Independent Report on Red Snapper in SEDAR 15

Prepared for
Southeastern Fisheries Association, Inc. (S.F.A.)
East Coast Fisheries Section

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The Southeast Data, Assessment, and Review (SEDAR) 15, Stock Assessment Report 1 (SAR 1) South Atlantic Red Snapper dated February 2008 revised March 2009 advises the Council, "The assessment indicates that the stock has been overfished since 1960 and overfishing is currently occurring". The most remarkable feature of this determination is that the historical ("virgin" in 1945) stock size was nearly 30,000 MT and current stock size about 600 MT! How can this be? How was this determination made?

The usual SEDAR process was followed involving three workshops: Data Workshop, Assessment Workshop, and an "Independent" Review.

Data Workshop (DW)

The workshop had among its tasks the determination of life history parameters for age, growth, fecundity, and natural mortality, historical catches, and abundance index trends. The workshop revealed the life history information and fishery data base for red snapper to be limited and/or of poor quality. Of particular concern are the facts that the DW was unable to:

- Provide observation based estimates of fecundity or natural mortality.
- Provide any fishery dependent or independent measure of recruitment.
- Provide early recreational catches prior to 1981 (headboat prior to 1972, with 1975 being the accepted year to start the series). However, three catch estimates for earlier recreational catches (US Fish and Wildlife Service (FWS) Saltwater Angling Survey 1960, 1965 and 1970) were discussed, but the DW recommended they not be used owing to the lack of reliability in the sampling methods.

The DW considered nine time trend series as possible indexes of abundance, three of which were recommended for use in the assessment. Two of these three have unacceptable levels of precision.

Assessment Workshop (AW)

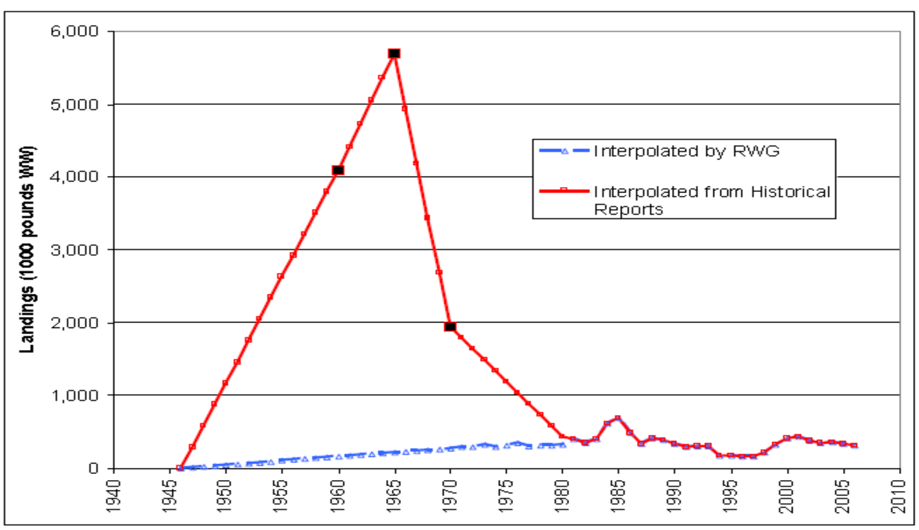
The AW employed a Catch-at-Age (SCA) model that permits benchmark estimation using very limited data and a production type model (ASPIC). The SCA model works the reverse of the more familiar virtual population type (VPA, SPA) models in that the SCA calculates forward in time from (in this case 1945) using life history values and catch data (and abundance indices when they enter the time stream) to estimate recruitment and biomass.

The VPA type starts at the most recent year and back calculates. Both types of model suffer from problems when the data available are poor or missing. The VPA has the desirable feature in that errors tend to be self diminishing as it back calculates whereas the forward progression models may become unstable.

The preliminary SCA model runs caused the AW Report to offer this interesting statement on 14 of Section III SAR 1 (rev):

"The RWG [Recreational Working Group] applied a linear interpolation from 0 in 1946 to estimated values in 1981 for MRFSS and 1972 for headboat. ***During the Assessment Workshop, preliminary model runs suggested significantly higher landings in the early period (1946-1980) than reflected in the landings.*** *Although the RWG dismissed estimates from the Salt-Water Angling reports (Clark 1962, Deuel and Clark 1968, Deuel 1973), the Assessment Panel agreed that these estimates were at least as reasonable as the linear interpolation to zero in 1946 used by the RWG. Therefore, recreational landings were interpolated between zero in 1946 to 1981 with intermediate landings estimates used for 1960 (Clark 1962), 1965 (Deuel and Clark 1968), and 1970 (Deuel 1973). In general, these values were assumed to include headboat landings for these years. Thus, when interpolating between 1970 and 1981, the headboat landings were subtracted for 1972-1980 (and listed separately for headboat). Headboat landings prior to 1972 were assumed zero (i.e., included in the MRFSS landings). Recreational landings (MRFSS and headboat) as estimated by the two approaches are compared in Figure 2.1"*

Figure 2.1. Comparison of red snapper recreational landings, including the original interpolated values provided by the Recreational Working Group (RWG) and the interpolation from historical reports by the Assessment Panel. Solid squares represent landings reported in Salt-Water Angling Surveys (Clark, 1962; Deuel and Clark, 1968; Deuel, 1973).



P30, Section III, SAR 1 (rev)

"Several changes were made to landings to better conform to assumptions made by the primary age-structured assessment model. The beginning of the time series was set to 1946, with extra recreational landings included from 1946 to 1980 to reflect the lack of data on these substantial fisheries (§III(2)). In particular, saltwater angling surveys indicated that

recreational landings amounted to 4.1 million lb in 1960 (Clark 1962), 5.7 million lb in 1965 (Deuel and Clark 1968), and 1.9 million lb in 1970 (Deuel 1973).”

Note (FJH): on page 1 in SAR 1, Section V this statement appears:

1 Revision and Corrections

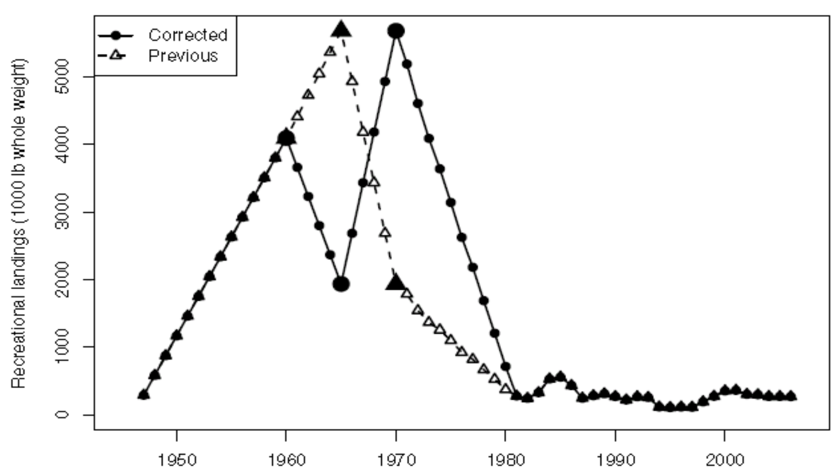
1.1 Correction to recreational landings data

This section documents a correction to recreational landings data used in the stock assessment of South Atlantic red snapper.

As described in section 2.2 of the Assessment Workshop report, the assessment included observed recreational landings from Salt-Water Angling reports. These landings were reported to the level of species for red snapper in the years 1965 and 1970, and as unclassified snappers in 1960. Thus, the value in 1960 was estimated as the unweighted average ratios of red snapper to all snapper from 1965 and 1970. Linear interpolation was used to estimate the recreational landings stream in years surrounding the 1960, 1965, and 1970 point estimates.

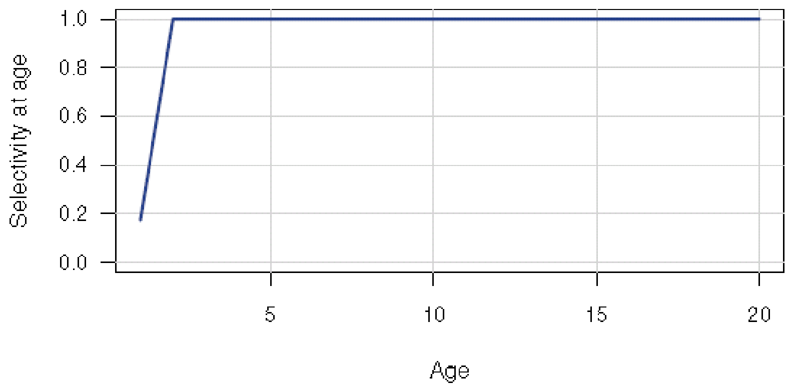
After completion of the assessment, it was discovered that the recreational landings in 1965 and 1970 had been transposed when developing the recreational landings stream. Correction of these values affected not only the point estimates in 1965 and 1970, but also estimates in surrounding years that depended on the linear interpolations (Figure 1.1). Using the corrected recreational landings stream, the base assessment model was re-run, as described below.

Figure 1.1. Red snapper: Comparison of previous and corrected recreational landings. Headboat landings are separated from these general recreational landings starting in 1972, but are assumed included prior. The large solid circles in 1960, 1965, and 1970 represent values from Salt-Water Angling Surveys and served as anchor points for linear interpolations, as documented in the Assessment Workshop report.



Deciding to use the FWS Reports causes a major problem. This may not have been apparent to the AW because they used only the landings data in weight. The total weight was apportioned into catch in number using the recreation catch selectivity curve.

Figure 1.28. Red snapper: Estimated selectivities of the general recreational fishery. Top panel – period 1 (prior to 1984, no regulations). Middle panel – period 2 (1984-1991, 12-inch limit). Bottom panel – period 3 (1992-2006, 20-inch limit).



However, the FWS reports also include the landings in numbers of fish and the average weight. These differ greatly from what the model estimates. This is a serious concern because the recreational catch dominates the landings as is shown below.

Table 2.3. Red snapper: Landings and associated coefficient of variation, as used in the assessment (base).

	Landings in Whole Weight (1000 pounds)				Coefficient of Variation (CV)			
	Commercial		Recreational		Commercial		Recreational	
Year	Hook & Line	Diving	Headboat	MRFSS	Hook & Line	Diving	Headboat	MRFSS
1945	240.9				0.17			
1946	262.6				0.16			
1947	284.4			292.4	0.16			0.29
1948	306.1			584.9	0.15			0.29
1949	327.8			877.3	0.14			0.29
1950	349.6			1169.8	0.14			0.29
1951	498.6			1462.2	0.13			0.29
1952	374.8			1754.7	0.12			0.29
1953	389.1			2047.1	0.12			0.29
1954	576.9			2339.6	0.11			0.29
1955	479.6			2632.0	0.10			0.29
1956	470.0			2924.4	0.10			0.29
1957	843.0			3216.9	0.09			0.29
1958	594.7			3509.3	0.08			0.29
1959	638.3			3801.8	0.08			0.29
1960	652.3			4094.2	0.07			0.29
1961	770.4			4411.8	0.06			0.29
1962	575.9			4729.3	0.05			0.29
1963	438.5			5046.9	0.05			0.29
1964	486.3			5364.4	0.05			0.29
1965	571.4			5682.0	0.05			0.29
1966	643.5			4933.2	0.05			0.29
1967	843.6			4184.4	0.05			0.29
1968	938.7			3435.6	0.05			0.29
1969	611.0			2686.8	0.05			0.29
1970	559.1			1938.0	0.05			0.29
1971	478.9			1787.3	0.05			0.29
1972	414.3		91.9	1544.7	0.05		0.10	0.29
1973	340.2		117.3	1368.6	0.05		0.10	0.29
1974	555.2		77.1	1258.2	0.05		0.10	0.29
1975	650.9		83.5	1101.0	0.05		0.10	0.29
1976	547.4		109.3	924.6	0.05		0.10	0.29
1977	579.2		59.9	823.2	0.05		0.10	0.29
1978	545.0		63.0	669.5	0.05		0.10	0.29
1979	380.7		54.1	527.7	0.05		0.10	0.29

The FWS data are summarized as follows:

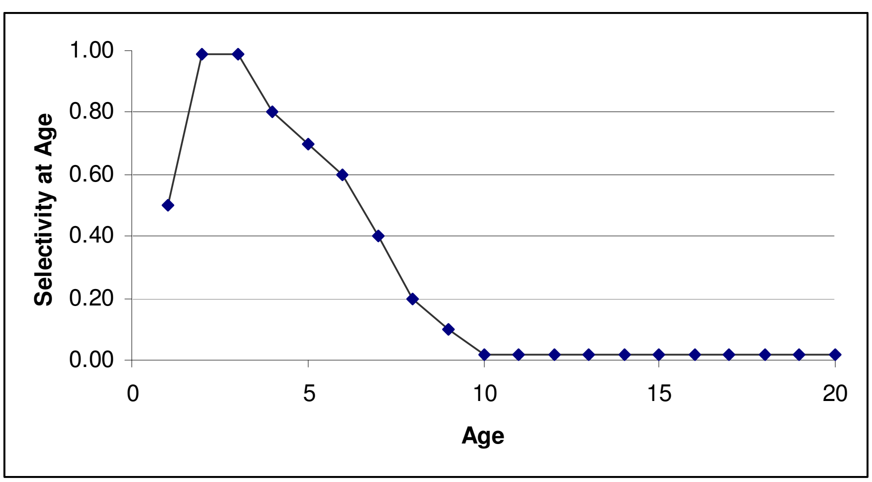
Survey Year	Species	No. Caught	Weight	No. Anglers	Ave. Wt.	No. per Angler	Age
1960	Snapper	9433	24400	245	2.59	38.50	
	YT Snapper	3231	3230	30	1.00	107.70	
1965	Red Snapper	598	1938	86	3.24	6.95	~2.5
	YT Snapper	**19686**	**25400**	**264**	**1.29**	**74.57**	
1970	Red Snapper	1797	5682	77	3.16	23.34	<2.5
	YT Snapper	10843	20163	339	1.86	31.99	

Catch, weight, and number of anglers are in thousands. SEDAR 15-RD08, RD09, and RD10

The FWS Report confounds snapper species in 1960, but for 1965 and 1970, the average weights for red snapper are available at a bit over three pounds. The fact that these are averages implies that half the landings are less than 3 pounds. Since the distribution about the mean is not likely a normal distribution, the proper weight to describe the center of the distribution is the median, and this will likely be less than the average. **(This bias from using the average weight or age in the data inputs is prevalent throughout the assessment. The effect may be minor, but should be examined.)**

Given the small size of the fish, the large number caught and the disproportionate size of the recreational take vs. commercial landings, one expects catch-at-age to heavily favor fish younger than three years old. In reality, the distribution from the model appears to include a disproportionate number of older fish. This is the result of the selectivity pattern, which, for recreational catch, is flat.

In order to have the average age of the fish to be about 3 lb and still have a large, lightly exploited adult biomass, as was likely in the early years at least, the selectivity should be closer to that shown in the figure below:



The discrepancy caused by not using only the weight of the total recreational catch for the three years 1960, 1965 and 1970 can be seen in the following excerpt from Table 1.10 of (SAR 1 Sec V p19). Note three things: 1) that more than half the catch is more than 3-years old. 2) that the average weight (obtained by dividing the weight-at-age table p 21 numbers by the numbers landed) is about 5 pounds, considerably greater than the 3 lbs reported by the FWS survey, and 3) That the total numbers landed are less than half than the totals reported by FWS.

Table 1.10. Red snapper: Landings at age (1000 fish), as estimated by the assessment model											
Age/Year	**1960**	1961	1962	1963	1964	**1965**	1966	1967	1968	1969	**1970**
1	**11.6**	11.5	10.5	9.3	8.4	**7.5**	10.2	13.7	17.6	21.2	**27.5**
2	**52.1**	51.8	47.3	42.2	38.5	**34.5**	46.2	61	77.1	91	**114.6**
3	**41.2**	40.5	36.9	33.2	30.6	**27.7**	37.4	48.3	59.2	67.3	**81.9**
4	**33.8**	32.8	29.5	26.5	24.6	**22.5**	30.7	40	48	52.9	**62.1**
5	**28.2**	27.3	24.3	21.5	20	**18.4**	25.3	33.3	40.3	43.5	**49.5**
6	**24.2**	23	20.4	17.9	16.3	**15**	20.9	27.7	33.8	36.8	**41**
7	**20.9**	19.8	17.3	15.1	13.6	**12.4**	17.2	23	28.4	31.1	**35**
8	**18.3**	17.2	14.9	12.8	11.5	**10.4**	14.2	19	23.6	26.2	**29.7**
9	**16.2**	15.1	13	11.1	9.9	**8.8**	11.9	15.7	19.5	21.9	**25**
10	**14.4**	13.4	11.5	9.7	8.6	**7.6**	10.2	13.3	16.2	18.1	**20.9**
11	**13**	12	10.2	8.6	7.5	**6.6**	8.7	11.3	13.7	15.1	**17.4**
12	**11.7**	10.7	9.1	7.6	6.6	**5.8**	7.6	9.7	11.7	12.8	**14.5**
13	**10.7**	9.7	8.2	6.8	5.9	**5.1**	6.7	8.5	10.1	10.9	**12.3**
14	**9.8**	8.9	7.4	6.1	5.3	**4.5**	5.9	7.4	8.8	9.4	**10.5**
15	**9**	8.1	6.7	5.6	4.8	**4.1**	5.2	6.6	7.7	8.2	**9**
16	**5.7**	7.5	6.2	5.1	4.3	**3.7**	4.7	5.9	6.8	7.2	**7.9**
17	**5.2**	4.7	5.7	4.6	3.9	**3.3**	4.2	5.3	6.1	6.4	**6.9**
18	**4.9**	4.4	3.6	4.3	3.6	**3**	3.8	4.7	5.5	5.7	**6.1**
19	**4.5**	4.1	3.3	2.7	3.3	**2.8**	3.5	4.3	4.9	5.1	**5.5**
20+	**60**	53.8	44.1	35.7	29.8	**25.5**	32.8	40.6	46.6	48.2	**51.4**
SAR Total Numbers	**395.4**	376.3	330.1	286.4	257	**229.2**	307.3	399.3	485.6	539	**628.7**
FWS Total Numbers						598					1797
Avg Wt lbs	5.44	5.34	5.23	5.13	5.04	4.97	4.92	4.86	4.79	4.67	4.50

The result is that the model has been fooled into assigning a high rate of fishing on the older fish in these early years when in reality the FWS low average weights are evidence that the higher catch rates were on young fish, and the spectacular decline in biomass from nearly 30,000 MT in 1945 to the low levels estimate after 1980 may be the result of using an incorrect selectivity at age curve.

Conclusions

Until the early catch problem and selectivity for the recreational fishery is resolved, the assessment is incomplete and it is impossible to evaluate stock status or provide management benchmarks. A concerted effort has to be made to establish the historical catch including any by foreign fleets if the assessment is to attempt to reconstruct the biomass 70 years in the past. Even when some agreement is reached on how to handle this particular problem, the assessment will suffer from a lack of data. At this time, I see little point in addressing projections, as these will necessarily change and the recruitment problem they are having with steepness may go away.

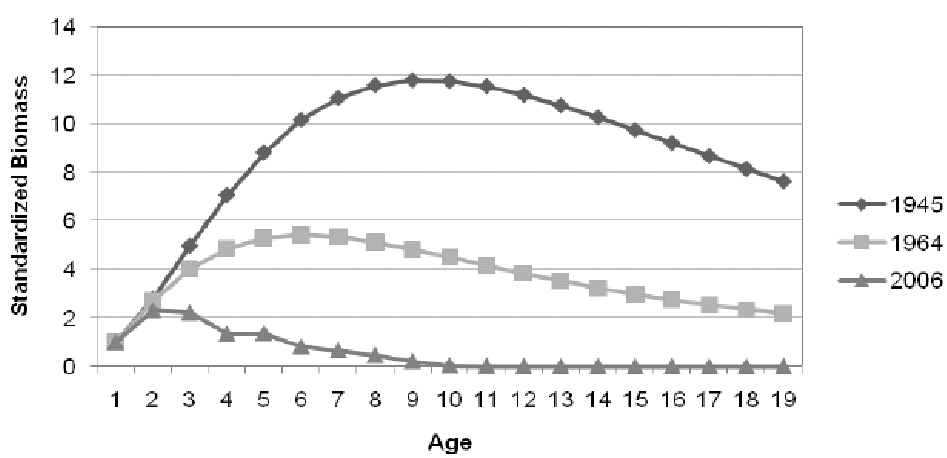
I am disappointed in the fact that once again the reviewers did not take it upon themselves to send what was an obviously flawed assessment back.

Discussion

In the short term about the best that can be offered to the Council is to provide a gross approximation of a stock status report. This could take the form of the fact that production and the abundance indices have been mostly level for the past 25 or so years, which implies that the stock is at equilibrium. The question is where the equilibrium lies in relation to the statutory requirements of the Sustainable Fisheries Act (SFA). The level production statistics and indices and the age-aggregated surplus production model results suggest that fishing mortality F is sustainable at the current level. Where that level lies also is a question that cannot be answered at this time from the existing data. It may be that further refinements of existing data sets are possible, and other sources of data found. Further, there is some comfort to be had in the existence of the Oculina closure that may provide a refuge for a large number of snappers. A test project to evaluate this would be welcome.

One activity that could be undertaken for a reasonable amount and could provide a better indication of stock status would be to launch an extensive and intensive cooperative sampling survey by the commercial and recreational sectors to address the assumption that red snapper age structure has been truncated to the degree suggested in the current assessment.

Figure 5. Age structure of the population (standardized to year-1 biomass).



Sampling of catches and landings stratified by sector, area and season might be able to verify the shape of the curve and the presence or absence of fish older than age 12, and provide a better estimate of selectivity/vulnerability by sector, season, area and depth.

And one change in regulations might improve the economics of the fisheries and perhaps improve the stock status. That would be to remove all size restrictions and require that every red snapper that is caught be retained. This would stop the odious practice of regulatory discards and move the discard mortality into the fishing mortality column where at least the yield would be utilizable in sales or personal consumption and recreational experience.

A properly designed and executed research program should provide some answers, but in the meanwhile, the Council needs to take some action. Clearly, it needs to order a new assessment because NMFS has a statutory obligation to meet. Unfortunately, in some cases meeting the obligation has been done regardless of the quality of the data. Assessments are subjective in that they call for judgments on the part of the analysts. When there is pressure to meet the statutory requirements of the SFA, it is safer for the analysts to presuppose that the stock is depleted in the SFA sense. Then the assessment becomes an exercise to provide a coherent mathematical basis for a declaration of stock depletion status and to provide a rebuilding plan. Once that is done, the burden is on the users to change the determination. The courts in general maintain that NMFS determines what is, “the best available science,” and will not accept arguments that provide alternative scientific analyses.

For the future, there is increasing pressure to move from single species management to ecosystem management. That is good in the sense that it moves from the fixed structure based on invariant K and (mostly) unchanging parameters to a flexible one that recognizes that the ecosystem may vary in ways that are outside even the stochastic boundaries of the present modeling systems. However, incorporating this concept into the law is a daunting task and offers many opportunities to enshrine bad science into law, as is already the case.