DRAFT

SEDAR 15 Summary Report

Red Snapper

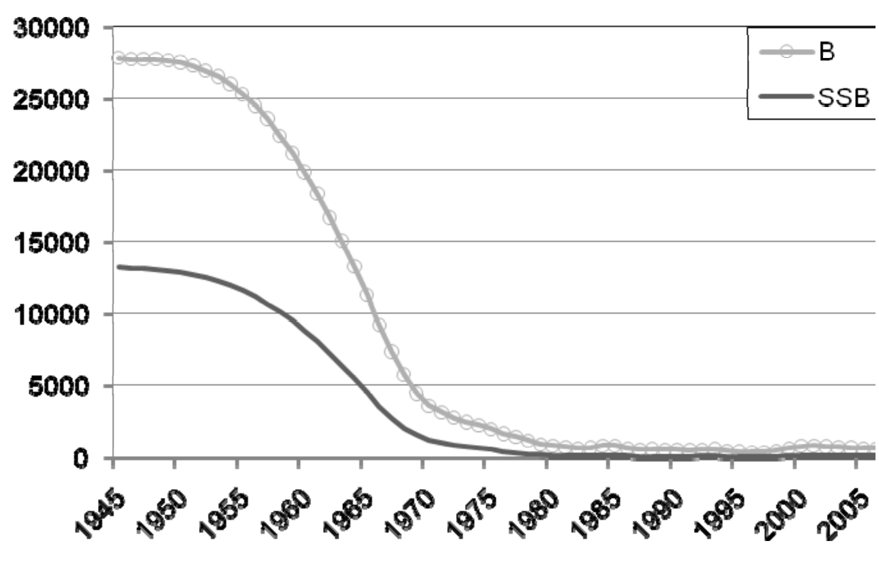
Stock Distribution and Identification

This assessment applies to the South Atlantic red snapper stock.

Stock Status

The assessment indicates that the stock has been overfished since 1960 and overfishing is currently occurring.

Figure 1. Biomass and Spawning Stock Biomass.



Assessment Methods

A statistical catch-at-age model (SCA) and a surplus-projection model (ASPIC) were considered in this assessment. A surplus-production model treats all fish in the population as having similar characteristics such as vulnerability to predation or to being caught in the fishery, and similar reproductive capacity. However, in fish populations natural mortality decreases with age, as fish become larger, and fecundity – reproductive capacity – increases with age. A catch-at-age model takes into account the changes in those characteristics with the age of the fish and it can account for recruitment variability and changes in selectivity due to regulations. Because of this enhanced ability to capture demographics, the catch-at-age model was chosen for evaluating stock status and providing management benchmarks and advice.

Assessment Data Summary

Data used for this assessment consist of records of commercial catch for the handline (hook-and-line) and dive fisheries, logbook data from the recreational headboat fishery, and MRFSS survey data of the rest of the recreational sector.

Table 1. Assessment Data Availability

Fishery	Landings	Estimated Discards	Indices
Commercial handline	1945-2006	1984-2006	1993-2006
Commercial dive	1984-2006	--	--
Headboat	1972-2006	1984-2006	1976-2006
Recreational (MRFSS)	1981-2006	1984-2006	1983-2006

A 12-inch length limit for red snapper was instituted in 1984, which is believed to have caused an increase in discarding. The dive fishery was assumed to generate no discards because of the selectivity of the method. Mortality rates used for discarded fish were 0.4 for the recreational fisheries and 0.9 for the commercial handline fishery. The higher mortality in the commercial fishery is due to the depth at which the fish are caught, and the effect of pressure changes as they are brought to the surface, and the length of time fish may be on deck before being returned to the water – the handling time of the fishery.

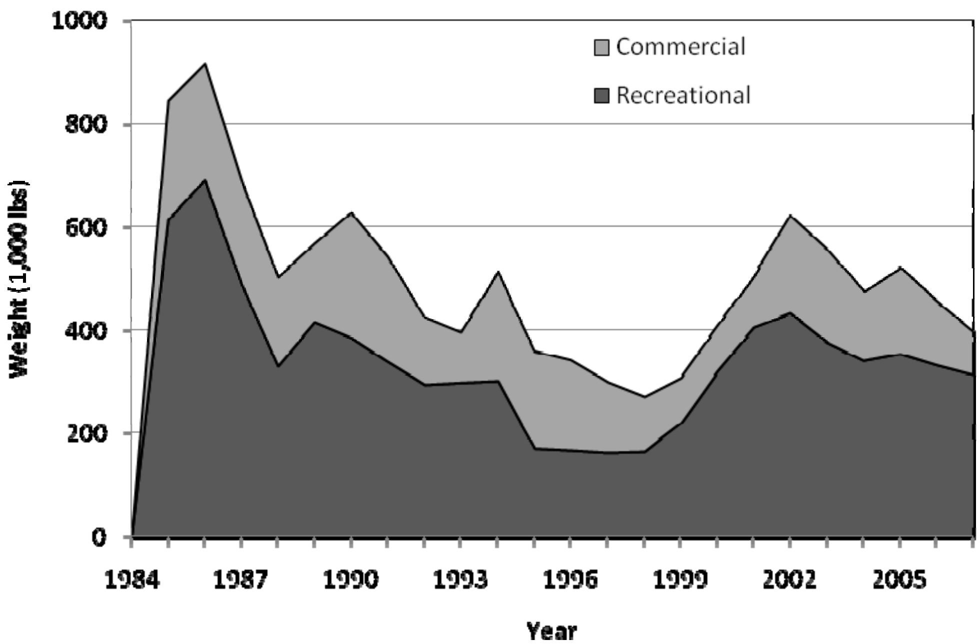
Overall natural mortality (M) in the fishery was assumed to be a constant 0.25 over time. This varies by age because younger fish are much more vulnerable (for example, to predation) than larger, older fish.

Reproductive maturity used in this assessment came from estimates for Gulf of Mexico red snapper. Red snapper do not change sex over their lifetimes, and studies supported a constant 50:50 sex ratio for the population. Red snapper are assumed to have a mean generation time of 20 years.

Catch Trends

The bulk of landings of red snapper come from the recreational fishery, which have exceeded the landings of the commercial fishery by 2-3 fold over the assessment period. Total landings were variable, with a downward trend through the 1990s.

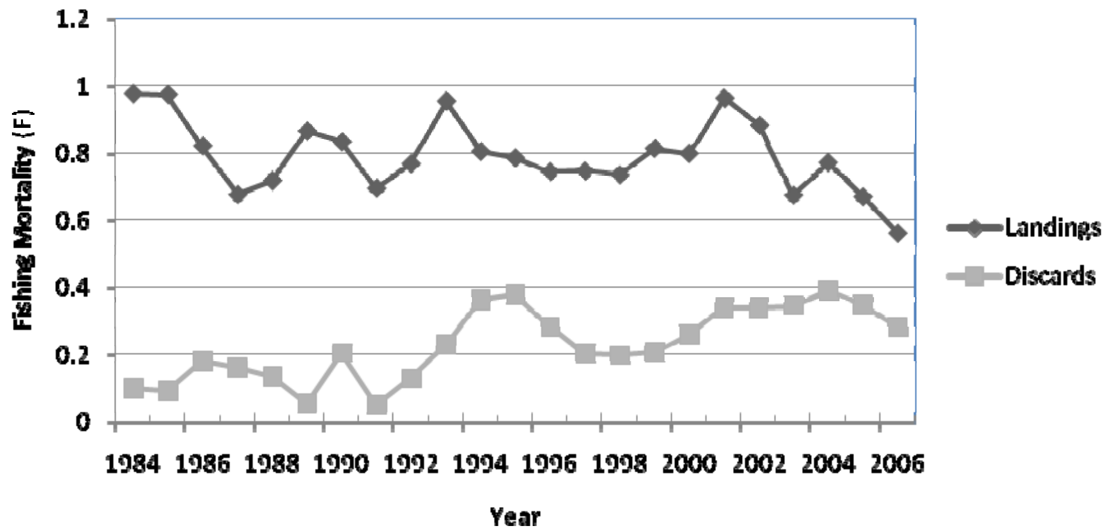
Figure 2. Landings by fishery sector, 1984-2006. (Discards by weight were unavailable in this assessment).



Fishing Mortality Trends

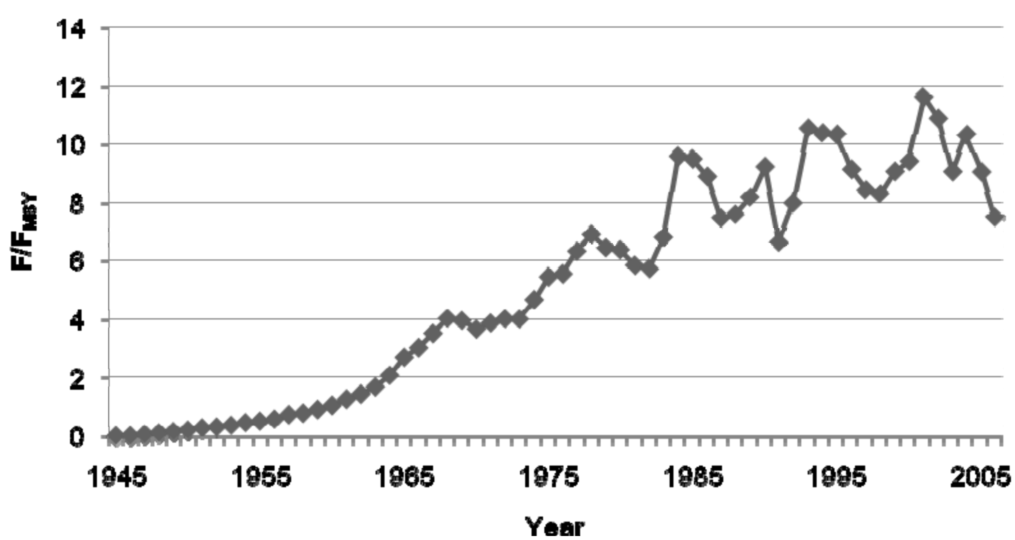
Fishing mortality can be evaluated by examining the time series of fully-recruited fishing mortality for both the landings and discards in the fishery. This is simply the sum of mortality by age in each component of the fishery.

Figure 3. Fully recruited fishing mortality.



The fishing mortality (F) is compared to what the fishing mortality would be if the fishery were operating at maximum sustainable yield (F_{MSY}). The ratio of F/F_{MSY} suggests a generally increasing trend from the 1950s through the mid-1980s, and since 1985 has fluctuated about a mean near 9.1. This indicates that overfishing has been occurring since 1960 at about 9 times the maximum sustainable level, with the 2006 estimate of $F/F_{40\%}$ at 7.512973

Figure 4. F/F_{MSY}



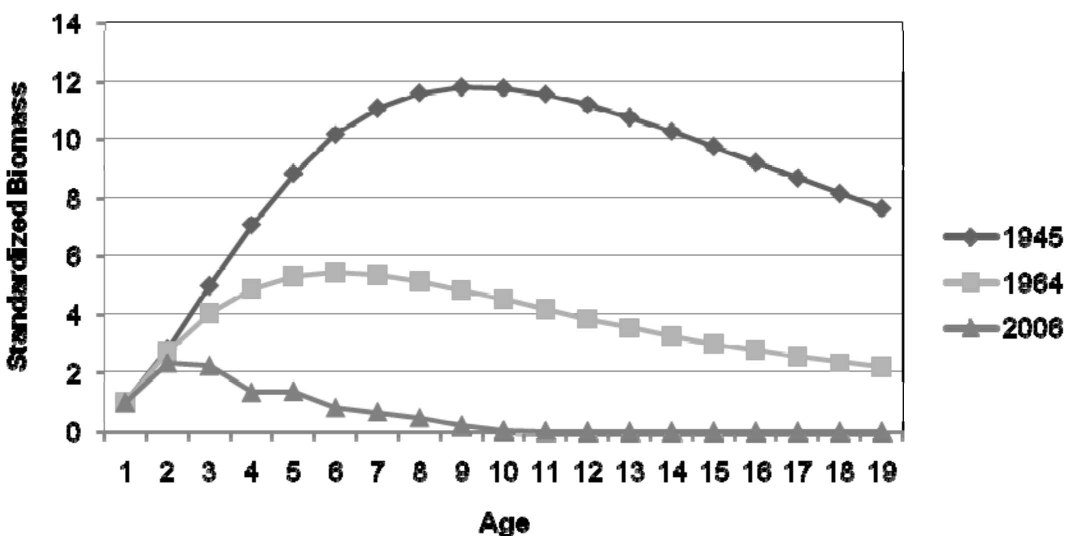
Stock Abundance and Biomass Trends

Estimated abundance-at-age shows truncation of the oldest ages from the 1950s into the 1980s; the age structure continues to be in a truncated condition. Fish of age 10 and above are practically non-existent in the population.

Estimated biomass-at-age follows a similar pattern of truncation as seen in the abundance data. Total biomass and spawning biomass show nearly identical trends—sharp decline during the 1950s and 1960s, continued decline during the 1970s, and stable but low levels since 1980.

Numbers of age-1 fish have declined during the same period, however notably strong year classes occurred in 1983 and 1984, and again in 1998 and 1999.

Figure 4. Age structure of the population (standardized to year-1 biomass).



Status Determination Criteria

The maximum fishing mortality threshold (MFMT) is defined by the Council as F_{MSY}, and the minimum stock size threshold (MSST) as $(1 - M)SSB_{MSY}$, where SSB refers to Spawning Stock Biomass, SSB_{MSY} is the level of SSB when the fishery is operating at maximum sustainable yield, and constant M is 0.25. Technically, "overfishing" is defined as occurring whenever F > MFMT and a stock is "overfished" when SSB < MSST. Current status of the stock and fishery are represented by the latest assessment year (2006).

Table 2. Status Summary Table (conditioned on the base run of the model).

Quantity	Units	Estimate
MFMT ($F_{40\%}$)	per year	0.07
$B_{40\%}$	mt	17347
$SSB_{F40\%}$	mt	7891
$MSST_{F40\%}$	mt	7275
$MSY_{F40\%}$	1000 lb	2314
$D_{F40\%}$	1000 fish	37
F_{MSY}	per year	0.112
$F_{2006}/F_{40\%}$	–	12.021
$SSB_{2006}/SSB_{F40\%}$	–	0.027

In addition to MSY-related benchmarks, proxies were computed based on per recruit analyses. These quantities may serve as proxies for F_{MSY}, if the spawner-recruit relationship cannot be estimated reliably. The proxies computed include F_{max}, $F_{30\%}$, and $F_{40\%}$, along with their associated yields. The value of F_{max} is defined as the level of fishing, F, that maximizes yield per recruit. $F_{30\%}$ and $F_{40\%}$ are the levels corresponding to 30% and 40% of the spawning potential ratio of the unfished stock. Uncertainty in the assessment led the review panel to choose $F_{40\%}$ as the MFMT value for red snapper.

Stock Status

Initial stock status was well above the maximum sustainable yield (MSY) benchmark, but declined sharply during the 1950s and 1960s. Declines slowed during the 1970s, and the stock has been stable at low levels since 1980. Based on the ratio of current estimated biomass to biomass at MSY, the stock is considered to be overfished. The benchmark history for period 1984-2006 is shown in Table 5.

Uncertainty

The effects of uncertainty in model structure were examined by comparing two structurally different assessment models—the catch-at-age model and a surplus-production model. For each model, uncertainty in data or assumptions was examined through sensitivity runs, which involve varying the value of a parameter and evaluating its impact on the model. Precision of benchmarks was computed by a parametric bootstrap procedure.

Projection methods

Projections were run to predict stock status in years after the assessment, 2007–2040. This 34 year time frame is the sum of mean generation time (20 years) and the number of years it would take for spawning biomass to reach SSB_{MSY} if no fishing occurred. The structure of the projection model was the same as that of the assessment model, and parameter estimates were those from the base run of the assessment model. Time-varying quantities, such as fishery selectivity curves, were fixed to reflect the most recent values of the assessment period, 2004-2006.

Table 3 shows the results of the 12 projection scenarios. What the discard-only projections show is that in order to rebuild the stock, the total catch (landings and discards) of red snapper will need to be reduced, not just the landings.

Special Comments

Reproduction in this model was calculated from mid-year spawning stock biomass (SSB), to reflect the actual timing of spawn. In most SEDAR models, the Jan. 1 SSB is assumed representative for purposes of calculating reproduction.

Table 3. Projection Scenarios (based on a reference run of the model). These are model projections based on the assumptions in the right hand column that provide an estimate of stock recovery dates.

Projection Scenario	Projected Recovery Date
$F = 0$	2020
$F = F_{current}$ (reflecting 2004-2006)	0.3% of recovered value by 2040
F_{MSY}	97.5% of recovered value by 2040
$F_{65\%MSY}$	2025
$F_{75\%MSY}$	2027
$F_{85\%MSY}$	2030
$F_{Rebuild}$ ($F_{Rebuild}$ = 0.109, about 97% of F_{MSY})	2040
Discard Only Scenarios: All fish caught at rate F are discarded, and discard mortalities are applied	
$F = F_{current}$ (without Commercial Dive fishing) Discard mortality: Com = 0.9, Rec = 0.4	15% of recovered value by 2040
$F = F_{current}$ (without Commercial Dive fishing) Discard mortality: Com = 0.8, Rec = 0.2	25% of recovered value by 2040
$F = F_{current}$ (without Commercial Dive fishing) Discard mortality: Com = 1.0, Rec = 0.6	9.8% of recovered value by 2040
$F = F_{Rebuild}$ Discard mortality: Com = 0.9, Rec = 0.4	2040
$F = F_{Rebuild}$ Discard mortality: Com = 0.7, Rec = 0.4	2040

Table 4. Landings by fishery sector in thousands of pounds (whole weight), and discards in thousands of fish; 1984-2006.

Year	Recreational Landings	Commercial Landings	Recreational Discards	Commercial Discards
1984	613.78	231.76	46.81	6.76
1985	691.65	225.27	31.78	3.34
1986	490.21	200.71	28.69	6.37
1987	329.50	173.24	28.85	13.82
1988	415.23	152.30	29.96	6.83
1989	384.54	243.63	10.55	2.52
1990	338.44	203.35	17.94	27.47
1991	294.30	130.69	9.35	3.70
1992	298.22	96.96	21.30	16.46
1993	301.50	212.11	31.68	16.07
1994	171.01	188.58	32.13	22.01
1995	167.52	174.24	29.28	21.74
1996	163.08	136.15	15.62	29.03
1997	165.22	106.37	9.52	30.35
1998	220.80	86.73	37.71	22.97
1999	319.33	88.84	69.51	20.66
2000	405.01	100.57	96.28	19.63
2001	432.89	189.85	98.88	21.31
2002	375.73	181.68	82.74	19.92
2003	340.80	134.45	74.24	17.04
2004	354.23	166.69	80.43	14.23
2005	331.95	124.40	75.91	13.74
2006	313.10	83.17	63.65	15.22

Table 5. Benchmarks 1984-2006. The fishing mortality rate is full F, which includes discard mortalities. B is the total biomass at the start of the year, and SSB is the spawning biomass at midyear. B and SSB are in units mt (metric tonnes: 1,000 kg). SPR is static spawning potential ratio

Year	F	$F/F_{40\%}$	B	SSB	$SSB/SSB_{40\%}$	SPR
1984	1.076	15.376	839	180	0.025	0.011
1985	1.066	15.230	825	191	0.027	0.012
1986	1.000	14.284	663	173	0.024	0.013
1987	0.838	11.967	591	160	0.022	0.020
1988	0.852	12.176	616	163	0.023	0.018
1989	0.920	13.137	598	153	0.021	0.016
1990	1.037	14.815	553	141	0.020	0.014
1991	0.745	10.649	520	142	0.020	0.025
1992	0.897	12.807	575	169	0.024	0.033
1993	1.185	16.924	607	174	0.024	0.022
1994	1.166	16.664	509	158	0.022	0.026
1995	1.161	16.589	457	140	0.019	0.024
1996	1.027	14.669	413	123	0.017	0.028
1997	0.948	13.547	414	122	0.017	0.032
1998	0.932	13.321	504	138	0.019	0.030
1999	1.019	14.561	668	175	0.024	0.026
2000	1.058	15.113	814	224	0.031	0.025
2001	1.303	18.612	863	243	0.034	0.021
2002	1.223	17.465	797	235	0.033	0.023
2003	1.019	14.550	747	231	0.032	0.027
2004	1.160	16.574	720	215	0.030	0.022
2005	1.017	14.533	661	195	0.027	0.024
2006	0.841	12.021	644	194	0.027	0.030