Updated Rebuilding Projections for Red Snapper
National Marine Fisheries Service
Southeast Fisheries Science Center
Southeast Regional Office
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Background

At the June 2006 Gulf of Mexico Fishery Management Council (Council) meeting, the Council requested the Southeast Fisheries Science Center (SEFSC) update rebuilding projections for red snapper. Specifically, the Council requested SEFSC staff reanalyze the rebuilding program based upon shrimp effort data through 2005. Additionally, the Council requested rebuilding projections be re-run incorporating directed fishery landings underages of 500,000 pounds for the last three years. The SEFSC intended to complete these projection runs prior to the August 2006 Council meeting, but were unable to because of workload constraints and the loss of several stock assessment personnel. In early October 2006, the Southeast Regional Office (SERO) sent a new data request to the SEFSC requesting three projection runs for red snapper. These projection runs were completed by the SEFSC in November and provided to SERO. These projections are intended to serve as plausible examples of various rebuilding scenarios for purpose of Council discussion. Below is a summary of the rebuilding projections provided by Porch (pers. comm.), including data inputs and results.

Projections

Red snapper rebuilding projections were re-run using directed fishery landings data and shrimp effort data through 2005. The projections also made the following assumptions:

1. Directed fishery landings in 2006 are similar to directed fishery landings in 2005;
2. Shrimp trawl effort/fishing mortality in 2006 is down by 60 percent relative to the 2001-2003 baseline shrimp trawl effort/fishing mortality rate;
3. Shrimp trawl fishing mortality rate is 50 percent of the 2001-2003 baseline shrimp trawl fishing mortality rate;
4. After 2010, the shrimp trawl fishing mortality rate is 50 percent of the 2001-03 baseline shrimp trawl fishing mortality rate, unless projection after 2010 assumes equal proportions in fishing mortality across all fisheries ($F_{msy\ linked}$);
5. Total allowable catch (TAC) for the directed fishery is held constant at 6.5 million pounds (mp) between 2007 and 2010;
6. Commercial directed fishery discards correspond to those estimated under a 13-inch minimum size limit;
7. Recreational directed fishery discards correspond to those estimated under a 16-inch minimum size limit;
8. The fishing mortality rate associated with commercial closed season discards is 10 percent less than the 2001-2003 baseline fishing mortality rate owing to implementation of the IFQ program; and,

9. The fishing mortality rate associated with recreational closed season discards is the same as the 2001-2003 baseline fishing mortality rate.

All three projections incorporated the same available data through 2010. After 2010, the following criteria were used for each of the three projections:

1. TAC set at 9.0 mp from 2011-2013, and 12 mp from 2014-2032 (6.5-9.0-12.0 TAC projection);
2. Hold fishing mortality rate constant at 2010 F from 2011-2032 ($F = F_{2010}$ projection); and,
3. Hold fishing mortality rate constant at $F_{26\%SPR}$ from 2011-2032 ($F_{msy\ linked}$ after 2010 projection).

All projections de-link (shrimp bycatch, closed season, and directed fishery mortality rates are not reduced in equal proportions to one another) shrimp and directed fishery bycatch mortality rates through 2010. After 2010, projections #1 and #2 continue to de-link shrimp and directed fishery mortality rates, whereas projection #3 rebuilds to the biomass associated with maximum sustainable yield under a linked rebuilding strategy (fishing mortality rates reduced proportionally across all fisheries). For purposes of comparison, the equal proportion $F_{26\%SPR}$ linked rebuilding projection from Thompson (2005) is also presented.

Directed Fishery Landings

Table 1 summarizes commercial and recreational red snapper landings from 1990 through 2005. During the past six years, there have been three quota overages and three quota underages. Underages occurring in 2000 and 2001 were primarily due to reductions in recreational landings resulting from implementation of the 6-month closed season. Overall, landings have approximated the TAC since it was increased to 9.12 million pounds in 1996.

Table 1. Commercial and recreational red snapper landings, TACs, and overages/underages, 1990-2005.

	Landings (whole weight)				
Year	Commercial	Recreational	Total	TAC	Overage/Underage
1990	2.65	1.34	3.99	no TAC	n/a
1991	2.21	2.31	4.52	4.0	(0.52)
1992	3.03	3.93	6.96	4.0*	(2.96)
1993	3.37	6.32	9.69	6.0	(3.69)
1994	3.22	5.03	8.25	6.0	(2.25)
1995	2.93	4.59	7.52	6.0	(1.52)
1996	4.31	3.89	8.20	9.12	0.92
1997	4.81	5.04	9.85	9.12	(0.73)
1998	4.68	4.69	9.37	9.12	(0.25)
1999	4.86	4.62	9.48	9.12	(0.36)
2000	4.84	3.28	8.12	9.12	1.00
2001	4.63	3.89	8.52	9.12	0.60
2002	4.78	5.02	9.80	9.12	(0.68)
2003	4.41	4.80	9.21	9.12	(0.09)
2004	4.67	5.08	9.76	9.12	(0.64)
2005	4.11	4.59	8.70	9.12	0.42

* emergency reopening of commercial fishery occurred in 1992

Shrimp Effort

Figure 1 shows the trend in offshore shrimp effort (days fished > 10 fathoms) used in the updated red snapper projections. Offshore effort during the baseline years (2001-03) averaged 190,800 days fished. In 2005, offshore effort was 102,840 days fished.

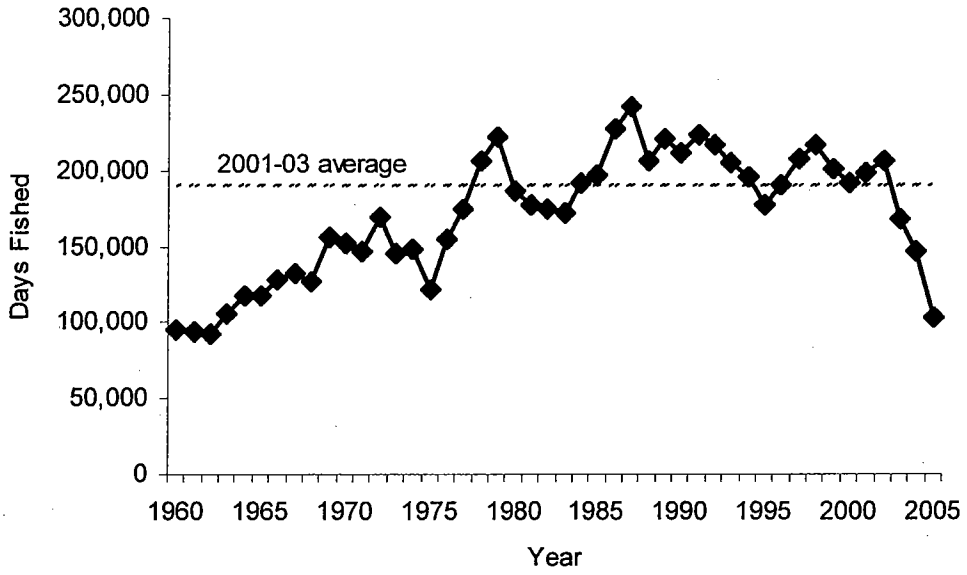

Figure 1. Trends in Gulf of Mexico offshore shrimp trawl effort (1960-2005).

Projection Results

Trends in yield and spawning potential for the three new projection runs and the equal proportion $F_{26\%SPR}$ linked rebuilding projection from Thompson (2005) are summarized in Tables 2 and 3 and Figures 2 and 3. Maximum long-term yields range from a minimum of 12 mp to a maximum of 25.4 mp (Table 2). If fishing mortality rates (F) after 2011 are set equal to the fishing mortality rate in 2010, then the maximum long-term yield would be 14.5 mp. Setting annual F after 2010 equal to the fishing mortality rate in 2010 would allow the stock to rebuild to a 19.4 percent spawning potential ratio (SPR) by 2032. If TAC is increased to 9.0 mp in 2010 and held constant after 2013 at 12 mp, then the stock would rebuild to an SPR of 21.2 percent by 2032. Higher yields and SPRs could be obtained if directed fishing and bycatch mortality rates across all fisheries are reduced proportionally (~74 percent of 2001-03 baseline levels) beginning in 2010 ($F_{msylinked}$ after 2010 projection).

Differences in yields and spawning potential for various projection runs can largely be explained by the amount of dead discards occurring for each rebuilding scenario. Figure 4 summarizes trends in red snapper dead discards across all fisheries for each of the rebuilding projections. There is an inverse relationship between the level of dead discards and spawning potential. Rebuilding projections resulting in greater levels of dead discards achieve lower spawning potential and result in less yield than rebuilding projections that require greater reductions in dead discards.

Table 2. Annual directed fishery yields for various red snapper rebuilding projections.

Year	Annual Yields for various Rebuilding Projections			
	6.5-9.0-12.0 TAC	F = F2010 after 2010	Fmsy linked after 2010	Fmsy Thompson
2007	6.5	6.5	6.5	5.3
2008	6.5	6.5	6.5	6.7
2009	6.5	6.5	6.5	8.4
2010	6.5	6.5	6.5	10.4
2011	9.0	7.7	10.6	12.6
2012	9.0	8.7	12.1	14.6
2013	9.0	9.6	13.4	16.4
2014	12.0	10.2	14.8	17.8
2015	12.0	10.8	16.3	18.9
2016	12.0	11.3	17.8	19.9
2017	12.0	11.8	19.1	20.6
2018	12.0	12.2	20.2	21.3
2019	12.0	12.5	21.1	21.9
2020	12.0	12.8	21.7	22.5
2021	12.0	13.1	22.3	22.9
2022	12.0	13.3	22.7	23.3
2023	12.0	13.5	23.2	23.7
2024	12.0	13.7	23.6	24.0
2025	12.0	13.8	23.9	24.3
2026	12.0	14.0	24.2	24.5
2027	12.0	14.1	24.4	24.7
2028	12.0	14.2	24.7	24.9
2029	12.0	14.3	24.9	25.0
2030	12.0	14.3	25.0	25.2
2031	12.0	14.4	25.2	25.3
2032	12.0	14.5	25.3	25.4

Table 3. Annual spawning potential ratios for various red snapper rebuilding projections.

Year	Annual SPRs for various Rebuilding Projections			
	6.5-9.0-12.0 TAC	F = F2010 after 2010	Fmsy linked after 2010	Fmsy Thompson
2001	1.3%	1.3%	1.3%	1.3%
2002	1.4%	1.4%	1.4%	1.4%
2003	1.5%	1.5%	1.5%	1.5%
2004	1.7%	1.7%	1.7%	1.7%
2005	1.9%	1.9%	1.9%	2.0%
2006	2.1%	2.1%	2.1%	2.3%
2007	2.4%	2.4%	2.4%	2.8%
2008	3.0%	3.0%	3.0%	3.6%
2009	3.8%	3.8%	3.8%	4.6%
2010	4.8%	4.8%	4.8%	5.9%
2011	5.9%	6.0%	5.9%	7.3%
2012	7.1%	7.2%	7.2%	8.9%
2013	8.2%	8.4%	8.5%	10.5%
2014	9.4%	9.5%	9.9%	12.0%
2015	10.3%	10.6%	11.3%	13.5%
2016	11.3%	11.7%	12.8%	15.0%
2017	12.2%	12.6%	14.2%	16.3%
2018	13.0%	13.5%	15.6%	17.6%
2019	13.9%	14.4%	16.9%	18.7%
2020	14.6%	15.1%	18.1%	19.7%
2021	15.4%	15.7%	19.1%	20.7%
2022	16.1%	16.3%	20.1%	21.5%
2023	16.8%	16.8%	21.0%	22.2%
2024	17.4%	17.3%	21.9%	22.9%
2025	18.0%	17.7%	22.6%	23.5%
2026	18.6%	18.1%	23.2%	24.0%
2027	19.1%	18.4%	23.8%	24.5%
2028	19.6%	18.7%	24.3%	24.9%
2029	20.0%	18.9%	24.7%	25.2%
2030	20.4%	19.1%	25.1%	25.5%
2031	20.8%	19.3%	25.4%	25.7%
2032	21.2%	19.4%	25.7%	26.0%

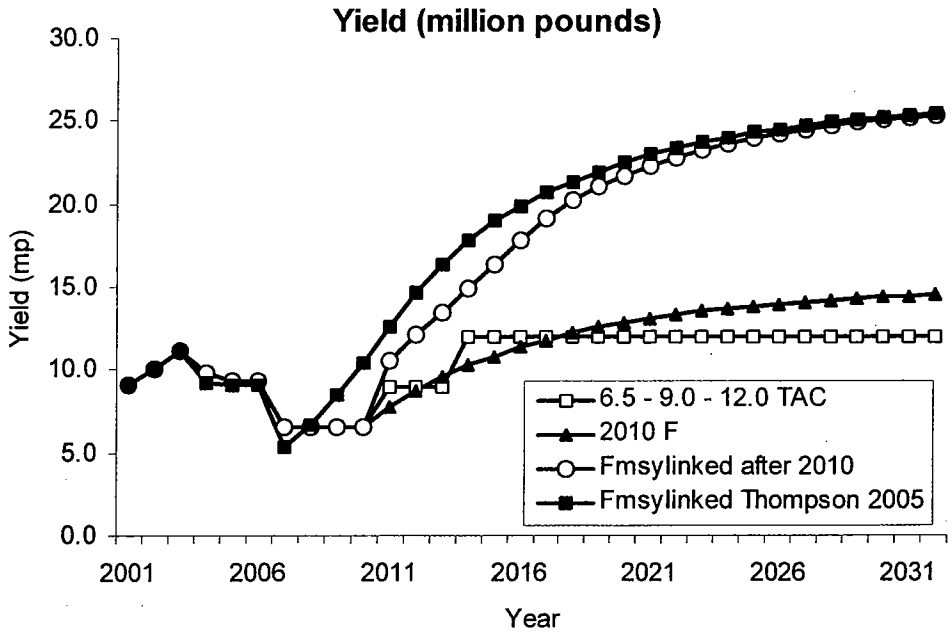

Figure 2. Red snapper directed fishery yield (millions of pounds) for various rebuilding projections.

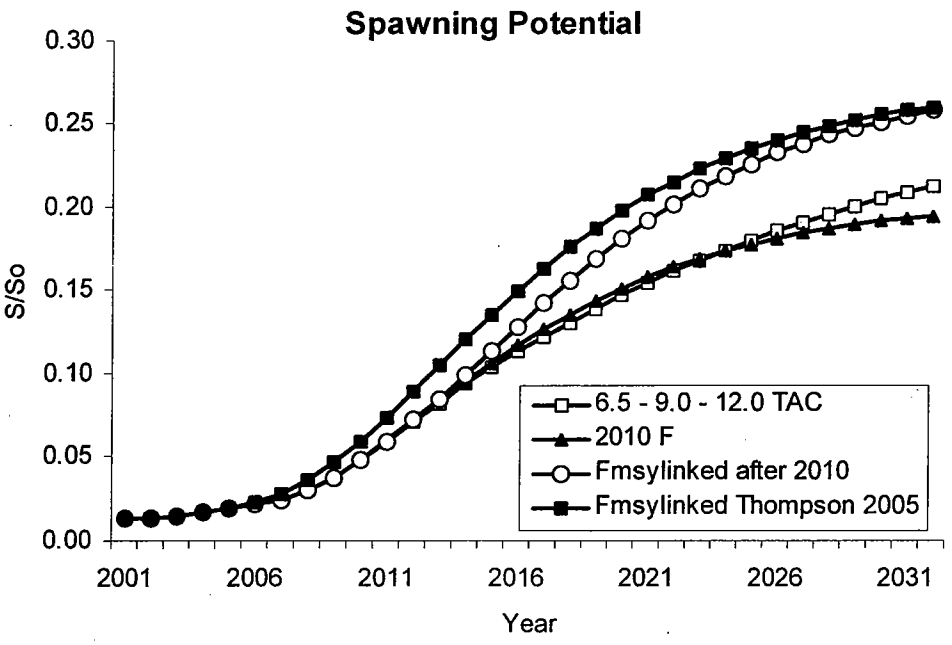

Figure 3. Red snapper spawning potential for various rebuilding projections.

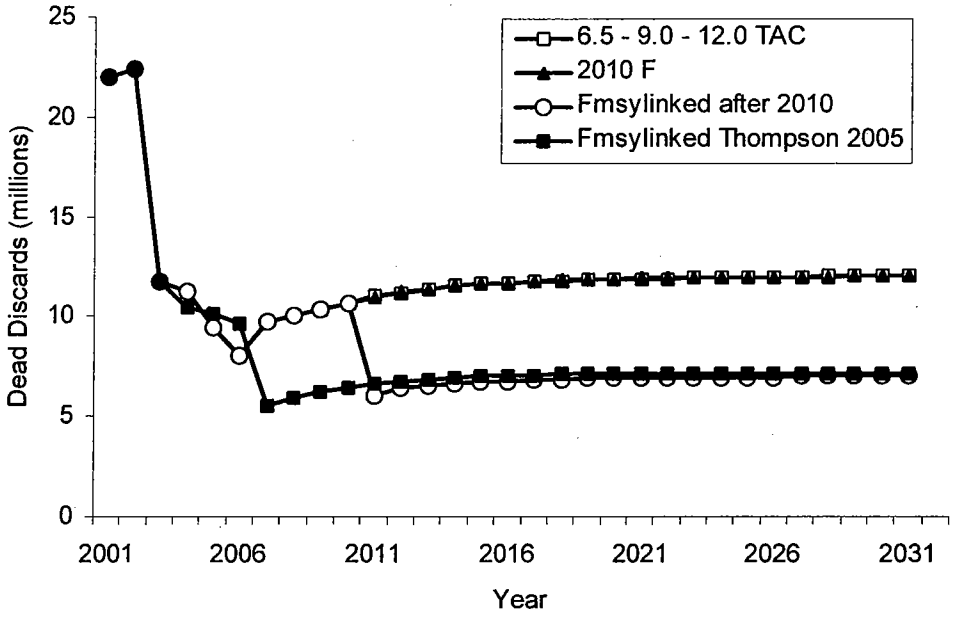

Figure 4. Estimated red snapper dead discards (all fisheries) for various rebuilding projections, 2001-2032.

Discussion

As mentioned previously, the projections summarized herein are intended to provide the Council with examples of potential red snapper rebuilding scenarios. These scenarios were selected to show the trade-offs between reducing fishing mortality and bycatch mortality rates equally across all fisheries (linked) versus reducing fishing mortality and bycatch mortality rates disproportionately (delinked) based on reasonable assumptions about bycatch reduction. Regardless of the rebuilding approach used, all rebuilding scenarios presented rebuild red snapper to SPRs exceeding 19 percent.