CIE Review Report for SEDAR 10

Dr. Din Chen

Prepared for

University of Miami

Center for Independent Experts

TABLE OF CONTENTS

EXECUTIVE SUMMARY **3**

1. Background **5**

2. Review activities **6**

3. Findings/related recommendations **7**

4. Conclusions/additional recommendations **26**

5. Appendix 1: Assessment Advisory Report for South Atlantic gag grouper **27**

6. Appendix 2: Consensus Summary Report for South Atlantic gag grouper **49**

7. Appendix 3: Assessment Advisory Report for Gulf of Mexico gag grouper **69**

8. Appendix 4: Consensus Summary Report for South Atlantic gag grouper **82**

9. Statement of Work from CIE **100**

EXECUTIVE SUMMARY

The South East Data, Assessment, and Review (SEDAR 10) was designed to review two stock assessments; South Atlantic gag grouper and Gulf of Mexico gag grouper. The assessment reports for these two stocks were provided by email from the SEDAR Coordinator (John Carmichael) before the SEDAR 10 meeting. The meeting took place in Atlanta, Georgia, June 26-30, 2006.

Discussions from the Panel and the Review participants focused mainly on the appropriateness of the fishery/survey data and the associated uncertainties, the stock assessment models and their assumptions and conclusions. Sensitivity runs were requested for both stocks by the Panel to evaluate the appropriateness of the model inputs and model structures. Recommendations were given by the Panel on a preferred "based model" for each stock and other issues for data, model improvement and developing sensible fishery management parameters.

The Panel recognized that the developments in these two stocks have been similar, presumably because the fisheries have followed similar paths. In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.

For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above the average, and close to the maximum observed in the early 1960s, while for the South Atlantic the 2004 SSB is 20% above the average.

Estimated fishing mortality increased at very similar rates from the early 1960s to the early 1980s. Since then, F values for both stocks have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.

Average fishing mortality at age (2001-2003 for the GOM, 2002-2004 for the SA) show different patterns, F's are higher at age 3-5 in the Gulf of Mexico than in the South Atlantic, but at older ages the opposite is true. The F at age pattern is clearly dome shaped in the Gulf of Mexico and nearly flat topped in the South Atlantic.

An important result of the Review Workshop is determination of current stock status relative to biological reference points established in the respective FMPs. In both stock areas, the stock and recruitment scatter plot do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSBs observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and B_{MSY} is estimated to be higher than SSB's observed in the past. The Review Panel considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

The Minimum Stock Size Threshold (MSST), currently defined by the South Atlantic Council as (1-M)*B_{MSY}, is very close to B_{MSY} because age-averaged natural mortality rate, M, is estimated as 0.14. Given the uncertainties in the assessment, the biomass would be expected to fall below MSST with a relatively high frequency even if, in fact, the true biomass was close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative. There are no indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the Review Panel suggests that MSST could be set at this level as an operational definition to be re-examined at the next assessment.

Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007 (see Advisory Report projections). Relative to the MSST proposed by the Review Panel, the stock is not overfished and is not projected to become overfished under any of suggested constant fishing mortality mid-term projection scenarios (also discussed and displayed in the Advisory Report).

1. BACKGROUND

Designated by the Center for Independent Experts (CIE) at the University of Miami, the author was invited as a panelist (Appendix 2) to the South East Data, Assessment, and Review (SEDAR 10) to review the stock assessments for South Atlantic gag grouper and Gulf of Mexico gag grouper. Before the meeting, the SEDAR Coordinator, John Carmichael, provided the author with documents (in Appendix 2),

including the stock assessment documents and the associated documents for the two stocks as well as the SEDAR website linking to these documents.

The meeting to review the assessments took place in Atlanta, Georgia, June 26-30, 2006. On Monday, June 26, the Review Workshop Panel received a presentation from the South Atlantic gag grouper assessment team, and on Tuesday, June 27, a similar presentation from the Gulf of Mexico gag grouper assessment team. The balance of the week, through Thursday afternoon, was devoted to additional discussion with the assessment teams to refine and better understand the assessments. Draft versions of the two advisory reports were discussed on Thursday. All parts of the meeting, with the exception of Friday morning, were open to the public. On Friday, the Panel discussed initial drafts of the Consensus Summary documents.

2. REVIEW ACTIVITIES

The meeting started with a presentation on the assessment for South Atlantic gag grouper on Monday afternoon, June 26, followed by Gulf of Mexico gag grouper on Tuesday, the June 27. Questions and comments from the Panel and Review participants followed the presentations.

The meeting was well arranged and progressed very smoothly, to the credit of the SEDAR Coordinator and Panel Chair (John Carmichael and Terry Smith, respectively). The Review Panel commends the two assessment teams and was especially impressed by the responsiveness of both teams to requests for additional analyses and clarifying information. The Review Panel was also very appreciative of the helpful feedback and suggestions from all SEDAR 10 attendees as we discussed initial drafts of Review

Workshop documents. The Review Panel also appreciates the organization of SEDAR 10 in that the two gag grouper stocks were assessed via a common Data Workshop and concurrent and complementary Assessment Workshops. This allowed the Review Panel to not only better understand the individual stock assessments but to offer more consistent advice to the two managing Councils.

Dr. Terry Smith chaired the meeting and all CIE panelists participated in the discussions for both stock assessments with Dr. John Wheeler leading the Gulf of Mexico gag grouper assessment, Dr. Din Chen leading the South Atlantic gag grouper assessment, and Dr. Jean-Jacques Maguire handling common grounds for these two stocks. Because Dr. Chen led the review of the South Atlantic gag grouper assessment, the report will be mainly for this stock where Dr. John Wheeler will be for the Gulf of Mexico gag grouper. In addition, the developments in these two stocks have been similar because the fisheries have followed similar paths, most of the comments and recommendations for this stock apply for Gulf of Mexico gag grouper.

The “Assessment Advisory Report” and the “Consensus Summary Report” for these two stocks were prepared for the Chair to review and are attached as Appendices 1 to 4 for detailed information and reference after this report.

3. FINDINGS/RELATED RECOMMENDATIONS

3.1. Assessment in general

The South Atlantic gag grouper stock was assessed with two models; a statistical catch-at-age model, as the primary assessment model, and an age-aggregated production model to investigate results under a different set of model assumptions. Within each type

of model various configurations and sensitivity runs were explored. Details of all models are available in the Stock Assessment Report and Addendum to the Stock Assessment Report. The assessment workshop developed two base runs; one assuming a time-varying catchability and one assuming constant catchability for the fishery dependent indices. Each base run of the catch-at-age model was the basis for estimation of benchmarks and stock status. The review workshop investigated these base runs and recommended the run with constant catchability as the preferred 'base run'.

The Gulf of Mexico gag grouper was assessed by the statistical age-structured forward reconstruction model (CASAL). CASAL was chosen as it provides flexibility in specifying population dynamics, parameter estimation, and model outputs. Most importantly, unlike Virtual Population Analysis (VPA), CASAL does not assume that the catch at age is known exactly, an important feature in the case of Gulf of Mexico gag grouper where catch at age is not well estimated. Additionally, the assessment model used in the 2001 assessment (VPA) was run to show the effects of updated data and the effects of adding indices of abundance not available in 2001. In addition to CASAL and VPA models, the Assessment Workshop provided a stochastic stock reduction analysis (SRA) using a long term historical (1880 to 2004) catch time series.

3.2. Evaluate the adequacy, appropriateness, and application of data used in the assessment

3.2.1. South Atlantic gag grouper

Data sources for South Atlantic gag grouper stock include fishery-dependent abundance indices, recorded landings, and samples of annual length and age compositions from fishery-dependent sources.

Three fishery–dependent abundance indices were developed by the SEDAR 10 data workshop: one from the NMFS headboat survey, one from the commercial logbook program, and one from the Marine Recreational Fishing Statistical Survey (MRFSS). There are no usable fishery–independent abundance data for this stock of gag at this time.

Landings data were available from all recreational (headboat, charter boat, private boat, and shore sectors) and commercial fisheries (handline and diving gears). This benchmark assessment included data through 2004.

Complete details about the data are available in the SEDAR 10 Data and Assessment Reports, and the SEDAR 10 workshop working papers. Additional information and discussion can be found in the companion SEDAR 10 Review Workshop Consensus Summary Report for South Atlantic Gag Grouper.

Overall, the data were deemed appropriate and used in an appropriate manner subject to concerns that systematic age and length sampling were lacking, there were no fishery independent indices, and the annual MFRSS estimates were highly variable.

Concern was raised about the MFRSS data because of its highly variable annual estimates and lack of age/length composition data. Lack of length samples from MRFSS

resulted in use of headboat length compositions to reflect MRFSS landings. Because charter boat landings dominated MRFSS, the Review Workshop agreed that this was a reasonable assumption, even though headboat length compositions may differ from those observed in the private boat mode.

Concern was raised about changes in catchability. The Review Workshop discussed the relationship of technology to catchability and the effects of catchability changes on fishery-dependent abundance indices. The Review Workshop recognized that technological improvements over time, particularly better electronics, have made fishermen more effective and efficient at catching fish, but disagreed with the assessment team's assumption of a simple constant percentage increase (2% annually). This issue is important for the present stock assessment because it relies heavily on fishery-dependent catch rate abundance (CPUE) indices.

Concern was raised regarding the stock structure. South Atlantic gag grouper and Gulf of Mexico gag grouper were assessed as two separate stocks. The Review Workshop discussed stock movement and mixing. It was reported that there were several mark-recapture experiments carried out on fish movement between these two regions. However, there was no consensus and quantitative analysis for these mark-recapture experiments. The Review Workshop believes that input data and assessment approaches are similar for the two stocks and provide a common ground for these two assessments. Differences between life history (e.g., sex ratio, maturity, etc.) for the Gulf and South Atlantic stocks were noted and habitat differences were suggested as possibly contributing to the differences. Nevertheless, the biological parameters (growth, maturity, natural mortality, gender changes) for the two stock areas appear sufficiently

similar to imply that it could be worthwhile to re-estimate the parameters using pooled data.

Concern was raised about the natural mortality rate. The Data Workshop and Assessment Workshop recommended age-based natural mortality (averaged M=0.14), derived using the Lorenzen (1996) approach. The Review Workshop discussed this rate and recommended that a future Data Workshop and Assessment Workshop analyze the existing mark-recapture data with some appropriate mark-recapture models, such as a Brownie model, to estimate the natural mortality.

3.2.2. Gulf of Mexico gag grouper

The Review Panel concluded that the Data and Assessment Workshops explored a full range of available data sources and selected those that were most appropriate and scientifically sound for the assessment. The data were considered to be adequate, although the Review Panel did concur with the observations of the Data and Assessment Workshops regarding the limited availability of biological sampling data (lengths and ages) prior to the 1980's. The Review Panel concluded that the data selected by the Assessment Workshop were applied appropriately in the assessment.

The Data Workshop categorized available information under four headings: 1) life history, 2) commercial fishery, 3) recreational fishery, and 4) abundance indices. Life history information included: estimates of total, natural and release mortality, age data, growth, reproduction, movements and migration, stock definition, and meristic conversions. Commercial fishery information included: landings, discards, and biological sampling. Recreational fishery information included: landings, discards, total catches, and length frequency distributions. There were six abundance indices; four of

which were fishery dependent and two that were fishery independent.

The Data Workshop examined the results of two relatively large tagging studies designed to estimate the degree of exchange between Atlantic and Gulf stock units. In general, the results suggested an ontogenetic movement to deeper waters with smaller gag exhibiting relatively high site fidelity. The Data and Assessment Working Groups concluded that recoveries from the tagging data were inconclusive and that council boundaries should continue to be used as the dividing line for the two stocks. The Review Panel noted that some movement occurred from the South Atlantic to the Gulf. The Florida Keys also represented an area of overlap. Further information was provided to the Panel regarding the results of an ultrasonic tagging study off the west coast of Florida. Tag recoveries indicated extensive migrations by at least two fish, one that was recaptured off Texas and one off Vera Cruz, Mexico. The management unit for Gulf of Mexico gag grouper, as defined by the Data Workshop, and endorsed by the Assessment Workshop, extends from the United States – Mexico border in the west through northern Gulf of Mexico waters and west of the Dry Tortugas and the Florida Keys (waters within the Gulf of Mexico Fishery Management Council Boundaries). The Review Panel accepted the current stock definition but recommended a further examination of stock structure before the next assessment. This should include a detailed analysis of existing tagging data and the initiation of new tagging experiments (see SEDAR 10 Consensus Summary Report for South Atlantic gag grouper).

3.3. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.

3.3.1. South Atlantic gag grouper

The South Atlantic gag grouper stock was assessed with two models: a statistical catch-at-age model as the primary assessment model and an age-aggregated production model to investigate results under a different set of model assumptions. Within each type of model various configurations were explored for testing sensitivity to the catchability coefficient.

The Review Workshop raised concerns about patterns in the recruitment residuals that might indicate that the stock-recruit model did not fit the data properly. The Review Workshop requested further investigation including graphs showing the years of the stock-recruit data. Results indicated that temporal autocorrelation was not statistically significant.

The Review Workshop raised concerns about the spawner-recruit (SR) models. The management benchmarks are based on the estimated stock-recruitment model. The Review Workshop had extensive discussion on this topic and requested analysis of autocorrelation in the recruitment time series. The Review Workshop also requested that the stock-recruit relationship be re-estimated with an additional autocorrelation parameter. The SR plot with year information suggested a negative slope to the S/R relationship. In addition there are two periods with a shift in the mid 1980s (Fig 6 in the Addendum), which indicates that a SR model with a regime shift would be more appropriate for this stock (Chen 2001). The Review Workshop suggested incorporating

environmental information into the SR analysis and recommended further investigation of the relationship in future assessments.

In the assessment, the parameters of the Beverton-Holt (BH) spawner-recruit model were estimated within the assessment model (based on years 1972-2004) with lognormal deviations (loosely constrained). Concern was raised that no model fits were made for an alternate model such as a Ricker spawner-recruitment relationship. During the meeting the Review Workshop was provided results from a Ricker SR model and found that the Ricker model provided a statistically better fit to the SR data than the BH model. The Review Workshop discussed the fact that the fitted Ricker relationship, if correct, implies the existence of some mechanism which leads to lower recruitment at higher SSB. Mechanisms were proposed and discussed but the issue could not be resolved given available data and life history information. The Review Workshop noted that the stock–recruitment relationship is crucial in determining the validity and value of status determination reference points and suggested that the stock-recruitment relationship for the two stocks reviewed in SEDAR 10 be comprehensively re-examined prior to the next formal assessment of gag grouper.

3.3.2. Gulf of Mexico gag grouper

The Review Panel generally endorsed the method used in the assessment and considered it to be scientifically sound. The Panel did, however, have concerns regarding the choice of a Beverton-Holt stock recruit function and recommended that a Ricker function be used to examine the sensitivity of the model to assumptions about the form of the stock recruitment function. The Panel was impressed with the number of alternative runs provided by the Assessment Workshop and the thorough presentation regarding

model inputs and results presented by the assessment team at the Review Workshop.

The Assessment Workshop considered six scenarios for CASAL model runs. It recommended using the longest possible catch series. Two time series were considered, one with commercial and recreational catches from 1963 to 2004, and a second with commercial catches from 1880 to 2004 and recreational catches from 1945 to 2004. The Assessment Workshop also recommended including potential changes in catchability. Two groups of model runs were made, one assuming constant catchability and a second assuming a 2% annual increase since 1984 to reflect improvements in gear and electronics available to both the commercial and recreational fisheries. The Assessment Workshop also discussed the recent report of NRC regarding MRFSS estimates and concluded that available estimates of recreational catch and indices of abundance were the best available information. However, to estimate the sensitivity of the model to these data, two runs were made, one where the MRFSS total estimated catch was increased by 25% for the entire time series, and a second where it was decreased by 25%.

3.4. Recommend appropriate estimates of stock abundance, biomass, and exploitation

For both stocks, the panel evaluated the original assessment results and requested several sensitivity runs. After further evaluation of the sensitivity runs, the panel reached a consensus for the preferred “base model” for this stock defined in Section 2.1 “Background” and also detailed in the Addendum to the Assessment Reports for both stocks. Details concerning the appropriate estimates of stock abundance, biomass and

exploitation are listed in the both Advisory reports and the Addendum to the Assessment Reports.

3.5. Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies); provide values for management benchmarks, range of ABC, and declarations of stock status.

3.5.1. South Atlantic gag grouper

The Review Panel evaluated the South Atlantic gag grouper assessment and identified a number of concerns, which led to requests for clarifications and several sensitivity runs. As a result, the Panel recommended the base run with constant catchability as the preferred “base model”.

The methods to estimate the population benchmarks and management parameters are based on the B-H stock-recruitment model estimated externally from the catch at age model with the Review Workshop's preferred “base model”. The estimates of these benchmarks are listed in the Advisory report and summarized as follows:

- MFMT, the Maximum Fishing Mortality Threshold, is set to F_{MSY} Proxy = $F_{30\%SPR}$.
- MSST, the Minimum Stock Size Threshold, is set to (1-M).B_{msy}.
- Status Determination Criteria: The SFA and management criteria recommendations and values are estimated from the preferred base model by the Review Workshop as follows:

Stock Status	Current Definition	Value from Previous Assessment	Value from Current Assessment
MSST	$(1\text{-}M)B_{MSY}$	NA	8062 klb
MFMT	F_{MSY} Proxy = $F_{30\%SPR}$	0.18	0.24
MSY	Yield at F_{MSY}	NA	1774 klb
OY	Yield at F_{OY} ($F_{45\%SPR}$)	NA	1570 klb
F_{OY}	$F_{45\%SPR}$	NA	0.13

Proposed Status Criteria	Definition	Value
MSST	Performance Based (see Advisory Report Special Comments)	5000 klb
MFMT	F_{MSY}	0.295
MSY	Yield at F_{MSY}	1774 klb
OY	$65\%F_{MSY}$ (Alt. 1) $75\%F_{MSY}$ (Alt. 2) $85\%F_{MSY}$ (Alt. 3)	1714 klb 1747 klb 1765 klb
F_{OY}	$65\%F_{MSY}$ (Alt. 1) $75\%F_{MSY}$ (Alt. 2) $85\%F_{MSY}$ (Alt. 3)	0.192 0.221 0.251
M (Age-varying)	Constant Equivalent	0.14

Additional Benchmarks	Exploitation Rate	SSB @	Yield @
F_{MAX}	0.330	8592 klb	1770 klb
$F_{20\%SPR}$	0.420	7087 klb	1737 klb
$F_{30\%SPR}$	0.240	10929 klb	1760 klb
$F_{45\%SPR}$	0.130	16370 klb	1570 klb

Declarations of Stock Status:

- Stock Status: Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007. Relative to the MSST proposed by the Review Workshop, the stock is not

overfished and is not projected to become overfished under any of the projection scenarios.

- The current definition of MSST may be overly conservative. The Review Workshop recommended an operational definition of MSST of 5 million pounds. SEDAR and the management agencies should be aware that all reference points are considered to be imprecisely estimated.

3.5.2. Gulf of Mexico gag grouper

For this stock, the estimated spawning stock biomass declined during the late 1960's and the 1970's, remained at about 20 million pounds during the 1980's and early 1990's and then increased from 1997 to 2001, perhaps as a result of the higher recruitment. Since 2002 spawning stock biomass has remained at about 41 million pounds. Estimated total biomass followed a similar pattern with lower levels in the 1980's and an increase in the 1990's. Estimated total biomass peaked at about 56 million pounds in 2002 and then declined to an estimated 51 million pounds in 2004.

Status determination criteria

- The SFA and management criteria recommendations and values are estimated from the preferred base model by the RW as follows.

Stock status	Current Definition	Value from Previous Assessment	Value from Current Assessment
MSST	$SPR_{20\%}$ (pre-SFA)	NA	NA
MFMT	$F_{30\%SPR}$ (F_{MSY} Proxy)	0.45	0.17
MSY	Yield at $F_{30\%SPR}$ (F_{MSY} proxy)	5.5 mp	3.9 mp
OY	Yield at $SPR_{20\%}$	NA	NA
F_{OY}	undefined	NA	NA

Proposed Status Criteria	Constant Catchability	
	Definition	Value
MSST	(1-M)SSB_{MSY} (see Special Comments)	NA
MFMT	F_{MSY}	NA
MSY	Yield at F_{MSY}	NA
OY	Yield at $F_{40\%SPR}$	NA
F_{OY}	$F_{40\%SPR}$	NA
M (Age-varying)	Constant Equivalent	0.14

Constant Catchability			
Additional Benchmarks	Exploitation Rate	SSB[1]	Yield[1,2]
F_{MAX}	0.23	37.6 mp	3.93 mp
$F_{20\%SPR}$	0.37	23.1 mp	3.74 mp
$F_{30\%SPR}$	0.25	34.6 mp	3.92 mp
$F_{0.1}$	0.13	55.9 mp	3.66 mp

Stock Status

- Estimated recruitment has ranged from 1 to 6 million fish over a moderate range of spawning stock sizes, resulting in a high degree of uncertainty about the stock recruitment relationship and estimates of biomass benchmarks (MSY, SSB_{MSY} and MSST). Because of the uncertainty in the biomass benchmarks, current stock status (SSB_{2004} / SSB_{MSY}) is not reported.
- Because of this, the MSY-based benchmarks in this assessment were not deemed useful for management.
- The current (2004) fishing mortality rate on this stock is estimated as 0.39. Relative to the current proxy for F_{MSY} ($F_{SPR30\%}$), estimated as 0.17, overfishing of the Gulf of Mexico gag grouper is occurring.

- For the Gulf of Mexico, a MFMT of 0.17 (current value of $F_{30\%SPR}$) is not consistent with the recent dynamics of gag grouper: fishing mortality has been fluctuating around F = 0.30 for more than twenty years and the stock biomass is near its historical maximum. The Review Panel could not provide advice on target F and biomass reference points, but noted that the stock has apparently increased as a result of good recruitment under estimated fishing mortality rates that have fluctuated around an average value of F = 0.30 since the early 1980s. The Review Panel advised that it would be prudent to reduce fishing mortality below F = 0.30.
- There is currently not a SFA-compliant definition of stock status relative to abundance. Apparently the Gulf of Mexico Fishery Management Council uses (1-M)SSB_{MSY} as a working definition. Since the value of that reference point cannot be determined, the status of the stock with respect to biomass is unknown
- The Review Panel notes that available stock recruitment information suggests that recruitment may be impaired below 20 million pounds. Given that the model estimates of the spawning stock biomass benchmarks are uncertain, the Panel recommends that the Council consider 20 million pounds as a temporary operational definition of the lower bound for spawning stock size (i.e. MSST). Relative to the Review Panel's suggestion of an operational MSST of 20 million pounds, the stock is not overfished and is not approaching an overfished state.

3.6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.

Projections for South Atlanta gag grouper stock are based on the recommended "base model" from the Panel. Estimates of recruitment in 2002-2004 are below average and fishing mortality rates in 2002-2004 are above the MSY level. As a result the stock projections suggest that the stock will decline to below MSST in 2007. Projections with various constant fishing mortality rates starting in 2008 are shown in Table 3 and Figures 6-10 in the Advisory report. We caution that the methods are not adequate for forecasting the effects of management measures that involve changing selection patterns, such as changes to minimum landing sizes and bag limits. They are however adequate for exploring the information content and management implications of small and incomplete data sets such as that available for gag.

Projections for Gulf of Mexico gag grouper could not be completed using CASAL. They were subsequently provided by the assessment team using an alternative age-structure projection software (PRO-2BOX). The following output data from CASAL were used as input for PRO-2BOX:

a) Stock size at age (NAA) from 1963 to 2004 ages 1-12+,

b) Fishing mortality rate at age (FAA) from 1963 to 2004,

c) Catch-at-age 1963-2004 all fisheries,

d) Weight at age 1963-2004 for spawning component and mean WAA for fisheries

e) Natural mortality at age 1963-2004.

Because of differences between the software programs, particularly regarding the estimation of mean weight at age and age composition for the plus group, estimates of biomass between CASAL and PRO2BOX differed prior to 1984, when age composition data were not available. However, the SSB and overall stock biomass estimates were similar for the latest years, which are the important components for the projection of current stock status.

As PRO2BOX can distinguish between landed and discarded (dead) numbers at age, the discard proportions were estimated (from CASAL) by age for 1984 - 2004, when age composition data were available; discards by age prior to 1984 were assumed to be the same as in 1984. With this information, estimates and benchmarks were then generated for total yield (landings only) versus total removals (landings plus dead discards).

Estimates of fishing mortality rates were similar between total yield and total removals. However, estimated retained yields were much lower (~ 50%), due to the large proportion of dead discards in the recreational fishery. Landed yield per recruit (YPR) also dropped by 50% compared to total removals.

Projections indicated that total removals over 6,614 MT or landed catches over 3,268 MT in 2006 and in following years are not sustainable, and would generate a fishing mortality rate at or above 2 (upper limit of fishing mortality rate).

This assessment implies that spawning stock biomass has declined from a 2003 peak. Projections indicate that stock spawning biomass, and also catch (removals or landed yield) would continue to decline at current (2004) fishing mortality rates. The

decline would continue if fishing occurred at a rate equivalent to $F_{20\%SPR}$. Fishing rates of $F_{30\%SPR}$, $F_{40\%SPR}$, $F_{0.1}$, F_{MAX} and F_{MSY} would reverse the declining trend.

3.7. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations

The panel recommended a preferred "base model" for South Atlanta gag grouper stock for the constant catchability and the alternative configurations for the new base model are listed in the Stock Assessment Report and the Addendum to the Assessment Report.

For Gulf of Mexico gag grouper, initial stock assessment results were clearly and accurately presented in the report of the Assessment Workshop (SEDAR10-SAR2-Section III). Additional analyses requested by the Review Panel will be incorporated as an addendum to the stock assessment report.

3.8. Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.

The Review Workshop evaluated the terms of reference from both Data Workshop and Assessment Workshop with consensus that the TOR were met generally.

3.9. Panel Review for the research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.

- **Time-varying catchability**: The Review Workshop is of the opinion that catchability has changed over time. However, it does not believe that a constant 2% increase per year adequately describes the changes in catchability that are likely to have occurred. Step changes with the introduction of new equipment or management measures are more likely than monotonic changes. Learning and technological changes in navigation, fish detection, and catching equipment have no doubt increased the efficiency of nominal fishing effort. However, management measures (increases in minimum size, time and area closures, and bag limits) and changes in fishing behavior (moving on when "enough" fish have been caught) would be expected to result in decreased catchability. The Panel believes that, overall, catchability is likely to have increased. The Panel recommends that a special workshop be convened to estimate and quantify changes in catchability over the last 25 to 30 years.
- Strengthen the **MRFSS** program to provide more precise estimations of the age/length composition.
- Provide more detailed model diagnostics, such as complete lists of estimated parameters together with their estimated standard errors, in model sensitivity runs.
- Provide the model residuals diagnostics to test for time series autocorrelation contributions to the lack of goodness of fit in the assessment.

- **Mark-recapture experiments**: analyze the existing mark-recapture data and initiate new mark-recapture studies, which will help identify movements and migrations between two stocks, estimate fishing mortality, enhance population estimates, and better identify the stock structure and habitat preferences.

  The Review Workshop recommends **analysis of** the existing tagging data for movement within/between the two stocks., Quinn and Deriso (1999) comprehensively reviewed different forms of movement models, including: the diffusion model (Hilborn 1987; Deriso et al. 1991; Fournier et al. 1998); the generalized movement estimation (Ishii 1979, Sibert 1984, Anganuzzi et al. 1994; Xiao 1996, Xiao et al. 1999; Xiao and McShane 2000); and the movement-estimation mark–recapture methods (Seber 1982, Brownie et al. 1985, Schwarz et al. 1993). The Brownie model may be an excellent approach to deriving alternate estimates of natural mortality rate.

  The Review Workshop recommends new tagging experiments, in order to estimate mixing rates and the associated fishing mortality independent of commercial fishing. It is essential to analyze the existing tagging database to ascertain what can be done with the existing data in order to develop a new design for the future tagging experiment. This would include an effective design for tagging mortality, tagging shedding, reporting rates to get a higher confidence level in stock assessment, migration patterns, and growth.

4. CONCLUSIONS/ADDITIONAL RECOMMENDATIONS

In general, SEDAR 10 was organized professionally and progressed smoothly. The presentations were well prepared and presented. I wholly appreciate the time and effort expended by participants in each assessment group.

Below, I provide three additional recommendations that can be implemented to improve future stock assessment efforts and the SEDAR process:

- There was large volume of documentation associated with this Review Workshop. The Review Panel recommends including a clear executive summary in each substantive Data and Assessment Document.
- It could be more informative to distribute a succinct table of model equations and parameters (estimated and observed) to be provided for each assessment along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.

5. Appendix 1:

SEDAR 10 Review Workshop

Assessment Advisory Report
South Atlantic Gag Grouper

Stock Distribution and identification:

10. The management unit for South Atlantic gag grouper includes gag grouper found in all waters within South Atlantic Fishery Management Council Boundaries.
11. The SEDAR 10 Review Workshop (RW), using several sources of information, examined and accepted the current stock definitions for the South Atlantic and Gulf of Mexico gag.

Assessment Methods:

- The South Atlantic gag grouper stock was assessed with two models; a statistical catch-at-age model, as the primary assessment model, and an age-aggregated production model to investigate results under a different set of model assumptions. Within each type of model various configurations and sensitivity runs were explored. Details of all models are available in the Stock Assessment Report and Addendum to the Stock Assessment Report.

- The assessment workshop (AW) developed two base runs; one assuming a time-varying catchability and one assuming constant catchability for the fishery dependent indices. Each base run of the catch-at-age model was the basis for estimation of benchmarks and stock status.

- The SEDAR 10 RW recommended the run with constant catchability as the preferred 'base run'.

Assessment Data:

- Data sources include fishery-dependent abundance indices, recorded landings, and samples of annual length and age compositions from fishery-dependent sources.

- Three fishery–dependent abundance indices were developed by the SEDAR 10 data workshop: one from the NMFS headboat survey, one from the commercial logbook program, and one from the Marine Recreational Fishing Statistical Survey (MRFSS). Currently, there are no usable fishery–independent abundance data for this stock of gag.

- Landings data were available from all recreational (headboat, charter boat, private boat, and shore sectors) and commercial fisheries (handline and diving gears). This benchmark assessment included data through 2004.

- Complete details are available in the SEDAR 10 Data and Assessment Reports, and the SEDAR 10 workshop working papers. Additional information and discussion can be found in the companion SEDAR 10 Review Workshop Consensus Summary Report for South Atlantic Gag Grouper.

Catch Trends:

- Landings are reported from the commercial and recreational sectors. The commercial landings are in gutted weight in pounds, while recreational landings are estimated in numbers. Commercial landings were converted to numbers for the assessment model (Table 1 and Figures 1-2).

- The commercial landings were dominated by handline gear peaking at over 1,000,000 pounds in 1984. Landings from the diving gear have been significant in recent years and are modeled separately. The contribution from other gears is small and included with the handline gear (Table 1 and Figure 1).

- The recreational sector catch peaked in 1984 at about 180,000 fish in 1984, and has two components: catch estimated from MRFSS which includes private and charter boats and a minor shore component, and catch estimated from a survey of headboats (larger for-hire vessels) (Table 1).

- When comparing across sectors, the largest landings in numbers are associated with the MRFSS (Table 1 and Figure 2).

- Coastwide landings of gag grouper in the South Atlantic had been increasing but have recently leveled off. The catch share among sectors has been changing over the last decade, with increased landings from the charter/private boat and shore mode recreational sectors relative to the commercial handline sector, which has been decreasing (see Tables and Figures below).

Fishing mortality trends

- Fishing mortality (fully selected F) increased from 0.03 in 1962 to 0.50 in 1983 (above F_{MSY} = 0.295; see discussion below). Fishing mortality has remained above F_{MSY} since then (Table 2 and Figure 3). .Fishing mortality in 2004 was estimated as 0.40.

Stock abundance and biomass trends

- Total and spawning stock biomass (both sexes combined) declined from initial high values in the 1960s, went below levels corresponding to MSY in 1970s, remained relatively constant through the early 1980s, declined through the remainder of the 1980s and has apparently been on an increasing trend since (Table 2 and Figure 4). In particular, spawning stock biomass declined from 16.6 million pounds (gutted

weight) in 1962 to 9.1 million pounds in 1979 (below the current value of SSB_{MSY} = 9.4 million pounds). Spawning stock biomass rose to 9.8 million pounds in 2003 (Table 2). The 2005 SSB value is estimated to be 11.0 million pounds.

Status determination criteria and Stock Status

- Status Determination Criteria: The SFA and management criteria recommendations and values are estimated from the preferred base model by the RW as follows:

Stock Status	Current Definition	Value from Previous Assessment	Value from Current Assessment
MSST	$(1\text{-}M)B_{MSY}$	NA	8062 klb
MFMT	F_{MSY} Proxy = $F_{30\%SPR}$	0.18	0.24
MSY	Yield at F_{MSY}	NA	1774 klb
F_{OY}	$F_{45\%SPR}$	NA	0.13
OY	Yield at F_{OY} ($F_{45\%SPR}$)	NA	1570 klb

Proposed Status Criteria	Definition	Value
MSST	$(1\text{-}M)SSB_{MSY}$ *(see special comment)	5000 klb
MFMT	F_{MSY}	0.295
MSY	Yield at F_{MSY}	1774 klb
OY	$65\%F_{MSY}$ (Alt. 1) $75\%F_{MSY}$ (Alt. 2) $85\%F_{MSY}$ (Alt. 3)	1714 klb 1747 klb 1765 klb
F_{OY}	$65\%F_{MSY}$ (Alt. 1) $75\%F_{MSY}$ (Alt. 2) $85\%F_{MSY}$ (Alt. 3)	0.192 0.221 0.251
M (Age-varying)	Constant Equivalent	0.14

Additional Benchmarks	Exploitation Rate	SSB	Yield
F_{MAX}	0.330	8592 klb	1770 klb
$F_{20\%SPR}$	0.420	7087 klb	1737 klb
$F_{30\%SPR}$	0.240	10929 klb	1760 klb
$F_{45\%SPR}$	0.130	16370 klb	1570 klb

Stock Status

- Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock (Figure 5). Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007 (see projections, Figure 6). Relative to the

MSST proposed by the RW, the stock is not overfished and is not projected to become overfished under any of the projection scenarios (Figure 6).

- The MSY-based benchmarks in this assessment are deemed useful for management.
- The current definition of MSST may be overly conservative. The RW recommends an operational definition of MSST of 5 million pounds (see Special Comments).

Projections

- Estimates of recruitment in 2002-2004 are below average and fishing mortality rates in 2002-2004 are above the MSY level. As a result, stock projections suggest that the stock will decline to levels below MSST in 2007. Projections for biomass, recruitment and fishing mortality at various levels of constant fishing mortality rates starting in 2008 are shown in Table 3 and Figures 6-10. The levels are based on current F (geometric mean of last three years of the base run, Figure 6), on F_{MSY} (Figure 7), and three levels of F_{OY} (65%, 75% and 85% of F_{MSY}, Figures 8-10).

Special Comments

1. **Constant and time-varying catchability alternative**: The RW discussed the relationship of technology to catchability and the effects of catchability changes on fishery-dependent abundance indices. The RW recognized that technology improvements over time, particularly better electronics, have likely made fishermen more effective and efficient at catching fish. The RW, however, did not support an assessment that assumed a simple linear (2% annually) increase Nevertheless, this is an important issue and the RW recommends further investigations of time-varying catchability.

2. **Uncertainties**: The primary uncertainties in the assessment are from the model process errors and the data measurement errors. Because of the inherited high uncertainties from the assessment data and the estimated stock-recruitment relationship, the RW evaluated the uncertainties in this assessment with sensitivity runs to investigate the robustness of management benchmark parameter estimates to alternative choices about data usage.

3. **Stock-recruitment relationship**: In both stock areas, the stock and recruitment scatter plot does not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSBs observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico,

both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and B_{MSY} is estimated to be higher than SSBs observed in the past. The RW considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

4. **Discussion of RW recommended MSST**: MSST, currently defined by the South Atlantic Council as $(1\text{-}M)*B_{MSY}$, is very close to B_{MSY} because age-averaged natural mortality rate, M, is estimated as 0.14. Given the uncertainties in the assessment, the biomass would be expected to fall below MSST with a relatively high frequency even if the true biomass were close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative. There are no indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the RW suggests that MSST could be set at this level, operationally, to be re-examined at the next assessment.

5. **Sensitivity investigations**: The RW requested sensitivity model runs for the constant catchability model. The panel wished to better understand the behavior of the model when certain data were left out of the model. The base model run contains three fishery dependent CPUE indices and three sets of age and length composition datasets (one for the commercial handline, commercial diving, and recreational headboat fisheries). The stock analysts completed nine additional model runs removing each index, each fishery age composition dataset, and each fishery length composition dataset one at a time. The results from this analysis suggest that the selected model provides a balanced fit to all data sources, illustrated by the base run falling within the middle of this set of sensitivity runs (Figures 12-14). When examining the spawning stock biomass time series, the run with the headboat CPUE data omitted shows the population increasing rapidly in the most recent years, reaching the highest terminal value of all the runs. In contrast, the run with the commercial handline CPUE omitted produces the lowest estimate of SSB value in the terminal year (Figure 12).

Sources of Information:

- The report from the Data Workshop along with the associated workshop documents.
- The report from the Assessment workshop along with associated documents.
- The SEDAR10 Review workshop discussions and presentations
- The SEDAR10 Review Workshop Consensus Summary Assessment of South Atlantic Gag Grouper

Tables: Catch and Status

Table 1. Commercial landings by gear in weight (gutted), recreational landings in numbers, and discards in numbers for gag grouper from the U.S. South Atlantic, 1962-2004.

	Commercial (gutted klb)		Recreational (1000s)		Discards (1000s)		
Year	Handline	Diving	Headboat	MRFSS	Handline	Headboat	MRFSS
1962	150.3		8.41	6.17			
1963	137.0		7.66	5.62			
1964	128.4		7.18	5.27			
1965	130.4		7.41	5.44			
1966	99.1		5.58	4.09			
1967	210.9		11.77	8.62			
1968	309.9		17.72	12.98			
1969	217.2		12.13	8.89			
1970	299.0		16.66	12.20			
1971	306.7		17.18	12.59			
1972	204.5		13.44	8.37			
1973	290.5		17.99	12.15			
1974	372.8		13.92	15.68			
1975	421.8		8.57	17.48			
1976	565.0	3.75	7.56	23.77			
1977	627.6	8.81	8.48	21.94			
1978	967.4	13.87	6.01	37.54			
1979	907.5	18.92	9.55	35.70			
1980	846.2	16.40	6.96	35.39			
1981	984.0	13.88	13.86	56.69		0.03	0.00
1982	1027.4	15.85	11.84	22.17		0.02	4.32
1983	1101.1	9.08	16.46	166.70		0.04	91.88
1984	1108.2	18.75	18.69	165.20		0.03	11.95
1985	865.7	11.62	16.13	55.31		3.76	3.09
1986	819.8	6.34	17.35	59.26		4.05	12.48
1987	857.8	21.93	24.09	97.68		5.63	10.30
1988	672.4	12.96	24.21	77.08		5.65	15.01
1989	967.0	22.26	22.42	118.69		5.23	43.41
1990	784.3	19.07	17.59	63.66		4.11	11.46
1991	656.4	85.01	13.55	60.90		3.16	24.19
1992	691.7	106.76	13.94	87.98		7.74	38.66
1993	756.6	78.15	11.80	83.03		6.54	31.23
1994	800.0	97.50	9.81	124.51		5.45	68.29
1995	840.4	83.77	10.54	114.50		5.85	73.97
1996	751.9	118.56	7.50	86.92		4.16	43.00
1997	608.2	98.71	6.85	114.74		3.81	82.41
1998	654.5	138.79	8.67	72.54		4.82	32.22
1999	538.1	113.49	5.34	109.31	7.37	4.80	58.86
2000	438.2	63.02	5.98	156.50	7.77	5.38	126.63
2001	450.1	82.30	5.12	90.15	13.71	4.60	47.41
2002	448.3	84.52	4.58	109.76	11.91	4.12	85.73
2003	443.9	117.41	3.27	183.73	5.10	2.95	137.62
2004	476.4	74.97	6.66	135.79	7.20	6.00	89.54

Table 2. Estimated time series and status indicators. Exploitation rate (E) is of ages 2+, F is the fully selected fishing mortality rate, and SPR is static spawning potential ratio. SSB is in thousands of gutted pounds.

Year	E	E/E_{MSY}	F	F/F_{MSY}	SSB	SSB/SSB_{MSY}	SPR
1962	0.0191	0.233	0.0291	0.0987	16639	1.775	0.783
1963	0.0176	0.216	0.0273	0.0926	16402	1.750	0.795
1964	0.0177	0.217	0.0267	0.0907	16236	1.732	0.799
1965	0.0199	0.243	0.0285	0.0967	15958	1.702	0.785
1966	0.0166	0.203	0.0237	0.0803	15383	1.641	0.819
1967	0.0372	0.456	0.0483	0.1638	14698	1.568	0.662
1968	0.0601	0.735	0.0760	0.2577	13598	1.451	0.539
1969	0.0430	0.527	0.0569	0.1930	12180	1.299	0.620
1970	0.0575	0.704	0.0798	0.2707	11201	1.195	0.531
1971	0.0601	0.735	0.0872	0.2959	10310	1.100	0.509
1972	0.0446	0.546	0.0652	0.2213	9623	1.027	0.587
1973	0.0376	0.461	0.0648	0.2197	9220	0.984	0.598
1974	0.0460	0.563	0.0827	0.2805	8953	0.955	0.545
1975	0.0462	0.566	0.1090	0.3696	8839	0.943	0.490
1976	0.0601	0.736	0.1640	0.5564	9243	0.986	0.408
1977	0.0675	0.826	0.1798	0.6097	9788	1.044	0.402
1978	0.1131	1.384	0.2483	0.8421	9832	1.049	0.318
1979	0.0991	1.213	0.2295	0.7785	9112	0.972	0.325
1980	0.0861	1.054	0.2054	0.6966	8741	0.933	0.348
1981	0.1233	1.509	0.2780	0.9429	9022	0.962	0.258
1982	0.0987	1.208	0.2603	0.8830	8673	0.925	0.317
1983	0.1816	2.223	0.5038	1.7087	8535	0.910	0.161
1984	0.2768	3.388	0.5572	1.8901	7566	0.807	0.113
1985	0.1614	1.975	0.5650	1.9162	6068	0.647	0.213
1986	0.1746	2.137	0.3014	1.0224	5402	0.576	0.174
1987	0.1953	2.390	0.4991	1.6930	5097	0.544	0.149
1988	0.1439	1.761	0.5551	1.8827	4854	0.518	0.191
1989	0.2106	2.578	0.7721	2.6186	5138	0.548	0.124
1990	0.1530	1.873	0.5134	1.7413	4853	0.518	0.178
1991	0.1148	1.405	0.4493	1.5241	5214	0.556	0.204
1992	0.1239	1.516	0.4475	1.5178	6175	0.659	0.187
1993	0.1458	1.785	0.3979	1.3495	7395	0.789	0.202
1994	0.2091	2.559	0.4707	1.5964	7951	0.848	0.159
1995	0.1953	2.391	0.4814	1.6328	6894	0.735	0.153
1996	0.1412	1.728	0.4323	1.4664	6019	0.642	0.183
1997	0.1447	1.771	0.4271	1.4486	6298	0.672	0.177
1998	0.1249	1.528	0.4031	1.3671	6877	0.734	0.214
1999	0.1468	1.797	0.5283	1.7920	7475	0.797	0.188
2000	0.1503	1.839	0.5810	1.9707	7394	0.789	0.161
2001	0.0948	1.161	0.3911	1.3267	7235	0.772	0.230
2002	0.0946	1.158	0.3927	1.3320	8479	0.904	0.226
2003	0.1247	1.526	0.5233	1.7749	9823	1.048	0.178
2004	0.1260	1.542	0.4019	1.3633	10563	1.127	0.216
2005	.	.	.	.	11005	1.174	.

Table 3. Biomass, landings and discard projections under various fishing mortality (F) scenarios starting in 2008 (F fixed at the current value in 2005-2007). All results are in 1,000s of gutted pounds (klb). For reference, SSB_{MSY} = 9,374 klb, MSY = 1,774 klb, discards at MSY (D_{MSY}) = 88 klb

	Fcurrent	**Fmsy**	**85% Fmsy**	**75% Fmsy**	**65% Fmsy**
SSB (2005) (klb)	11005	11005	11005	11005	11005
SSB (2007) (klb)	7435	7435	7435	7435	7435
SSB (2010) (klb)	6265	7206	7545	7784	8034
SSB (2014) (klb)	6769	8689	9499	10112	10793
Landings (2005) (klb)	2720	2720	2720	2720	2720
Landings (2007) (klb)	2175	2175	2175	2175	2175
Landings (2010) (klb)	1523	1278	1166	1079	981
Landings (2014) (klb)	1698	1626	1560	1497	1415
Discards (2005) (klb)	138	138	138	138	138
Discards (2007) (klb)	75	75	75	75	75
Discards (2010) (klb)	117	84	73	65	58
Discards (2014) (klb)	118	87	76	68	60

Figure 1. Commercial gag grouper landings (gutted weight in pounds) by gear from the U.S. South Atlantic, 1962-2004.

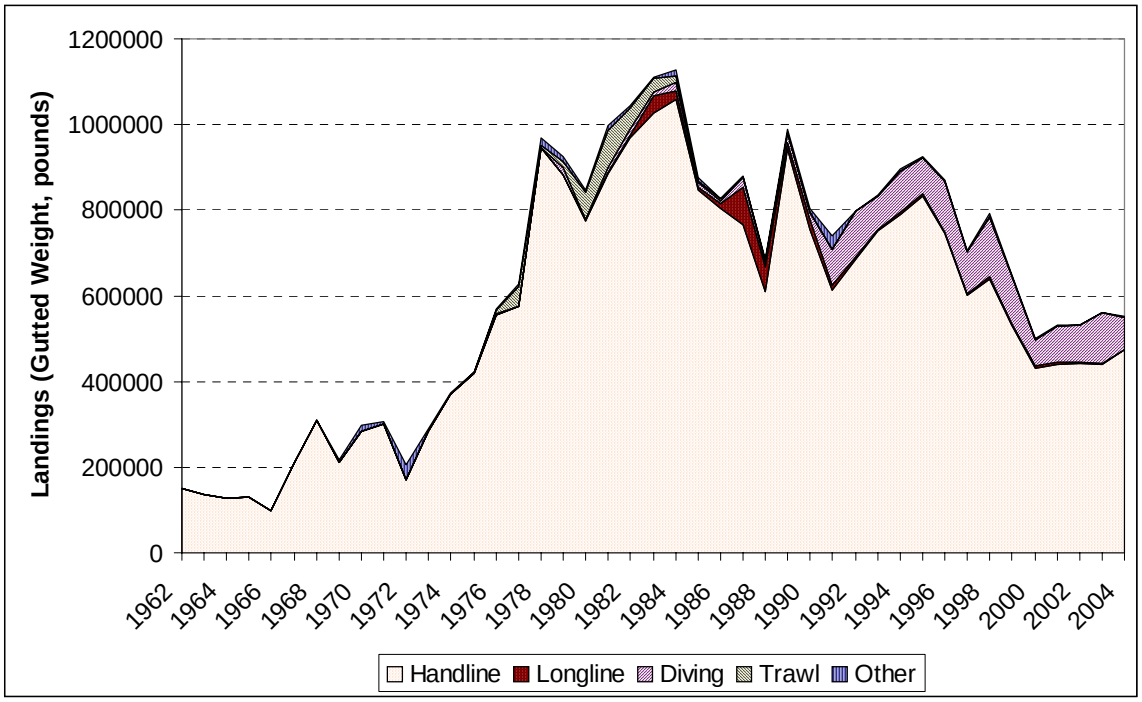


Figure 2. Total gag grouper catches (landings and discards) in numbers by sector from the U.S. South Atlantic, 1962-2004.

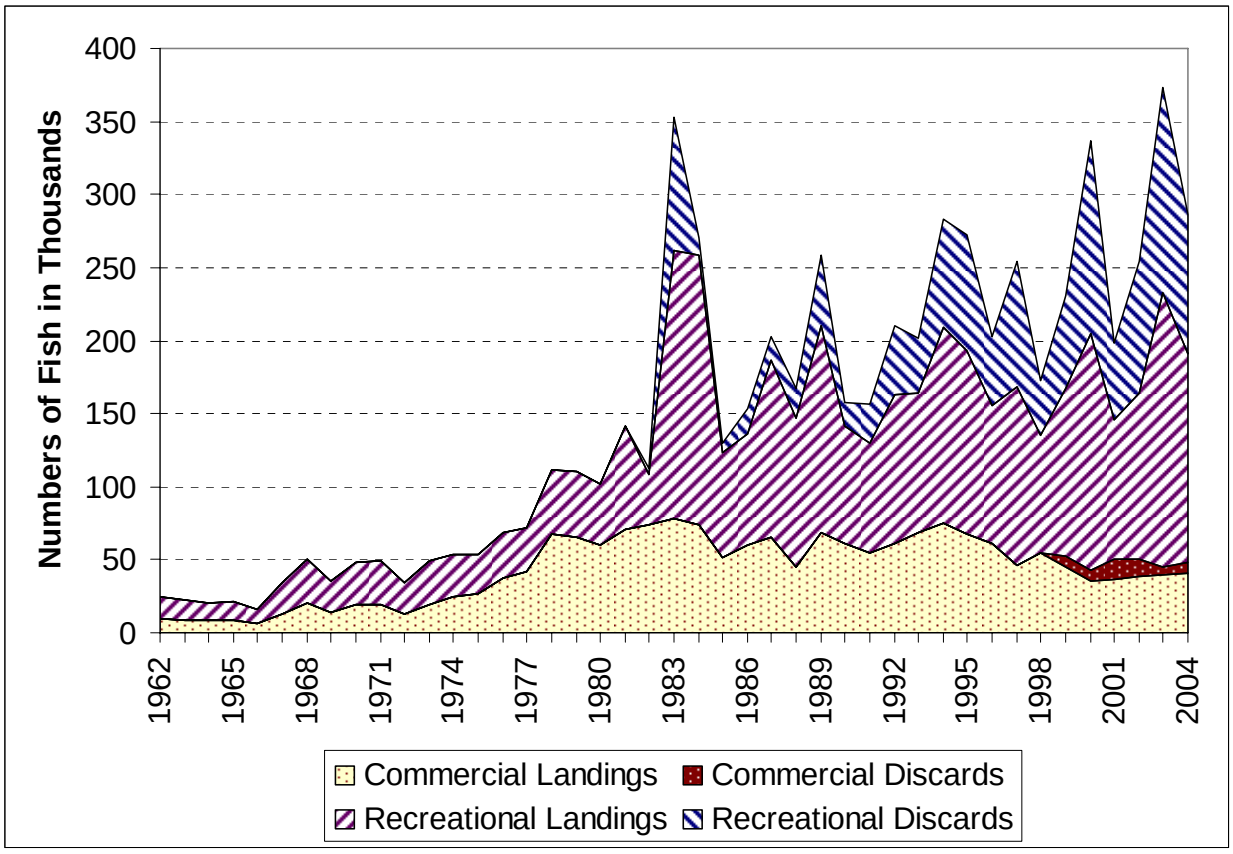


Figure 3. Estimated fully-selected fishing mortality rate. Solid horizontal line represents F_{MSY}.

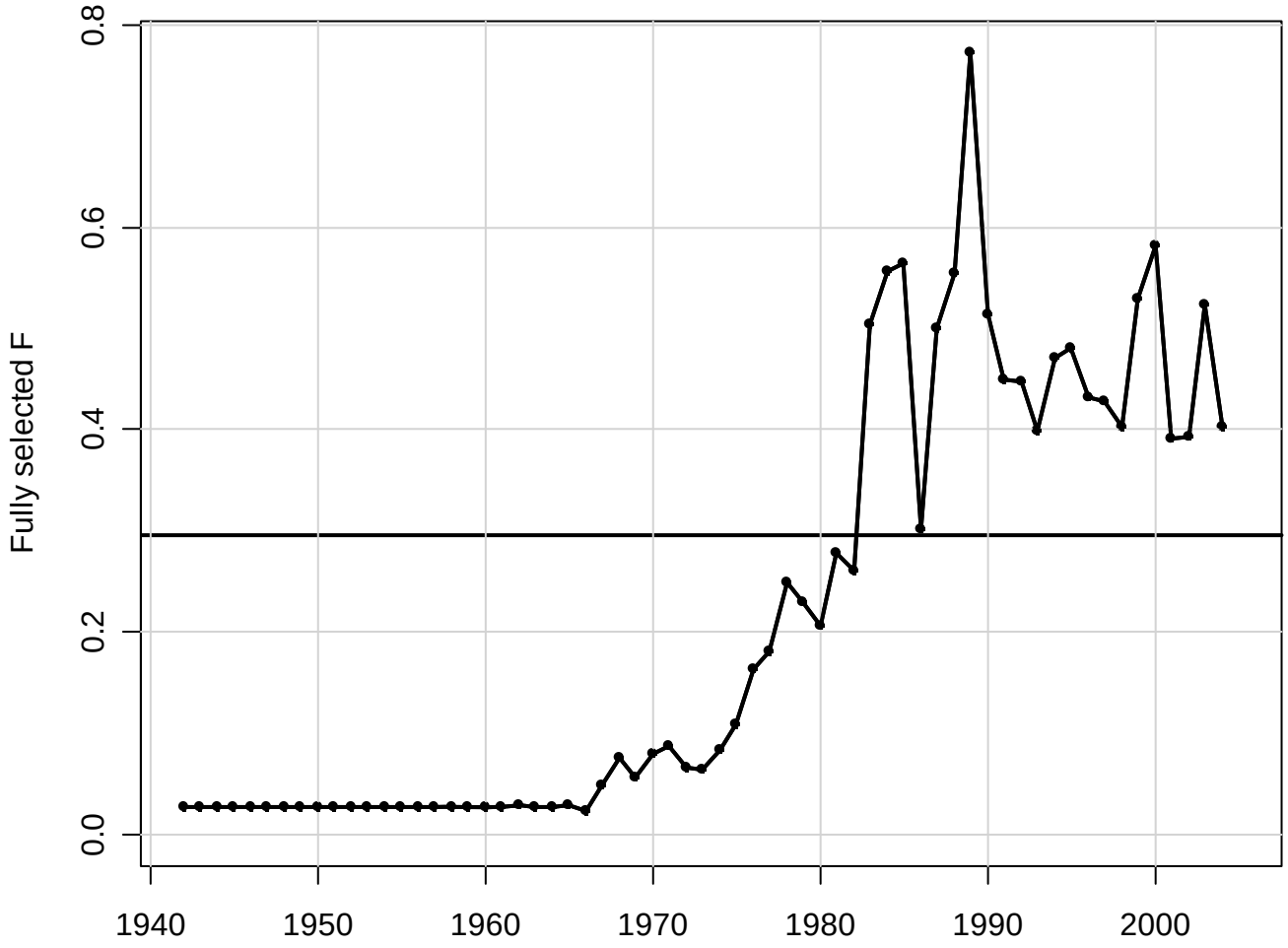


Figure 4. Estimated biomass time series (biomass in gutted weight). Total biomass (solid trend line) and spawning stock biomass (male mature biomass + female mature biomass, dashed trend line). The horizontal lines represents the level of biomass corresponding to MSY (B_{MSY} and SSB_{MSY}).

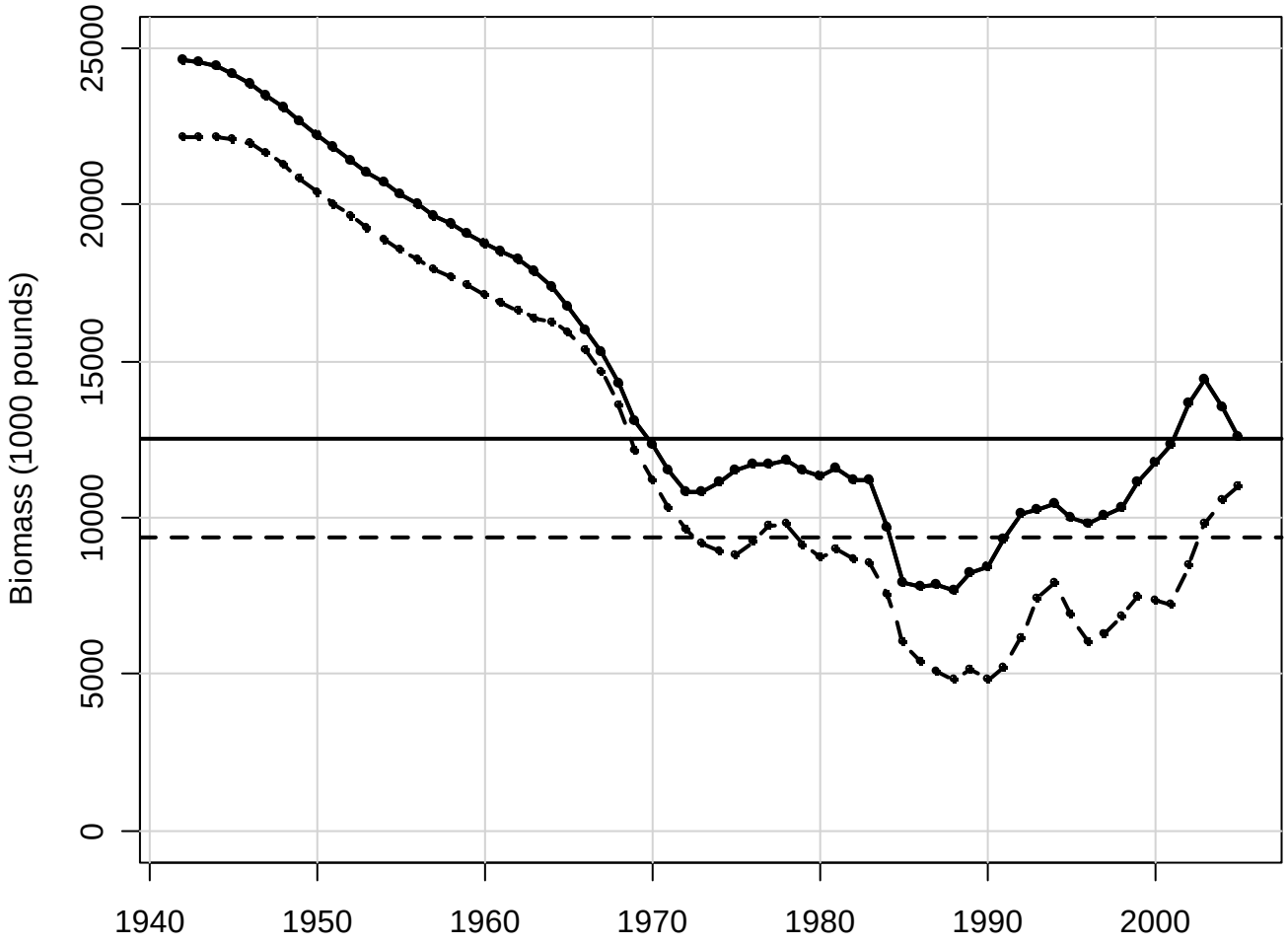


Figure 5. Phase plot of recent estimates of spawning stock biomass (klb, gutted weight) and fishing mortality rate. Solid lines correspond to MSY levels; vertical dashed line corresponds to MSST, defined as (1-M)SSB_{MSY}; and the vertical dotted line corresponds to the RW recommendation for an operational MSST.

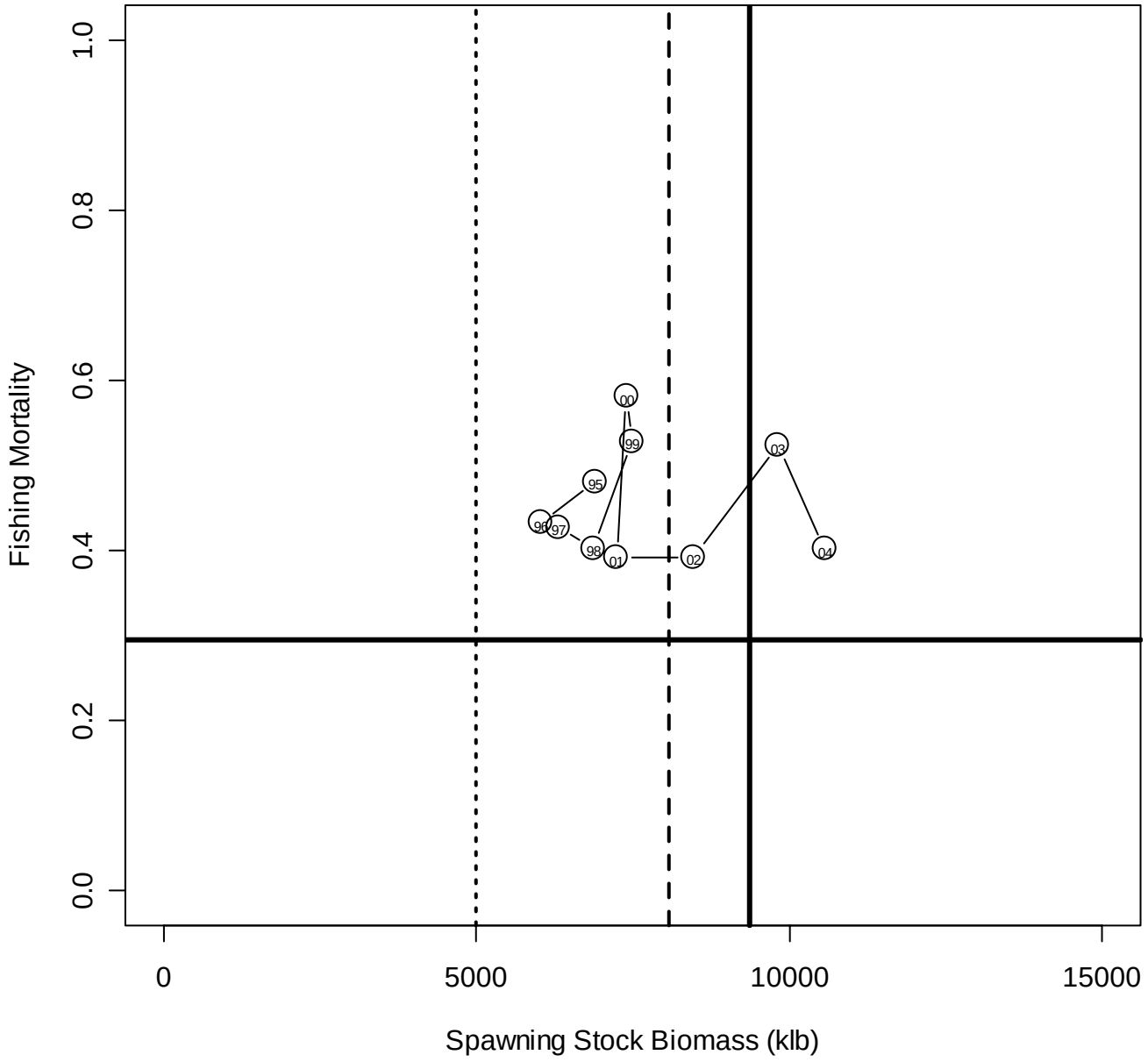


Figure 6. Projections under current fishing mortality rate for all years. Expected values represented by solid lines with circles, and uncertainty represented by thin lines corresponding to 10th and 90th percentiles of 1000 bootstrap replicates. A) SSB, horizontal solid line is SSB_{MSY} and dashed line is MSST (defined as (1-M)SSB_{MSY}); B) Recruits, horizontal line is R_{MSY}; C) Fishing mortality rate, horizontal line is F_{MSY}; and D) Landings, horizontal line is MSY.

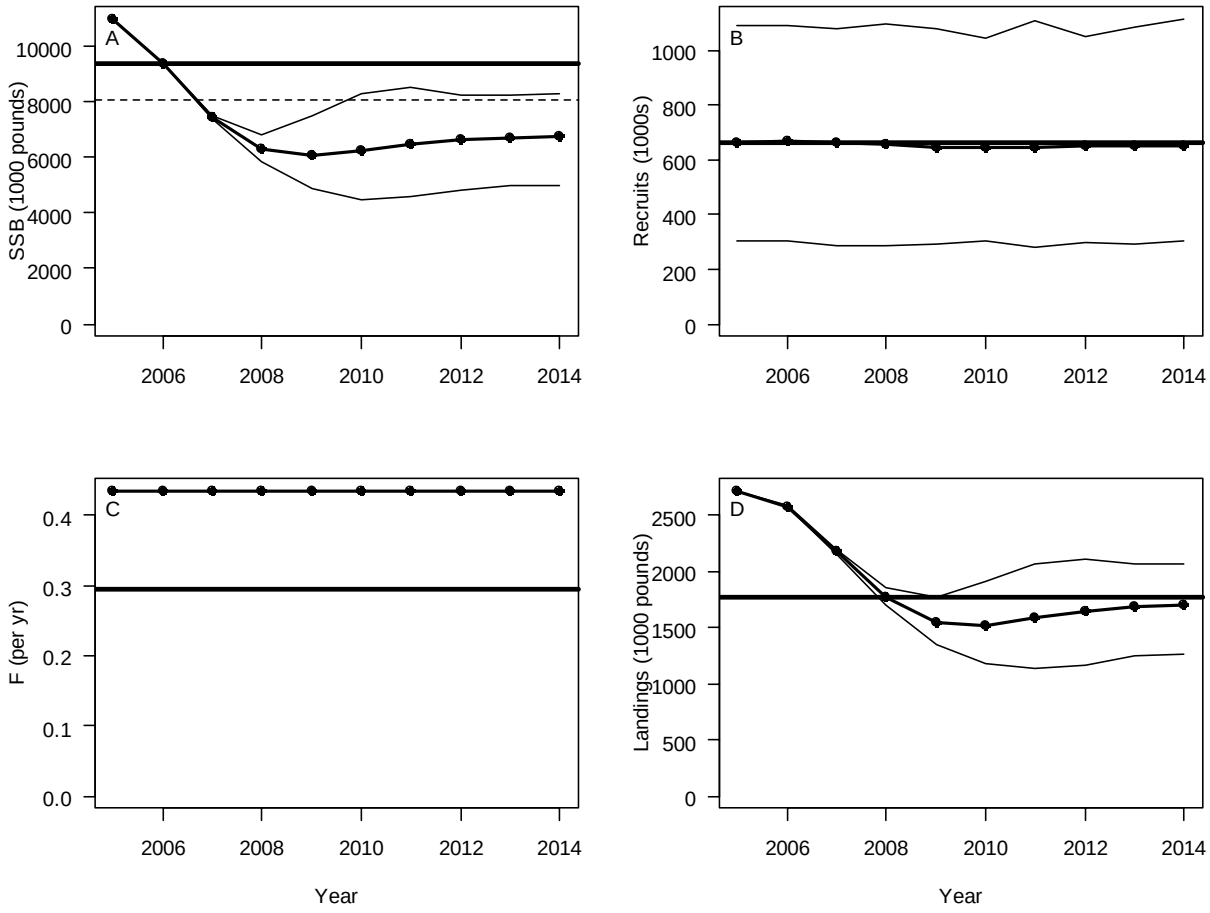


Figure 7. Projections under current fishing mortality rate in 2005-2007 and F_{MSY} in 2008-2014. Expected values represented by solid lines with circles, and uncertainty represented by thin lines corresponding to 10th and 90th percentiles of 1000 bootstrap replicates. A) SSB, horizontal solid line is SSB_{MSY} and dashed line is MSST (defined as (1-M)SSB_{MSY}); B) Recruits, horizontal line is R_{MSY}; C) Fishing mortality rate, horizontal line is F_{MSY}; and D) Landings, horizontal line is MSY.

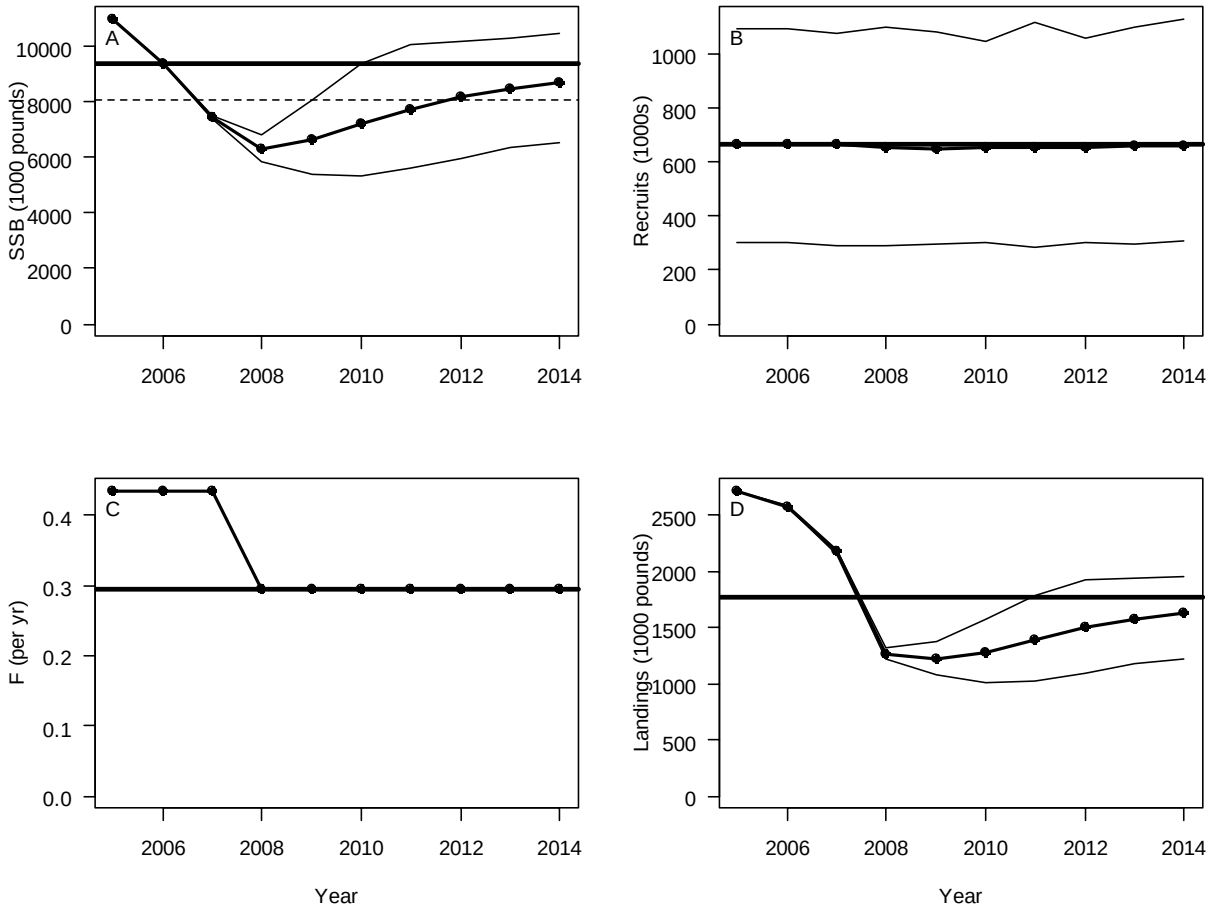


Figure 8. Projections under current fishing mortality rate in 2005-2007 and 85% of F_{MSY} in 2008-2014. Expected values represented by solid lines with circles, and uncertainty represented by thin lines corresponding to 10th and 90th percentiles of 1000 bootstrap replicates. A) SSB, horizontal solid line is SSB_{MSY} and dashed line is MSST (defined as (1-M)SSB_{MSY}); B) Recruits, horizontal line is R_{MSY}; C) Fishing mortality rate, horizontal line is F_{MSY}; and D) Landings, horizontal line is MSY.

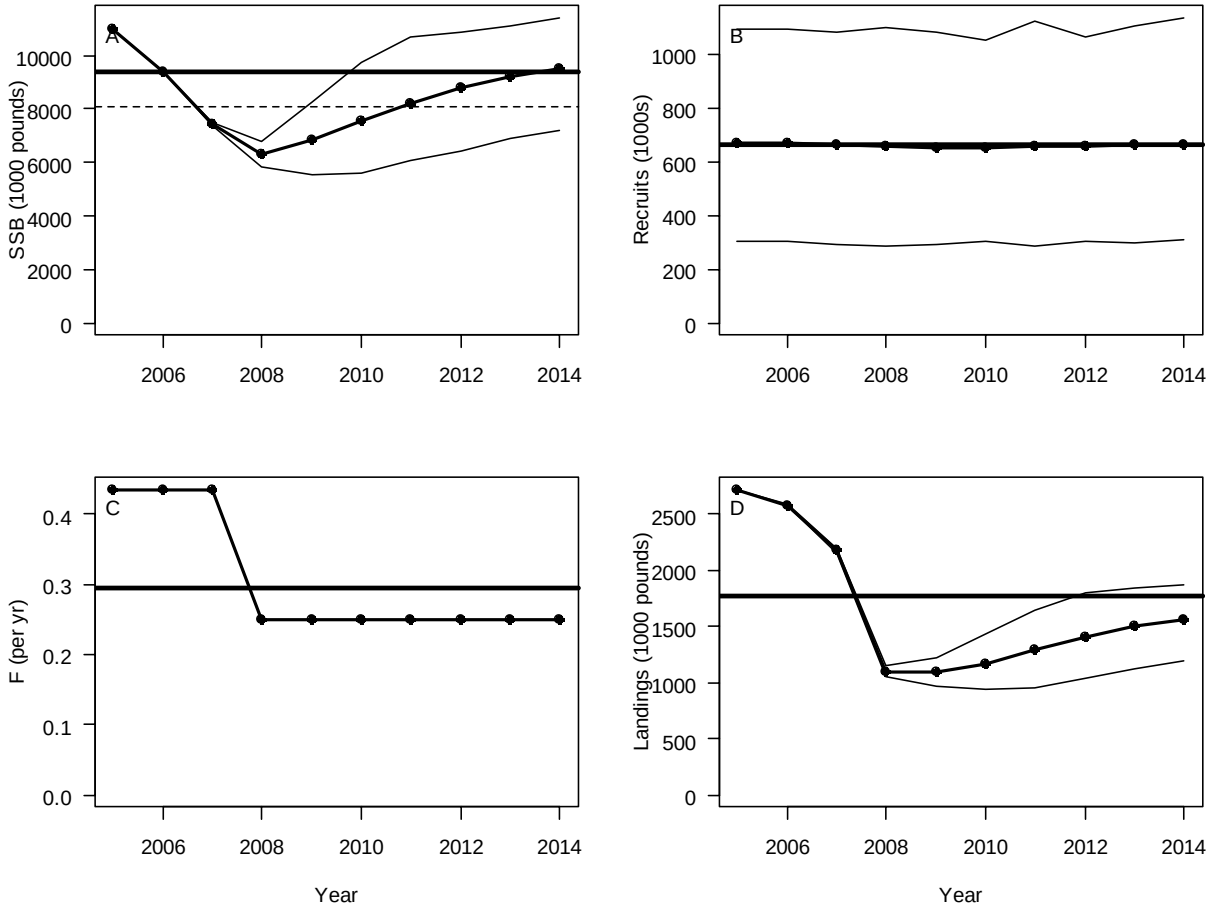


Figure 9. Projections under current fishing mortality rate in 2005-2007 and 75% of F_{MSY} in 2008-2014. Expected values represented by solid lines with circles, and uncertainty represented by thin lines corresponding to 10th and 90th percentiles of 1000 bootstrap replicates. A) SSB, horizontal solid line is SSB_{MSY} and dashed line is MSST (defined as (1-M)SSB_{MSY}); B) Recruits, horizontal line is R_{MSY}; C) Fishing mortality rate, horizontal line is F_{MSY}; and D) Landings, horizontal line is MSY.

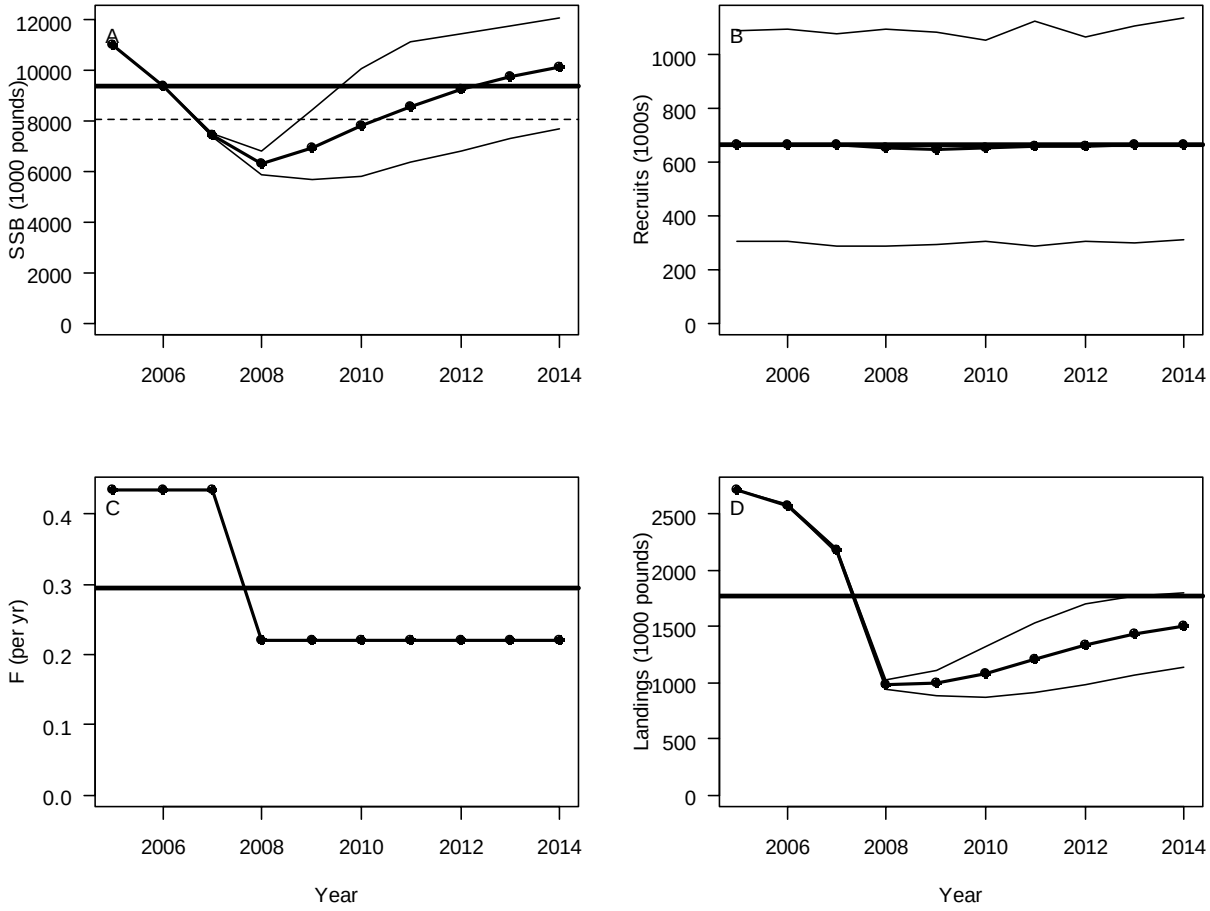


Figure 10. Projections under current fishing mortality rate in 2005-2007 and 65% of F_{MSY} in 2008-2014. Expected values represented by solid lines with circles, and uncertainty represented by thin lines corresponding to 10th and 90th percentiles of 1000 bootstrap replicates. A) SSB, horizontal solid line is SSB_{MSY} and dashed line is MSST (defined as (1-M)SSB_{MSY}); B) Recruits, horizontal line is R_{MSY}; C) Fishing mortality rate, horizontal line is F_{MSY}; and D) Landings, horizontal line is MSY.

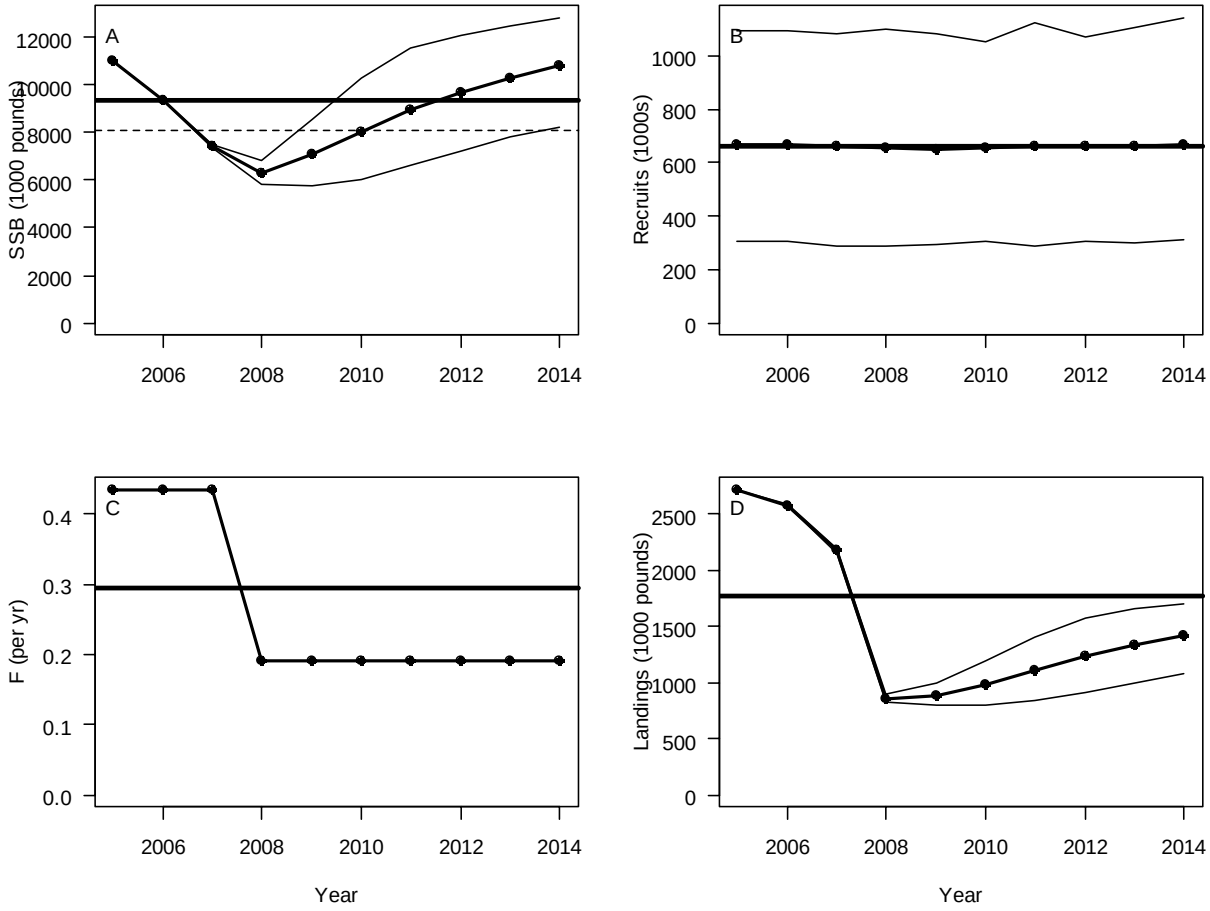


Figure 11. Estimated Beverton-Holt stock-recruitment relationship presented for South Atlantic gag grouper. Two digit year labels represent estimated recruitment values from 1972-2004; Dashed curve is estimated relationship; Solid curve is estimated relationship with lognormal bias correction, from which benchmarks are derived.

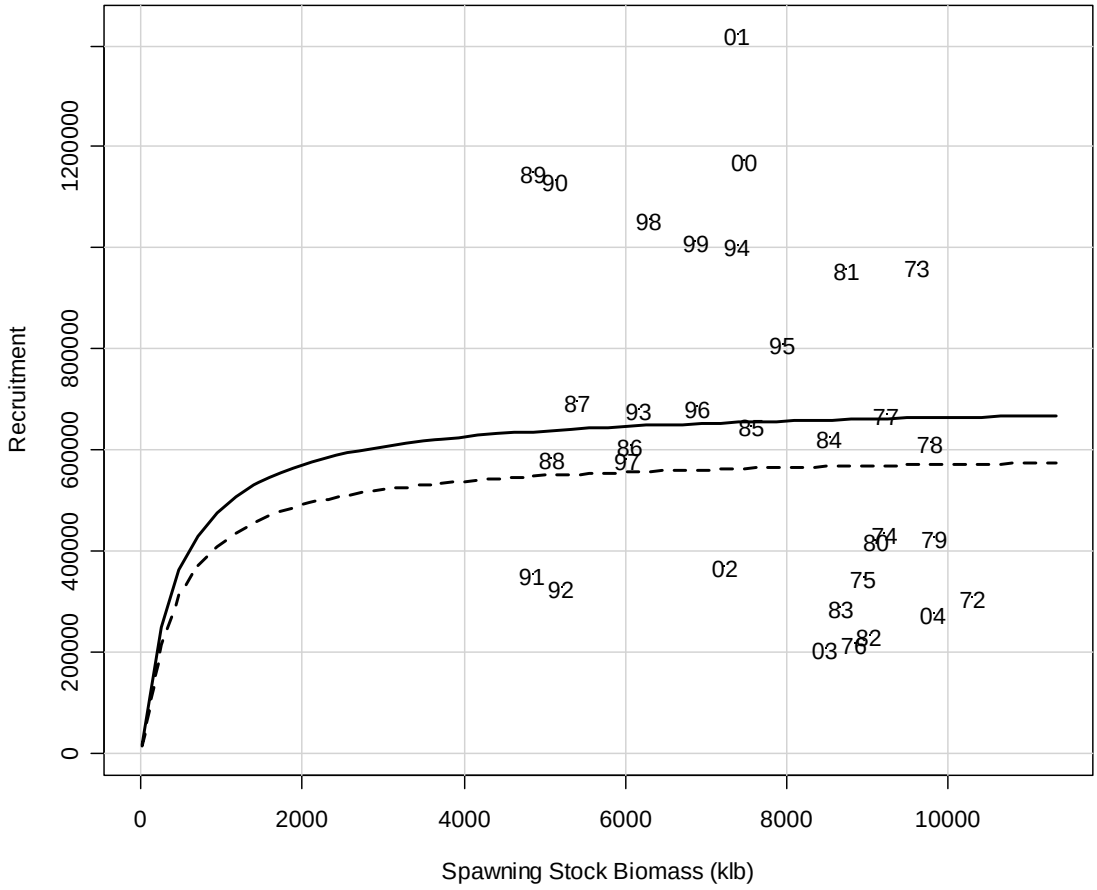


Figure 12. Estimated time series of spawning stock biomass (klb, gutted weight) from the base run model with constant catchability. The base run model with all data included is illustrated with a thick black line. Other runs with the labeled dataset left out of the model are shown in various colors and point markers.

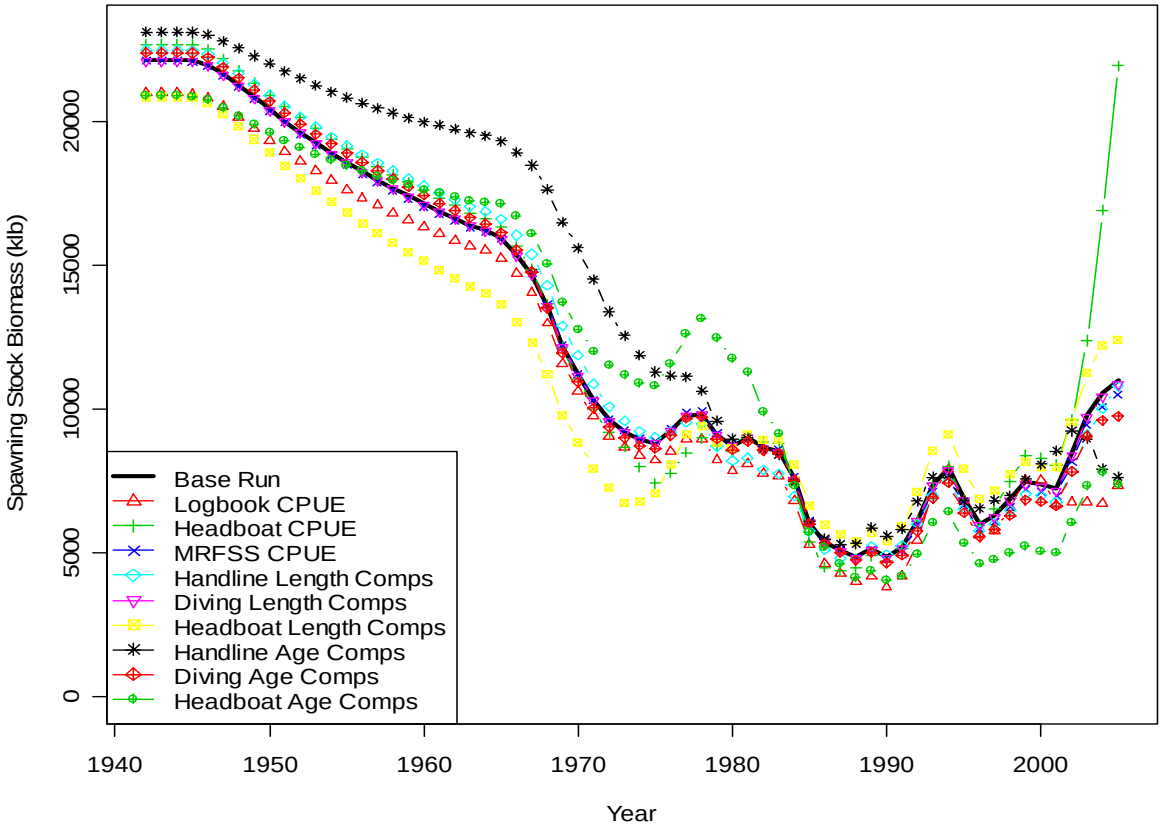


Figure 13. Estimated time series of fishing mortality rate from the base run model with constant catchability. The base run model with all data included is illustrated with a thick black line. Other runs with the labeled dataset left out of the model are

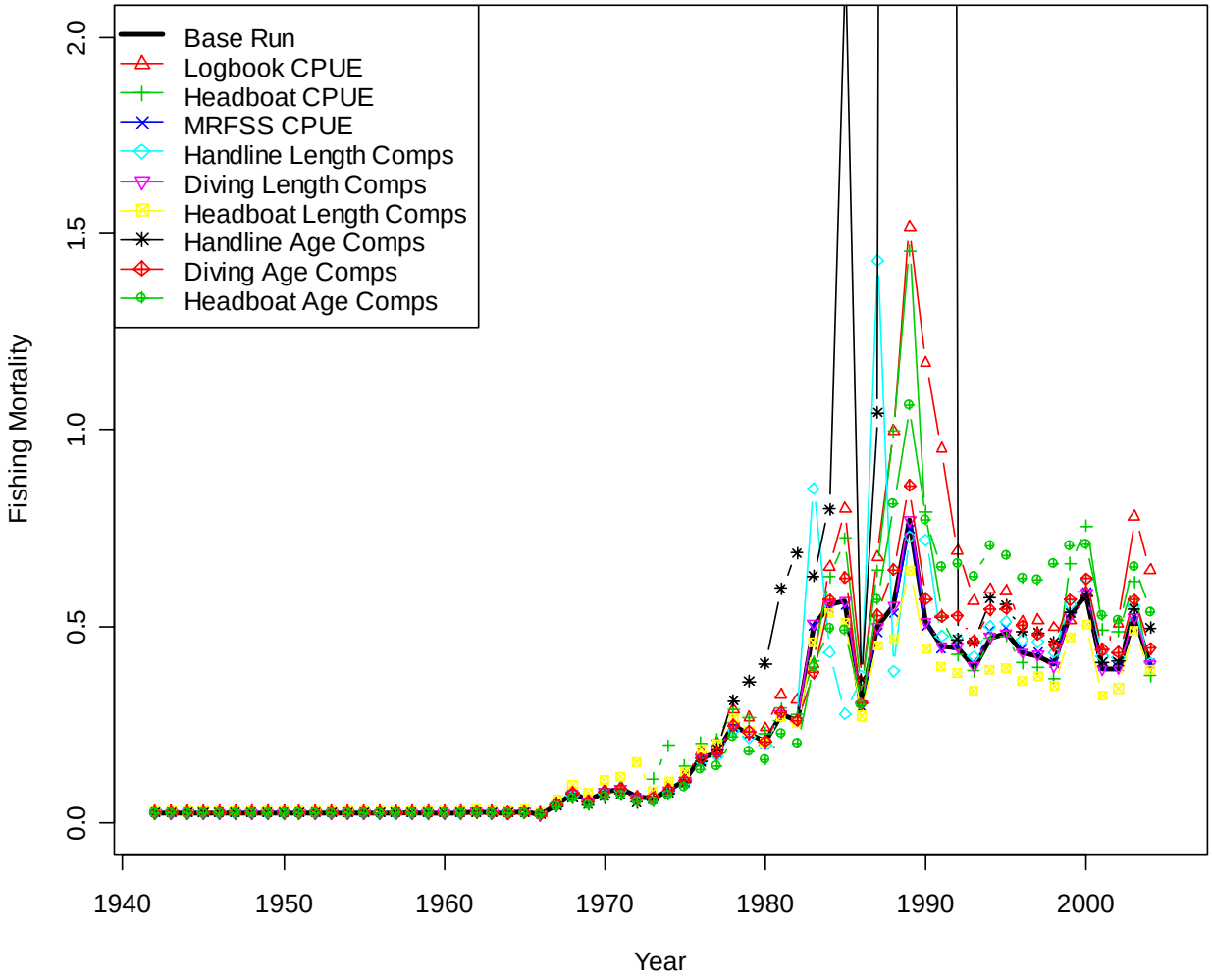
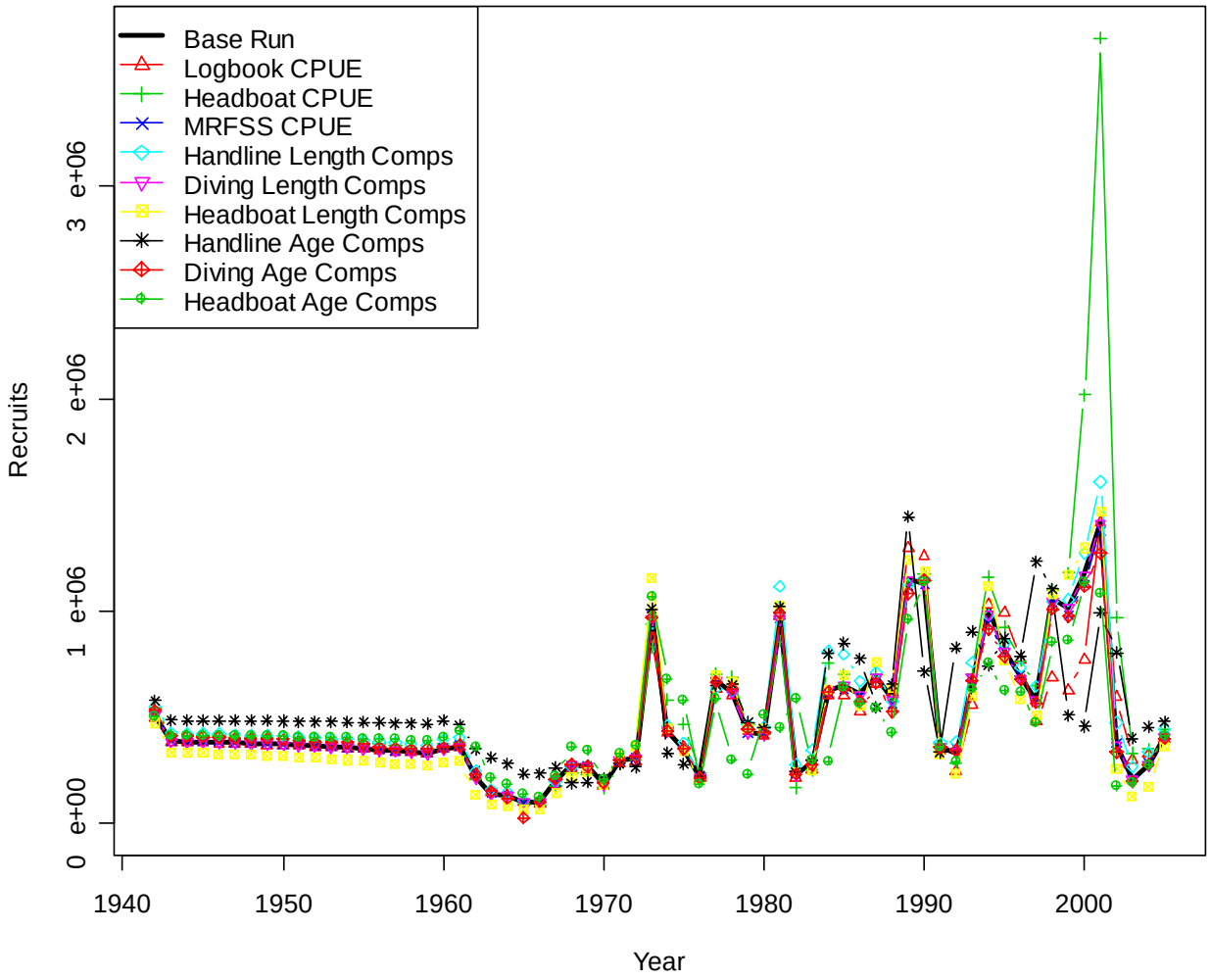


Figure 14. Estimated time series of recruitment from the base run model with constant catchability. The base run model with all data included is illustrated with a thick black line. Other runs with the labeled dataset left out of the model are shown in



6. Appendix 2:

SEDAR 10 Review Workshop Report

South Atlantic Gag Grouper

Prepared by the SEDAR 10 Review Panel
June 26 - 30, 2006
Atlanta GA

Executive Summary

The SEDAR 10 Review Workshop took place in Atlanta, Georgia, June 26-30, 2006 and reviewed two stock assessments; South Atlantic gag grouper and Gulf of Mexico gag grouper. On Monday, June 26, the Review Workshop Panel received a presentation from the South Atlantic gag grouper assessment team, and on Tuesday, June 27, a similar presentation from the Gulf of Mexico gag grouper assessment team. The balance of the week, through Thursday afternoon, was devoted to additional discussion with the assessment teams to refine and better understand the assessments. Draft versions of the two advisory reports were discussed on Thursday. All parts of the meeting, with the exception of Friday morning, were open to the public. On Friday, the Panel discussed initial drafts of the Consensus Summary documents.

The Review Panel commends the two assessment teams and was especially impressed by the responsiveness of both teams to requests for additional analyses and clarifying information. The Review Panel was also very appreciative of the helpful feedback and suggestions from all SEDAR 10 attendees as we discussed initial drafts of Review Workshop documents.

The Review Panel also appreciates the organization of SEDAR 10 in that two gag grouper stocks were assessed via a common Data Workshop and concurrent and complementary Assessment Workshops. This allowed the Review Panel to not only better understand the individual stock assessments but to offer more consistent advice to the two managing Councils.

From that point of view the Review Panel notes that the development of the stocks has been similar, presumably because the fisheries have followed similar paths.

In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.

For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.

Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.

An important result of the Review Workshop is determination of current stock status relative to biological reference points established in the respective FMPs.

In both stock areas, the stock and recruitment scatter plot do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSBs observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and B_{MSY} is estimated to be higher than SSB's observed in the past. The Review Panel considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

The Minimum Stock Size Threshold (MSST), currently defined by the South Atlantic Council as $(1\text{-}M)*B_{MSY}$, is very close to B_{MSY} because age-averaged natural mortality rate, M, is estimated as 0.14. Given the uncertainties in the assessment, the biomass would be expected to fall below MSST with a relatively high frequency even if, in fact, the true biomass was close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative. There are no indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the Review Panel suggests that MSST could be set at this level as an operational definition to be re-examined at the next assessment.

Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007 (see Advisory Report projections). Relative to the MSST proposed by the Review Panel, the stock is not overfished and is not projected to become overfished under any of suggested constant fishing mortality mid-term projection scenarios (also discussed and displayed in the Advisory Report).

- Introduction

- Workshop Time and Place

The SEDAR 10 Review Workshop met at the Doubletree Atlanta Buckhead in Atlanta, Georgia from June 26 - 30, 2006.

- Terms of Reference

  - Evaluate the adequacy, appropriateness, and application of data used in the assessment.
  - Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
  - Recommend appropriate estimates of stock abundance, biomass, and exploitation.
  - Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); provide values for management benchmarks, range of ABC, and declarations of stock status.
  - Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.
  - Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.
  - Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.
  - Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.
  - Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)

- List of Participants

Review Panel

Terry Smith, Chair .....NOAA Fisheries/Sea Grant
Din Chen ..... CIE
Jean-Jacques Maguire ..... CIE
John Wheeler ..... CIE

Presenters

Mauricio Ortiz.....SEFSC
Clay Porch.....SEFSC
Steve Turner.....SEFSC
Doug Vaughan.....SEFSC
Erik Williams.....SEFSC

Appointed Observers

Brian Cheuvront.....SAFMC SSC
Phil Conklin.....SAFMC AP
George Geiger.....SAFMC
Will Patterson.....GMFMC SSC
Roy Williams.....GMFMC
Bob Zales II.....GMFMC AP

Observers

Roy Crabtree.....SERO
Andy Strelchek.....SERO

Staff

Steven Atran.....GMFMC
John Carmichael.....SEDAR
Tyree Davis.....SEFSC
Rick DeVictor.....SAFMC

- List of Review Workshop Working Papers & Documents

The Review Panel was provided all SEDAR Working Papers and associated research documents considered at the SEDAR 10 Data and Assessment Workshops. Additional resources provided for the Review Workshop are listed below.

SEDAR Working Papers		
SEDAR10-RW01	Virtual population analysis of the Gulf of Mexico gag grouper stock: the continuity case.	Sladek-Nowlis, J.
SEDAR10-RW02	Status review of gag grouper in the US Gulf of Mexico, SEDAR 10.	Ortiz, M.
SEDAR DRAFT ASSESSMENT REPORTS		
SEDAR10-SAR1 *Review Draft*	South Atlantic Gag Grouper SEDAR Assessment Report	
SEDASR10-SAR2 *Review Draft*	Gulf of Mexico Gag Grouper SEDAR Assessment Report	

2. Consensus Summary

2.1. Background and summary

- **Documents provided and reviewed**: The Review Workshop (RW) is the third meeting in the SEDAR 10 process. The Panel was provided reports (*S10SAR1-SAgag Sect12.pdf and S10SAR1Sect3AtlGagAW.pdf*) from both Data Workshop (DW) and Assessment Workshop (AW) before the Review Workshop. The panel reviewed these documents and the series of working documents cited in those reports.

- **Assessment Scientists:** The Atlantic gag grouper assessment was presented by Drs. Erik Williams and Doug Vaughan on Monday, June 26th.

- **Assessment Data**: The Assessment was based on the data from the Data Workshop, which are summarized in *S10SAR1-SAgag Sect12.pdf*. Data sources include abundance indices, recorded landings (commercial handline and diving, recreational headboat and recreational landings derived from the Marine Recreational Fishing Statistics Survey, MRFSS), and samples of annual size compositions and age compositions. Three fishery–dependent abundance indices were developed by the SEDAR-10 DW: one from the NMFS headboat survey, one from the commercial logbook program, and one from the MRFSS survey. There are no usable fishery–independent abundance data for this stock at this time. Landings data were available from all recreational and commercial fisheries.

- **AW Assessment Model and base runs:** The South Atlantic gag grouper stock was assessed with two models: a statistical catch-at-age model as the primary assessment model and an age-aggregated production model to investigate results under a different set of model assumptions. Within each type of model various configurations and sensitivity runs were explored. The AW developed two base runs; one assuming a time-varying catchability and one assuming constant catchability for the fishery dependent indices. Each base run of the catch-at-age model was the basis for estimation of benchmarks and stock status. Assumptions and results are summarized in *S10SAR1Sect3AtlGagAW.pdf.*

- **RW Preferred based model**: The Review Panel evaluated the assessment and identified a number of concerns, which led to requests for clarifications and several sensitivity runs. As a result, the Panel recommended the base run with constant catchability as the preferred “base model”.

2.2. Review Workshop Terms of Reference

6. Evaluate the adequacy, appropriateness, and application of data used in the assessment.

- **Assessment Data Adequacy, Appropriateness**: The data for this species were finalized from the SEDAR Data Workshop and reported in *S10SAR1-SAgag Sect12.pdf*. Overall, the data were deemed appropriate and used in an appropriate manner subject to the concerns of lacking systematic age and length sampling, no fishery independent indices, and highly variable annual MFRSS estimates.

- **MFRSS**: The RW was concerned about the MFRSS series because of highly variable annual estimates and the lack of age/length composition. Lack of length samples from MRFSS resulted in use of headboat length compositions to reflect MRFSS landings. Because charter boat landings dominated MRFSS, the RW agreed that this was a reasonable assumption although headboat length compositions may differ from those observed in the private boat mode.

  MRFSS PSE (proportion standard error) was highly variable with generally higher values in the earlier years (1980s). More importantly, the sensitivity runs by the AW which examined model output by increasing and decreasing MRFSS catch by 50% (especially the decreasing run), substantively changed the view of the status of the stock. In addition, removing a portion of the MRFSS catch can make the stock appear to be less productive. However, given the lack of evidence of a consistent and persistent bias in the MRFSS data, the RW panel concluded that the MFRSS was variable but not biased and the decision was made to use the original data.

  MRFSS landings are the largest contributor to total landings (incl. headboat and commercial) but are poorly sampled. The MRFSS landings are dominated by charter boat landings, presumably from fishing similar to that on headboats. It was noted that the MRFSS index is based on catch (A+B1+B2) while headboat and commercial handline indices are based only on landings.

- **Model fits to sex ratio data:** A detailed description of the life history data and initial probit analysis on sex ratio and maturity of South Atlantic gag was presented in a report prior to the Data Workshop (SEDAR10-DW-15). Following the Data Workshop, final parameter fits were developed and summarized in Table 2.1 (p. II-33) of the Data Workshop Report (Section II). Discussion by the panel was concerned with the data available for the probit analysis on sex transition (proportion females) at age. Initially a request was made to compare the observed proportions female at age with model predicted female at age for each time period. Because these data was not readily available, the sample sizes available for each time period were provided:

Early period (1977-82): 322 fish

- Middle period (1994-95): 1508 fish
- Late period (2004-05): 1048 fish

These sample sizes were deemed adequate for representing sex ratio. Linear interpretation of the model predicted proportion female at age was applied to years between these periods.

- **Catchability**: The RW discussed the relationship of technology to catchability and the effects of catchability changes on fishery-dependent abundance indices. The RW recognized that technology improvements over time, particularly better electronics, have made fishermen more effective and efficient at catching fish, but disagreed with the assumption of a simple linear (2% annually) constant increase. This issue is important for the present stock assessment because the assessments rely heavily on fishery-dependent catch rate abundance (CPUE) indices.

  When a unit of effort becomes more efficient at catching fish, the resulting abundance index becomes biased, making fish appear relatively more abundant. In contrast, fishery-independent indices based on standardized methods to control fishing efficiency over time are not subject to this problem. No fishery-independent indices were available for the South Atlantic gag assessment.

- **Indices:** Correlation among the three fishery dependent indices was discussed. It was noted that there was a marginally-significant negative correlation between the headboat and commercial handline indices. In the most recent few years, commercial handline CPUE is increasing while the headboat index is declining.

- **Stock structure**: South Atlantic gag grouper and Gulf of Mexico gag grouper were assessed as two separate stocks. The RW discussed stock movement and mixing. It was reported that there were several mark-recapture experiments carried out on fish movement between these two regions. However, there was no consensus and quantitative analysis for these mark-recapture experiments. The RW believes that input data and assessment approaches are similar and there is common ground for these two assessments.

  Differences between life history (e.g., sex ratio, maturity, etc.) for the Gulf and South Atlantic stocks were noted and habitat differences were suggested as possibly contributing to the differences.

  Nevertheless, the biological parameters (growth, maturity, natural mortality, gender changes) for the two stock areas appear sufficiently similar to imply that it could be worthwhile to re-estimate the parameters using pooled data.

In the South Atlantic, the age range tabulated in the analyses extends to age 20 while in the Gulf of Mexico (GOM) it extends to age 12.

- **Natural mortality rate**: The DW and AW recommended age-based natural mortality (averaged M=0.14) using the Lorenzen (1996) approach. The RW discussed this rate and recommended that the DW and AW analyze the existing mark-recapture data with some appropriate mark-recapture models, such as a Brownie model, to estimate the natural mortality.

- **Length-weight bias**: The RW discussed the bias correction used for weight-length regressions and confirmed that there was no transformation of the data prior to running the regression. It was noted that the correction assumes that the regression parameters are known (based on lognormal distributional properties). However, these parameters are estimated and not known. The proper statistical correction can be found in Chen (2004). Here, given the small value of MSE (~0.047), the difference is generally small (but would be larger for extreme values of lengths away from mean length). A more detailed discussion of this topic can be found in the research recommendations.

7. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.

- **Methods:** The assessment methods are considered to be appropriate for the available data. The methods used for standardization of the catch and effort data are appropriate. The RW Panel was impressed with the presentation and the number of sensitivity analyses.

- **Models**: For the available data, two models were used as the assessment methods for this stock. A statistical catch-at-age model was used as the primary assessment model and an age-aggregated production model was used to investigate results under a different set of model assumptions. Within each type of model various configurations and sensitivity runs were explored for the catchability coefficient.

- **Residuals**: The RW was concerned about patterns in the recruitment residuals which might indicate that the SR model did not fit the data properly. The RW requested further investigation, including graphs, showing the year of the stock-recruit data observation. Results indicated that temporal autocorrelation was not statistically significant.

- **Spawner-recruit models**: The management benchmarks are based on the estimated stock-recruitment model. The RW had extensive discussion on this topic and requested analysis of autocorrelation in the recruitment time series (as reported above). The RW also requested that the stock-recruit relationship

be re-estimated with an additional autocorrelation parameter. The autocorrelation function fit suggests there is no significant autocorrelation at lag 1 or higher (Figs 8 and 9 in the Addendum to Stock Assessment Report).

The S/R plot with year information suggested a negative slope to the S/R relationship (Fig 6 in the Addendum). The RW suggested incorporating environmental information into the SR analysis and recommended further investigation of the relationship in future assessments.

In the assessment, the parameters of the Beverton-Holt (BH) spawner-recruit model were estimated within the assessment model (based on years 1972-2004) with lognormal deviations (a loose constraint was put on these deviations). Concern was raised that no model fits were made for an alternate model such as a Ricker spawner-recruitment relationship. During the meeting the RW was provided results from a Ricker SR model and found that the Ricker model provided a statistically better fit to the SR data than the BH model. The RW discussed the fact that the fitted Ricker relationship, if correct, implies the existence of some mechanism which leads to lower recruitment at higher SSB. Mechanisms were proposed and discussed but the issue could not be resolved given available data and life history information. The RW noted that the stock–recruitment relationship is crucial in determining the validity and value of status determination reference points and suggested that the stock-recruitment relationship for the two stocks reviewed in SEDAR 10 be comprehensively re-examined prior to the next formal assessment of gag grouper.

- **CPUE Index Weighting**: The RW discussed the weightings on indices, suggesting that increased weighting on MRFSS would lead to poorer fits

- **Sensitivity investigations**: To better understand the behavior of the assessment model for the input data series, the RW panel requested sensitivity model runs for the preferred base model (i.e., constant catchability). The base model run contains three fishery dependent CPUE indices and three sets of age and length composition datasets (commercial handline, commercial diving, and recreational headboat fisheries). Nine additional model runs removing each index, each fishery age composition dataset, and each fishery length composition dataset, one at a time were provided. Results suggest that the base model provides a balanced fit to all the data sources, illustrated by the base run falling within the middle of this set of sensitivity runs (Figures 12-14 in the Advisory Report). Relative to SSB, the run with the headboat CPUE data omitted shows the population increasing rapidly in the most recent years, reaching the highest terminal value of all the runs. In contrast, the run with the commercial handline CPUE omitted results in the lowest SSB value in the terminal year (Figure 12 in the Advisory report). This highlights the balanced fit between these two indices, which show opposite trends in the last few years. The RW Panel recommends that a way of displaying the influence of

each data source on the final assessment results be found and shown in the next assessment.

8. Recommend appropriate estimates of stock abundance, biomass, and exploitation.

- The details and rationale for the appropriate estimate of stock abundance, biomass and exploitation are listed in the Advisory report and the Addendum to the Assessment Report.

9. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); provide values for management benchmarks, range of ABC, and declarations of stock status.

- The methods to estimate population benchmarks and management parameters are based on the B-H stock-recruitment model estimated externally from the catch at age model with the RW preferred "base model". The estimates of these benchmarks are listed in the Advisory report and summarized as follows:

  MFMT, the Maximum Fishing Mortality Threshold, is set to F_{MSY} Proxy = $F_{30\%SPR}$.
  MSST, the Minimum Stock Size Threshold, is set = (1-M).B_{msy}.

- Status Determination Criteria: The SFA and management criteria recommendations and values are estimated from the preferred base model by the RW as follows:

Stock Status	Current Definition	Value from Previous Assessment	Value from Current Assessment
MSST	$(1-M)B_{MSY}$	NA	8062 klb
MFMT	F_{MSY} Proxy = $F_{30\%SPR}$	0.18	0.24
MSY	Yield at F_{MSY}	NA	1774 klb
OY	Yield at F_{OY} ($F_{45\%SPR}$)	NA	1570 klb
F_{OY}	$F_{45\%SPR}$	NA	0.13

Proposed Status Criteria	Definition	Value
MSST	Performance Based (see Advisory Report Special Comments)	5000 klb
MFMT	F_{MSY}	0.295
MSY	Yield at F_{MSY}	1774 klb

OY	65%F_{MSY} (Alt. 1) 75%F_{MSY} (Alt. 2) 85%F_{MSY} (Alt. 3)	1714 klb 1747 klb 1765 klb
F_{OY}	65%F_{MSY} (Alt. 1) 75%F_{MSY} (Alt. 2) 85%F_{MSY} (Alt. 3)	0.192 0.221 0.251
M (Age-varying)	Constant Equivalent	0.14

Additional Benchmarks	Exploitation Rate	SSB @	Yield @
F_{MAX}	0.330	8592 klb	1770 klb
$F_{20\%SPR}$	0.420	7087 klb	1737 klb
$F_{30\%SPR}$	0.240	10929 klb	1760 klb
$F_{45\%SPR}$	0.130	16370 klb	1570 klb

Declarations of Stock Status:

- Stock Status: Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007 (see projections, Figure 6). Relative to the MSST proposed by the RW, the stock is not overfished and is not projected to become overfished under any of the projection scenarios (Figure 6).

- The current definition of MSST may be overly conservative. The RW recommended an operational definition of MSST of 5 million pounds (see Special Comments).

- SEDAR and management agencies should be aware that all reference points are considered to be imprecisely estimated.

10. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.

- Projection of this stock is based on the RW-recommended "base model

- Estimates of recruitment in 2002-2004 are below average and fishing mortality rates in 2002-2004 are above the MSY level. Nevertheless, the stock projections suggest that the stock will remain above the proposed MSST in the medium-term. Projections with various constant fishing mortality rates starting in 2008 are shown in Table 3 and Figures 6-10 in the Advisory report.

- These projection methods are not adequate for forecasting the effects of management measures that involve changing selection patterns, such as

changes to minimum landing sizes and bag limits. The methods are, however, adequate for exploring the information content and management implications of small and incomplete data sets such as that available for gag grouper.

11. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.

- The panel recommended a preferred "base model" for this stock based on an assumption of constant catchability. Alternative configurations l are listed in the Stock Assessment Report and the Addendum to the Assessment Report.

12. Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.

- The RW evaluated the terms of reference from both DW and AW with consensus that the TOR were met.

13. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.

Additional Recommendations

- **Time-varying catchability**: The RW is of the opinion that catchability has changed over time, however, it does not believe that a constant 2% increase per year adequately describes the changes in catchability that are likely to have occurred. Step changes with the introduction of new equipment or management measures are more likely than monotonic changes. Learning and technological changes in navigation, fish detection and catching equipment have no doubt increased the efficiency of nominal fishing effort. However, management measures (increases in minimum size, time and area closures, bag limits) and changes in fishing behavior (moving on when "enough" fish have been caught) would be expected to result in decreased catchability. The Panel believes that, overall, catchability is likely to have increased. The Panel recommends that a special workshop be convened to estimate and quantify changes in catchability over the last 25 to 30 years.

- Strengthen the **MRFSS** program to provide more precise estimations of the age/length composition.

- Provide more detailed model diagnostics, such as complete lists of estimated parameters together with their estimated standard errors, in model sensitivity runs.

- Enforce the model residuals diagnostics to test for time series autocorrelation contributions to the lack of goodness of fit in the assessment.

- **Mark-recapture experiments**: Analyze the existing mark-recapture data and initiate new mark-recapture studies, which will help identify movements and migrations between two stocks, estimate fishing mortality, enhance population estimates; and better identify the stock structure and habitat preferences.

  The RW recommends analysis of the existing tagging data for movement within/between the two stocks., Quinn and Deriso (1999) comprehensively reviewed different forms of movement models, including: the diffusion model (Hilborn 1987; Deriso et al. 1991; Fournier et al. 1998); the generalized movement estimation (Ishii 1979, Sibert 1984, Anganuzzi et al. 1994; Xiao 1996, Xiao et al. 1999; Xiao and McShane 2000); and the movement-estimation mark–recapture methods (Seber 1982, Brownie et al. 1985, Schwarz et al. 1993). The Brownie model may be an excellent approach to alternate estimates of natural mortality rate.

  The RW recommends new tagging experiments, in order to estimate mixing rates and the associated fishing mortality independent of the commercial fishing. It is essential to analyze the existing tagging database to ascertain what can be done with the existing data in order to develop a new design for the future tagging experiment. This would include an effective design for tagging mortality, tagging shedding, reporting rates to get a higher confidence level in stock assessment, migration patterns, and growth.

- **Bias on estimating weight from the log-log length-weight relationship**

  The two stocks reviewed in SEDAR 10 used a log-log length-weight relationship to estimate weights from a back-transformation. The RW discussed a potential bias associated with this back-transformation illustrated as follows:

  Usually, the length-weight relationship is assumed to be $wt = aL^b$ with a log-normal error. A log-transformation is commonly used to linearize the equation and cast the estimation problem into the simple linear regression as:

$$y = \ln(wt) = \ln(a) + b\ln(L) + \varepsilon = \alpha + \beta\ln(L) + \varepsilon \qquad (1)$$

  The parameters from this simple linear regression can be estimated by least squares. With estimated parameters: $\hat{\alpha}, \hat{\beta}$, the predicted weight ($w_0$) from a specific length (L_0) is then back-calculated:

$$\hat{w}_0 = e^{\hat{\alpha}+\hat{\beta}\ln(L_0)} \qquad (2)$$

Or with a bias corrected equations as in both assessments as

$$\hat{w}_0 = e^{\hat{\alpha}+MSE/2+\hat{\beta}\ln(L_0)} \qquad (3)$$

We would want an unbiased predicted weight of w. It can be shown that both back-calculations in (2) and (3) are biased high as an estimate to the weight of $wt = e^{\alpha+\beta\ln(L)} = aL^b$ with (3) used in the Assessment bias-higher than (2) since

$$E(\hat{w}) = E\left(e^{\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon}\right) = e^{E\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)+\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = e^{\alpha+\beta\ln(L)}e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = w\times e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}}$$

The predicted weight from the estimated log-log length-weight model is biased-high with the bias: $e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = e^{\frac{\sigma^2+V\left(\hat{\alpha}+\hat{\beta}\ln(L)\right)}{2}}$.

Therefore this bias is not only dependent on the estimated model variance $\hat{\sigma}^2$=MSE, but is also dependent on the estimated correlation between the parameters. In addition, the bias is dependent on the specified length (len_0) to be predicted with the smallest bias at len_0 = (mean observed length). This means that the prediction bias is not constant over the data range (contrary to the common bias correction $wt_0 = e^{\hat{\alpha}+\hat{\beta}\times len_0-\hat{\sigma}^2/2}$). In the case of extrapolation to large lengths, this bias could be remarkably significant. Details can be found in Chen (2004).

14. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)

First drafts of the Consensus Summary and Advisory Report were completed during the Review Workshop. All Review Panel members contributed to the Consensus Report. The assessment team completed the first draft of the Advisory Report which was then reviewed by the Review Panel. The Consensus Report and Advisory Report were completed by email subsequent to the Review Workshop.

General recommendations to SEDAR

- There was large volume of documentation associated with this RW. The Review Panel recommends a clear executive summary for all substantive Data and Assessment Documents.

- It could be more informative to distribute a succinct table of model equations and parameters (estimated and observed) to be provided for each assessment

along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.

2.4 Special Comments

In both stock areas, the stock and recruitment scatter plot do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSBs and that B_{MSY} falls in the range of SSBs observed in the past. The Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico both the Beverton and Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and B_{MSY} is estimated to be higher than SSBs observed in the past. The RW considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

MSST, currently defined in the FMP as (1-M)*BMSY, will be very close to B_{MSY} because M = 0.14 is used. Given the uncertainties in the assessment, the biomass would be expected to be estimated to fall below MSST with a relatively high frequency even if the true biomass were close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative for the South Atlantic. There are no indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the MSST could be set at 5 million lbs as an operational definition to be re-examined at the next assessment.

Comparing and Contrasting the Two Gag Grouper Assessments

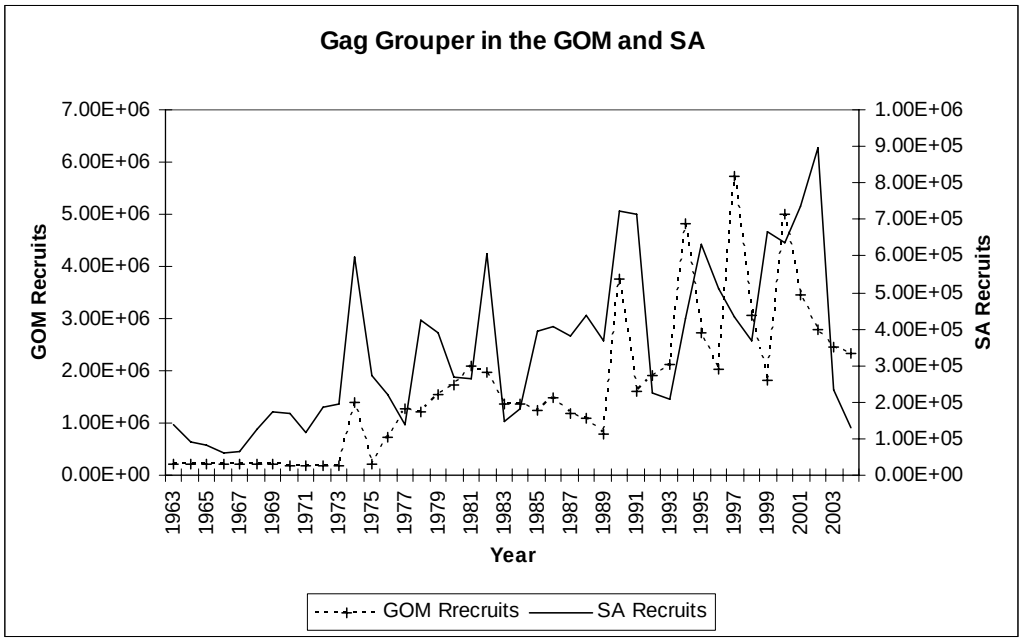
The main assessment model for both stock areas is a statistical catch at age model, but the implementations differ. For the South Atlantic a customized model has been developed using ADMB while for the Gulf of Mexico, an existing software (CASAL (C++ algorithmic stock assessment laboratory) can be downloaded from ftp://ftp.niwa.co.nz/software/casal) was used. CASAL was one of several integrated assessment software recently evaluated by the IATTC; the report can be downloaded at http://www.iattc.org/PDFFiles2/Assessment-methods-WS-Nov05-ReportENG.pdf . For the South Atlantic, a production model (ASPIC) was also run and for the Gulf of Mexico two VPAs were run: one was a strict continuity run and the other one was parameterized to mimic the CASAL run. VPA was not used in the South Atlantic because of insufficient complete catch at age information. The RW Panel considers that the statistical catch at age approach has better statistical foundations and more flexibility in

the type of information that can be used than VPA or general production models. The RW Panel recommends that alternate assessment approaches (ASPIC for the South Atlantic and VPA for the Gulf of Mexico) continue to be used in parallel and that the results be presented in the report of the Assessment Workshops. Standard inputs (catch at age, length at age, weights at age, indices of stock size (by age and length if appropriate) and outputs (population numbers at age, population biomass at age, spawning biomass, fishing mortality at age) should be provided in a format easily readable by spreadsheet programs. Neither of the assessments considers gender explicitly.

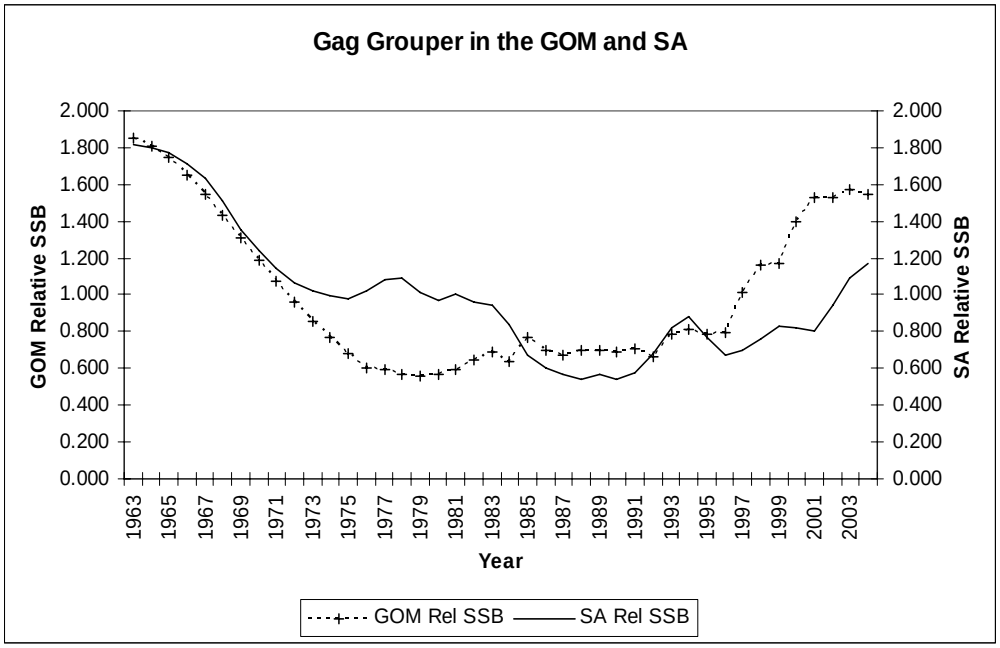
Although the approach has been used in the assessment of other species, it is not clear that the ADMB statistical catch at age implementation conforms to the Model Acceptance Note 1 in the ToRs of the AW. The assessment team is encouraged to provide the required documentation and work towards including the assessment in the NFT packages. Presumably, the evaluation performed by the IATTC implies that the CASAL does conform to the Model Acceptance Note 1.

In summary, the development of the stocks has been similar, presumably because the fisheries have followed similar paths.

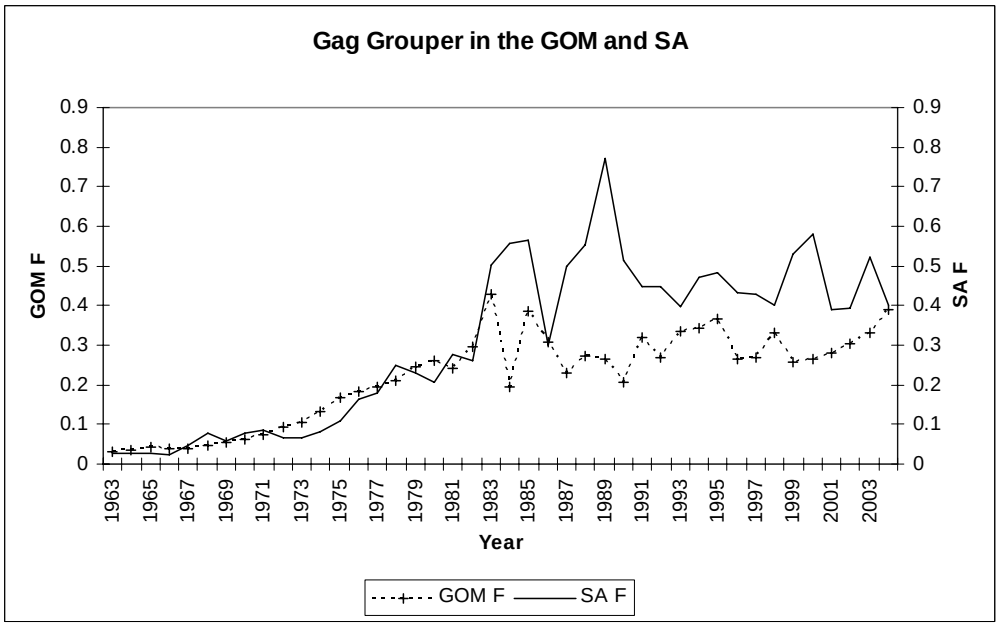
In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.



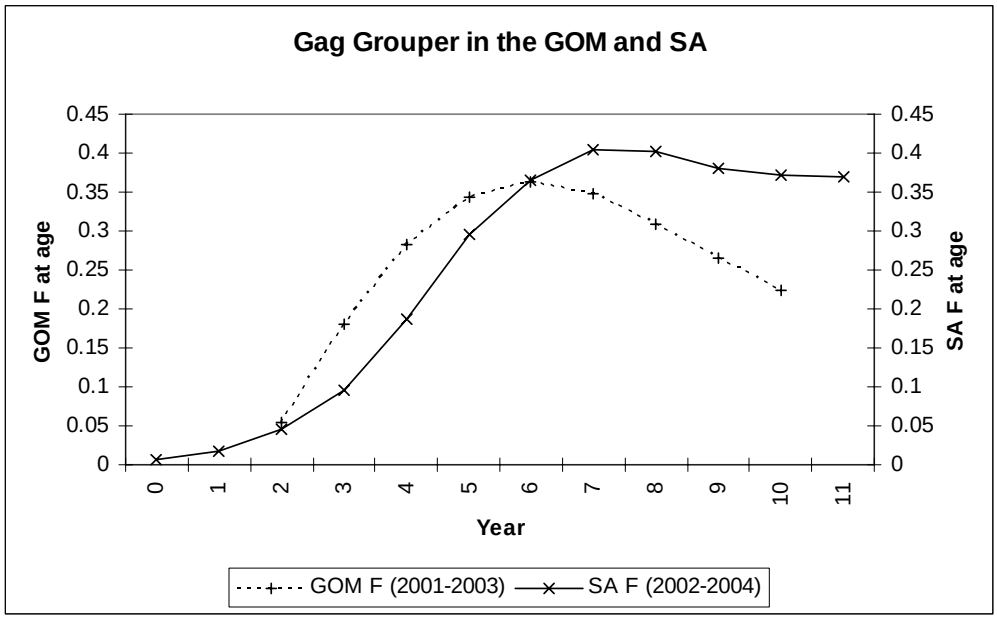
For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.



Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.



Average fishing mortality at age (2001-2003 for the GOM, 2002-2004 for the SA) show different patterns. F's are higher at age 3-5 in the Gulf of Mexico than in the South Atlantic but at older ages it is the opposite. The F at age pattern is clearly dome shaped in the Gulf of Mexico and nearly flat topped in the South Atlantic.



References

Anganuzzi, A., Hilborn, R., and Skalski, J.R. 1994. Estimation of size selectivity and movement rates from mark–recovery data. Can. J. Fish. Aquat. Sci. **5**1: 734–742.

Brownie, C., Anderson, D.R., Burnham, K.P., and Robson, D.S. 1985. Statistical inference from band-recovery data—a hand-book. 2nd ed. U.S. Fish Wildl. Serv. Resour. Publ. No. 156.

Chen, D. G. 2004. Bias and bias correction in fish recruitment prediction. North American Journal of Fisheries Management, 24:724-730.

Deriso, R.B., Punsly, R.G., and Bayliff, W.H. 1991. A Markov model of yellowfin tuna in the eastern Pacific Ocean and some analyses for international management. Fish. Res. **1**1: 375–395.

Fournier, D.A., Hampton, J., and Sibert, J.R. 1998. MULTIFAN-CL: a length-based, age-structured model for fisheries stock assessment, with application to South Pacific albacore, *Thunnus alalung*a. Can. J. Fish. Aquat. Sci. **5**5: 2105–2116.

Hilborn, R. 1987. Spatial models of tuna dynamics in the western Pacific: is international management of tuna necessary? *In* Modelling and management of resources under uncertainty. *Edited by* T.L. Vincent, Y. Cohen, W.J. Grantham, G.P. Kirkwood, and J.M. Skowronski. Lecture notes in biomathematics. No. 72. Springer-Verlag, Berlin. pp. 276–286.

Ishii, T. 1979. Attempt to estimate migration of fish population with survival parameters from tagging experiment data by the simulation method. Investig. Pesq. **4**3: 301–317.

Quinn, T.J., II, and Deriso, R.B. 1999. Quantitative fish dynamics. Oxford University Press, New York.

Schwarz, C.J., Schweigert, J.F., and Arnason, A.N. 1993. Estimating migration rates using tag recovery data. Biometrics, **4**9: 177–193.

Seber, G.A.F. 1982. The estimation of animal abundance and related parameters. 2nd ed. Griffin, London.

Sibert, J.R. 1984. A two-fishery tag attrition model for the analysis of mortality, recruitment, and fishery interaction. Tuna and Billfish Assessment Programme, South Pacific Commission, Noumea, New Caledonia. Tech. Rep. No. 13.

Xiao, Y. 1996. A framework for evaluating experimental designs for estimating rates of fish movement from tag recoveries. Can. J. Fish. Aquat. Sci. **5**3: 1272–1280.

Xiao, Y., and McShane, P. 2000. Estimation of instantaneous rates of fishing and natural mortalities from mark–recapture data on the western king prawn *Penaeus latisulcatus* in the Gulf St. Vin-cent, Australia, by conditional likelihood. Trans. Am. Fish. Soc. **12**9: 1005–1017.

Xiao, Y., Stevens, J.D., and West, G.J. 1999. Estimation of fishing and natural mortalities from tag experiments with exact or grouped times at liberty. Can. J. Fish. Aquat. Sci. **5**6: 868–874.

7. Appendix 3.

SEDAR 10 Review Workshop

Assessment Advisory Report
Gulf of Mexico Gag Grouper

Stock distribution and identification

- The management unit for Gulf of Mexico gag grouper extends from the United States – Mexico border in the west through northern Gulf of Mexico waters and west of the Dry Tortugas and the Florida Keys (waters within the Gulf of Mexico Fishery Management Council Boundaries).
- The SEDAR 10 Review Workshop (RW), using several sources of information, examined and accepted the current stock definitions for the South Atlantic and Gulf of Mexico gag grouper.

Assessment methods

- Gulf of Mexico gag grouper were primarily assessed with a statistical forward projection catch-at-age model (CASAL). Additionally, the assessment model used in the 2001 assessment (VPA, virtual population analysis), was run to show the effects of updated data and the effects of adding indices of abundance not available in 2001. With the statistical catch-at-age model, various configurations and sensitivity runs were explored. Details of all models are available in the Stock Assessment Report.
- The Assessment Workshop (AW) developed two base runs: one assuming constant catchability for the fishery- dependent indices and the other assuming a time-varying catchability. Each base run of the catch-at-age model was the basis for estimation of benchmarks and stock status.
- The SEDAR 10 Review Workshop recommended the run with constant catchability as the preferred 'base run'.
- The RW carefully reviewed the stock recruitment relationships developed from 1983-2004, considering the Beverton- Holt, Ricker and "hockey stick" (Barrowman and Meyers, 2000) models. Although the AW preferred the Beverton-Holt relationship over the Ricker, the RW concluded that both might overestimate virgin recruitment and, thus, MSY and SSB_{MSY}.

Assessment data

- Data sources include abundance indices, recorded landings and catch estimates, and calculated total annual size and age composition from the fisheries.
- Both fishery-dependent and fishery-independent indices of abundance were included in the assessment. Fishery-dependent abundance indices were available from the commercial handline fishery, the commercial longline fishery, the recreational headboat fishery and a combined index from the recreational charter and private boat fisheries (MRFSS) as presented by the SEDAR-10 data workshop. The two fishery-independent abundance indices were developed from the SEAMAP reef fish video survey.
- Catch information (including both landings and dead discards) was available for all recreational and commercial fisheries. This benchmark assessment included data through 2004.
- Complete details are available in the SEDAR 10 Data and Assessment Workshop Reports, and the SEDAR 10 workshop working papers. Additional information and discussion can be found in the companion SEDAR 10 Review Workshop Consensus Summary Report for Gulf of Mexico Gag Grouper.

Catch trends

- Estimated catches (landings and dead discards) in the last 7 years (1998-2004) have exceeded all previous levels and show an increasing trend since 2000. The 2004 estimated catches were about 85% higher than the highest estimated catches before 1998 and about 75% above the latest estimated catches (1999) used in the last assessment. Commercial landings since the late 1990's have increased about 60% compared to the 1980's (Figure 1). Estimated recreational landings have almost doubled since the 1980's while the estimated recreational dead discards have roughly tripled (Figure 2).

Fishing mortality trends

- Estimated fishing mortality rates have generally increased over the period of the assessment, ranging from about 0.2 to about 0.4 (Figure 3). In the last four years the annual fishing mortality rate has increased every year and is currently estimated to be 0.39.

Stock abundance and biomass trends

- During the 1980's recruitment was estimated to average about 1.2 million fish (age 1). Since 1990 recruitment has averaged about 2 million fish (Figure 4). The model estimated that there were four strong year classes from 1990 to 2000 which averaged about 4.6 million fish. After 2000, estimated recruitment declined each year and was estimated to be 2.3 million fish in 2004.

- Estimated spawning stock biomass declined during the late 1960's and the 1970's, remained at about 20 million pounds during the 1980's and early 1990's and then increased from 1997 to 2001, perhaps as a result of the higher recruitment. Since

2002 spawning stock biomass has remained at about 41 million pounds (Figure 4). Estimated total biomass followed a similar pattern with lower levels in the 1980's and an increase in the 1990's. Estimated total biomass peaked at about 56 million pounds in 2002 and then declined to an estimated 51 million pounds in 2004.

Status determination criteria

- The SFA and management criteria recommendations and values are estimated from the preferred base model by the RW as follows.

:

Stock Status	Current Definition	Value from Previous Assessment	Value from Current Assessment
MSST	$SPR_{20\%}$ (pre-SFA)	NA	NA
MFMT	$F_{30\%SPR}$ (F_{MSY} Proxy)	0.45	0.17
MSY	Yield at $F_{30\%SPR}$ (F_{MSY} proxy)	5.5 mp	3.9 mp
OY	Yield at $SPR_{20\%}$	NA	NA
F_{OY}	undefined	NA	NA

Proposed Status Criteria	Constant Catchability	
	Definition	Value
MSST	(1-M)SSB_{MSY} (see Special Comments)	NA
MFMT	F_{MSY}	NA
MSY	Yield at F_{MSY}	NA
OY	Yield at $F_{40\%SPR}$	NA
F_{OY}	$F_{40\%SPR}$	NA
M (Age-varying)	Constant Equivalent	0.14

Constant Catchability			
Additional Benchmarks	Exploitation Rate	SSB[1]	Yield[1,2]
F_{MAX}	0.23	37.6 mp	3.93 mp
$F_{20\%SPR}$	0.37	23.1 mp	3.74 mp
$F_{30\%SPR}$	0.25	34.6 mp	3.92 mp
$F_{0.1}$	0.13	55.9 mp	3.66 mp

1. Assuming future recruitment is equal to geometric mean recruitment from 1984-2004
2. Yield values reflect both landings and dead discards.

Stock Status

- Estimated recruitment has ranged from 1 to 6 million fish over a moderate range of spawning stock sizes, resulting in a high degree of uncertainty about the stock recruitment relationship and estimates of biomass benchmarks (MSY, SSB_{MSY} and MSST). Because of the uncertainty in the biomass benchmarks, current stock status (SSB_{2004} / SSB_{MSY}) is not reported.
- Because of this, the MSY-based benchmarks in this assessment were not deemed useful for management.
- The current (2004) fishing mortality rate on this stock is estimated as 0.39. Relative to the current proxy for F_{MSY} ($F_{SPR30\%}$), estimated as 0.17, overfishing of the Gulf of Mexico gag grouper is occurring.
- For the Gulf of Mexico, a MFMT of 0.17 (current value of $F_{30\%SPR}$) is not consistent with the recent dynamics of gag grouper: fishing mortality has been fluctuating around F = 0.30 for more than twenty years and the stock biomass is near its historical maximum. The Review Panel could not provide advice on target F and biomass reference points, but noted that the stock has apparently increased as a result of good recruitment under estimated fishing mortality rates that have fluctuated around an average value of F = 0.30 since the early 1980s. The Review Panel advised that it would be prudent to reduce fishing mortality below F = 0.30.
- There is currently not a SFA-compliant definition of stock status relative to abundance. Apparently the Gulf of Mexico Fishery Management Council uses (1-M)SSB_{MSY} as a working definition. Since the value of that reference point cannot be determined, the status of the stock with respect to biomass is unknown
- The Review Panel notes that available stock recruitment information suggests that recruitment may be impaired below 20 million pounds. Given that the model estimates of the spawning stock biomass benchmarks are uncertain, the Panel recommends that the Council consider 20 million pounds as a temporary operational definition of the lower bound for spawning stock size (i.e. MSST). Relative to the Review Panel's suggestion of an operational MSST of 20 million pounds, the stock is not overfished and is not approaching an overfished state.

Projections

- Projections assumed a constant stock recruitment relationship equal to geometric mean recruitment (1984-2004; 2,124,871 fish). Projections were generated for true yield (landings only) and total removals (landings plus dead discards) assuming 2005 total removals of 12.38 million pounds (5.81 mp landed and 6.57 mp dead discards). Stock projections were done for scenarios of constant catch (fixed quotas) and constant fishing mortality rate (F) but only those assuming constant F are shown here.

- Projections for spawning stock biomass (mature females in mt), annual fishing mortality and total removals and yield at various levels of constant fishing mortality rates starting in 2006 are shown in Table 3 and Figure 8.

Special Comments

- *Constant and time-varying catchability alternative.* The Review Panel discussed the relationship of technology to catchability and the effects of catchability changes on fishery-dependent abundance indices. The Panel recognized that technology improvements over time, particularly better electronics, have likely made fishermen more effective and efficient at catching fish. The Panel, however, did not support an assessment that assumed a simple linear (2% annually) increase. Nevertheless, this is an important issue and the Review Panel recommends further investigations of time-varying catchability.

- *Stock-recruitment relationship.* In both stock areas, the stock and recruitment scatter plot does not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSBs observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico, both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and SSB_{MSY} is estimated to be higher than SSB's observed in the past. The Review Panel considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

- *Discussion of RW recommended MSST.* MSST, defined as $(1\text{-M})SSB_{MSY}$, is very close to SSB_{MSY} because M = 0.14 is used. Given the uncertainties in the assessment, the biomass would be expected to be estimated to fall below MSST with a relatively high frequency even if true biomass were close to B_{MSY}. In the Gulf of Mexico, there are indications that recruitment could become impaired below a SSB of 20 million lbs and the Review Workshop suggested that MSST could be set at this level as a temporary operational definition, to be re-examined at the next assessment.

Table 1. Landings and discards for commercial longline, handline and others, recreational private charter and headboat and landed and dead discards by sector, 1963-2004, in millions of pounds.

							Landings		Dead discards		
Year	Headboat	MRFSS	Longline	Handline	Others	Total	Commercial	Recreational	Commercial	Recreational	Total
1963	-	443,710	-	1,288,786	1,445	1,733,941	1,290,231	443,710	-	-	1,733,941
1964	-	479,243	-	1,632,460	9,088	2,120,792	1,641,549	479,243	-	-	2,120,793
1965	-	517,622	-	1,815,588	573	2,333,783	1,816,162	514,193	-	3,429	2,333,784
1966	-	559,075	-	1,456,566	1,227	2,016,868	1,457,793	546,372	-	12,703	2,016,868
1967	-	603,848	-	1,155,546	9,839	1,769,233	1,165,387	580,407	-	23,441	1,769,234
1968	-	652,205	-	1,192,284	4,414	1,848,904	1,196,699	616,389	-	35,816	1,848,905
1969	-	704,436	-	1,376,520	3,205	2,084,161	1,379,725	654,412	-	50,024	2,084,161
1970	-	760,849	-	1,283,654	2,502	2,047,005	1,286,158	694,572	-	66,277	2,047,007
1971	-	869,493	-	1,376,502	2,782	2,248,777	1,379,285	779,756	-	89,737	2,248,778
1972	-	993,651	-	1,460,381	3,980	2,458,012	1,464,362	875,105	-	118,546	2,458,013
1973	-	1,135,538	-	1,081,222	4,899	2,221,659	1,086,122	981,786	-	153,752	2,221,660
1974	-	1,297,685	-	1,184,110	1,355	2,483,150	1,185,465	1,101,090	-	196,595	2,483,150
1975	-	1,482,652	-	1,446,621	4,465	2,933,737	1,451,086	1,234,168	-	248,483	2,933,738
1976	-	1,697,042	-	1,198,438	9,115	2,904,595	1,207,552	1,385,311	-	311,731	2,904,594
1977	-	1,942,432	-	977,267	7,513	2,927,212	984,780	1,554,358	-	388,074	2,927,212
1978	-	2,225,942	-	875,262	10,952	3,112,156	886,213	1,745,396	-	480,546	3,112,155
1979	-	2,551,406	1,383	1,342,247	9,685	3,904,721	1,353,314	1,959,527	-	591,879	3,904,720
1980	-	2,908,996	89,304	1,317,859	11,866	4,328,024	1,419,030	2,187,337	-	721,659	4,328,026
1981	-	2,458,563	467,068	1,498,744	15,608	4,439,984	1,981,421	1,829,502	-	629,061	4,439,984
1982	-	3,508,922	1,009,998	1,334,617	14,163	5,867,699	2,358,780	3,216,983	-	291,939	5,867,702
1983	-	7,459,833	681,064	1,039,425	17,652	9,197,974	1,738,139	6,379,368	-	1,080,465	9,197,972
1984	-	2,134,042	433,159	1,098,289	18,407	3,683,897	1,549,855	1,950,479	-	183,563	3,683,898
1985	-	6,967,353	380,850	1,398,341	27,879	8,774,423	1,807,070	6,570,911	-	396,442	8,774,423
1986	308,430	4,263,230	517,405	1,155,013	29,022	6,273,100	1,701,441	3,597,491	-	974,168	6,273,101
1987	230,540	2,827,000	656,042	852,579	29,544	4,595,705	1,538,166	2,447,832	-	609,708	4,595,706
1988	164,606	4,223,613	402,244	791,073	23,178	5,604,715	1,216,494	3,747,483	-	640,736	5,604,713
1989	337,797	3,264,214	426,018	1,235,438	31,374	5,294,841	1,692,830	2,314,324	-	1,287,686	5,294,840
1990	307,722	1,990,704	624,659	1,129,877	40,817	4,093,779	1,793,090	1,259,887	2,261	1,038,538	4,093,777
1991	111,374	4,842,904	509,707	992,667	63,090	6,519,743	1,565,320	2,748,231	145	2,206,048	6,519,744
1992	156,438	3,950,703	592,824	1,002,725	68,548	5,771,238	1,663,880	2,245,860	217	1,861,282	5,771,239
1993	211,126	5,874,147	482,328	1,280,529	105,760	7,953,890	1,865,116	2,787,852	3,502	3,297,421	7,953,892
1994	316,998	6,457,563	351,815	1,148,121	119,046	8,393,543	1,618,740	1,999,707	243	4,774,854	8,393,544
1995	195,110	7,250,518	393,648	1,157,606	104,670	9,101,551	1,651,664	2,700,221	4,260	4,745,406	9,101,551
1996	176,888	5,310,846	397,024	1,106,573	67,504	7,058,835	1,566,658	2,353,437	4,444	3,134,296	7,058,834
1997	167,797	6,793,551	419,837	1,101,101	82,634	8,564,921	1,597,645	2,573,108	5,928	4,388,240	8,564,922
1998	427,681	8,597,631	608,998	1,848,718	81,579	11,564,607	2,530,686	3,519,315	8,610	5,505,998	11,564,609
1999	315,278	7,251,549	549,813	1,481,357	68,278	9,666,274	2,097,739	3,721,784	1,709	3,845,042	9,666,274
2000	270,612	8,375,360	636,817	1,605,425	81,260	10,969,475	2,283,311	4,972,529	40,192	3,673,445	10,969,477
2001	166,914	8,766,604	1,052,744	2,088,284	100,916	12,175,463	3,128,510	4,031,469	113,436	4,902,049	12,175,463
2002	145,311	10,640,507	1,059,401	1,933,577	61,659	13,840,455	2,983,506	4,435,518	71,132	6,350,300	13,840,455
2003	240,352	12,219,344	1,189,696	1,476,593	67,095	15,193,079	2,626,122	3,773,139	107,262	8,686,558	15,193,081
2004	327,271	13,718,083	1,190,773	1,756,584	72,808	17,065,519	2,901,692	4,913,422	118,472	9,131,932	17,065,519

Table 2. Estimated fishing mortality rate, spawning stock size (millions of pounds of mature females) and recruitment for Gulf of Mexico gag.

Year	F pressure	SSB Fem	Recruits
1963	0.029	49.109	214586
1964	0.036	47.911	214574
1965	0.041	46.334	213181
1966	0.039	43.826	211267
1967	0.039	40.962	208019
1968	0.045	37.971	203970
1969	0.054	34.813	199294
1970	0.061	31.532	193783
1971	0.076	28.430	187283
1972	0.093	25.451	180294
1973	0.105	22.661	172637
1974	0.131	20.337	1393800
1975	0.168	17.988	202205
1976	0.183	15.959	721440
1977	0.194	15.804	1267200
1978	0.210	15.164	1216470
1979	0.245	14.805	1541900
1980	0.259	15.072	1712720
1981	0.243	15.696	2094330
1982	0.296	17.165	1972460
1983	0.428	18.335	1364890
1984	0.194	17.021	1358380
1985	0.384	20.498	1252910
1986	0.306	18.521	1476470
1987	0.231	17.885	1192730
1988	0.274	18.595	1086810
1989	0.263	18.550	793166
1990	0.208	18.350	3761120
1991	0.318	18.842	1602020
1992	0.270	17.584	1916250
1993	0.334	20.902	2119320
1994	0.344	21.509	4814020
1995	0.368	20.972	2712410
1996	0.267	20.987	2033390
1997	0.270	26.900	5741390
1998	0.329	30.734	3062170
1999	0.257	30.963	1833230
2000	0.266	37.195	5007130
2001	0.281	40.578	3467710
2002	0.305	40.494	2789170
2003	0.329	41.768	2452980
2004	0.389	40.951	2344190

Table 3. Projection trends for Gulf of Mexico gag grouper assuming constant recruitment and various constant fishing mortality rates. "All Removals" includes landings and dead discards and "Landed Yield" landings only. SPR% refers to fishing rates that will achieve the indicated percent SPR under equilibrium conditions.

ALL REMOVALS

SSB mature female wgt MT

Year	SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
1995	9297	9297	9297	9297	9297	9297	9297
1996	9357	9357	9357	9357	9357	9357	9357
1997	12170	12170	12170	12170	12170	12170	12170
1998	13950	13950	13950	13950	13950	13950	13950
1999	14100	14100	14100	14100	14100	14100	14100
2000	17100	17100	17100	17100	17100	17100	17100
2001	18450	18450	18450	18450	18450	18450	18450
2002	18370	18370	18370	18370	18370	18370	18370
2003	18970	18970	18970	18970	18970	18970	18970
2004	18410	18410	18410	18410	18410	18410	18410
2005	15110	15110	15110	15110	15110	15110	15110
2006	13240	13240	13240	13240	13240	13240	13240
2007	12350	13620	14440	14970	13870	13870	12190
2008	11470	13740	15340	16410	14220	14220	11190
2009	11120	14210	16520	18130	14880	14880	10770
2010	10980	14700	17660	19800	15560	15560	10570

F annual mortality rate

Year	SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
1995	0.458	0.458	0.458	0.458	0.458	0.458	0.458
1996	0.310	0.310	0.310	0.310	0.310	0.310	0.310
1997	0.315	0.315	0.315	0.315	0.315	0.315	0.315
1998	0.399	0.399	0.399	0.399	0.399	0.399	0.399
1999	0.297	0.297	0.297	0.297	0.297	0.297	0.297
2000	0.309	0.309	0.309	0.309	0.309	0.309	0.309
2001	0.330	0.330	0.330	0.330	0.330	0.330	0.330
2002	0.364	0.364	0.364	0.364	0.364	0.364	0.364
2003	0.400	0.400	0.400	0.400	0.400	0.400	0.400
2004	0.493	0.493	0.493	0.493	0.493	0.493	0.493
2005	0.422	0.422	0.422	0.422	0.422	0.422	0.422
2006	0.375	0.251	0.177	0.132	0.228	0.228	0.392
2007	0.375	0.251	0.177	0.132	0.228	0.228	0.392
2008	0.375	0.251	0.177	0.132	0.228	0.228	0.392
2009	0.375	0.251	0.177	0.132	0.228	0.228	0.392
2010	0.375	0.251	0.177	0.132	0.228	0.228	0.392

Total removals (landed + dead discards)

Year	SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
1995	4134	4134	4134	4134	4134	4134	4134
1996	3203	3203	3203	3203	3203	3203	3203
1997	3883	3883	3883	3883	3883	3883	3883
1998	5243	5243	5243	5243	5243	5243	5243
1999	4376	4376	4376	4376	4376	4376	4376
2000	4960	4960	4960	4960	4960	4960	4960
2001	5509	5509	5509	5509	5509	5509	5509
2002	6263	6263	6263	6263	6263	6263	6263
2003	6877	6877	6877	6877	6877	6877	6877
2004	7732	7732	7732	7732	7732	7732	7732
2005	5622	5622	5622	5622	5622	5622	5622
2006	4536	3180	2307	1751	2914	2914	4709
2007	4263	3261	2494	1956	3037	3037	4375
2008	4083	3353	2681	2161	3166	3166	4152
2009	3989	3459	2867	2365	3302	3302	4028
2010	3931	3551	3028	2546	3419	3419	3950

LANDED YIELD

SSB mature female wgt MT

SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
9297	9297	9297	9297	9297	9297	9297
9357	9357	9357	9357	9357	9357	9357
12170	12170	12170	12170	12170	12170	12170
13950	13950	13950	13950	13950	13950	13950
14100	14100	14100	14100	14100	14100	14100
17100	17100	17100	17100	17100	17100	17100
18450	18450	18450	18450	18450	18450	18450
18370	18370	18370	18370	18370	18370	18370
18970	18970	18970	18970	18970	18970	18970
18410	18410	18410	18410	18410	18410	18410
15110	15110	15110	15110	15110	15110	15110
13710	13710	13710	13710	13710	13710	13710
12740	14050	14900	15240	14090	14090	12570
11750	14100	15740	16410	14160	14160	11460
11330	14490	16860	17870	14580	14580	10950
11120	14930	17940	19270	15040	15040	10690

F annual mortality rate

SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
0.458	0.458	0.458	0.458	0.458	0.458	0.458
0.310	0.310	0.310	0.310	0.310	0.310	0.310
0.315	0.315	0.315	0.315	0.315	0.315	0.315
0.399	0.399	0.399	0.399	0.399	0.399	0.399
0.297	0.297	0.297	0.297	0.297	0.297	0.297
0.309	0.309	0.309	0.309	0.309	0.309	0.309
0.330	0.330	0.330	0.330	0.330	0.330	0.330
0.364	0.364	0.364	0.364	0.364	0.364	0.364
0.400	0.400	0.400	0.400	0.400	0.400	0.400
0.493	0.493	0.493	0.493	0.493	0.493	0.493
0.378	0.378	0.378	0.378	0.378	0.378	0.378
0.375	0.251	0.177	0.149	0.248	0.248	0.392
0.375	0.251	0.177	0.149	0.248	0.248	0.392
0.375	0.251	0.177	0.149	0.248	0.248	0.392
0.375	0.251	0.177	0.149	0.248	0.248	0.392
0.375	0.251	0.177	0.149	0.248	0.248	0.392

Total landed yield MT

SPR20%	SPR30%	SPR40%	F0.1	Fmax	Fmsy	Fcurrent
2019	2019	2019	2019	2019	2019	2019
1766	1766	1766	1766	1766	1766	1766
2057	2057	2057	2057	2057	2057	2057
3001	3001	3001	3001	3001	3001	3001
2685	2685	2685	2685	2685	2685	2685
3615	3615	3615	3615	3615	3615	3615
3169	3169	3169	3169	3169	3169	3169
3636	3636	3636	3636	3636	3636	3636
3275	3275	3275	3275	3275	3275	3275
3463	3463	3463	3463	3463	3463	3463
2637	2637	2637	2637	2637	2637	2637
2378	1669	1211	1030	1651	1651	2471
2174	1675	1286	1118	1660	1660	2231
2057	1712	1379	1221	1701	1701	2088
2002	1769	1481	1331	1760	1760	2017
1960	1806	1557	1416	1799	1799	1964

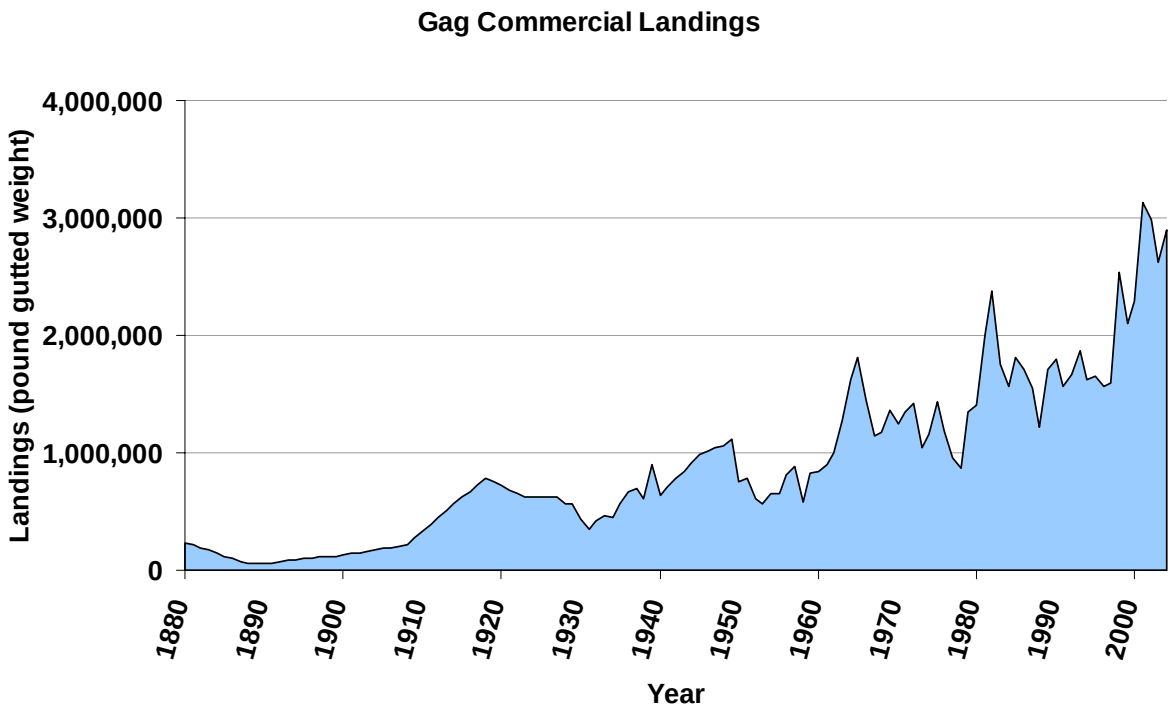


Figure 1. Estimated historical commercial landings of gag from U.S. Gulf of Mexico waters from 1880 to 2004 in pounds gutted weight.

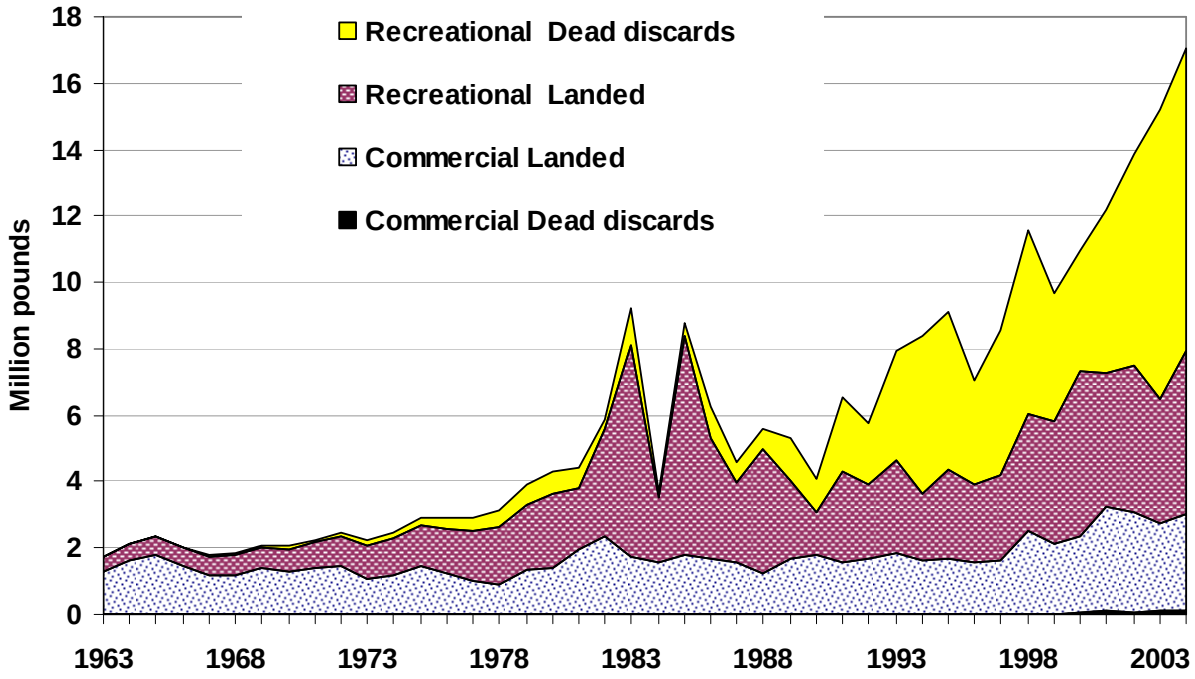


Figure 2. Gulf of Mexico gag landings and dead discards by the commercial and recreational fisheries in pounds gutted weight.

Figure 3. Estimated fishing pressure on Gulf of Mexico gag.

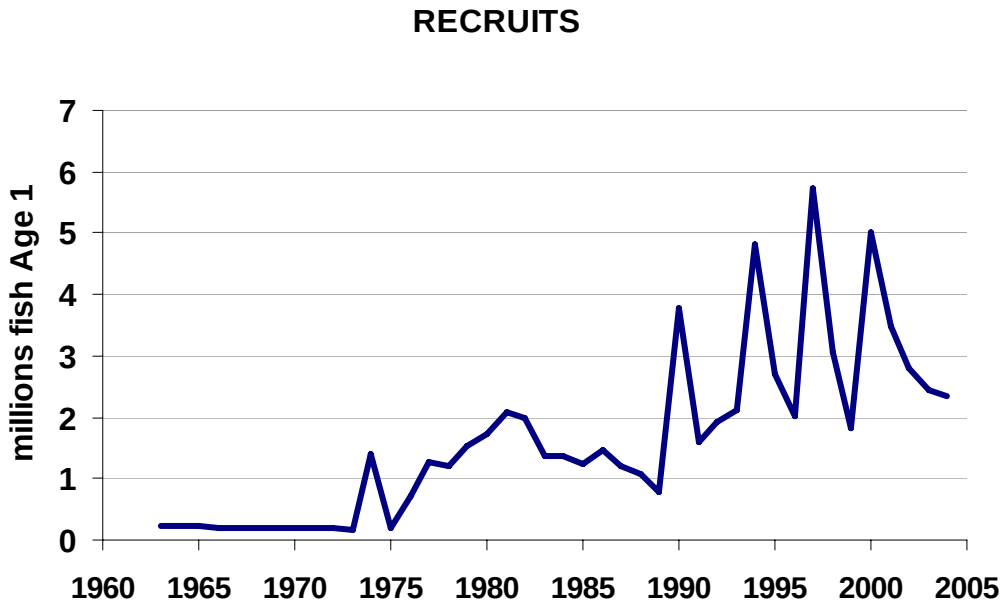


Figure 4. Estimated recruitment of Gulf of Mexico gag. Early recruitment estimates are considered unreliable and are thought to be due in large part to the absence of age composition and indices of abundance before 1981.

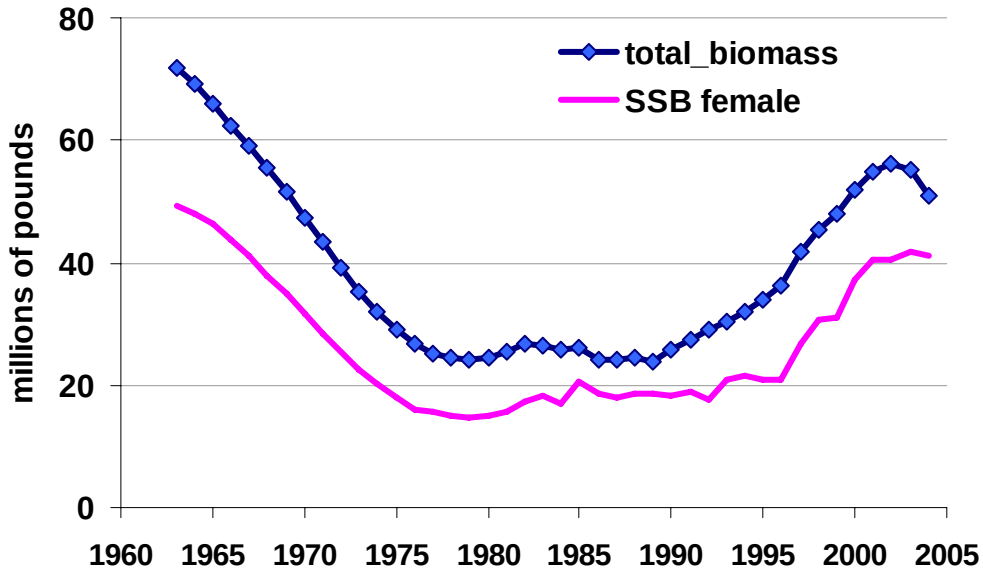


Figure 5. Estimated biomass of Gulf of Mexico showing spawning stock biomass (SSB, mature female) and total biomass in gutted weight.

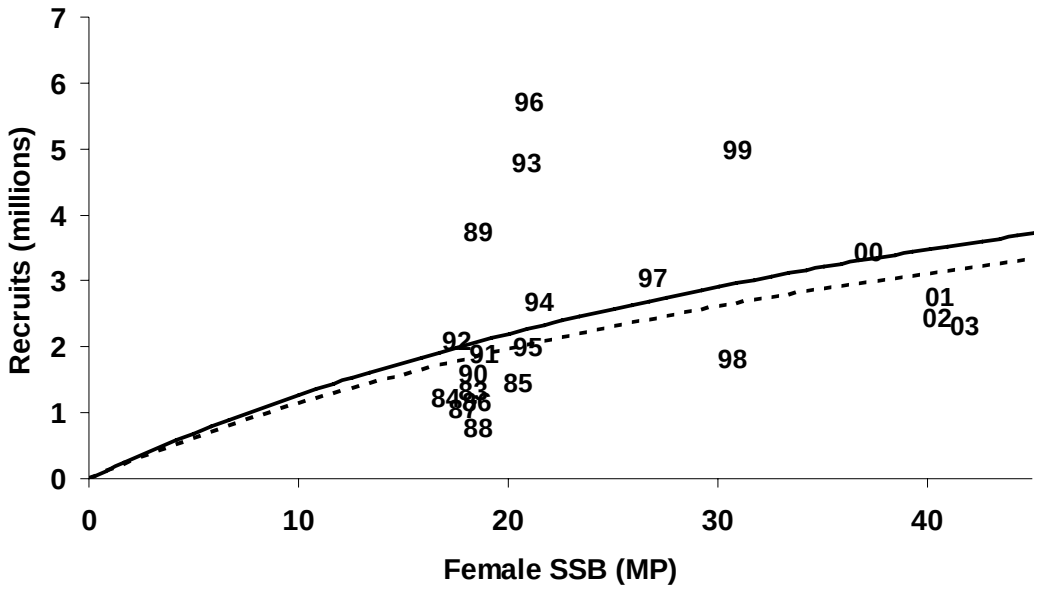


Figure 6. Estimated Beverton-Holt stock-recruitment relationship for Gulf of Mexico gag. Two digit year labels represent estimated recruitment for the 1983-2003 year classes and the associated female spawning stock biomass. The dashed curve is the estimated relationship, and the solid curve is the estimated relationship with lognormal bias correction.

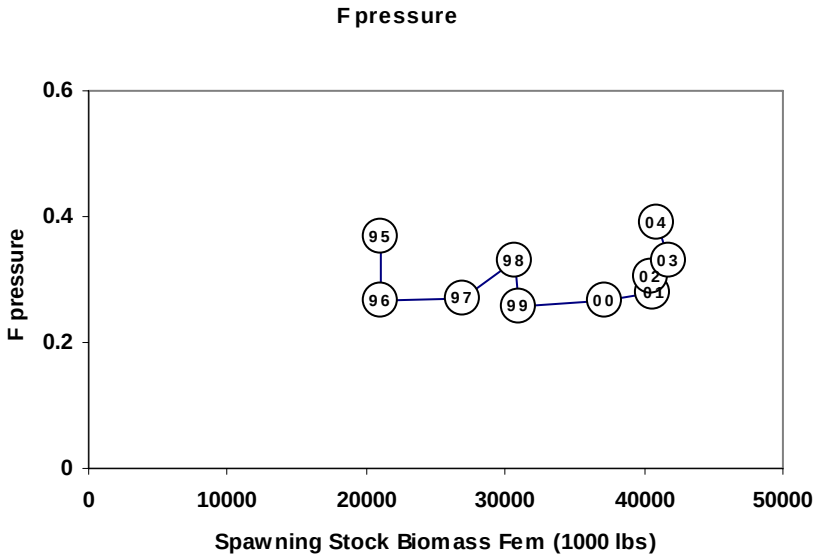


Figure 7. Phase plot of recent estimates of spawning stock biomass (thousand pounds, gutted weight) and fishing mortality rate.

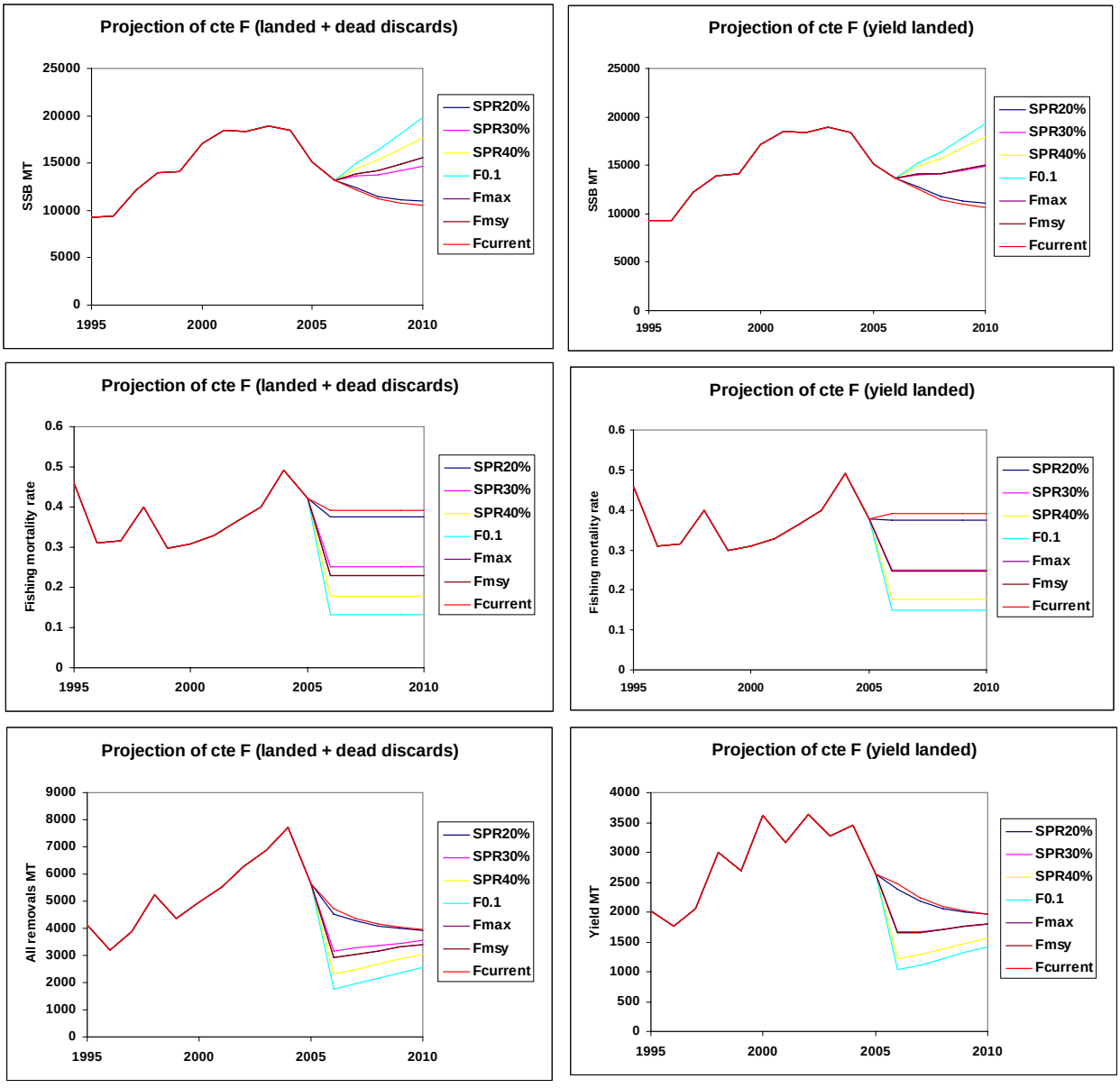


Figure 8. Projection trends from base model run assuming constant future recruitment. Projections of constant F mortality rate scenarios, projections on the left include total removals (landings & dead discards), those shown on the right are landed yield only.

8. Appendix 4:

SEDAR 10 Review Workshop Report

Gulf of Mexico Gag Grouper

Prepared by the SEDAR 10 Review Panel
June 26 - 30, 2006
Atlanta GA

Executive Summary

The SEDAR 10 Review Workshop took place in Atlanta, Georgia, June 26-30, 2006 and reviewed two stock assessments: South Atlantic gag grouper and Gulf of Mexico gag grouper. On Monday, June 26, the Review Workshop Panel received a presentation from the South Atlantic gag grouper assessment team, and on Tuesday, June 27, a similar presentation from the Gulf of Mexico gag grouper assessment team. The balance of the week, through Thursday afternoon, was devoted to additional discussion with the assessment teams to refine and better understand the assessments. Draft versions of the two advisory reports were discussed on Thursday. All parts of the meeting, with the exception of Friday morning, were open to the public. On Friday, the Panel discussed initial drafts of the Consensus Summary documents.

The Review Panel commends the two assessment teams and was especially impressed by the responsiveness of both teams to requests for additional analyses and clarifying information. The Review Panel was also very appreciative of the helpful feedback and suggestions from all SEDAR 10 attendees as we discussed initial drafts of Review Workshop documents.

The Review Panel also appreciates the organization of SEDAR 10 in that two gag grouper stocks were assessed via a common Data Workshop and concurrent and complementary Assessment Workshops. This allowed the Review Panel to not only better understand the individual stock assessments but to offer more consistent advice to the two managing Councils.

From that point of view the Review Panel notes that the development of the stocks has been similar, presumably because the fisheries have followed similar paths.

In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.

For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.

Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.

An important result of the Review Workshop is determination of current stock status relative to biological reference points established in the respective FMPs.

In both stock areas, the stock and recruitment data do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSB's observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSB's lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSB's and SSB_{MSY} is estimated to be higher than SSB's observed in the past. The Review Panel considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

The Minimum Stock Size Threshold (MSST) for the Gulf of Mexico gag grouper stock, $(1\text{-}M)*SSB_{MSY}$, is very close to SSB_{MSY} because age-averaged natural mortality rate, M, is estimated as 0.14. Given the uncertainties in the assessment, the biomass would be expected to fall below MSST with a relatively high frequency even if true biomass were close to SSB_{MSY}. In the Gulf of Mexico, there are indications that recruitment could become impaired below a SSB of 20 million lbs and the Review Workshop suggested that MSST could be set at this level as a temporary operational definition, to be re-examined at the next assessment.

The current (2004) fishing mortality rate on this stock is estimated as 0.39. Relative to the current proxy for F_{MSY} ($F_{SPR30\%}$), estimated as 0.17, overfishing of the Gulf of Mexico gag grouper is occurring. For the Gulf of Mexico, a MFMT of 0.17 is not consistent with the recent dynamics of gag grouper: fishing mortality has been fluctuating around F = 0.30 for more than twenty years and the stock biomass is near its historical maximum. The Review Panel could not provide advice on target F and biomass reference points, but noted that the stock has apparently increased as a result of good recruitment under estimated fishing mortality rates that have fluctuated around an average value of F = 0.30 since the early 1980s. The Review Panel advised that it would be prudent to reduce fishing mortality below F = 0.30.

1. Introduction

1.1. Workshop Time and Place

The SEDAR 10 Review Workshop met at the Doubletree Atlanta Buckhead in Atlanta, Georgia from June 26 - 30, 2006.

1.2. Terms of Reference

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.
2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.
4. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); provide values for management benchmarks, range of ABC, and declarations of stock status.
5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.
6. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.
7. Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.
8. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.
9. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)

1.3. List of Participants

Review Panel

Terry Smith, Chair .....NOAA Fisheries/Sea Grant
Din Chen ..... CIE
Jean-Jacques Maguire ..... CIE
John Wheeler ..... CIE

Presenters

Mauricio Ortiz.....SEFSC
Clay Porch.....SEFSC
Steve Turner.....SEFSC
Doug Vaughan.....SEFSC
Erik Williams.....SEFSC

Appointed Observers

Brian Cheuvront.....SAFMC SSC
Phil Conklin.....SAFMC AP
George Geiger.....SAFMC
Will Patterson.....GMFMC SSC
Roy Williams.....GMFMC
Bob Zales II.....GMFMC AP

Observers

Roy Crabtree.....SERO
Andy Strelchek.....SERO

Staff

Steven Atran.....GMFMC
John Carmichael.....SEDAR
Tyree Davis.....SEFSC
Rick DeVictor.....SAFMC

1.4. List of Review Workshop Working Papers & Documents

The Review Panel was provided all SEDAR Working Papers and associated research documents considered at the SEDAR 10 Data and Assessment Workshops. Additional resources provided for the Review Workshop are listed below.

SEDAR Working Papers		
SEDAR10-RW01	Virtual population analysis of the Gulf of Mexico gag grouper stock: the continuity case.	Sladek-Nowlis, J.
SEDAR10-RW02	Status review of gag grouper in the US Gulf of Mexico, SEDAR 10.	Ortiz, M
SEDAR DRAFT ASSESSMENT REPORS		
SEDAR10-SAR1 *Review Draft*	South Atlantic Gag Grouper SEDAR Assessment Report	
SEDASR10-SAR2 *Review Draft*	Gulf of Mexico Gag Grouper SEDAR Assessment Report	

2. **Consensus Summary**

2.1 Terms of Reference

1. *Evaluate the adequacy, appropriateness, and application of data used in the assessment.*

The Review Panel concluded that the Data and Assessment Workshops explored a full range of available data sources and selected those that were most appropriate and scientifically sound for the assessment. The data were considered to be adequate, although the Review Panel did concur with the observations of the Data and Assessment Workshops regarding the limited availability of biological sampling data (lengths and ages) prior to the 1980's. The Review Panel concluded that the data selected by the Assessment Workshop were applied appropriately in the assessment.

The Data Workshop categorized available information under four headings: 1) life history, 2) commercial fishery, 3) recreational fishery, and 4) abundance indices. Life history information included: estimates of total, natural and release mortality, age data, growth, reproduction, movements and migration, stock definition, and meristic conversions. Commercial fishery information included: landings, discards, and biological sampling. Recreational fishery information included: landings, discards, total catches, and length frequency distributions. There were six abundance indices; four of which were fishery dependent and two that were fishery independent.

The Data Workshop reviewed several recent studies on estimates of release mortalities and recommended further investigation into the practicality of applying depth-mortality functions. The Assessment Workshop concurred and recommended using size-depth release mortality estimates rather than a fixed proportion, as used in the previous assessment. The Review Panel noted that although data were limited, information was consistent between the South Atlantic and Gulf of Mexico.

Several new growth studies were available for review by the Data Workshop. These updated datasets provided increased sample sizes for improved temporal coverage and contrast. As growth models can be influenced by size-biased samples due, for example, to minimum size limits, the Data Workshop calculated a modified von Bertalanffy growth model accounting for size limited data. Model fits used area, sector and temporal specific size limits. The new von Bertalanffy model, in combination with new age-length keys, resulted in a substantial change in catch in age between the current and previous assessment. There were fewer fish aged 1 to 3 and more fish aged 4 and older. This resulted in an overall lower number of fish caught in the current assessment relative to estimates for the same time period in the previous assessment. The Review Panel noted that, in the recreational fishery since 1990, discards far exceeded landings, suggesting that management measures regarding minimum sizes may not have had as large an effect as anticipated. Catch at age, which includes mostly discards, has increased substantially with the implementation of these measures in the 1990s.

The Data Workshop examined several aspects relating to aging of fish, including age structure samples, age reader precision, and age patterns. With regard to age structure samples, they noted that pre-1998 sample sizes of otoliths collected from the longline fishery were low compared to recent years and that samples from the recreational fishery and fishery independent samples were not well represented throughout the time series. Results from an age reading workshop in 2005 indicated that all labs used comparable procedures and that there was very good agreement and precision among readers. The Review Panel noted the importance of this initiative and recommended that exchange of otoliths between labs continue in the future. In the South Atlantic, the age range tabulated in the analyses extend to age 20 while in the Gulf of Mexico it extends to age 12. In the GOM, the age range used in the assessment could be extended to age 20, as in the assessment for the South Atlantic.

The Data Workshop examined the results of two relatively large tagging studies designed to estimate the degree of exchange between Atlantic and Gulf stock units. In general, the results suggested an ontogenetic movement to deeper waters with smaller gag exhibiting relatively high site fidelity. The Data and Assessment Working Groups concluded that recoveries from the tagging data were inconclusive and that council boundaries should continue to be used as the dividing line for the two stocks. The Review Panel noted that some movement occurred from the South Atlantic to the Gulf. The Florida Keys also represented an area of overlap. Further information was provided to the Panel regarding the results of an ultrasonic tagging study off the west coast of Florida. Tag recoveries indicated extensive migrations by at least two fish, one that was recaptured off Texas and one off Vera Cruz, Mexico. The management unit for Gulf of Mexico gag grouper, as defined by the Data Workshop, and endorsed by the Assessment Workshop, extends from the United States – Mexico border in the west through northern Gulf of Mexico waters and west of the Dry Tortugas and the Florida Keys (waters within the Gulf of Mexico Fishery Management Council Boundaries). The Review Panel accepted the current stock definition but recommended a further examination of stock structure before the next assessment. This should include a detailed analysis of existing tagging data and the initiation of new tagging experiments (see SEDAR 10 Consensus Summary Report for South Atlantic gag grouper).

In anticipation that a statistical age-structured model would be used in this assessment, the Data Workshop tabulated commercial landings for 1963 to 2004. The previous stock assessment used landings from 1986. This assessment also examined issues concerning stock boundaries, the misidentification of gag as black grouper, and the adjustment of gag landings to include a portion of unclassified grouper species, primarily prior to the mid-1980s. The proportions of gag and black grouper from 1986 to 1989 were used to calculate the amount of unclassified groupers from 1963 to 1985. This time period was used as size limits had not yet been imposed and it was thought that these proportions would best reflect the historical time period. The Review Panel accepted this method, noting, however, that it introduced a further source of uncertainty in historical commercial landings.

Size limits, which have been in effect since 1990, are thought to have resulted in discarding of undersized fish in the commercial fishery. The Data Workshop examined estimates of total discards by the handline fishery from 2001 to 2004. The Assessment Workshop accepted the handline discard estimates but also used size frequency distributions from catch-at-size files for three periods, prior to 1990 when no size limits existed, 1990 to 1999 when the size limit was 20", and 2000 to 2004 when the size limit was increased to 24".

The Data Workshop examined several issues regarding recreational catches, including assignment of catches in the Florida Keys, the misreporting of gag as black grouper, catches from MRFSS shore mode, and extending recreational catches back through time. In back-calculating catches, they examined three possible relationships: a correlation with commercial catches, a correlation with coastal human populations, and a linear relationship starting at a time when the stock was considered to be close to unexploited. Two series of recreational catches and discards from 1963 to 2004 were generated, one based upon a correlation with commercial catches and one based upon a linear increase from 1945. The Assessment Workshop rejected the historical recreational time series and recommended an alternative approach using a relationship between the MRFSS fishing effort and the number of boats built between 1981 and 2004. The issue of extending recreational (and commercial) catches back through time generated considerable debate among the Review Panel. Concerns were expressed regarding the accuracy of such catches and the impact they may have within the assessment model. However, it was concluded that although back-calculated historical catches may not be accurate, they do provide valuable information and should be included in the assessment.

Six abundance indices were considered by the Data Workshop to be appropriate measures of abundance. These included four fishery dependent indices, commercial handline, commercial longline, headboat survey, and the marine recreational fisheries statistical survey (MRFSS). Two independent indices were also available, the SEAMAP video survey, and the Florida Estuaries Index. The Data Workshop described each of these indices in detail, along with concerns and advantages of each index. The Assessment Workshop accepted this set of indices for inclusion in the assessment model. There was a limited discussion by the Review Panel regarding the abundance indices. A question was raised regarding the spatial coverage of the fishery independent indices. The Review Panel concurred with the inclusion of the six indices in the assessment model.

2. *Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.*

The Review Panel generally endorsed the method used in the assessment and considered it to be scientifically sound. The Panel did, however, have concerns regarding the choice of a Beverton-Holt stock recruit function and recommended that a Ricker function be used to examine the sensitivity of the model to assumptions about the form of the stock recruitment function. The Panel was impressed with the number of alternative runs provided by the Assessment Workshop and the thorough presentation regarding model

inputs and results presented by the assessment team at the Review Workshop.

The Assessment Workshop selected a statistical age-structured forward reconstruction model (CASAL) as the primary method for the assessment. CASAL was chosen as it provides flexibility in specifying population dynamics, parameter estimation, and model outputs. Most importantly, unlike Virtual Population Analysis (VPA), CASAL does not assume that the catch at age is known exactly, an important feature in the case of Gulf of Mexico gag grouper where catch at age is not well estimated. Additionally, the assessment model used in the 2001 assessment (VPA) was run to show the effects of updated data and the effects of adding indices of abundance not available in 2001. In addition to CASAL and VPA models, the Assessment Workshop provided a stochastic stock reduction analysis (SRA) using a long term historical (1880 to 2004) catch time series.

The Assessment Workshop considered six scenarios for CASAL model runs. It recommended using the longest possible catch series. Two time series were considered, one with commercial and recreational catches from 1963 to 2004, and a second with commercial catches from 1880 to 2004 and recreational catches from 1945 to 2004. The Assessment Workshop also recommended including potential changes in catchability. Two groups of model runs were made, one assuming constant catchability and a second assuming a 2% annual increase since 1984 to reflect improvements in gear and electronics available to both the commercial and recreational fisheries. The Assessment Workshop also discussed the recent report of NRC regarding MRFSS estimates and concluded that available estimates of recreational catch and indices of abundance were the best available information. However, to estimate the sensitivity of the model to these data, two runs were made, one where the MRFSS total estimated catch was increased by 25% for the entire time series, and a second where it was decreased by 25%.

The Assessment Workshop presented two model runs to the Review Panel as base case scenarios, one with commercial and recreational catches from 1963 to 2004, assuming constant catchability, and the second with the same catch series, assuming 2% annual increase in catchability. Each base run was provided as the basis for estimation of benchmarks and stock status. After considerable discussion, the Review Panel concluded that catchability has changed over time. However, the Panel does not believe that a constant 2% increase per year adequately describes the change in catchability that is likely to have occurred. Step changes with the introduction of new equipment or management measures are more likely than monotonic changes. Learning and technological changes in navigation, fish detection, and fishing gear have no doubt increased the efficiency of nominal fishing effort. However, management measures (increases in minimum size, time and area closures, bag limits) and changes in fishing behaviour (moving on when enough fish have been caught) would likely result in decreased catchability. The Review Panel believes that, overall, catchability is likely to have increased and recommends that a special workshop be convened to estimate and quantify changes in catchability over the last 25 to 30 years.

The base case CASAL model run included commercial and recreational catches from

1963 to 2004. As indicated earlier, the Review Panel expressed concerns regarding the back-calculation of catch data and asked the assessment team to provide a CASAL run with actual catch data only (1986 to 2004). The assessment team was also asked to provide the results of two VPA runs for comparison with the CASAL model. The results indicated similar trends in stock size and fishing mortality estimates with higher biomass and lower fishing mortalities for the shorter time series.

The Assessment Workshop assumed a Beverton-Holt stock recruitment relationship in all CASAL model runs. Examination of stock-recruit scatter plots indicated that recruitment is not strongly linked to SSB. Given the variability in the stock recruit data, the Review Panel requested further evaluation using Ricker and 'hockey stick' (Barrowman and Myers 2000) stock recruitment relationships. The assessment team provided these comparisons during the Review Workshop; the Beverton-Holt and Ricker curves were virtually identical through the range of data. However, both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs, and B_{MSY} is estimated to be higher than SSBs observed in the past. It was noted that the Assessment Workshop preferred the Beverton-Holt relationship over the Ricker. However, the Review Workshop concluded that both might over estimate virgin recruitment and thus MSY and SSB_{MSY}. More stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

3. *Recommend appropriate estimates of stock abundance, biomass, and exploitation.*

The Review Panel evaluated the various assessment runs provided by the Assessment Workshop. It agreed upon a base run as reported above (terms of reference #2); the base run is described in the addendum to the assessment report. The accepted estimates of stock abundance, biomass, and exploitation are provided in the SEDAR 10 Gulf of Mexico Gag Grouper Advisory Report.

4. *Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies); provide values for management benchmarks, range of ABC, and declarations of stock status.*

In both stock areas, the stock and recruitment scatter plots do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt relationship indicates little change in recruitment for a wide range of SSBs and that B_{MSY} falls in the range of SSBs observed in the past. The Ricker relationship indicates that maximum recruitment occurs at SSBs lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico, both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSBs and SSB_{MSY}

is estimated to be higher than SSBs observed in the past. The Review Workshop considered that the stock recruitment relationships in both stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

MSST, defined as (1-M)* SSB_{MSY}, would be very close to SSB_{MSY} because an M = 0.14 is used. Given the uncertainties in the assessment, the biomass would be expected to be estimated to fall below MSST with a relatively high frequency even if in true biomass were close to SSB_{MSY}. In the Gulf of Mexico, there are indications that recruitment could become impaired below 20 million lbs and the Review Workshop suggested that MSST could be set at 20 million lbs as an operational definition, also to be re-examined at the next assessment.

For the Gulf of Mexico, a MFMT of 0.17 (current value of $F_{30\%SPR}$) is not consistent with the recent dynamics of gag grouper: fishing mortality has been fluctuating around F = 0.30 for more than twenty years and the stock biomass is near its historical maximum. The Review Panel could not provide advice on target F and biomass reference points, but noted that the stock has apparently increased as a result of good recruitment under estimated fishing mortality rates that have fluctuated around an average value of F = 0.30 since the early 1980s. The Review Panel advised that it would be prudent to reduce fishing mortality below F = 0.30.

5. *Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition*.

The Review Panel requested stock projections assuming constant catchability and geometric mean recruitment from 1984 through 2004. These projections were not available during the Review Workshop as they could not be completed using CASAL. They were subsequently provided by the assessment team using an alternative age-structure projection software (PRO-2BOX).

The following output data from CASAL were used as input for PRO-2BOX:

a) Stock size at age (NAA) from 1963 to 2004 ages 1-12+,
b) Fishing mortality rate at age (FAA) from 1963 to 2004,
c) Catch-at-age 1963-2004 all fisheries,
d) Weight at age 1963-2004 for spawning component and mean WAA for fisheries
e) Natural mortality at age 1963-2004.

Because of differences between the software programs, particularly regarding the estimation of mean weight at age and age composition for the plus group, estimates of biomass between CASAL and PRO2BOX differed prior to 1984, when age composition

data were not available. However, the SSB and overall stock biomass estimates were similar for the latest years, which are the important components for the projection of current stock status.

As PRO2BOX can distinguish between landed and discarded (dead) numbers at age, the discard proportions were estimated (from CASAL) by age for 1984 - 2004, when age composition data were available; discards by age prior to 1984 were assumed to be the same as in 1984. With this information, estimates and benchmarks were then generated for total yield (landings only) versus total removals (landings plus dead discards).

Stock projections were completed for 2006 to 2010 and included scenarios of constant catch, constant fishing mortality, total yield, and total removals.

Estimates of fishing mortality rates were similar between total yield and total removals. However, estimated retained yields were much lower (~ 50%), due to the large proportion of dead discards in the recreational fishery. Landed yield per recruit (YPR) also dropped by 50% compared to total removals.

Projections indicated that total removals over 6,614 MT or landed catches over 3,268 MT in 2006 and in following years are not sustainable, and would generate a fishing mortality rate at or above 2 (upper limit of fishing mortality rate).

This assessment implies that spawning stock biomass has declined from a 2003 peak. Projections indicate that stock spawning biomass, and also catch (removals or landed yield) would continue to decline at current (2004) fishing mortality rates. The decline would continue if fishing occurred at a rate equivalent to $F_{20\%SPR}$. Fishing rates of $F_{30\%SPR}$, $F_{40\%SPR}$, $F_{0.1}$, F_{MAX} and F_{MSY} would reverse the declining trend

The Review Panel endorsed the inclusion of dead discards with landings to provide an estimate of total removals and recommended that these estimates be used in the Advisory Report.

6. *Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.*

Initial stock assessment results were clearly and accurately presented in the report of the Assessment Workshop (SEDAR10-SAR2-Section III). Additional analyses requested by the Review Panel will be incorporated as an addendum to the stock assessment report.

7. *Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of*

Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.

The Review Panel agreed that the terms of reference of the Data and Assessment Workshops were met and were adequately addressed in the Stock Assessment Report.

8. *Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted*.

The Review Panel reviewed research recommendations offered by the Data and Assessment Workshops (see respective reports). The Panel also developed the three additional recommendations listed below.

Age determination: The Review Panel noted the importance of age reading comparisons and recommended that exchange of otoliths between labs continue in the future.

Stock structure: The Review Panel recommended a further examination of stock structure before the next assessment, including a detailed analysis of existing tagging data and the initiation of new tagging experiments.

Time-varying catchability: The Panel is of the opinion that catchability has changed over time, however, it does not believe that a constant 2% increase per year adequately describes the changes in catchability that are likely to have occurred. Step changes with the introduction of new equipment or management measures are more likely than monotonic changes. Learning and technological changes in navigation, fish detection and catching equipment have no doubt increased the efficiency of nominal fishing effort. However, management measures (increases in minimum size, time and area closures, bag limits) and changes in fishing behavior (moving on when "enough" fish have been caught) would be expected to result in decreased catchability. The Panel believes that, overall, catchability is likely to have increased. The Panel recommends that a special workshop be convened to estimate and quantify changes in catchability over the last 25 to 30 years.

9. *Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)*

First drafts of the Consensus Summary and Advisory Report were completed during the Review Workshop. All Review Panel members contributed to the Consensus Report. The assessment team completed the first draft of the Advisory Report which was then reviewed by the Review Panel. The Consensus Report and Advisory Report were completed by email subsequent to the Review Workshop.

2.2 Additional Comments

Participants in the Data and Assessment Workshops are to be highly commended for their detailed compilation and analysis of diverse data sets. Information was summarized well in their respective reports. During the Review Workshop, the assessment team provided a clear presentation of the assessment model and results and was highly capable and willing to accede to requests for further analyses from the Review Panel.

General recommendations to SEDAR

There was large volume of documentation associated with this RW. The Review Panel recommends a clear executive summary for all substantive Data and Assessment Documents.

It could be more informative to distribute a succinct table of model equations and parameters (estimated and observed) to be provided for each assessment along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.

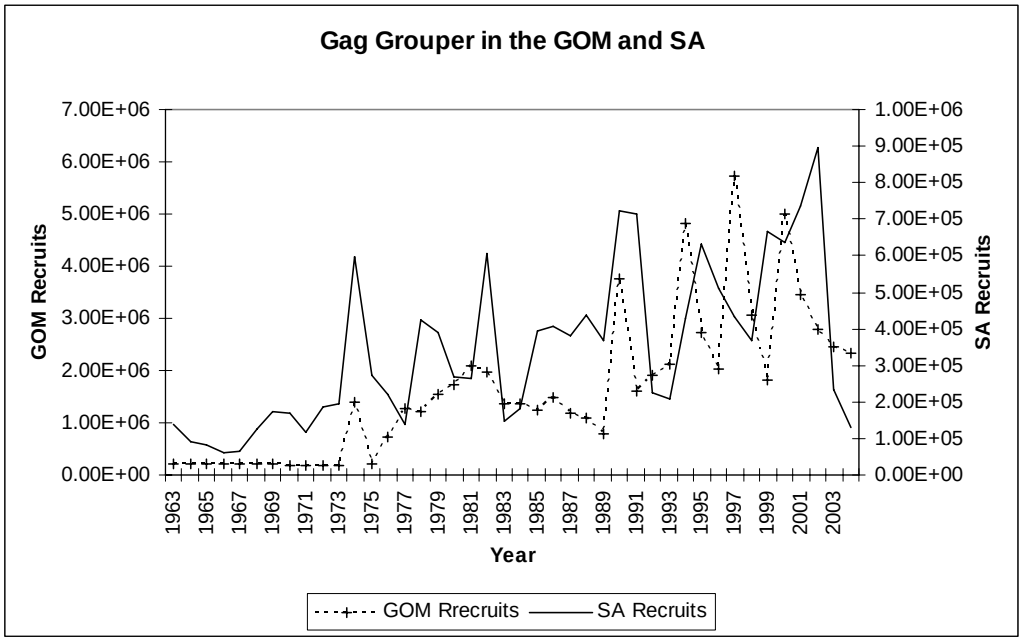
2.5 Special Comments

Comparing and Contrasting the Two Gag Grouper Assessments

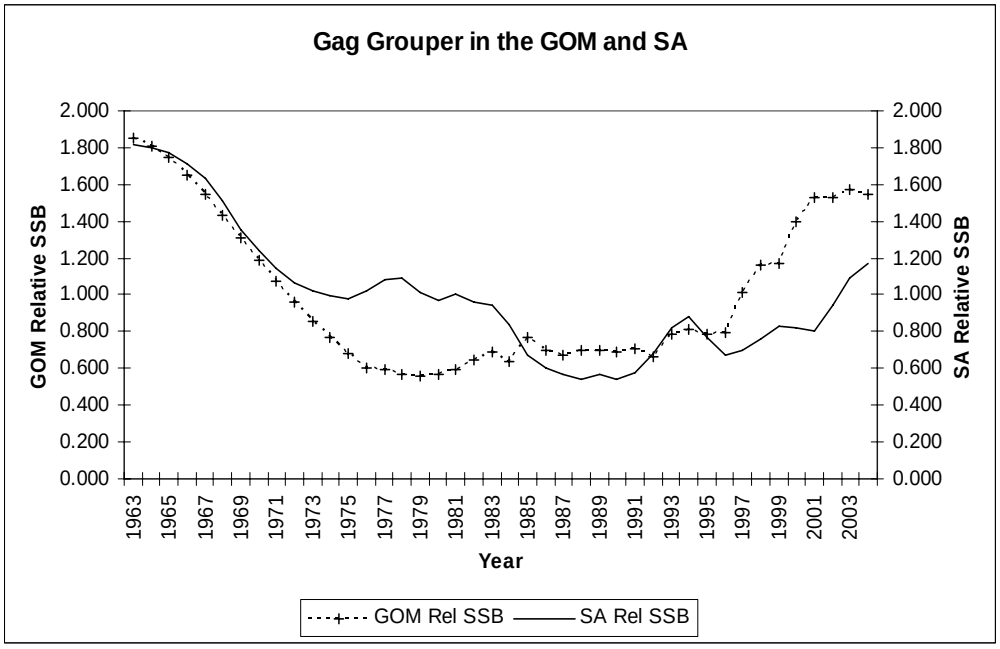
The main assessment model for both stock areas is a statistical catch at age model, but the implementations differ. For the South Atlantic a customized model has been developed using ADMB while for the Gulf of Mexico, an existing software (CASAL (C++ algorithmic stock assessment laboratory) can be downloaded from ftp://ftp.niwa.co.nz/software/casal) was used. CASAL was one of several integrated assessment software recently evaluated by the IATTC; the report can be downloaded at http://www.iattc.org/PDFFiles2/Assessment-methods-WS-Nov05-ReportENG.pdf . For the South Atlantic, a production model (ASPIC) was also run and for the Gulf of Mexico two VPA's were run: one was a strict continuity run and the other one was parameterized to mimic the CASAL run. VPA was not used in the South Atlantic because of insufficient complete catch at age information. The RW Panel considers that the statistical catch at age approach has better statistical foundations and more flexibility in the type of information that can be used than VPA or general production models. The RW Panel recommends that alternate assessment approaches (ASPIC for the South Atlantic and VPA for the Gulf of Mexico) continue to be used in parallel and that the results be presented in the report of the Assessment Workshops. Standard inputs (catch at age, length at age, weights at age, indices of stock size (by age and length if appropriate) and outputs (population numbers at age, population biomass at age, spawning biomass, fishing mortality at age) should be provided in a format easily readable by spreadsheet programs. Neither of the assessments considers gender explicitly.

Although the approach has been used in the assessment of other species, it is not clear that the ADMB statistical catch at age implementation conforms to the Model Acceptance Note 1 in the ToRs of the AW. The assessment team is encouraged to provide the required documentation and work towards including the assessment in the NFT packages. Presumably, the evaluation performed by the IATTC implies that the CASAL does conform to the Model Acceptance Note 1.

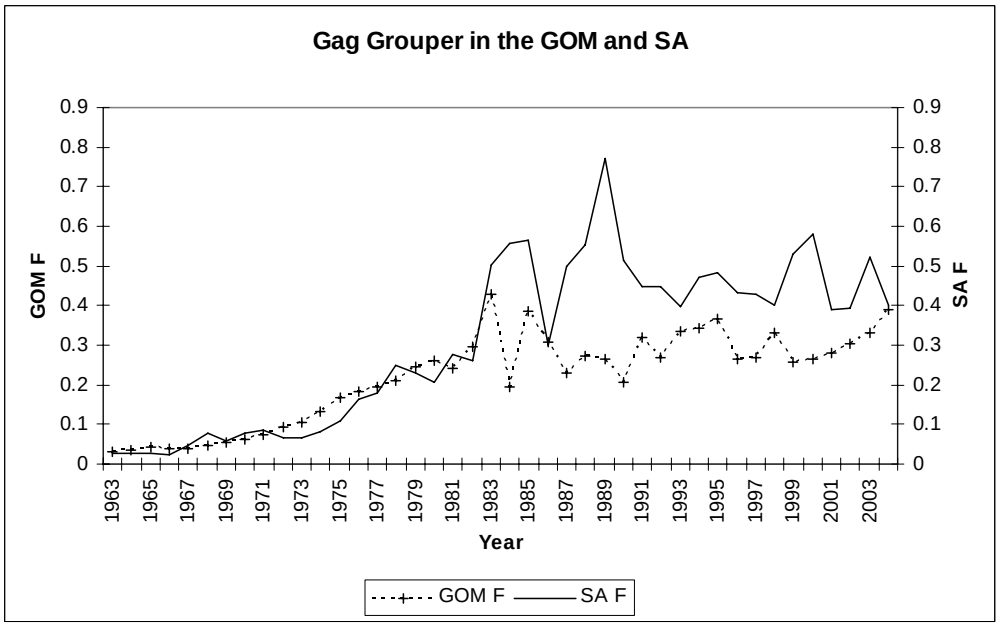
In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.



For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.

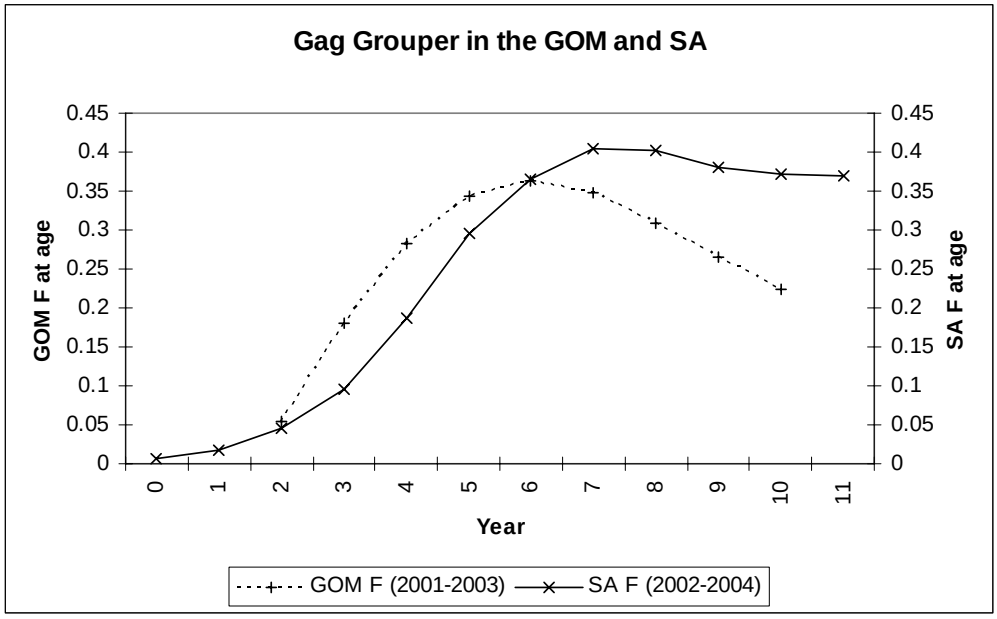


Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.



Average fishing mortality at age (2001-2003 for the GOM, 2002-2004 for the SA) show different patterns. F's are higher at age 3-5 in the Gulf of Mexico than in the South

Atlantic but at older ages it is the opposite. The F at age pattern is clearly dome shaped in the Gulf of Mexico and nearly flat topped in the South Atlantic.



References

Barrowman, N.J. and R.A. Myers. 2000. Still more spawner-recruitment curves: The hockey stick and its generalizations. *Can. J. Fish. Aquat. Sci.* 57:665-676.

9. Appendix 5: Statement of Work from CIE

Consulting Agreement between the University of Miami and Din Chen

Statement of Work

June 9, 2006

SEDAR Overview:

South East Data, Assessment, and Review (SEDAR) is a process for fisheries stock assessment development and review conducted by the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; NOAA Fisheries Southeast Fisheries Science Center (SEFSC) and Southeast Regional Office (SERO); and the Atlantic and Gulf States Marine Fisheries Commissions. SEDAR is organized around three workshops: data, assessment, and review. Input data are compiled during the data workshop, population models are developed during the assessment workshop, and an independent peer review of the data, assessment models, and results is provided by the review workshop. SEDAR documents include working papers prepared for each workshop, supporting reference documents, and a SEDAR Stock Assessment Report. The SEDAR Stock Assessment Report consists of a data report produced by the data workshop, a stock assessment report produced by the assessment workshop, and a peer review consensus report and advisory report prepared by the review workshop.

SEDAR is a public process conducted by the Fishery Management Councils in the Southeast US. All workshops, including the review, are open to the public and noticed in the Federal Register. All documents prepared for SEDAR are freely distributed to the public upon request and posted to the SEDAR website. Public comment during SEDAR workshops is taken on an 'as needed' basis; the workshop chair is allowed discretion to recognize the public and solicit comment as appropriate during panel deliberations. The names of all participants, including those on the Review Panel, are revealed.

The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, correction of errors, and sensitivity runs of the assessment model provided by the assessment workshop. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The review panel task is specified in Terms of Reference.

The SEDAR 10 review panel will be composed of 3 CIE-appointed reviewers and a chair appointed by the SEFSC director. Council staff, Council members, and Council AP and SSC members will attend as observers. Members of the public may attend SEDAR review workshops.

CIE Request:

NMFS-SEFSC requests the assistance of three fisheries assessment scientists from the CIE to serve as technical reviewers for the SEDAR 10 review panel that will consider assessments for Gulf of Mexico gag grouper and South Atlantic gag grouper. Reviewer tasks are listed below.

The species assessed through SEDAR 10 are within the jurisdiction of the Gulf of Mexico Fishery Management Council, the South Atlantic Fishery Management Council, and respective southeastern states.

The review workshop will take place at the Doubletree Buckhead Atlanta, from 1:00 p.m. Monday, June 26, 2006 through 1:00 p.m. Friday, June 30, 2006.

Meeting materials will be forwarded electronically to review panel participants and made available through the internet (http://www.sefsc.noaa.gov/sedar/); printed copies of any documents are available by request. The names of reviewers will be included in workshop documents.

Please contact John Carmichael (SEDAR Coordinator; 843-571-4366 or John.Carmichael@safmc.net) for additional details.

Hotel arrangements:

Doubletree Buckhead
3342 Peachtree Road NE
Atlanta, GA 30326
(800) 222-8733; (404) 231-1234
FAX (404) 231-5236

Group Rate $115 + 15% tax ($17.25) = $132.25; guaranteed through Monday, June 5, 2006.

SEDAR Review Workshop Panel Tasks:

The SEDAR 10 Review Workshop Panel will evaluate assessments of Gulf of Mexico and South Atlantic gag grouper. During the evaluation the panel will consider input data, assessment methods, and model results. The evaluation will be guided by Terms of Reference that are specified in advance. For each species assessed the Review Workshop panel will document its findings in a Peer Review Consensus Summary and summarize assessment results in a Peer Review Advisory Report.

SEDAR 10 Review Workshop Terms of Reference (apply to each assessment):

10. Evaluate the adequacy, appropriateness, and application of data used in the assessment.
11. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
12. Recommend appropriate estimates of stock abundance, biomass, and exploitation.
13. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); provide values for management benchmarks, a range of ABC, and declarations of stock status.
14. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.
15. Ensure that reported results are consistent with Review Panel recommendations.
16. Evaluate the SEDAR Process. Review performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report; suggest any changes or improvements to the process.
17. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.
18. Prepare a Peer Review Consensus Summary for each assessment summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report for each assessment summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop. Final drafts are due to the Chair within 2 weeks (July 14, 2006). Final reports are due to the SEDAR Coordinator one week later (July 21, 2006).

NOTE: These Terms of Reference may be modified prior to the Review Workshop. Final Terms of Reference will be provided to the Reviewers with the workshop briefing materials.

SEDAR Review Workshop Panel Supplementary Instructions

The review panel Chair is responsible for conducting the meeting during the workshop in an orderly fashion. The Chair is responsible for compiling and editing the Peer Review Consensus Summary and Peer Review Advisory Report for each species assessed and submitting them to the SEDAR Coordinator by a deadline specified by the SEDAR Steering Committee.

Review panel reviewers are responsible for reviewing documents prior to the workshop, participating in workshop discussions addressing the terms of reference, preparing assessment summaries and consensus reports during the workshop, and finalizing workshop documents within two weeks of the conclusion of the workshop. Each reviewer appointed by the CIE is responsible for preparing an additional CIE Reviewer Report as described in Annex 1.

The Chair and SEDAR Coordinator will appoint one panelist to serve as assessment leader for each assessment reviewed. The leader will be responsible for providing an initial draft of consensus and advisory report text for consideration by the panel. However, as stated above, all panelists are expected to participate in preparation of report text.

The Review Panel's primary responsibility is to ensure that assessment results are based on sound science, appropriate methods, and appropriate data. During the course of review, the panel is allowed limited flexibility to deviate from the assessment provided by the Assessment Workshop. This flexibility may include modifying the assessment configuration and assumptions, requesting a reasonable number of sensitivity runs, requesting additional details and results of the existing assessments, or requesting correction of any errors identified. However, the allowance for flexibility is limited, and the review panel is not authorized to conduct an alternative assessment or to request an alternative assessment from the technical staff present. The Review Panel is responsible for applying its collective judgment in determining whether proposed changes and corrections to the presented assessment are sufficient to constitute an alternative assessment. The Review Panel Chair will coordinate with the technical staff present to determine which requests can be accomplished and prioritize desired analyses.

Any changes in assessment results stemming from modifications or corrections solicited by the review panel will be documented in an addendum to the assessment report. If updated estimates are not available for review by the conclusion of the workshop, the review panel shall agree to a process for reviewing the final results.

The review panel should not provide specific management advice. Such advice will be provided by existing Council Committees, such as the Science and Statistical Committee and Advisory Panels, following completion of the assessment.

If the Review Panel finds an assessment deficient to the extent that technical staff present cannot correct the deficiencies during the course of the workshop, or the Panel deems that desired modifications would result in a new assessment, then the Review Panel shall provide in writing the required remedial measures, including an appropriate approach for correcting and subsequently reviewing the assessment.

Statement of Tasks for Technical Reviewers:

Roles and responsibilities:

1. Approximately 3 weeks prior to the meeting the CIE reviewers shall be provided with the stock assessment reports, associated supporting documents, and review workshop instructions including the Terms of Reference. Reviewers shall read these documents to gain an in-depth understanding of the stock assessment, the resources and information considered in the assessment, and their responsibilities as reviewers.
2. During the Review Panel meeting, the reviewers shall participate in panel discussions on assessment methods, data, validity, results, recommendations, and conclusions as guided by the Terms of Reference. The reviewers also shall participate in the development of Peer Review Consensus Summary reports and the Peer Review Advisory Reports. Reviewers may be asked to serve as assessment leaders during the review to facilitate preparing first drafts of review reports.
3. Following the Review Panel meeting, the reviewers shall review and provide comments to the Panel Chair on the Peer Review Panel Reports. Final review panel documents shall be provided to the Chair by July 14, 2006.
4. Following the Review Panel meeting, the reviewers shall each prepare a CIE Reviewer Report. This report shall be submitted to CIE no later than July 14, 2006, addressed to the "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson, via email to David.Sampson@oregonstate.edu, and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu. See Annex I for complete details on the report outline.

   It is estimated that the Review Panelist duties will occupy a maximum of 14 workdays; several days prior to the meeting for document review; five days at the SEDAR meeting, and several days following the meeting to ensure that final review comments on documents are provided to the Chair and to complete a CIE review report.

Workshop Final Reports:

The SEDAR Coordinator will send copies of the final Review Panel Consensus Report and Advisory Report to Dr. David Sampson and Mr. Manoj Shivlani at the CIE.

CIE Reports:

Once finalized and accepted by the CIE, CIE reviewer reports shall be distributed by the CIE to:

SEFSC Director: Nancy Thompson, NMFS Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149 (email, Nancy.Thompson@NOAA.gov)

SEDAR Coordinator: John Carmichael, SAFMC, One Southpark Circle, Suite 306, Charleston, SC 29407 (email, John.Carmichael@safmc.net)

Gulf of Mexico Fishery Management Council: Wayne Swingle, Executive Director, GMFMC, 2203 N. Lois Avenue, Suite 1100, Tampa, FL 33607 (email (Wayne.Swingle@gulfcouncil.org)

South Atlantic Fishery Management Council: Bob Mahood, Executive Director, SAFMC, One Southpark Circle #306, Charleston SC 29407 (email Bob.Mahood@safmc.net).

For Additional Information or Emergency:

SEDAR contact: John Carmichael, One Southpark Circle, Suite 306, Charleston, SC 29407. Phone: 843-571-4366; cell phone (843) 224-4559. Email: John.Carmichael@safmc.net.

Draft Agenda

SEDAR 10: Gulf of Mexico and South Atlantic Gag Grouper

Monday, June 24, 2006

1:00 p.m.	**Convene**	
1:00 – 1:30	**Introductions and Opening Remarks**	
	Coordinator	
	- Agenda Review, TOR, Task Assignments	
1:30 – 3:30	**Gulf of Mexico Gag Grouper Presentation**	**TBD**
3:30 – 4:00	**Break**	
4:00 – 6:00	**GoM Gag Discussion**	**Chair**
	- Data, Methods, Results Evaluation	

Tuesday, June 25, 2006

8:30 a.m. – 11:30 a.m.	**South Atlantic Gag Grouper Presentation**	**Chair**
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**SA Gag Discussion**	**TBD**
	- Data, Methods	
	- identify additional analyses, sensitivities, corrections	
3:30 p.m. – 4:00 p.m.	**Break**	
4:00 p.m. – 6:00 p.m.	**Panel Deliberations**	**Chair**
	- Continue discussions	
	- Review additional analyses	

***Tuesday Goals*:** Initial presentations completed, sensitivities and modifications identified.

Wednesday, June 26, 2006

8:30 a.m. – 11:30 a.m.	**Panel Deliberations**	**Chair**
	- Continue Discussions	
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**Panel Deliberations**	**TBD**
3:30 p.m. – 4:00 p.m.	**Break**	
4:00 p.m. – 6:00 p.m.	**Panel Deliberations**	**Chair**

Wednesday Goals: Final sensitivities identified, Preferred models selected, Projection approaches approved, Consensus report drafts begun

Thursday, June 28, 2006

8:30 a.m. – 11:30 a.m.	**Panel Deliberations**	**Chair**
	- Final sensitivities reviewed.	
	- Projections reviewed..	
11:30 a.m. – 1:30 p.m.	**Lunch Break**	
1:30 p.m. – 3:30 p.m.	**Panel Deliberations**	**Chair**
	- Final assessment discussions.	
3:30 p.m. - 4:00 p.m.	**Break**	
4:00 p.m. - 6:00 p.m.	**Panel Deliberations**	**Chair**

- *Review Consensus Reports*
- *Discuss Advisory Reports Contents*

Thursday Goals: Complete assessment work and discussions. Final results available. Drafts of Consensus Reports and Advisory Reports Reviewed.

Friday, June 29, 2006

8:30 a.m. – 1:00 p.m.	**Final Review of Panel Documents**	**Chair**
1:00 p.m.	**ADJOURN**	

SEDAR Review Workshop Document Contents

Consensus Summary Outline

I. Terms of Reference

List each Term of Reference, and include a summary of the Panel discussion regarding the particular item. Include a clear statement indicating whether or not the criteria in the Term of Reference are satisfied.

II. Additional Comments

Provide a summary of any additional discussions not captured in the Terms of Reference statements.

III. Recommendations for Future Workshops

Panelists are encouraged to provide general suggestions to improve the SEDAR process.

Advisory Report Outline

Stock Distribution and Identification

Summary of the unit stock and its geographic distribution.

Assessment Methods

Summary of the assessment method.

Assessment Data

Summary of input data sources.

Catch Trends

Summary of catches by fishery

Fishing Mortality Trends

Summary of fishing mortality estimates

Stock Abundance and Biomass Trends

Summary of abundance, biomass, and recruitment

Status Determination Criteria

Summary of SFA and management criteria.

Stock Status

Declaration of stock status.

Projections

Summary of stock projections.

Special Comments

Additional comments of importance

Sources of Information

Source of results contained in advisory report (i.e., workshop report or addendum)

Tables:

Catch and Status

The Catch and Status table summarizes recent stock and fishery conditions. Items listed in the table typically include: catch and discards by fishery sector, fishing mortality estimates, stock abundance and biomass, spawning stock biomass, recruitment, and stock status relative to benchmark values (e.g., F/Fmsy, B/Bmsy). Values will be provided by the analytical team.

Stock Status Criteria

Summary of recommended or mandated benchmarks and estimated values.

FIGURES:

1. Landings
2. Exploitation
3. Stock Biomass
4. Stock-Recruitment
5. Control Rule
6. Projections

ANNEX I: Contents of CIE Reviewer Report

1. The reviewer report shall be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the reviewer report shall consist of a background, description of review activities, summary of findings, and conclusions/recommendations. The summary of findings shall address the workshop Terms of Reference 1- 8 under the above heading "SEDAR Review Workshop Panel Tasks". Reviewers are also encouraged to provide any criticisms and suggestions for improvement of the SEDAR process.

3. The reviewer report shall include as separate appendices the bibliography of materials provided for review and a copy of the CIE Statement of Work.