Review of Gulf of Mexico Red Grouper Assessment 3.0 with Analysis of Scientific Support for Management Options

by

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A Report to the University of Miami

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Introduction

This review has been conducted in the limited context of the reports provided and listed in Appendix I. The major objective of the review is to determine if the assessment of Gulf of Mexico Red Grouper *(Epinephelus morio)* is the most reliable and useful interpretation of the available data for developing management strategies. Specifically, I have been asked to evaluate the scientific support for management decisions, the soundness of the assessment, and the appropriateness of the modeling tools.

It is difficult reviewing a process using paper documentation alone, as much of the information available for understanding and managing a fishery exists in terms of the experience embodied in the fishermen, scientists, and managers who make up the community. Given that caveat, I present my observations as an independent scientist who is knowledgeable about current scientific and statistical methods applied to understanding fisheries dynamics and is familiar with many of the issues that arise for managers operating under the Magnuson-Stevens Fishery Conservation and Management Act.

The approach I will take in conducting this review will be to address the specific questions raised in the Statement of Work forwarded to me by the University of Miami. I will then provide a broader perspective that I hope will help the Scientific and Statistical Committee and the Council in their deliberations on the red grouper fishery.

Question 1

Is the available scientific evidence consistent with the conclusion that the red grouper stock in the Gulf of Mexico is experiencing overfishing and/or the stock is overfished as defined in the fishery management plan?

I found the scientific and statistical methods discussed in The Red Grouper Fishery of the Gulf of Mexico: Assessment 3.0 by Schirripa, Legault, and Ortiz (1999) to be a sound state-of-the-art approach for examining data available on the grouper fishery. In particular, the approach of using alternative assessment strategies to evaluate the robustness of assessment estimates and to provide some perspective on the influence of alternative assessment assumptions is consistent with the advice provided in the National Research Council report on Improving Fish Stock Assessments (NRC 1998).

However, there are several issues that must be explicitly recognized and dealt with by scientists, managers, and stakeholders. These issues are not problems with the assessment per se, but how one can or should interpret the data and therefore the assessment results. These issues have been touched on peripherally in questions raised in a number of subsequent documents, and I will expand on them further here.

The Sustainable Fisheries Act (SFA) requirements of managing the stock so as to maintain the capacity to produce maximum sustainable yield (MSY) is, of course, contingent upon our ability to actually determine the productive capacity of the stock. For the grouper fishery, an attempt to address this was taken through stock production analysis in the case of the ASPIC model and through a stock recruitment analysis in the case of the ASAP model. As mentioned above, the modeling methodology appears sound.

However, a useful estimate of productivity requires sufficient contrast in the estimated biomasses in order to understand what will happen under different biomass conditions. Such a contrast appears to be present only in the data available for the years from 1940 through 1980, but not in the data subsequent to that (as both the catch per unit effort (CPUE) and the catch remain fairly constant). Thus grouper productivity estimates are dependent on the 1940 through 1980 data series. The lack of information in the later series can be seen in Figure 70 of Assessment 3.0 where the stock recruitment relationships without the earlier data series can be fit with almost any curve as the remaining points are all clustered around one spawning stock biomass level. As the stock production estimate is based on the full time series alone, we would surmise this method would suffer the same problems of definition if applied only to the more recent time series.

What this means is that the estimated SFA benchmarks are dependent upon the earlier data series. This raises two important concerns. First, are the earlier data of good quality? William Hogarth appears to answer several questions related to this concern in his letter to Robert Shipp. However, the data could perhaps be looked at more critically to evaluate their quality and self-consistency as an index. Second, if the data are determined to be of high enough quality to be used, does it geographically reflect the same stock as is currently being fished? It was not clear to me from the reports provided if the Cuban fleet fished the same grounds as the U.S. fleet. If the Cuban fleet was fishing on a different component of the stock (e.g. a deep water component say, or a component outside the region the Florida fishermen currently fish) then the estimated productivity levels may be for this expanded stock, and not the stock currently fished by U.S. fishermen.

This defining of the goal posts, that is identifying the stock being fished and the appropriate SFA benchmarks, requires a closer look. If the quality of the early data is good, and if one believes the same stock is being fished now as then, then I would conclude from the analyses that the stock is overfished and that a recovery plan should be implemented. And, given this, I would say that the seven scenarios outlined in Table 65 of the assessment provide a sufficient range of control rules for the Council to choose from or to formulate reasonable alternatives from to achieve recovery. The proposal by the Reef Fish Stock Assessment Panel provides two specific alternatives (F=0.11 and F=0.23) given these results that allow the Council to achieve its objectives by 2010 or 2018.

If the quality of the early data is found questionable or if there is evidence to suggest that the Cuban fleet fished on a different component of the stock, then management will have to be based on data taken subsequent to 1980. Under these circumstances, I would say that the trends indicated by the available CPUE data suggest that current fishing levels are at or slightly above what the stock can sustain (Figures 45 – 53).

Obviously the judgements I am making are based on the narrow perspective of the documents reviewed. But, given the assumptions outlined above, the management measures appear to be appropriate to achieve SFA objectives and would be consistent with a precautionary approach.

Question 2

Are the stock assessment conclusions robust to choices regarding the data and models?

Yes. Consistency among alternative assessment approaches, while not guaranteeing the accuracy of the estimates, at least indicates a degree of robustness across alternative assumptions concerning the stock and the data.

Does the stock assessment make use of the available scientific data most appropriately?

I think the assessment does a good job of systematically addressing the numerous issues associated with the data. What might one do in addition to what was done (if one had the time and the resources)?

(1) Apply a generalized linear model (GLM) to the CPUE for all gear types simultaneously, holding year and grid as factors across all gear types, and incorporate a year-grid interaction to see if movement by area by year plays any role in explaining the variation between gear types.
(2) Model productivity using the percent female information. Simulate alternative management control rule scenarios that take into account the effects of targeting or selectivity as it changes with depth or timing of harvest. Why are there samples of older fish that are100% female in both Moe's and Koenig's data? Is the assumption that all fish above a given age are males valid? How would a departure in this assumption affect the productivity estimates for the stock? The size limit makes intuitive sense, but is the stock structure post size limit a more productive size structure? What is the mortality rate for sublegal-sized released fish? Is that estimate reliable?
(3) Examine if fishermen now fish differently than they did in the past. Here we refer broadly to differences seen in the pre-1980 to the post-1980 fishery, but differences may also exist in the fishery over the last few decades that may influence trend interpretation. Is the fishery using different bait? Is fishing occurring in different areas or are the fleets using different gears?
(4) Conduct the stock recruitment estimates separately from the stock assessment procedure. I would not incorporate a stock recruitment relationship into my age-based stock assessment for fear that it would overly constrain the assessment model.
(5) Explore why the recreational selectivity differs so much between the ASAP assessments for the long and short time series. I suppose there is a selectivity change with the onset of the size limit, although I do not see that in the figures. Would it be useful to apply a size-age model? Does the selectivity curve represent to some degree the change in catchability on to off shore?
(6) Come up with an objective way of determining how much the different data sources should influence the fit. Is the upward trend in the video-index as valid as the downward trend in private charter index? Are all these included in the assessment? Do they receive equal weight?
(7) Do a retrospective analysis to see if the estimates are consistently under or over estimated through time.

Are the estimates of the biological parameters, model assumptions, and model specifications appropriate for the available data and the actual fishery?

Yes, assuming the concern about the early versus later data proves unfounded, I would conclude that the models and their estimates are appropriate. The most striking feature of this fishery, that may make current models and estimates inappropriate, is that the fish are protogynous hermaphrodites. This biological characteristic would suggest that the current size limit would be a fruitful management option. But, the implementation of this size limit did not appear to help the fishery. Why was that?

Question 3

Are the ASAP and ASPIC models appropriate for the red grouper stock assessment, and under what circumstances would they be appropriate for other stocks?

Both the ASAP and the ASPIC models are sound stock assessment approaches that can be applied to a number of different species. The ASAP model makes use of age structure, which if available, is quite useful for interpreting the effects of changes in age-structure. This may be quite appropriate for red grouper given the hermaphroditic nature of the stock. The observation that both models are so similar in their estimates would suggest that changes in age structure are not important to the productivity of the stock. I find this surprising, and think contrasting expected productivity levels at different stock levels as predicted by the two models might be instructive.

Given the length information available perhaps a procedure that uses length would be useful, but I wouldn't go too far in this direction until I was convinced that there was sufficient contrast in the stock size data and that current data were comparable to earlier data.

Scientists and managers should recognize that ASAP and ASPIC are two generic model formulations with features appropriate for general stock assessment (others are VPA, ADAPT, CAGEAN, Stock Synthesis). But, the modern population dynamicist now should have the tools available to develop a model specific to the fishery of concern, accounting for different fleet compositions, changes in catchability, and even differing recruitment regimes. The scientist, if he or she so chooses, is no longer stuck with a generic model that doesn't quite fit the fishery, but can construct one that addresses the specific needs of the fishery. I mention this because I am often asked if one type of model is better than another. Should one be using ADAPT or ASAP? I would create my own, and then use the generic models as a check for assumptions and robustness. The 1999 assessment appears to take this approach, and goes the extra step of providing a contrasting assessment (ASPIC). As specific models grow into more general use scientists and stakeholders will have to get better at asking specific questions, e.g. How is bycatch mortality taken into account?, and at judging specific performance, e.g. Does the model do a good job of explaining what we see?, rather than relying upon the fact that the model is a Ford or a Chevy for performance.

Question 4

Do the results and range of scenarios presented in the stock assessment represent an adequate description of the uncertainty in the data and modeling, and are uncertainties in the assessment and their management implications adequately expressed to allow informed management decisions?

I think the assessment does a good job of addressing many of the uncertainties. Including alternative approaches and subsetting data sets is informative. However, it was not clear to me how the uncertainty in the CPUE, say, translates into uncertainty in the estimates and projections. And while having projections under different harvest scenarios is quite a good method for judging alternatives, better than many fisheries I've seen, these scenarios are projected from estimates that are uncertain and will undergo changes (e.g. recruitment) that are likely to be stochastic in nature rather than deterministic. Incorporating such uncertainty into our projections will be important as we try to account for risk in our decision making. Many methods exist for developing projections that account for uncertainty (e.g. Markov Chain Monte Carlo which can be implemented in ADModel), and scientists working in this fishery should move forward in that direction. But, it must be done simultaneously with assessing the risk associated with falling below the prescribed levels, so that uncertainty doesn't translated into a rational for capriciousness. These approaches, unfortunately, will be computationally intensive, so managers, scientists, and fishermen should work together to establish reasonable management scenarios and control rules for exploration so that analyses can move forward efficiently.

Conclusions

The assessment appears to be thorough and state of the art. Any independent population scientist asked for a review will come up with a list of other things that might be done or could be explored. This part of the peer review process helps us move forward, but it shouldn't keep us from acting with the information we have in hand.

The reason I have focussed on the early (pre-1980) versus late (post-1980) data is that the early data provide the contrast and effectively set the goal for fishery productivity. It is good to step back from the models and look at the data to best interpret the degree of influence this data should have. Clearly, based upon the CPUE and catch estimates the stock was producing more fish than what we are seeing now. There are two obvious explanations, although there may be others I have not considered. One is that the stock was larger, and that it was gradually fished down over a forty-year period to the low level seen in the 1980s, where it has remained. This is the assumption implicitly accepted by the stock assessment panel. The second is that the earlier data are representative of some expanded stock, and that the current fleet does not

have access to that stock. In that case not much has changed over time, and the management actions needed to maintain the fishery are more subtle.

Given these concerns I believe there is enough information in the 1999 assessment to formulate a reasonable management plan, which may include further analyses with subsequent management actions contingent upon results. I would not fall back onto status quo management without explicitly acknowledging the assumptions entailed so that those assumptions can be fully validated as part of the process.

Appendix I – Background Materials

1) Schirripa, M. J., C. M. Legault and M. Ortiz. 1999. The Red Grouper Fishery of the Gulf of Mexico: Assessment 3.0. SEFSC, Miami, SFD Contribution No. SFD-98/99-56.
2) Legault, C. M. and V. R. Restrepo. 1998. A flexible forward age-structured assessment program. ICCAT Collected Volume of Scientific Papers (in press). SCRS/98/53.
3) Legault, C. M., K. M. Burns, V. R. Restrepo, C. E. Porch, M. J. Schirripa and G. Scott.1999. Trends in red grouper mortality rates estimated from tagging data. SEFSC, Miami, SFD Contribution No. SFD-98/99-57.
4) Reef Fish Stock Assessment Panel. 1999. September 1999 Report of the Reef Fish Stock Assessment Panel. Gulf of Mexico Fishery Management Council. 3018 U. S. Highway 301 North, Suite 1000, Tampa, FL 33619.
5) Draft Minutes of the Standing and Special Reef Fishing Scientific and Statistical Committee, October 27, 1999, Tampa, Florida.
6) Verbatim transcript of above meeting (Not available).
7) Ketchington, T. J. 1999. Gulf of Mexico red grouper: a review of the scientific advice and its management implications. Prepared for Southeastern Fisheries Association, Florida Offshore Fishing Consortium and Southern Offshore Fishing Association, October, 1999.
8) Letter from William Hogarth to Robert Shipp, May 3, 2000, responding to several council questions.
9) Letter from Bob Jones to Wayne Swingle, May 25, 2000, to which a letter from Dr. Trevor Ketchington is attached.
10) Department of Commerce, 1998. Magnuson-Stevens Act Provisions; National Standard Guidelines, Federal Register Vol. 63, No. 84, Rules and Regulations.
11) Restrepo, V. R., G. G. Thompson, P. M. Mace, W. L. Gabriel, L. L. Low, A. D. MacCall, R. D. Methot, J. E. Powers, B. L. Taylor, P. R. Wade, and J. F. Witzig. 1998. Technical guidance on the use of the precautionary approaches to implementing national standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Technical Memorandum.
12) NRC. 1998. Improving Fish Stock Assessments. National Academy Press, Washington D. C.
13) MRAG, Americas Inc. 1997. Consolidated Report on the Peer Review of Red Snapper Research and Management in the Gulf of Mexico. Prepared for The Office of Science and Technology. NMFS.

Appendix II – Statement of Work

STATEMENT OF WORK

Consulting Agreement Between the University of Miami and Dr. Patrick Sullivan

July 24, 2000

General

Recognizing Sustainable Fisheries Act (SFA) mandates for stock assessment benchmarks as indicated in the Guidelines and Technical Guidelines, the major objective of this review is to determine if the assessment of Gulf of Mexico Red Grouper provided the most reliable and useful interpretation of the available data for use of the Council in developing their management strategy.

In particular, the review should advise on whether the results of the assessment provided robust scientific support to the Council and their Scientific and Statistics Committee Panel regarding consequences of choices among management options. The review should also determine whether the model results and conclusions from the assessment represent the most scientifically sound interpretation of all available information, and adequate characterize stock status and associated uncertainties. Additionally, the review should address the appropriateness of the modeling/analysis tools for this assessment, given the availability of data and the requirement for estimation of management quantities.

Specific questions that the review should address are:

1. Is the available scientific evidence consistent with the conclusion that the red grouper stock in the Gulf of Mexico is experiencing overfishing and/or the stock is overfished as defined in the fishery management plan?
    a. If so, and given that the management objective is to prevent further overfishing and to promote rebuilding of depleted stocks, are the management measures in the Reef Fish Fishery Management Plan appropriate to achieve the objective, too stringent, or not stringent enough.
    b. Are the current management of red grouper in the Gulf of Mexico and the scientific advice consistent with a precautionary approach to fisheries as expressed in the United Nations Food and Agriculture Organization Code of Conduct for Responsible Fisheries.

2. Are the stock assessment conclusions robust to choices regarding the data and models.

a. Does the stock assessment make use of the available scientific data most appropriately?.
b. Are the estimates of the biological parameters, model assumptions, and model specifications appropriate for the available data and the actual fishery?.

3. Are the ASAP and ASPIC models appropriate for the red grouper stock assessment, and under what circumstances would they be appropriate for other stocks.

4. Do the results and range of scenarios presented in the stock assessment represent an adequate description of the uncertainty in the data and modeling, and are uncertainties in the assessment and their management implications adequately expressed to allow informed management decisions.

Specific

The consultant's duties shall not exceed a maximum total of three weeks- several days for document review and several days to produce a written report of the findings. The consultant may perform all review, analysis, and writing duties out of the consultant's primary location, as no travel is required.

The itemized tasks of the consultant include:

1. Reading and analyzing the relevant documents provided to the consultant;

2. No later than August 14, 2000, submitting a written report of findings, analysis, and conclusions. The report should be addressed to the "UM Independent System for Peer Reviews, " and sent to Manoj Shivlani, UM/RSMAS, 4600 Rickenbacker Causeway, Miami, FL 33149 (or via email to mshivlani@rsmas.miami.edu).

Signed_____

Date_____

PRELIMINARY BUDGET

1. Salary ($600/day for 3 weeks)	$12,600
2. Office supplies	$ 200
3. Mailing costs	$ 100
TOTAL	$12,900