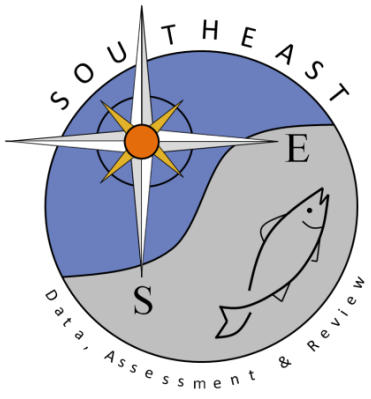

SEDAR

Southeast Data, Assessment, and Review

SEDAR 2 Update

South Atlantic Vermilion Snapper

Stock Assessment Report

May 2007

SEDAR
4055 Faber Place Drive, Suite 201 North Charleston, SC 29405

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Each Section is Numbered Separately

Preface

SEDAR (Southeast Data, Assessment and Review) was initially developed by the Southeast Fisheries Science Center and the South Atlantic Fishery Management Council to improve the quality and reliability of stock assessments and ensure a robust and independent peer review of stock assessment products. SEDAR expanded in 2003 to address the assessment needs of all three Fishery Management Council in the Southeast Region (South Atlantic, Gulf of Mexico, and Caribbean) and provide a platform for reviewing assessments developed through the Atlantic and Gulf States Marine Fisheries Commissions.

SEDAR strives to improve the quality of assessment advice provided for managing fisheries resources in the Southeast US by increasing and expanding participation in the assessment process, ensuring the assessment process is transparent and open, and providing a robust and independent review of assessment products. SEDAR is overseen by a Steering Committee composed of: NOAA Southeast Fisheries Science Center Director and the Southeast Regional Administrator; the Executive Directors and Chairs of the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; and the Executive Directors of the Atlantic States and Gulf States Marine Fisheries Commissions.

SEDAR benchmark assessments are conducted through a three workshop process. First is the Data Workshop, during which fisheries, monitoring, and life history data are reviewed and compiled. Second is the Assessment workshop, during which assessment models are developed and population parameters are estimated using the information provided from the Data Workshop. Third and final is the Review Workshop, during which independent experts review the input data, assessment methods, and assessment products.

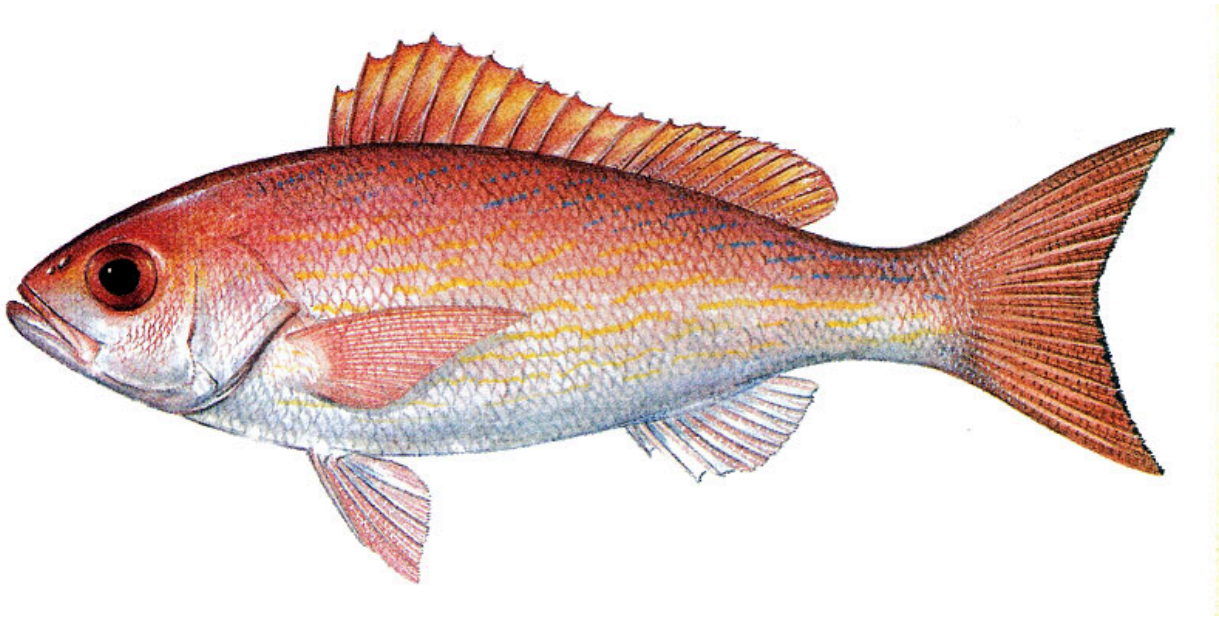
SEDAR Update assessments are conducted through Council SSCs or other relevant technical advisory bodies following guidelines established by the SEDAR Steering Committee and addressing terms of reference developed by the Council and SSC. Update assessments are prepared during an update workshop and reviewed by the Council SSC.

This assessment is an update of the South Atlantic vermilion snapper benchmark assessment prepared in 2003 through SEDAR II.

Report of Stock Assessment:

Vermilion Snapper

SEDAR Update



Assessment Workshop of April 2–4, 2007

Beaufort, North Carolina

Report issued: May 18, 2007

Executive Summary

A SEDAR stock assessment workshop (AW) was convened at the NOAA Center for Coastal Fisheries and Habitat ResearchBeaufort, North Carolina, on Monday, April 4, 2007. The workshop's objectives were to conduct an update assessment of the vermilion snapper (Rhomboplites aurorubens) off the southeastern U.S. and to conduct stock projections based on possible management scenarios (Terms of Reference; Appendix A). Participants in the update assessment (Appendix B) included state and federal scientists, SAFMC AP and SSC members, and various observers. All decisions regarding stock assessment methods and acceptable data were made by consensus.

Available data on the species included all those utilized for the benchmark assessment conducted in 2002 – no additional data sources were identified during the scoping workshop (SW). These data were abundance indices, recorded landings, and samples of annual size compositions from indices and landings. Four abundance indices were used in the benchmark assessment: one from the NMFS headboat survey and three from the SC MARMAP fishery-independent monitoring program. Landings data were available from all recreational and commercial fisheries. While the MARMAP chevron trap index decreased in recent years, the remaining abundance indices showed neither marked increase nor decline during the assessment period (1976–2006).

The statistical model of catch at length as developed for the benchmark assessment was used as the only assessment model. The AW provided the base run of the model, identical to that used in the benchmark assessment. This base run was used for the estimation of benchmarks and stock status. The benchmark assessment concluded that the high degree of uncertainty in recruitment and spawning stock biomass estimates meant that no reliable biomass based benchmarks could be developed from the assessment, and this was found to be the case for the updae assessment as well. The ratio of fishing mortality in 2006 to $F_{MAX}$was 2.05, compared to 1.71 in the benchmark assessment, suggesting that overfishing continues.

Projections were used to evaluate the potential of the stock to be rebuilt, but could only be conduted for constant F scenarios. Four projections were considered: $F=F_{MAX}$; $F=85\%F_{MAX}$; $F=75\%F_{MAX}$ and $F=65F_{MAX}$; the results of each were very similar.

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71 Introduction

An update of the vermilion snapper benchmark assessment was scheduled to be conducted in Spring, 2007. This was to be accomplished through a SEDAR update process and terms of reference were provided by the SEDAR steering committee. A SEDAR Assessment Workshop (AW) was convened at the NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, North Carolina, by the South Atlantic Fishery Management Council (the Council) and the NMFS Southeast Fisheries Science Center (the Center) under the SEDAR process. The AW met for three days, from April 2 through April 4, 2007. Participation in the workshop (Appendix B) included representatives of the Council and its Scientific and Statistical Committee; representatives of the fishing industry; and scientists from the states of Georgia, North Carolina, and South Carolina and federal (NMFS) agencies.

The AW's major objectives were to conduct an update to the SEDAR-02 benchmark assessment of vermilion snapper, *Rhomboplites aurorubens*, off the southeastern US (SEDAR 2003), and to conduct corresponding stock projections. In support of those tasks, the AW received data and recommendations resulting from a scoping workshop (SW) that was convened on March 15, 2007. The SW was charged with recommending any data changes to be made in this assessment, which was otherwise to be based on the benchmark assessment of vermilion snapper conducted during SEDAR-02.

As an update report, this document is less detailed than full SEDAR assessment reports. Material not covered in detail here is given in more detail in the benchmark assessment report (SEDAR 2003).

2 Scoping Workshop

The Scoping Workshop (SW) met by conference call on March 15, 2007. Its purpose was to identify data sources for the data to be added to the assessment, and to discuss and specify any changes in data processing from the preceding SEDAR benchmark assessment of vermilion snapper. This section summarizes major conclusions of the SW.

2.1 Data availability and additions

Workshop participants agreed to provide all requested data from 2002 through 2006. Landings data from 2006, while thought to be complete, should nonetheless be considered preliminary.

2.2 Abundance indices

Abundance indices will continue those used in the benchmark assessment. Updates of the MARMAP chevron trap index will be provided through 2006 by the MARMAP program. Updates of the headboat index as used in the benchmark assessment will be provided through 2006 by NMFS Beaufort.

2.3 Landings

Landings data from the Beaufort headboat survey, the NMFS general canvass, and the NMFS MRFSS program will be used through 2006.

2.3.1 Commercial landings

Landings were updated through 2006 by state, year and gear (hook and line, trawl, and other as used in the benchmark assessment).

2.3.2 Headboat landings

Landings were updated through 2005 by state and year. Headboat landings for 2006 were not available and were taken to be the average of the landings recorded from 2002-2005.

2.3.3 MRFSS landings

Landings were updated through 2006 by state and year using the same estimation procedures as used for the benchmark assessment.

2.5 Modeling

The model to be used was not discussed as the Terms of Reference (TOR, Appendix A) provided by the SEDAR Steering Committee limited the scope of the update to adding new data to the model used for the benchmark assessment.

2.5.2 Discards

Handling of discards will be unchanged from the benchmark assessment.

2.5.4 Sensitivity runs

No sensitivity runs will be conducted.

2.5.5 Projections

The TOR requested several projections be run, and these will be done as possible; however, the structure of the model restricts projections only to those with a fixed fishing mortalilty (F). The allowable time for rebuilding will be assumed to be ten years. The SW agreed that future recruitment would be determined using the average recruitment from the base run model.

2.6 Report

The report will be brief, and it will be written with references to the benchmark assessment report wherever possible, but it will include a complete description of changes from the benchmark assessment. It will also include new tables and graphs of data and estimates from the update.

3 Background information

3.1 Regulatory history

This stock is managed by the South Atlantic Fishery Management Council (SAFMC 1988; 1991; 1998; 2000). For a summary of regulatory history, see Table 1 on page 6 of the benchmark assessment.

3.2 Assessment history

The preceding SEDAR benchmark assessment was conducted in 2002–03, as part of the second SEDAR cycle. The benchmark assessment was conducted for 1976-2001.

4 Life History

The description of the life history of the vermilion snapper is unchanged from the benchmark assessment (Section 2: Stock and fishery characteristics, pages 5-10).

5 Commercial fisheries

5.1 Overview

Vermilion snapper is a valuable species in commercial fisheries. The most common commercial gear remains hook and line.

5.2 Commercial landings

Some changes were made to commercial landings data used in the benchmark assessment. Hook and line catches from Georgia were updated for 1997 (53,648 lbs in SEDAR 2 assessment replaced with 61,197 lbs) and 1999-2001, where zero catches were replaced with 88,132 lbs, 220,986 lbs, 254,805 lbs, respectively. The catches reported as zeros were reported as such in the benchmark assessment because of confidentiality issues. Minimal changes were made to state landings for 2001 from Florida, South Carolina and North Carolina as these data reflected the terminal year of the benchmark assessment and were reported as in that assessment as uncertain. No changes were made to landings from previous years.

It was noted that the entire time series for the 'trawl' and 'other' categories of commercial landings were mislabeled for Georgia, South Carolina and North Carolina in the benchmark assessment. That is, trawl landings were labeled as other for these three states and vice versa. This was corrected in the update assessment.

Reported catches for the commercial trawl landings were zero for 2001, 2003 and 2006. The mean value of landings from the each of the bracketing years (approximately 80 kg for each year) was substituted for the zero values in each year; however the model failed to converge with these values. The AW decided to assume that the zero values reflected the real landings, and changed the zero values to one kg, but the model again failed to converge. The zero values were then set to ten kg, which allowed model convergence.

During the AW, gear types included in the other category was queried. Because most of the other gear landings were from Florida, an email was sent to the Florida SW representative who provided these data. He emailed back the following week that an error had been made for the updated other landings (2001-2006; hook and line catches erroneously provided in the other category), and provided corrected landings data for the hook and line and other gears.

Commercial landings used for the benchmark assessment are summarized in Table 1.

5.3 Length composition

Length compositions were updated for commercial gears (hook and line, trawl, and other) for 2002–2006, using the same methodology as in the benchmark assessment. Sample size by gear, including those from recreational and fishery-independent sources, is summarized in Table 2.

6 Recreational fisheries—description and data

6.1 Overview of components

The general recreational fishery is sampled by Marine Recreational Fishery Statistical Survey (MRFSS). The headboat fishery is sampled separately, and for that reason is distinguished from the general recreational fishery. These two recreational sectors are referred to here as "MRFSS" and "Headboat." Both recreational fisheries use hook-and-line gear almost exclusively. Recreational landings are summarized by fishery in Tables 3.

6.2 General recreational (MRFSS)

Recreational fishery sectors were defined as for the benchmark assessment and were updated to include data from 2002 through 2006.

6.2.1 Landings

The MRFSS data used in the benchmark assessment used numbers of fish, not kilograms. This was corrected for the update assessment.

6.2.2 Length composition

Data on length composition of general recreational landings were updated for 2002–2006 using the same methodology as in the benchmark assessment.

6.3 Headboat fishery

6.3.2 Landings

Headboat landings changed insignificantly from the benchmark assessment resulting from data updating and file merging.

6.3.3 Length composition

Data on length composition of headboat landings were updated for 2002–2006 using the same methodology as in the benchmark assessment.

6.3.4 Abundance index

An abundance index developed using data on CPUE from the headboat sector as defined in the benchmark assessment was updated for 2002-2006. As a lognormal general linear model (GLM) is used to calculate headboat CPUE, they are recalculated each time new data are added, resulting in slightly different values from those used in the benchmark assessment. These differences were expected and are not significant (Table 4).

7 Fishery-independent survey data—MARMAP

7.1 Methods, gears, and coverage

Four indices of abundance from MARMAP were used in the benchmark assessment, and all four were used in the update. Only the chevron index was updated as this is the only gear that has been used continuously by MARMAP since 1990 (see benchmark assessment). Abundance indices calculated for the chevron trap index were slightly higher than used in the benchmark

assessment as traps catching no reef fish species at all were removed from the analysis. The trends in the data remained unchanged (Table 4).

7.2 Length composition

Length compositions of MARMAP chevron-trap samples were updated through 2006.

8 Stock assessment methods

8.1 Length-structured model

As defined by the TOR provided by the SEDAR Steering Committee, no changes were made to the length-structured model utilized for the benchmark assessment for this update assessment.

8.1.3 Sensitivity analyses

Sensitivity analyses were not run.

9 Assessment results

9.1 Results of length-structured model

Estimates from the base run of the updated length-structured model are summarized below. For further details on the structure and specific methods used in the model, see the benchmark assessment report (SEDAR 2003).

In general, the results suggest that the stock continues to be overfishing. The overfished status could not be determined; a decision made during the benchmark assessment. Fully selected fishing mortality in 2006 is estimated to be 0.73. For comparison, the estimate of F_{MAX} from the update assessment is 0.355 (Table 5).

9.1.1 Model fit

The length-structured model was able to match observed landings almost exactly (Fig. 1-5). The fits to the abundance indices were good (Fig. 6-9). In the most recent years there appears to be some conflict in the observed data between the headboat fishery CPUE and the MARMAP chevron trap CPUE. The model appears to reconcile these differences by underestimating the headboat CPUE and overestimating the chevron trap CPUE in the most recent three years (2004-2006) (Fig. 6 and 7). The fit of the age and length composition data is not shown In Its entirety, but may be described as ranging from good (Fig. 10-11) in some years and bad (Fig. 12) in other years. The AW compared the fit of the benchmark assessment to the update assessment for each year of data and concluded that the degree of fit to these data did not differ from that seen in the benchmark assessment.

Figure 1. Observed (solid circles) and predicted (open squares) commercial hook-and-line landings from the base run of the length-structured model of vermilion snapper. Landings are reported in kilograms.

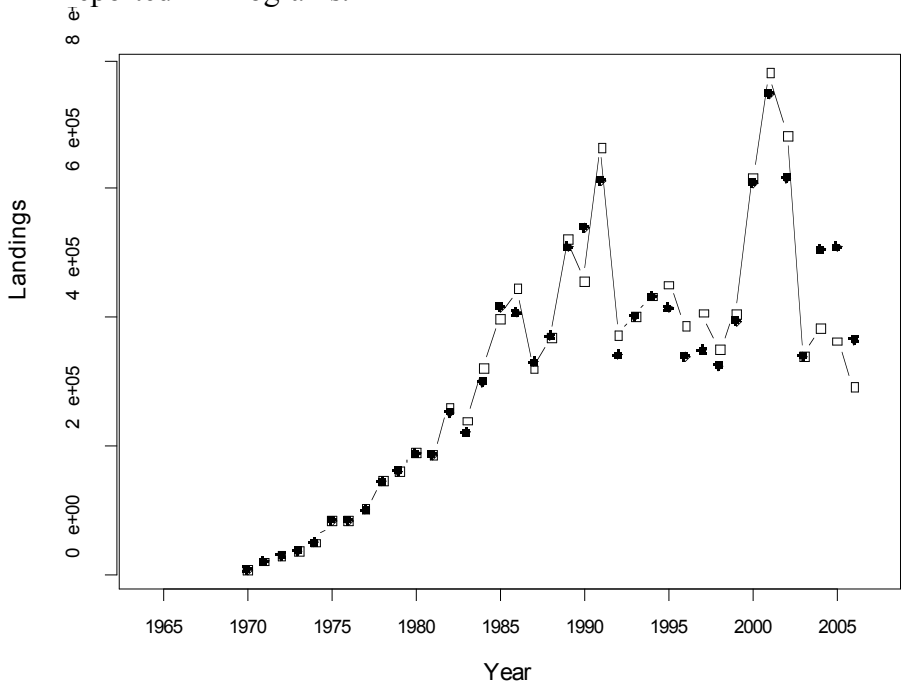


Figure 2. Observed (solid circles) and predicted (open squares) commercial trawl landings from the base run of the length-structured model of vermilion snapper. Landings are reported in kilograms.

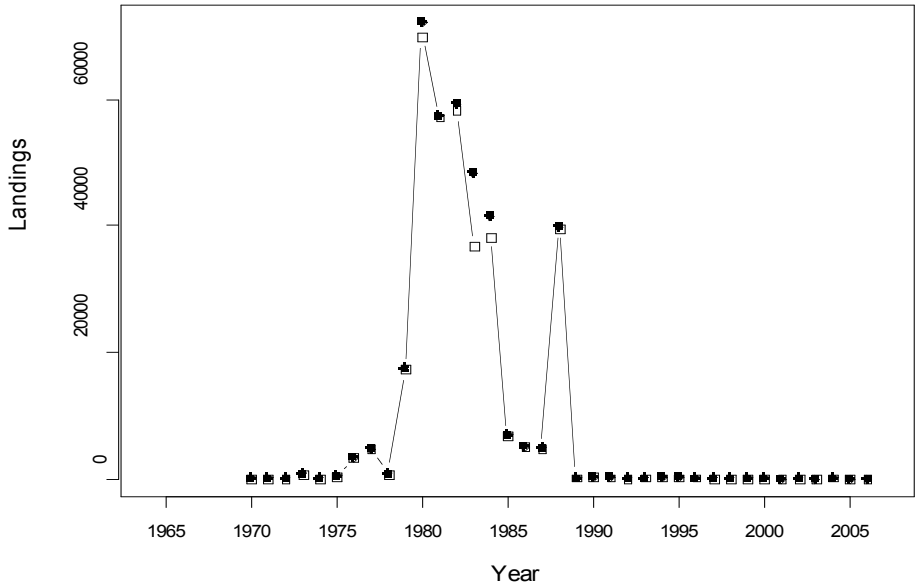


Figure 3. Observed (solid circles) and predicted (open squares) commercial other landings from the base run of the length-structured model of vermilion snapper. Landings are reported in kilograms.

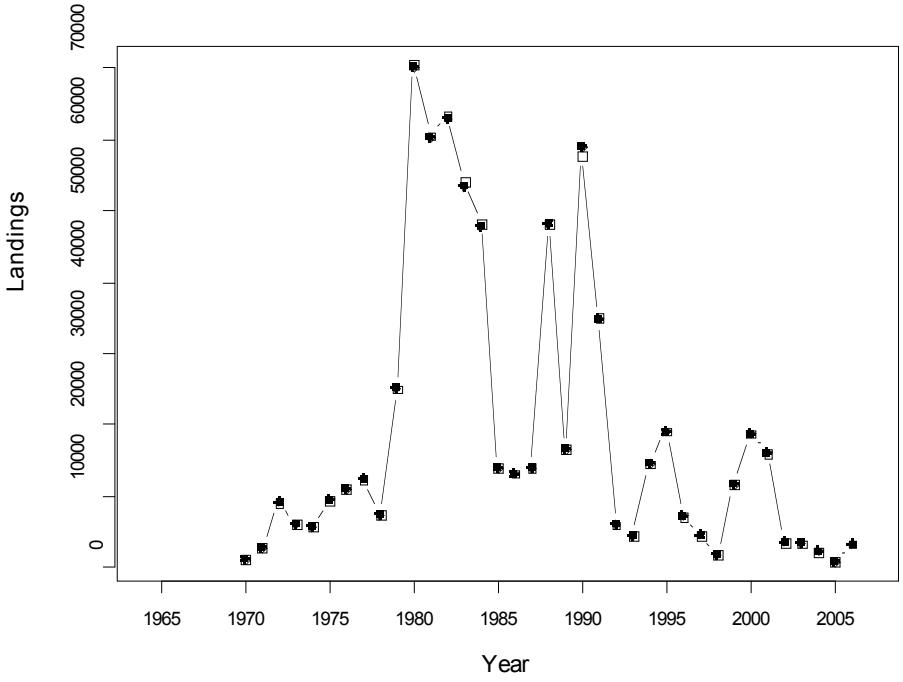


Figure 4. Observed (solid circles) and predicted (open squares) recreational headboat landings from the base run of the length-structured model of vermilion snapper. Landings are reported in kilograms.

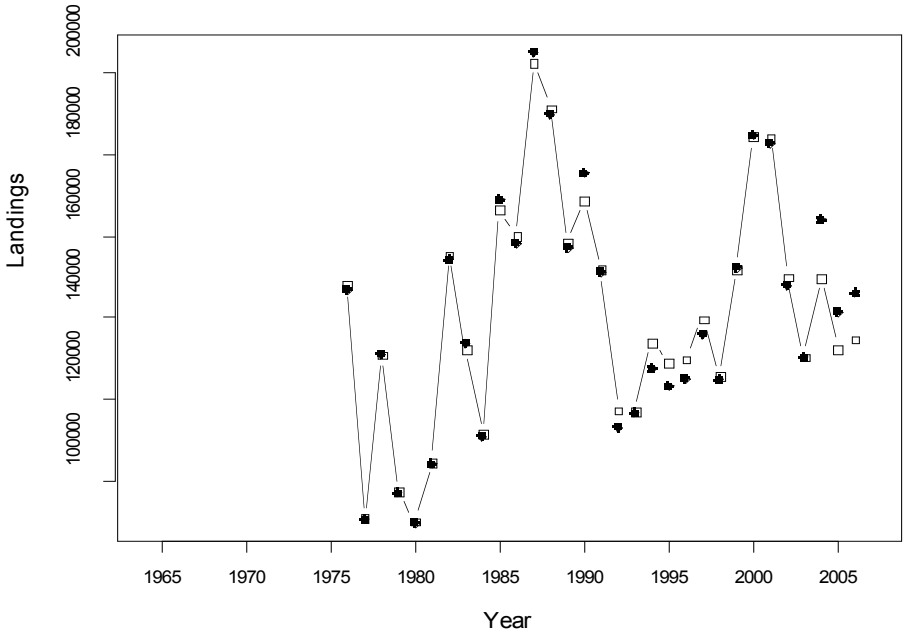


Figure 5. Observed (solid circles) and predicted (open squares) recreational private and charter boat landings from the base run of the length-structured model of vermilion snapper. Landings are reported in kilograms.

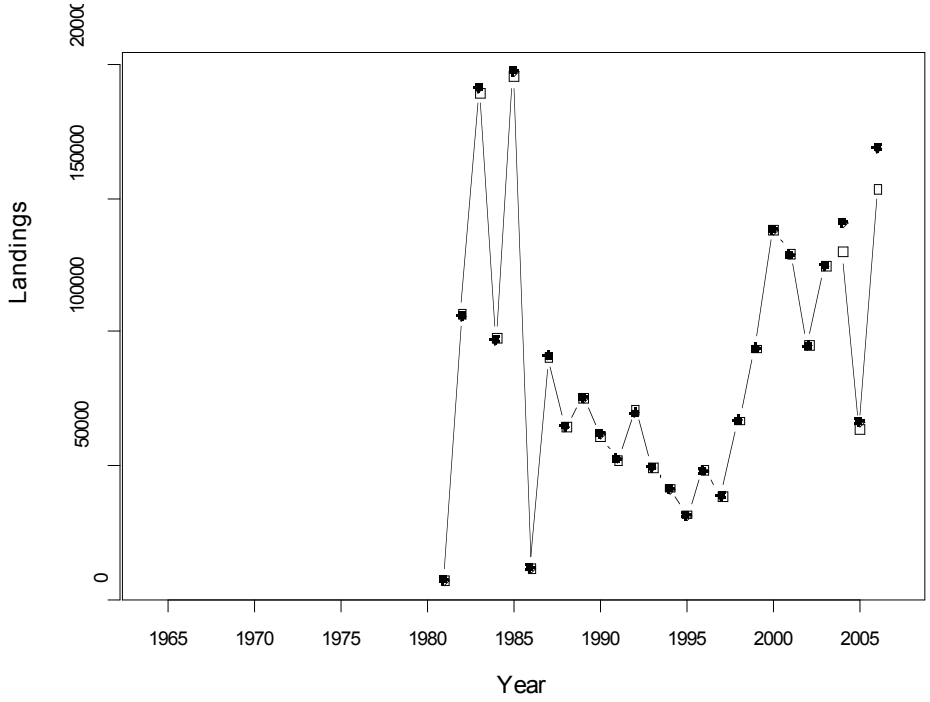


Figure 6. Observed (solid circles) and predicted (open squares) headboat fishery CPUE abundance index from the base run of the length-structured model of vermilion snapper.

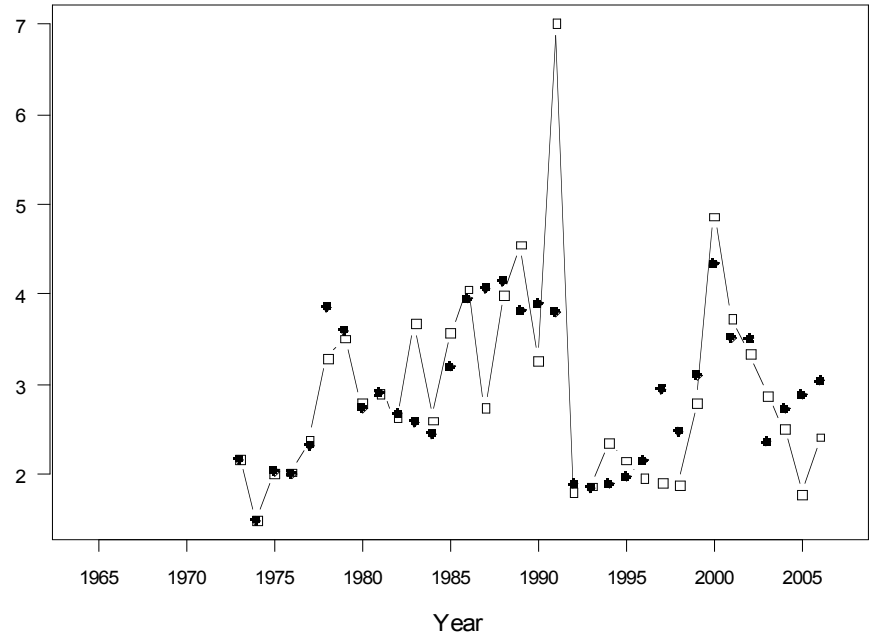


Figure 7. Observed (solid circles) and predicted (open squares) MARMAP chevron trap CPUE abundance index from the base run of the length-structured model of vermilion snapper.

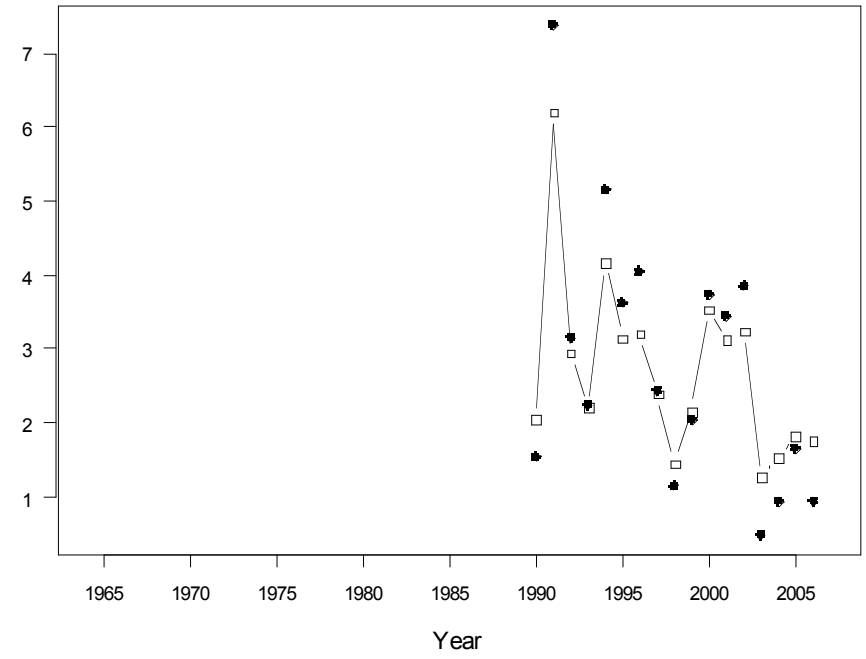


Figure 8. Observed (solid circles) and predicted (open squares) MARMAP Florida trap CPUE abundance index from the base run of the length-structured model of vermilion snapper.

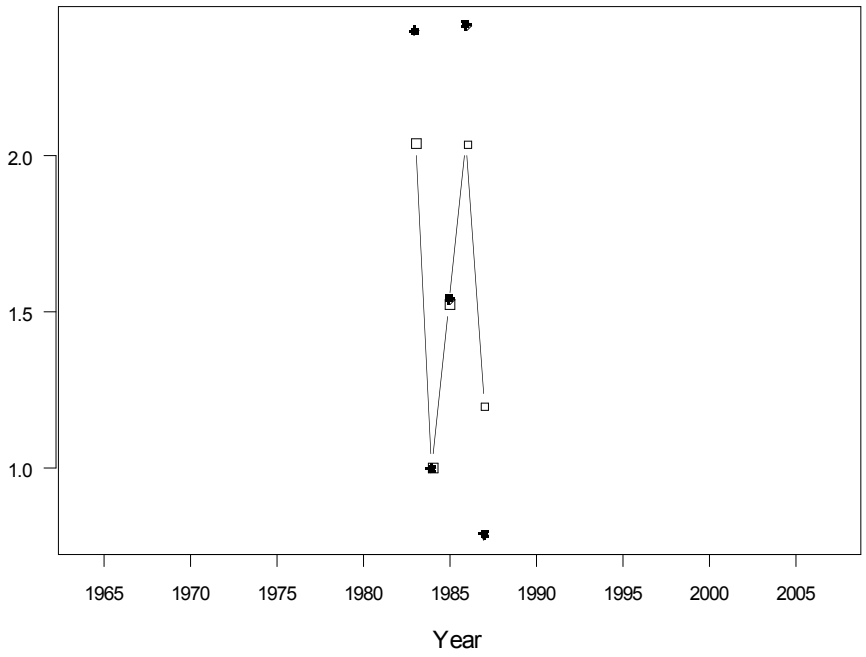


Figure 9. Observed (solid circles) and predicted (open squares) MARMAP hook-and-line CPUE abundance index from the base run of the length-structured model of vermilion snapper.

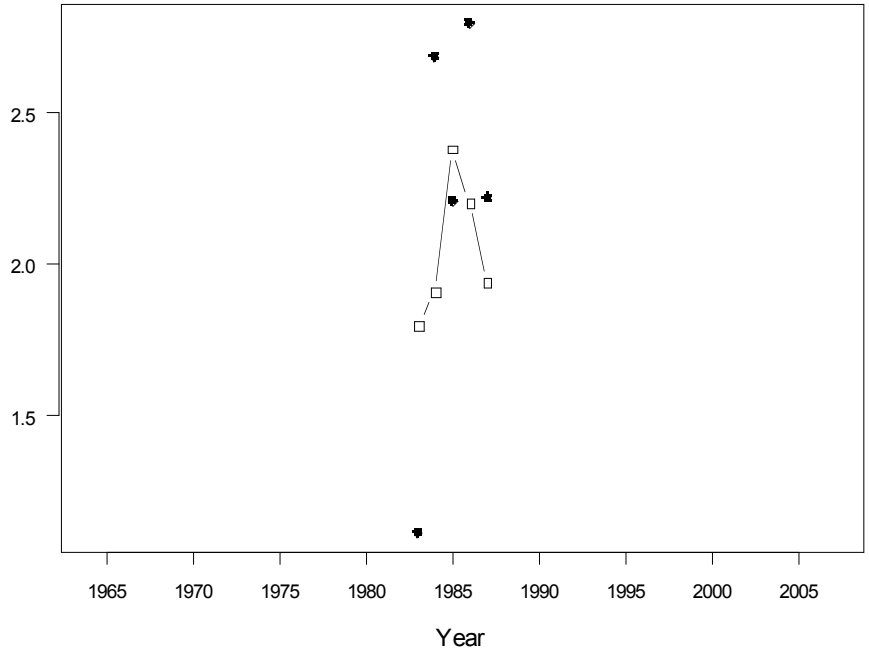


Figure 10. Observed (solid circles) and predicted (line) MARMAP chevron trap length composition data in 1999 from the base run of the length-structured model of vermilion snapper.

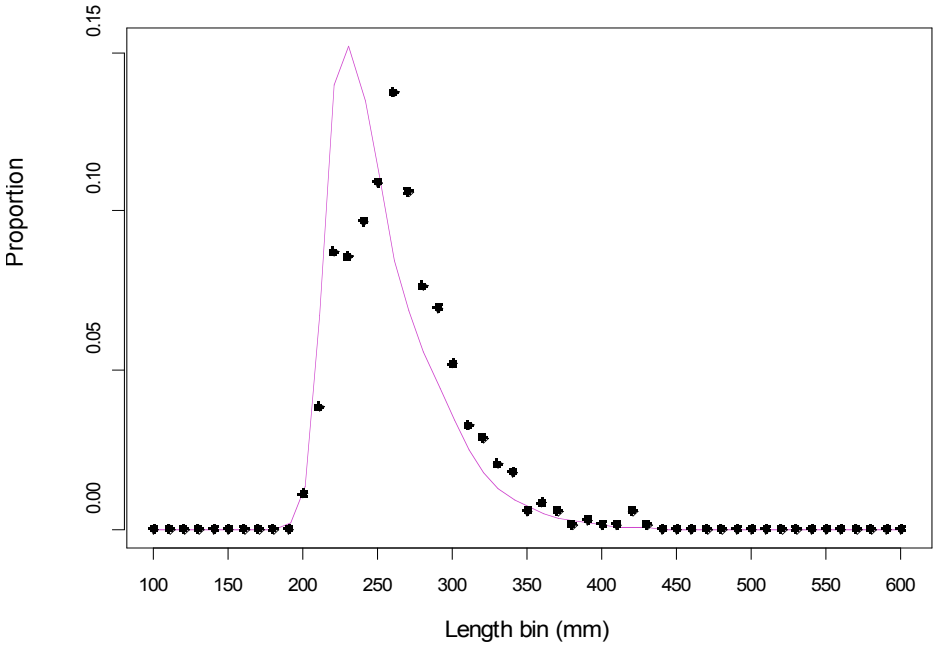


Figure 11. Observed (solid circles) and predicted (line) commercial hook-and-line length composition data in 2006 from the base run of the length-structured model of vermilion

snapper.

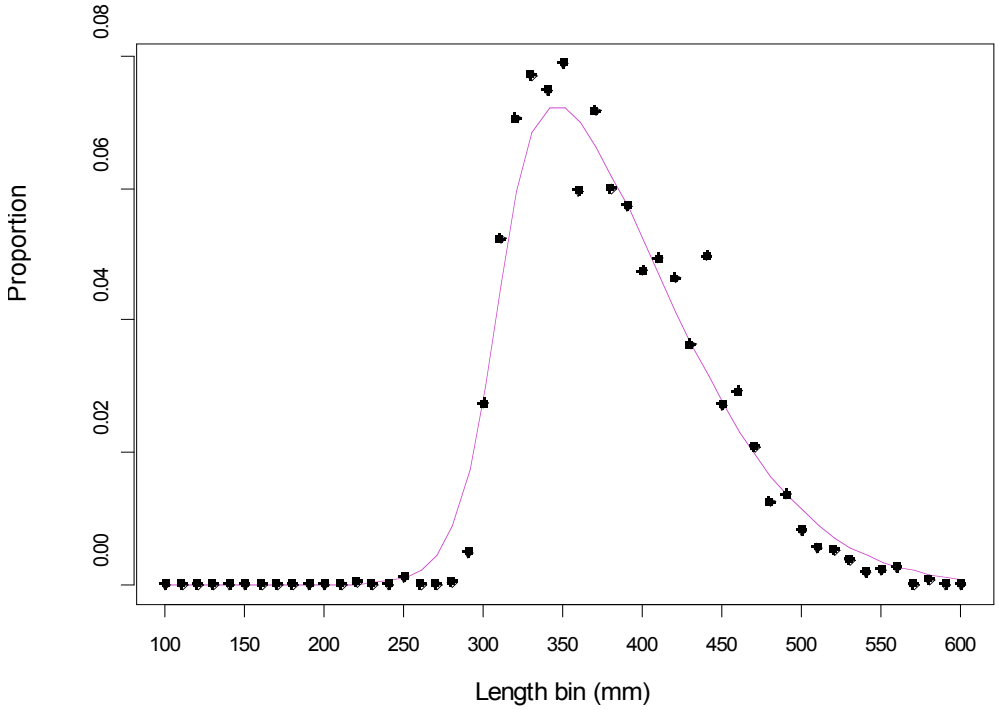
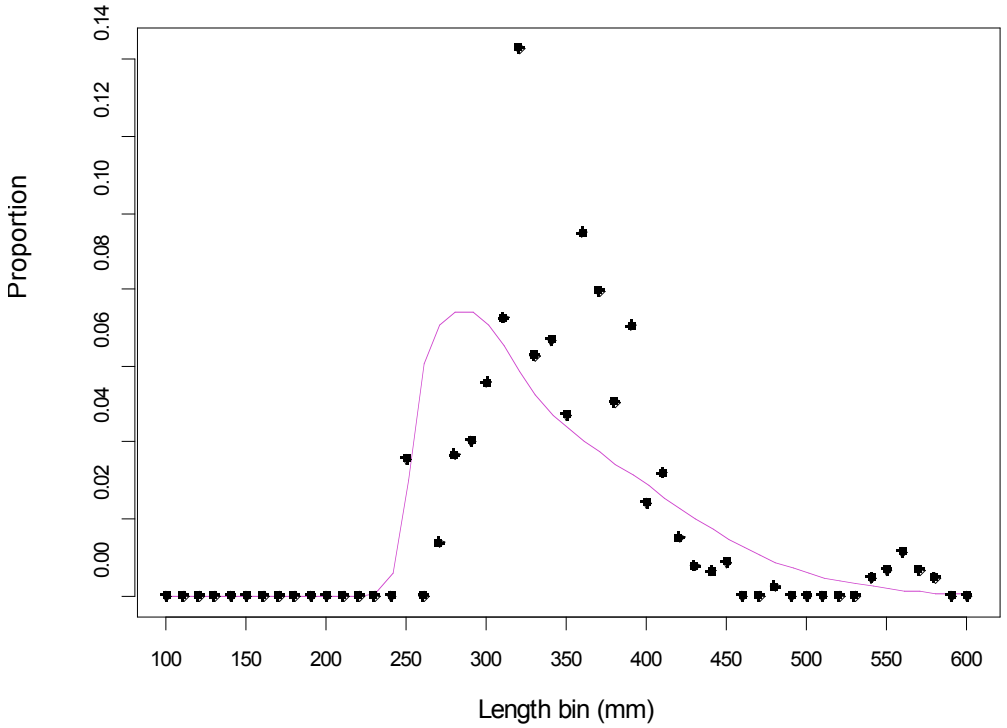


Figure 12. Observed (solid circles) and predicted (line) recreational MRFSS length composition data in 2006 from the base run of the length-structured model of vermilion snapper.



9.1.2 Selectivity

Estimated selectivity curves of the fishery-independent (MARMAP) gears indicate that the two trap gears have dome-shaped selectivity (Fig. 13). The MARMAP hook-and-line selectivity curve was specified as logistic, not dome-shaped. Estimated selectivity curves of commercial hook-and-line gear and the recreational fisheries (MRFSS and headboat fisheries assume the same selectivity) show the expected changes from minimum size regulations (Fig. 14 and 17). The one exception is the apparent shift in selectivity in the recreational sector from 1998 to 1999. The shift is in the opposite direction than what would be expected with a change from a 10" (254 mm) to 11" (279 mm) minimum size limit; however, this same tendency was observed in the benchmark assessment. Furthermore, as was seen in the benchmark assessment, the other commercial fisheries did not appear to be affected by the minimum size regulation changes (Fig. 16).

Figure 13. Estimated selectivity of the fishery-independent from the base run of the length-structured model of vermilion snapper.

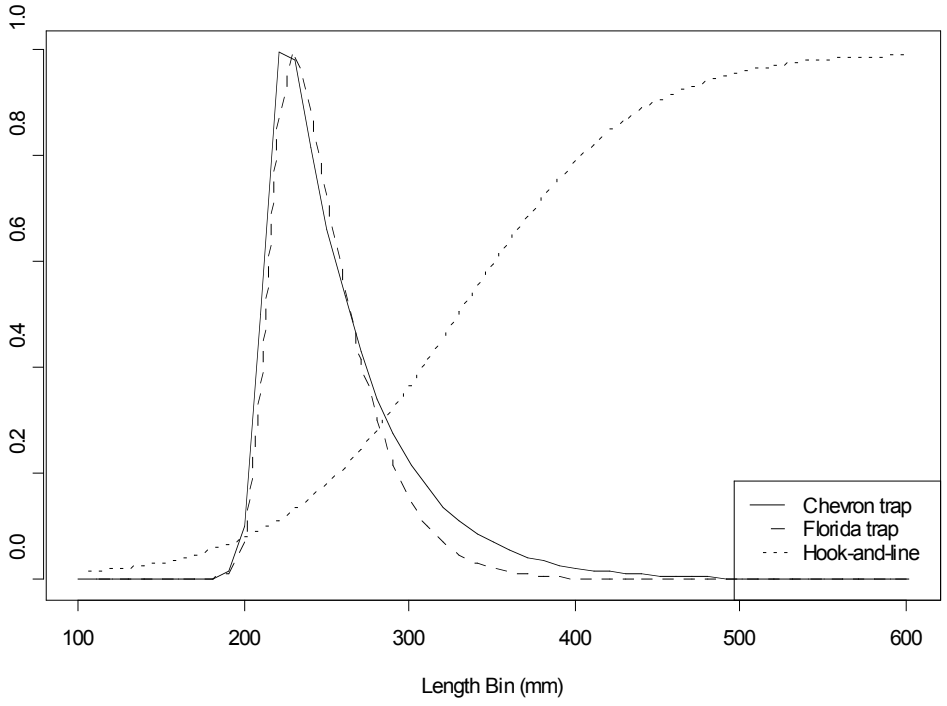


Figure 14. Estimated selectivity of the commercial hook-and-line fishery from the base run of the length-structured model of vermilion snapper.

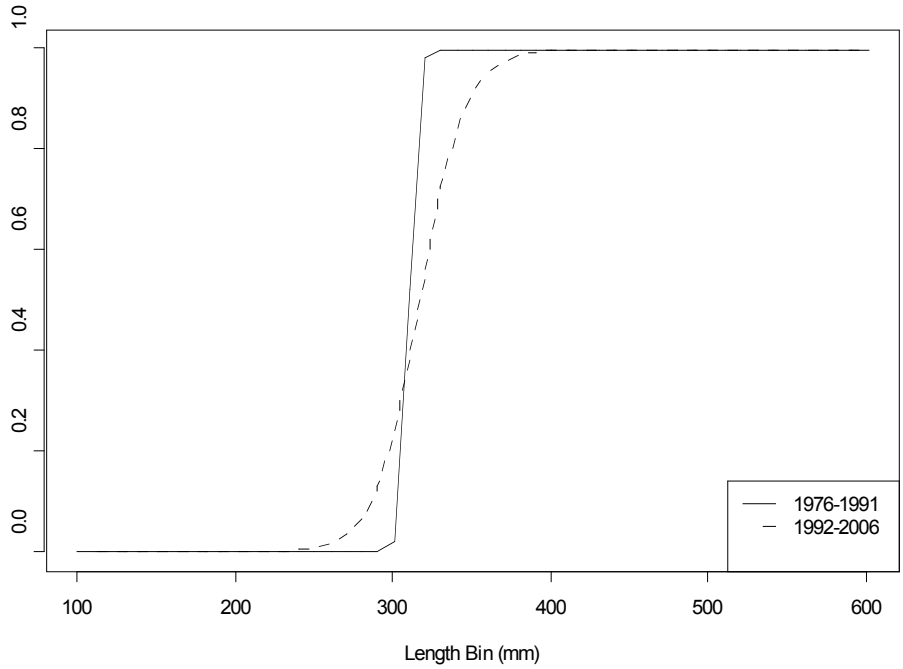


Figure 15. Estimated selectivity of the commercial trawl fishery from the base run of the length-structured model of vermilion snapper.

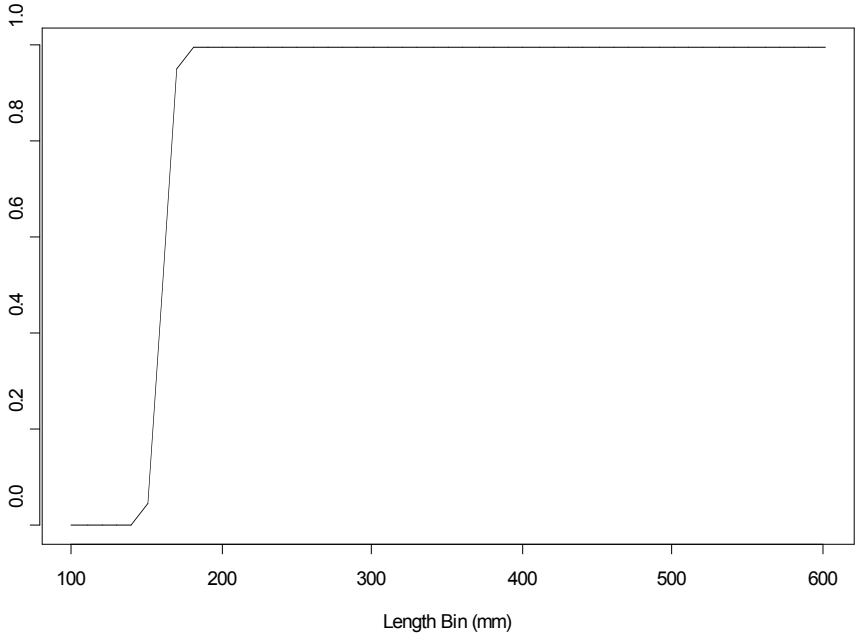


Figure 16. Estimated selectivity of the commercial other fisheries from the base run of the length-structured model of vermilion snapper.

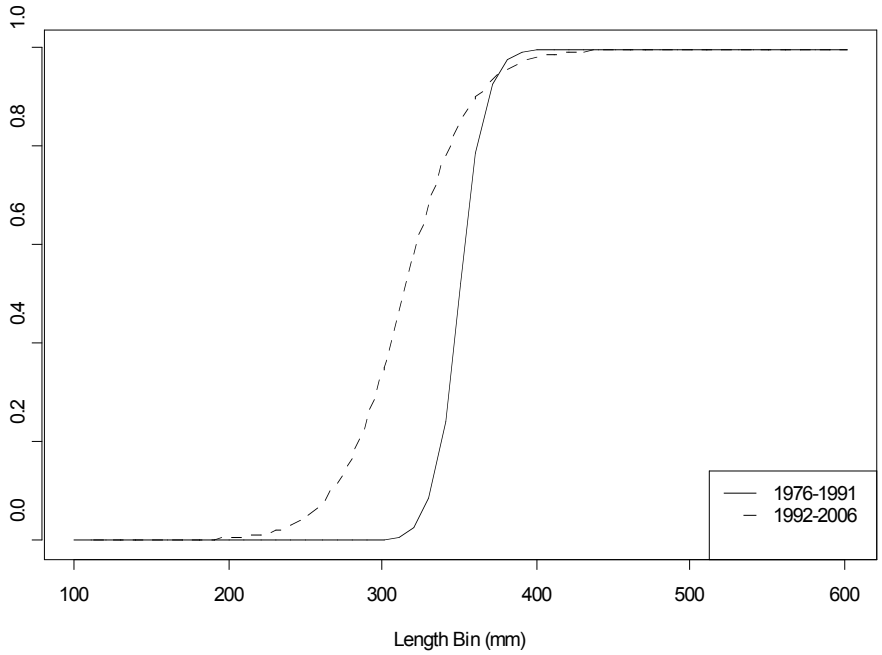
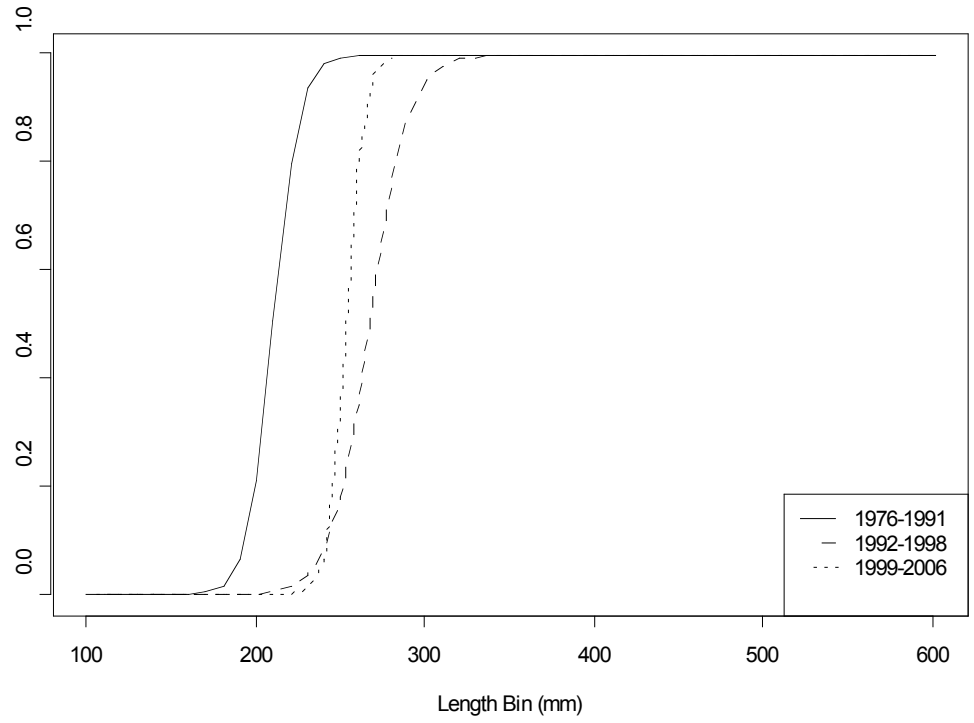


Figure 17. Estimated selectivity of the recreational fisheries from the base run of the length-structured model of vermilion snapper.



9.1.3 Mortality rates

Estimated fully-selected fishing mortality rates (F) reflect the relative landings of the various fisheries (Table 6, Fig. 18 and 19). The largest source of fishing mortality is the commercial hook-and-line fishery. The combined headboat and MRFSS recreational fisheries contribute the largest portion of the remaining mortality, with the commercial trawl and other being negligible sources, particularly in the more recent years. The model estimated fully selected fishing mortality rates in excess of 0.355, the value corresponding to F_{MAX}, for all years except 1981 (Fig. 18 and 19). The 2006 estimate of F is 0.73, a little more than twice the F_{MAX} benchmark level.

Figure 18. Estimates of full fishing mortality rate (F) by fishery from the base run of the length-structured model of vermilion snapper. The fisheries are labeled as recreational (.r) and commercial (.c), and further sub-labeled as headboat (.hb), hook-and-line (.hal), MRFSS (.mr), other (.xxx), and trawl (.twl). Discard mortality rates are denoted by (.d).

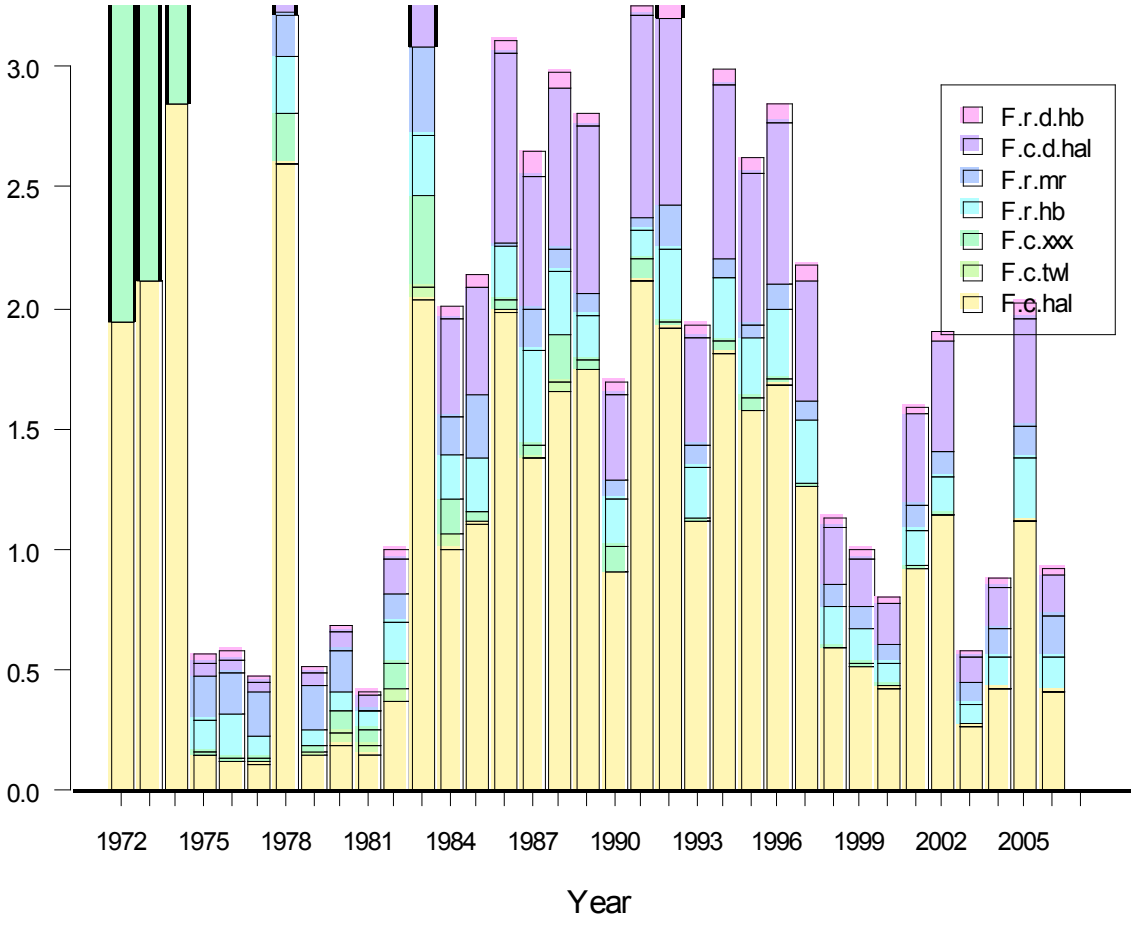
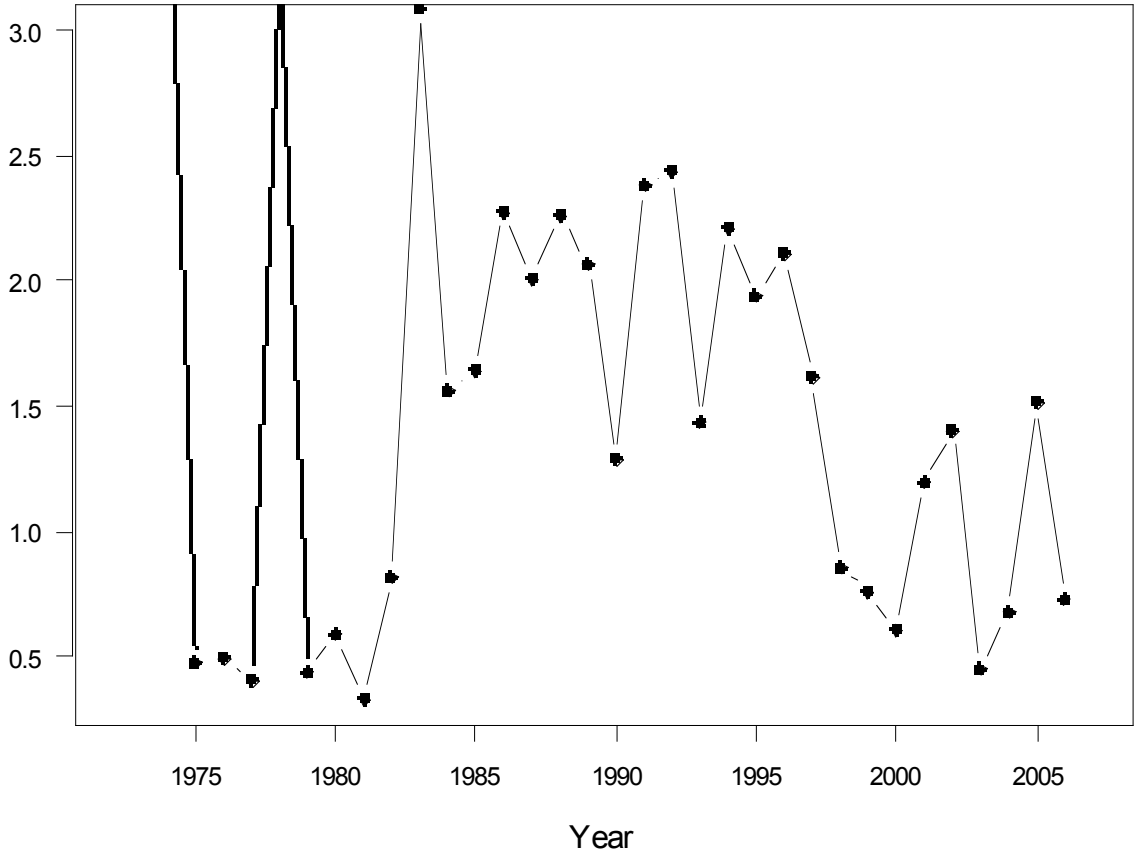


Figure 19. Estimates of total full fishing mortality rate (F) from the base run of the length-structured model of vermilion snapper. For reference, the estimate of F_{MAX} from the base run was 0.355.



9.1.4 Total biomass and spawning stock

Spawning stock as measured by total egg production is estimated to have increased from the early years to a peak in 2000 and has since declined to levels consistent with the average of the post-1970s time series (Fig. 20). Recruitment appears highly variable but shows a general declining trend since 1987 (Fig. 21). Some of the lower recruitment values were estimated in the most recent years with the lowest for the whole time series estimated in 2003 (Fig. 21).

Figure 20. Trajectory of population egg production (total eggs) from the base run of the length-structured model of vermilion snapper.

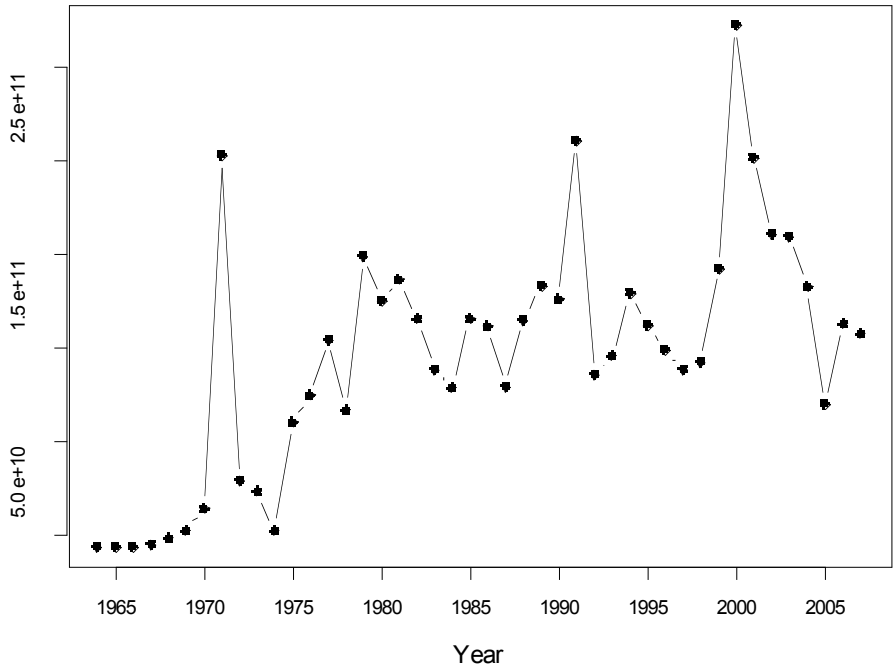
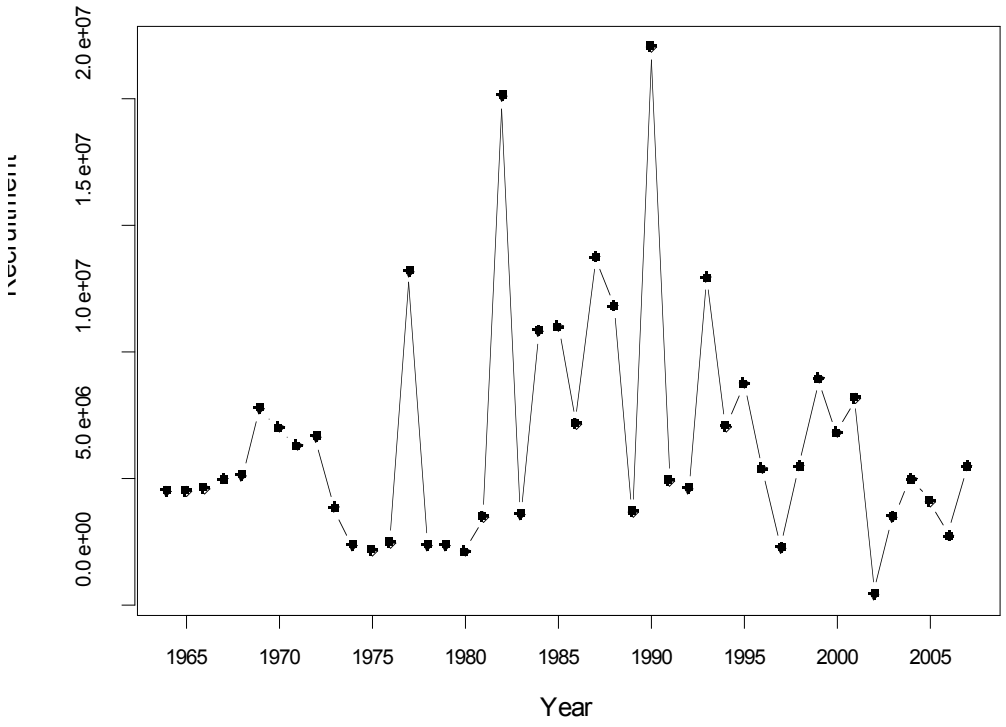


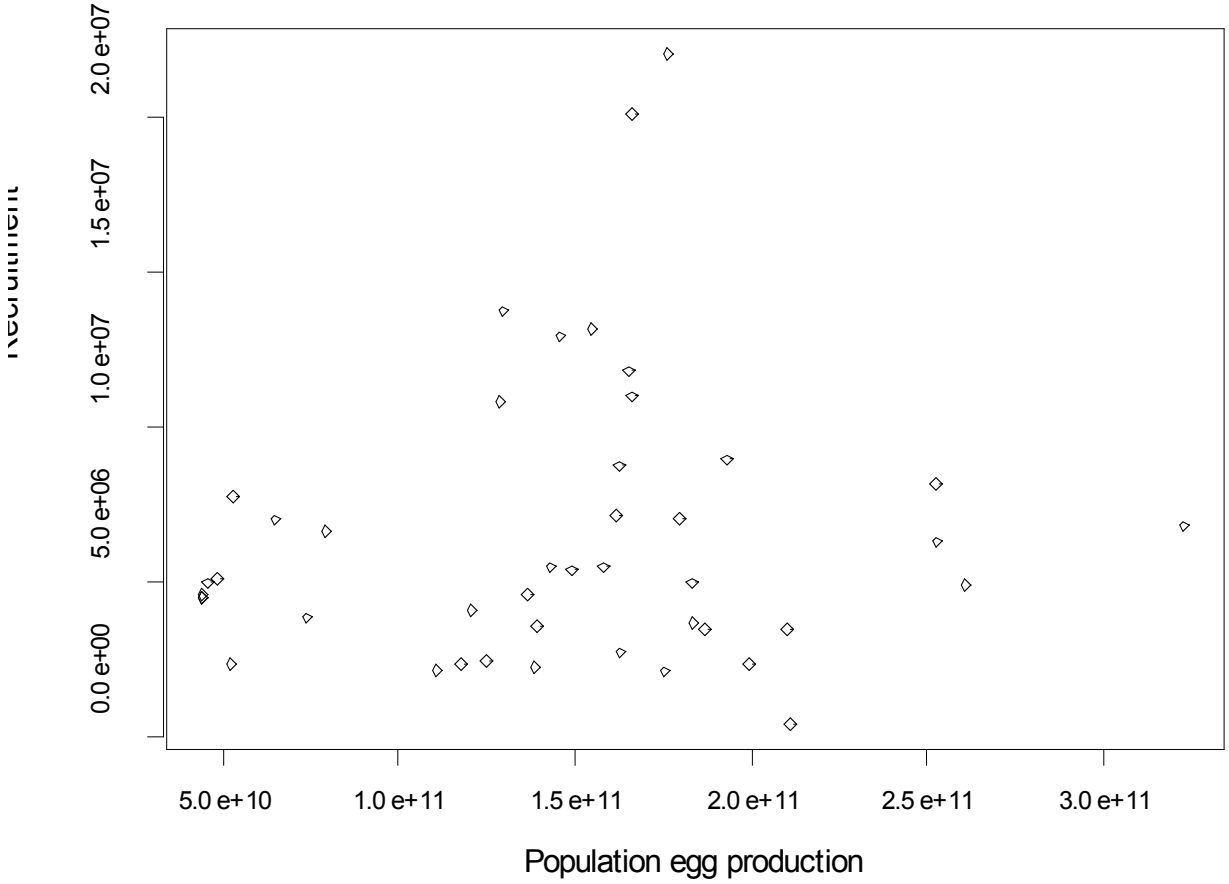
Figure 21. Trajectory of recruitment (numbers) from the base run of the length-structured model of vermilion snapper. The estimate for 2007 is a projected estimate.



9.1.5 Stock and recruitment

The spawner-recruit relationship shows the usual scatter with very little pattern to suggest a functional relationship (Fig. 22).

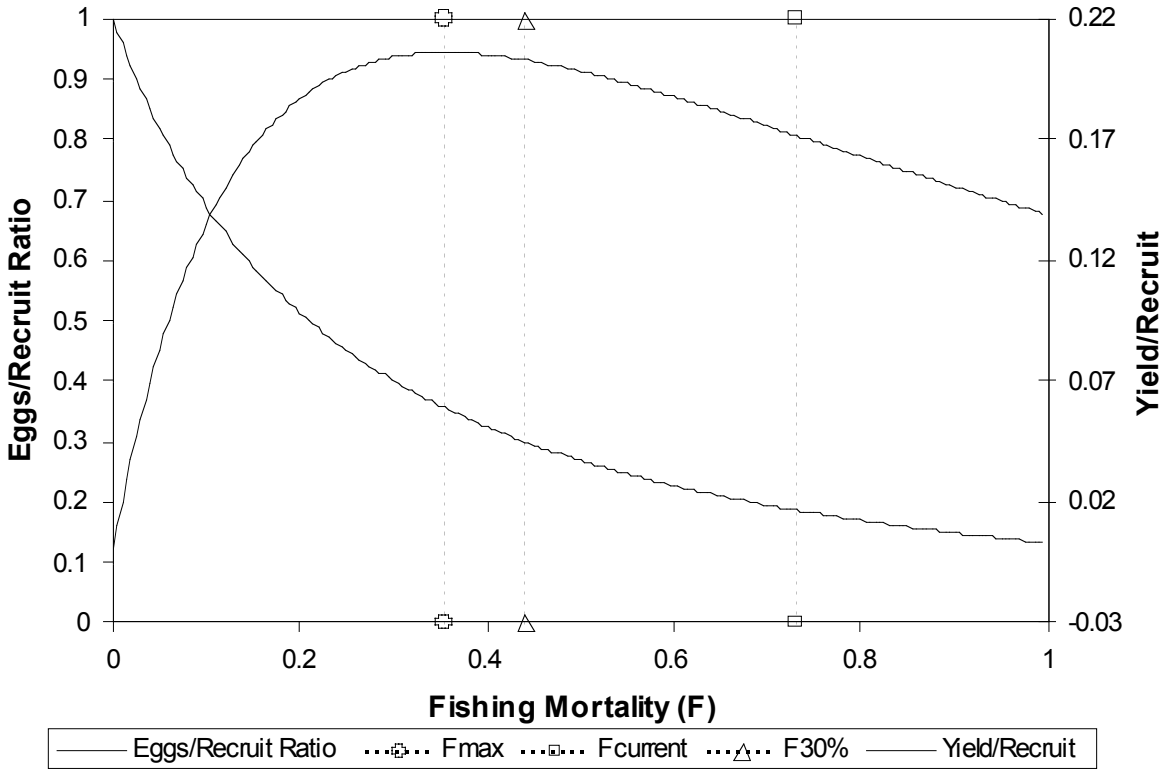
Figure 22. Population egg production and recruitment from the base run of the length-structured model of vermilion snapper.



9.1.6 Per recruit analyses

Egg production and yield per recruit do not rely on an assumption of a stock-recruit relationship. The per-recruit analysis from the base run model for vermilion snapper resulted in an F_{MAX} value of 0.355 (Fig. 23). For comparison, the value corresponding to $F_{30\%}$ is 0.44 and the total F rate estimated from the model in 2006 is 0.73 (Fig. 23).

Figure 23. Egg production relative to the unfished state and yield, both on per-recruit basis from the base run of the length-structured model of vermilion snapper.



10 Biological reference points

10.1 Estimation methods

Because of the uncertainty in the stock-recruitment relationship, the review panel for the benchmark stock assessment recommended using F_{MAX} as a proxy for F_{MSY}. This decision was not changed with this update assessment. In the benchmark assessment the high degree of uncertainty in recruitment and spawning stock biomass estimates resulted in a recommendation that no reliable biomass based benchmark could be used.

10.2 Results

The estimate for F_{MAX} from the update assessment is 0.355. This compares to the estimate of F_{MAX} =0.375 from the original benchmark assessment (SEDAR 2003). For comparison, the value corresponding to $F_{30\%}$ is 0.44 and the total F rate estimated from the model in 2006 is 0.73.

The difference in the benchmark and update assessment estimates of F_{MAX} is largely due to differences in the estimates of catch-weighted selectivity. In order to estimate F_{MAX}, a single selectivity curve is used in the calculations. This single selectivity curve is calculated as the catch-weighted average selectivity from all the fisheries (each fishery has its own unique selectivity). Because the proportion of the total vermilion snapper harvest associated with each fishery changes from year to year, so does the catch-weighted average selectivity used in the computation of F_{MAX}. As was the case for the benchmark assessment, no biomass based benchmark was recommended.

10.3 Status indicators

The ratio of F in the last year (2006) to F_{MAX} was estimated to be 2.05 in the update assessment. This compares to an estimate of the ratio of F in 2001 to F_{MAX} of 1.71 from the benchmark assessment, suggesting overfishing continues and may have increased slightly relative to the last benchmark assessment. As was the case for the benchmark assessment, no biomass status indicator was recommended.

10.3.1 Definitions

The maximum fishing mortality threshold (MFMT) was taken to be F_{MSY} (or its proxy), and the minimum stock size threshold (MSST) was taken to be $(1-M)SSB_{MSY}$ (Restrepo et al. 1998). Overfishing is defined by $F >$ MFMT and overfished by SSB < MSST.

11 Projections (rebuilding analyses)

11.1 Projection methods

The projections methods are identical to what was done in the benchmark assessment (SEDAR 2003).

11.2 Management scenarios considered

Projections were conducted with a constant F starting in 2007. Four scenarios were computed with $F=F_{MAX}$, F=85% F_{MAX}, F=75% F_{MAX}, and F=65% F_{MAX}. The results of these projections are shown in Fig. 24-27.

Figure 24. Projected yield under a constant $F=F_{MAX}$ management scenario.

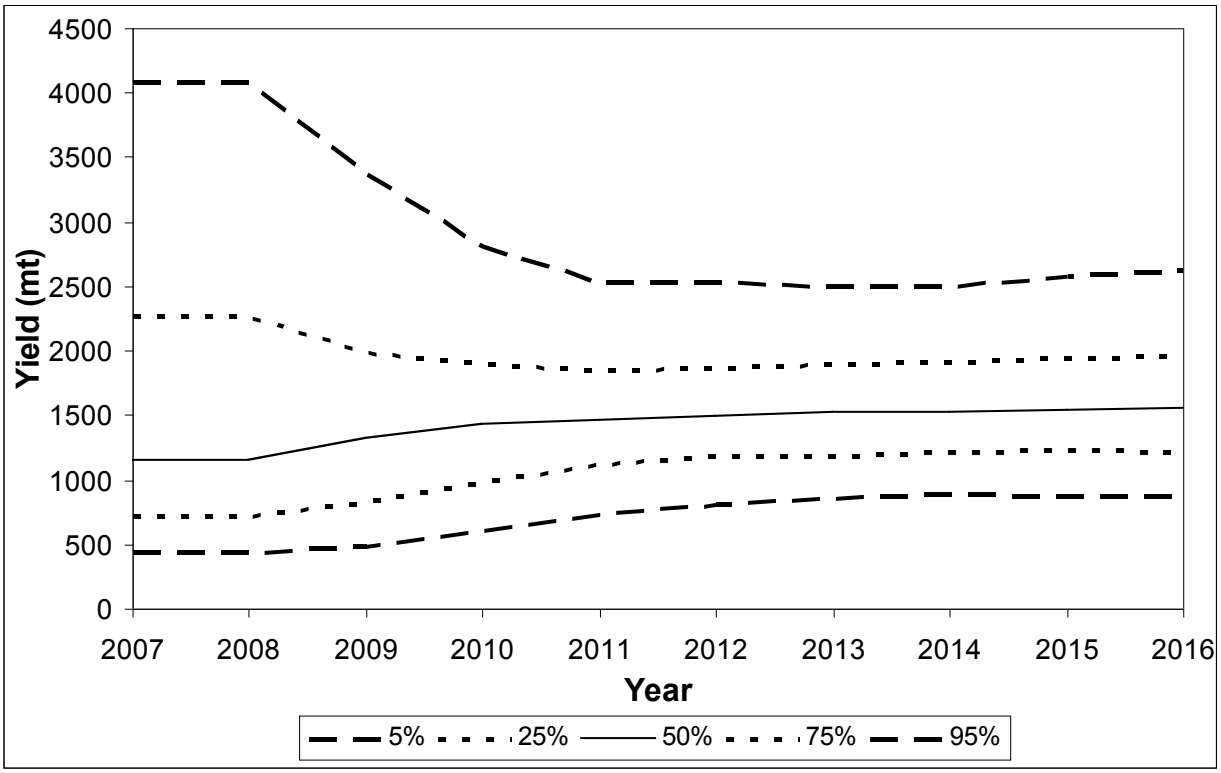


Figure 25. Projected yield under a constant F=85%F_{MAX} management scenario.

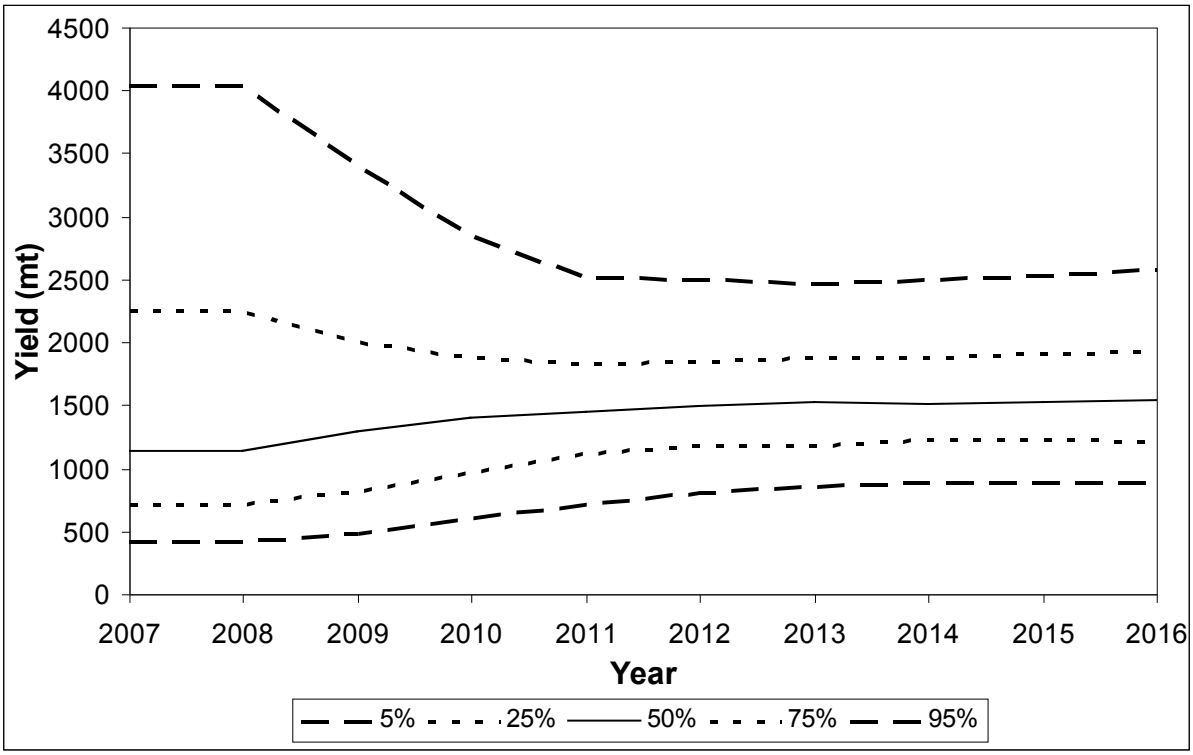


Figure 26. Projected yield under a constant F=75%F_{MAX} management scenario.

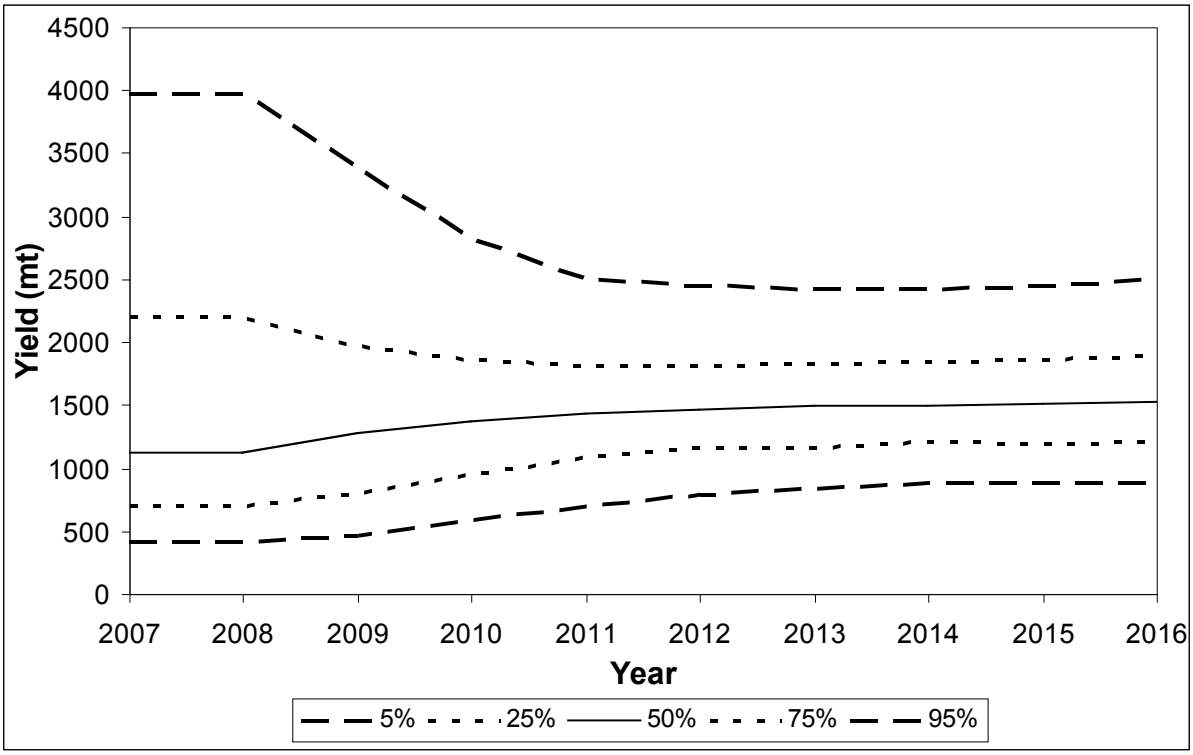
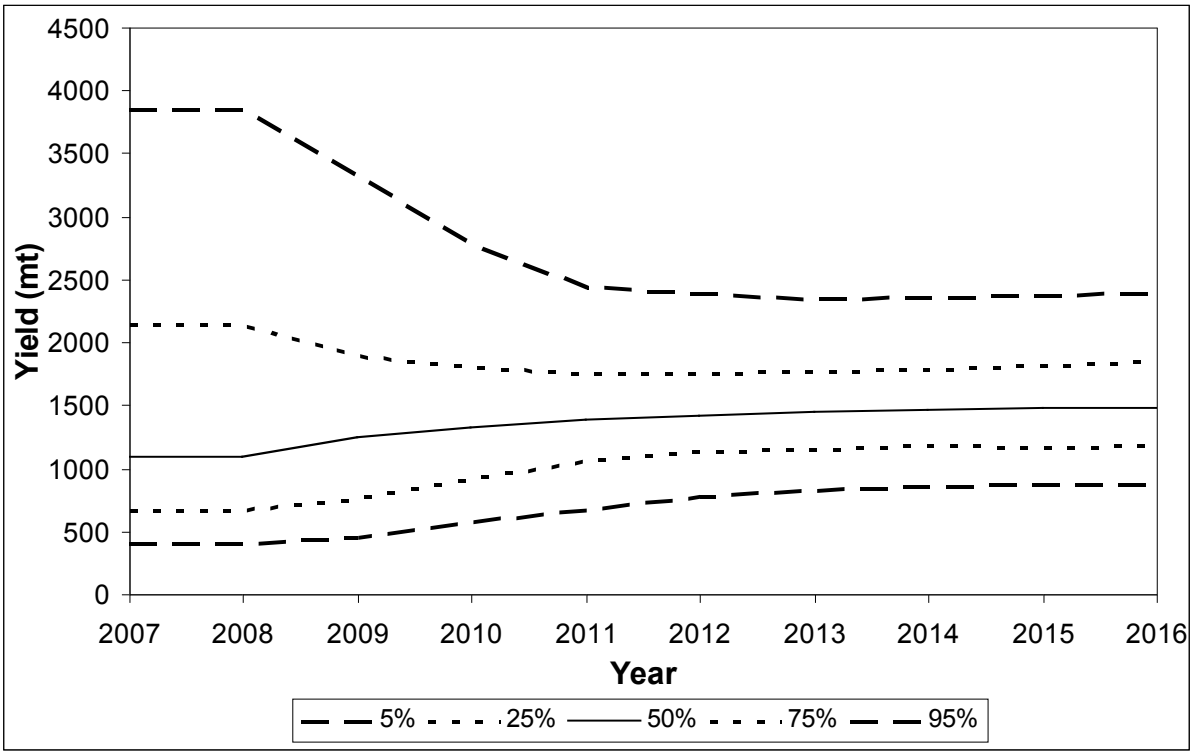


Figure 27. Projected yield under a constant F=65%F_{MAX} management scenario.



12 Recommendations for future research and assessment

12.1 Progress on previous recommendations.

Several research recommendations were provided in the vermilion snapper benchmark assessment report. The update AW documented (to the extent practicable) any progress made on meeting these recommendations.

1. Investigate methods of weighting applied to the input data.

   This could not be addressed as part of an update assessment. It will, however, be considered in the next benchmark assessment.

2. Expand MARMAP area coverage, and include more deep-water habitat.

   In 1996 MARMAP added a new gear type to sample rocky reefs in water deeper than 90 meters – depths as which the chevron trap is less effective. Each year, more deepwater sites have been added to the sampling site database, particularly at the northern and southern portions of the sampling zone. However, addition of new sites is strongly correlated to available funding.

3. Sampling programs must be strengthened to obtain better estimates of discard mortality, particularly in the commercial fishery.

   Estimates of commercial discard mortality provided by ongoing or recently completed research projects have been incorporated into other benchmark assessments. However, there is no explicit calculation of discard mortality in the vermilion snapper length-structured model, and including this in the model would require significant time to recode the model. This would exceed the terms of reference of an assessment update, however, this will be evaluated for inclusion in the next benchmark assessment.

4. Incorporating commercial logbooks for use as an abundance index.

   These data have been incorporated into other benchmark assessments. As this is an update assessment, the incorporation of a new index is outside the terms of reference; however, this will be evaluated for inclusion in the next benchmark assessment.

5. Need to increase number of age samples, with a minimum of 500 samples annually for specific fishery segments (i.e., hook and line and headboat).

   While many samples have been collected, additional resources to process and interpret these samples have not been forthcoming, resulting in a backlog of otoliths to be processed. As the rate of sampling is increasing for many species, without the addition of new staff to process and interpret these samples, this backlog will persist. The sampling schedule suggested by the ACCSP for vermilion snapper would appear to be adequate to provide sufficient age information for each of the major fisheries targeting vermilion snapper (TOR 7).

6. Investigate alternative age models to obtain more robust population estimates.

This could not be addressed under the auspices of an update assessment. It will, however, be considered in the next benchmark assessment.

7. Investigate smoothing techniques to reduce large year to year variation.

This could not be addressed under the auspices of an update assessment. It will, however, be considered in the next benchmark assessment.

8. Fecundity at age estimates should be developed for future use in age structured models.

Age based estimates of fecundity are available for a small sample size (approximately 50 specimens). However, as the benchmark assessment utilized a length-structured model, age based estimates of fecundity could not be incorporated.

The SEDAR-02 Review Panel Document (section 3.4) also provided research recommendations, and the update AW addressed these recommendations in a similar fashion to those provided by the benchmark assessment report

1. Synoptic study of MARMAP gear (specifically the chevron and Florida traps) comparing relative gear efficiencies.

This study is currently being conducted by South Carolina Department of Natural Resources, and will be completed by December 2007.

2. Increase the number of age samples.

Refer to Number 5 above.

3. Commercial fisheries based index of abundance be developed.

Refer to Number 4 above.

4. Expand the MARMAP sampling into deeper water.

Refer to Number 2 above.

5. Estimation of discards by fishing sector and gear.

A pilot observer program for the snapper/grouper fishery is been conducted through the Gulf and South Atllantic Foundation to track discard rates on commercial vessels participating in the snapper/grouper fishery in the South Atlanitc.

6. Develop an index of recruitment for the entire stock.

This is currently being examined from data collected through MARMAP. It will be available and evaluated during the next benchmark assessment.

7. Externally combine the indices of abundance into one index to be used in parallel with the existing age-structured model, rather than including the individual indices.

This could not be addressed under the auspices of an update assessment. It will, however, be considered in the next benchmark assessment.

12.2 New recommendations

1. The update assessment workshop strongly suggests that a new model type be investigated for the vermilion snapper assessment, and that the next assessment be conducted as a benchmark assessment.

2. While the collection of aging structures appears to be providing sufficient samples to estimate the annual age structure of commercial and headboat landings, inadequate samples have been collected to represent the age structure of the recreational landings other than those captured on headboats. Furthermore, the infrastructure to process and interpret these structures is woefully inadequate, and must be significantly enhanced if the goal of adequate age samples for all species in the SEDAR process is to ever be met.

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Table 1a. Commercial landings in kilograms. Bold and italic values were converted from 0 to improve assessment model behavior.

	Hook and Line		Trawl		Other		Total	
Year	Update	Benchmark	Update	Benchmark	Update	Benchmark	Update	Benchmark
1970	7839	7839	16	1016	1016	16	8871	8871
1971	20458	20458	42	2652	2652	42	23152	23152
1972	28651	28651	55	3532	9041	5564	37748	37748
1973	36167	36167	746	5001	6018	1763	42932	42932
1974	49796	49796	83	5269	5617	431	55496	55496
1975	83507	83507	384	9368	9368	384	93259	93258
1976	84305	84305	3363	10976	10976	3363	98645	98645
1977	100996	100996	4775	12327	12382	4830	118153	118153
1978	144810	144810	760	6642	7260	1378	152830	152830
1979	160366	160365	17485	25015	25015	17485	202866	202865
1980	187268	187268	72251	78134	70282	64399	329802	329801
1981	185633	185633	57446	60646	60336	57136	303416	303415
1982	252087	252086	59258	62803	62981	59436	374326	374326
1983	221397	221397	48381	52578	53480	49282	323257	323257
1984	298852	298851	41576	47474	47832	41934	388260	388260
1985	415761	415760	6903	14377	13946	6472	436610	436609
1986	406844	406844	5109	10978	13142	7273	425095	425095
1987	330406	330406	4824	9645	13903	9082	349133	349133
1988	369784	369784	39912	46715	48135	41332	457831	457831
1989	509484	509484	163	10370	16514	6307	526161	526160
1990	539649	539648	243	15452	59053	43844	598944	598943
1991	614018	614017	197	12552	34803	22447	649017	649017
1992	341838	341837	133	5750	5896	279	347867	347867
1993	401430	401430	140	1658	4353	2835	405923	405923
1994	431660	431660	190	11583	14472	3078	446321	446321
1995	415067	415066	219	15369	19031	3880	434316	434316
1996	339975	339974	156	4987	7142	2311	347273	347272
1997	349376	345952	99	2175	4430	2326	353906	350452
1998	323918	323917	72	1087	1656	641	325645	325645
1999	394089	354113	77	5044	11543	6576	405710	365733
2000	610356	510117	130	15953	18695	2872	629181	528943
2001	732851	615588	***10***	30991	31645	513	764506	647093
2002	601469		31		18789		620289	
2003	316691		***10***		26090		342791	
2004	473990		177		34140		508307	
2005	478600		1		30530		509132	
2006	301314		***10***		67724		369049	

Table 1b. Commercial landings in pounds. Bold and italic values were converted from 0 to improve assessment model behavior.

	Hook and Line		Trawl		Other		Total	
Year	Update	Benchmark	Update	Benchmark	Update	Benchmark	Update	Benchmark
1970	17282	17282	35	2240	2240	35	19558	19558
1971	45103	45102	92	5847	5847	92	51042	51041
1972	63165	63165	122	7786	19931	12267	83218	83218
1973	79735	79735	1644	11025	13268	3887	94647	94647
1974	109780	109780	182	11617	12384	949	122346	122346
1975	184100	184100	846	20652	20652	846	205598	205598
1976	185860	185860	7415	24198	24198	7415	217472	217472
1977	222656	222656	10527	27175	27298	10649	260480	260480
1978	319249	319248	1676	14642	16005	3039	336930	336929
1979	353542	353541	38547	55149	55149	38547	447238	447237
1980	412852	412851	159285	172254	154944	141975	727081	727080
1981	409247	409246	126646	133701	133018	125962	668910	668909
1982	555750	555749	130641	138457	138849	131033	825240	825239
1983	488092	488091	106660	115913	117901	108648	712653	712653
1984	658849	658848	91659	104661	105450	92448	855958	855957
1985	916587	916585	15218	31694	30746	14269	962550	962549
1986	896929	896928	11264	24202	28972	16034	937165	937163
1987	728413	728412	10634	21264	30651	20022	769699	769698
1988	815226	815225	87991	102987	106118	91121	1009335	1009333
1989	1123209	1123208	359	22861	36406	13904	1159975	1159973
1990	1189709	1189708	535	34065	130188	96657	1320432	1320430
1991	1353664	1353662	435	27673	76726	49487	1430824	1430822
1992	753615	753614	293	12677	12999	615	766908	766907
1993	884993	884992	309	3654	9596	6251	894898	894897
1994	951638	951637	418	25537	31904	6785	983960	983958
1995	915056	915055	483	33883	41955	8555	957494	957493
1996	749508	749507	345	10995	15745	5094	765598	765597
1997	770235	762685	219	4794	9767	5128	780220	772608
1998	714109	714108	158	2396	3651	1413	717918	717917
1999	868810	780677	171	11120	25448	14498	894428	806296
2000	1345591	1124605	287	35171	41216	6332	1387093	1166108
2001	1615643	1357126	***22***	68323	69766	1131	1685431	1426581
2002	1325998		69		41421		1367488	
2003	698177		***22***		57517		755716	
2004	1044958		390		75265		1120613	
2005	1055123		2		67307		1122432	
2006	664278		***22***		149305		813605	

Table 2. Number of fish sampled for lengths for each fishery.

	Commercial			Recreational		MARMAP		
Year	Hook and Line	Trawl	Other	Headboat	MRFSS	Chevron Trap	Florida Trap	Hook and Line
1976				1325				
1977				1038				
1978				1777				
1979				1389				
1980				1348				
1981				1335	3			
1982				2777	22			
1983				4481	21		460	45
1984	6957	194	16	4545	14		264	130
1985	9701	276	96	5894	17		394	91
1986	7593	616	669	6159	19		267	106
1987	7158	640	157	6327	36		225	122
1988	5192		434	4759	145			
1989	5295		330	4767	80			
1990	4995		1017	5308	66	830		
1991	9379		1454	4028	50	3066		
1992	5912		341	2825	114	1514		
1993	7773		518	3316	75	1326		
1994	6980		508	5723	77	3350		
1995	11849		585	4799	74	2495		
1996	6137		241	3858	16	2745		
1997	5914		261	4133	68	1805		
1998	6178		497	4239	76	1240		
1999	12271		153	4306	194	735		
2000	18871		358	4469	214	1637		
2001	16470		1709	3387	400	1369		
2002	11650		214	3895	393	1260		
2003	11648		323	3824	577	557		
2004	11137		39	3324	888	324		
2005	90		13	2206	230	527		
2006	2731		17		539	278		

Table 3a. Recreational Landings in kilograms of vermilion snapper as used in the assessment update and benchmark data with the percentage of discards (25% of B2) included as landings to the input model given for the update assessment.

	Headboat		MRFSS			
				Update		Benchmark
Year	Update	Benchmark	A+B1	25% of B2	Total	Total
1976	146802	146802				
1977	90768	90768				
1978	131200	131200				
1979	97192	97192				
1980	90025	90025				
1981	104310	104468	7206	0	7206	19559
1982	154150	154165	102658	3131	105789	322059
1983	133986	134008	191101	92	191193	316804
1984	111115	111270	95372	1621	96993	251202
1985	168814	202669	197179	450	197629	672173
1986	158448	158457	11137	405	11542	50340
1987	204999	205012	91081	215	91296	127984
1988	189893	189944	61108	3230	64338	130840
1989	157189	157206	70518	4803	75321	248902
1990	175439	175444	54959	6826	61785	105634
1991	151185	151200	49087	3274	52361	181444
1992	113216	113234	54141	15303	69444	95765
1993	116665	117295	44546	4920	49466	103991
1994	127754	127849	33552	7584	41136	73863
1995	123314	123681	21278	10186	31464	88519
1996	125332	125589	43519	4384	47903	81499
1997	136039	138495	34433	4118	38551	94657
1998	124962	125315	57722	9128	66850	99665
1999	152287	159223	67193	26786	93979	208721
2000	184517	190325	111786	26699	138485	261659
2001	182627	192522	112123	16943	129066	243737
2002	148075		80282	14349	94632	
2003	130384		102335	22386	124722	
2004	164003		122622	18571	141193	
2005	141512		58025	8261	66285	
2006	145994		154968	13908	168876	

Table 3b. Recreational Landings in pounds of vermilion snapper as used in the assessment update and benchmark data with the percentage of discards (25% of B2) included as landings to the input model given for the update assessment.

	Headboat		MRFSS			
			Update			Benchmark
Year	Update	Benchmark	A+B1	25% of B2	Total	Total
1976	323640	323640				
1977	200107	200107				
1978	289244	289244				
1979	214269	214269				
1980	198469	198469				
1981	229962	230309	15886	0	15886	43120
1982	339840	339873	226320	6903	233222	710011
1983	295385	295434	421301	203	421504	698425
1984	244964	245306	210257	3573	213830	553800
1985	372168	446803	434701	991	435692	1481872
1986	349315	349333	24553	892	25445	110979
1987	451941	451970	200797	474	201271	282154
1988	418638	418750	134719	7121	141840	288450
1989	346539	346576	155464	10588	166052	548729
1990	386774	386784	121163	15049	136212	232881
1991	333303	333334	108217	7218	115436	400012
1992	249597	249636	119359	33736	153096	211124
1993	257200	258589	98206	10847	109053	229259
1994	281647	281857	73969	16720	90689	162839
1995	271859	272668	46909	22455	69364	195150
1996	276308	276874	95942	9664	105606	179673
1997	299912	305327	75911	9077	84988	208680
1998	275492	276270	127254	20123	147377	219721
1999	335732	351022	148134	59051	207185	460145
2000	406785	419590	246443	58861	305305	576854
2001	402620	424434	247186	37354	284539	537342
2002	326447		176991	31635	208626	
2003	287444		225608	49353	274961	
2004	361562		270332	40941	311274	
2005	311977		127921	18211	146132	
2006	321858		341642	30662	372304	

Table 4. Abundance indices (headboat and MARMAP) provided for the vermilion snapper udate assessment.

	CPUE in Numbers				Coefficient of Variation			
		MARMAP				MARMAP		
Year	Headboat	Chevron	Florida	Hook and Line	Headboat	Chevron	Florida	Hook and Line
1973	2.172				0.204			
1974	1.498				0.123			
1975	2.040				0.152			
1976	2.012				0.150			
1977	2.323				0.182			
1978	3.858				0.300			
1979	3.601				0.249			
1980	2.737				0.212			
1981	2.911				0.214			
1982	2.676				0.203			
1983	2.590		2.400	1.116	0.191		0.184	0.435
1984	2.458		1.001	2.686	0.186		0.236	0.771
1985	3.201		1.544	2.212	0.251		0.231	0.394
1986	3.946		2.419	2.798	0.285		0.272	0.373
1987	4.075		0.792	2.222	0.300		0.242	0.431
1988	4.144				0.292			
1989	3.816				0.287			
1990	3.903	1.544			0.283	0.173		
1991	3.808	7.384			0.315	0.121		
1992	1.900	3.157			0.145	0.199		
1993	1.851	2.248			0.127	0.117		
1994	1.889	5.151			0.140	0.116		
1995	1.970	3.618			0.152	0.122		
1996	2.153	4.051			0.162	0.237		
1997	2.947	2.433			0.238	0.234		
1998	2.484	1.160			0.198	0.204		
1999	3.110	2.054			0.235	0.180		
2000	4.346	3.745			0.329	0.160		
2001	3.521	3.443			0.280	0.182		
2002	3.512	3.858			0.269	0.146		
2003	2.360	0.493			0.188	0.273		
2004	2.729	0.949			0.207	0.187		
2005	2.889	1.649			0.241	0.197		
2006	3.035	0.938			0.226	0.233		

Table 5. Required SFA evaluations.

Criteria	Definition	Value
MFMT		
Current:	$F_{30\%SPR}$	0.440
Proposed:	F_{MAX} [1]	0.355
MSST		
	SSB_{MSY}	5.27×10^{11}
Current:	{max(0.5or 1-M)}SSB_{MSY} [2]	3.95×10^{11}
Proposed:	(1-M)SSB_{MSY} [2]	3.95×10^{11}
	75% SSB_{MSY} [2]	3.95×10^{11}
	50% SSB_{MSY} [2]	2.64×10^{11}
MSY	Yield @ F_{MAX} [1]	1,224,680 kg
FOY		
Current:	$F_{40\%SPR}$	0.30
Proposed:	65% MFMT	0.195
	75% MFMT	0.225
	85% MFMT	0.255
OY		
Current:	Yield @ 40%SPR	1,218,730 kg
Proposed:	Yield @ 65% MFMT	1,114,920 kg
	Yield @ 75% MFMT	1,161,410 kg
	Yield @ 85% MFMT	1,192,960 kg
Generation Time		
Base M		
Rebuild Time	(if B2006<MSST)	
T_{min}	@ F=0	
Midpoint	mid of T_{min}, T_{max}	
T_{max}	if T_{min}>10, T_{min} + 1 Gen	
ABC	Recommend Range	

1. MSY-based benchmarks deemed unreliable by SEDAR 2 and SAFMC SSC. Recommendation is to base criteria on proxy FMAX=FMSY.

2. MSST estimates based on SSBMSY proxy of SSB@FMAX.

Table 6. Estimates of total full fishing mortality rate (F) by fishery from the base run of the length-structured model of vermilion snapper.

Year	Commercial Hook-and-line	Commercial Trawl	Commercial Other	Recreational Headboat	Recreational MRFSS	Total
1974	2.848	0.0003	0.590	0.129	0.182	3.749
1975	0.146	0.0005	0.021	0.129	0.182	0.477
1976	0.120	0.004	0.019	0.173	0.182	0.497
1977	0.118	0.004	0.017	0.088	0.182	0.409
1978	2.607	0.001	0.200	0.236	0.182	3.226
1979	0.146	0.012	0.028	0.070	0.182	0.437
1980	0.191	0.057	0.084	0.076	0.182	0.590
1981	0.157	0.040	0.059	0.074	0.005	0.335
1982	0.369	0.057	0.109	0.168	0.116	0.819
1983	2.041	0.057	0.373	0.251	0.361	3.083
1984	1.006	0.057	0.144	0.188	0.165	1.561
1985	1.111	0.008	0.037	0.224	0.263	1.643
1986	1.989	0.006	0.051	0.212	0.015	2.273
1987	1.379	0.008	0.056	0.389	0.175	2.006
1988	1.654	0.048	0.189	0.273	0.092	2.256
1989	1.748	0.00017	0.049	0.180	0.086	2.063
1990	0.908	0.00025	0.111	0.198	0.071	1.288
1991	2.124	0.00014	0.092	0.118	0.041	2.375
1992	1.926	0.00019	0.027	0.299	0.181	2.432
1993	1.121	0.00017	0.011	0.213	0.090	1.437
1994	1.819	0.00019	0.052	0.254	0.079	2.205
1995	1.574	0.00025	0.060	0.243	0.060	1.937
1996	1.686	0.00019	0.027	0.285	0.106	2.104
1997	1.260	0.00013	0.013	0.267	0.074	1.614
1998	0.596	0.00008	0.003	0.168	0.090	0.857
1999	0.517	0.00006	0.014	0.143	0.088	0.763
2000	0.428	0.00006	0.013	0.095	0.071	0.608
2001	0.919	0.00001	0.018	0.150	0.106	1.194
2002	1.146	0.00003	0.006	0.155	0.099	1.405
2003	0.273	0.00001	0.003	0.089	0.085	0.450
2004	0.426	0.00014	0.002	0.135	0.117	0.681
2005	1.126	0.00000	0.002	0.262	0.127	1.517
2006	0.414	0.00001	0.005	0.145	0.165	0.729

Appendix A – Terms of Reference

SEDAR

SouthEast Data, Assessment, and Review

South Atlantic Fishery Management Council
Gulf of Mexico Fishery Management Council
Caribbean Fishery Management Council
NOAA Fisheries
Atlantic States Marine Fisheries Commission
Gulf States Marine Fisheries Commission

1 Southpark Circle #306
Charleston SC 29407
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DRAFT Terms of Reference Version 3
South Atlantic Vermilion Snapper Assessment Update

1. Update the approved SEDAR 2 base configuration, length-structured assessment model of South Atlantic vermilion snapper with data through 2006.

2. Document any changes or corrections made to input datasets and tabulate complete updated input datasets. Provide tables of commercial and recreational landings and discard in pounds. Clarify units of measurement in all tables.

3. Estimate and provide complete updated tables of stock parameters.

4. Update measures of uncertainty and provide representative measures of precision for stock parameter estimates.

5. Update estimates of stock status and SFA parameters; provide declarations of stock status relative to current SFA criteria; provide SFA criteria required for Snapper-Grouper Amendment 15. (See Table 1 for complete list of required values.)

6. Evaluate future stock status for 2007-2016 according to the specifications in Table 2.

7. Recommend sampling intensity in terms of the number of sampling events and the quantity of individual lengths measured and age structures taken by gear, quarter, state, market category, fishery, and area in order to complete the ACCSP sampling design matrix.

8. Review the research recommendations from the previous assessment, note any which have been completed, and make any necessary additions or clarifications.

9. Develop a stock assessment workshop report to fully document the input data, methods, and results of the stock assessment update.

Appendix B – List of Participants

Workshop Panel

Pat Harris, Chair.....SAFMC SSC/SC DNR
Carolyn Belcher .....SAFMC SSC/ GA DNR
Christine Burgess .....NC DMF
Phil Conklin ..... SAFMC AP
Doug Vaughan ..... SEFSC/Beaufort
Erik Williams ..... SEFSC/Beaufort

Council Representation

Brian Cheuvront..... SAFMC

Observers

Alan Bianchi .....NC DMF
Andi Stephens ..... SEFSC/Beaufort
Helen Takacle .....NC DMF

Staff

Rob Cheshire..... SEFSC/Beaufort
Rick DeVictor ..... SAFMC
Rachael Lindsay.....SEDAR