Review Report for SEDAR 9

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Prepared for

University of Miami

Center for Independent Experts

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EXECUTIVE SUMMARY

South East Data, Assessment, and Review (SEDAR 9) was designed to review assessments for the Gulf of Mexico Vermilion Snapper, Greater Amberjack and Gray Triggerfish. The assessment reports for these three species were provided by email from the SEDAR Coordinator (John Carmichael) before the SEDAR 9 meeting. The meeting was carried out from the 27th to the 31st of March, 2006 at the Hotel Monteleone, New Orleans, LA (Appendix 2). The assessment for Gray Triggerfish was presented to the panel on Monday, March 27th, followed by Vermilion Snapper and Greater Amberjack on Tuesday, March 28th, and Wednesday, March 29th, respectively. Discussions proceeded section by section after the presentations.

In summary, 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 all three species by the Panel to evaluate the appropriateness of the model inputs and model structures. Recommendations were given by the Panel on the preferred "base model" for each species and other issues for data, model improvement and developing sensible fishery management parameters.

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 9) to review the stock assessments for Gulf of Mexico Vermilion Snapper, Greater Amberjack and Gray Triggerfish. 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 three stocks by means of the SEDAR website.

The meeting to review the assessments took place at the Hotel Monteleone, New Orleans, LA from the 27th to the 31st of March, 2006.

2. REVIEW ACTIVITIES

The meeting started with a presentation on the assessment for Gray Triggerfish on Monday afternoon (March 27th), followed by Vermillion Snapper and Greater Amberjack. Questions and comments from the Panel and Review participants followed the presentations.

The meeting was well arranged and progressed smoothly, which should be credited to the SEDAR Coordinator and Panel Chair (John Carmichael and Elizabeth Clarke, respectively).

Each CIE panelist was appointed to lead a specific stock assessment, but all participated in the discussions for all three species. Dr. Kenneth Patterson was the panel leader for Vermillion Snapper, Dr. Malcolm Haddon for Greater Amberjack and the author was responsible for Gray Triggerfish. Consequently, a more detailed summary is provided for the triggerfish stock. The “Consensus Summary Report” and the “Assessment Summary Report” for this stock, which were prepared for the Chair to review, are attached as Appendices 2 and 3 to this report, to provide detailed information and for reference purposes.

During the Review Workshop, the Review Panel developed and adopted a useful review guideline to guide the SEDAR 9 review activities (Appendix 1).

The review activities for Gulf of Mexico Gray Triggerfish started on Monday, March 27th. Dr. Joshua Sladek Nowlis presented the draft stock assessment, and discussions followed section by section. The main points of discussions were on: a) the adequacy and appropriateness of the data used for the assessment, with questions on shrimp bycatch and the MRFSS recreational index; b) adequacy and appropriateness of the two assessment models applied to this stock (i.e. A Stock Production Model Incorporating Covariates (ASPIC) and State-Space Age-Structured Production Models (SSASPM)).

3. FINDINGS/RELATED RECOMMENDATIONS

3.1. Assessment in general

The review Panel evaluated the assessment and identified a number of concerns. Consequently, the Panel requested several sensitivity runs. Subsequent to these investigations, the Panel recommended a preferred "base model" for this stock. The recommended "base model" utilized a number of constraints and weightings, the details of which can be found in Appendices 2 and 3 of this report.

3.2. Assessment data

Overall, the data were deemed by the Panel to be appropriate and applied in an appropriate manner for the assessment, subject to serious concerns about the shrimp

bycatch, which is a major removal for this stock but for which there is a lack of adequate sampling.

Concern was raised regarding the high variability in the MRFSS recreational index, which is essentially a fishery-dependent index since it is tracing the fishery, but with limited coverage, mostly in Florida (eastern) and not in other, western areas.

Concern was raised regarding the absence of complete catch-at-age information, which substantially limits the precision of the analysis and the accuracy of the forecasts.

Concern was raised regarding the stock structure – there are two management regions, east and west. A more precautionary action for this assessment would treat this stock as two management areas (since they have different Fs and selectivity). There are no quantitative studies, such as mark-recapture, that document the movement of fish between these two regions.

3.3. Assessment models

For the available data, two models (ASPIC and SSASPM) were used as the assessment methods for this stock. The panel considered them to be appropriate for the available data.

The ASPIC model continued the method established by the previous assessment and still concluded that the stock was overfished and experiencing overfishing. There are questionable issues in ASPIC about convergence, ignoring all fishery-independent indices and age information; therefore it is not very informative and not recommended by this Panel.

The SSASPM was the newly developed age-structured model for this stock, which uses more information from growth patterns, size/age distribution, age-structure of the harvest, etc. with a weighted likelihood-based structure. Therefore, the Panel considered the SSASPM to be more informative and preferable.

However, concerns about the time series structures in the model residuals indicated that the model did not fit the data properly, possibly because of a lack of optimal/appropriate weighting and violation of the implemented first-order autoregressive model assumption. The figures for the autocorrelation function (ACF) and partial ACF for the commercial Headline and Headboat residuals in the Consensus Summary Report (Appendix 2) revealed that the residuals from the default SSASPM model structure, which assumed a first-order autoregressive error, still had further time series structure.

3.4. Stock status evaluated from the preferred "base model".

The stock experienced overfishing, but there is high uncertainty in the underlying SR relationship.

The Review Workshop could not come to a conclusion whether the stock is overfished or not, although it appears to be approaching an overfished condition.

3.5. Recommendations

- Enforcing an observer program to estimate levels of shrimp bycatches and appropriate age composition, supplemented with some well-designed, systematic research programs, which are essential to provide the data necessary for effective management. Shrimp bycatches for gray triggerfish are the dominant removals for

this species and it is scientifically important for an accurate stock assessment that there be better estimates.

- Establishing a comprehensive age-reading programme in the major sectors, to provide more accurate estimates of age distribution and more accurate and precise assessment. This became more important for this species since the assessment method changed from ASPIC model to SSASPM, which uses catch at age data.
- Strengthening the MRFSS programme so that more precise estimations of total catches for this stock.
- Initiating a mark-recapture study, which will help:
    - Identify movements and migrations between east and west regions;
    - Estimate fishing mortality;
    - Enhance the population estimates; and
    - Identify the stock structure;
    - Lead to better understanding of habitat preferences.
- Providing more detailed model diagnostics, such as complete lists of estimated parameters together with their estimated standard errors, the most important element for investigating model sensitivity runs.

4. CONCLUSIONS/ADDITIONAL RECOMMENDATIONS

In general, the SEDAR 9 process was organized professionally and progressed smoothly. The presentations were well prepared and presented. I greatly appreciate the time and effort expended by participants in each assessment group.

Below, I provide three additional recommendations, which, if implemented, would improve future stock assessment efforts and the SEDAR process:

- Including all the data used for the assessment in the Reports as well as the model formulations for the assessment. There was a large volume of documentation associated with this Review Workshop (listed in Appendix 2). The Review Panel recommended the need for 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) for each assessment along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.
- Providing for the Review Panel an executive summary for any substantive documents from Data and Assessment Workshops, a succinct table of model structural equation and parameters, and, if appropriate, a table of management options. A glossary of all the acronyms used in the assessments should be provided as an appendix in every assessment report.
- There were some concerns expressed in the Review Workshop that pressure may have been brought to bear on participants at some of those workshops to progress management further than was possible given the available time frame and available time series data, which were likely inadequate to support the development of meaningful assessments for the stocks.

5. Appendix 1:

Panel's approach to evaluating stock assessments

Basic Principles

The review panel considered the characteristics that would ideally be desirable in a stock assessment process used for advisory purposes. In order to guide its deliberations relevant to the terms of reference, the panel considered the following attributes to be desirable. Specific issues of concern addressed for each stock are addressed in this framework. Overall conclusions are summarized in Section 2.2.

1. All relevant data should be used, unless there is an *a priori* reason to exclude a data series, or a sound *a posteriori* reason can be identified. Data should be real observations, not "filled-in" using assumptions or other criteria, to the extent possible. Fish stock assessment depends on having reasonably long time-series of catch, effort and fishery-independent abundance estimates.

2. Conclusions about stock status with respect to reference points should be robust to underlying assumptions about data and structural model, e.g. reliance on filling-in assumptions, dependence on most contested parts of the data sets.

3. Assessments should include the following:

- 3.1 Data screening, to check assumptions in 1 and 2.
- 3.2 Model screening, to see if broadly similar conclusions are drawn from different models, including sensitivity to constraints etc.
- 3.3 Residual pattern screening: Does the model replicate the trends in the data?
- 3.4 Credibility check: are the estimated model parameters reasonable (e.g. selection pattern, r, B_0/B_{msy}, trends in F etc. in the context of biological knowledge about the stock and the fishery?
- 3.5 Variance estimates (or posteriors) for the estimated interest parameters, and *a priori* model testing, using simulated data, which should demonstrate that the model has useful precision in predicting interest parameters when presented with data.

4. Assessment documentation should include:

4.1. Data used to fit the assessment model.
4.2. Structural model equations, including process-error model if applicable
4.3. Observation-error model
4.4. Description of estimating algorithm
4.5. List of final parameter estimates and their s.d.s
4.6. Computational validation, including simulation testing
4.7. Source code (and ideally documentation) of the programs used should be made available.

6. Appendix 2:

Consensus Summary Report

Gulf of Mexico Gray Triggerfish (*Balistes capriscus*)

Prepared by the SEDAR 9 Review Panel for:

Gulf of Mexico Fishery Management Council

Edited by M. Elizabeth Clarke for
SEDAR 9, March 27- 31, 2006
New Orleans, Louisiana

Executive summary

To be written by the Chair after the meeting

1. Introduction

1.1 Time and Place

The SEDAR 9 Review Workshop met in New Orleans, Louisiana, from 27 to 31 March 2006.

1.2 Terms of Reference for the Review Workshop

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 stocks.
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 estimated values for management benchmarks, a 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* (e.g., exploitation, abundance, biomass).
6. Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters*. Ensure the implications of uncertainty in technical conclusions are clearly stated.
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. (In the event corrections are made in the assessment, alternative model configurations are recommended, or additional analyses are prepared as a result of review panel findings regarding the TORs above, ensure that corrected estimates are provided by addenda to the assessment report)
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.
9. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted. Clearly indicate the research and monitoring needs that may appreciably improve the reliability of future assessments.
10. 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

Participants	Affiliation
Panel Chair:	
M. Elizabeth Clarke	NOAA Fisheries/NWFSC
Review Panel:	
Haddon, Malcolm	CIE Reviewer
Patterson, Kenneth	CIE Reviewer
Chen, Din	CIE Reviewer
Presenters:	
Craig Brown	NMFS/SEFSC Miami
Shannon Cass-Calay	NMFS/SEFSC Miami
Guillermo Diaz	NMFS/SEFSC Miami
Josh Sladek Nowlis	NMFS/SEFSC Miami
Steve Turner	NMFS/SEFSC Miami
Jerry Scott `	SEFSC
Observers:	
Chris Dorsett	The Ocean Conservancy/GMFMC AP
Myron Fischer	GMFMC
Mike Nugent	GMFMC AP
Andy Strelcheck	NMFS/SERO
Wayne Werner	GMFMC AP
Joseph Powers	NMFS/SEFSC Miami
Staff support:	
John Carmichael	SEDAR
Dawn Aring	GMFMC Staff
Patrick Gilles	NMFS/SEFSC Miami
Stu Kennedy	GMFMC Staff
Joseph Powers	NMFS/SEFSC Miami
Jerry Scott `	SEFSC

1.4 Review Workshop Documents

The following documents were available to the Review Panel during SEDAR 9.

Document #	Title	Authors
	Documents Prepared for the Data Workshop	
SEDAR9-DW1	History of vermillion snapper, greater amberjack, and gray triggerfish management in Federal waters of the US Gulf of Mexico, 1984-2005	Hood, P.
SEDAR9-DW2	Vermillion Snapper Otolith Aging: 2001-2004 Data Summary	Allman, R J., J. A. Tunnell. B. K. Barnett
SEDAR9-DW3	Reproduction of vermillion snapper from the Northern and Eastern Gulf of Mexico, 1991-2002.	Collins, L. A., R. J. Allman, and H. M Lyon
SEDAR9-DW4	Standardized catch rate indices for vermilion snapper landed by the US recreational fishery in the Gulf of Mexico, 1986-2004	Cass-Calay, S. L.
SEDAR9-DW5	Standardized catch rate indices for vermilion snapper landed by the US commercial handline fishery in the Gulf of Mexico, 1990-2004	McCarthy, Kevin J., and Shannon L. Cass-Calay
SEDAR9-DW6	Standardized catch rates of vermilion snapper from the US headboat fishery in the Gulf of Mexico, 1986-2004	Brown, Craig A.
SEDAR9-DW7	Estimated Gulf of Mexico greater amberjack recreational landings (MRFSS, Headboat, TXPW) for 1981-2004	Diaz, Guillermo
SEDAR9-DW8	Size frequency distribution of greater amberjack from dockside sampling of recreational landings in the Gulf of Mexico 1986-2003	Diaz, Guillermo
SEDAR9-DW9	Size frequency distribution of greater amberjack from dockside sampling of commerical landings in the Gulf of Mexico 1986-2003	Diaz, Guillermo
SEDAR9-DW10	Standardized catch rates of gulf of Mexico greater amberjack for the commercial longline and handline fishery 1990-2004	Diaz, Guillermo
SEDAR9-DW11	Length Frequency Analysis and Calculated Catch at Age Estimations for Commercially Landed Gray Triggerfish (*Balistes capriscus*) From the Gulf of Mexico	Saul, Steven

SEDAR9-DW12	Estimated Gray Triggerfish (*Balistes capriscus*) Landings From the Gulf of Mexico Headboat Fishery	Saul, Steven
SEDAR9-DW13	Estimated Gray Triggerfish (*Balistes capriscus*) Commercial Landings and Price Information for the Gulf of Mexico Fishery	Saul, Steven
SEDAR9-DW14	Estimated Gray Triggerfish (*Balistes capriscus*) Recreational Landings for the State of Texas	Saul, Steven
SEDAR9-DW15	Estimated Gray Triggerfish (*Balistes capriscus*) Landings From the Marine Recreational Fishery Statistics Survey (MRFSS) In the Gulf of Mexico	Saul, Steven, and Patty Phares
SEDAR9-DW16	Length Frequency Analysis for the Gray Triggerfish (*Balistes capriscus*) Recreational Fishery In the Gulf of Mexico	Saul, Steven
SEDAR9-DW17	Estimates of Vermilion Snapper, Greater Amberjack, and Gray Triggerfish Discards by Vessels with Federal Permits in the Gulf of Mexico	McCarthy, Kevin J.
SEDAR9-DW18	Size Composition Data from the SEAMAP Trawl Surveys	Nichols, Scott
SEDAR9-DW19	Species Composition of the various amberjack species in the Gulf of Mexico	Chih, Ching-Ping
SEDAR9-DW20	Standardized Catch rates of Gulf of Mexico greater amberjack catch rates for the recreational fishery (MRFSS, Headboat) 1981-2004	Diaz, Guillermo
SEDAR9-DW21	SEAMAP Reef Fish Survey of Offshore Banks: Yearly indices of Abundance for Vermilion Snapper, Greater Amberjack, and Gray Triggerfish	Gledhill, et. al.
SEDAR9-DW22	Data Summary of Gray Triggerfish (*Balistes capriscus),*Vermilion Snapper (*Rhomboplites aurorubens)*, and Greater Amberjack (*Seriola dumerili)* Collected During Small Pelagic Trawl Surveys, 1988 – 1996	Ingram, Jr., G. Walter
SEDAR9-DW23	Abundance Indices of Gray Triggerfish and Vermilion Snapper Collected in Summer and Fall SEAMAP Groundfish Surveys (1987 – 2004)	Ingram, Jr., G. Walter
SEDAR9-DW24	Review of the Early Life History of Vermilion Snapper, *Rhomboplites auroubens*, With a Summary of Data from SEAMAP plankton surveys in the Gulf of Mexico: 1982 – 2002	Lyczkowski-Shultz, J. and Hanisko, D.

SEDAR9-DW25	Review of the early life history of gray triggerfish, *Balistes capriscus,* with a summary of data from SEAMAP plankton surveys in the Gulf of Mexico: 1982, 1984 – 2002	Lyczkowski-Shultz, J., Hanisko, D. and Zapfe, G.
SEDAR9-DW26	Shrimp Fleet Bycatch Estimates for the SEDAR9 Species	Nichols, Scott
SEDAR9-DW27	SEAMAP Trawl Indexes for the SEDAR9 Species	Nichols, Scott
SEDAR9-DW-28	Standardized Abundance Indices for Gulf of Mexico Gray Triggerfish (*Balistes capriscus)* based on catch rates as measured by the Marine Recreational Fisheries Statistics Survey (MRFSS)	Nowlis, Josh Sladek
SEDAR9-DW-29	Standardized Abundance Indices for Gulf of Mexico Gray Triggerfish (*Balistes capriscus)* based on catch rates as measured by the NMFS Southeast Zone Headboat Survey	Nowlis, Josh Sladek
SEDAR9-DW-30	Standardized Abundance Indices for Gulf of Mexico Gray Triggerfish (*Balistes capriscus)* based on catch rates as measured from commercial logbook entries with handline gear	Nowlis, Josh Sladek
SEDAR9-DW-31	Estimated Gulf of Mexico vermillion snapper recreational landings (MRFSS, headboat, TPWD) for 1981-2004	Cass-Calay, Shannon, & Guillermo Diaz
Documents Prepared for the Assessment Workshop		
SEDAR9-AW1	Incorporating age information into SEAMAP trawl indices for SEDAR9 species	Nicholls, S.
SEDAR9-AW2	Separating Vermilion Snapper Trawl Indexes into East and West Components	Nicholls, S
SEDAR9-AW3	Modeling Shrimp Fleet Bycatch for the SEDAR9 Assessments	Nicholls, S
SEDAR9-AW4	Status of the Vermilion Snapper (*Rhomboplites Aurorubens)* Fisheries of the Gulf of Mexico	Cass-Calay, S.
SEDAR9-AW5	Gulf of Mexico Greater Amberjack Stock Assessment	Diaz, Guillermo A., and Elizabeth Brooks
SEDAR9-AW6	A Categorical Approach to Modeling Catch at Age for Various Sectors of the Gray Triggerfish (*Balistes Capriscus)* Fishery in the Gulf of Mexico	Saul, Steven and G. Walter Ingram, Jr.
SEDAR9-AW7	Updated Fishery-Dependent Indices of	Nowlis, Joshua

	Abundance for Gulf of Mexico Gray Triggerfish (*Balistes Capriscus)*	Sladek
SEDAR9-AW8	An Aggregated Production Model for the Gulf of Mexico Gray Triggerfish (Balistes Capriscus) Stock	Nowlis, Joshua Sladek and Steven Saul
SEDAR9-AW9	Age-Based Analyses of the Gulf of Mexico Gray Triggerfish (Balistes capriscus) Stock	Nowlis, J. S.
SEDAR9-AW10	Gulf of Mexico greater amberjack virtual population analysis assessment	Brown, C. A.,C. E. Porch, and G. P. Scott
SEDAR9-AW11	Rebuilding Projections for the Gulf of Mexico Gray Triggerfish (Balistes capriscus) Stock.	Nowlis, J. S.
Documents Provided for the Review Workshop		
SEDAR9-RW01	Performance of production models on simulated data. (Presentation for NMFS National SAW 8, 2006)	Brooks, E. N. et al
Reference Documents Provided at Workshops		
SEDAR9-RD01 Univ. South AL. PhD Thesis	Stock structure of gray triggerfish on multiple spatial scales in the Gulf of Mexico.	Ingram, W.G.
SEDAR9 RD02 2002. Proc. 53rd GCFI	Indirect estimation of red snapper and gray triggerfish release mortality	Patterson, W. F. et al.
SEDAR9-RD03 1997 Proc. 49th GCFI	Preliminary Analysis of Tag and Recapture Data of the Greater Amberjack, *Seriola dumerili*, in the Southeastern United States	McClellan, D. and Cummings, N.
SEDAR9 RD04 SEFSC Doc. No. SFD-99/00-99	Trends in Gulf of Mexico Greater Amberjack Fishery through 1998: Commercial landings, Recreational Catches, Observed length Frequencies, Estimates of Landed and Discarded Catch at Age, and Selectivity at Age.	Cummings, N. J., and D. B McClellan
SEDAR9-RD05 Fish. Res. 70 (2004) 299-310	A multispecies approach to subsetting logbook data for purposes of estimating CPUE	Stephens, A. and A. MacCall.
S9-RD06	Stock assessments of Gulf of Mexico greater	Turner, S. C, N.J.

SFD 99/00-100	amberjack using data through 1998.	Cummings, and C. E. Porch
S9-RD07 SFD 99/00-92	Catch rates of greater amberjack caught in the handline fishery in the Gulf of Mexico in 1990-1998	Turner, S. C.
S9-RD08 SFD 99/00-107	Catch rates of greater amberjack caught in the headboat fishery in the Gulf of Mexico, 1986-1998.	Turner, S. C.
S9-RD09 SFD 01/02-150	Projections of Gulf of Mexico greater amberjack from 2003-2012	Tuner, S. C. and G. P. Scott
S9-RD10 SFD 99/00-98	Gulf of Mexico greater amberjack abundance from recreational charter and private boat anglers from 1981-1998.	Cummings, N. J.
S9-RD11 SFD00/01-124	A stock assessment for gray triggerfish in the Gulf of Mexico.	Valle, M, C. Legault, and M. Ortiz.
S9-RD12 SFD00/01-126	Another assessment of gray triggerfish in the Gulf of Mexico using a space-state implementation of the Pella-Tomlinson production Model	Porch, C. E.
S9-RD13 SFD01/02-129	Status of the vermilion snapper fishery in the Gulf of Mexico. Assessment 5.0	Porch, C. E. and S. Cass-Calay.
S9-RD14 Panama City 01-1	Report of vermilion snapper otolith aging; 1994-2000 data summary	Allman, R. J., G. R. Fitzhugh, and W. A. Fable
S9-RD15 FWRI IHR2005-3	Genetic stock structure of vermilion snapper in the Gulf of Mexico and southeastern United States	Tringali, M. D. and M. Higham
S9-RD16 SCDNR	Age, growth, and reproduction of greater amberjack in the Southwestern North Atlantic. December 2004 Analytical Report	Harris, P. J.
S9-RD17	Preliminary Assessment of Atlantic white marlin using a state-space implementation of an age-structured production model	Porch, C. E.
S9-RD18	VPA-2BOX Program Documentation, Version 2.01. 2003. ICCAT Assessment Program Documentation.	Porch, C. E.
S9-RD19	VPA-2BOX Program Documentation, Version 3.01. 2003. ICCAT Assessment Program Documentation.	Porch, C. E.
Final Assessment Reports		
SEDAR9-AR1	Gray Triggerfish	
SEDAR9-AR2	Greater Amberjack	
SEDAR9-AR3	Vermillion Snapper	

2. Response to Terms of Reference

2.1. Background

- The Review Workshop (RW) is the third meeting in the SEDAR 9 process. The Panel was provided reports (documents: *S9DWREP GT.pdf* and *S9AWREP GRT.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.

- The Gray Triggerfish assessment was presented by Dr. Josh Sladek-Nowlis on Monday, the March 27th.

- The Assessment was based on the data from the Data Workshop. The assessment methodologies used for this assessment were "A Stock Production Model Incorporating Covariates" (ASPIC) and "State-Space Age-Structured Production Models" (SSASPM).

- The review Panel evaluated the assessment and identified a number of concerns. Consequently, the Panel requested several sensitivity runs. With this investigation, the Panel recommended a preferred "base model" for this stock. The recommended "base model" utilized a number of constraints and weightings and the details can be found from the Addendum to the Assessment Report and outlined below. Data series were weighted as follows using CV multipliers unless otherwise stated, such that larger numbers represent greater uncertainty:

    - Commercial catch: 1;
    - Recreational catch: 2 from 1981-1987; 1 from 1988-2004;
    - Shrimp bycatch: 2;
    - All indices: 1.5; and
    - Catch at age was weighted using a sample size equivalent—these were set annually with a maximum of 25, and 1 sample counted for every 10 fish.

  Restrictions were placed on deviations of various series as follows:

    - Recruitment deviations were penalized using a variance term of 0.15, equivalent to a 40% CV;
    - Effort deviations for directed fleets were penalized using a variance term of 0.223, equivalent to a 50% CV;
    - Effort deviations for the shrimp fleet were penalized using a variance term of 0.0392, equivalent to a 20% CV; and

- All effort series were serially autocorrelated with a correlation coefficient of 0.5.

2.2. Review of the Panel's deliberations

The deliberations on each species are presented in the form of responses to the terms of reference questions specifically, followed by relevant comments on the discussions.

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

- The data for this species were finalized from the SEDAR Data Workshop (DW) and reported in *S9DWREP GT.pdf*. Overall, the data were deemed as appropriate and applied in an appropriate manner by the Panel for the assessment subject to the serious concerns of the shrimp bycatch.

- Data used for the assessment were:
  - Annual catches of gray triggerfish by relevant sector (recreational East, recreational West, commercial East, commercial West, shrimp bycatch).
  - Indices of abundance from a variety of sources, including fishery-dependent catch and effort series from headboat surveys, other recreational surveys (MRFSS), and commercial logbooks (restricted to handlines and equivalent gears). Fishery-independent surveys were also used, including a Neuston net larval survey, a shrimp-trawl style young-of-year survey, and a video survey which primarily sampled adult habitat.
  - Life history parameters were entered based on recent studies of the biology of gray triggerfish in the Gulf of Mexico.
  - Catch at age, which was inferred from size at age data using area-specific growth patterns.

However, there are serious weaknesses in the data:

- Shrimp bycatch: data were very sparse since this species was not "listed", therefore this data series was lack of adequate sampling of the shrimp bycatch. However it is a major source of mortality on this stock (more than 1 million fish for some years). There were concerns that the shrimp bycatch might be biased high if fishers reported gray triggerfish only when they caught large amounts and the known catches were extrapolated to cover the fleet and all catches.

- The high variability in the MRFSS recreational index; essentially fishery-dependent index since it is tracing the fishery; limited coverage with mostly in Florida (eastern) and not in western (such as TX, note that TX conducts its own survey, so not included in comparisons of MRFSS).

- The fishery dependent indices of abundance were questionable on whether the

indices were representative. This is obvious when the data only comes from Florida since this species has east and west gulf with different effort in both areas.

- No discard information for Headboat. The discard mortality was assumed to be zero in the assessment

- The absence of complete catch-at-age information substantially limited the precision of the analysis and the accuracy of the forecasts.

- Stock structure – there are two management regions of east and west. The assessment should treat the stock as two management areas (since they have different Fs and selectivity). More precautionary actions to separate the Gulf into two.

- Two region again. There were no quantitative studies, such as mark-recapture, on movement of fish between these two regions. It is known biologically that there is little or no adult movement but there is long larval phase with plenty of mixing.

2.2.2. Evaluate the adequacy, appropriateness and application of methods used to assess the stocks.

- 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.

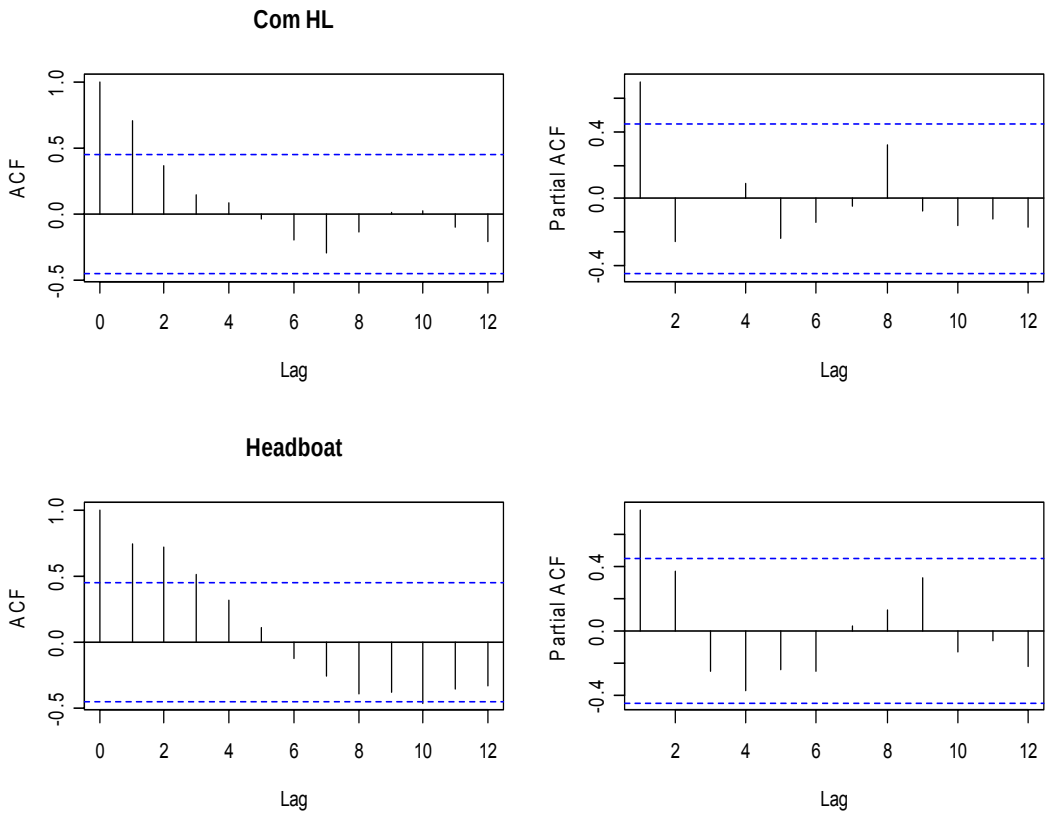
- For the available data, two models (ASPIC and SSASPM) were used as the assessment methods for this stock.

- The ASPIC model was used as a continuity run from the previous assessment and still concluded that the stock is overfished and experiencing overfishing. There are questionable issues in ASPIC about convergence, ignoring all fishery-independent indices and age information; therefore it is not very informative and not recommended by this Panel.

- The SSASPM was the newly developed age-structured model for this stock using more information from growth patterns, size/age distribution, age-structure of the harvest, etc. with a weighted likelihood-based structure. Therefore the SSASPM was determined as more informative and preferable from the Panel.

- However, concerns about the time series structures in the model residuals indicated that the model did not fit the data properly possibly because of the lack of optimal/appropriate weighting and the implemented first-order

autoregressive model assumption. The following figures are used to illustrate this concern, which are the autocorrelation function (ACF) and partial ACF for commercial Headline and Headboat residuals (other landing series and indices can be also generated). It revealed that the residuals from the default SSASPM model structure with first-order autoregressive assumption still existed further time series structure, i.e. first-order autoregressive and moving average for commercial headline, second-order autoregressive and first-order moving average for headboat.



- For adequacy of the assessment methods, there are no absolute levels of adequacy of the methods to be assessed at present. Simulation testing of the assessment methods would have to be performed under conditions approximating those believed to pertain to gray triggerfish. Such simulations were not available to the review panel.

- 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 limit. They are however adequate for exploring the information content and management implications of small and incomplete data sets such as that available for gray triggerfish. Although it is true that the assessment models do not specifically address such management

measures, it is worth noting that (1) they are sufficient for exploring total allowable catches, and (2) the very low release mortality indicates that size limits and bag/trip limits would be appropriate methods for controlling total allowable catches. It is noted that data collection in the Gulf of Mexico fisheries is a difficult and challenging task.

- The application of the methods was considered to be appropriate. Sensitivity runs were established in order to identify the change in perception of stock status in response to new information. Methods were chosen in order to reflect the availability of data and the way in which it was collected. However, it was clear that insufficient time and resources had been made available to consider fully the model constraints and parameterizations. In this context, further model and data explorations at the review workshop were a helpful step in the process.

- The practice of testing the sensitivity of model interest parameters (e.g. current F/F msy) to the use of simulated data series, and to the fixing of structural parameters and constraints is essential in the application of stock assessment models and should be developed and continued.

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

- The panel evaluated the original assessment results and requested several sensitivity runs

- Further evaluated the sensitivity runs, the panel had 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 Report prepared by Dr. Josh Sladek Nowlis.

- A number of issues were explored but not fully resolved during the meeting. The assessment model was unexpectedly inflexible in fitting to simulated indices of abundance, which could suggest that some structural features of the model could have a strong influence on the model fit. Also, the review meeting did not identify which – if any – of the model parameters were bound constrained at the solution, did not investigate correlations in the parameters at the solution, and did not examine parameter uncertainty estimates. Despite this, the review panel considered the final assessment as an acceptable representation of the stock dynamics because the main data trends were represented and the model structure was, *a priori*, reasonable. However, some research recommendations concerning the foregoing concerns are included below.

- The details for the appropriate estimate of stock abundance, biomass and

exploitation are listed in the Addendum to the Assessment Report.

- SEDAR and management agencies should be aware that high uncertainties are attached to this assessment

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

- The methods to estimate population benchmarks and management parameters are based on the maximum-likelihood parameter estimates from the recommended "base model". The estimates of these benchmarks are listed in the Addendum to the Assessment report.

- In general, the ASPIC model (the continuity case) estimates the surplus production parameters (carrying capacity, intrinsic population growth) and biomass trajectories over the course of the time period in the assessment model. These estimated parameters are then combined to produce other useful population benchmarks and management parameters, such as MSY-related reference points of biomass and fishing mortality rates and fishing mortality rate trajectories.

- For the SSASPM base model, the reference points are calculated numerically with reference to the maximum of the product of the equilibrium fecundity-per-recruit and recruitment-per-fecundity functions

- These methods are considered to be appropriate for the available data in the present situation. However, improved methods based on stochastic modelling of the fishery, the stock, and the sampling from the stock could be developed that would give greater insight into the dynamics of the assessment and management process if more resources were available. Such studies could lead to different benchmarks.

- With the recommended base model run, the detailed estimates of management benchmarks and management parameters with reference to the population parameters from the SSASPM are listed in the Addendum to the Assessment report and summarized as follows:

    - MFMT, the Maximum Fishing Mortality Threshold, is set = $F_{30\%SPR}$.
    - MSST, the Minimum Stock Size Threshold, is set = $(1\text{-}M).B_{msy}$.
    - F_{OY}, the optimum yield is defined as $0.75.F_{30\%SPR}$.

The parameters relevant to management are estimated as follows:

Parameter	*Base Value (Low-High Steepness)*
Population parameters and management benchmarks	
$F_{20\%SPR}$	0.419
$F_{30\%SPR}$ = MFMT	0.269
$F_{40\%SPR}$	0.186
F_{msy}	0.45 (0.294-0.525)
SSB_{msy} (eggs)	1.21t (1.78t-1.049t)
$SSB_{30\%SPR}$ = MSST	2.094t (1.967t-2.109t)
F_{OY}	Not defined
MSY (lbs, incl shrimp bycatch)	1.638m (1.441m-1.707m)
Stocks parameters in 2004	
F_{2004}	0.435 (0.431-0.435)
F_{2004}/MFMT	1.62 (1.6-1.62)
SSB_{2004} (eggs)	1.345t (1.323t-1.351t)
SSB_{2004}/MSST	1.02 (1.22-1)
F_{2004}/OY	Not defined

Declarations of Stock Status:

- The stock experienced overfishing, but there is high uncertainty in the underlying instead of the current SR relationship.

- The RW could not come to a conclusion whether the stock is overfished or not, although it appears to be approaching an overfished condition.

2.2.5. Evaluate the adequacy, appropriateness and application of methods used to project future population status; recommend appropriate estimates of future stock condition (eg., exploitation, abundance, biomass)

- Projection of this stock is based on the recommended “base model” from the Panel.

- Project the future population status for this stock will depend on the assumptions that the catches and shrimp bycatches continuing at the current trends and the model assumptions remain unchanged.

- 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 gray triggerfish. It is noted that data collection in the Gulf of Mexico fisheries is a difficult and challenging task.

- Management agencies should be aware that high uncertainty is attached to this assessment

- The panel recommended the "base model" at present for the projection for this stock and the estimate the stock condition (Fig 9 in the Assessment Report Addendum).

2.2.6. Evaluate the adequacy, appropriateness and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure the implications of uncertainty in technical conclusions are clearly stated.

- The primary uncertainties are from the model process errors and the data measurement errors. Because of the inherited high uncertainties from the data and the model structure, the basic tool for evaluating this type of uncertainty is the calculation of sensitivity analyses, by investigating the robustness of interest parameter estimates to alternative choices about data usage, to specification of structural parameters. Numerous trial runs are calculated in order to identify key sensitivities and develop appropriate relevant treatments. This is considered highly appropriate.

- With the selected base model, the model-based estimates of the standard errors in the most important parameter estimates were calculated. The method is based on using automatically-calculated derivatives of the interest parameter with respect to the inverse Hessian matrix of the likelihood at the solution (the method is specific to the software used, "AD model builder"). The AD will automatically produce the standard error for the parameters and the specified MSY management benchmark parameters. The uncertainty measures for the ratio estimates, such as SSB/SSBmsy and F/Fmsy should be produced and in fact can be produced by the delta (approximate Taylor expansion) method and recommended by the panel to be included in the assessment report.

- Improvement in the documentation of the method would be encouraged. These uncertainty estimates are considered to be more useful as diagnostics of model fitting rather than as reflecting the "real" uncertainty in the assessment.

2.2.7. 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. (In the event corrections are made in the assessment, alternative model configurations are recommended, or additional analyses are prepared as a result of review panel findings regarding the TORs above, ensure that corrected estimates are provided by addenda to the assessment report).

The panel recommended a new "base model" for this stock and the alternative configurations for the new base model are listed in the Assessment Report Addendum.

2.2.8. 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 terms of reference and the results of gray triggerfish Data Workshop are documented in *S9DWREP GT.pdf.* The review panel evaluated the terms of reference with consensus that the TOR were met in general except for TOR 5 ("Evaluate the adequacy of available data for estimating the impacts of current management actions") and TOR 6 ("Recommend assessment methods and models that are appropriate given the quality and scope of the data sets reviewed and management requirements"), which were not pertinent and outside the scopes of the Data Workshop and recommended removing from the TOR in the future data workshop. The TOR 7 ("Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Include specific guidance on sampling intensity and coverage where possible") was not addressed sufficiently in the Report.

- The terms of reference and the results of gray triggerfish Assessment Workshop are documented in *S9AWREP GRT.pdf.* The review panel evaluated the terms of reference with consensus that the TOR were met generally with deviations for the best possible base model. The panel evaluated data and the model and suggested several sensitivity runs. The Panel recommended a preferred "base model" for gray triggerfish (see Addendum to the Assessment Report for details).

- In general, there were no sufficient recommendations for research addressed in both Data and Assessment Workshop as stated in the TOR.

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

<u>indicate the research and monitoring needs that may appreciably improve the reliability of future assessments.</u>

The Panel strongly recommends:

- Providing for the Review Panel an executive summary for substantive documents from Data and Assessment Workshops, a succinct table of model structural equation and parameters, and if appropriate a table of management options. A glossary of all the acronyms used in the assessments should be provided as an appendix in every assessment report.

- Including all the data used for the assessment in the Reports as well as the model formulations for the assessment. Some of the data in gray Triggerfish (such as age composition data) used in the assessment were missing from the Assessment Report, which could preclude further independent evaluation of the assessment results. The Addendum to the gray triggerfish Assessment Report includes these data now.

- Enforcing an observer program to estimate levels of shrimp bycatches and appropriate age composition with some well-designed, systematic research programs, which are essential to provide the data necessary for effective management. Shrimp bycatches for gray triggerfish are the dominant removals for this species and it is scientifically important for better estimates for an accurate stock assessment. Catch in numbers of fish is dominated by shrimp bycatch which mainly consists of age-0 and age-1 fish (Table 1 and Fig 1 in the Addendum). The shrimp bycatch fishery annually removes roughly 1 million fish age-1 equivalent and peaked at 5 million fish at year 2002. However the recreational and commercial fisheries combined take roughly 1 million pounds in recent years but had past peaks reaching 3 million pounds annually.

- Establishing a comprehensive age-reading programme in the major sectors for more accurate age distribution in order for more accurate and precise assessment. This became more important for this species since the assessment method changed from ASPIC model to SSASPM using catch at age data.

- Strengthening the MRFSS programme for more precise estimations of total catches for the assessment.

- Initiating a mark-recapture study, which will help:
    - Identifying movements and migrations between east and west regions;
    - Estimating fishing mortality;
    - Enhancing the population estimates; and
    - Identifying the stock structure;
    - Better understanding habitat preferences.

- Documenting the methods more thoroughly, including the structural model equations, the observation-error models, process-error models (if appropriate), values of constants, constraints and priors, and description of the fitting algorithm including the uncertainty-estimation method.

- Providing more detailed model diagnostics, such as complete lists of estimated parameters together with their estimated standard errors, the most important investigation of model sensitivity runs.

- Enforcing the model residuals diagnostics to test whether there is still time series autocorrelation for lack of goodness of fit in the assessment.

- Significantly increasing the resources available to the assessment data collection, processing and modelling teams would be required in order to allow the foregoing recommendations to be implemented realistically.

- Following the panel's internally-adopted guidelines for assessing assessments developed during the SEDAR 9 RW (see Appendix 1).

2.3. General recommendations to SEDAR

- There were some concerns expressed in the RW that pressure may have been brought to participants at some of those workshops to progress management further than was possible from the available time frame and available time series data, which were likely difficult to work and support the development of meaningful assessments for the stocks.

- Incorporation of fishermen's knowledge into the data and assessment process for better stock assessment and management process.

- There was large volume of documentation associated with this RW. The Review Panel recommended the need for 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.

Appendix: Panel's approach to evaluating stock assessments

Basic Principles

The review panel considered the characteristics that would ideally be desirable in a stock assessment process used for advisory purposes. In order to guide its deliberations relevant to the terms of reference, the panel considered the following attributes to be desirable. Specific issues of concern addressed for each stock are addressed in this framework. Overall conclusions are summarized in Section 2.2.

1. All relevant data should be used, unless there is an *a priori* reason to exclude a data series, or a sound *a posteriori* reason can be identified. Data should be real observations, not "filled-in" using assumptions or other criteria, to the extent possible. Fish stock assessment depends on having reasonably long time-series of catch, effort and fishery-independent abundance estimates.

2. Conclusions about stock status with respect to reference points should be robust to underlying assumptions about data and structural model, e.g. reliance on filling-in assumptions, dependence on most contested parts of the data sets.

3. Assessments should include the following :

- 3.1 Data screening, to check assumptions in 1 and 2.
- 3.2 Model screening, to see if broadly similar conclusions are drawn from different models, including sensitivity to constraints etc.
- 3.3 Residual pattern screening: Does the model replicate the trends in the data?
- 3.4 Credibility check : are the estimated model parameters reasonable (e.g. selection pattern, r, B_0/B_{msy} , trends in F etc. in the context of biological knowledge about the stock and the fishery ?
- 3.5 Variance estimates (or posteriors) for the estimated interest parameters, and *a priori* model testing, using simulated data, which should demonstrate that the model has useful precision in predicting interest parameters when presented with data.

4. Assessment documentation should include :

4.1. Data used to fit the assessment model.
4.2. Structural model equations, including process-error model if applicable
4.3. Observation-error model
4.4. Description of estimating algorithm
4.5. List of final parameter estimates and their s.d.s
4.6. Computational validation, including simulation testing
4.7. Source code (and ideally documentation) of the programs used should be made available.

7. Appendix 3:

Assessment Summary Report
Gulf of Mexico Gray Triggerfish
SEDAR 9 Review Workshop

Stock Distribution:

- The gray triggerfish are found throughout the Gulf of Mexico, which is considered a single stock based on its prolonged, indeterminate larval stage.
- This assessment addresses gray triggerfish in the U.S. Gulf of Mexico. The stock is divided into eastern and western gulf components at the Mississippi River to allow application of area-specific life history characteristics, catch statistics, and survey indices.

Assessment Methods & Data:

- Gray triggerfish in the Gulf of Mexico were assessed with two models, including ASPIC and SSASPM. Within each type of model various configurations and sensitivity runs were explored. Details of all models are available in the Stock Assessment Report and the Review Panel Consensus Summary.
- The Assessment Workshop chose the SSASPM model to provide the base assessment results based on its flexibility and better mathematical rigor to incorporate more information on life history and on the age structure of the harvest. The RW accepted this model with modifications that are detailed in the Assessment Report Addendum (prepared by Dr. Josh Sladek Nowlis and attached with this report in the Appendix) and summarized here in a subsequent section.
- Data sources include landings by relevant sectors from recreational east, recreational west, commercial east, commercial west and shrimp bycatch (Table 1 and Fig 1 in the Addendum); five fishery-dependent indices and three fishery-independent indices (Table 2 and Fig 2 in the Addendum); gray triggerfish life history parameters based on the biological studies (Table 3 in the Addendum), as well as relative age composition data inferred from size at age data using area-specific growth patterns (Table 4 in the Addendum).

Sources of Information:

- Results are summarized in the following bullets. Complete details are available in the SEDAR 9 Data and Assessment Reports, Assessment Report Addendum and the SEDAR 9 Review Panel Consensus Summary, and the many SEDAR 9 workshop working papers.

- Complete results of the SSASPM model configuration preferred by the Review Panel are contained in the Stock Assessment Report Addendum.

Catch Trends:

- Catch in numbers of fish is dominated by shrimp bycatch which mainly consists of age-0 and age-1 fish (Table 1 and Fig 1 in the Addendum). The shrimp bycatch fishery annually removes roughly 1 million age-1 equivalent and peaked at 5 million fish at year 2002 (Table 1 and Fig 1 in the Addendum). The recreational and commercial fisheries combined take roughly 1 million pounds in recent years but had past peaks reaching 3 million pounds annually.
- Catch information was derived from several fleets (SEDAR9-DW-Report). Based on age-structure of the catches, these were pooled into four directed fleet categories: recreational east, recreational west, commercial east, and commercial west, with the east-west split occurring at the Mississippi River.

Fishing mortality trends

- Fishing mortality is variable and irregular ranged about between 0.4 to 0.6 with MSY at 0.45 (Fig 6 in the Addendum). Generally, it shows a decreasing trend from the mid 80s to the early 90s and an increasing trend to its peak during the mid 90s (F = 0.65), then decreasing from the mid 90s to 2000, slowly building to F_{MSY} in recent years.

Stock abundance and biomass trends

- Model assumed virgin condition in 1963 with virgin SSB of 7.5 trillion eggs, model predicts a drop to ¼ virgin at trough in the mid 1980s, 50% increase through early 1990s, cut in half by late 1990s to MSST, 25% rise by 2002 and drop by 10% in 2004 (Fig 6 in the Addendum).

Status determination criteria and Stock Status

- The parameters relevant to management are estimated from the preferred base model by the RW as follows:

Parameter	***Base Value (Low-High Steepness)***
Population parameters and management benchmarks	
$F_{20\%SPR}$	0.419
$F_{30\%SPR}$ = MFMT	0.269
$F_{40\%SPR}$	0.186
F_{msy}	0.45 (0.294-0.525)
SSB_{msy} (measured as egg production)	1.21t (1.78t-1.049t)
$SSB_{30\%SPR}$ = MSST	2.094t (1.967t-2.109t)

Parameter	*Base Value (Low-High Steepness)*
F_{OY}	Not defined
MSY (lbs, incl. shrimp bycatch)	1.638m (1.441m-1.707m)
Stocks parameters in 2004	
F_{2004}	0.435 (0.431-0.435)
F_{2004}/MFMT	1.62 (1.6-1.62)
SSB_{2004} (eggs)	1.345t (1.323t-1.351t)
SSB_{2004}/MSST	1.02 (1.22-1)
F_{2004}/OY	Not defined

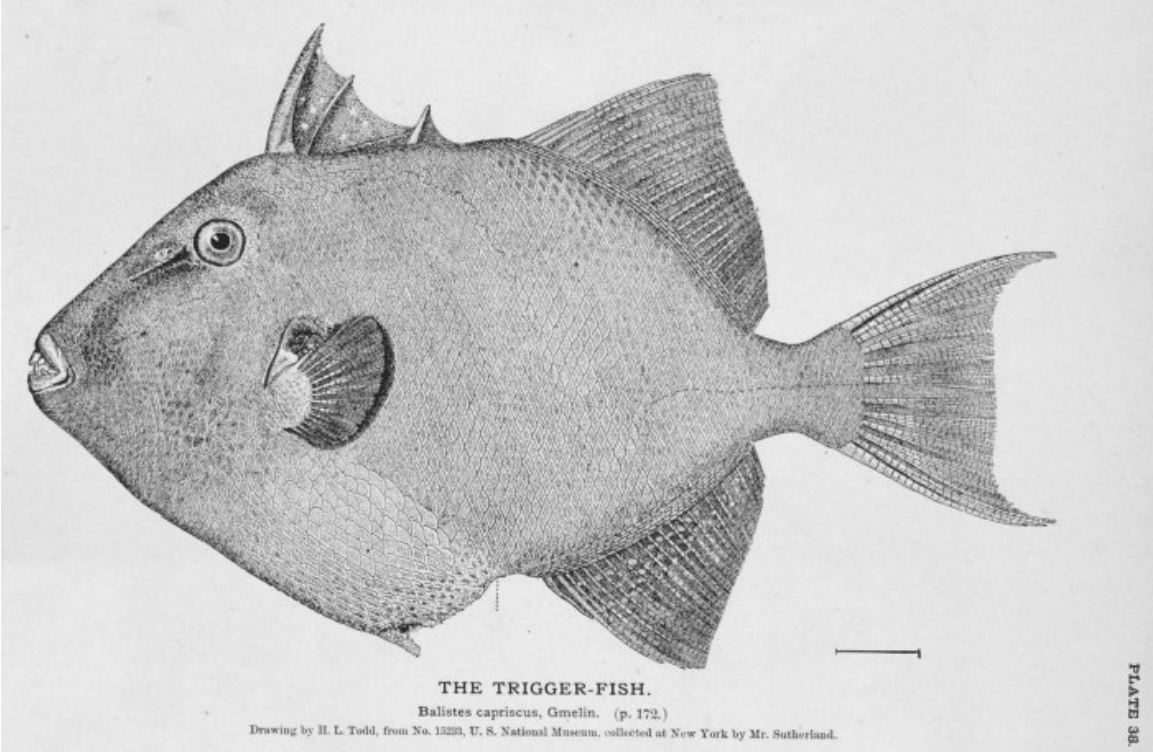
- Declarations of Stock Status:
  - The stock experienced overfishing. According to the existing $F_{30\%SPR}$ maximum fishing mortality threshold (MFMT), current fishing mortality rates are 60% too high (Table 6 and Fig 8 in the Addendum). Current fishing mortality rates are in the range of MSY-based fishing mortality rates (F_{MSY}) as estimated by the base model (F_{2004}/F_{MSY} = 0.97). However, this status measure is sensitive to the stock-recruitment relationship, which is poorly estimated with the data available on this stock. Over a range of potentially realistic parameter values, current fishing mortality rates range from 83 to 147 percent of F_{MSY}(Table 6 and Fig 8 in the Addendum).
  - The RW cannot come to a conclusion whether the stock is overfished or not, although it appears to be approaching an overfished condition. The stock is estimated to be just above the minimum stock size threshold, currently defined as a stock condition below 20%SPR. This status measure has some sensitivity to the stock-recruitment relationship, but in most cases the stock is identified as being just above the threshold. However, current fishing rates are predicted to drive the stock below the threshold in the near future.

Projections

- Quantitative projections are available for the preferred base model from RW (Table 7 and Fig 9 in the Addendum). These indicate:
  - If conditions in 2004 continue, forecasts are uncertain but indicate the stock is slightly more likely to decrease than to increase;
  - The extent of reduction in fishing mortality brought about by additional management measures in 2005 cannot be evaluated at present since no new management measures were put in place for gray triggerfish in 2005.

Appendix:

Addendum to Assessment Report for Gray Triggerfish



by
Josh Sladek Nowlis
March 2006
SFD Contribution ###

Based on Results of the Southeast Data Assessment Review (SEDAR) 9 Review Workshop
Held 27-31 March 2006
New Orleans, LA

Base Model Structure

After extensive review of available data and attributes of gray triggerfish biology and the fisheries that catch it, it was determined that an age-structured production model would best describe the Gulf of Mexico gray triggerfish (*Balistes capriscus*) stock. The particular model used, a State Space Age-Structured Production Model (SSASPM) is described elsewhere (Porch 2002). Its fundamental features include:

- Fits to catch, abundance index, and catch-at-age data;
- Fits to or use of fixed parameters describing the life history of the stock (e.g., natural mortality, growth rates, stock-recruitment relationships);
- Recruitment deviations from the stock-recruitment relationship, constraints on which are controlled by the user—note that these recruitment deviations can be asymmetrical (i.e., they need not sum to 1) and as a result they can create a circumstance in which recruitment patterns in recent years, and corresponding management benchmarks, may differ from the underlying stock-recruitment relationship;
- Effort deviations that can include serial autocorrelation;
- The ability to weight the importance of each data series in the objective function, as well as specifying interannual variability within each series; and
- A "pre-historical" or "burn in" period, which begins the model at virgin condition and uses prescribed effort patterns (e.g., linear increase) until the time period when more data streams are available—this feature is principally used to condition the model for the beginning of the "historical" period.

Data Inputs

Several types of data were used as input to the model. These included:

- Annual catches of gray triggerfish by relevant sector (recreational East, recreational West, commercial East, commercial West, shrimp bycatch). See Table 1 and Fig. 1 for the data.
- Indices of abundance from a variety of sources, including fishery-dependent catch and effort series from headboat surveys, other recreational surveys (MRFSS), and commercial logbooks (restricted to handlines and equivalent gears). Fishery-independent surveys were also used, including a Neuston net larval survey, a shrimp-trawl style young-of-year survey, and a video survey which primarily sampled adult habitat. See Table 2 and Fig. 2 for the data.
- Life history parameters were entered based on recent studies of the biology of gray triggerfish in the Gulf of Mexico. See Table 3 for the data.

- Catch at age, which was inferred from size at age data using area-specific growth patterns. See Table 4 for the data.

The model began in 1963, at which point the stock was assumed to be unfished. The burn in/pre-historic period lasted through 1980, while the historical/data-oriented period stretched from 1981 to 2004. A single stock was assumed for the entire US Gulf of Mexico, but directed fishing sectors were split into western and eastern components at the Mississippi River (resulting in five fleets—recreational west, recreational east, commercial west, commercial east, and shrimp Gulf-wide). The stock was modeled using 10 age classes spanning from 1 year olds to 10+ year olds. The base model used a number of constraints and weightings that reflected tinkering and the advice and input of the review panel. Data series were weighted as follows using CV multipliers unless otherwise stated, such that larger numbers represent greater uncertainty:

- Commercial catch: 1;
- Recreational catch: 2 from 1981-1987; 1 from 1988-2004;
- Shrimp bycatch: 2;
- All indices: 1.5; and
- Catch at age was weighted using a sample size equivalent—these were set annually with a maximum of 25, and 1 sample counted for every 10 fish.

Restrictions were placed on deviations of various series as follows:

- Recruitment deviations were penalized using a variance term of 0.15, equivalent to a 40% CV;
- Effort deviations for directed fleets were penalized using a variance term of 0.223, equivalent to a 50% CV;
- Effort deviations for the shrimp fleet were penalized using a variance term of 0.0392, equivalent to a 20% CV; and
- All effort series were serially autocorrelated with a correlation coefficient of 0.5.

This fully summarizes the base model. The actual input files are shown in Appendix 1.

Fits to Data

The base model's fits to the data series were generally good. Catches were not perfectly fit but captured most of the dynamics of rising and falling catches over time (Fig. 3). The fit to shrimp bycatch was most problematic, but so was that data and as a result the model was given more latitude to sacrifice this fit to the benefit of better fits elsewhere. Indices also generally fit well, although only in broad form and not necessarily in detail (Fig. 4). In particular, large spikes in abundance were not well represented in the model's predictions (e.g., MRFSS 1990, trawl 1991 and 2001). Catch at ages, despite having been down weighted substantially compared to previous version of the base model, were still fit well as exemplified by the 2004 fits (Fig. 5).

Model Estimates

Estimates for key parameters and management benchmarks from both the base model and sensitivity analyses are shown in Table 5. These data illustrate the sensitivity of the model to changes in assumptions.

The model estimated trajectories for spawning stock biomass, fishing mortality rates, and recruitment (Fig. 6). With respect to SSB, the model assumed virgin condition in 1963 and predicted a drop to one-fourth virgin SSB in the mid-1980s. It then predicted a 50 percent increase through early 1990s, followed by a drop to the minimum stock size threshold by the late-1990s. The stock was predicted to have risen about 25 percent by 2002 and then to have dropped by 10 percent in 2004. These patterns were consistent across different stock-recruitment relationships, but with differences in benchmark reference points (see Table 5).

Fishing mortality rates were predicted to have ranged between about 0.4 and 0.6 in the base model, with peaks in the early-1980s and throughout the 1990s, and troughs in the late 1980s and in 2000, slowly building to F_{MSY} in recent years. In this version, F_{MSY} was estimated at 0.45, corresponding to an SPR level of less than 20 percent, and the maximum fishing mortality threshold (MFMT) of 30% SPR corresponded to a fishing mortality rate equal to 0.269. Different stock recruitment relationships showed the same annual trends but with shifted F_{MSY} values (see Table 5).

Recruitment followed the underlying stock-recruitment relationship in the pre-historical/burn in period. However, the pattern of recruitment was clearly different when the model was allowed to estimate recruitment deviations starting in the early 1980s. One can see that recruitment was estimated to be above virgin levels throughout most of the 1980s and into the early-1990s, with a subsequent high peak occurring in 2001. When recruitment in recent years (1986 to 2004) was examined as a function of spawning stock biomass, a dramatically different stock-recruitment relationship is inferred. The underlying S-R relationship was fixed at a steepness of 0.89, and the maximum recruitment was estimated as 2.146 million fish, while the relationship estimated from the model's results, which included deviations, was a steepness of only 0.442 and a maximum recruitment of 15.3 million fish (Fig. 7). Considering that steepness must fall between 0.2 and 1, these results are starkly different and illustrate the inability of the data on gray triggerfish to inform us of the actual stock-recruitment function. As a result, any S-R dependent benchmarks, including MSY and its associated reference points, should be viewed as highly uncertain. SPR-based benchmarks, which are independent (F) or only slightly dependent (SSB) on S-R, should be viewed as more reliable.

Stock Status

The stock experienced overfishing. According to the existing $F_{30\%SPR}$ maximum fishing mortality threshold (MFMT), current fishing mortality rates are 60% too high (Table 6, Fig. 8). Current fishing mortality rates are in the range of MSY-based fishing mortality rates (F_{MSY}) as estimated by the base model ($F_{2004}/F_{MSY} = 0.97$). However, this status measure is sensitive to the stock-recruitment relationship, which is poorly estimated with the data available on this stock. Over a range of potentially realistic parameter values, current fishing mortality rates range from 83 to 147 percent of F_{MSY} (Table 6, Fig. 8).

We cannot come to a conclusion whether the stock is overfished or not, although it appears to be approaching an overfished condition. The stock is estimated to be just above the minimum stock

size threshold, currently defined as a stock condition below 20%SPR. This status measure has some sensitivity to the stock-recruitment relationship, but in most cases the stock is identified as being just above the threshold. However, current fishing rates are predicted to drive the stock below the threshold in the near future.

Model Projections

The base model was used to project stock status into the future under various F-based management scenarios (Table 7, Fig. 9). The scenarios included no fishing (F=0) and fishing at current rates (Fcurr), rates associated with the poorly estimated MSY level (Fmsy), 30% SPR rates (F30, also MFMT), and 75 percent of F30 (0.75F30). All scenarios were predicted to result in a reduction in catches over the next five to ten years, while fishing at Fcurr or Fmsy were predicted to drive the stock to an overfished condition. The F30 scenario was significant because it would end overfishing, and it and the more restrictive 0.75F30 would avoid an overfished condition.

References

Porch, CE. 2002. Preliminary assessment of Atlantic white marlin (*Tetrapturus albidus*) using a state-space implementation ff an age-structured production model. *Col. Vol. Sci. Pap. ICCAT* 55(2): 559-577.

Tables

Table 1—Catches. Directed fleets expressed in pounds, while shrimp bycatch is expressed in the number of age-1 equivalent fish.

Year	Rec-E	Rec-W	Comm-E	Comm-W	Shrimp
1963			3100	4200	
1964			15700	4300	
1965			17400	4300	
1966			8600	5200	
1967			12200	5200	
1968			8600	3900	
1969			14600	7700	
1970			16000	8200	
1971			30500	9900	
1972			47400	15200	
1973			40000	13200	112277.6
1974			40000	13100	342364.6
1975			62000	16000	380204.4
1976			69700	14800	220049.9
1977			50095.91	9290.086	189051.1
1978			48518.03	10196.7	460314.5
1979			65670.02	35732.98	1771057
1980			65421.67	31001.23	606637.6
1981	748779.46	179616.8	64498	25362	1467734
1982	2032601.4	362711	62959	33714	1206518
1983	397613.53	387301.1	49588	23831	1462755
1984	120970.49	844622.8	37445	32749	304993.5
1985	280865.15	479950.2	54840	37786	855586
1986	898096.37	79076.84	72858	22771	279373.7
1987	1135997.7	199066.1	89313	34290	1044555
1988	1638073.3	158328.2	137978	57084	1364168
1989	1765965.4	212002	230361	87271	906437.2
1990	2313261.1	184940.6	359686.4	99351.17	1286703
1991	1688391.7	399955	341319.2	103211.2	523154.4
1992	1434485.1	688825	338118.9	112075.7	3100516
1993	1317044.1	309425.4	381279.2	177448.4	432659.9
1994	1152103	186425.4	251578.1	153141.4	1951471
1995	1139966.8	329440.7	207212.3	130664.3	1065855
1996	618124.69	226005.8	142184.6	125331.6	1498133
1997	664793.77	100211.2	107779.8	76909.41	1751775
1998	560509.32	93309.19	106152.6	70570.89	1004208
1999	445429.52	43997.12	116194.3	102826.1	242741.5
2000	337240.63	109208.6	63041.56	95094.95	1656166
2001	487621.94	152571.5	108463.6	67718.28	490376.2
2002	721871.85	77016.21	148600.1	86962.79	5115407
2003	856626.38	58622.49	166424.7	85385.05	854441.3
2004	951559.09	78092.38	141411.1	77121.77	167161.8

Table 2—Indices

Year	MRFSS E	Rel CV	HB E	Rel CV	HB W	Rel CV	CmHL E	Rel CV	CmHL W	Rel CV	Neuston	Rel CV	Trawl	Rel CV	Video	Rel CV
1981	59.56	2.35														
1982	50.87	2.07														
1983	35.54	2.76														
1984	213.94	6.95														
1985	7.82	7.2														
1986	131.05	0.94	1.58	1.37	2.46	0.95					28.09					
1987	41.94	1.21	1.04	1.83	2.43	0.85					20.7	0.93	221.22	1.06		
1988	74.32	1.13	1.37	1.29	3.34	0.72					13.96	1.09	190.22	1.12		
1989	122.18	1.15	3.13	0.68	3.08	0.81					8	1.16	338.04	0.53		
1990	256.47	1.09	5.02	0.45	4.34	0.61					13.8	0.87	77.93	3.7		
1991	107	1.05	3.96	0.55	5.13	0.52					27.84	0.83	1291	0.21		
1992	94.73	0.85	4.57	0.48	4.56	0.56					91.81	0.9	75.78	3.27	68.55	0.87
1993	58.76	1	3.59	0.57	4.59	0.56	155.57	1.06	55.92	1.02	31.13	1.13	640.45	0.31	37.4	0.91
1994	53.3	1.09	2.78	0.71	4.46	0.53	146.65	0.97	71.33	1	35.77	0.84	613.49	0.33	33.63	0.88
1995	82.09	1.17	2.42	0.85	4.1	0.56	151.96	1.08	80.53	1.02	35.64	0.81	257.2	0.74	31.82	0.97
1996	47.63	1.22	1.72	1.05	4.18	0.57	66.9	1.01	50.18	1.01	24.18	0.97	226.35	0.82	29.65	0.87
1997	26.71	1.07	1.82	1.02	3.77	0.66	55.95	1.07	39.95	1.01	25.41	0.93	154.5	1.79	62.53	1.06
1998	20.24	1.04	1.56	1.11	2.57	0.87	52.8	1.11	52.27	1		1.18	14.68	0.74		
1999	20.98	0.9	1.65	1.04	1.14	1.73	50.81	0.95	70.79	0.99	8.05	0.86	346.25	0.51		
2000	16.46	0.98	1.16	1.38	1.16	1.64	37.05	1.07	52.93	0.99	83.12	1.18	602.55	0.31		
2001	25.28	0.9	1.3	1.33	1.37	1.39	54.92	1.02	36.57	1	13.72	1.03	1114.51	0.21	5.34	1.4
2002	26.18	0.89	1.98	1.02	1.51	1.39	97.78	0.91	39.08	0.99	19.01	0.82	258.03	0.7	29.96	1.04
2003	25.25	0.9	2.01	1	1.86	1.09	109.07	0.85	35.09	0.99		1.44	218.78	0.88		
2004	29.05	0.82	2.15	0.91	2.14	1	86.61	0.92	35.26	0.99		1.02	261.61	0.77		

Table 3—Life History Attributes

- Maturity: 87.5% @ 1 yr, 100% when older.
- $Fec = 170289e^{0.3159x}$, where x = age.
- $M = 0.27$ for all modeled age classes.
- $FL = 423.4\ (1-e^{-0.4269(x+0.6292)})$, where FL = fork length in mm and x = age.
- $Wt = 4.4858*10^{-8}\ FL^{3.0203}$, where Wt = weight in lbs and FL = fork length in mm.

Table 4—Catch at Age by Fleet and Year.
A. Recreational East

Year	N	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10+
1981	5	0.136	0.34	0.47	0.51	0.42	0	0	0	0	0
1982	9	0.14	0.32	0.46	0.51	0.47	0	0	0	0	0
1983	7	0.114	0.32	0.46	0.5	0.42	0	0	0	0	0
1984	2	0.158	0.41	0.48	0.44	0.36	0	0	0	0	0
1985	3	0.1	0.25	0.34	0.43	0.39	0	0	0	0	0
1986	25	0.103	0.29	0.41	0.46	0.45	0.01	0	0	0	0
1987	25	0.135	0.31	0.4	0.46	0.49	0.01	0.01	0	0	0
1988	25	0.128	0.33	0.44	0.49	0.49	0.01	0.01	0	0	0
1989	25	0.179	0.36	0.43	0.47	0.52	0.02	0.01	0	0	0
1990	25	0.177	0.4	0.47	0.49	0.52	0.03	0.01	0	0	0
1991	25	0.136	0.33	0.44	0.5	0.51	0.03	0.01	0	0	0
1992	25	0.136	0.34	0.45	0.5	0.5	0.04	0.01	0.01	0	0
1993	25	0.141	0.36	0.46	0.5	0.5	0.02	0.01	0	0	0
1994	25	0.164	0.38	0.46	0.49	0.51	0.02	0.01	0	0	0
1995	25	0.156	0.39	0.48	0.5	0.51	0.02	0.01	0	0	0
1996	25	0.148	0.38	0.48	0.51	0.51	0.01	0.01	0	0	0
1997	25	0.143	0.36	0.46	0.49	0.51	0.02	0.01	0	0	0
1998	25	0.14	0.38	0.49	0.5	0.5	0.04	0.01	0	0	0
1999	25	0.136	0.38	0.49	0.51	0.5	0.04	0.01	0	0	0
2000	25	0.126	0.34	0.46	0.5	0.51	0.04	0.01	0	0	0
2001	25	0.139	0.38	0.48	0.5	0.51	0.05	0.01	0	0	0
2002	25	0.129	0.37	0.48	0.5	0.5	0.05	0.01	0	0	0
2003	25	0.133	0.37	0.48	0.51	0.51	0.05	0.01	0	0	0
2004	25	0.128	0.36	0.48	0.51	0.5	0.05	0.01	0	0	0

Table 4 (cont.)—Catch at Age by Fleet and Year.
B. Recreational West

Year	N	0	0	0.05506	0.27679	0.33185	0.45536	0.42411	0.28274	0.05506	0.11905
1981	1	0	0	0.02	0.14	0.23	0	0	0	0	0
1982	1	0.014	0.11	0.13	0.23	0.3	0	0	0	0	0
1983	1	0	0	0.03	0.14	0.09	0	0	0	0	0
1984	3	0	0	0.03	0.06	0.14	0	0.01	0	0	0
1985	1	0	0.02	0.03	0.15	0.14	0	0	0	0	0
1986	22	0.026	0.09	0.11	0.21	0.32	0.02	0.01	0	0	0
1987	24	0.021	0.07	0.09	0.2	0.33	0.02	0.02	0	0	0
1988	17	0.015	0.09	0.1	0.22	0.34	0.02	0.01	0	0	0
1989	25	0.008	0.06	0.08	0.2	0.34	0.03	0.02	0.01	0	0
1990	25	0.007	0.05	0.07	0.19	0.32	0.04	0.02	0.01	0	0
1991	25	0.004	0.03	0.06	0.18	0.31	0.03	0.02	0.01	0	0.01
1992	25	0.013	0.06	0.08	0.2	0.33	0.07	0.05	0.02	0	0.01
1993	25	0.003	0.03	0.05	0.16	0.29	0.05	0.04	0.01	0	0.01
1994	25	0.005	0.05	0.07	0.18	0.32	0.07	0.05	0.02	0.01	0.01
1995	25	0.003	0.03	0.05	0.17	0.32	0.06	0.04	0.01	0	0.01
1996	25	0.005	0.04	0.06	0.18	0.34	0.05	0.04	0.01	0	0.01
1997	19	0.005	0.05	0.07	0.18	0.28	0.02	0.02	0.01	0	0
1998	25	0.004	0.04	0.06	0.17	0.32	0.04	0.03	0.01	0	0
1999	14	0.003	0.03	0.06	0.18	0.32	0.02	0.01	0	0	0
2000	6	0	0.03	0.06	0.14	0.29	0.01	0.01	0	0	0
2001	11	0.003	0.03	0.05	0.18	0.33	0.01	0.01	0	0	0
2002	15	0.005	0.02	0.03	0.17	0.3	0.02	0.01	0	0	0
2003	18	0.003	0.04	0.06	0.18	0.3	0.02	0.01	0.01	0	0
2004	12	0.001	0.03	0.06	0.17	0.31	0.01	0.01	0	0	0

Table 4 (cont.)—Catch at Age by Fleet and Year.

C. Commercial East

Year	N	0	0	0	0	0	0	0	0	0	0
1989	1	0.087	0.44	0.52	0.59	0.02	0	0	0	0	0
1990	7	0.048	0.15	0.23	0.27	0.27	0	0	0	0	0
1991	4	0.026	0.04	0.07	0.16	0.2	0	0	0	0	0
1992	5	0.047	0.14	0.21	0.27	0.3	0	0	0	0	0
1993	25	0.084	0.26	0.39	0.45	0.42	0.02	0.01	0	0	0
1994	25	0.096	0.27	0.39	0.46	0.46	0.02	0.01	0	0	0
1995	25	0.097	0.29	0.42	0.49	0.49	0.02	0.01	0	0	0
1996	25	0.102	0.29	0.42	0.49	0.47	0.02	0.01	0	0	0
1997	25	0.112	0.3	0.43	0.51	0.5	0.02	0.01	0	0	0
1998	25	0.119	0.33	0.43	0.46	0.44	0.01	0.01	0	0	0
1999	25	0.086	0.26	0.38	0.44	0.42	0.02	0.01	0	0	0
2000	25	0.085	0.27	0.4	0.46	0.42	0.01	0	0	0	0
2001	25	0.101	0.29	0.43	0.49	0.47	0.02	0.01	0	0	0
2002	25	0.11	0.31	0.42	0.45	0.43	0.01	0	0	0	0
2003	25	0.101	0.26	0.35	0.39	0.4	0.01	0	0	0	0
2004	19	0.069	0.22	0.35	0.42	0.41	0.01	0	0	0	0

D. Commercial West

Year	N	0	0	0	0	0	0	0	0	0	0
1990	25	0.001	0.01	0.04	0.12	0.22	0.03	0.03	0.01	0	0
1991	25	0.002	0.02	0.04	0.14	0.26	0.06	0.06	0.02	0.01	0.01
1992	25	0.001	0.02	0.04	0.14	0.27	0.1	0.08	0.03	0.01	0.01
1993	25	0.001	0.01	0.04	0.11	0.23	0.05	0.05	0.02	0.01	0.01
1994	25	0.002	0.02	0.04	0.11	0.22	0.07	0.07	0.03	0.01	0.01
1995	25	0.002	0.02	0.04	0.13	0.25	0.04	0.03	0.01	0	0.01
1996	25	0	0.01	0.03	0.12	0.23	0.02	0.02	0.01	0	0
1997	25	0	0	0.03	0.11	0.22	0.02	0.03	0.01	0	0
1998	12	0.006	0.02	0.04	0.14	0.28	0.01	0.01	0	0	0
1999	5	0	0	0.03	0.12	0.21	0.01	0.01	0	0	0
2000	4	0	0.01	0.03	0.13	0.23	0	0	0	0	0
2001	10	0.001	0.01	0.04	0.11	0.22	0.01	0.01	0	0	0
2002	15	0.001	0.01	0.04	0.12	0.25	0.02	0.02	0.01	0	0
2003	21	0.003	0.01	0.04	0.13	0.23	0.02	0.02	0.01	0	0
2004	8	0	0.02	0.04	0.15	0.27	0.01	0.01	0	0	0

Table 5—Model Estimates and Benchmarks. *Note that the estimated α run is presented in a form where α was fixed to facilitate comparison to other runs, which also fixed α.

A. Fits

	Base	Median α	Est α*	M = 0.25	M = 0.3	20% recr dev	60% recr dev	1950 start
Data pts	292	292	292	292	292	292	292	292
Est params	170	170	170	170	170	170	170	170
Obj Func	-78.5	-74.1	-79.3	-74.4	-77.7	-82.3	-75.8	-49.9
AIC	183	192	181	191	185	175	188	240

B. Benchmarks

	Base	Median α	Est α*	M = 0.25	M = 0.3	20% recr dev	60% recr dev	1950 start
Alpha	32.8	12.9	50.3	33	32.5	32.9	32.6	32.9
Steepness	0.89	0.76	0.93	0.89	0.89	0.89	0.89	0.89
Max Recr (m fish)	2.146	2.326	2.105	2.019	2.344	2.522	1.893	2.193
SSB_{virgin} (t eggs)	7.513	8.14	7.369	8.298	6.561	8.826	6.627	7.675
SSB_{MSY} (t eggs)	1.21	1.78	1.049	1.345	1.051	1.421	1.071	1.233
$SSB_{20\%SPR}$ (t eggs)	1.316	1.083	1.355	1.456	1.148	1.546	1.159	1.343
$SSB_{30\%SPR}$ (t eggs)	2.094	1.967	2.109	2.315	1.823	2.458	1.842	2.138
$SSB_{40\%SPR}$ (t eggs)	2.868	2.855	2.861	3.17	2.505	3.373	2.526	2.933
$SSB_{50\%SPR}$ (t eggs)	3.648	3.743	3.618	4.029	3.188	4.276	3.215	3.722
F_{MSY}	0.45	0.294	0.525	0.406	0.484	0.448	0.447	0.465
$F_{20\%SPR}$	0.419	0.421	0.419	0.38	0.449	0.417	0.418	0.432
$F_{30\%SPR}$	0.269	0.27	0.269	0.246	0.289	0.268	0.269	0.276
$F_{40\%SPR}$	0.186	0.186	0.186	0.171	0.199	0.185	0.186	0.19
$F_{50\%SPR}$	0.131	0.131	0.131	0.121	0.14	0.131	0.131	0.134
MSY (m lbs)	1.638	1.441	1.707	1.595	1.703	1.925	1.443	1.678

Table 6—Stock Status.

	Base	Median α	Est α*	M = 0.25	M = 0.3	20% recr dev	60% recr dev	1950 start
SSB_{2004} (t)	1.345	1.323	1.351	1.286	1.461	1.478	1.319	1.372
$/SSB_{MSY}$	1.11	0.74	1.29	0.96	1.39	1.04	1.23	1.11
$/SSB_{20\%SPR}$	1.02	1.22	1	0.88	1.27	0.96	1.14	1.02
$/SSB_{30\%SPR}$	0.64	0.67	0.64	0.56	0.8	0.6	0.72	0.64
F_{2004}	0.435	0.431	0.435	0.451	0.371	0.422	0.435	0.436
$/F_{MSY}$	0.97	1.47	0.83	1.11	0.77	0.94	0.97	0.94
$/F_{30\%SPR}$	1.62	1.6	1.62	1.83	1.28	1.58	1.62	1.58

Table 7—Projections. New F rates applied starting in 2007.
Directed Catches (m lbs) Under Various Fishing Mortality Rates.

Year	F=0	F_{2004}	F_{MSY}	$F_{30\%SPR}$	$0.75*F_{30\%SPR}$
2000	0.762	0.762	0.762	0.762	0.762
2001	1.0032	1.0032	1.0032	1.0032	1.0032
2002	1.1784	1.1784	1.1784	1.1784	1.1784
2003	1.0896	1.0896	1.0896	1.0896	1.0896
2004	0.9864	0.9864	0.9864	0.9864	0.9864
2005	0.9828	0.9828	0.9828	0.9828	0.9828
2006	0.9168	0.9168	0.9168	0.9168	0.9168
2007	0	0.8598	0.8826	0.56514	0.43278
2008	0	0.7998	0.8148	0.57924	0.46206
2009	0	0.8328	0.8442	0.6384	0.52212
2010	0	0.8526	0.861	0.6882	0.57648
2011	0	0.735	0.738	0.6342	0.54666
2012	0	0.6978	0.6996	0.6216	0.5451
2013	0	0.6546	0.6546	0.6042	0.5391
2014	0	0.657	0.657	0.6102	0.54786
2015	0	0.6636	0.663	0.621	0.55962
2016	0	0.696	0.696	0.645	0.58014
2017	0	0.8178	0.8196	0.7374	0.6552

Spawning Stock Biomass Relative to 20% SPR Levels Under Various Fishing Mortality Rates.

Year	F=0	F_{2004}	F_{MSY}	$F_{30\%SPR}$	$0.75*F_{30\%SPR}$
2000	0.953753	0.953753	0.953753	0.953753	0.953753
2001	1.123578	1.123578	1.123578	1.123578	1.123578
2002	1.129644	1.129644	1.129644	1.129644	1.129644
2003	1.064443	1.064443	1.064443	1.064443	1.064443
2004	0.980288	0.980288	0.980288	0.980288	0.980288
2005	0.97953	0.97953	0.97953	0.97953	0.97953
2006	0.912813	0.912813	0.912813	0.912813	0.912813
2007	1.030326	0.874905	0.870356	0.931008	0.954511
2008	1.269901	0.815011	0.803639	0.961334	1.030326
2009	1.608795	0.838514	0.822593	1.065201	1.178923
2010	1.937074	0.835481	0.81577	1.13116	1.289613
2011	2.145565	0.743518	0.721531	1.084913	1.278999
2012	2.402578	0.719333	0.696133	1.094769	1.319181
2013	2.608795	0.663306	0.639651	1.059894	1.308567
2014	2.86884	0.664746	0.640561	1.079606	1.349507
2015	3.091736	0.655118	0.630705	1.082638	1.369219
2016	3.345716	0.683927	0.658908	1.125853	1.428355
2017	3.651251	0.777104	0.750569	1.242608	1.561789

Table 7 (cont.)—Projections. New F rates applied starting in 2007.
Fishing Mortality Rates Relative to 30% SPR Levels Under Various Fishing Mortality Rates.

Year	F=0	F_{2004}	F_{MSY}	$F_{30\%SPR}$	$0.75*F_{30\%SPR}$
2000	1.412698	1.412698	1.412698	1.412698	1.412698
2001	1.501512	1.501512	1.501512	1.501512	1.501512
2002	1.566893	1.566893	1.566893	1.566893	1.566893
2003	1.613757	1.613757	1.613757	1.613757	1.613757
2004	1.643235	1.643235	1.643235	1.643235	1.643235
2005	1.60771	1.60771	1.60771	1.60771	1.60771
2006	1.60771	1.60771	1.60771	1.60771	1.60771
2007	0	1.60771	1.657596	1	0.748299
2008	0	1.60771	1.657596	1	0.748299
2009	0	1.60771	1.657596	1	0.748299
2010	0	1.60771	1.657596	1	0.748299
2011	0	1.60771	1.657596	1	0.748299
2012	0	1.60771	1.657596	1	0.748299
2013	0	1.60771	1.657596	1	0.748299
2014	0	1.60771	1.657596	1	0.748299
2015	0	1.60771	1.657596	1	0.748299
2016	0	1.60771	1.657596	1	0.748299
2017	0	1.60771	1.657596	1	0.748299

Figures

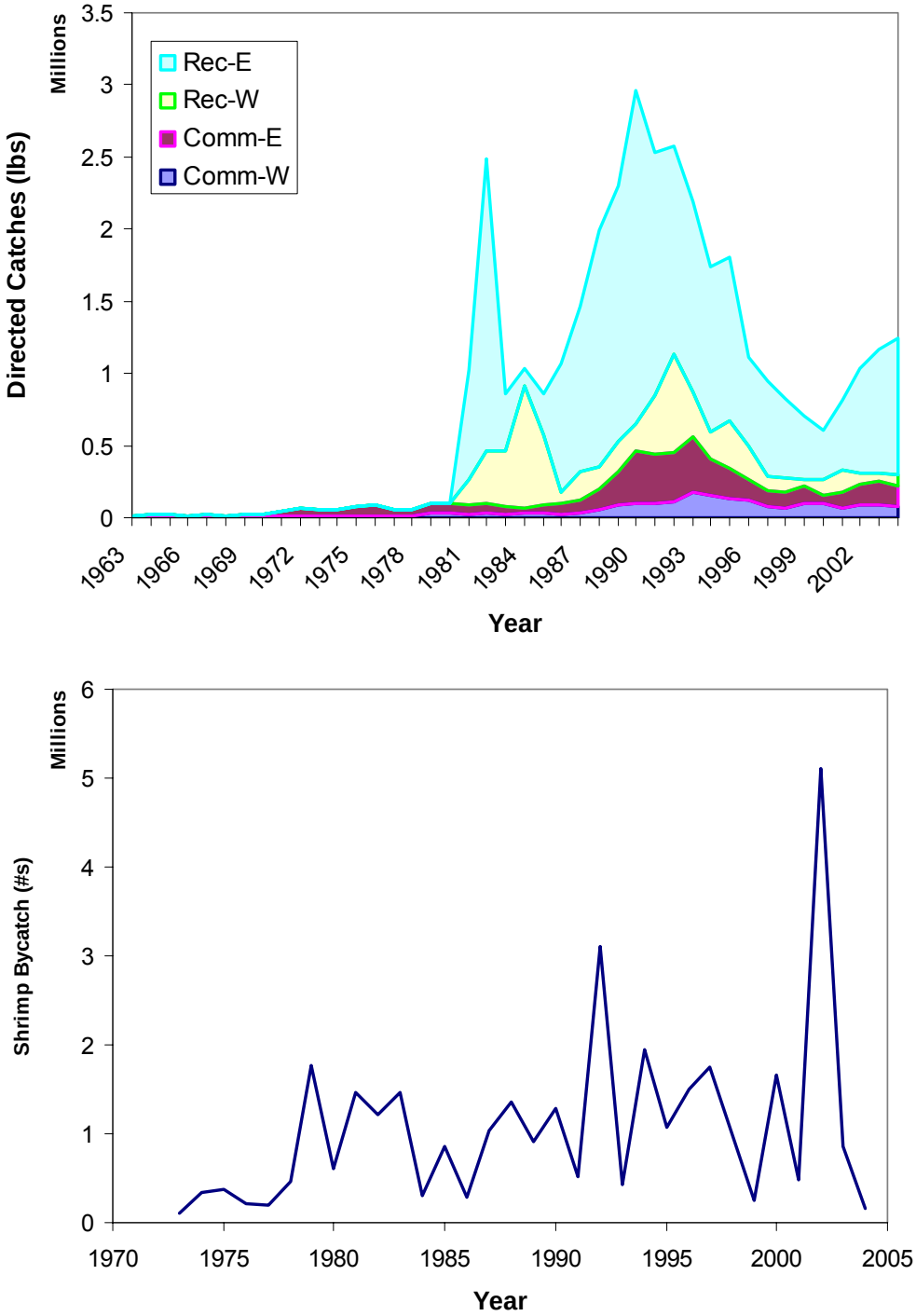
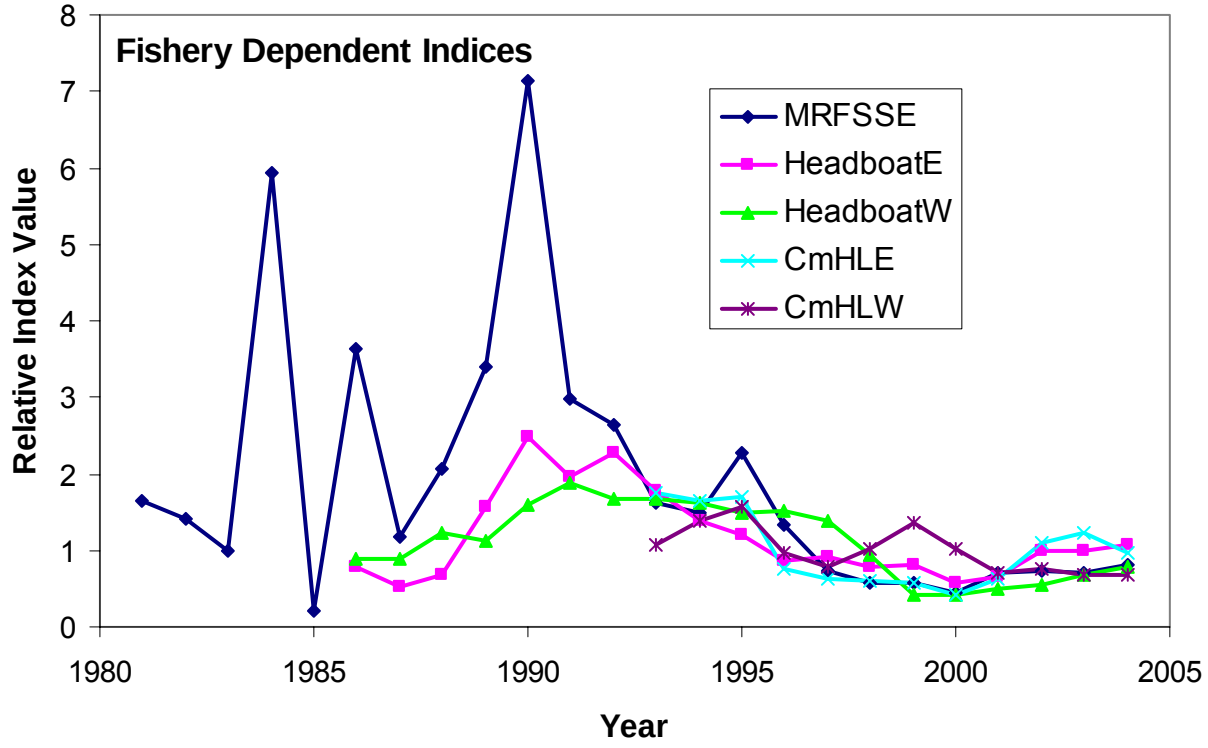


Fig. 1—Catches by Sector (stacked).



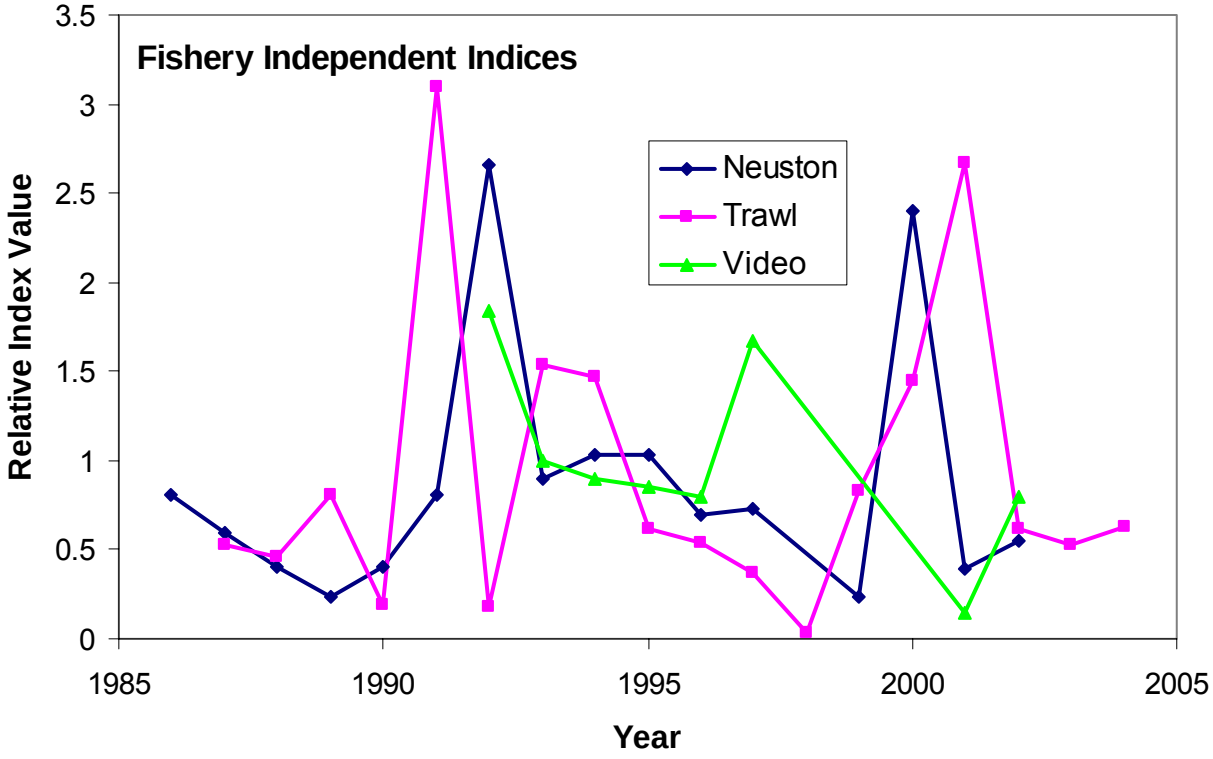


Fig. 2—Indices of Abundance.

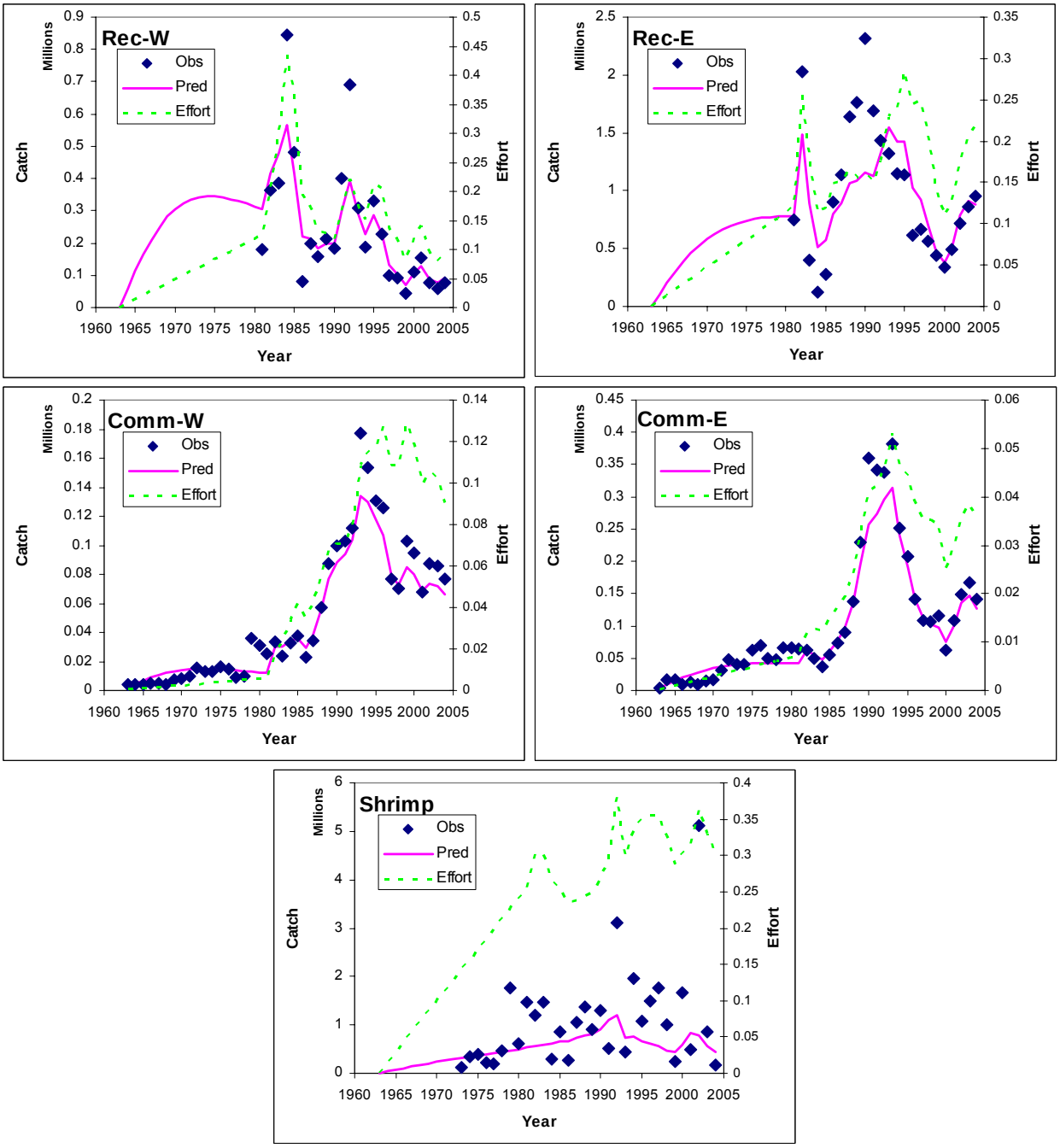


Fig. 3—Catch Fits.

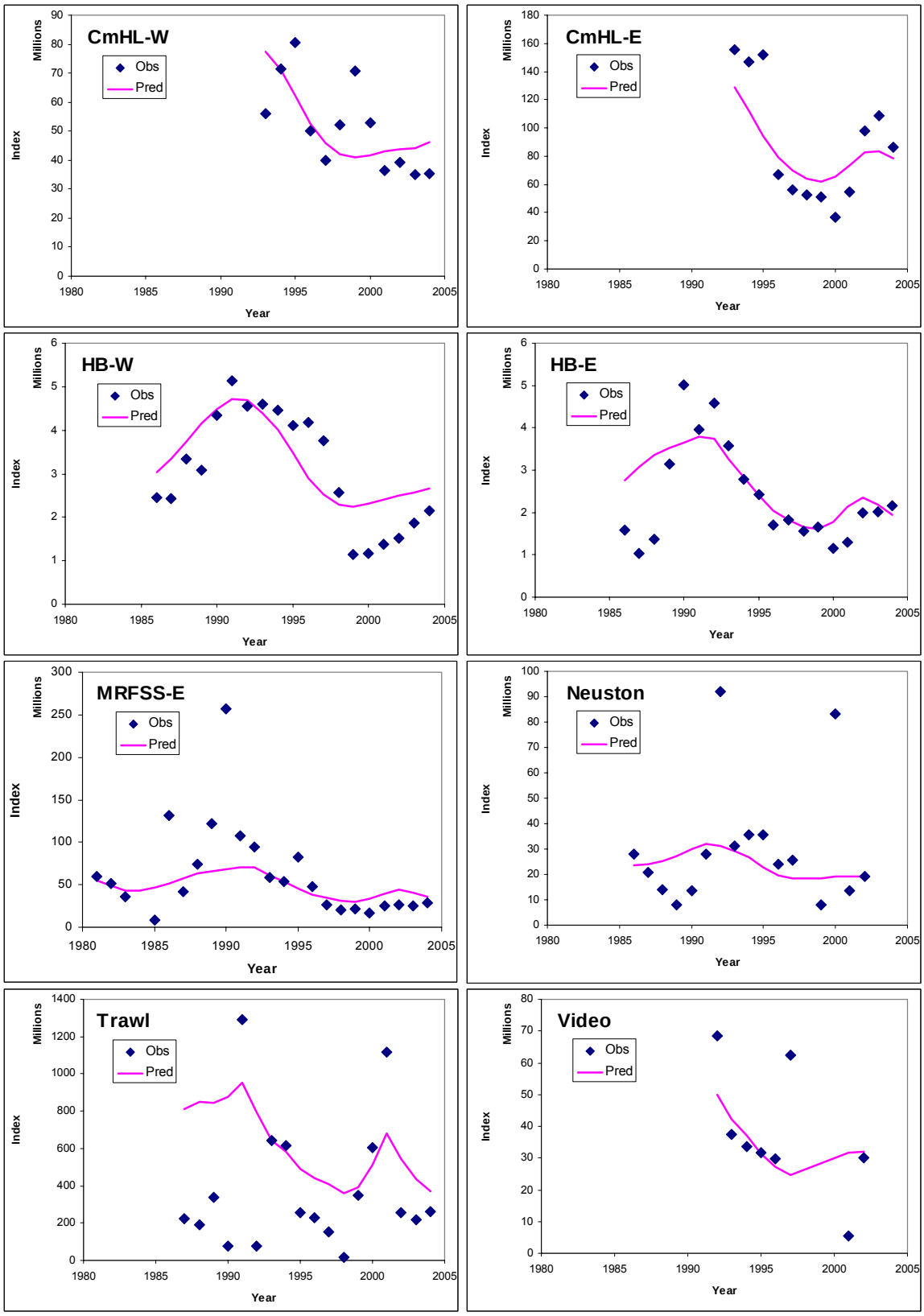


Fig. 4—Index Fits.

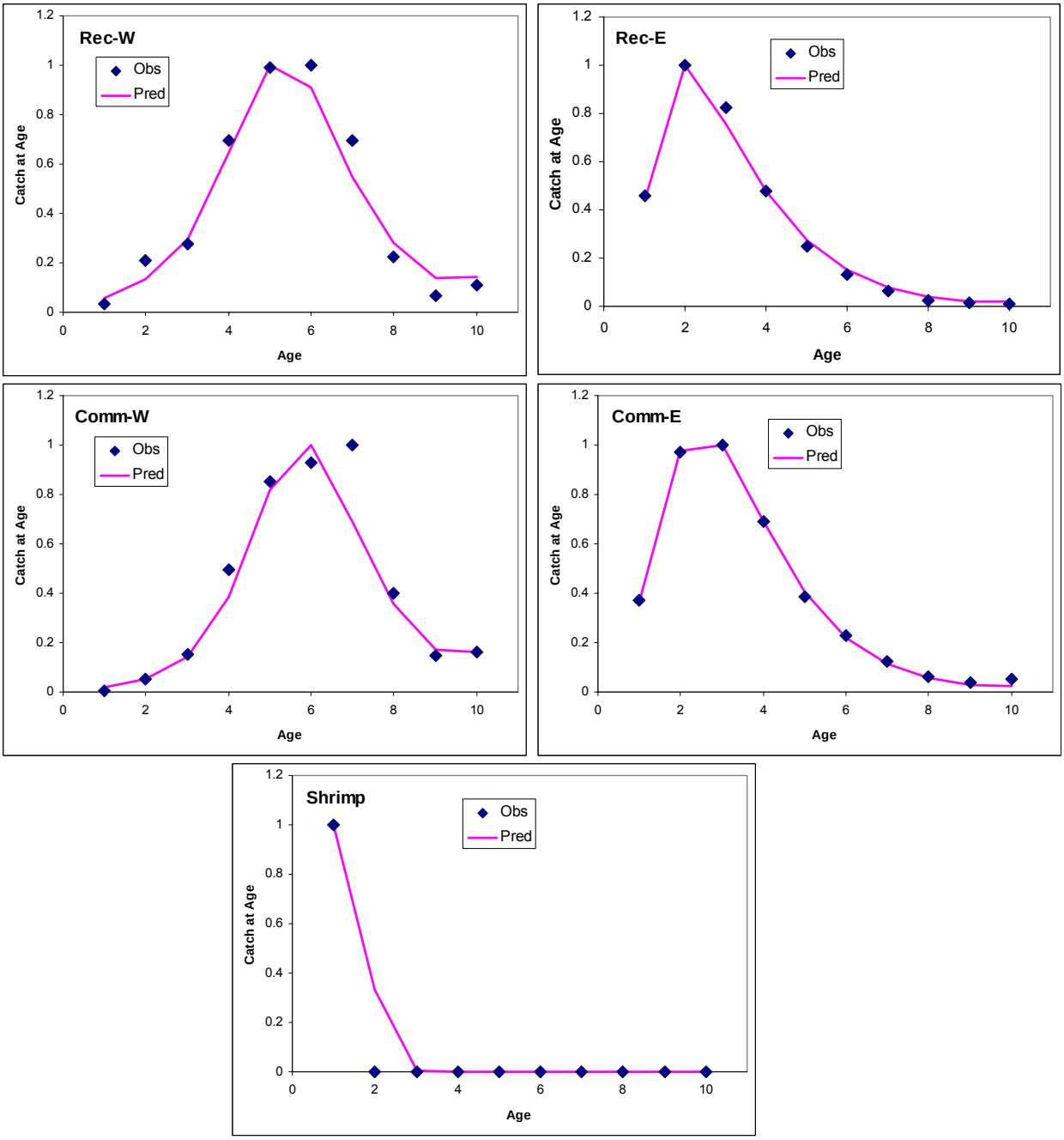


Fig. 5—Catch at Age Fits in 2004

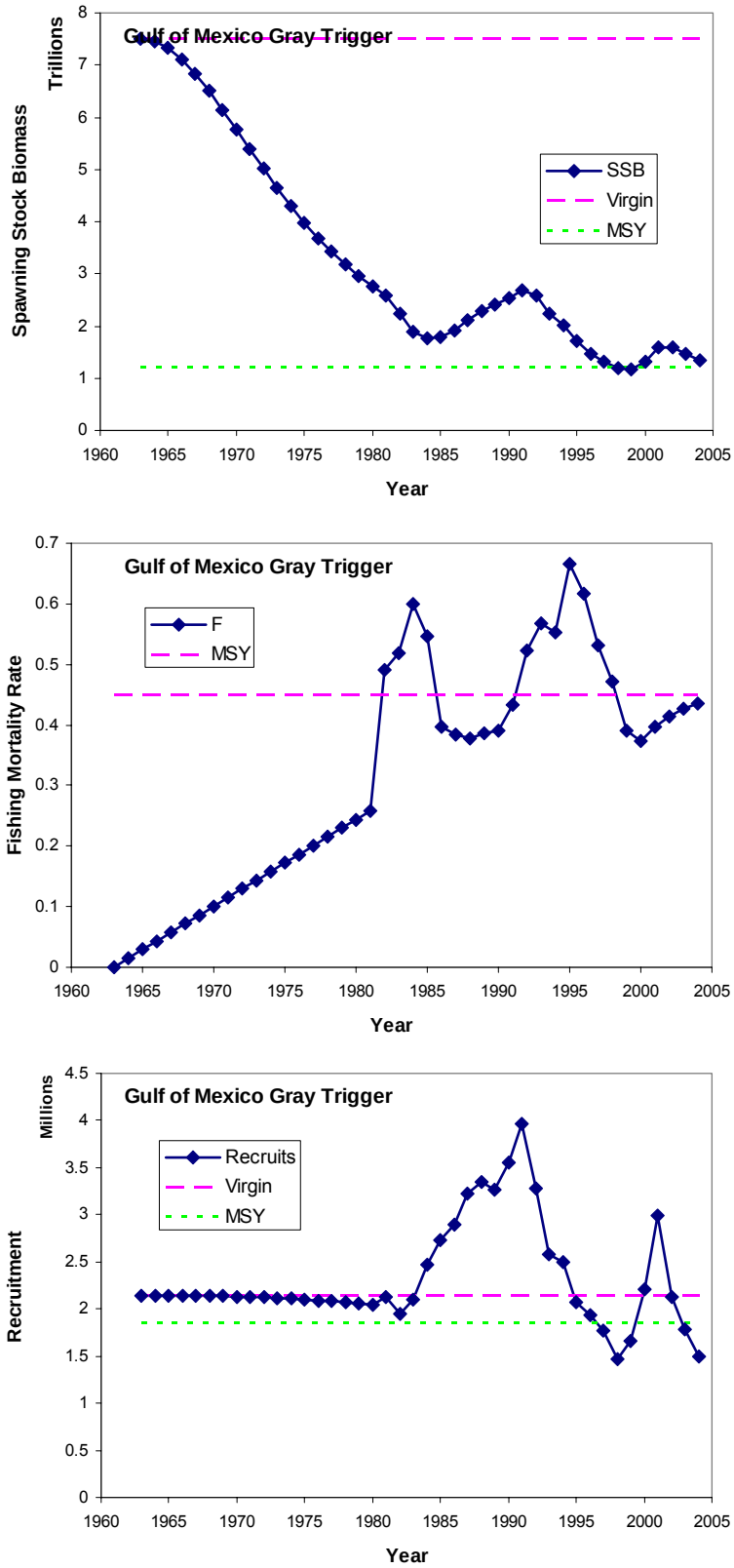


Fig. 6—Trajectories According to the Base Model. (a) SSB, (b) F, (c) recruitment.

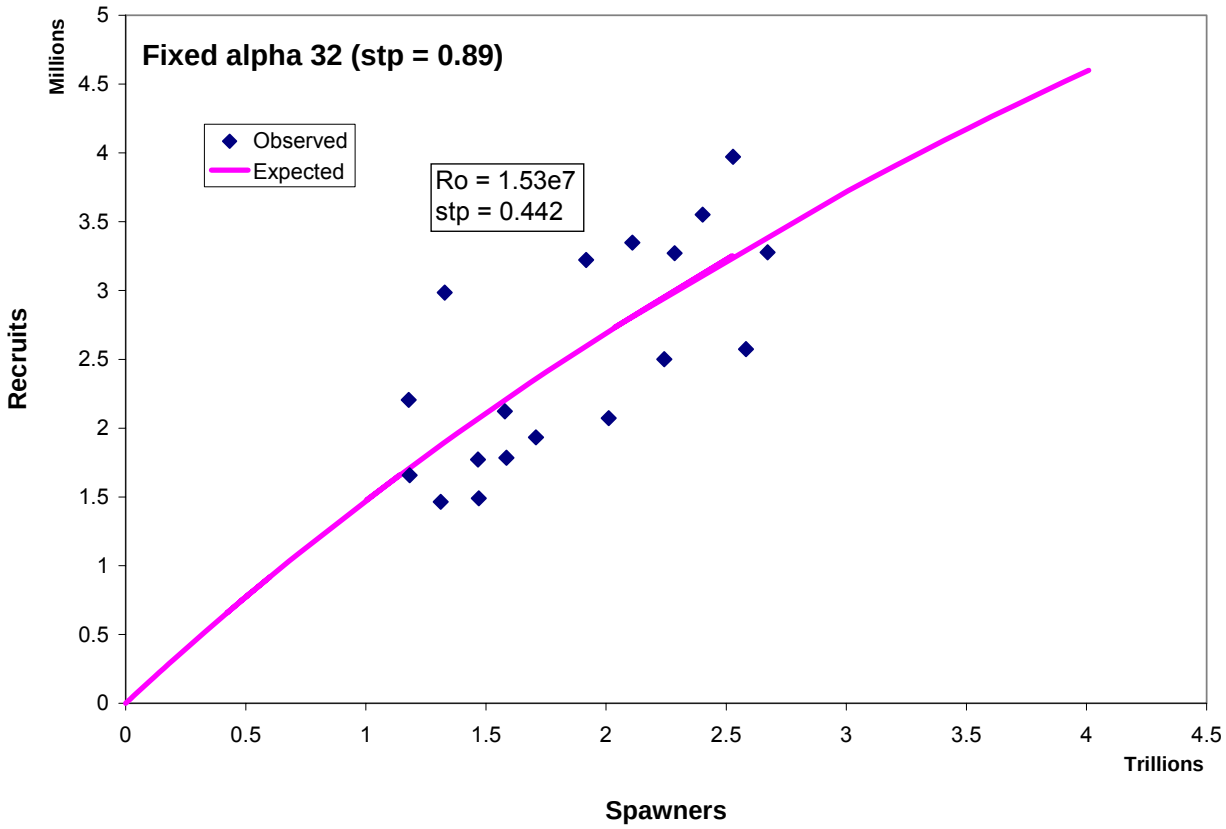


Fig. 7—Stock-Recruitment Patterns Considering the Deviations Predicted by the Model.

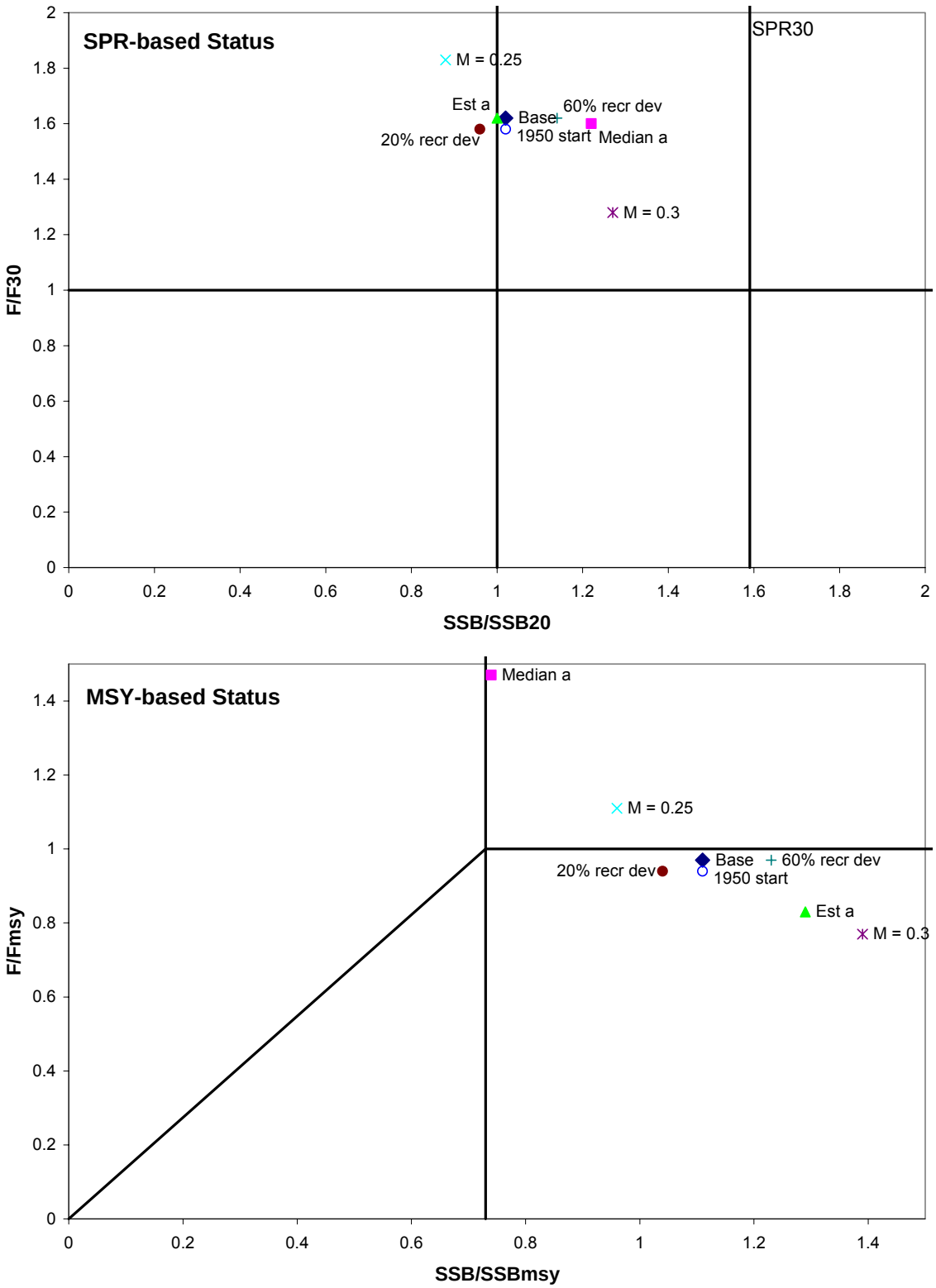


Fig. 8—Status Across Sensitivity Analyses. (a) SPR-based benchmarks (current practice), (b) MSY-based benchmarks (sine the Gulf Council has not yet specified these, the benchmarks are assumed based on history).

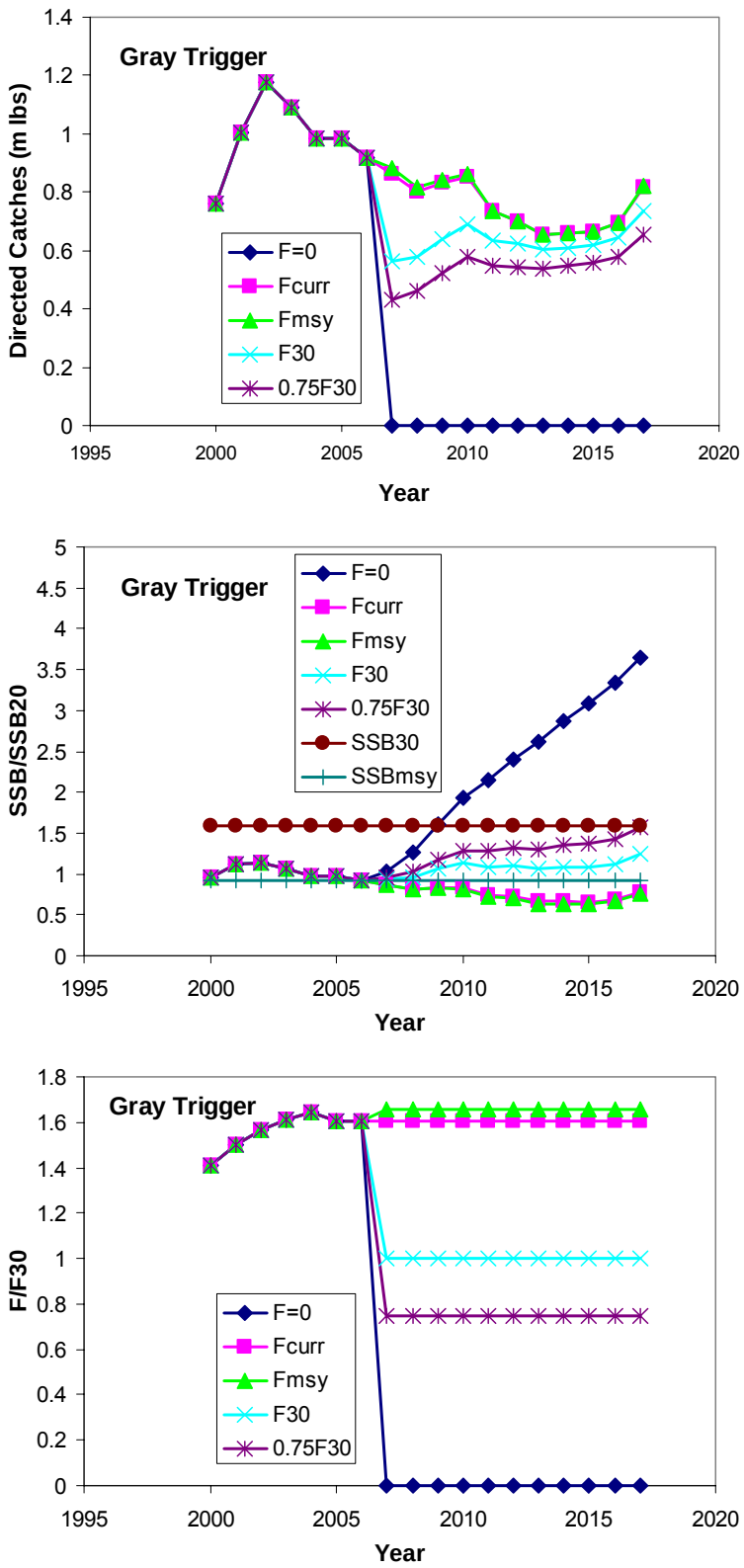


Fig. 9—Projections Under Various Fishing Mortality Rates. (a) Directed catches, (b) SSB rel to 20% SPR (MSST), (c) F relative to 30% SPR (MFMT). New F rates applied starting in 2007.

8. Appendix 4:

STATEMENT OF WORK

SEDAR 9 Assessment Review
Gulf of Mexico vermilion snapper, greater amberjack, and gray triggerfish

March 27-31, 2006
Hotel Monteleone
New Orleans, Louisiana

SEDAR Overview:

South East Data, Assessment, and Review (SEDAR) is a process for stock assessment development and review conducted by the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; NOAA Fisheries, SEFSC and 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 a data report produced by the data workshop; a stock assessment report produced by the assessment workshops; a peer review consensus report evaluating the assessment and a peer review advisory report, both drafted during the review panel workshop; and collected stock assessment documents considered during the workshops.

SEDAR is a public process. All workshops, including the review, are open to the public and noticed in the Federal Register. All documents 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 review workshop is an independent peer review of the stock assessment. 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 9 Review panel will be composed of three CIE-appointed reviewers and a chair appointed by the SEFSC director.

CIE Request:

NMFS-SEFSC requests the assistance of three assessment scientists from the CIE to serve as technical reviewers for the SEDAR 9 Review Panel that will consider assessments for Gulf of Mexico vermilion snapper, greater amberjack, and gray triggerfish.

The species assessed through SEDAR 9 are within the jurisdiction of the Gulf of Mexico Fishery Management Council and respective southeastern states.

The review workshop will take place at the Hotel Monteleone in New Orleans, Louisiana, from March 27, 2006 (beginning at 1:00 pm) through March 31, 2006 (ending at 12:00 noon). Meeting materials will be forwarded electronically to review panel participants and made available on 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:

Hotel Monteleone
214 Royal Street
New Orleans LA 70130-2201
Phone: (800) 217-2033, (504) 523-3341
Fax: (504) 528-1019

Group Rate $133.00 + 13% tax ($17.29) + $2.00 occupancy tax = $152.29; guaranteed through February 24, 2006.

SEDAR Review Workshop Panel Tasks:

The SEDAR 9 Review Workshop Panel will evaluate assessments of Gulf of Mexico greater amberjack, vermilion snapper, and gray triggerfish populations, including input data, assessment methods, and model results as put forward in stock assessment reports. 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 9 Review Workshop Terms of Reference (apply to each assessment):

1.Evaluate assessment data sources: determine if they are adequate and appropriate for stock assessment.

2. Evaluate the assessment methods: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.

3. Evaluate the assessment configuration, assumptions, and input data: determine if data are properly used, models are appropriately configured, and assumptions are reasonably satisfied.
4. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT*); recommend values for management benchmarks (or appropriate proxies) and provide clear statements of stock status.
5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.
6. Evaluate 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 are adequately addressed in the Data and Assessment Workshop Reports.
7. Consider research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.
8. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. (Report to be drafted by the Panel during the review workshop with a final version submitted to the SEDAR Coordinator no later than Monday, April 14, 2006)
9. Prepare a Peer Review Advisory Report summarizing key assessment results. (Report to be drafted by the Panel during the review workshop with final versions submitted to the SEDAR Coordinator no later than Monday, April 14, 2006)

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 an assessment summary and consensus report during the workshop, and finalizing the assessment summary and consensus report within two weeks of the conclusion of the workshop.

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.

Each reviewer appointed by the CIE is responsible for preparing an additional CIE Reviewer Report as described in Annex 1.

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 1) provide in writing the required remedial measures, 2) suggest an appropriate approach for correcting the assessment, and 3) subsequently review the corrected assessment.

Statement of Tasks for CIE 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 CIE 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 the Peer Review Consensus Summary and the Peer Review Advisory Report. Reviewers may be asked to serve as assessment leaders during the review to facilitate preparation of first drafts of review reports.
3. Following the Review Panel meeting, the CIE reviewers shall review and provide comments to the Panel Chair on the Peer Review Panel Reports.

4. Following the Review Panel meeting, each CIE reviewer shall prepare a CIE Reviewer Report[1]. The summary of findings shall address the workshop Terms of Reference 1-7 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. This report shall be submitted to CIE no later than April 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 CIE Review Panelist duties will occupy a maximum of 12 workdays each; 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 Mr. Manoj Shivlani at the CIE.

CIE Reports:

Once finalized and accepted by the CIE, CIE reviewer reports shall be distributed 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, GMFMC, 2203 N. Lois Avenue, Suite 1100, Tampa, FL 33607 (email (Wayne.Swingle@gulfcouncil.org)

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.

Submission and Acceptance of CIE Reports

The CIE shall provide via e-mail the three final CIE reviewer reports in pdf format to Dr. Joseph Powers (joseph.powers@noaa.gov) for review by NOAA Fisheries and approval by the COTR, Dr. Stephen K. Brown, by April 28, 2006. The COTR shall notify the CIE

[1] All reports will undergo an internal CIE review before they are considered final.

via e-mail regarding acceptance of these reports by May 3, 2006. Following the COTR's approval, the CIE will provide pdf versions of the CIE reports with a digitally signed cover letter to the COTR via e-mail (Stephen.K.Brown@noaa.gov) by May 5, 2006.

Draft Agenda

SEDAR 9: Gulf vermilion snapper, greater amberjack, gray triggerfish

Monday, March 27, 2006		
1:00 p.m.	**Convene**	
1:00 – 1:30	**Introductions and Opening Remarks**	
	Coordinator	
	- Agenda Review, TOR, Task Assignments	
1:30 – 3:30	**Vermilion Snapper Presentation**	**TBD**
3:30 – 3:45	**Break**	
3:45 – 6:00	**Vermilion Snapper Discussion**	**Chair**
	- Data, Methods, Results Evaluation	
	- identify additional analyses, sensitivities, corrections	
	Evening Work Session	
	Informal	
	- Vermilion assessment runs	
	- First draft vermilion advisory and consensus	
Tuesday, March 28, 2006		
8:00 a.m. – 11:30 a.m.	**Vermilion Snapper Assessment Discussion**	**Chair**
	- Continue Discussions	
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 3:00 p.m.	**Greater Amberjack Presentation**	**TBD**
3:00 p.m. – 3:15 p.m.	**Break**	
3:15 p.m. – 6:00 p.m.	**Greater Amberjack Discussion**	**Chair**
	- Data, Methods, Results Evaluation	
	- identify additional analyses, sensitivities, corrections	
	Evening Work Session	
	Informal	
	- Amberjack assessment runs	
	- First draft amberjack advisory and consensus	
	- Second draft vermilion advisory and consensus	

Wednesday, March 29, 2006

8:00 a.m. – 11:30 a.m.	**Greater Amberjack Discussion**	**Chair**
	- Continue Discussions	
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 3:00 p.m.	**Gray Triggerfish Assessment Presentation**	**TBD**
3:00 p.m. – 3:15 p.m.	**Break**	
3:15 p.m. – 6:00 p.m.	**Gray Triggerfish Discussion**	**Chair**
	- Data, Methods, Results Evaluation	
	- identify additional analyses, sensitivities, corrections	
	Evening Work Session	
	Informal	
	- Triggerfish analyses	
	- First draft triggerfish consensus, advisory	
	- Second draft amberjack consensus, advisory	

Thursday, March 30, 2006

8:00 a.m. – 11:30 a.m.	**Gray Triggerfish Discussion**	**Chair**
	- Continue Discussions	
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 6:00 p.m.	**Discuss & Review Workshop Reports**	**Chair**
	- Vermilion 2nd D. Consensus Summary & Advisory Report	
	- Amberjack 2nd D. Consensus Summary & Advisory Report	
	Evening Work Session	
	Informal	
	- Final edits to Vermilion and Amberjack	
	- Second draft Triggerfish	

Friday, March 31, 2006

8:00 a.m. – 12:00 a.m.	**Final Review of Panel Documents**	**Chair**
12:00 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. Special consideration should be given to the review panel composition, as the Steering Committee intends to evaluate the alternative review panel composition used for SEDAR 9.

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 1-7 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 Statement of Work.