Dec 31	794,202		385,413	206.1	548,641	144.8	3/24/17	MRIP
2016	June 1- July 31	1,962,559		1,034,442	189.7	1,197,670	163.9	6/1/16	MRIP
2015		1,352,930		1,130,000	119.7	1,299,000	104.2	9/28/15	MRFSS
2014		912,254		894,538	102.0	1,063,538	85.8	8/24/14	MRFSS
2013		1,534,462		NA	NA	1,299,000	118.1		MRFSS
2012		1,322,788				1,368,000	96.7		MRFSS
2011		1,032,063				1,315,224	78.5		MRFSS
2010		1,316,291				1,243,184	105.9		MRFSS

Greater amberjack landings exclude Monroe County, Florida.

*The rule implementing the January through June closure went into effect January 27, 2018. The rule that modified the seasonal closure to be November through April and June through July, as well as establishing the August 1 - July 31 fishing year, went into effective April 30, 2018. Due to when these rules went into effect, only landings from January 1, 2018 through July 31, 2018 are attributed to the 2017-2018 fishing year.

Year	ABC
2015	1,720,000 lbs ww
2016	2,230,000 lbs ww
2017	2,490,000 lbs ww
2018	2,620,000 lbs ww