Independent Peer Review Report on SEDAR 47 Assessment of Goliath Grouper
St Petersburg, FL, 17-19 May 2016

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Prepared for the Center for Independent Experts

Contents

Executive Summary

1. The review workshop provided an independent peer review of SEDAR stock assessments of goliath grouper and took place in St Petersburg, Florida from the 17-19 May 2016.
2. Data used in the assessments included estimates of historical catches and abundance indices from MRFSS/MRIP, the Everglades National Park (ENP) index and a "citizen science" REEF index. The juvenile indices display similar trends, but the REEF and MRFSS offshore index of adults show differing trends in recent years.
3. Significant uncertainty surrounds both the abundance indices and the catch data. The REEF index is based on size categories or "ranks" and does not reflect abundance in a conventional way. Treating the index as proportional to abundance may bias the assessment.
4. Other biological data such as natural mortality, maturity, and growth were based on published material and are likely to be the best available.
5. Two age-based assessment models were used. These were Stochastic Stock Reduction Analysis (SSRA) and a "catch free" model that only uses abundance indices. The assessments are an important and valuable contribution to understanding trends in biomass and exploitation of goliath grouper.
6. Both models require a number of strong conditioning assumptions that should be tested before a preferred analysis can be identified. These analyses were not available in the assessment report so that the range of uncertainty in the assessments is unknown but probably large.
7. SSRA treats the catch data as known without error. However, it is clear that there is considerable uncertainty about the catch estimates especially during a period of apparent over reporting from 1965-1984. As sensitivity to alternative catch assumptions was not explored it is difficult to have confidence in the final run of this model as catch is likely to be influential in determining model results.
8. MCMC exploration of the catch free model likelihood surface was performed. The lack of convergence of some chains and erratic behaviour of others strongly suggest the model is ill-conditioned and that the posterior distributions of the parameters have multiple modes. This makes interpretation of the output problematic.
9. All the indices and the assessments suggest the stock has increased since the 1990s and may have stabilised or slightly decreased recently. This is likely to be a robust indication of trends.
10. It is not possible to evaluate stock status in relation to MSY reference points. Both models suggest the stock is not overfished, and the SSRA model also suggested the stock was not undergoing over-fishing. The uncertainties in the analyses are too large to have confidence in these assessments of stock status.
11. Much of the uncertainty surrounding the assessment needs to be explored to evaluate the robustness of any conclusions. In particular, a more thorough analysis to estimate unbiased values for selectivity or vulnerability is required as these values are

influential in both models and directly affect the stock recruitment relationship in SSRA.

12. Future work should focus on developing a good fishery independent abundance index. A systematic well designed underwater visual survey conducted either by divers and/or with the use of cameras may prove effective in the longer term. Simpler methods of assessment that can provide insights into the data should be attempted before more complex age-structure models are used.
13. Wider discussion with other experts to get a broader perspective from a range of expertise during the data and assessment process may enhance modelling choices and the use of data.

Background

SEDAR 47 is a compilation of data, an assessment of the stock, and a Center for Indepdendent Experts (CIE) assessment review conducted for Southeastern Goliath Grouper. The stock assessed through SEDAR 47 is within the jurisdiction of the South Atlantic and Gulf of Mexico Fisheries Management Council and the states of Florida, Georgia, South Carolina, North Carolina, Mississippi, Alabama, Louisiana, and Texas. The review workshop provided an independent peer review of SEDAR stock assessments and took place in St Petersburg, Florida from the 17-19 May 2016.

Description of the Individual Reviewer's Role

The reviewer received the assessment document on the 6th May 2016 and commenced reviewing the report. During the review of the main assessments a number of additional documents were consulted that included two peer reviewed papers documenting the assessment methods (Porch et al. 2006, Martell et al. 2009). After an initial examination of the report, the reviewer participated in a Review Workshop (RW) meeting in St Petersburg. During the meeting, the reviewer actively participated in the discussion and requested some additional model runs. The task of preparing an initial RW summary draft report was shared with other panel members. The contributions to the initial draft were discussed before the end of the meeting with the panel chair. The reviewer's draft report was completed before the 9th June and sent to the CIE as required.

Summary of Findings

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions.

a) Are data decisions made by the data providers and assessment analysts sound and robust?

Life history data that included sex ratio, age at maturity and fecundity used such information as available. While fecundity was based only on two specimens, this is not critical to the assessment. The assumption of a 1:1 sex ratio appears reasonable even though there is a possibility that some fish may change sex. Natural mortality estimates were based on standard relationships published by Hoenig (1983) and Lorenzen (1996, 2005). The former provided an overall level of M while the latter provided the basis for an age specific mortality. These values conform to standard practice though, as noted below, the two assessment models used slightly different Lorenzen equations, which is arbitrary and needlessly inconsistent. An additional question arises over the level of M in years of cold kills. There is evidence that in some years fish suffer high mortality as a result of cold weather. No allowance for this was made in the models used in the assessments.

Indices of abundance were derived from three main sources. These were the recreational fishery MRFSS/MRIP database, the Everglades National Park survey (ENP), and the "citizen science" REEF survey. The MRFSS indices were derived from fitting a delta-lognormal model to extract the annual abundance signal. A similar approach but using a Poisson model was used to derive the REEF survey index. However, for this index the response variable was the "rank" of the abundance rather than a true count of the fish observed. In practice, the "ranks" were not ordered observations but abundance categories. Hence true abundance does not map linearly or continuously to the "rank". As a result, the REEF index is likely to reflect the sign of any trend (positive or negative) correctly, but the abundance signal will be distorted. As discussed below, the REEF index has an important influence on the assessment which means that this problem is of particular concern that requires further investigation.

The data series used for the indices were not collected for the purpose of constructing abundance information but are the only available sources. The Assessment Team (AT) used standard methods to extract the MRFSS/MRIP index, though a number ad hoc judgements were made to correct for missing data, and it would be useful to see more analysis of the influence these decisions have on the final index. Similarly, the decision to use ranks as the response variable for the REEF index may be satisfactory, but without further analysis the consequences of this choice for the index are unclear and undermine confidence in its accuracy.

A time series of catch data was constructed for use in the SSRA model. In common with the abundance index data, MRFSS/MRIP data were used to derive estimates of recreational catch. In addition, dealer reports and other records were used to estimate commercial catch. A substantial revision of the commercial catch was made for the period 1965-1984 based on a single dealer's reports that appeared to have been over-reporting goliath grouper catches. This decision seems reasonable though inevitably leads to uncertainty about the true catch levels. Given the importance of the catch data in the SSRA model where they are assumed to be error free, a thorough analysis of the uncertainties in the catch data is needed to provide confidence in these data.

The SSRA mode and to some degree the catch free model require estimates of fleet selectivity. It is of particular importance to note that the SSRA model estimates Fmsy and MSY conditioned on the external assumption about selectivity, which may make the choice of selectivity crucial to the model results. Dome shaped selectivity was estimated for juveniles and asymptotic selectivity for adults, but these were based on the size composition in catch without accounting for the size composition of the fishable stock and are therefore biased estimates of true selectivity. Whether this bias is important remains to be investigated, but it adds to a lack of confidence in the robustness of the assessments.

b) Are data uncertainties acknowledged, reported, and within normal or expected levels?

Uncertainties in the data are acknowledged and discussed in the report. What is missing, however, is a thorough analysis of the influence the necessary ad hoc decisions have on the calculated indices and catch data. As a result, it is difficult to comment on whether the uncertainties are within normal or expected levels. This is of particular importance in relation to the REEF index and the catch time series as these may be influential on the results of the assessments.

c) Are data applied properly within the assessment model?

In general, the data are used correctly in the assessments. One might question a number of assumptions made by the models such as that which assumes the catches are known exactly, and that M is time invariant given evidence of cold kills. The issue is therefore more to do with developing the assessment models to accommodate the available data or selecting models better suited to them.

d) Are input data series reliable and sufficient to support the assessment approach and findings?

As noted above, there are a large number of uncertainties in the data series that are sufficient to undermine confidence in the assessments. While the assessment approach is appropriate for the data, much more sensitivity analysis is required before the findings can be accepted as a fair assessment of stock status.

2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data.

a) *Are methods scientifically sound and robust?*

Two principal assessment models were presented and discussed in the assessment report. These were the "Stochastic Stock Reduction Analysis" (SSRA) (Martell et al. 2009) and the "Catch Free" model (Porch et al. 2006). Both models have been published in the peer reviewed literature, though it is important to note that the SSRA model has been modified by FWC to allow the inclusion of multiple survey indices and this change does not appear to have been externally reviewed. The models share some important similarities which include:

- The underlying population model is age structured.
- A Beverton-Holt stock recruitment model is assumed.
- Recruitment deviations are treated as random effects and characterise relative year class strength.
- Fishing mortality is modelled as the product of an age and year effect.
- Survey indices are treated as proportional to biomass conditioned on age specific selectivity.

- Parameters are estimated by maximising a likelihood function.
- Penalty functions are used to constrain some of the model parameters. These are referred to as "priors" but are not true Bayesian priors and may result in improper posterior distributions where parameter values hit bounds.

Important differences between the models are:

- SSRA uses an estimate of total fishery removals (dead catch) and these are treated as error free. They do not contribute to the likelihood.
- Unlike SSRA, the Catch Free model treats selectivity, natural mortality, growth parameters and fishing mortality as parameters to be estimated.
- SSRA parameterises the stock recruitment function in terms of Fmsy and MSY, and these are the main ("lead") parameters to be estimated. An important consequence of this is that the stock recruitment parameters are conditioned on the assumption of selectivity and will change if the selectivity assumption is changed.

It should also be noted that, while not a feature of either model, the analysts assumed different Lorenzen relationships between natural mortality and weight, which reduces the comparability between the models and will affect the calculation of MSY reference points.

The models are well known variants of age-structured production models and can be regarded as scientifically sound. Whether they are considered "robust" depends heavily on the data used. Here "data" may include constants, such as the fishery removals, age at maturity, selectivity, M, etc., that do not enter the likelihood as well as observations such as survey indices that do. Where data enter the model as constants it is particularly important that they are accurate to avoid cumulative errors. Fishery removals and selectivity, for example, can be critical in determining the model outcome, yet there is considerable uncertainty surrounding the values used in these assessments. It not possible to conclude that the methods are robust and various analyses reported in the assessment document (the MCMC runs for the Catch Free model), and additional runs performed during the meeting (the "leave-one-out" survey analysis for SSRA) suggest the results are not robust. Where priors are used, as is the case in these assessments, it is particularly important to examine whether these are updated by the observations and to examine the sensitivity of model estimates to the priors. These diagnostics were not done, which prevents an assessment of robustness.

b) Are assessment models configured properly and used consistent with standard practices?

For each model only one or a very few model configurations were presented. These configurations were legitimate, but do not necessarily represent the optimal model configuration. As mentioned in (a) much more analysis of the prior assumptions is needed. More consideration is needed as to which indices to include. While the juvenile indices (MRFSS estuarine and ENP) show good agreement, this is not so for the REEF and MRFSS offshore indices that show conflicting trends in the period 2005-2015. This is an important period since it drives the perception of current stock trends and given the treatment of the REEF index as a categorical variable this raises doubts about consistency.

It is questionable, given the uncertainty in the catch data, that these are included as error free constants. It would be much better to treat the catches as data that enter the likelihood as observations (as opposed to parameters) and allow errors to be estimated.

For the SSRA model it was assumed that the stock in 1950 (the base year for the assessment) was in an equilibrium virgin state. This is unlikely to be the case but may be adequate so long as the assumption does not greatly influence the biomass and fishing mortality estimates for the more recent years. However, when additional sensitivity runs were performed that started in 1975, it was assumed that a virgin state prevailed in this year and this made comparison with the 1950 analysis problematic.

An important assumption in the catch free model is the amount by which F is reduced following the fishing moratorium. This is characterised by a gamma penalty function on the proportion by which F is reduced. While the construction of the prior is based on expert opinion it is crucial to understand whether the posterior distribution is updated by the data. Otherwise stock status is largely determined by the choice of prior. No diagnostics were presented to evaluate this issue.

c) Are the methods appropriate for the available data?

The SSRA and Catch free models are appropriate tools but need to be used as part of a suite of alternative models if only to characterise model uncertainty. The available data could potentially be analysed using a variety of models including, for example, surplus production models and other data-poor approaches. Much more thought needs to be given to the implication of handling the fishery removals as known constants and to developing changes to the SSRA/Catch Free models so that this issue can be explored.

MCMC samples from the catch free model (Fig 7.5.8) strongly suggest the model is ill-conditioned because the chains flip between at least two equilibria, suggesting that the parameters have multi-modal posterior distributions, or more likely the chains are unable to converge on a unique solution. Indeed two of the eight chains were excluded as they did not converge at all. This is not surprising given the very large number of parameters to be estimated yet from very little informative data. It is difficult enough to estimate a single constant value of M in data rich assessments, yet the catch free model attempts to estimate age-specific M from very little data and in the absence of any catch information which might otherwise help partition Z into F and M. This is an analysis of extra-ordinary optimism.

Given the very real difficulty of trying to construct abundance indices and fishery removals, it is important to review what can be realistically derived in terms of useful reference points. Simpler methods that consider only stock trends may be more useful than trying to reconstruct a fully age structured population model from information of unknown veracity.

3. Evaluate the assessment findings.

a) Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?

The abundance and exploitation estimates are likely to be adequate to give an indication of trends. However, they are not adequate to make inferences about stock status. In the case of the catch free model, a very small change in M made a substantial change to the perception of stock status (Figure 7.5.10). In the case of SSRA, altering the start period of the analysis radically changed biomass trends. Furthermore, for this model, when sensitivity runs were performed by changing the mix of abundance indices included, large changes in biomass trends were apparent. All of this suggests that the assessments do not provide a reliable basis for evaluating stock status.

b) Is the stock overfished? What information helps you reach this conclusion?

The SSRA and the catch free model estimated the stock to be "not overfished". Neither of these estimates can be regarded as reliable and hence the status is unknown in relation to MSY reference points. The conclusion that the stock has increased since the late 1990s is probably robust as all indices and assessments support this change.

c) Is the stock undergoing overfishing? What information helps you reach this conclusion?

The SSRA model suggested the stock was not undergoing overfishing while the catch free model estimated the converse. In the latter case, the estimate is sensitive to the assumption on natural mortality. It is not possible to evaluate status in relation to overfishing.

d) Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?

Both assessment models estimate a Beverton-Holt stock recruitment curve. For SSRA, an informative penalty function on the Goodyear parameter, κ, was used to constrain the parameter estimates, but it is not clear what was done for the catch free model. As the data contain almost no year class information, it is very unlikely that the estimated stock recruitment relationship is robustly estimated. Furthermore, in the case of the SSRA model, the function will be affected by the assumption of selectivity which is almost certainly biased. Overall, the stock recruitment relationship shown in Figure 6.9.6 is likely to be a product of modelling assumptions rather than informed by data.

e) Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?

Quantitative estimates of stock status are not reliable for reasons stated above. The abundance and exploitation estimates are likely to be adequate to give an indication of trends.

4. Evaluate the stock projections, including discussing strengths and weaknesses

No projections were performed using output from the SSRA model. A limited number of projections were run for the catch free model but the stock-recruitment assumption is not

clear. It is especially difficult to assess the value of these projections given the uncertainties discussed above and the effect of cold kills in recent years. The projected populations possibly provide indicative future trends, but cannot realistically indicate status in relation to reference points.

5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.

While uncertainties in the data and the assessments are discussed, there is very little analytical exploration of uncertainty which makes interpretation of the assessment results problematic, because it is not possible to place these results within a quantitative envelope of plausible outcomes. Nearly all the input data, whether observations or assumed constants, are subject to large uncertainty and the consequences of this uncertainty need to be more thoroughly explored. This is especially true of the catch data and the survey indices, but also applies to crucial assumptions about M and selectivity. While some alternative runs were carried out under different values of M, these were very limited yet illustrated high sensitivity.

For the SSRA model the assumption of error free catches needs far more investigation. It is very clear that the catch is not well known and alternative but plausible catch streams need to be investigated as sensitivity runs. A retrospective analysis was done that showed the model was well behaved, but this is conditioned on assumptions about the data that were not themselves tested. Uncertainty was also looked at using MCMC on the final log likelihood, but it did not look at the extent to which the priors were updated and hence it is very difficult to understand how much of the model output is driven by the prior assumptions. Given that selectivity is crucial to the determination of MSY reference points, sensitivity runs making alternative selectivity assumptions are necessary. During the meeting, the Review Panel requested additional model runs to investigate the sensitivity of the results to the survey data. At face value these suggested high sensitivity to the inclusion/exclusion of surveys, especially the REEF index. However, these runs were performed assuming a virgin state in 1975, and could not be compared with the AT assessment which had assumed a virgin state in 1950.

For the catch free model, the principal uncertainty investigated was the choice of M and therefore only considers one quite small part of the potential uncertainty. It did show that the evaluation of stock status was very sensitive to M. MCMC runs showed that the model was ill-conditioned since some chains failed to converge and those that did show some convergence exhibited multiple stable states. The output from the model is not therefore reliable and more work is required to find a sound model configuration.

The catch free model can generate model estimates of relative catch, i.e. catch biomass that should correlate with the estimates of actual catches and differ from them by a proportionality constant. At the request of the panel, this relative catch was extracted from the model output

and compared to the estimates of actual catch. The two-time series did show some similarities which is encouraging. It shows that a worthwhile improvement to the catch free model would be to include the catch data as observations in the likelihood. This may help in better conditioning the model.

Overall, the potential consequences of uncertainty were not fully explored so that considerable doubt remains over the robustness of the assessment results.

6. Consider the research recommendations provided and make any additional recommendations or prioritizations warranted.

The Assessment Report lists a number of recommendations for further research based on a workshop held in March 2016. From the perspective of improving the assessment, the recommendations relating to developing a good fishery independent index of abundance should be of highest priority. These include a number of proposals to enhance and develop underwater surveys using cameras and extending coverage to artificial reefs. It should be possible to brigade a selection of these recommendations into a more comprehensive proposal for a systematic well designed underwater visual survey conducted either by divers and/or with the use of cameras.

In addition to developing a survey index, the following research should improve the existing approach to assessment:

- Fully investigate improvements to the catch data and evaluate, quantitatively, the uncertainties associated with them.
- Develop and validate the REEF index as a true index of abundance to overcome the use of ranks.
- Develop the "catch free" model to allow M to vary in years of cold kills and include the catch data as observations in the likelihood to make it a "catch inclusive" model.
- Develop proper estimates of selectivity (vulnerability) that take account of the proportion of the stock taken by the gear at each size/age. This means calculating the proportion of fish in the sea taken by the gear, not the proportion of a size/age class in the overall catch.

The current approach to the assessment uses methods that are really better suited to data rich assessments where high quality data are available usually with at least size and often age data. It may be better to accept the limitations of the current data and develop a framework for assessment that avoids the use of complex models with numerous age-referenced latent parameters. For example, simply monitoring the occupancy of sampling sites over time may provide a much more interpretable perspective of stock status where a reference point might be defined in terms of the proportion of sites occupied. At the very least, the raw data should be investigated to see just how much useful information it contains and then design a model that helpfully exploits that information.

7. Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

The assessments presented are an important and valuable contribution to understanding trends in biomass and exploitation of goliath grouper, but they are not sufficient to be able to evaluate stock status in relation to MSY reference points as a result of substantial uncertainty which has yet to be fully explored. The assessments themselves were conducted following the assessment model author's guidelines though at times some of the modelling choices were not entirely clear. Why, for example, was 1950 assumed to be a virgin state and what alternative assumptions might be made? Perhaps wider discussion of assessment approaches at an earlier stage in the assessment process would help in teasing out the critical issues and make modelling choices more transparent.

Much effort has gone into preparing data, especially in relation to catch and abundance indices and all potential sources of useful data were considered. Decisions made in deriving catch data and abundance indices were objective. There may be something to be gained by conducting a data review workshop to test and validate the decisions made in working up the data as it was not possible to do this at the assessment review and, by necessity, many decisions require expert judgement, which is best achieved through collective discussion with a range of experts where consensus can be achieved.

8. Provide guidance on key improvements in data or modelling approaches which should be considered when scheduling the next assessment.

Section 6 above discusses future research and some of the issues that may be addressed before the next assessment. Apart from trying to improve the data, careful consideration needs to be given the choice of assessment model. The highly complex models used in the assessments at the review meeting have their place but where data are limited, they require a raft of critical assumptions to be made that need to be tested in order to bracket plausible results. Furthermore, the interaction between alternative assumptions can be vast and difficult to assess. It would be useful therefore to try using models parameterised more sympathetically for the data available. For example, the Martell and Froese (2013) approach simply explores feasible parameter space using a Schaefer model given an observed catch stream. It does not require maximising a likelihood function and is easily adapted to include an abundance index. At the most elementary level, simply looking at the catch biomass/index ratio may provide an indication of exploitation rate that is at least as reliable as estimates of F emerging from a complex model. These very simple approaches should be looked at first before embarking on more complex models so that a good understanding of the data can be developed.

The SEDAR Process

Relevant documents pertaining to the meeting were received well in advance and provided sufficient time for preparation. The meeting facilities were good and well organised.

Most of the work leading up to the assessment review workshop took place outside the SEDAR process by the State of Florida, unlike many stocks that fall within Federal waters. I felt that wider engagement with peers during data preparation and assessment stages that is otherwise a feature of the full SEDAR process would have benefitted the current assessment by providing a wider perspective and internal challenge during the scientific analysis.

Conclusions and Recommendations

The assessments reviewed were an important and valuable contribution to understanding trends in biomass and exploitation of goliath grouper, but they are not sufficient to be able to evaluate stock status in relation to MSY reference points. The stock appears to have increased since the 1990s as a result of the moratorium but more recent trends are uncertain and there may be some decline due to cold kills.

Much of the uncertainty surrounding the assessment needs to be explored to evaluate the robustness of any conclusions. A more thorough analysis to estimate unbiased values for selectivity or vulnerability is required.

Future work should focus on developing a good fishery independent abundance index. A systematic well designed underwater visual survey conducted either by divers and/or with the use of cameras may prove effective in the longer term.

Simpler methods of assessment that can provide insights into the data should be attempted before more complex age-structure models are used.

The assessment process may benefit from wider discussion with other experts as the data and assessments are being undertaken to get a broader perspective from a range of expertise that may enhance modelling choices and the use of data.

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Martell, S.D.J., Pine III, Walters, C. 2008. Parameterizing age-structured models from a fisheries management perspective. Canadian Journal of Fisheries and Aquatic Sciences, 65:1586-1600.

Martell S, Froese R. 2013. A simple method for estimating MSY from catch and resilience. Fish. Fish. 14: 504-514.

Porch C.E., Ecklund, A-M., and Scott, G.P. 2006. A catch free stock assessment model with application to goliath grouper (Epinephelus itajara) off southern Florida. Fisheries Bulletin 104:89-101.

Appendix 1: Bibliography of materials provided for review

Joe O'Hop and Joseph Munyandorero. SEDAR 47 Stock Assessment Report for Goliath Grouper of the South Atlantic and Gulf of Mexico, 2016.

Joe O'Hop and Joseph Munyandorero. SEDAR 47: Assessment Data and Methods. Comparison of data used in previous Goliath Grouper Assessments. PowerPoint presentation.

Joe O'Hop. SEDAR 47 Data and Assessment Methods: Structure of the catch-free assessment model, assumptions, and 2014 model estimates. PowerPoint presentation.

Joe O'Hop. RW predicted catch, free and fixed selectivities.xlsx. Excel spreadsheet.

Joseph Munyandorero. Other ASPM.doc: Summary of additional runs requested by the panel.

Joseph Munyandorero :Assessing the Goliath Grouper Stock off the Southeast U.S.A Using an Age–Structured Production Model (ASPM). PowerPoint presentation.

Appendix 2: Statement of Work

External Independent Peer Review by the Center for Independent Experts

SEDAR 47 Southeastern Goliath Grouper Assessment Review Workshop

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: SEDAR 47 will be a compilation of data, an assessment of the stock, and CIE assessment review conducted for Southeastern Goliath Grouper. The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, error corrections and sensitivity runs of the assessment models provided by the assessment panel. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The stocks assessed through SEDAR 47 are within the jurisdiction of the South Atlantic and Gulf of Mexico Fisheries Management Council and the states of Florida, Georgia, South Carolina, and North Carolina, Mississippi, Alabama, Louisiana, and Texas. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge expertise in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference. Experience with data-limited or catch-free assessment methods would be preferred. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting **scheduled in St. Petersburg, FL during May 17-19, 2016**.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

CIE reviewers shall conduct an impartial and independent peer review of the assessment in accordance with the SoW and ToRs herein.

A description of the SEDAR Review process can be found in the SEDAR Policies and Procedures document:
http://sedarweb.org/docs/page/A6-SEDARPoliciesandProcedures_June2014_0.pdf

The CIE reviewers may contribute to a Summary Report of the Review Workshop produced by the Workshop Panel. .

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting **tentatively scheduled in St. Petersburg, FL during May17-19, 2016.**
3) **Tentatively in St. Petersburg, FL during May 17-19, 2016** as specified herein, and conducts an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than REPORT SUBMISSION DATE, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Dr. Manoj Shivlani, CIE Lead Coordinator, via email to mshivlani@ntvifederal.com, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following **tentative** schedule.

March 29, 2016	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
April 29, 2016	NMFS Project Contact sends the CIE Reviewers the pre-review documents
May17-19, 2016	Each reviewer participates and conducts an independent peer review during the panel review meeting
June 9, 2016	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
June 23, 2016	CIE submits CIE independent peer review reports to the COTR
June 30, 2016	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: This 'Time and Materials' task order may require an update or modification due to possible changes to the terms of reference or schedule of milestones resulting from the fishery management decision process of the NOAA Leadership, Fishery Management Council, and Council's SSC advisory committee. A request to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent changes. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on changes. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) The CIE report shall completed with the format and content in accordance with **Annex 1**,

(2) The CIE report shall address each ToR as specified in **Annex 2**,
(3) The CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

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NMFS Office of Science and Technology
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Key Personnel:

NMFS Project Contact:

Julie A Neer
SEDAR Coordinator
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julie.neer@safmc.net

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference

SEDAR 47 Southeastern Goliath Grouper Assessment Review Workshop

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following:
   a) Are data decisions made by the data providers and assessment analysts sound and robust?
   b) Are data uncertainties acknowledged, reported, and within normal or expected levels?
   c) Are data applied properly within the assessment model?
   d) Are input data series reliable and sufficient to support the assessment approach and findings?
2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:
   a) Are methods scientifically sound and robust?
   b) Are assessment models configured properly and used consistent with standard practices?
   c) Are the methods appropriate for the available data?
3. Evaluate the assessment findings and consider the following:
   a) Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?
   b) Is the stock overfished? What information helps you reach this conclusion?
   c) Is the stock undergoing overfishing? What information helps you reach this conclusion?
   d) Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?
   e) Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?
4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:
   a) Are the methods consistent with accepted practices and available data?
   b) Are the methods appropriate for the assessment model and outputs?
   c) Are the results informative and robust, and useful to support inferences of probable future conditions?
   d) Are key uncertainties acknowledged, discussed, and reflected in the projection results?

5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.

   - Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods.
   - Ensure that the implications of uncertainty in technical conclusions are clearly stated.

6. Consider the research recommendations provided and make any additional recommendations or prioritizations warranted.

   - Clearly denote research and monitoring that could improve future assessments

7. Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

8. Provide guidance on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.

9. CIE Reviews may contribute to Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference.

Annex 3: Agenda

SEDAR 47 Southeastern Goliath Grouper Review Workshop

Saint Petersburg, Florida
17-19 May 2016

Tuesday

9:00 a.m.	**Introductions and Opening Remarks** **Coordinator** *- Agenda Review, TOR, Task Assignments*	
9:30 a.m. – 11:30 a.m.	**Assessment Presentations**	**Analytic Team**
	- Assessment Data & Methods *- Identify additional analyses, sensitivities, corrections*	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 6:00 p.m.	**Assessment Presentations (continued)**	**Analytic Team**
	- Assessment Data & Methods *- Identify additional analyses, sensitivities, corrections*	
6:00 p.m. – 6:30 p.m.	**Public comment**	**Chair**

***Tuesday Goals*:** Initial presentations completed, sensitivity and base model discussion begun

Wednesday

8:00 a.m. – 11:30 a.m.	**Panel Discussion** *- Assessment Data & Methods* *- Identify additional analyses, sensitivities, corrections*	**Chair**
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 6:00 p.m.	**Panel Discussion/Panel Work Session** *- Continue deliberations* *- Review additional analyses* *- Recommendations and comments*	**Chair**
6:00 p.m. – 6:30 p.m.	**Public comment**	**Chair**

***Wednesday Goals*:** sensitivities and modifications identified, preferred models selected, projection approaches approved, Report drafts begun

Thursday

8:00 a.m. – 11:30 a.m.	**Panel Discussion** *- Final sensitivities reviewed.* *- Projections reviewed.*	**Chair** **Chair**
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 5:30 p.m.	**Panel Discussion or Work Session** *- Review Reports*	**Chair**

5:30 p.m. – 6:00 p.m.	**Public comment**	**Chair**
6:00 p.m.	**ADJOURN**	

Thursday Goals: Complete assessment work and discussions, final results available. Draft Reports reviewed.

Appendix 3: Panel Membership

Carolyn Belcher, Department of Natural Resources, GA

Mary Christman, University of Florida

Bob Ellis, Fish and Wildlife Research Institute, FL

Robin Cook, CIE

Desmond Kahn, CIE

Marcel Reichert (Chair), DNR-Marine Resources Division, SC

Joel Rice, CIE