

Updated Projections and Evaluation of Alternative Projection Scenarios for Gulf of Mexico Greater Amberjack

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August 2, 2021

Background

This document was prepared in response to the request for additional projection allocation scenarios for SEDAR 70 Greater Amberjack stock assessment, received 8 July 2021, from the Gulf of Mexico Fishery Management Council.

Alternative projection scenarios defined in the request were as follows:

Years of inclusion for allocation scenario	Percent Allocation Commercial:Recreational
1981-2004	16:84
1993-2007	22:78
1993-2019	20:80
1981-2004 COM FIXED ACL=484,380 lbs, ww	Variable

In the process of these analyses, the OFL and F_{Rebuild} projections for the base stock assessment model that was approved by the GMFMC, Science and Statistical Committee (SSC) in January 2021, were also updated using new updated projection software that was not available before the January 2021 SSC meeting. This new code results in improvements in maintaining catch allocations between fleets over the projection period. Tables 1 and 2 provide the projection settings and the updated MSRA benchmarks and reference points for the base model, respectively. The updated projection results for the SEDAR 70 base model are presented in Tables 3 and 4 and illustrated in Figure 1. Both the OFL and F_{Rebuild} projection scenario as defined in the SEDAR 70 Terms of Reference are presented for comparison with previous results. Table 5 provides a summary of the short-term (2022-2030) projection results for the OFL, F_{Rebuild} projection scenario, and the time at recovery information. As per the Council's request, we have provided projection results for the alternative allocation scenarios (Table 6).

Tables

Table 1. 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 Landings	156.907 mt (Commercial Vertical Line), 14.51 mt (Commercial Longline), 22.979 thousands of fish (Charter/Private), 0.99 thousands of fish (Headboat)	2019 landings
2020 and 2021 Landings	184.01 mt (Commercial Vertical Line), 11.891 mt (Commercial Longline), 66.1150 thousands of fish (Charter/Private), 1.377 thousands of fish (Headboat)	Average landings between 2016-2018
Allocation Ratio Base Model	27:73	commercial:recreational

Table 2. 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%	0.242
MFMT	Equilibrium F that achieves SPR30%	0.242
$F_{Rebuild}$	F that rebuilds the stock to $SSB_{SPR30\%}$ by 2027	0.232
F_{OY}	$0.75 * \text{Directed F at } F_{SPR30\%}$	0.118
$F_{current}$	Geometric Mean ($F_{2016-2018}$)= $F_{current}$	0.302
$F_{current}/F_{MSY}$ proxy	Current stock status based on F_{MSY} proxy	1.25
$F_{current}/MFMT$	Current stock status based on MFMT	1.25
Biomass Criteria		
SSB_{MSY} proxy	Equilibrium SSB at $F_{SPR30\%}$	3,179
MSST	$0.5 * SSB_{SPR30\%}$	1,589
SSB at Optimum Yield	Equilibrium SSB for $\text{Directed F} = 0.75 * \text{Directed F at } F_{SPR30\%}$	4114
SSB_{2018}	SSB_{2018}	2,433
SSB_{2018}/SSB_{FMSY} proxy	Current stock status based on $SSB_{SPR30\%}$ (Equil)	0.77
$SSB_{2018}/MSST$	Current stock status based on MSST	1.53
$SSB_{2018}/SSB_{unfished}$	2018 SPR	0.1

Table 3. 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 $F_{SPR30\%} = 0.2415$, $SSB_{FSPR30\%} = 3,179$ metric tons, and $MSST_{FSPR30\%} = 1,589$ metric tons which was calculated as $(0.5) * SSB_{FSPR30\%}$. SSB_{ratio} 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
2022	1,651	0.242	1	2,471	0.777	1.555	0.104	2.102
2023	1,651	0.242	1	2,652	0.834	1.669	0.112	2.235
2024	1,651	0.242	1	2,813	0.885	1.770	0.119	2.342
2025	1,651	0.242	1	2,931	0.922	1.844	0.123	2.418
2026	1,651	0.242	1	3,017	0.949	1.898	0.127	2.471
2027	1,651	0.242	1	3,079	0.969	1.937	0.130	2.507
2028	1,651	0.242	1	3,121	0.982	1.964	0.132	2.531
2029	1,651	0.242	1	3,146	0.990	1.979	0.133	2.544
2030	1,651	0.242	1	3,160	0.994	1.988	0.133	2.552

Table 4. Results of projections at F_{Rebuild} for Gulf of Mexico Greater Amberjack, which will rebuild the stock to $SSB_{\text{SPR30\%}}$ (3,179 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 $SSB_{\text{FSR30\%}} = 3,179$ metric tons and $MSST_{\text{FSR30\%}} = 1,589$ metric tons ($0.5 * SSB_{\text{FSR30\%}}$). SSBratio was calculated as annual SSB divided by SSB_0 where $SSB_0 = 23,733$ metric tons.

Year	R	F	SSB	SSB/ $SSB_{\text{SPR30\%}}$	SSB/ $MSST$	SSB/ SSB_0	Yield
2022	1,651	0.232	2,471	0.777	1.555	0.104	2.021
2023	1,651	0.232	2,681	0.843	1.687	0.113	2.168
2024	1,651	0.232	2,868	0.902	1.804	0.121	2.288
2025	1,651	0.232	3,007	0.946	1.892	0.127	2.373
2026	1,651	0.232	3,110	0.978	1.957	0.131	2.434
2027	1,651	0.232	3,183	1.001	2.003	0.134	2.475
2028	1,651	0.241	3,234	1.017	2.035	0.136	2.602
2029	1,651	0.241	3,229	1.016	2.032	0.136	2.594
2030	1,651	0.241	3,218	1.012	2.025	0.136	2.586

Table 5. 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 $F_{SPR30\%} = 0.2415$, $SSB_{FSPR30\%} = 3,179$ metric tons, and $MSST_{FSPR30\%} = 1,589$ 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=$F_{SPR30\%}$		2022	2036
	2022	2.102		
	2023	2.235		
	2024	2.342		
	2025	2.418		
	2026	2.471		
ABC	Annual yield (mp, ww) at $F_{Rebuild}$		2022	2027
	2022	2.021		
	2023	2.168		
	2024	2.288		
	2025	2.373		
	2026	2.434		

Table 6. Summary of projected retained yields in millions of pounds whole weight (mp ww) over the short-term for alternative projection scenarios and the updated base model (identified as “1981-2004 (SSC-new projection code, July 2021)” in the table below. For comparison purposes projection results from the base model as shown at the January 2021 GMFMC SSC meeting are also included.

Scenario	Sector Allocation %	Projected Yields (millions pounds (ww))				
		2022	2023	2024	2025	2026
OFL = $F_{SPR30\%}$	COM:REC					
1981-2004 (CURRENT, SSC January 2021)	27:73	1.637	2.223	2.781	3.207	3.497
1981-2004 (SSC-new projection code, July 2021)	27:73	2.102	2.235	2.342	2.418	2.471
1981-2004	16:84	1.996	2.130	2.234	2.305	2.354
1993-2007	22:78	2.052	2.186	2.291	2.365	2.417
1993-2019	20:80	2.033	2.167	2.272	2.345	2.395
1981-2004 COM FIXED ACL=484,380 lbs, ww	variable	2.053	2.181	2.282	2.352	2.400
ABC = $0.75F_{SPR30\%}$		2022	2023	2024	2025	2026
1981-2004 (CURRENT, SSC January 2021)	27:73	1.214	1.706	2.193	2.584	2.867
1981-2004 (SSC-new projection code, July 2021)	27:73	1.582	1.778	1.945	2.072	2.166
1981-2004	16:84	1.503	1.695	1.857	1.979	2.069
1993-2007	22:78	1.545	1.739	1.904	2.029	2.121
1993-2019	20:80	1.531	1.724	1.887	2.012	2.103
1981-2004 COM FIXED ACL=484,380 lbs, ww	variable	1.580	1.762	1.919	2.039	2.127
ABC = $F_{REBUILD}$		2022	2023	2024	2025	2026
1981-2004 (CURRENT, SSC January 2021)	27:73	1.255	1.767	2.270	2.672	2.961
1981-2004 (SSC-new projection code, July 2021)	27:73	2.021	2.168	2.288	2.373	2.434
1981-2004	16:84	1.928	2.074	2.188	2.268	2.324
1993-2007	22:78	1.979	2.125	2.242	2.325	2.383
1993-2019	20:80	1.961	2.107	2.223	2.305	2.362
1981-2004 COM FIXED ACL=484,380 lbs, ww	variable	1.998	2.135	2.245	2.322	2.376

Figures

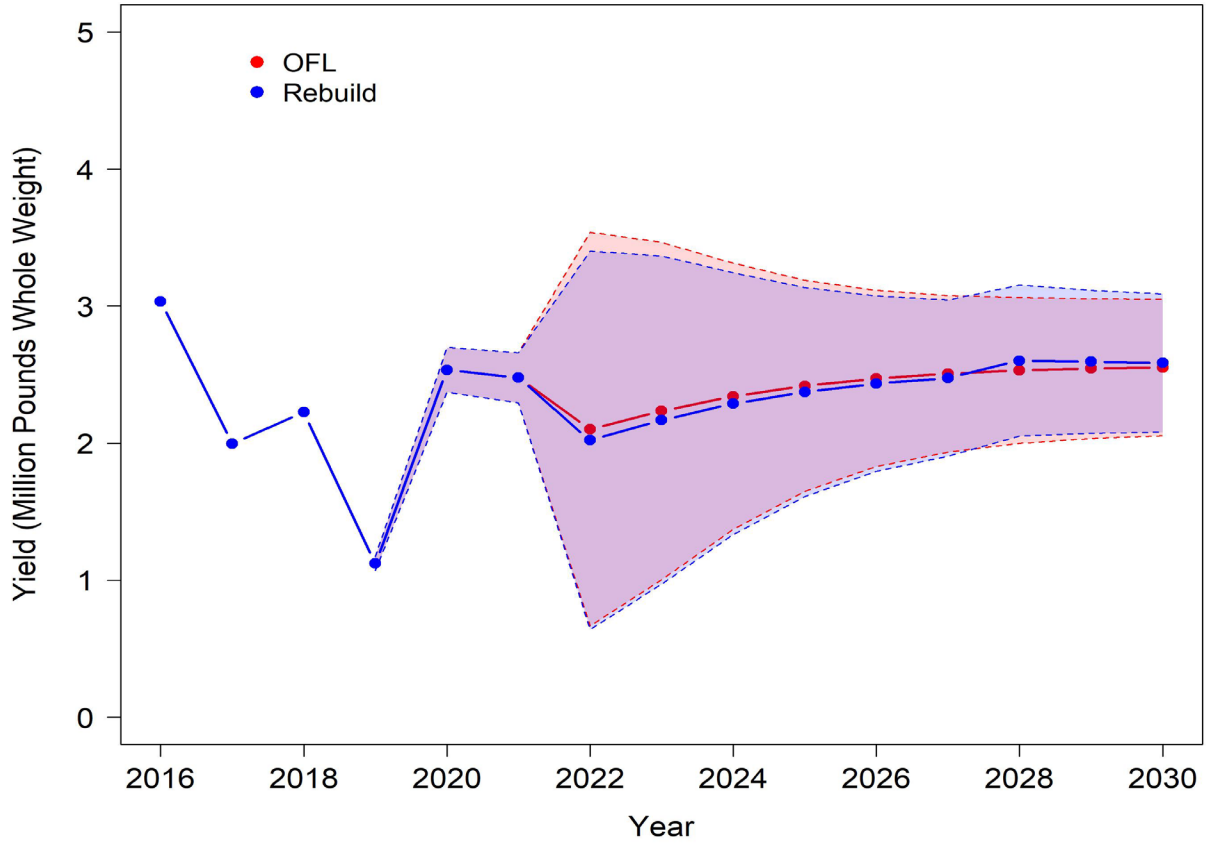


Figure 1. Historic (2016 – 2018) and updated forecasted yields with 95% uncertainty bands for the OFL projections (red) and F_{Rebuild} projections (blue) for the base model accepted for the SEDAR 70 Greater Amberjack stock assessment.